Contra Costa Electric Vehicle Readiness Blueprint

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1 Preface from Contra Costa Transportation Authority Leadership

Message from Contra Costa Transportation Authority Executive Director Randell H. Iwasaki

As the county's transportation planning and congestion management agency, the Contra Costa Transportation Authority (CCTA) is dedicated to improving the sustainability of our transportation system and achieving a greener, healthier Contra Costa. We help people get to where they need to go safely and with as little carbon impact as possible. Approximately 47% of all greenhouse gas emissions within Contra Costa County are from on-road vehicles. CCTA and the County of Contra Costa are developing a range of strategies and actions to improve air quality in the county. CCTA is committed to reducing emissions through funding transit, paratransit, rideshare, bike lanes, trails, sidewalks, and school bus programs – and why we are proud to have a leadership role in this Electric Vehicle Readiness Blueprint.

The Contra Costa Electric Vehicle Readiness Blueprint provides CCTA, County departments, and jurisdictions within the county data, best practices, and strategies to bring about a broad transition to electric vehicles across the county. Preparing our county for greater electric vehicle use translates to numerous air quality and economic benefits. By advancing electric vehicle adoption, we can make progress on greenhouse gas emission reduction goals, expand access to mobility options, help our residents save money on vehicle operations and maintenance costs, maintain and enhance workforce opportunities, and improve our community's health. Furthermore, by integrating equity considerations throughout the Blueprint, we can help ensure all our community members take advantage of these benefits.

This Blueprint was funded through a grant from the California Energy Commission and was led by CCTA, with strong support from the Contra Costa Department of Conservation and Development and 511 Contra Costa. It was assembled with extensive input from stakeholders throughout the county, including cities and towns, transit agencies, education and training providers, electric utilities, electric vehicle infrastructure providers, and local employers.

The Blueprint culminates in tailored strategies for CCTA and Contra Costa County departments to consider pursuing, ranging from new policy solutions to cutting-edge pilots that build upon the county's strong history of innovation in advanced vehicle technologies. The implementation of this Blueprint will establish Contra Costa as a strong leader in transportation electrification and equip us to meet and exceed local and state greenhouse gas reduction goals. As you review this plan, I encourage you to reflect on how you can support our vital mission. Together, we can transform how Contra Costa residents get around, and further enhance the sustainability of the transportation system we all rely upon.

2 Executive Summary

In June 2018, the Contra Costa Transportation Authority (CCTA) received a grant award as part of the California Energy Commission's (CEC) Electric Vehicles (EV) Ready Communities Challenge Phase I—Blueprint Development. The grant aims to accelerate deployment of electrified transportation at the local and regional levels, adopting a holistic and futuristic view of regional transportation planning. These Phase I funds are for developing blueprints that identify the actions and milestones needed to achieve an EV-ready community. Phase II is anticipated to provide funding to support execution of the blueprints developed under Phase I.

CCTA initiated a robust stakeholder engagement process to gather input and buy-in for development of the Contra Costa EV Readiness Blueprint. To develop the Blueprint, CCTA reviewed relevant best practices, assessed current and future need for charging infrastructure through mapping exercises, evaluated the potential for shared mobility hubs, developed training frameworks to prepare the electrician and mechanic workforce for a future with more EVs, and analyzed electricity demand associated with increased charging needs for EVs. The Contra Costa EV Readiness Blueprint is based on a series of principles that serve as recurring themes throughout the document:

- **Empower jurisdictions** to support build-out of a countywide EV charging network.
- **Harmonize policies** across jurisdictional boundaries.
- **Maximize effective usage of funding opportunities** for EV adoption and electric vehicle service equipment (EVSE) deployment.
- **Stimulate mass market replacement of conventional vehicles** with EVs.
- **Capture synergies with major concurrent shifts in the transportation landscape**, such as connected, autonomous, and shared vehicles.
- **Electrify everything.** Encouraging EV adoption should work hand in hand with the electrification efforts of other transportation modes.
- **Ensure all county residents have equitable access** to EV benefits.
- **Contribute to a regional electrified network.**

As a complement to the principles, CCTA and stakeholders throughout the county share this vision:

> *Everyone that lives, works, or plays in Contra Costa County has reliable, convenient, and affordable access to electric mobility options, regardless of their means, life stage, location, and background. Throughout the county, the process of installing electric vehicle charging infrastructure is simple, predictable, and consistent. Electrified transportation is a significant contributor to reduced emissions, enhanced well-being, and equitable mobility in the county and the region.*

The Blueprint creates a path towards this vision through a series of short-, medium-, and long-term strategies with example actions. The strategies directly address the top barriers preventing further advancement on EV readiness within Contra Costa County and are representative of the influence CCTA

and County departments have to advance EV adoption and EVSE deployment, listed below. Table 1 summarizes the strategies.

	Provide technical assistance to constituents and cities
	Conduct outreach
	Conduct research
	Implement pilots
	Install EVSE
	Regulate and incent
	Fund EVSE or EV
	Set targets and maintain adaptable implementation plan
	Regional advocacy and engagement

Table 1. Summary of Strategies

	Strategy									
Short	Continuously Assess Needs			■						
	Install Infrastructure in Priority Areas					■		■		
	Implement Low-Income Customer Outreach and Education Program		■							
	Amplify Regional Outreach to Consumers, Site Hosts, and Other Entities	■	■							
	Adopt and Promote EV Reach Codes						■			
	Adopt and Promote Streamlined Permitting	■					■			■
	Contribute to a Regional Charging Network and Engage in Statewide Policy			■						■
	Integrate EV Readiness with Growth Management						■			
	Track Progress	■	■	■	■	■	■	■	■	■
	Electrify County Fleets and Encourage Fleets Within Jurisdictions to Electrify					■			■	
Medium	Implement Scalable Shared, Electric, Connected, and Autonomous Vehicle Pilots				■					
	Expand Pilot Programs to Provide Electric Mobility Services to Underserved Populations				■					
	Integrate EV Carpool and Shuttle Services into County 511 Programs						■			
Long	Incorporate EV Resilience Planning into County Preparedness Strategies				■	■				
	Pilot Wireless Inductive Charging on Streets				■					
	Implement and Enhance Shared Mobility Hubs with Electric Options				■	■	■			
	Explore Options to Disincentivize Usage of ICE Vehicles and Incent Their Replacement						■			

3 Introduction and Methods

3.1 Acronyms

Table 2 lists acronyms used throughout this Blueprint.

Table 2. Acronyms Used in This Blueprint

Acronym	Definition
AFLEET	Alternative Fuel Life-Cycle Environmental and Economic Transportation Tool
AV	Autonomous vehicle
ARFVTP	Alternative and Renewable Fuel and Vehicle Technology Program
BAAQMD	Bay Area Air Quality Management District
BART	Bay Area Rapid Transit
BEV	Battery electric vehicle
CalCAP	California Capital Access Program
CALeVIP	California Electric Vehicle Infrastructure Project
CALGreen Code	California Green Building Standards Code
CAP	Climate Action Plan
CARB	California Air Resources Board
CCA	Community Choice Aggregation
CCTA	Contra Costa Transportation Authority
CEC	California Energy Commission
CNWS	Concord Naval Weapons Station
CPCFA	California Pollution Control Financing Authority
CV	Connected vehicle
CVRP	Clean Vehicles Rebate Project
DAC	Disadvantaged Community
DCF	Discounted cash flow
DCFC	Direct current fast charge
DOE	U.S. Department of Energy
DVC	Diablo Valley College
EIA	U.S. Energy Information Administration
EV	Electric vehicle
EVI-Pro	Electric Vehicle Infrastructure Projection Tool
EVSE	Electric vehicle supply equipment
EVSP	Electric vehicle charging service provider
FCEV	Fuel cell electric vehicle
FHWA	Federal Highway Administration
GIS	Geographic Information Systems
GHG	Greenhouse gas
GMP	Growth Management Program
GWh	Gigawatt hours
HEV	Hybrid electric vehicle
HOA	Homeowners association
HOV	High-occupancy vehicle
ICE	Internal combustion engine
ICCT	International Council on Clean Transportation

Acronym	Definition
ICT	Innovative Clean Transit
kW	Kilowatt
kWh	Kilowatt hour
MCE	Formerly known as Marin Clean Energy, but now known as MCE
MSP	Mobility service provider
MTC	Metropolitan Transportation Commission
MUDs	Multiunit dwellings
MW	Megawatt
MWh	Megawatt hour
NHTSA	National Highway Traffic Safety Administration
NREL	National Renewable Energy Lab
NYSERDA	New York State Energy Research and Development Authority
OEM	Original equipment manufacturer
PEV	Plug-in electric vehicle
PCE	Peninsula Clean Energy
PM	Particulate matter
PHEV	Plug-in hybrid electric vehicle
PG&E	Pacific Gas and Electric Company
PUSD	Pittsburg Unified School District
PV	Photovoltaic
PVRAM	Solar photovoltaic and renewable auction mechanism
RFP	Request for proposal
SAV	Shared autonomous vehicles
SUV	Sport utility vehicle
TOU	Time-of-use
TNC	Transportation network company
TRANSPAC	Transportation Partnership and Cooperation
ULL	Urban limit line
USDOT	U.S. Department of Transportation
VW EMT	Volkswagen Environmental Mitigation Trust
V2G	Vehicle-to-grid
XSP	Excess Supply Program
ZEV	Zero emission vehicle

3.2 Glossary of Terms

Table 3 lists several key terms related to EV readiness and sustainable transportation, in addition to their definitions and relevant contextual information.

Table 3. Glossary of Terms

Term	Definition
Autonomous Vehicle (AV)	A vehicle equipped with "technology that has the capability to drive [the] vehicle without the active physical control or monitoring by a human operator."[1]
Circulator	A bus that operates on a fixed route and predictable schedule, looping between major areas of interest.
Connected Vehicle (CV)	A vehicle that "leverages new technologies that give vehicles the capability to communicate wirelessly with one another and with devices on surrounding infrastructure for purposes of improving transportation safety, mobility, and impact on the environment."[2]
Decarbonization	The process of switching away from sources that rely on carbon as the root source of energy, and toward switching to renewable energy sources.
Electrification	The switching of processes typically powered by a fossil fuel (gasoline, diesel, or any other derivative of oil) source to electricity.
Emissions Factor	An emissions factor is a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant. These factors are usually expressed as the weight of the pollutant, divided by a unit weight, volume, distance, or duration of the activity emitting the pollutant (e.g., kilograms of particulate emitted per megagram of coal burned).[3]
First-Mile/ Last-Mile	This term refers to the beginning or ending section of a trip that primarily uses public transit. For example, if a person drives their car to a light rail station, takes the train, and then walks from the train station to their final destination, then first mile/last mile refers to the car trip to the light rail station and their walk from the station to their final destination. Reducing emissions from these trips can pose challenges for transportation planners. If first mile/last mile trips are arduous, a person may elect not to take public transit (e.g., if they are already in their car driving to the light rail station they may decide to just drive all the way to their final destination).
Greenhouse Gas (GHG)	Gases that trap heat in the atmosphere, such as carbon dioxide, methane, and nitrous oxide.
Internal Combustion Engine (ICE)	Any engine that combusts a fuel source (often gasoline or diesel) to generate energy and power a vehicle.
Islandable microgrid	A microgrid is a localized electrical grid that, in the event of a power outage, can disconnect from the traditional grid—a condition sometimes referred to as "islanding." The availability of backup generation and distributed energy resources such as solar can enhance the

1 https://www.dmv.ca.gov/portal/dmv/detail/vr/autonomous/definitions

2 http://www.dot.ca.gov/research/operations/one_california/index.htm

3 https://www.epa.gov/air-emissions-factors-and-quantification/basic-information-air-emissions-factors-and-quantification

Term	Definition
	resilience of the community served by the microgrid by reducing the likelihood that power will be interrupted.
Make-Ready	In the "make-ready" model, a public utility invests in electrical infrastructure on their local distribution system rather than behind the customer's meter, including upgrading electrical system components, digging trenches, and laying wires, thus making the site ready for installing electric vehicle service equipment (EVSE).
Micromobility	Micromobility refers to small, manually or electrically powered vehicles used to travel short distances. Examples include bicycles, e-bicycles, scooters, e-scooters, one-wheels, and skateboards.[4]
Microtransit	An often privately-operated form of transit, with select, smaller routes or available solely on an as-needed or on-demand basis.
Particulate Matter (PM)	A complex mixture of tiny particles that vary greatly in shape, size, and chemical composition, and can be made up of many different materials (such as metals, soot, soil, and dust). Exposure to outdoor PM levels exceeding current air quality standards is associated with increased risk of hospitalization for lung and heart-related respiratory illness, including emergency room visits for asthma.[5]
Shared Mobility	The shared use of any form of transportation—bicycle, scooter, motorcycle, ICE vehicle or EV— in a way that reduces the need for personal ownership of these vehicles and devices.
Transportation Network Company (TNC)/ Mobility Service Provider (MSP)/ Ride Hailing company	A company using technology to connect drivers and vehicles with people needing transportation to a destination.
Underinvested Communities	Communities in which population members face hardships, including but not limited to lower incomes, limited English proficiency, lack of access to credit, or historic discrimination. The term Disadvantaged Community (DAC) will be used to refer specifically to communities within the 25% highest scoring census tracts, using results from the California Communities Environmental Health Screening Tool (CalEnviroScreen), as defined by the California Environmental Protection Agency. CalEnviroScreen is a mapping tool that helps identify California communities most affected by many pollution sources, and where people often are especially vulnerable to pollution's effects.
Well to Wheels Emissions	The full upstream emissions associated with the whole lifecycle of the fuel source, from drilling to refining to transportation to combustion in the vehicle.

[4] https://transportation.ucsd.edu/mobility/micro.html

[5] https://ww3.arb.ca.gov/research/aaqs/caaqs/pm/pm.htm

3.3 Background and Context

EV readiness refers to a community-wide, coordinated planning effort to build a supportive environment to advance EV adoption, as reflected in policy, infrastructure development, municipal investments in EVs, encouraging consumers through incentives and outreach, and participation in stakeholder coalitions.[6] The fact that Contra Costa's EV readiness effort is countywide and deliberately coordinated is of vital importance. To reap the greatest benefits from this transition, deliberate planning is required. Through the Contra Costa EV Readiness Blueprint, the county can shape EV adoption and EV charging infrastructure deployment in ways that will maximize opportunities for the local workforce, promote equitable access to clean transportation options, synchronize with ongoing initiatives, and effectively transform the market.

EV readiness planning can offer the county and its residents numerous benefits. It contributes to achievement of the County's Climate Action Plan (CAP), as well as statewide targets and executive orders related to emissions reduction and transportation electrification. Without action, climate change is expected to lead to more extreme heat, degraded air quality, decreased fresh water supplies, increased storm severity, and rising sea levels within the county.[7] As the transportation sector accounts for 47% of the greenhouse gas (GHG) emissions contributing to climate change in Contra Costa County, transitioning away from conventional vehicles that burn fossil fuels will be an absolutely critical component for achieving CAP goals and mitigating climate change's worst effects.[8] EVs do not produce particulate matter emissions at the tailpipe, eliminating one source of pollutants especially harmful to human health and leading to respiratory issues such as asthma.

Several key terms are used throughout the Blueprint, which are important to define upfront. Table 4 defines different vehicle types and provides important information about each of these.

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6 https://afdc.energy.gov/pev-readiness.html and http://opr.ca.gov/docs/ZEV_Guidebook.pdf and https://www.sciencedirect.com/science/article/pii/S1040619015300075

7 http://www.ccCounty.us/4554/Climate-Action-Plan

8 Contra Costa County is home to several large industrial facilities. These facilities are regulated by the CARB and the Bay Area Air Quality Management District. The County has limited ability to impact their emissions profile. Upon taking out the large industrial sources and focusing on those sectors where the County has more control, transportation is by far the largest emissions source.

Table 4. Descriptive Information About Vehicle Types

	Internal Combustion Engine (ICE) Vehicle	Hybrid Electric Vehicle (HEV)	Plug-in Hybrid Electric Vehicle (PHEV)	Battery Electric Vehicle (BEV)
Description[9]	Any vehicle powered solely by an ICE, fueled with gasoline or diesel.	Hybrid electric vehicles commercially available today, combining an internal combustion engine with a battery and electric motor.	Plug-in hybrids, similar to traditional hybrids, but equipped with a larger, more advanced battery that allows the vehicle to be plugged in and recharged in addition to refueling with gasoline.	Battery electric vehicles run entirely on electricity stored in batteries and with an electric motor rather than a gasoline engine.
Electric Range[10]	None	N/A (cannot operate solely on electricity)	10–80 miles	80–350 miles
Examples	Ford Expedition	Honda Insight, Toyota Prius, Toyota Camry Hybrid	Toyota Prius Prime, Hyundai Ioniq Plug-in Hybrid	Tesla Model 3, Chevrolet Bolt, Nissan Leaf
Charging approach	None	Charged with regenerative braking, no plug-in ability	Charged with regenerative braking **and** plug-in charger	Charged with regenerative braking **and** plug-in charger

The Blueprint uses the term "EV" throughout to refer to plug-in electric vehicles—in other words, PHEVs and BEVs together.[11] Additionally, several types of EV chargers exist—otherwise known as electric vehicle supply equipment (EVSE). Table 5 presents more information on the three charger types. Several factors influence total ownership costs associated with EVs, including charging costs: available incentives, typical miles traveled, electricity rates, charging fees, and type of chargers. Light-duty EVs potentially offer significant total cost of ownership savings compared to ICEs, a particularly beneficial factor for low-income residents dependent on a personal vehicle. For more personalized ownership cost information for different EV types, Pacific Gas and Electric Company (PG&E) provides an EV Savings Calculator at https://ev.pge.com/vehicles.

9 https://www.driveclean.ca.gov/Search_and_Explore/Technologies_and_Fuel_Types.php

10 Ranges cited are typical for vehicle models available in the U.S. between 2011 and 2019. Specific vehicle ranges may vary. Source: https://phev.ucdavis.edu/about/faq-phev/

11 This plan does not address readiness for fuel cell electric vehicles (FCEV) due to the fact that FCEVs are at an earlier stage of adoption than plug-in electric vehicles, and while there are parallels between the technologies in the barriers to widespread deployment, the suite of policy options available to encourage FCEV are quite different. Furthermore, the U.S. Energy Information Administration Annual Energy Outlook 2019 reference scenario projects that FCEV will be less than 0.3% of light duty vehicle sales in the Pacific region by 2050.

Table 5. Descriptive Information About EV Charger Types

	Level 1	Level 2	Level 3 (Commonly Called Direct Current Fast Charge [DCFC])
Primary Use Case	Home charging, but can be used for workplace and public charging (though rarely)	Home charging; sometimes for public and workplace charging	Public, on-the-go charging; sometimes for multifamily residents and shared mobility providers[12]
Charge Time	8–15 hours	3–8 hours	20 minutes–1 hour
Cost to Install[13]	Low: just a wall outlet ($300–$1,500 per unit) ($0–$3,000 per install)	Medium ($400–$6,500 per unit) ($600–$12,700 per install) PG&E's construction cost estimates for its EV Charge Network are: $16,500 per unit.[14]	High: takes up large amount of space and often requires upgrades to electrical infrastructure ($10,000–$40,000 per unit) ($4,000–$51,000 per install)

[12] Lessons Learned on Early Electric Vehicle Fast-Charging Deployments. ICCT. 2018. https://www.theicct.org/sites/default/files/publications/ZEV_fast_charging_white_paper_final.pdf

[13] https://afdc.energy.gov/files/u/publication/evse_cost_report_2015.pdf

[14] PG&E presentation at the Q1 2019 Clean Transportation Program Advisory Council Meeting in March 2019.

3.4 Motivation: Why Now?

The transportation sector produces 47% of GHG emissions in Contra Costa County. Emissions from on-road vehicles and other fossil fuel activities pose a persistent threat to the health of residents and exacerbate the increasingly damaging and costly effects of climate change. Therefore, reducing transportation sector emissions is critical for reducing overall emissions, improving the public's well-being, and mitigating further climate change impacts. Stimulating a broad, strategic transition to EVs within the county will significantly contribute to transportation emission reductions. Several motivating factors, explained below, add to the already high priority of addressing transportation emissions in the county, making this the best time to create a countywide EV Readiness Blueprint.

3.4.1 California's Decarbonization and Electrification Goals Require Immediate Action

In September 2018, Governor Brown signed Executive Order B-55-18, which established a new statewide goal "to achieve carbon neutrality as soon as possible, and no later than 2045, and achieve and maintain net negative emissions thereafter." This Executive Order operates in addition to previous statewide GHG targets of reducing emissions to 40% below 1990 levels by 2030 and reducing emissions to 80% below 1990 levels by 2050. The new goal complements and will likely further accelerate efforts to electrify transportation as achieving carbon neutrality will require deep emission cuts from the transportation sector, California's largest contributor to GHG emissions.

Transportation sector emissions continue to grow in California and the Bay Area, despite numerous policy efforts to implement Sustainable Community Strategies (e.g., Senate Bill 375) and remedy jobs-housing imbalances (e.g., the Association of Bay Area Governments' Regional Housing Needs Assessment targets) to reduce the need for single-occupant vehicle travel. Fuel economy progress and substantial statewide investments in EVs and alternative fuels have not overcome emissions increases associated with increased travel activity.

Compounding this challenge, vehicles are a durable good with a long lifetime. Scenario modeling conducted for this report indicates sales of internal combustion engine vehicles would essentially need to stop by the late 2020s, and the electric grid would need to be fully carbon free to substantially eliminate emissions from personal transportation by 2045. Even in this case, early retirement of vehicles that county residents would otherwise drive would be required for a small percentage of on-road vehicles. Scaling county BEV sales from 3%–5% adoption to 100% adoption approximately within a decade requires immediate and aggressive action. However, the rapid pace of transition to renewables in California has exceeded expectations, offering a hopeful corollary to transformation just beginning in the transportation system.[15]

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[15] In a June 2019 keynote on global urban EV adoption, CEC Chair David Hochschild provides an inspiring primer on clean technology's progress in California and how it might apply to transportation emissions. https://www.law.berkeley.edu/wp-content/uploads/2019/06/Keynote-Day-2-Driving-California-into-the-Clean-Energy-Era.pdf

3.4.2 Actions Now Will Enhance Market Momentum and Create Synergies with Statewide Activities

Contra Costa County is primed to take advantage of growing momentum associated with private EV ownership and statewide policy focused on transportation electrification. Nationwide, EVs' market share has steadily increased in recent years, rising from 0.7% in 2015 to 1.2% in 2017.[16] In 2018, 1.12 million EVs were deployed in the United States, up from 0.76 million in 2017.[17] California stands as the biggest contributor to these figures, with over 500,000 EVs sold in the state from 2011 through the end of 2018.[18] Thus far, EV sales in 2019 are on pace to exceed 2018 sales.[19]

Contra Costa County reflects trends seen throughout the state and nationwide. In 2011, fewer than 200 EVs operated within the county; in 2018, that figure increased exponentially to an estimated 13,000 EVs operating in the county.[20] Consumer demand for EVs is expected to continue rising. Contra Costa Transportation Authority (CCTA) and County departments must meet this demand by ensuring appropriate infrastructure is in place, not only for EV charging but for EVs that may require towing if running out of charge.

In conjunction with momentum on EV ownership, several statewide policies contribute to accelerated efforts to electrify transportation. In 2018, the California Air Resources Board (CARB) implemented the Innovative Clean Transit (ICT) regulation, which sets a statewide goal for public transit agencies to transition to 100% zero emission bus fleets by 2040. As transit agencies transition to zero emission buses, expertise in charging infrastructure installation will grow (both among agencies and contractors installing the infrastructure), utilities will remain deeply engaged, and more constituents and decision-makers will gain familiarity with EVs. All of these developments will bring value to electrification efforts within other transportation sectors.

Additionally, through the Clean Miles Standard (SB 1014) and Incentive Program, also enacted in 2018, the CARB and the California Public Utilities Commission will develop and implement new requirements for transportation network companies (TNC)—such as Uber and Lyft—to curb GHG emissions. The new regulations will seek to increase zero emission miles traveled, encourage low-emission vehicles among emerging modes (such as autonomous vehicles), and maximize equitable transportation access. These recent and emerging EV policy initiatives complement California's ongoing progress as part of its Zero Emission Vehicles (ZEV) Action Plan, a roadmap to support ambitious EV and EV infrastructure goals. In early 2018, former Governor Brown reaffirmed the original plan's goal of 1.5 million ZEV (including hydrogen fuel cell vehicles) on the road in California by 2025 and set a new goal of 5 million ZEVs by

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16 https://www.iea.org/gevo2018/

17 https://www.iea.org/gevo2019/

18 https://autoalliance.org/energy-environment/advanced-technology-vehicle-sales-dashboard/

19 https://www.veloz.org/sales-dashboard/

20 Estimates based on data from Clean Vehicle Rebate Project and EV registration data provided by Clean Cities.

2030 through Executive Order B-48-18. The Executive Order also set a target of 250,000 EV chargers by 2025.

3.4.3 Local Stakeholders are Eager to Collaborate

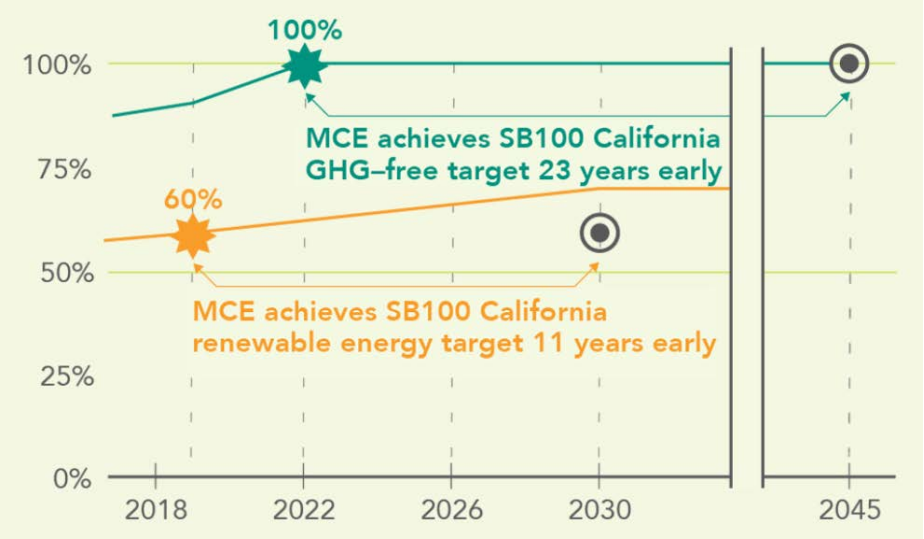
CCTA and County departments have an opportunity to collaborate with other entities to ensure implementation of this Blueprint coordinates with ongoing, related initiatives. External parties (such as Electrify America, PG&E, MCE, and Bay Area Air Quality Management District [BAAQMD]) are pursuing their own EV-charging infrastructure buildout plans. Collaborating with these entities and sharing the charging priority areas identified through this Blueprint will allow CCTA and County departments to supplement and enhance the effectiveness of those efforts.

Electrification of transportation is an important element of MCE's mission related to climate change and clean energy, and also supports our commitment to reinvesting in our 34 (and growing) member communities, while providing affordable and stable electric rates. With smart policy and programs, MCE can work with our Contra Costa County partners to ensure that EVs are charged on renewable energy, accessible to everyone, and that infrastructure deployment is optimized for usage and availability of renewables on the grid. MCE is proud to take a leadership role in supporting EV deployment and is eager to help implement the strategies outlined in the EV Readiness Blueprint."—Dawn Weisz, CEO of MCE

Further, collaboration opportunities exist through County and local climate planning efforts. Contra Costa County is updating its CAP, as are other jurisdictions within the county. As transportation is such a significant contributor to GHG emissions, EVs will play a key role in helping jurisdictions meet their climate goals. CCTA and County departments are encouraged to collaborate with CAP update efforts, as this Blueprint can serve as the primary means to unify EV-related efforts within the CAPs.

Additionally, while EVs are only as green as the electricity used to fuel them, MCE's efforts to provide a GHG-free electricity mix by 2022 for portions of the county within its service territory mean that many EVs driven in Contra Costa County will result in the maximum possible GHG reductions relative to gasoline. Figure 1 illustrates the timeline.

Figure 1. Timeline of MCE's Anticipated Progress Towards SB100 GHG-Free (green line) and Renewable Energy (orange) Targets
(Source: https://www.mcecleanenergy.org/news/press-releases/mce-resource-plan-2019/)



Autonomous Electric Circulator Shuttle in San Ramon's Bishop Ranch Office Park. The Bishop Ranch Office Park in San Ramon, CA, in a partnership with the GoMentum Station, is running two autonomous, electric, driverless, EZ10 shuttles, manufactured by EasyMile. The EZ10s at Bishop Ranch were the first high-occupancy vehicles using level 4 autonomy to be granted license plates and permission to operate on California's public roads. The EZ10 shuttles operated on a test course on private property within the office park until spring 2018, when GoMentum Station and Bishop Ranch received permission from the California Department of Motor Vehicles to operate the two vehicles on public roads. Thanks to a federal exception allowing these test vehicles to operate without a steering wheel or control pedals, the State of California and the City of San Ramon took steps to enable expansion of testing and operations to the public roadway. The EZ10s seat six people each and have space for another six standing—or for one wheelchair. The EZ10 is part of a last-mile transportation strategy prioritizing smaller-format, last-mile, high-occupancy, public autonomous transportation. Future routes will be direct or have few stops, and will connect major transit hubs directly to surrounding destinations, akin to spokes of a bicycle wheel. Planners see this approach to public transit as a solution to hurdles posed by first- and last-mile transportation needs.

3.4.4 Several Large Funding Programs are Currently Available

The funding environment for EVs and EVSE often changes, but, currently, a large number of programs exist that are worth leveraging in support of this Blueprint:

- **Volkswagen Environmental Mitigation Trust (VW EMT)**: Administered by the Bay Area Air Quality Management District, the VW EMT has $5 million available for EV charging stations. This funding will cover 100% of costs for public chargers on government-owned properties, 80% of costs for public chargers on privately owned properties, and 60% of costs for non-public

chargers at workplaces and multiunit dwellings. Furthermore, 50% of total funds will be used for Disadvantaged Communities (DAC).

- **Bay Area Air Quality Management District:** In addition to administering the VW EMT, BAAQMD manages several funding programs. BAAQMD's *Charge!* Program offers grant funding to offset costs of purchasing and installing new, publicly available EV charging stations within the Bay Area. BAAQMD's Carl Moyer Program offers fleets funding for charging infrastructure, if combined with equipment replacement. For low-income residents, BAAQMD offers Clean Cars for All, which offers a charger rebate and grants for replacing cars with EVs.
- **Pacific Gas and Electric Company:** PG&E offers EV owners an $800 clean fuel rebate and two time-of-use electricity rate options. Through its EV Charge Network program, PG&E is installing and helping to cover costs for 7,500 EV chargers at condominiums, apartment buildings, and workplaces, including sites in DACs. In addition, PG&E's EV Fleet program offsets some costs associated with installing charging equipment for medium- and heavy-duty fleet vehicles (such as transit buses, school buses, shuttles, and other vehicle segments that are heavier than most personally owned vehicles).
- **MCE:** MCE's MCEv Program provides qualifying low-income customers with a $3,500 EV rebate for new and used EVs. MCE also offers EV owners with two time-of-use electricity rate options. The MCEv Charging program offers rebates and technical installation aid for installing charging stations at workplaces and multifamily properties, including low-income properties.
- **California Energy Commission:** CEC's Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP) made grant funding available for a two-phase, EV-ready communities effort. The funding's first phase supported development of this Blueprint; the second phase is anticipated to provide funding for Blueprint implementation. ARFVTP funding also supports charging infrastructure and workforce training. Managed through the California Pollution Control Financing Authority (CPCFA), CEC also funds the California Capital Access Program's (CalCAP) Electric Vehicle Charging Station Financing Program, which provides incentives for small business owners and landlords to install EV charging stations.
- **California Air Resources Board:** Administered by the Center for Sustainable Energy, CARB's Clean Vehicles Rebate Project (CVRP) provides rebates for purchasing or leasing an EV, though the program is currently available only for low-income applicants and has a waitlist for others. CARB's Clean Vehicle Assistance Program, which provides grants and affordable financing to help income-qualified Californians purchase a new or used EV, is anticipated to accept new applications later in 2019.

Charging Up Contra Costa's Community Colleges

After a 511 Contra Costa survey revealed a need for more EV charging stations at Diablo Valley College, Contra Costa Community College District's Energy Manager Tracy Marcial sprang into action. Ms. Marcial led a successful grant application through BAAQMD's *Charge!* Program, resulting in $80,000 for charging stations at several of the District's campuses. To cover remaining costs, the District is leveraging funds from PG&E's EV Charge Network, CCTA, and a

bond program as well as having the colleges contribute. Construction on the new charging stations began in June 2019, and eventually the District will have a total of 84 parking spots dedicated for charging. The stations will add charging capacity for faculty, staff, students, and the surrounding community, and will use a fee-based system to make up for increased electricity costs. Based on the District's experience, Ms. Marcial recommends that organizations seeking a similar build out pursue all available grants and programs as early as possible and prepare for potential fluctuations in rules and requirements along the way. She encourages staying focused and persistent throughout the process, keeping in mind the ultimate goal of doing the right thing for the planet and future generations. In addition to the big picture goal, Ms. Marcial underscores the importance of finding champions for the cause and securing support from key decision-makers to make sure the initiative maintains momentum and priority.

3.4.5 Significant New Construction Anticipated in the County

A substantial amount of new development and redevelopment is anticipated within Contra Costa County in the near future. These prime opportunities for integrating EV readiness include the following: redevelopment of the former Concord Naval Weapons Station into housing, commercial space, schools, and parks; anticipated new developments in the Antioch Bridgehead area and East County; and plans for further development within transit-oriented cities.

The 2016 California Building Code already requires supporting infrastructure for future EVSE installation. Contra Costa County code goes further by requiring installations of fully operational EV spaces, based on the total number of parking spaces. Implementing these requirements for developments under the County's purview and urging other jurisdictions to adopt similar EV-ready code will encourage EV adoption and reduce costs of future charging infrastructure installations within new developments.

Contra Costa County's Electric Vehicle Readiness Blueprint will serve as a beneficial asset and guide to the City of Concord as we promote zero emission transportation options and commute alternatives. Through local efforts, such as the redevelopment of the Concord Naval Weapons Station, the City has exciting opportunities to pool resources and leverage regional, local, and private investment and capital to develop a robust EV network and serve as a model smart city.
—Michael P. Cass, Principal Planner: Long-Range & Sustainability Policy, City of Concord

3.4.6 Workforce Opportunities

Identifying and preparing to meet workforce needs plays an integral role in establishing EV readiness within Contra Costa County. Many industries face dual challenges presented by accelerating technology changes and aging workforces. Increased EVs provide an opportunity to upskill existing workers and to entice students to pursue fields where a worker shortage is anticipated, such as electricians and auto mechanics. To this end, CCTA convened a stakeholder group, dedicated to identifying training needs for electricians and auto mechanics in the county and designing training programs that meet these needs. A

central goal was to ensure that financial and job security benefits flow to local workers and, in particular, help underinvested communities.

The strategic plan for workforce training for mechanics, developed as part of this Blueprint, outlines existing training needs for auto technicians, estimates demand for a County-led training program, provides an overview of potential collaborators and resources, and suggests curriculum and cost estimates for the program.

Similarly, the strategic plan for workforce training for electricians identifies training needs that will enable electricians to safely and effectively install an increased number of EVSEs. It proposes a training program founded on curriculum already established by the Electric Vehicle Infrastructure Training Program. The plan includes components to spark interest in EVSE installation for future workforce members and estimates costs for such a program.

Both plans are available online at https://www.ccta.net/.

A future with more EVs provides valuable career opportunities for graduates within the Pittsburg Unified School District. Pittsburg High School's Auto program has recently been awarded over $640,000 through grant programs from the California Energy Commission and California Department of Education, which will allow us to provide cutting-edge career opportunities for our students, not only in EVs, but in AVs as well. We are excited to collaborate with Contra Costa County to find ways to equip the future workforce with skills needed to succeed in the shifting transportation environment.—Sherene Sasser, Workforce Liaison, Pittsburg Unified School District

3.5 Blueprint Principles

The following principles underpin the Blueprint, guiding its development. Using implementation strategies featured in the next section, CCTA and County departments will work towards realizing these principles.

- **Empower jurisdictions** to support build-outs of a countywide EV charging network. Through actions such as providing technical assistance, highlighting established best practices, and establishing mechanisms for reporting progress, CCTA and County departments can galvanize jurisdictional-level efforts to contribute to a countywide EV charging network.

- **Harmonize policies** across jurisdictional boundaries. Bringing EV-related policies closer to uniformity across Contra Costa County can help foster a more predictable and easier-to-navigate regulatory environment. This Blueprint supports opportunities for aligning EV-related policies countywide.
- **Maximize effective use of funding opportunities** for EV adoption and EVSE deployment. The funding landscape for EVs and EVSE constantly evolves. Through this Blueprint, CCTA and County departments seek to take full advantage of existing funding opportunities and determine upcoming needs to the extent possible to prepare for future funding opportunities.
- **Stimulate mass market replacement of conventional vehicles** with EVs. Through short-, medium-, and long-term strategies, this Blueprint lays the groundwork for a substantial shift towards EVs within the vehicle fleet owned and shared in Contra Costa County.
- **Capture synergies with major concurrent shifts in the transportation landscape**, such as connected, autonomous, and shared vehicles. Developments within the EV market do not occur in a vacuum; this Blueprint seeks to maximize opportunities to synchronize EV adoption with ongoing developments within the transportation space.
- **Electrify everything.** Encouraging EV adoption should work hand-in-hand with the electrification efforts for other transportation modes. Promoting EVs will not come at the expense of promoting electrified transit and active transportation.
- **Ensure all county residents have equitable access** to EV benefits. Through actions such as strategic siting of EV infrastructure, targeted education and outreach, or EV car-share programs, CCTA and County departments can work towards all county residents accessing EVs and their associated benefits.
- **Contribute to a regional electrified network.** Through implementation of this Blueprint, CCTA and County departments have an opportunity to not only influence electrified travel within county boundaries, but to contribute to the region's collective impact. As improvements in EV batteries facilitate travel across longer distances, building a robust charging network and establishing a supportive EV environment help promote EV use regionally.

Contra Costa County's EV Readiness Blueprint will help standardize the regulatory environment Countywide, lowering a barrier to EV charging infrastructure installation and better preparing the County's jurisdictions for when infrastructure investments are available. As an EV-charging service provider, we are encouraged by the steps Contra Costa County is taking to facilitate continued build out of regional charging infrastructure.—Thomas Ashley, Vice President, Policy, Greenlots

3.6 Blueprint Methods

Figure 2. Key Components of the Blueprint Development Process

As highlighted in the graphic above, several key components influenced development of the Blueprint, with details included in the Appendices. Stakeholder engagement proved critical throughout, resulting in valuable inputs that guided and enhanced the plan. In consultation with the full project team, CCTA initially developed a list of stakeholders, including other County departments and consultants. Over time, the stakeholder list was augmented as awareness of the project grew.

At the first stakeholder workshop, participants were invited to volunteer for varying levels of engagement and contribution to development of the EV Readiness Blueprint. Participants most interested in sustained involvement and active contributions were allowed to nominate themselves to the main project Steering Committee, with the expectation that they would attend each workshop, additional meeting, and phone call to provide critical input to shape the plan. Participants interested in workforce development could nominate themselves to a separate Workforce Committee. A substantial number of participants self-selected into both committees. Participants not joining either committee were encouraged to continue their involvement through the stakeholder workshops. Steering Committee members, Workforce Committee members, and general participants remained highly engaged throughout the process, and additional stakeholders joined later workshops as information about the planning process became more widely available. Representatives from the following organization types actively participated:

It is encouraging to see stakeholders from various city and County offices come together to build a holistic and ambitious plan to increase EV adoption in Contra Costa County. The Air District is excited to see how the County and its stakeholders implement the actions outlined in this Blueprint to raise public awareness of EVs, increase their green workforce, and catalyze investment in electrified transportation and related infrastructure. – Rebecca Fisher, Program Lead for Electric Vehicle Outreach and Partnerships, Bay Area Air Quality Management District

As the Town of Danville continues to proactively engage in sustainable transportation planning, we have appreciated the opportunity to comment on the Contra Costa County EV Readiness Blueprint. – Thomas Valdriz, Program Analyst, Town of Danville

1. County, regional, and other public agencies.
2. Local cities and towns.
3. Transit operators.
4. Private companies, including EV charging service providers (EVSPs), other industry and utility representatives, installers, commercial real estate representatives, and others.

Table 6 provides a summary of forums and formats for soliciting input. Workshop locations were selected with attention to geographic equity, enabling stakeholders from every part of the county to participate. Dialing-in was also available for most of the workshops.

Table 6. Stakeholder Engagement Activities

Event	Location	Topics
Stakeholder Workshop #1	Walnut Creek (CCTA Headquarters)	Visions for the Roadmap; Facilitated Brainstorm of Opportunities for EV Readiness
Stakeholder Workshop #2	San Pablo (San Pablo Library)	Best Practices Tool Box
Stakeholder Workshop #3	Pittsburg (Pittsburg Unified School District)	EV and EV Charging Mapping and Gap Analysis
Stakeholder Workshop #4	Lafayette (Lafayette Library)	Electrification of Shared Mobility
Steering and Workforce Committee Meetings	Mix of in-person discussions and phone calls	Debrief Workshops; Review Deliverables; Develop Workforce Training Plans
Written Feedback	N/A	Steering Committee members received an opportunity to suggest high-priority strategies for the EV Readiness Plan, provide quotes articulating the plan's importance for their constituents, and provide written feedback on deliverables throughout the project.

3.7 Barriers to Increased and More Equitable EV Deployment

To achieve the bold, important vision for EV readiness articulated earlier in this Blueprint, several barriers must be addressed. The barriers listed below emerged through numerous stakeholder discussions as the most critical challenges that must be overcome in Contra Costa County to promote EV adoption and EVSE deployment.

The featured barriers are often more acute for underinvested communities. Many members of these communities may not have the ability to purchase a vehicle (let alone an EV) due to challenges such as lack of a credit card, bank account, or good credit. Underinvested communities also disproportionally reside in multiunit dwellings (MUD) and/or rent instead of owning housing. In these cases, installing EV charging infrastructure can be especially challenging if residents do not have a dedicated parking space, must coordinate with a landlord or other advisory body, and do not want to make an investment in a location from which they may soon move. Language barriers may impede some communities from taking full advantage of resources and programs from which they might benefit.

Given these and other factors, it is particularly important to tailor strategies to reach such members of the Contra Costa community, so all county residents have access to EV options and their associated benefits. The implementation strategies detailed in a subsequent section of the Blueprint were selected and tailored to overcome the barriers featured below.

Table 7. Top EV Deployment Barriers

Limited Access to EV Charging	Current and prospective EV owners face limitations with their charging options. Contributing factors include: • Limited number of public charging stations, and increasing demand and competition for charging at existing stations • Limited availability of workplace charging • Difficulties installing home charging stations due to lack of off-street parking, challenges with permitting, and lack of renter decision-making power
Cost and Financial Barriers	Several cost and financial barriers prevent additional consumers from EV ownership. Contributing factors include: • Relatively high EV purchase prices compared to ICE vehicles • Cost associated with installing residential EV charging stations • Affordability of EV ownership, including charging costs • Lack of incentives for and availability of used EVs through a secondary market
Consumer Perception Barriers	Consumers may make a number of assumptions about EVs that deter their interest in purchasing or using one. Contributing factors include: • Perception that EV ranges are insufficient for daily activities, and thus that EVs are not reliable to meet driving needs • Perception that EVs are unaffordable and reserved only for high-income households • Perception that EV battery longevity is limited and that battery packs degrade quickly and lack a replacement mechanism • Lack of awareness of the wide range of EV models on the market (or coming to market soon), including more options in the crossover and SUV markets • Fears about charging during power outages and emergency situations, particularly given the likelihood of increased disruptions and proactive power shutoffs during times of high wildfire risk
Technological Barriers	Current and prospective EV owners can encounter technological barriers that detract from a seamless experience. Contributing factors include: • Limited electrical capacity for EV charging station installation in certain locations, necessitating “make-ready” investment and customer-side electrical work • Lack of standardization of charging equipment, even for the same vehicle types
Soft Costs Associated with EV Charging Permitting and Processes	In addition to direct costs associated with EV charging infrastructure, indirect—or soft—costs contribute to overall installation expenses. Contributing factors include: • A patchwork of permitting processes across jurisdictions that proves time-consuming and confusing for installers and property owners • Lack of uniform adoption of an ordinance with an expedited, streamlined process for permitting EV charging stations, as required in California Assembly Bill 1236, due to lack resources and expertise
Equitable Adoption Barriers	Overcoming the above barriers will not guarantee equitable adoption of EVs. Additional challenges prevent some community members from learning about and/or taking advantage of EV benefits. Contributing factors include: • Educational, permitting, and other materials not being translated into languages other than English • Lack of credit access, bank account, or good credit • Lack of representation in decision-making

4 Status of Countywide EV Infrastructure Readiness

4.1 Scale of Electrification Required and Current Infrastructure

To understand the infrastructure needs required to support increased electrification in Contra Costa County, it is helpful to evaluate the short-, medium-, and long-term timeframes, both in terms of the number of vehicles that could be on the road and how many chargers of each type would support them. Not only has Contra Costa County proven itself as a hotbed of innovation, with both public and private entities piloting leading-edge technologies and demonstrating leadership in EV charging installations, but the county has seen substantial growth in EV adoption and infrastructure availability. **Notwithstanding these trends, EV adoption and infrastructure will need to significantly accelerate to reach the sales rate required to meet California's aggressive climate targets and goals.** The data and scenarios presented below underscore the critical nature of continuing the county's track record of innovation and accelerating efforts to address this challenge.

4.1.1 Short- and Medium-Term

For the short- to medium-term, the 2018 CEC staff report "California Plug-In Electric Vehicle Infrastructure Projections: 2017–2025" serves as the most authoritative report estimating workplace, public, and fast-charging needs in the state by county; the report provides a general, statewide estimate of EV numbers that will be located at multifamily dwellings (assuming a charger is needed for each), but does not address chargers at single-family homes.[21] This CEC report models EV charging needs from the perspective of "how many chargers, by type and location are needed…to ensure that both [BEVs] and [PHEVs] can travel primarily with electricity by 2025." At a high level, it concludes that approximately 46,000 EVs could be registered in the county by 2025, with a need for 3,700 to 4,600 charging ports at workplaces and public sites, in additional to the number of fast-charging sites.

Table 8 presents the CEC's high and low estimates of the number of workplace, public, and fast chargers needed in Contra Costa County. The two scenarios were based on variations of several major factors, such as assumptions on how well chargers can be shared between vehicles, battery ranges of future vehicles, the fleet mix of BEVs vs PHEVs, pricing, and others. Table 8 also provides data on the current number of workplace, public, and fast chargers available in the county (excluding Tesla chargers), based on Plugshare data downloaded in March 2019.

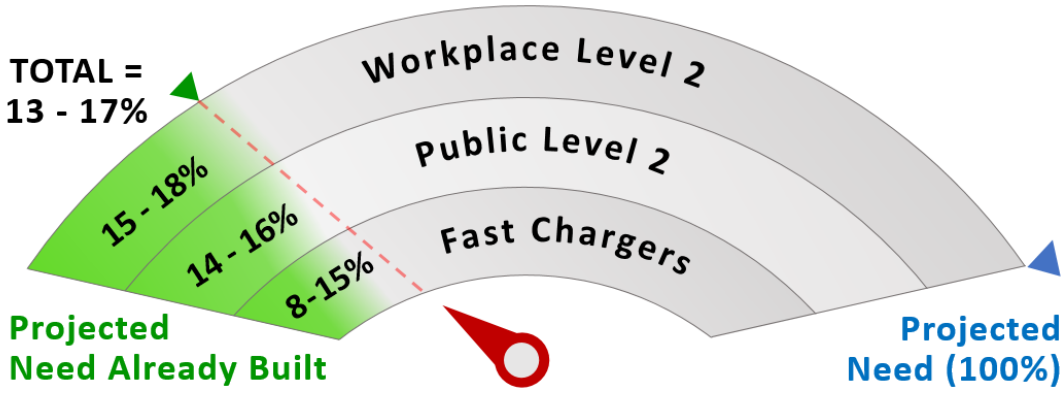
[21] https://www.nrel.gov/docs/fy18osti/70893.pdf

Table 8. Comparison of Current County EVSE Availability with Projected Needs from the CEC Study

	Workplace Level 2		Public Level 2		Fast Chargers		Total[22]	
Projected need by 2025 (Source: CEC)	Low	High	Low	High	Low	High	Low	High
	1,195	1,507	2,107	2,420	352	674	3,654	4,601
Current number of plugs (Source: Plugshare, as of March 2019)	221[23]		342		52		615	
Percentage of projected need already built	15%–18%		14%–16%		8%–15%		13%–17%	

Table 8 does not, however, include data on the number of chargers needed at MUDs as the CEC study does not disaggregate its charging needs estimates at MUDs by county, and Plugshare does not specify whether chargers are located at MUDs. One can assume the number of chargers at MUDs remain quite low in Contra Costa County, with the CEC study estimating that, statewide, 121,000 chargers will be needed for 121,000 EVs located at MUDs in 2025. Given Contra Costa County accounts for approximately 2.9% of California's population, one can infer that approximately 3,500 chargers at MUDs will be needed in the county by 2025, for a total of 7,100 to 8,100 chargers countywide (when including public, workplace, and fast chargers identified in Table 8).

Figure 3. Percentage of EVSE Built, Out of Projected Need



As shown in Table 8, **the county probably has installed less than 13%–17% of the workplace, public, and fast-charging infrastructure recommended by the CEC study**, and potentially less than 13% when

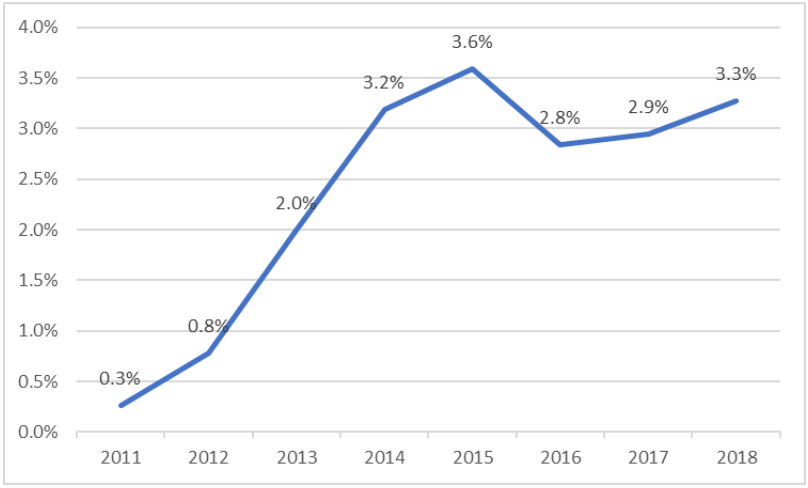
[22] Excluding multiunit dwelling charging needs, addressed separately in the CEC study.

[23] Plugshare data do not specify whether ports are at workplaces or other locations. When reviewing the list of restricted plugs, however, the vast majority of these plugs appeared at the top 10 sites, all of which appear to be workplaces. Therefore, for this table, it was assumed that any nonresidential port designated as "restricted" was a workplace port. Additionally, a large percentage of these restricted workplace chargers were at Bishop Ranch. Workplace charging does not appear to spread across the county, which should be factored into interpretations of amounts of charging relative to the need projected by CEC; effectively, Contra Costa is less prepared than the 15%–18% figure might imply.

accounting for MUDs. Several large projects and initiatives, currently underway, will substantially increase charging port availability, including 542 ports planned through PG&E's EV Charge Network[24] and any additional charging installed via MCE's program and Electrify America. Just PG&E's pipeline of planned chargers would nearly double available charging in the county.

Notably, despite the growth in the percentage of annual EV light duty vehicle sales in the county (shown in Figure 4) over the next six years, **the EV sales percentage would need to nearly triple and reach 10%** to meet the CEC study's estimate for the county by 2025 (45,873 EVs). This increase comes somewhat close to the EV sales percentage increase that the U.S. Energy Information Administration (EIA) forecasts for the Pacific Region in its 2018 Annual Energy Outlook. Despite that the EV adoption increase appears to have slowed since 2015, Contra Costa is one of the top counties in California by per-capita EV adoption (ranked seventh as of October 2018),[25] and many counties ahead of Contra Costa are areas of considerable wealth and/or are technology industry centers, with both factors possibly contributing to the high EV-adoption rates.

Figure 4. Estimated EV Percentage of Sales by Year in Contra Costa County[26]



4.1.2 Long-Term

With respect to long-term needs, California's statewide goal of achieving carbon neutrality by 2045 (established through Executive Order B-55-18) implies that ICE vehicles must be phased out by that

[24] According to data that PG&E provided to the project team in April 2019.

[25] https://jointventure.org/news-and-media/news-releases/1776-silicon-valley-sets-pace-for-electric-vehicle-adoptionnew-data-shows-region-accounts-for-nearly-20-of-electric-vehicles-in-california

[26] This estimate was constructed by scaling historical California Vehicle Rebate Project statistics to the number of EVs registered in the county on October 1, 2018, according to DMV registration records. Though no explanation was found for the 2016–2017 dip in sales, the 2018 sales numbers were likely higher than reflected through these data as information was available only through October 1, 2018, and EV sales tend to peak at year-end.

time. According to the California Department of Finance, the county's population is expected to grow to 1.46 million by 2045, a 27% increase from present numbers. If the amount of travel activity increases proportionally to the increase in population, and if EVs remain the dominant low-carbon, light-duty vehicle option, as many as 1.2 million light-duty vehicles may need charging in the county by that time (or roughly 25 times the amount of EVs that the CEC staff report projected for 2025). While workplace, public, and fast-charging infrastructure needs (in terms of numbers of charging ports) may not linearly scale perfectly with the number of vehicles, particularly as the county approaches 100% electrification, the significant number of vehicles should be noted as should the ubiquity of charging required to meet their energy needs.

Due to substantial uncertainty in the future of battery technologies, charging rates, connected and autonomous vehicles, shared mobility, and mobility as a service, tighter projections on infrastructure volumes needed in 2045 or 2050 would not be warranted at this time. Still, the EV market adoption's energy and environmental impacts through 2050 can be assessed. Doing so required developing a fleet model using three scenarios to evaluate impacts on fuel consumption, electricity consumption, and GHG emissions:

1. If Contra Costa County EV sales followed the trajectory defined by U.S. EIA's most recent Pacific Region forecast in the Annual Energy Outlook;
2. If Contra Costa County deployed enough EVs to achieve an 80% reduction below 1990 levels in personal transportation emissions by 2050 (80x50); and
3. If Contra Costa County deployed enough EVs to achieve carbon neutrality in personal transportation by 2045, in alignment with Executive Order B-55-18.

Because this Blueprint focuses on readiness for plug-in electric vehicles and because fuel-cell electric vehicles (FCEV) lag plug-in vehicles substantially in terms of sales and ownership, this analysis was simplified by assuming FCEVs do not contribute substantially to sales within the horizon years. This simplifying assumption aligned with U.S. EIA's projections of vehicle sales through 2050, which show FCEVs remaining below a 0.3% sales share in 2050.[27]

It must be noted, however, that the CARB developed multiple scenarios as part of its 2017 Midterm Review Report, including some in which FCEVs comprise a substantial portion of total ZEVs in 2050 (approximately one-third of ZEVs) as well as other scenarios in which FCEVs play a relatively minor role.[28] As a scenario modeling goal for the Contra Costa EV Readiness Blueprint was to determine how much electricity might be required within the county to charge vehicles in 2050, the decision not to

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27 https://www.eia.gov/outlooks/aeo/data/browser/#/?id=48-AEO2019&region=1-9&cases=ref2019

28 CARB 2017 Advanced Clean Cars Midterm Review, Appendix F. https://www.arb.ca.gov/msprog/acc/mtr/acc_mtr_finalreport_full.pdf

include a substantial share of FCEVs helped establish a boundary case—the most extreme scenario for the amount of electricity required at charging points throughout the county.[29]

Figure 5. Modeled EV Percentage of Sales by Year in Contra Costa County (EIA Forecast Compared to Two Aspirational Targets)

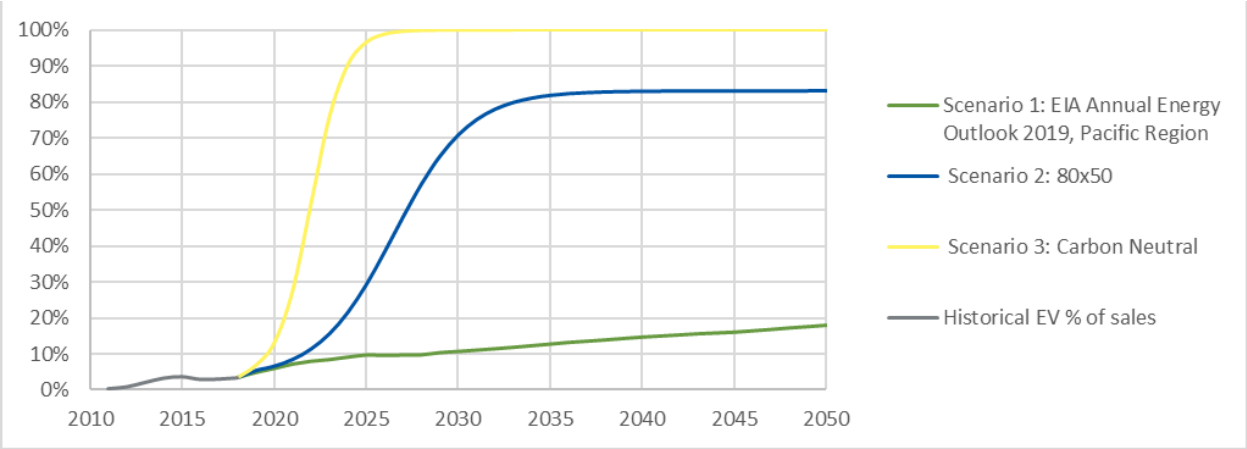


Figure 5 depicts the electric share of total light duty vehicle sales in Contra Costa by model scenario from 2011 to 2050. **As vehicles are driven for many years, it is estimated that EV sales would need to increase rapidly to drive the fleet-wide transition required to reach midcentury climate targets, or gasoline vehicles would need to be retired before the end of their useful life.** Assuming normal vehicle scrappage rates, to achieve net-zero carbon by 2045, EV sales shares would need to reach about 90% by 2024 and 100% by 2029 (up from 3.3% in 2017). To meet California's 80x50 goal, EV sales will need to increase to more than 80% of total sales as soon as 2035.

For context, the scenario implications for Contra Costa County were compared to published sales rate projections at the regional and global levels. These public projections varied significantly, but none came close to the electrification level shown in the aspirational scenarios designed to meet climate-related policy targets (Scenarios 2 and 3). For instance, estimates from Navigant, Bloomberg New Energy Finance, and the International Energy Agency predict EVs will account for 20%–30% of vehicle sales by 2030, based on current technology and cost trends, falling far short of 70% sales modeled for achieving 80% GHG reduction by 2050 in Scenario 2. A more optimistic forecast provided by the oil company Total still falls short of Scenarios 2 and 3, projecting EVs reaching 50% of global passenger vehicle sales by

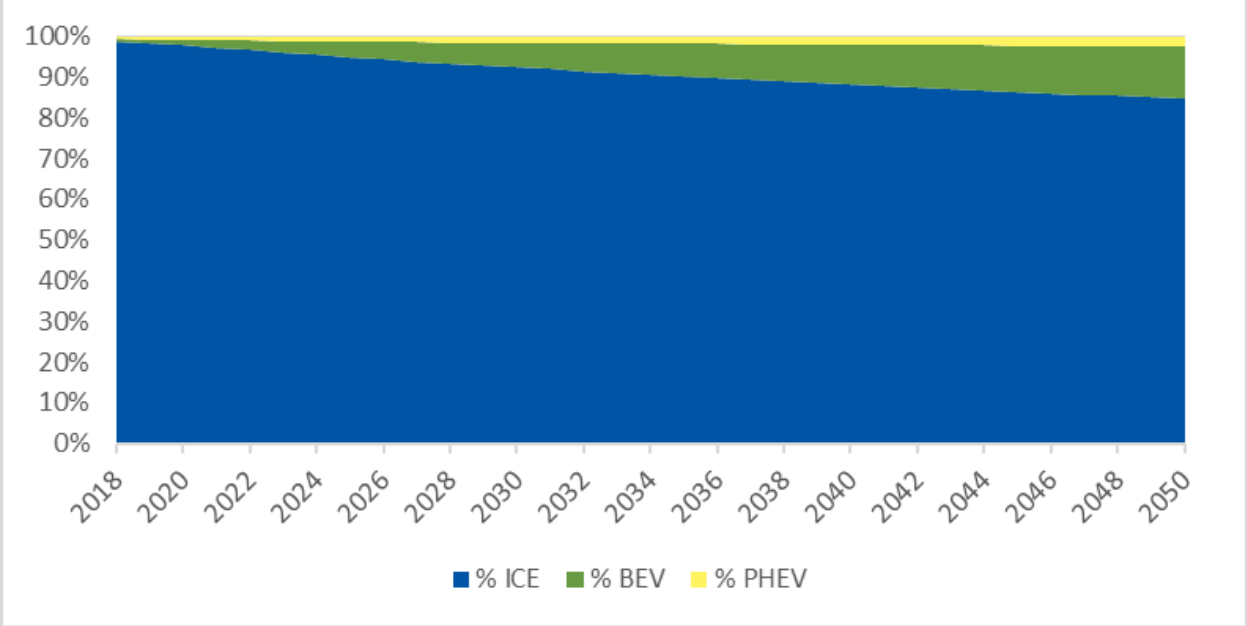
[29] Hydrogen-to-fuel FCEVs will be produced through various pathways, including electrolysis, which also requires electricity. However, electricity required for hydrogen production would likely be easier to spread evenly throughout the day and would not have as much impact on generation planning needs as plug-in vehicles, which may still exhibit uneven charging patterns in 2050.

2040.[30] EIA's Pacific region sales forecast (adopted for Scenario 1) provides the most modest projection reviewed.

Considering the overall make-up of the vehicle fleet used for personal transportation in the described scenarios also proves useful as this will affect demand for charging infrastructure in the county. With typical vehicle scrappage rates from the National Highway Traffic Safety Administration (NHTSA) applied, Figure 6, Figure 7, and Figure 8 show the results.

As shown in Figure 8, reaching the carbon neutrality target set in Executive Order B-55-18 would require that EVs make up approximately 30% of the countywide in-use fleet of light duty vehicles by 2025, 70% by 2030, and 100% by 2045. To meet an 80% reduction by 2050 goal (shown in Figure 7), these deployments would need to be 10%, 30% and over 80% in these horizon years. The 80x50 scenario roughly mirrors model pathways published in 2018 by the CEC and Energy and Environmental Economics to achieve the same reduction target, with EVs accounting for 6% of the light-duty vehicle stock by 2025, over 20% by 2030, and more than 70% by 2045.[31]

Figure 6. Percentage of EVs as Total In-use Light Duty Vehicles Under EIA Scenario



[30] Ajay Chawan. Navigant (5.2.19 @ IEPR workshop, p.4). BNEF EV Outlook 2019. https://about.bnef.com/electric-vehicle-outlook/#toc-viewreport

[31] E3 for the CEC: https://www.ethree.com/projects/deep-decarbonization-california-cec/; PATHWAYS model: Transportation, building stock, and equipment results. Excel spreadsheet.

Figure 7. Percentage of EVs as Total In-use Light Duty Vehicles Under 80x50 Scenario

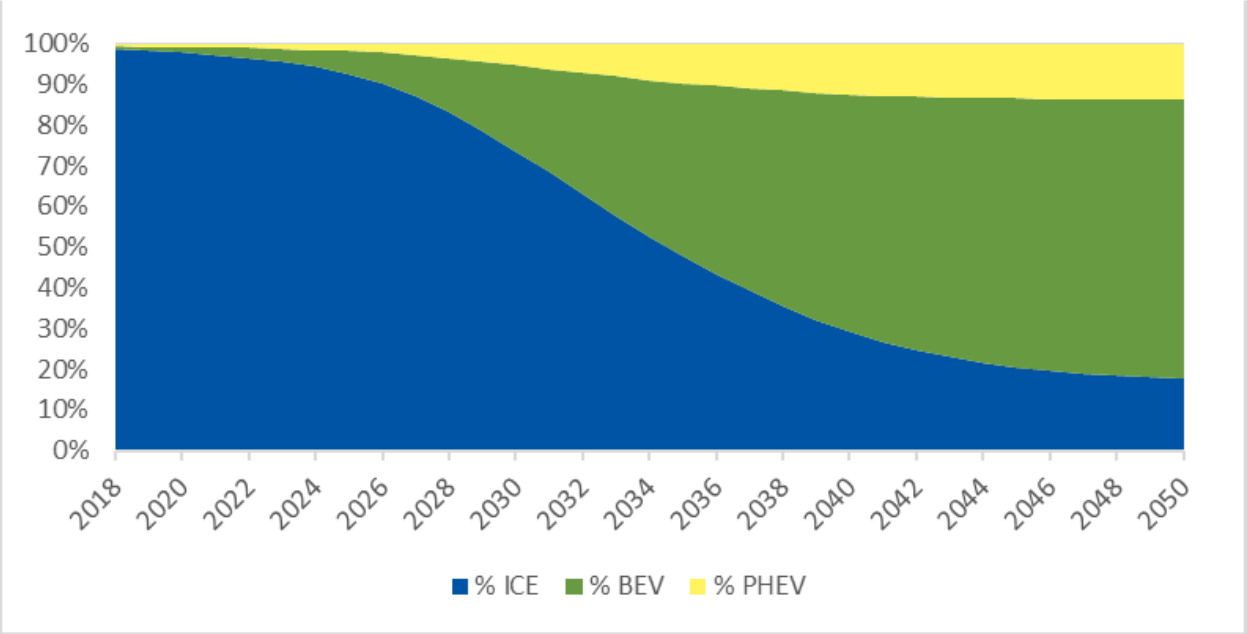
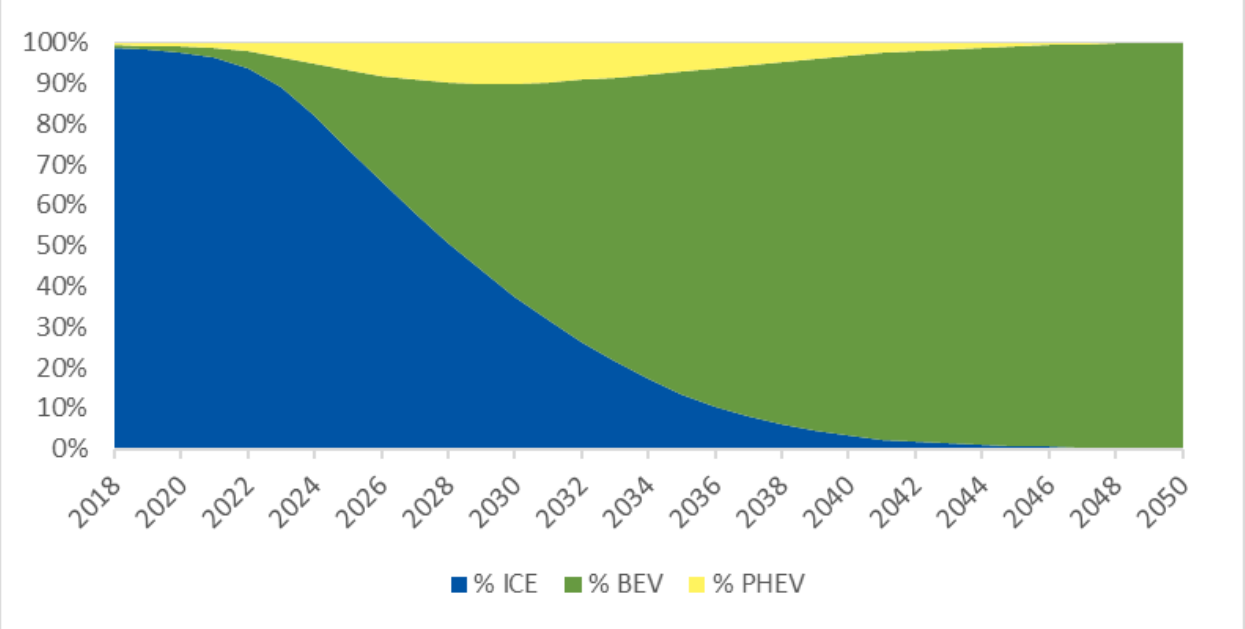


Figure 8. Percentage of EVs as Total In-use Light Duty Vehicles Under Carbon Neutral Scenario



The electrification scale required to align the county with statewide climate targets appears considerable. While the county's transportation-related GHG emissions are expected to decline (even in the base case scenario), these reductions are expected to become even more dramatic under the decarbonization scenarios. Under the 80x50 case, annual fuel-related emissions from the county's transportation fleet will decline by 11% in 2025, 34% in 2030, and 82% in 2050, relative to current

levels.[32] Under the carbon neutral case, these emissions reductions would fall 26% below current levels in 2025, 64% below in 2030, and, by 2050, all fuel-related emissions from vehicles in Contra Costa County must essentially be eliminated.

These trends play out in contrast with the vehicle fleet makeup in the scenario aligned with U.S. EIA's most recent reference case and the two aspirational scenarios shown in Figure 7 and Figure 8. Furthermore, getting on track with climate and GHG targets will require significant departures from present trajectories of vehicle sales, fleet makeup, and installations of EV infrastructure within the county.

4.2 Electricity Demand

In light of the substantial EV scale-up projected for the county under the 80x50 and Carbon Neutral scenarios, it is important to assess the amount of electricity these vehicles would consume and the impacts of that consumption, especially during peak demand periods. Gauging the level of additional electricity demand also helps inform strategies and actions CCTA and County departments choose to pursue in implementing this Blueprint. For instance, knowing projected electricity demand can help determine how to best synchronize the county's EV efforts with its available renewable resources.

CARB already projects that electricity demand from light-duty EV deployment could noticeably impact the grid in 2020.[33] Eventually, increased demand from EVs will affect the grid in several ways. Utilities will need to adjust their **generation** procurement plans to account for meeting this new electricity demand. As the number of EVs increases, supplying their required electricity will pressure existing **transmission and distribution** systems that connect generators to consumers. Distribution utilities and transmission operators must plan accordingly, designing prudent investments and upgrades in these systems with EV loads in mind. One consideration will be the shape of EV-related demand over the course of a day, which, if concentrated during certain hours, could require significant adjustments or **ramping** of generation serving the system to keep supply and demand in harmony.

4.2.1 How Much More Electricity Might be Consumed?

The widespread shift to electricity as the primary transportation energy source will significantly increase overall electricity consumption and will require more electricity generation. For context, consider that Contra Costa consumed 9,778 gigawatt hours (GWh) of electricity in 2017.[34] Assuming an EV fleet of about 20,000 vehicles by 2020, and assuming these vehicles are driven about the same number of miles

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[32] Fuel-related emissions that were considered include the full upstream emissions associated with the whole lifecycle of the fuel source from drilling to refining to transportation to combustion in the vehicle, often referred to as "well-to-wheels" emissions. The methodology was based on the emissions factors in the AFLEET model and is not inclusive of the embodied emissions in the production of the vehicle itself.

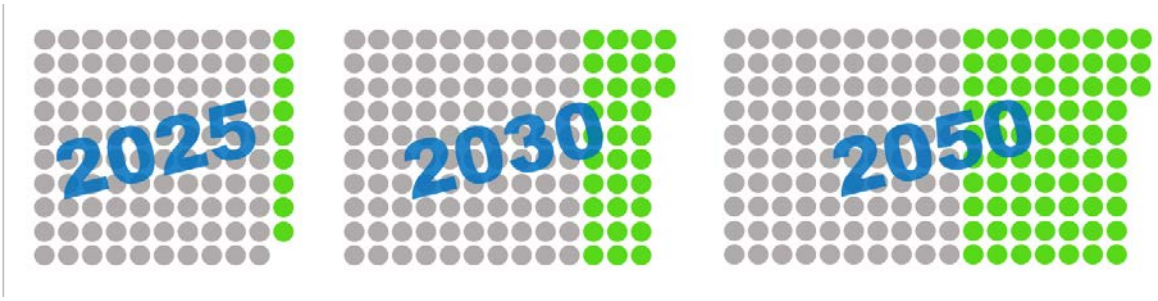
[33] CARB 2017 Advanced Clean Cars Midterm Review. https://www.arb.ca.gov/msprog/acc/mtr/acc_mtr_finalreport_full.pdf

[34] https://ecdms.energy.ca.gov/elecbyCounty.aspx

as an average vehicle, EV charging will amount to less than 1% of total consumption in the county. Over the long term, however, EV charging could require a substantial generation increase. Figure 9 shows the possible low end of this additional consumption (based on Scenario 1 and following U.S. EIA projections for likely EV deployment in the Pacific region). Figure 10 shows the high end of this consumption, if the county deployed sufficient EVs to be make light-duty vehicle transportation carbon neutral. In Scenario 1, EVs would add 6% to countywide electricity demand by 2050, whereas, in Scenario 3, EVs would add 40% by the same year.

Figure 9. Comparison of New Electric Loads from EVs (Green) with Existing Consumption (Grey, based on 2017 data): Scenario 1

Figure 10. Comparison of New Electric Loads from EVs (Green) with Existing Consumption (Grey, based on 2017 data): Scenario 3



4.2.2 How Does the Maximum Increase in EV Demand Compare to Potentially Available Renewable Resources Within the County?

To provide a scale of reference, consider that, in the most ambitious vehicle adoption scenario (assuming 100% electrification, aligned with carbon neutrality), **anticipated EV load could equal one-half to all solar potential identified in the County's recent Renewable Resource Potential Study** (middle row of Table 9).

The county's solar potential includes rooftops, parking lots, urban land unlikely to be developed for other purposes, and the least constrained agricultural land. The solar potential estimate is considered an upper limit on solar realistically developed in the county before accounting for economics, as economics may change in the long term; it accounts for factors such as solar insolation, land area requirements for solar farms of various configurations, and exclusion of land uses incompatible with solar (e.g., land for

parks and recreation, land reserved for habitat or biological values, higher-value agricultural land, highly sloped land, and land with potential for residential development or job creation).[35]

The county also possesses other potential renewable energy resources, including wind, biomass combustion (e.g., agricultural waste, wood waste, landfill waste), and biogas from food waste, waste water treatment facilities, and landfills. When including all of these resources, EV-related load remains quite substantial, at 49% to 84% of total renewable technical potential (Table 9's final row). Though these other renewable resources would have different generation patterns from the solar resource, both over the course of a typical day and throughout the year, and therefore would offer value in balancing out solar production and potentially better-matching the timing of EV electricity consumption. These resources, however, probably would be as suitable for widespread behind-the-meter adoption by customers who may also have EVs, and the total solar resource is at least five times larger than the total of all other renewable resources identified in the county.

Table 9. Comparison of EV Loads from Electrification of 100% of Light Duty Vehicles in the County to Available Renewable Energy Resources in the County.

Resource Type	Total EV Load (GWh/yr in 2050)	Estimate of Renewable Potential (GWh/yr)		EV Load as Percentage of Renewable Potential	
		Low	High	Using Low Est.	Using High Est.
Rooftop solar only	3,911	2,290[36]	4,100	171%	95%
Total solar (including parking lot and ground mounted solar in urban and rural areas)	3,911	3,960[37]	6,960	99%	56%
Total renewables (including solar, wind, biomass, biogas)	3,911	4,674[38]	7,990	84%	49%

[35] For a full description of the methodology, refer to the County's Renewable Resource Potential Study. https://www.contracosta.ca.gov/DocumentCenter/View/55843/Final-Contra-Costa-County-Renewable-Resource-Assessment-Technical-Report

[36] The low estimate Includes solar systems that could be installed on all flat and south-facing rooftops in the county—the most likely rooftops to have solar installed. The high estimate expands to include north-, east-, and west-facing rooftops as well.

[37] The low estimates include only sites deemed most suitable for solar, based on factors such as close proximity to a substation, in an area with the least value for agriculture. The high estimate loosens these criteria to include sites farther from substations, with slightly higher agricultural value.

[38] The low and high estimates of total biomass and biogas resource potential in the county reflect the variation in assumptions of conversion efficiencies and other factors found in the literature. There is only a point estimate for the wind resource, rather than low and high estimates.

School Bus and Light-Duty Fleet Electrification in Pittsburg Unified School District (PUSD)

Pittsburg Unified School District's Transportation Department, with financial support from EVGo, the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project, and BAAQMD, refreshed its aging fleet by purchasing two electric buses, 14 low-emission, propane-powered buses, and six Kia Soul EVs for District staff use, including transportation of Special Education students, with plans to purchase up to seven more electric buses to bring its total to nine. PUSD installed 22 EV charging stations, made available to staff and students at Pittsburg High for free charging. In addition to its commitment to building out its electric and low-emissions fleet, PUSD launched its Bioswale Solar and Wind Generation Project. Completed in September 2018, the project outfitted an acre of land with solar panels and vertical-axis wind turbines, with capacity to generate more than 200 kilowatts (kW) of energy to service the needs of the District's current EV fleet. In seeing PUSD's commitment to not only expanding its electric fleet but to planning to self-sufficiently support it with on-site renewable energy sources, PG&E, through its Electric School Bus Renewables Integration Pilot, agreed to accommodate the entire infrastructure for nine Level 2 EV bus chargers, including plans, design work, a new transformer, and meter aggregation, so any energy generated in excess of the building's consumption could be credited against the electric bus consumption. PUSD looks forward to sharing its experience with other districts to help them avoid pitfalls and maximize their success with fleet electrification.

Beyond the demonstrated need for increased generation to serve this new electric load, questions also arise regarding EVs' impact on the county's transmission and distribution systems. While diving deeply into these for all locations extends beyond this study's scope, analysis of EV capacity on PG&E's grid at certain locations, ideally suited for shared mobility hubs, is covered in Sections 4.3.4 through 4.3.6, based on assessments of charging technologies and speeds most suitable for locations under consideration.

Other potential grid impacts include ramping and capacity implications of EV electricity demand. As discussed, concentrated charging at certain times of day could require significant increases in generation resources deployed over a short time period to keep supply and demand in balance (called the "ramping" need). Significant uncertainty still exists regarding the nature of future EV-related charging demand over the course of a day, given variables such as the following

- The increase in shared mobility through TNCs
- The statewide shift towards electric rates that vary throughout the day (time-of-use [TOU] rates)
- Technological innovations, such as smart charging and improved battery efficiencies

- Changes in charging behaviors as costs and geographic availability of public and workplace charging infrastructure evolve[39]

Despite these uncertainties, the "Electric Vehicle Infrastructure Projection Tool (EVI-Pro) Web Portal" provides the best resource to understand likely EV charging patterns. Created by the CEC and National Renewable Energy Lab (NREL), the portal models load profiles that represent electricity demand from EVs on typical weekdays and weekends for each county in California. Generally, EV electricity demand is expected to vary more dramatically on weekdays than on weekends, given weekend charging would likely be less concentrated than weekday charging as many peoples' schedules become more flexible across hours on weekends.

By 2025, demand from EVs in the county is projected to peak at about 35 megawatts (MW) on weekday evenings, as shown in Figure 11. The CEC models weekend charging as a bit less concentrated, with a slightly lower peak in evenings of 31 MW, shown in Figure 12.[40] The 35 MW peak amounts to about 1% of the low estimate of total, in-county, renewable resource potential, described in the County's 2018 study.

The timing, however, of peak EV electricity consumption projected by CEC differs greatly from the timing of renewable generation that could be achieved in the county. About 85% of these renewables are solar, and the sun will have set by the time projected peak EV load occurs at 7:00 or 8:00 pm. Nevertheless, the substantial amount of renewable resource available in the county presents significant opportunities to offset growth in EV charging with clean local energy. Substantial value could be created by distributing EV loads in the county more evenly across hours of the day to better align with solar production.

[39] The vast majority of charging happens at home overnight, and, unless significant efforts and pricing changes are implemented, this is unlikely to change substantially.

[40] CEC and NREL. "EVI-Pro Web Portal." https://maps.nrel.gov/cec

Figure 11. Weekday Load Profile, Contra Costa (EVI-Pro)[41]

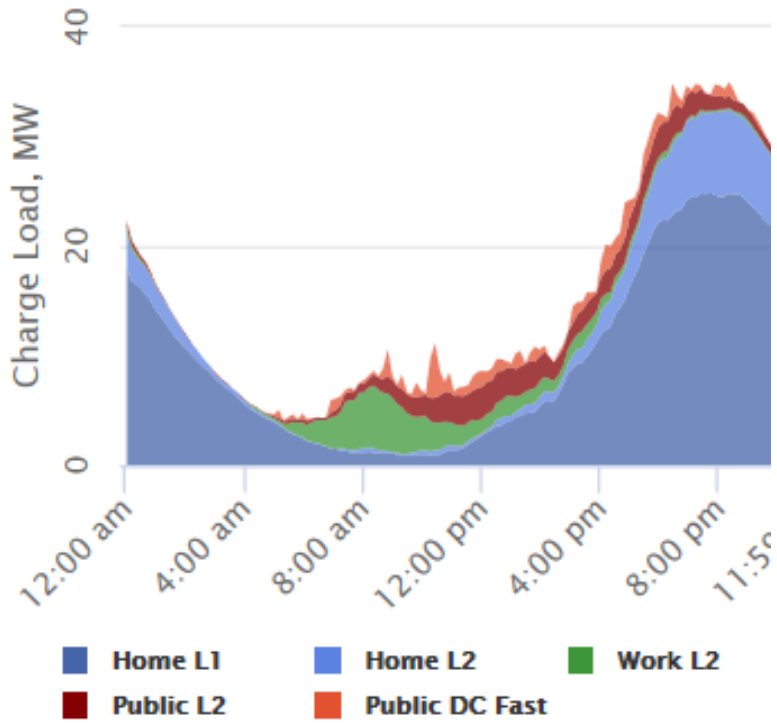
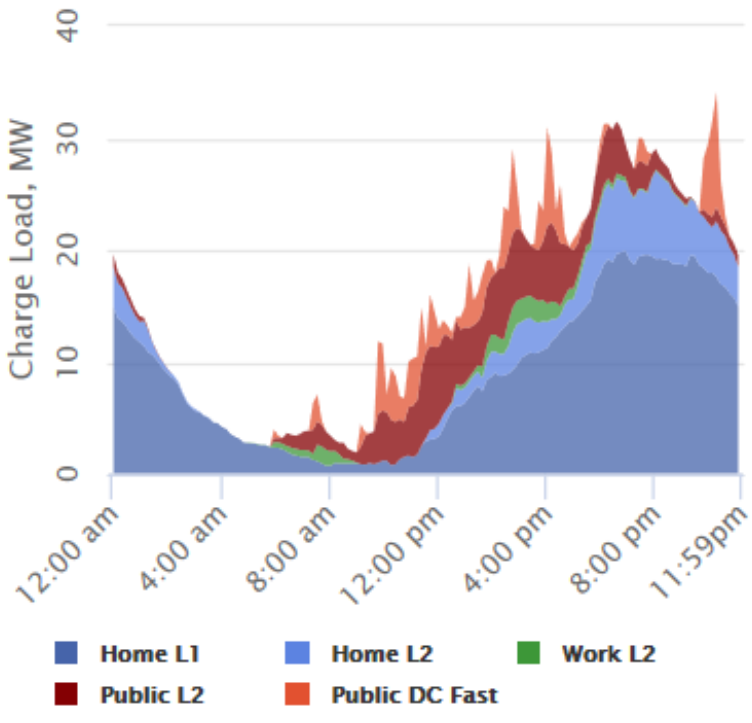


Figure 12. Weekend Load Profile, Contra Costa (EVI-Pro)



[41] NREL EVI-Pro Tool: https://maps.nrel.gov/cec/?aL=0&bL=cdark&cE=0&lR=0&mC=38.07674409597339%2C-121.9976806640625&zL=10

The CEC's EV load profiles also prove informative as they indicate hours when electricity demand—and therefore market prices—may be higher due to increased vehicle electrification. Stakeholders can use these insights to test the financial soundness of innovative EV projects that integrate with battery storage, solar power, and front- and behind-the-meter energy management strategies. Complementary timing plays an important role in EV integration into the electricity grid.

Taken together, this section illustrates that transportation electrification will drive significant changes to the county's electricity needs. By the mid-century, EVs' energy appetite could grow from today's relatively insignificant levels to play a central role in the county's electricity demand. Not only will EVs change the amount of electricity consumed, but may change electricity grid consumption patterns as numerous chargers come on and off line throughout the county.

4.2.3 How Much Renewable Energy Could be Co-located with EV Charging in Priority Locations, and What Would be the Benefits?

As described in Section 4.4 (Mapping Analysis), this study identifies priority geographic areas for increasing availability of EV charging. Given potential benefits of co-locating EV infrastructure and renewables, this section describes available renewable resources in these priority areas.

Analysis was conducted as co-locating EV infrastructure and renewable energy projects can produce a range of benefits for vehicle-owners, grid operators, and the environment. Vehicle owners may be able to accelerate charging using innovative technologies that combine photovoltaic (PV) energy with grid-sourced energy, achieving cost savings by taking full advantage of appropriate utility tariffs, and implementing behind-the-meter demand management.[42,43] For grid operators, co-located generation and load can reduce line-losses and, if charging is carefully managed/matched to the generation profile, could potentially offset EV consumption behind the meter, reducing current flows on local distribution systems, and delaying or displacing distribution system upgrades otherwise necessary to meet vehicle electricity needs.[44] In the future, vehicles with grid integration capabilities could support resilience by serving as backup home energy storage and could be powered by co-located rooftop solar when the grid is offline.

Finally, opportunities exist for cost-efficiencies when making these investments and installations in tandem, not only in system design and installation, but potentially in "soft costs" (for instance, if permitting, inspections, or interconnection processes for a project's solar and EV-charging components could be coordinated).

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42 https://www.solaredge.com/sites/default/files/ev_charging_inverter_brochure_eng.pdf

43 https://arxiv.org/ftp/arxiv/papers/1705/1705.02720.pdf

44 A pilot project to co-optimize on-site wind and solar production with electric bus charging timing is being conducted as a collaboration between PG&E and Pittsburg Unified School District.

As shown in Table 10, 10 census tracts inside the county's Urban Limit Line had the highest EV charging "gaps" for public and workplace Level 2 infrastructure (using the methodology described in Section 4.4, Mapping Analysis). The study used the *public and workplace charging score* rather than the residential score for this analysis as public and workplace charging would most likely have a load profile more akin to a typical solar generation profile. The conservative (low) solar capacity estimates in those tracts informed quantification of the potential for co-locating EVSE and solar infrastructure. This included solar on rooftops, parking lots, urban land currently underutilized, and agricultural lands relatively unconstrained.[45] This energy supply was characterized in terms of annual megawatt hours (MWh) the site could be expected to produce, which was then converted to the equivalent number of smaller or larger EV batteries it could charge. Another way to slice these data is to evaluate the equivalent number of vehicle miles that this amount of energy could support. The same process was conducted for five high-priority tracts outside of the county's Urban Limit Line, as shown in Table 11.

[45] In the 2018 Renewable Resource Potential Study, the County defined a category of land as "urban land unlikely to be developed" that was particularly desirable for solar installation in urban areas, considered land unlikely to be developed for other purposes. This includes brownfields, industrial buffer land, surplus land along freeways, and other lands unlikely to be developed for other purposes and presenting few, if any, tradeoffs.

For more information on the methodology used to determine the low estimates, see the Contra Costa County Renewable Resource Potential study.

Table 10. Top 10 EVSE Priority Tracts (Inside the Urban Limit Line)

Census Tract	EVSE Index Score	Total MWh/yr (low estimate)	Equivalent BEV Batteries (Smaller)[46]	Equivalent BEV Batteries (Larger)[47]	Equivalent BEV miles[48]
6013312000	1.00	19,888	662,948	331,474	65,830,699
6013316000	0.95	6,623	220,769	110,385	21,922,385
6013345204	0.89	6,310	210,336	105,168	20,886,388
6013320001	0.89	74,226	2,474,209	1,237,104	245,688,951
6013309000	0.87	12,773	425,771	212,885	42,279,016
6013305000	0.86	35,692	1,189,731	594,866	118,140,337
6013357000	0.86	4,732	157,719	78,859	15,661,488
6013302007	0.84	18,450	615,000	307,500	61,069,500
6013328000	0.84	60,734	2,024,463	1,012,231	201,029,175
6013352202	0.84	6,150	205,000	102,500	20,356,500
	Total	245,578	8,185,946	4,092,973	812,864,439

[46] The size of smaller batteries is modeled as 30 kilowatt hours (kWh), such as that used by the Nissan Leaf, prior to the 2019 model.

[47] The size of larger batteries is modeled as 60 kWh, such as that used by the 2019 Chevy Bolt.

[48] This calculation relies on a projected efficiency of 3.31 miles per kWh in 2025, assuming a steady incremental increase in battery efficiency from typical efficiencies today.

Table 11. Top 5 EVSE Priority Tracts (Outside the Urban Limit Line)

Census Tract	EVSE Index Score	Total MWh/yr (low estimate)	Equivalent BEV Batteries (Smaller)[49]	Equivalent BEV Batteries (Larger)[50]	Equivalent BEV miles[51]
6013304002	1.00	150,002	5,000,053	2,500,026	496,505,250
6013309000	0.94	12,773	425,769	212,885	42,278,885
6013303103	0.84	36,112	1,203,745	601,872	119,531,835
6013357000	0.73	7,728	257,591	128,795	25,578,758
6013314103	0.72	29,230	974,325	487,163	96,750,483
	Total	235,844	7,861,482	3,930,741	780,645,210

Together, solar that could be sited in the set of 10 tracts within the Urban Limit Line and the set of five tracts outside the Urban Limit Line could provide the substantial energy needed to support EV charging. **This solar could support the equivalent of bringing a battery from empty to full from 8 to 16 million times, equating to powering almost 1.6 billion miles per year, or about 20% of the county's annual vehicle miles traveled.**[52] The impressive magnitude of solar resource available in these census tracts shows a targeted approach to co-located EVSE and solar energy could offer a powerful method to work toward the County's climate goals.

Furthermore, although the data are not provided here, calculations were conducted showing that the nominal capacity of the available solar resource is an order of magnitude more than the capacity required for the amount of DCFC chargers predicted to be needed in the county by 2025.[53] Still, it should be noted that absent significant investment in storage and other clean resources with differing generation profiles, solar resources described above could not fully support all this DCFC infrastructure, given timing considerations and natural variability due to weather and seasons.

4.3 Shared Mobility Hub Analysis

CCTA has a long history innovation regarding shared, connected, and autonomous mobility. Such innovation has been driven by necessity—shared mobility is seen as a potential solution to address several of the county's transportation challenges, including congestion, local and GHG pollution, and

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49 The size of smaller batteries is modeled as 30 kWh, such as that used by Nissan Leaf prior to its 2019 model.

50 The size of larger batteries is modeled as 60 kWh, such as that used by the 2019 Chevy Bolt.

51 This calculation relies on a projected efficiency of 3.31 miles per kWh in 2025, assuming a steady increase in battery efficiency.

52 Based on an estimate of 8.2 billion vehicle miles traveled in-county as of 2013. http://www.bayareacensus.ca.gov/transportation/VitalSigns/Total_vehicle_miles_traveled_2015.xlsx

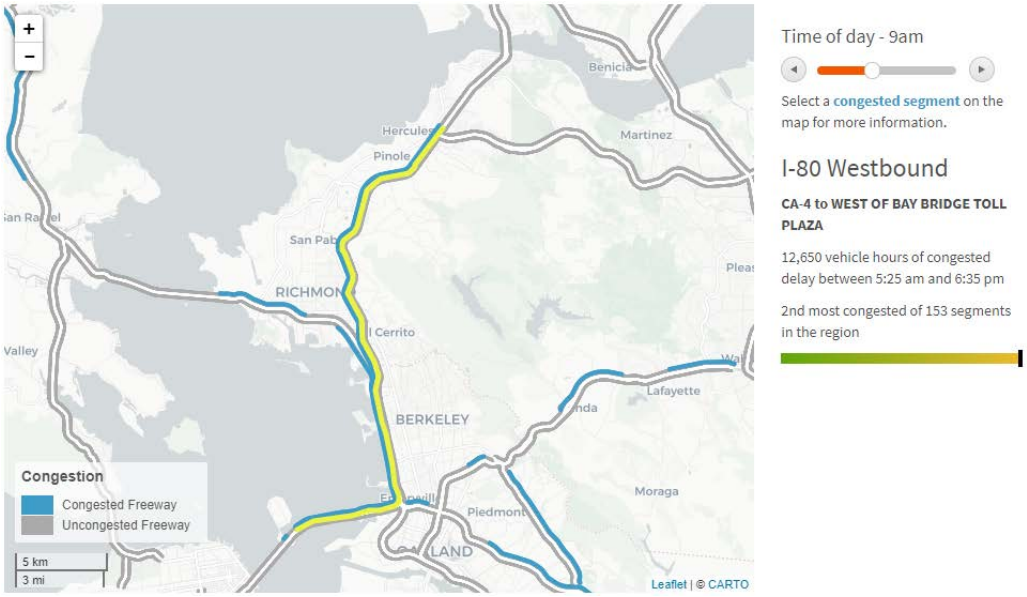
53 This calculation relies on the high estimate of in-county DCFC need (674 chargers); if a smaller number of chargers is necessary (352), available capacities are even higher relative to projected need.

affordability. This EV Blueprint looks to build upon the county's shared mobility leadership, with specific analysis of opportunities related to electrification.

4.3.1 The Need and the Opportunity

The Bay Area experiences some of the worst traffic congestion in the country, and Contra Costa County is not immune. In 2017, four county locations were among the top 10 most congested in the region.[54] This congestion poses a real cost to county residents; for example, the stretch of I-80 Westbound from CA-4 to west of the Bay Bridge Toll Plaza costs drivers 12,650 vehicle hours each weekday morning (see Figure 13); the segment of I-680 Northbound from Sycamore Valley Road to Buskirk Avenue/Oak Park Boulevard costs commuters 4,500 vehicle hours of congestion each weekday evening (see Figure 14).[55] About two-thirds of Contra Costa residents still commute by driving alone, meaning substantial room may exist for improvements offered by shared mobility solutions.[56]

Figure 13. 2017 Time Spent in Highway Congestion, I-80 Westbound.

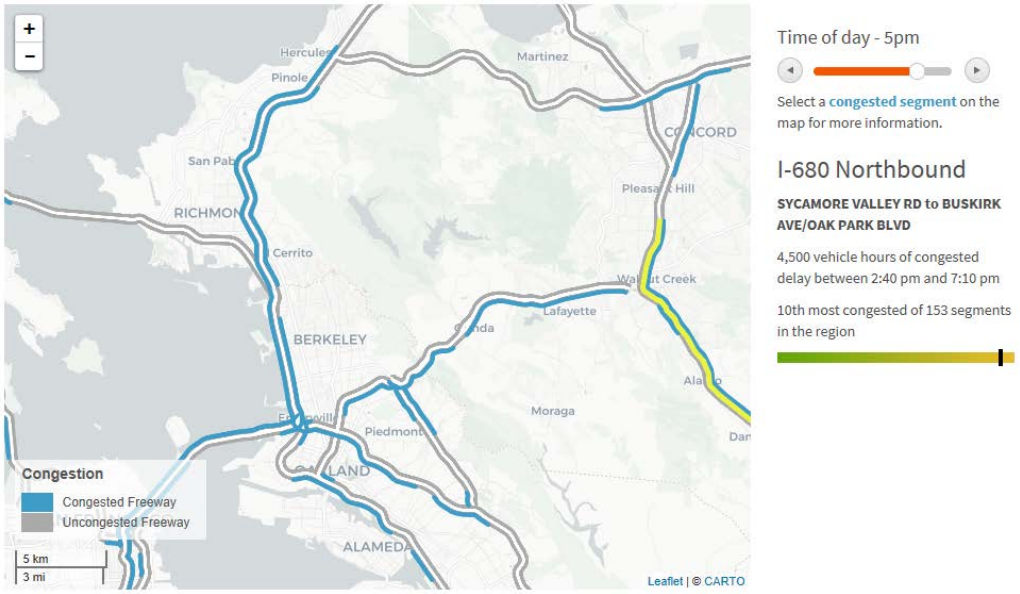


54 https://mtc.ca.gov/sites/default/files/top_50_congestion_locations-2017.pdf

55 http://www.vitalsigns.mtc.ca.gov/time-spent-congestion#chart-0; https://mtc.ca.gov/whats-happening/news/bay-area-vital-signs-freeway-congestion-levels-delays-are-still-record-highs

56 http://www.vitalsigns.mtc.ca.gov/commute-mode-choice#chart-2

Figure 14. 2017 Time Spent in Highway Congestion, I-680 Northbound.



The rise of shared mobility alternatives may also help reduce the energy and emissions implications of the county's transportation demand. Idling and stop-and-go traffic can contribute to higher emission rates of local air pollutants and GHGs;[57] consequently, these can be lowered by reducing the number of vehicles on the road and by accelerating EV adoption—both of which can be achieved by promoting electric shared mobility solutions.

Additionally, state and regional policies such as SB1014, which calls for improving the GHG emissions profile of TNC miles, and Bay Area Rapid Transit's (BART's) 100% renewable power target aim to reduce the GHG footprint of shared mobility solutions.[58] Due to the policies in place, these new forms of mobility will more likely depend on electricity than the alternatives they replace. A cleaner transportation system should result as more commutes incorporate these modes.

Transportation affordability poses a continuing challenge for Contra Costa, especially as county residents spend an average of 18% of their incomes on transportation costs; many low-income households pay substantially more for transportation costs as a percentage of their incomes.[59] Vehicle ownership can carry a significant financial burden, but the lack of transportation autonomy experienced by those not owning cars can translate to costs through lost time or missed wages. Shared mobility options may offer county residents opportunities to reduce these transportation expenditures or to earn

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57 https://www.bu.edu/sph/files/2018/09/Gately_et_al_2017.pdf; https://www.accessmagazine.org/fall-2009/traffic-congestion-greenhouse-gases/

58 https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180SB1014

59 https://htaindex.cnt.org/fact-sheets/?focus=County&gid=1129; The typical-income household modeled consists of 2.68 people, 1.22 of whom are workers, earning an annual income of $81,552; the moderate-income household features the same characteristics but is modeled earning an annual income of $65,242.

additional income by providing these shared mobility services. Between potential costs savings, income opportunities, and improved access to jobs and important destinations for low-income and underserved populations, shared mobility solutions potentially support equity goals as long as they have been carefully designed to meet community needs based on early engagement with potential beneficiaries.

To the extent that electrified shared mobility solutions can take hold in the county, they have the potential to alleviate concurrent pressures of congestion, environmental impacts, and transportation affordability. The county has already made strides towards achieving these benefits through a number of innovative programs.

First and foremost, a significant number of shared mobility assets already exist in the county. Contra Costa boasts very popular and high ridership transit lines, including BART, express buses, and commuter shuttles offered by major trip generators (e.g., Bishop Ranch). The area also experiments with shared autonomous vehicles, such as the innovative EasyMile pilot program.[60] These shuttles will likely serve some of the first-mile-last-mile solutions included in the County's comprehensive Innovate 680 efforts.[61] Other shared mobility strategies encompassed by Innovate 680 include enabling bus-on-shoulder operations, completing express lanes that target travelers using transit, carpool, vanpool, or motorcycles, and creation of a transportation demand management program to reduce single-occupancy vehicle travel. CCTA's history with GoMentum Station, the largest testing facility for connected and autonomous vehicle technology in the United States, underscores the County's role as a transportation innovator.[62]

Because much thinking has already addressed shared mobility, and significant shared mobility assets already exist in the county, this study focused on examining ways to accomplish electrification of shared mobility hubs, and, in particular, the capacity available to charge EVs at locations identified as key types of shared mobility hubs. These types include sites with sufficient potential to reduce single-occupant vehicle travel and congestion in the county (e.g., Park and Rides) or those already emerging as hubs (e.g., BART stations and Transit Centers). The next section describes the methodology used to identify the distribution system's capacity at these locations, without additional investments or upgrades. Appendix C provides the full results of this analysis.

4.3.2 Methodology

This assessment began with a set of promising host sites for charging (e.g., BART stations, Park and Rides, Transit Centers), evaluating them for different types of charging types, as shown in Figure 15.

In actual practice, each specific site will offer a different, optimal mix of Level 1, Level 2, and DCFC, depending on each site's surroundings and the travel patterns of its users. However, since the Blueprint

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60 https://ccta.net/wp-content/uploads/2018/11/Shared-Autonomous-Vehicle-Pilot-Program-Fact-Sheet-EasyMile_pilot_onepage.pdf

61 https://ccta.net/wp-content/uploads/2018/11/Innovate680_Summer2018_FINAL.pdf

62 https://gomentumstation.net/about/

was not intended to create plans for specific sites, these three hub types were used to generalize the analysis, focusing on different charging levels (depending on the hub type). EV charging installations' impacts on the distribution grid will vary, based on the instantaneous power amount drawn by a charger (in kW) and the degree of congestion experienced by the segment on which they are installed (i.e., nearing its capacity limit). Installing substantial EV charging loads in congested areas will likely require upgrades and investments. Such congestion depends on more that location, differing, for example, if charging loads come online at the same time as other electricity demand peaks.

Figure 15. Summary of Shared Mobility Hub Types

As discussed above, a charging installation's impact on the distribution grid at a particular site partly depends on the amount of power that the installation would draw. Typical Level 1 chargers draw about 1.4 kW of power, while Level 2 chargers draw about 7 kW—both an order of magnitude less than the 150 kW emerging as a standard for many DCFC installations.[63] The time required to charge a full battery decreases with the increase in charger power. Selecting the appropriate charging infrastructure for a given type of shared mobility hub must incorporate two key considerations: the duration that vehicles are expected to park at the location, and the types of charging services users expect.

At Park and Rides and BART stations, commuters will likely leave their cars at the site for eight to 10 hours, aligning well with use-profiles of lower-powered charger types (Level 1 and Level 2). Level 1 chargers may offer an appealing option at some of these sites, especially given their generally lower installation costs compared to higher-powered charger alternatives. As EV adoption reaches the very high levels contemplated in the scenarios above, it may become desirable to have more ubiquitous Level 1 charging at parking facilities with long dwell times. As Level 1 charging can be achieved via a standard three-prong wall outlet, and since it requires such a low power draw relative to Level 2 and DCFC, analysis of the distribution system capacity for Level 1 charging would not be particularly informative. Therefore, while this report anticipates Level 1 as part of the solution for Park and Rides and BART stations, the analysis focuses on Level 2 and above.

63 https://www.energy.gov/eere/vehicles/articles/fact-995-september-18-2017-electric-vehicle-charging-home-typically-draws; https://electrek.co/2019/04/25/electrify-30-dc-charging/

Using Google Maps satellite imagery, the location and orientation of parking lots were identified, utilizing the PG&E Solar Photovoltaic and Renewable Auction Mechanism (PVRAM) tool[64] to find the closest feeder(s) to each site, and ignoring feeders unable to serve as interconnections due to obstructions (e.g., needing to pull service across a major highway or a river). Figure 16 illustrates this process in context with the San Ramon Transit Center, where two available feeder lines were identified adjacent to the parking lot as well as an EV charging system already in place.

Figure 16. Feeders Selected to Serve San Ramon Transit Center

Utilizing capacity and line information from PG&E's Distributed Resource Plan, the lowest and greatest Minimal Impact (kW) for these locations were collected.[65] PG&E's PVRAM tool provided estimates of capacity available, assuming daytime and nighttime charging profiles. PG&E's estimates of available

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64 Though created as a resource for project developers (primarily for distributed generation), this tool proved applicable to this report's purpose as it offers information related to transmission and distribution lines, substations, operating voltages, and line capacities. PVRAM served as the basis for identifying feeder characteristics at the chosen priority sites. https://www.pge.com/en_US/for-our-business-partners/distribution-resource-planning/distribution-resource-planning-data-portal.page

65 Feeders contain many line segments, each of which may have unique capacity limitations. The lowest Minimal Impact kW data characterize the capacity available on the most-constrained line segment on a particular feeder, while the greatest Minimal Impact kW data characterize the capacity available on the least-constrained line segment. As the map does not show specific line segments, the Minimal Impact kW was considered conservative when estimating available capacity, presenting the worst-case situation, according to 2015 data.

capacity at sites served by multiple feeders were aggregated to calculate an indicative number of EV chargers that could service vehicles at that site. The results yielded an understanding of kW levels that PG&E did not expect to impact the distribution grid.

Still, a few caveats must be considered. First, it is important to remember that data available through this tool at the time of the analysis were last updated in 2015. Therefore, information provided by the tool does not necessarily reflect reality on the ground, particularly where more growth and development has occurred, or where new sizable loads or renewable resources have become available.

Second, queued projects may soon be installed that would affect the available capacity on any given line segment or substation. Therefore, for projects seeking to install substantial EV-charging amounts, early engagement with PG&E will prove essential, and capacity and charger estimates provided here should **not** be considered authoritative.

The application process for interconnecting an EV charging system depends on project specifics, with higher-capacity systems installing DCFC(s) or multiple Level 2 chargers requiring more review than most residential Level 2 interconnections.[66] To install a DCFC charger, interested parties must first apply online and speak with a PG&E representative before approving the project design supplied by PG&E. This process may change as PG&E partners with charging developers to refine planning and interconnection procedures.[67] Numbers presented in this report should simply be considered a starting point for informing very early consideration of electrified shared mobility hubs.

4.3.3 Transit Agencies and Shared Mobility Hubs

As transit agencies operate at each of the three shared mobility hub types analyzed below, one should note that these agencies are currently (or soon to be) in the process of developing and adopting plans to transition to 100% zero-emission buses by 2029, under the CARB ICT regulation. This effort will require significant implications for the capacity available on PG&E feeders where the buses are charged.

In many cases, the transit agencies may primarily opt to charge in their overnight depots, which typically are not nearby shared mobility hubs. In other cases, however, transit agencies may consider Transit Centers, BART stations, and even Park and Rides and other locations along their routes as potential sites for en-route charging, where they would deliver substantial power to buses during short stops (e.g.,

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66 See "Site Information for Electric Vehicle Direct Current Fast Chargers" (https://www.pge.com/en_US/about-pge/environment/what-we-are-doing/electric-program-investment-charge/direct-current-electric-vehicle-fast-chargers.page)and "Building and Renovation" (https://www.pge.com/en_US/small-medium-business/building-and-property/building-and-maintenance/building-and-renovation/understand-the-process.page) for more information about PG&E's interconnection process for EVSE.

67 https://www.utilitydive.com/news/utilities-charger-vendors-find-interconnection-best-practices-to-propel-ev/549593/

layover times between scheduled trips). In these instances, transit agencies may take advantage of PG&E's Fleet program.[68]

Through this program, PG&E would install the necessary infrastructure to support zero-emission buses up to but not including the charger itself, known as make-ready infrastructure. These plans and upgrades would significantly affect the availability of electrical capacity on the local grid.

As each transit agency has yet to develop its fleet electrification plan, this EV Readiness Blueprint cannot factor in future agency plans. Still, PG&E has just launched its EV Fleet program; so, opportunities to improve distribution grid infrastructure can be expected in the near term. Examining the needs for transit buses in parallel with the needs of commuters and other parking lot users at each type of shared mobility hub potentially could result in better and more efficient outcomes in assessing optimal, make-ready investments that PG&E could undertake.

4.3.4 Shared Mobility Hub Type #1: Park and Rides

This study identified Park and Rides as prime locations for developing of Shared Mobility Hubs, integrated with EV infrastructure. These locations already serve as hubs for many different transit services, offering commuters opportunities to pair a single-occupant vehicle trip with a carpool, vanpool, or a ride on a public transit bus. Vehicles serving any portion of these trips eventually could be electrified; so shared mobility innovation at these sites potentially could complement countywide vehicle electrification efforts.

In addition to existing transit buses, new commuter shuttles or additional express bus lines could stop at these Park and Rides. As discussed, CCTA has been exploring a bus-on-shoulder pilot project that would enable buses to bypass heavily congested segments of the county's busiest corridors (such as I-680).[69] Such innovation would likely cut travel times and improve quality of life levels for passengers, making Park and Rides even more important as hubs for shared mobility solutions. To the extent that Park and Rides target some innovative, shared, autonomous programs that the County is putting in place, the grid capacity modeled here could eventually supply charging for these vehicles as well.[70] Because Park and Rides operate at the intersection of many vehicle types and transportation modes, it is useful to understand their capacity to support EV infrastructure from a grid engineering perspective.

Park and Rides provide a great opportunity for increasing the availability of Level 1 and Level 2 charging, and, in some cases, if located near amenities, they could also provide suitable locations for a limited number of DCFC ports. In this analysis, however, Park and Rides were evaluated for the amount of

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68 https://www.pge.com/en_US/large-business/solar-and-vehicles/clean-vehicles/ev-fleet-program/ev-fleet-program.page

69 https://www.nbcbayarea.com/news/local/Contra-Costa-Co-May-Allow-Buses-to-Drive-on-Freeway-Shoulders-to-Diminish-Rush-Hour-Traffic-502043572.html

70 https://ccta.net/wp-content/uploads/2018/11/Shared-Autonomous-Vehicle-Pilot-Program-Fact-Sheet-EasyMile_pilot_onepage.pdf

Level 2 charging that could be supplied by current grid resources. This is because many Park and Ride users will park at the facilities, continuing on to a workplace through a carpool or other shared transportation mode; therefore, their vehicles would have long dwell times.

Furthermore, providing Level 2 charging at Park and Rides, combined with new, potentially shared mobility services, could provide incentives to reduce the number of miles traveled by single-occupant vehicles by encouraging EV drivers not to drive all the way to their final destination. Level 2 charging at Park and Rides also could provide charging opportunities for commuters without access to home charging infrastructure (e.g., those with only street parking or those living in MUDs).

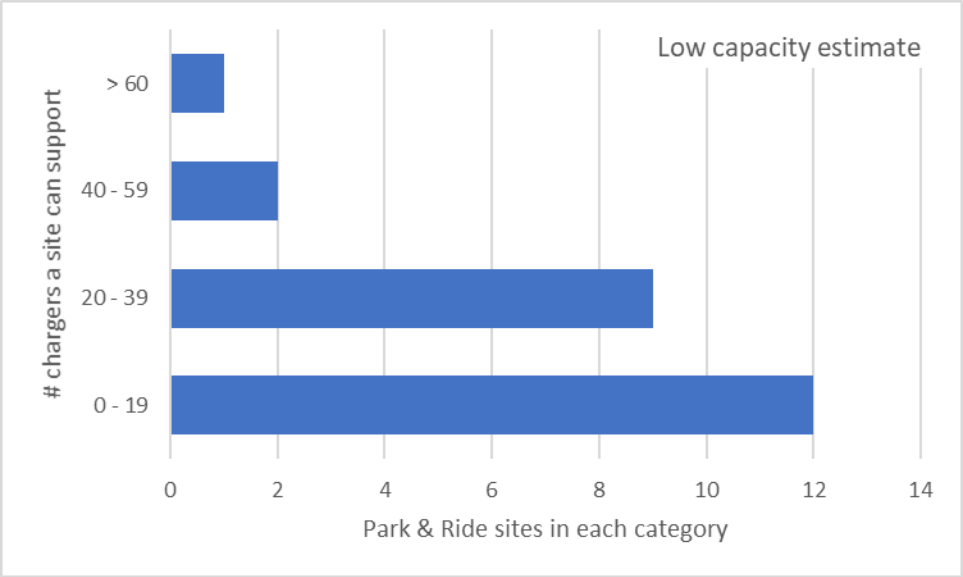
The 24 Contra Costa Park and Ride facilities examined can support an average of about 22 Level 2 EV chargers at each site, even when incorporating PG&E's low estimates for line capacities. Sites, however, exhibit significant variations. Figure 17 suggests that many Park and Ride sites in Contra Costa have the capacity to support significant EV charging infrastructure without causing harm or requiring costly upgrades to the distribution grid.

In fact, one-half of the county's Park and Rides have the capacity to support installations of at least 20 Level 2 charging ports at each site (and a full two-thirds could support at least 10 Level 2 ports). These capacity estimates draw upon the lowest possible feeder line constraints; the upper-bound capacity estimates suggest host capabilities for an order of magnitude more chargers at some locations. Introducing Level 2 charging at appropriate Park and Ride sites could reduce congestion, facilitate all-electric commutes for even shorter-range vehicles (e.g., used EVs, plug-in hybrids), and provide a regular charging location for renters and MUD residents who also use the Park and Rides.

While this analysis focuses on distribution grid capacity, a question remains regarding the actual number of parking spaces each site offers for installing charging infrastructure. As noted, great variation occurs between low and high grid capacity estimates, but the upper end of the range suggests capacity many times the actual number of parking spaces available.

Finally, it should be noted that even if a Park and Ride does not currently have a nearby PG&E feeder with sufficient capacity, opportunities still exist to collaborate with PG&E to provide make-ready infrastructure, particularly if analysis can show the site will likely support a significant amount of charging or provide a strategically important shared mobility location.

Figure 17. Expected Level 2 Charger Capacity at Park and Ride Sites in Contra Costa County



In some cases, Park and Rides may be located in settings with substantial other destinations and activities (for instance, some Park and Rides in the county are co-located with BART stations). In these cases, potential exists for integration with TNCs such as Uber and Lyft, looking to serve first-mile-last-mile commuter needs in delivering passengers to transit. Installing EVSE to support the TNC fleet's top-up or recharge needs may offer a method for attracting more electric TNC activity at the sites, though these sites were not evaluated for such opportunities as the places more likely to realize impacts also tend to be located at other types of shared mobility hubs, such as BART stations.

4.3.5 Shared Mobility Hub Type #2: BART Stations

Appropriate EV charging technologies for BART stations may not only depend on transit operations at these locations, but also on how shared mobility services develop in the surrounding areas. Many bus routes connect to BART at key stations. As noted, transit agencies will be conducting extensive planning for their own bus fleet's electrification, some of which will likely include en-route charging, and each agency's plans of each agency remain unknown. Therefore, this analysis focuses on charging needs of shared mobility services and private vehicles, leaving the discussion of transit agency needs for another time.

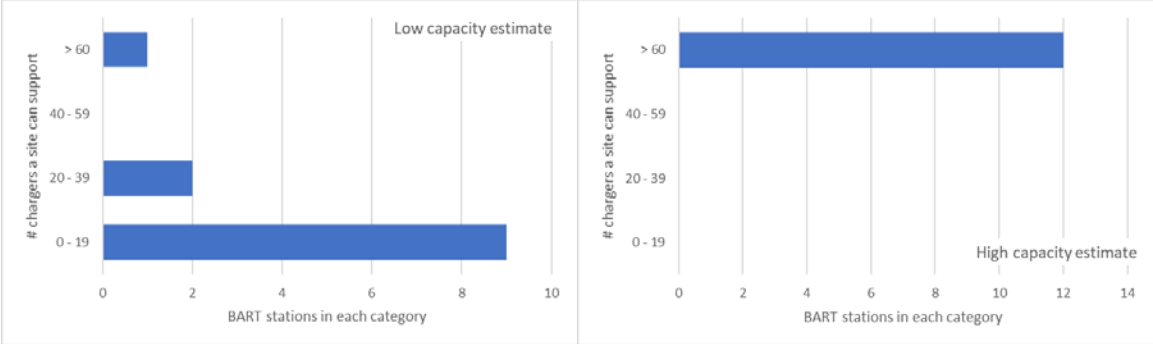
Accordingly, BART stations were investigated for Level 2 and DCFC charging—the former because many of these stations offer substantial amounts of commuter parking that will inherently have a long dwell times, and the latter because, unlike most Park and Rides, many BART stations are close to a substantial number of destinations and activities that generate many trips that could be served by electrified TNCs providing first mile-last mile solutions for BART riders. The anticipated mix of Level 1, Level 2, and DCFC ports would be provided at BART stations to serve various types of drivers frequenting them.

4.3.5.1 Level 2 Charging for Commuter Parking

For every feeder line reviewed, a significant range exists between the lowest and highest estimates of its potential capacity. If capacity is on the low end of its potential range, four stations (e.g., Orinda, El

Cerrito Plaza, Antioch, and Pittsburg Center) may not have space available on local distribution lines to support such additional electricity demand, as shown in Figure 18. On the other hand, the high end of the range suggests there should be sufficient capacity on local distribution lines to support hundreds of Level 2 chargers at each station. In this optimistic scenario, the limiting factors would not be distribution-line capacity, but rather potential installation costs in addition to the number of parking spaces available at the station.

Figure 18. Expected Level 2 Charger Capacity at BART Stations in Contra Costa County



Appendix C elaborates upon the available capacity at individual stations.

4.3.5.2 DCFC Charging for Transportation Network Companies

The opportunity to support TNCs via DCFC plazas at or near BART stations is even more salient given the dual mandates of SB1014 for TNCs to increase deployment of EVs and to reduce GHG emissions per passenger-mile traveled.[71] Through this legislation, the state and its agencies are creating demand pull for TNC-accessible charging infrastructure; the county can capitalize on this demand with appropriate installations at sites where there is grid capacity.

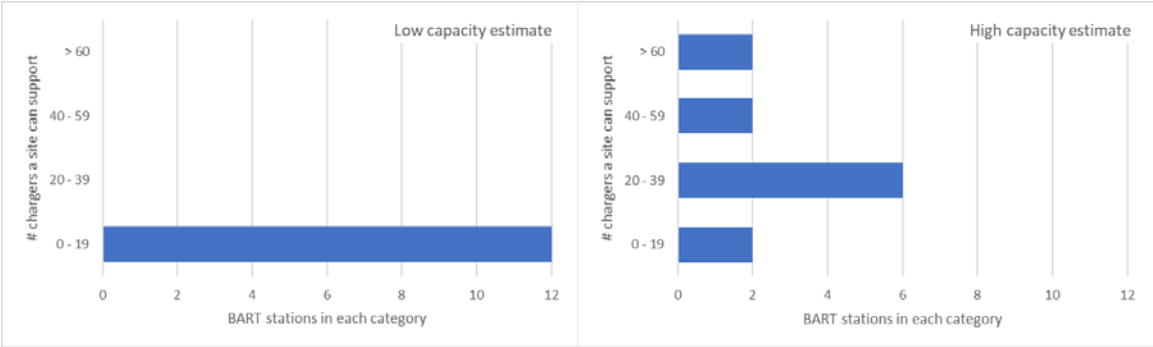
For such shared mobility services, fast charging is essential to reduce non-revenue hours. As discussed earlier, however, DCFC charging requires much higher capacity than Level 1 or Level 2 charging, imposing more significant strains on distribution systems. Without additional upgrades to local electric infrastructure, conservative estimates suggest only two BART stations considered in this analysis have the capacity for DCFC installations: Concord (10 chargers) and Pleasant Hill (1 charger). Still, just as substantial variations occur between low and high estimates across sites, assuming distribution line capacities at the high end of PG&E's suggested range, all 12 BART stations in the county could be candidates for DCFC installations.

Particularly at BART parking lots, PG&E's data included substantial uncertainty due to significant variations in the capacity amounts available on each line segment for any given feeder. As it is not known which line segment EV charging would connect to, this analysis cannot determine if low or high estimates are more appropriate. These estimates sometimes differ by an order of magnitude. This

[71] https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180SB1014

Blueprint suggests undertaking additional investigation and discussion with PG&E would prove prudent before considering buildouts of charging infrastructure at specific BART stations.

Figure 19. Expected DCFC Charger Capacity at BART Stations in Contra Costa County



While the above analysis focuses on distribution capacity located *at* BART stations, TNC charging hubs located *near* BART stations offer another potential solution. Better opportunities may exist for DCFC interconnections to the distribution grid within a one- or two-minute drive to BART stations. These opportunities would serve the same function as locating DCFC charging at stations themselves, while potentially offering more flexibility to select locations with more capacity available, less expensive installations, or DCFC siting that would not detract from available commuter parking (which is already constrained).

4.3.6 Shared Mobility Hub Type #3: Transit Centers

This analysis included five Transit Centers in the county as potential sites where electrification efforts could be paired, in a complementary fashion, with shared mobility solutions. Transit Centers are well-suited to serve as shared mobility hubs as they connect riders to various mobility services, such as bus transit and light rail, and to places of interest.[72] When the Transit Centers were originally sited and built, their sites were selected strategically by local transit and planning agencies to serve critical nodes and junctures of various transportation systems. By focusing on Transit Centers as targets for incorporating new shared mobility innovations, communities can build on decades of planning and investment going into establishing these centers, better ensuring patterns of new shared mobility innovations are complementary to existing systems.

The appropriate mix of EV charging technologies for Transit Centers may not only depend on transit operations at these locations, but also on how shared mobility services develop in surrounding areas. As noted above, transit agencies will do extensive planning for their own fleet electrification, some of which will likely include en-route charging, and each agency's plans remain unknown. Therefore, this analysis focuses on the charging needs of shared mobility services and private vehicles, leaving discussion of transit agency needs for another time.

[72] https://www.transit.wiki/Hercules_Transit_Center

Each Transit Center may require a different, appropriate set of solutions. For instance, if an area is sufficiently dense to support regular TNC service, it may make sense for the Transit Centers to develop fast-charging hubs targeted at TNCs (as described in the section on BART stations). In some instances, Transit Centers may be connected to substantial parking resources, supporting a significant amount of long dwell-time commuter parking, suggesting that electrification spending should focus similarly to methods applied at Park and Rides, with a heavier emphasis on Level 1 and Level 2 charging. On the other hand, if the Transit Center is not expected to offer substantial parking now or in the near future, it may not make sense to treat them as targets for EV infrastructure serving personal vehicles, leaving it open for transit agencies to consider if en-route charging makes sense within their planning and operations.

4.3.6.1 Level 2 Charging for Commuter Parking

As discussed, the opportunity for Level 2 charging at Transit Centers relies on the number of parking spaces at each site as well as the nature in which the sites are typically used. Transit Centers with substantial parking available, allowing riders to leave vehicles for long periods, are better suited to Level 2 infrastructure.

For example, as shown in Table 12, the Hercules Transit Center has many parking spaces and a distribution grid with the capacity to support at least 15 Level 2 chargers. On the other hand, the San Ramon Transit Center has only 52 parking spaces; if these are in high-demand and should not be occupied for long periods by single vehicles filling their batteries, this site may not be well suited for installation of Level 2 infrastructure. Like the other types of shared mobility hubs examined, Transit Centers experience significant ranges in the distribution grid's estimated capacity to absorb EV charging installations without triggering upgrades. Given this variation, opportunities for Level 2 charging at Transit Centers in Contra Costa County merits further research.

Table 12. Transit Center Level 2 Charger Capacity

Location	Parking Spaces	Low Estimate of Level 2 Capacity (Number of Ports)	High Estimate of Level 2 Capacity (Number of Ports)
Pacheco Transit Center	110	20	> # of parking spaces at site
San Ramon Transit Center	52	88	> # of parking spaces at site
Diablo Valley College (DVC) Transit Center	0	19	> # of parking spaces at site
Richmond Parkway Transit Center	206	0	> # of parking spaces at site
Hercules Transit Center	422	15	> # of parking spaces at site

4.3.6.2 DCFC Charging for Transportation Network Companies

Across the sites, conservative estimates of the number of instances with enough charging capacity to support DCFC chargers appear unpromising. Using PG&E's conservative capacity availability estimate, the San Ramon Transit Center is the only site with the capacity for installation, but it would only be able to handle three stations. On the higher end of PG&E's capacity estimates, the story is somewhat better, with all sites capable of serving some DCFC infrastructure, as shown in Table 13.

Table 13. Transit Center DCFC Capacity

Location	Parking Spaces	Low Estimate of DCFC Capacity (Number of Ports)	High Estimate of DCFC Capacity (Number of Ports)
Pacheco Transit Center	110	0	26
San Ramon Transit Center	52	3	55 (> # of parking spaces at site)
DVC Transit Center	0	0	26 (> # of parking spaces at site)
Richmond Parkway Transit Center	206	0	20
Hercules Transit Center	422	0	75

4.3.7 Final Notes on Shared Mobility Hub EV Infrastructure Capacity

The analysis for all three shared mobility hub archetypes—Park and Rides, BART stations, and Transit Centers—underscores the importance of coordinating with PG&E to understand the most up-to-date status of grid capacity at potential shared mobility hub sites. It is not unreasonable to expect that prime locations for development of new EVSE infrastructure will require accompanying investments to upgrade the local distribution systems. PG&E has developed programs to perform make-ready investments on the grid to support new charging needs in other settings; so collaboration opportunities also may exist to fill the need for charging at shared mobility hubs. Substantial coordination will be required with transit agencies, property owners, local jurisdictions, and other stakeholders to further refine the viability of planning a shared mobility hub pilot project at any of these sites and to review the collaboration opportunities that arise.

4.4 Mapping Analysis

4.4.1 Introduction

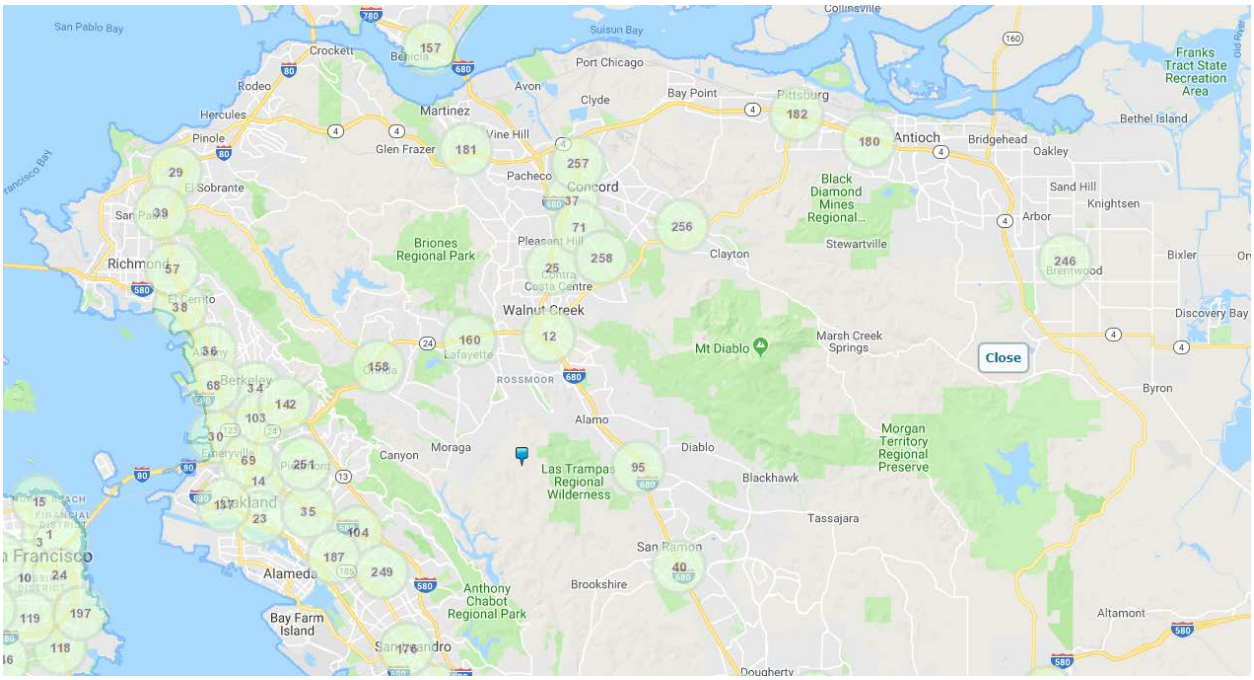
Section 4.1 showed that less than 15% of EV charging infrastructure needed in 2025 is currently available in the county. Of equal importance is identifications of geographic locations where the greatest need for charging exists. Substantial geospatial analysis was performed to identify gaps within the county's existing EV charging network. This analysis resulted in development of over 30 maps relevant to EV charging in the county. The analysis' scope was confined to suggesting areas of high priority for charging at multiunit residential housing (Level 1 or Level 2) and for Level 2 charging in public places and workplaces.

Though DCFC suitability was not part of the analysis, a 2016 report through the Electric Program Investment Charge program produced an analysis that identified 19 locations in Contra Costa County within the top 300 sites for the importance of siting DCFC across the entire PG&E service territory.[73] A few locations, particularly highly ranked at the time of analysis publication, included Walnut Creek,

[73] Interactive map: https://www.pge.com/b2b/energysupply/wholesaleelectricsuppliersolicitation/PVRFO/ev.html
Full report: https://www.pge.com/pge_global/common/pdfs/about-pge/environment/what-we-are-doing/electric-program-investment-charge/EPIC-1.25.pdf

Contra Costa Centre, and Concord as well as locations in El Cerrito, Richmond, and San Pablo, as shown in Figure 20.

Figure 20. PG&E's Interactive DCFC Siting Tool Priority Locations (Lower Numbers are Higher Priority)



Setting aside PG&E's DCFC suitability analysis, the CCTA EV Readiness Plan focused on residential and public Level 2 charging. Key takeaways from this analysis of suitable sites are highlighted below, and a description of the analysis methodology and a complete set of interactive maps can be found at https://www.ccta.net/. The analysis was conducted at the block-group level, a geographical unit used by the United States Census Bureau and the smallest geographical unit for which the Bureau publishes sample data.

This section shows key indicators of EV adoption and EV readiness compiled to assess where the county *should* provide more EV charging. The question regarding where the county should offer more EV charging is not only a technical one—it is also a value-driven one. As discussed, the county must uphold a critical principle to provide infrastructure that ensures *all county residents have equitable access to charging.* Additionally, electrification of shared, multimodal mobility should be promoted rather than focusing exclusively on electrification of single-occupant vehicles.

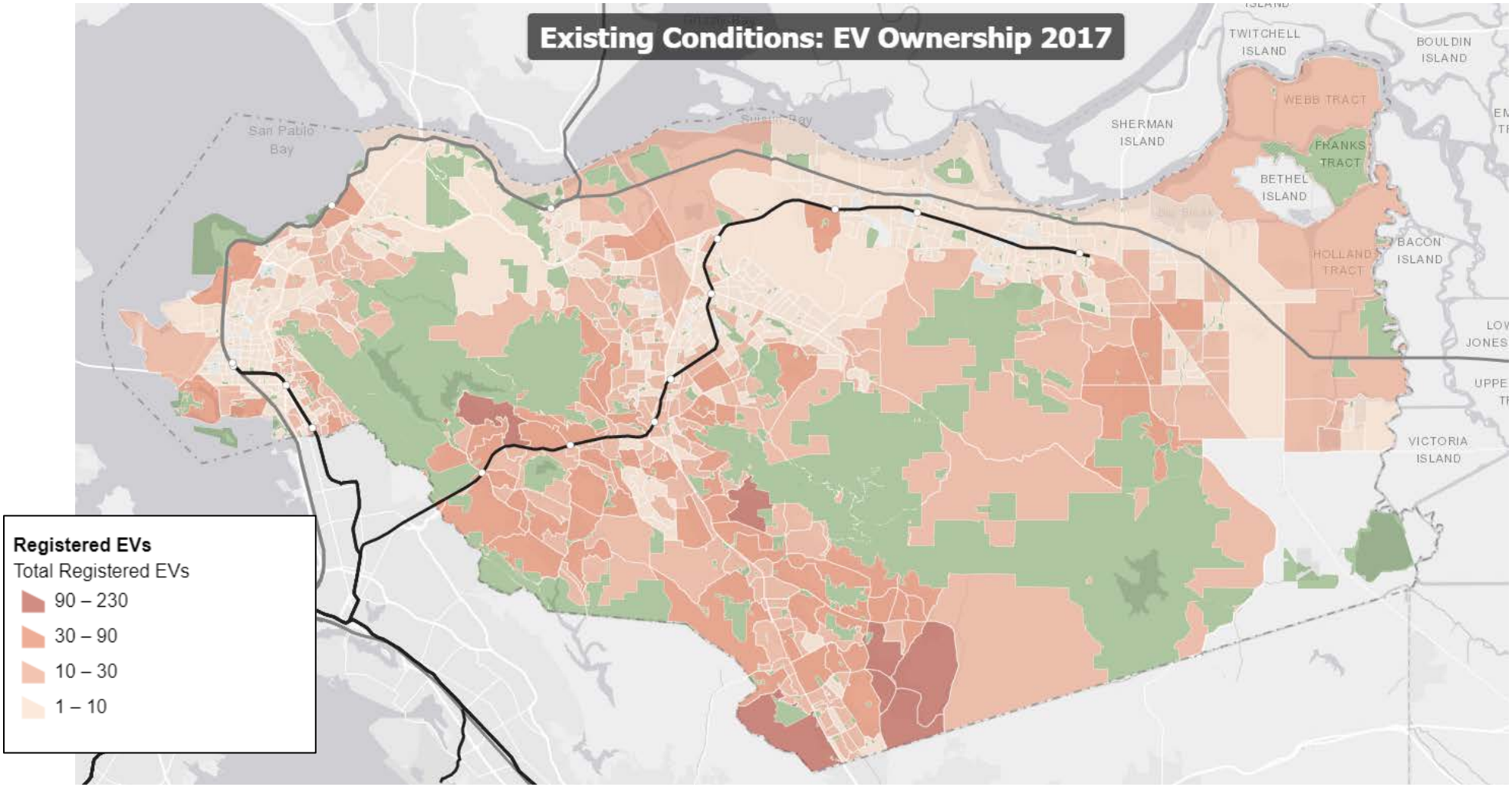
Therefore, the maps do not simply indicate locations where charging utilization is expected to be highest; they also indicate locations that would help the county fulfill these objectives. Actions taken to make EV ownership accessible and possible for *all* county residents may result in a different profile of the next set of EV adopters, now that the early adopter market is beginning to saturate.

4.4.2 Existing Conditions

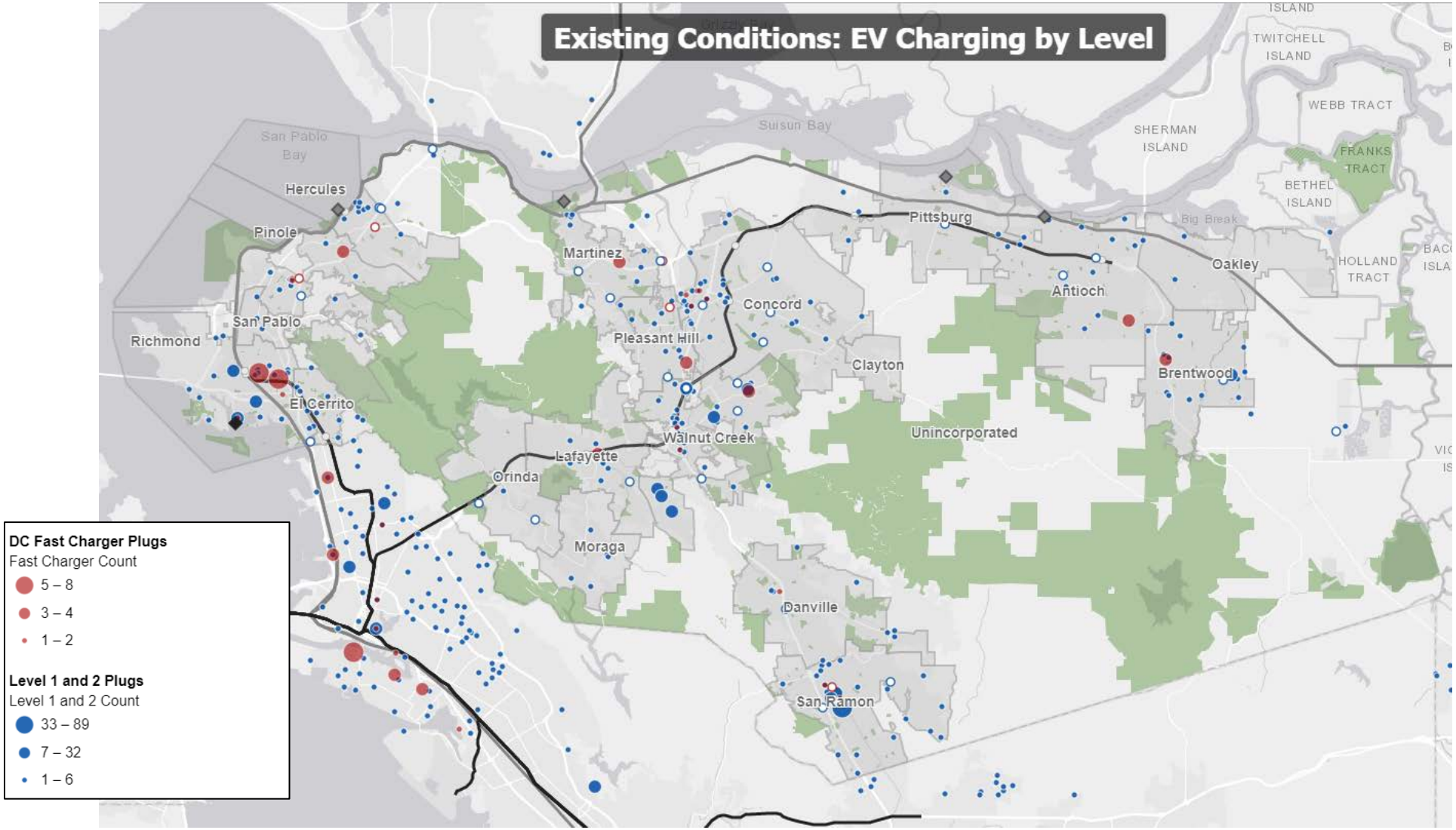
Development of the following maps underscored the following takeaway messages about EVs and EV charging in the county:

1. While EV adoption remains uneven throughout the county, substantial numbers of EVs are registered in every corner of the county, including urban areas, rural areas, and everywhere in between (Map #1).
2. Substantial land areas outside the county's Urban Limit Line are preserved as open space and parks and have minimal buildings and roads. These do not necessarily represent gaps in EV adoption since few, if any, vehicles are registered in these areas (shaded green in Map #1).
3. The largest numbers of Level 2 and DCFC ports are concentrated in major urban centers and highway corridors. It appears EV infrastructure has followed market demand, with a clear concentration existing in activity centers, BART corridors, and highway corridors in the county. This has left some corners of the county particularly less comprehensively covered with public infrastructure (Maps #2 and #3).
4. Not all EV charging displayed on the map contributes equally to the available network of public charging. Specifically, some Level 1 and 2 chargers have different levels of access, as in some are restricted for use by employees or by other rules, some can only be used by Tesla owners, and some are residential chargers posted to PlugShare by homeowners willing to make their chargers available (see Map #3 for where the same chargers in Map #2 are symbolized by access level). Note that the hollow blue dots and hollow red dots in both maps are park and rides and transit centers, respectively.
5. The number of EV charging ports is expected to substantially increase within the next year, with completion of the ports approved through PG&E's EV Charge Network (which includes a queue of 542 ports in the county as of April 2019, including 403 at workplaces and 139 at MUDs. The quantity of these ports in each part of the county should be accounted for in assessing the desirability of future sites to complement the existing network of public chargers. Although this depends on access rules for each site, non-employees or nonresidents may not be able to use these, and therefore should be appropriately caveated when examined as part of the overall network (Map #4). Similar efforts should be undertaken to understand the locations and queue sizes for participation in BAAQMD's Charge! grant program, MCE's EV grant program, and Electrify America in advance of selecting sites at which to deploy infrastructure.

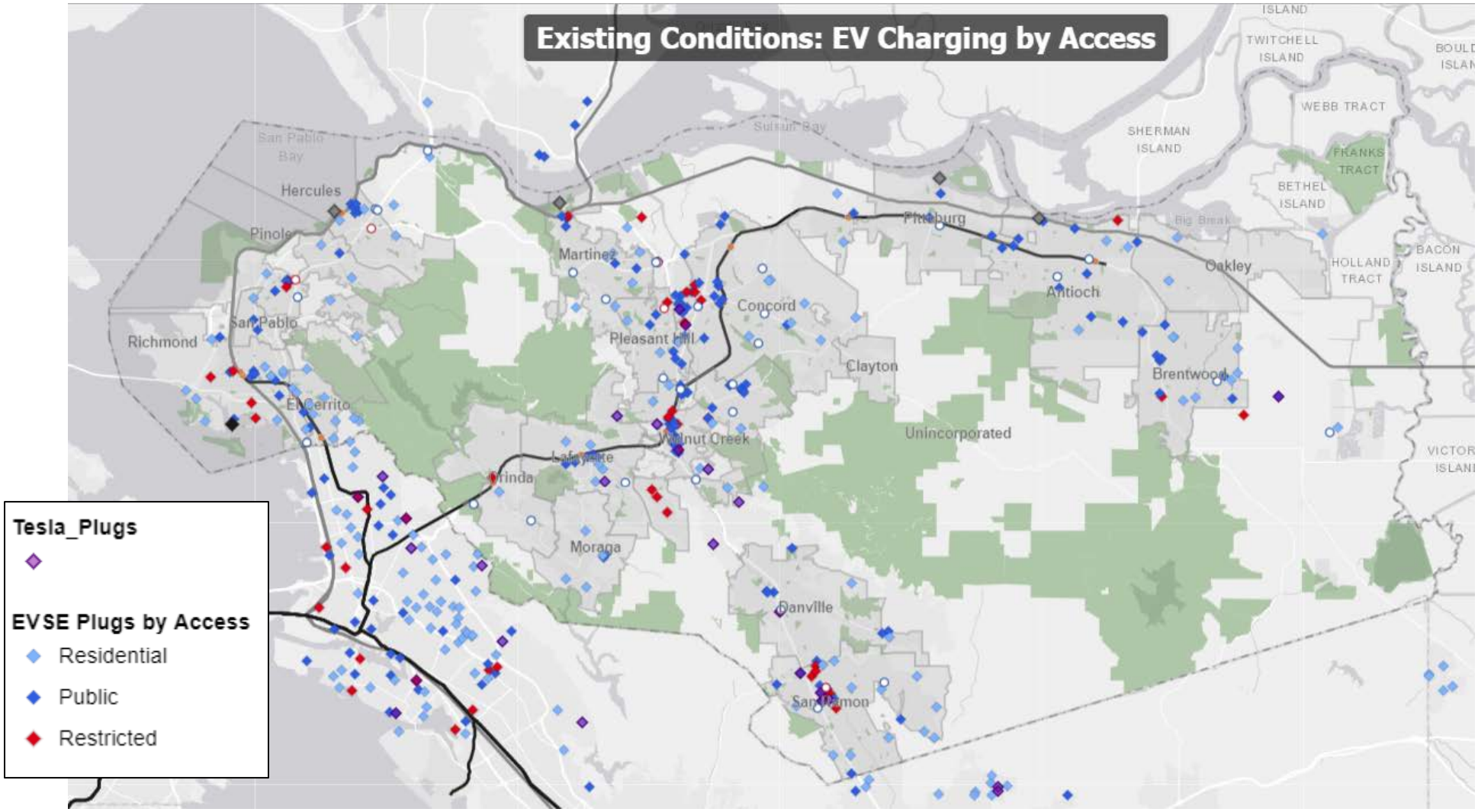
Map 1. EV Ownership by Block Group, from CARB's Online Fleet Database from DMV Data



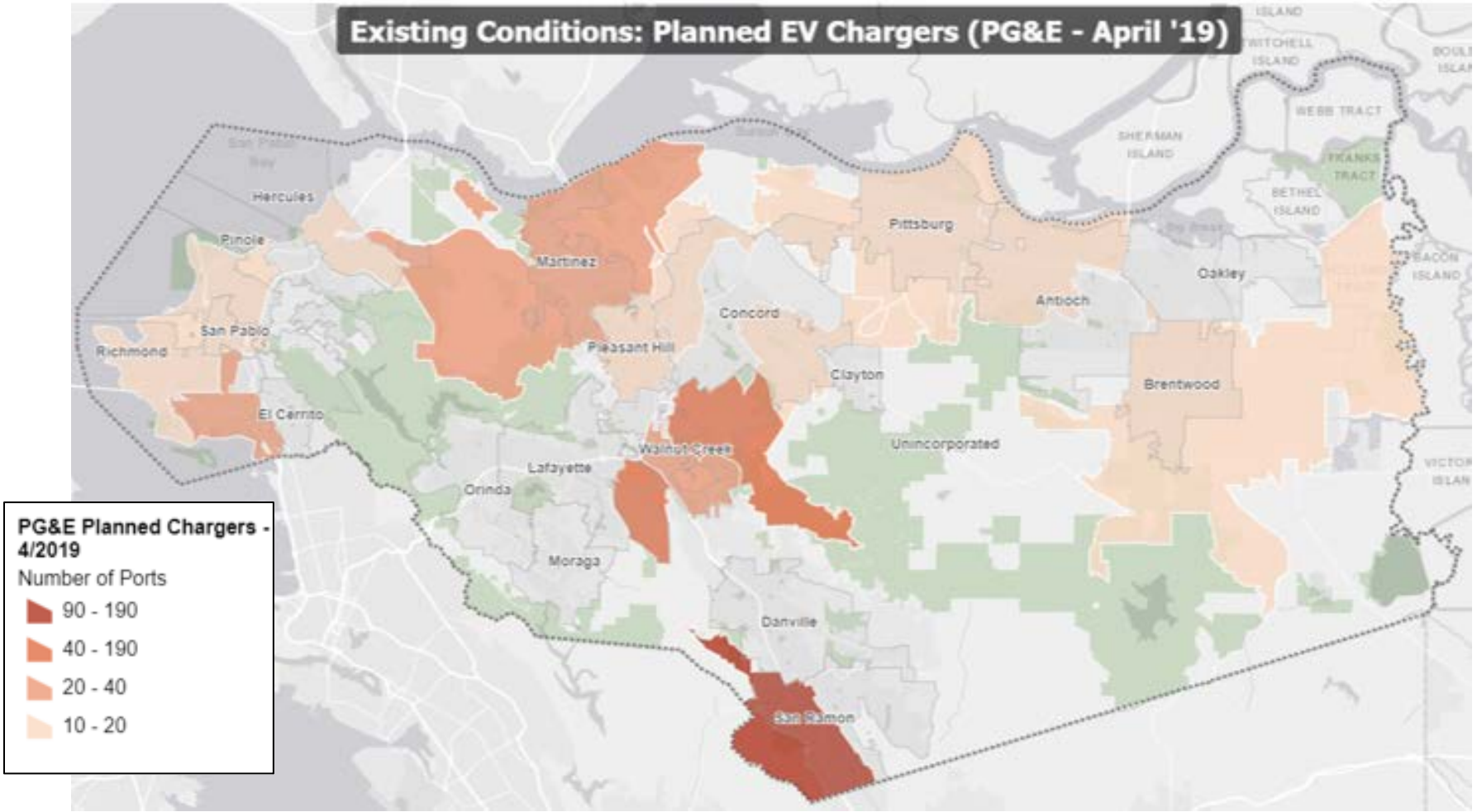
Map 2. Existing Conditions: EV Charging by Level



Map 3. Existing Conditions: EV Charging by Access



Map 4. Existing Conditions: Planned EV Chargers



With this understanding of the county's existing EV adoption profile and existing infrastructure as context, the next map set shows potential priority areas for investment. As previously noted, the mapping is designed to balance a technical approach to filling gaps with the most impact on the market, adopting an approach to ensuring fairness in resource investments (including attention to underinvested communities, multifamily housing, and rural county areas). This can be accomplished by creating a composite score for each block group, based on a large number of factors. Scores range from zero to one, with a score of zero indicating the lowest priority areas for EV charging, and a score of one indicating the highest priority.

Location suitability scores were calculated separately for the use case of public and workplace charging and the use case of residential multifamily charging. This enabled usage of different attribute sets to score block groups for these very distinct charging types. Furthermore, because factors making an urban (or more densely developed) site desirable for charging differ from factors making a rural area site desirable for charging, and because of stakeholders' desire to include priority locations for charging in both urban and rural areas, a separate index was created for block groups inside and outside the Urban Limit Line.

4.4.3 Public and Workplace EVSE Needs

Factors deemed important to weigh heavily in developing a score for public and workplace charging included the density of "long dwell time" sites (e.g., entertainment, medical, retail, lodging), the employment density, the lower number of nearby public or workplace charging ports, the lower number of nearby DCFC ports, higher CalEnviroScreen scores,[74] and areas with longer commutes.

According to the resulting maps, key observations for block groups' suitability for public and workplace charging include the following:

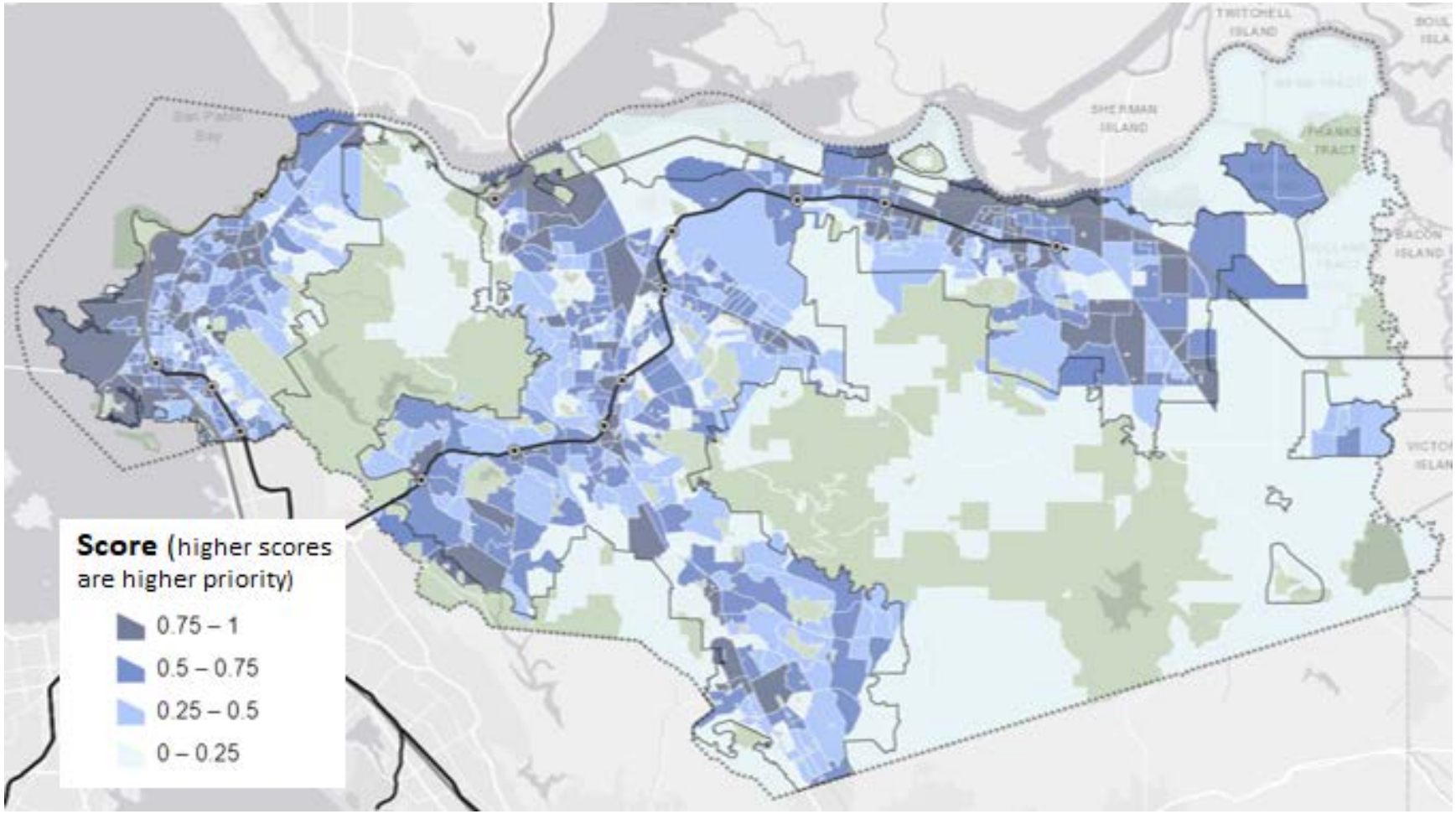
1. Inside the Urban Limit Line (Map #5):
    a. The scoring scheme resulted in high-priority areas distributed throughout all areas within the Urban Limit Line.
    b. Scores were very variable, with many block groups receiving quite low scores and many receiving very high scores, indicating that the methodology successfully highlighted obvious priority locations.
    c. Block groups with low scores were commonly near block groups with much higher scores. Given the limited distance that the average driver may be willing to walk from a parking location to their destination, this differentiation can likely be explained by factors such as underlying land uses and zoning in these locations.

[74] CalEnviroScreen is a tool managed by the Office of Environmental Health Hazard Assessment. The scoring metric identifies California communities most affected by pollution and especially vulnerable to its effects, considering environmental, health, and socioeconomic factors. https://oehha.ca.gov/calenviroscreen/about-calenviroscreen

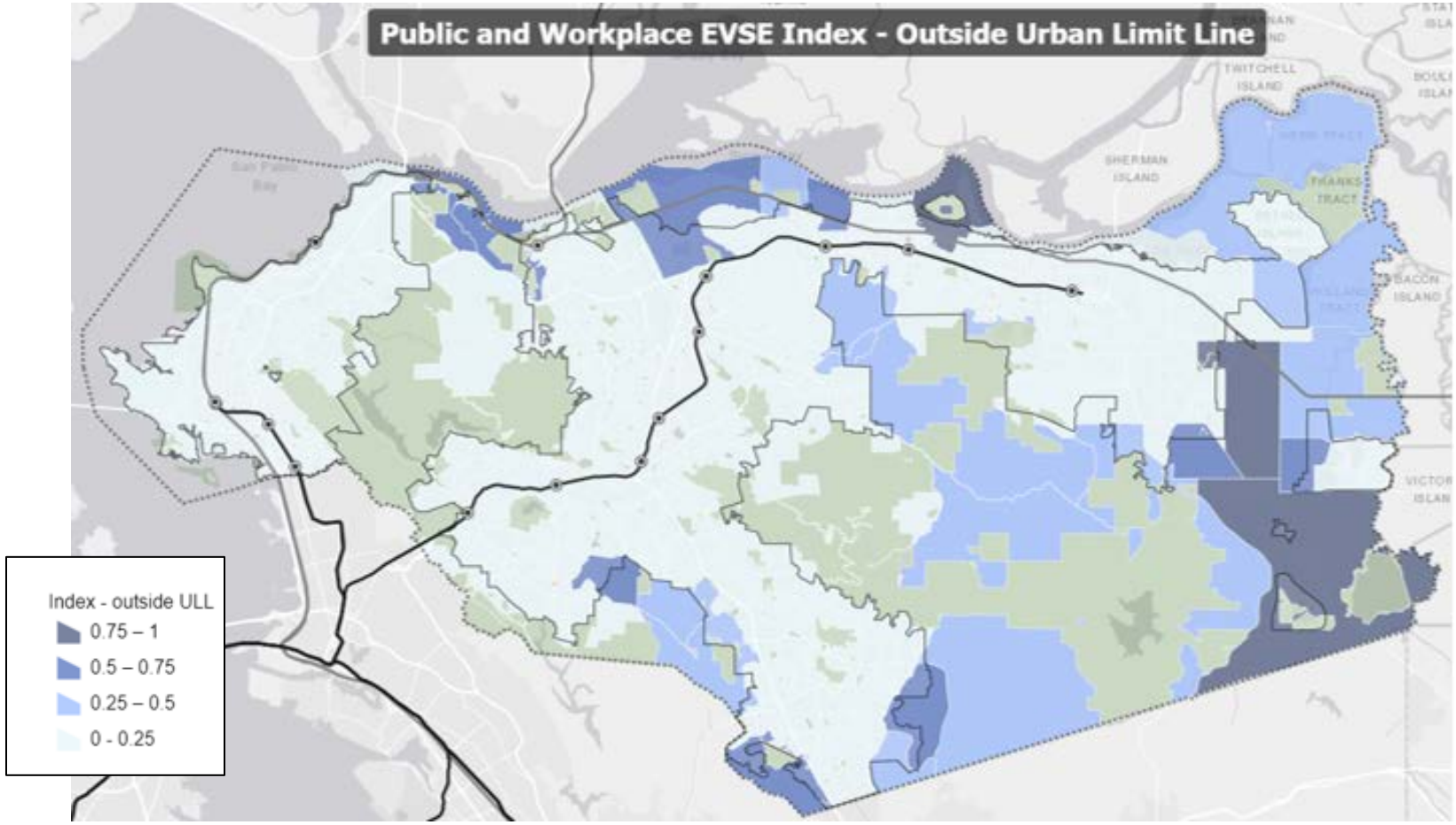
d. A large number of the highest-scoring block groups fall within the county's Northern Waterfront, which contains a higher concentration of DACs than the rest of the county.

2. Outside the Urban Limit Line (Map #6)
   a. As the U.S. Census designs block groups to have roughly comparable populations, block groups outside the Urban Limit Line often span a very large area.
   b. In many of these block groups, development is concentrated in small areas within larger block groups. For instance, some Delta Island block groups only experience development along their borders. As such, visual displays of priority areas can be deceptive. The next step in determining suitable public charging sites within these rural areas will be to review the underlying land uses and the presence of specific facility types that may have higher associated activity levels within block groups with the highest scores.

Map 5. Public and Workplace EVSE Index Scores—Areas Inside the Urban Limit Line



Map 6. Public and Workplace EVSE Index Scores—Areas Outside the Urban Limit Line



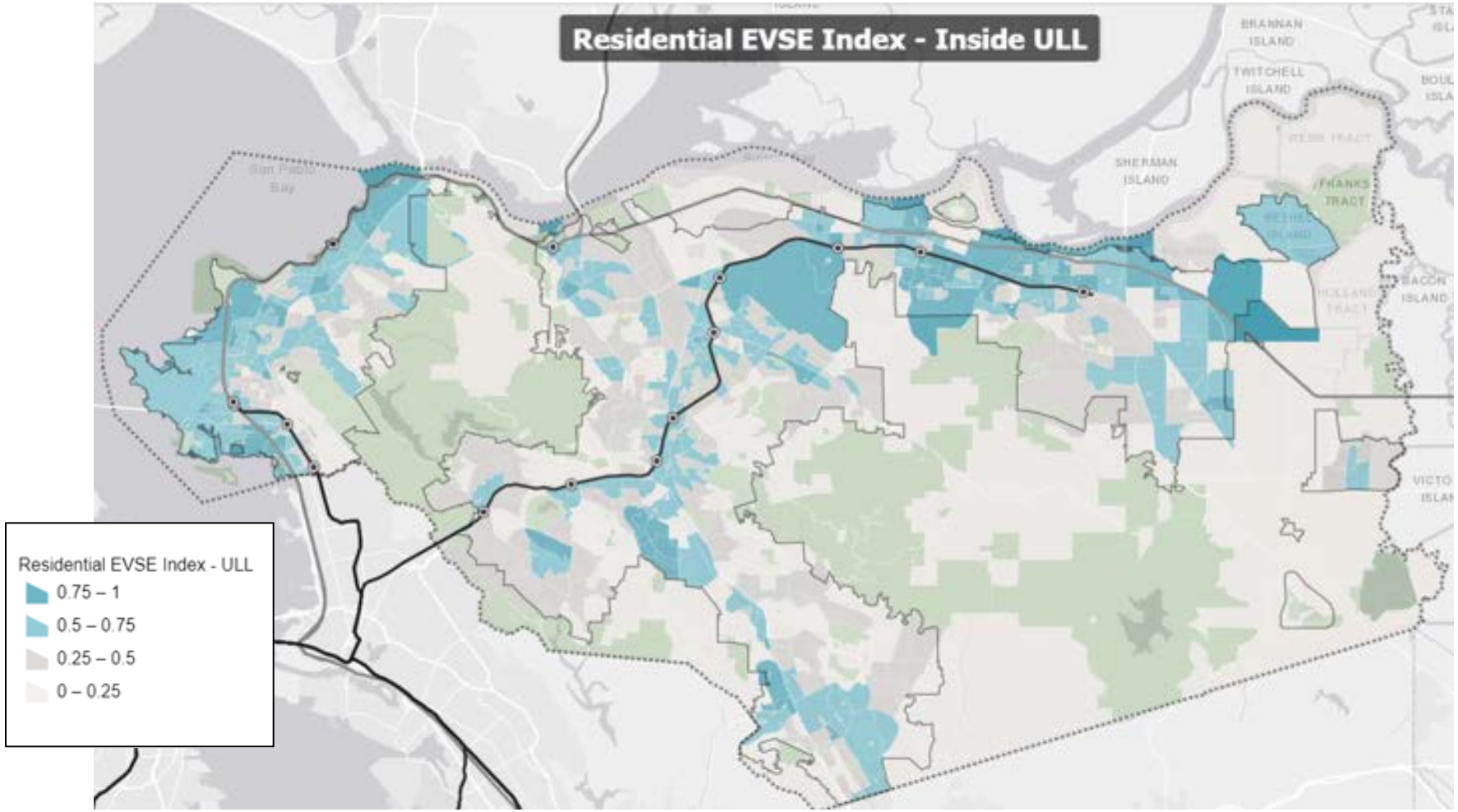
4.4.4 Residential EVSE Needs

Factors deemed sufficiently important to weigh heavily in development of scores for residential charging included: the number of MUDs; the projected number of MUDs in 2040; higher single-occupant vehicle usage for commuting; the lower number of public charging ports (including Level 1, Level 2, and DCFC); higher CalEnviroScreen scores; and average distances driven per day by block group residents.

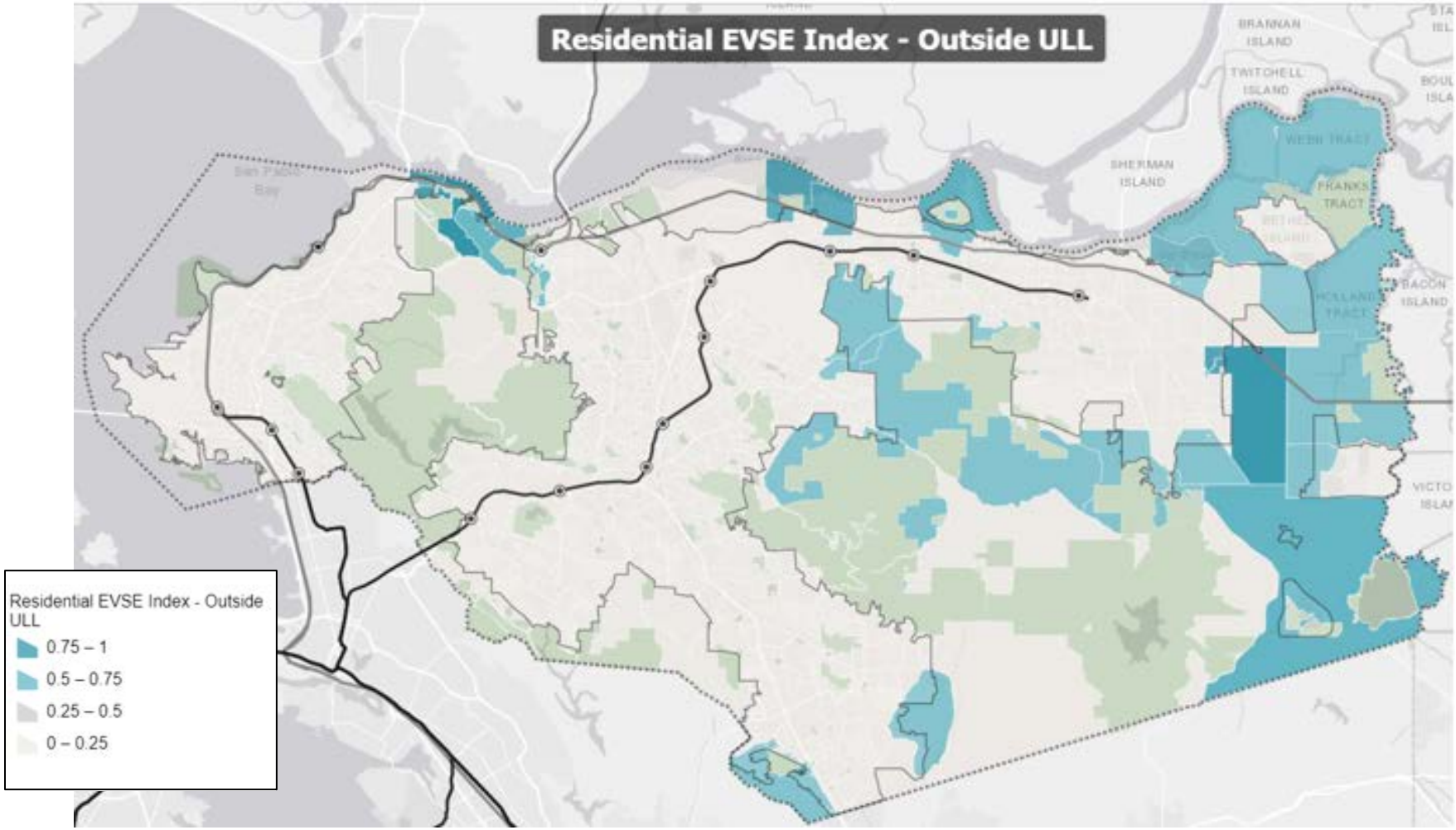
Per the resulting maps, key observations for the suitability of block groups for residential charging include the following:

1. Inside the Urban Limit Line (Map #7)
    a. Compared to the public and workplace charging map, suitable block groups were more heavily concentrated in a smaller number of block groups.
    b. The strongest concentrations of suitable block groups occurred in the eastern part of the Northern Waterfront and the area roughly from Richmond to Rodeo.
    c. Miscellaneous other block groups throughout the county emerged as moderate priorities, and a few unique locations stood out, such as the former Concord Naval Weapons Station (CNWS), slated for redevelopment as a transit-oriented neighborhood with a substantial amount of new multifamily housing.
    d. Due to inclusion of future, planned MUD development as a major factor in assigning scores, some high-scoring areas may not immediately be ready to receive infrastructure, but they still should be monitored and encouraged to exceed EV-ready thresholds adopted by the County when they ultimately do undergo development. Such locations include CNWS and the Bridgehead area of Antioch and Oakley.
2. Outside the Urban Limit Line (Map #8)
    a. Given the limited development in many block groups outside of the Urban Limit Line, this map should be viewed as more speculative. While Plan Bay Area identifies some locations as having more multifamily development by 2040, some time may occur before such multifamily development is built; accordingly, the areas shown on this map are more likely to be medium- to long-term priority areas rather than places requiring immediate action.
3. Overall
    a. Viewing all high-priority sites from Map #7 and Map #8 together, it becomes apparent that a correlation exists between areas identified as priority locations for residential charging and areas with higher incidences of asthma and lower incomes (Figure 22 and Figure 23). Therefore, using the prioritization approach developed for this project may help target charging investments more equitably. Section 4.4.5 shows this relationship quantitively.

Map 7. Residential EVSE Index—Inside ULL



Map 8. Residential EVSE Index—Outside ULL



4.4.5 Equity Implications

For a reader familiar with broad socioeconomic patterns in Contra Costa County, visual inspections of the maps above indicate that many areas identified as priority gaps in the EV charging network are also areas of higher pollution burdens and lower incomes. In particular, the Northern Waterfront and many areas of the county's rural, eastern part tend to have higher asthma rates per capita and a higher number of low-income households than the rest of the county (shown in Figure 22 and Figure 23).

As noted, the California Office of Environmental Health Hazard Assessment scores census tracts with its CalEnviroScreen tool to identify communities most affected by pollution and especially vulnerable to its effects, considering environmental, health, and socioeconomic factors. Figure 21 shows how the CalEnviroScreen score correlates with the average EV-charging index score developed for public and workplace charging. While the graph contains outliers (i.e., some DACs did not receive very high EV charging priority scores, and some census tracts with very low CalEnviroScreen scores had relatively high EV charging priority scores), generally, the more the tract was classified as disadvantaged, the higher the EV charging score. Communities tending to be least-served by EV charging also tend to face hardships in terms of socioeconomic status, health outcomes, and environmental quality.

Figure 21. Correlation Between EVSE Index Score and CalEnviroScreen Score

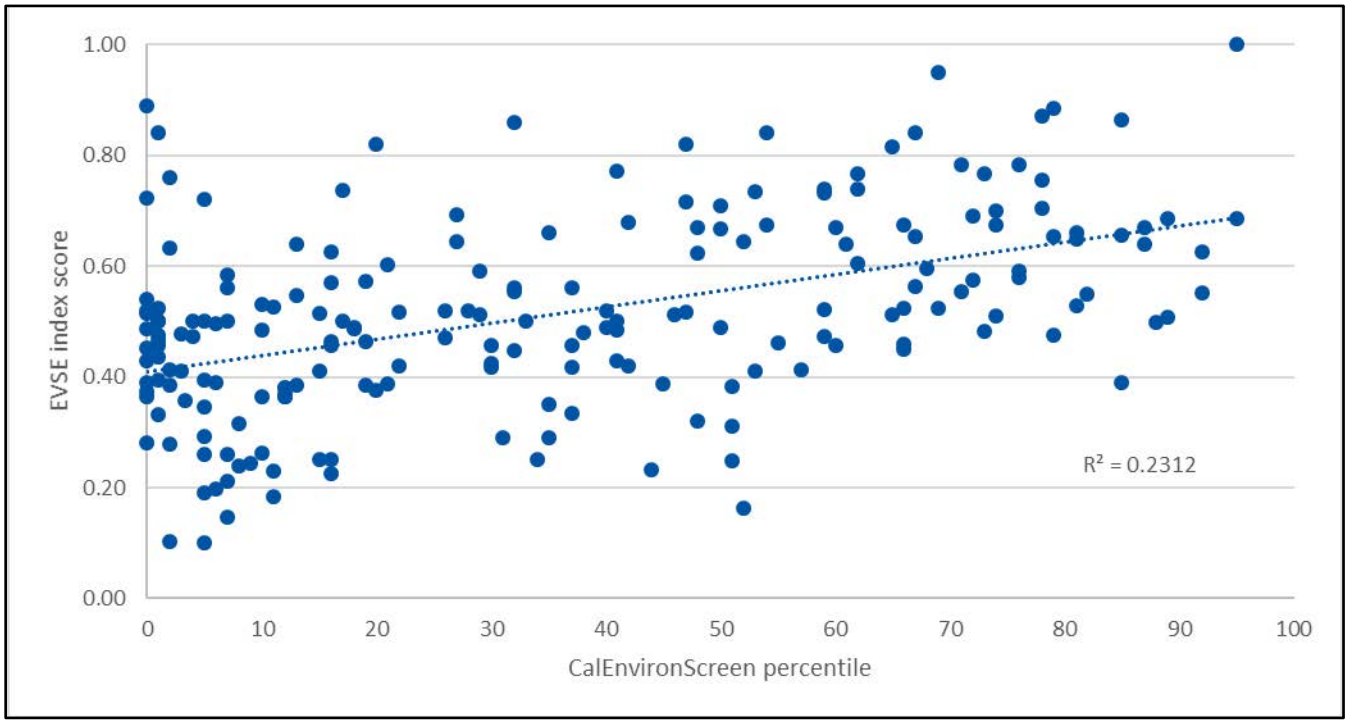
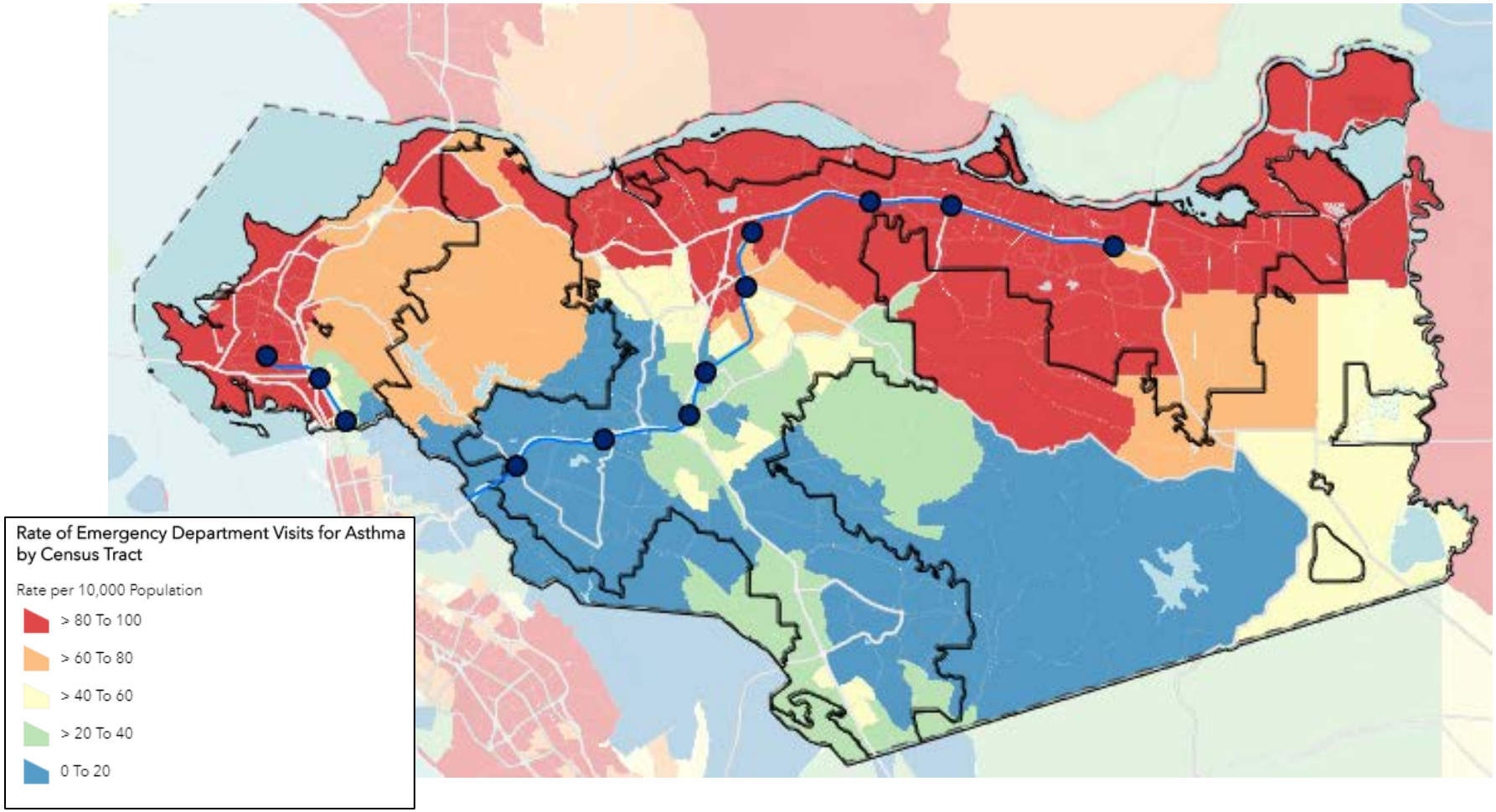
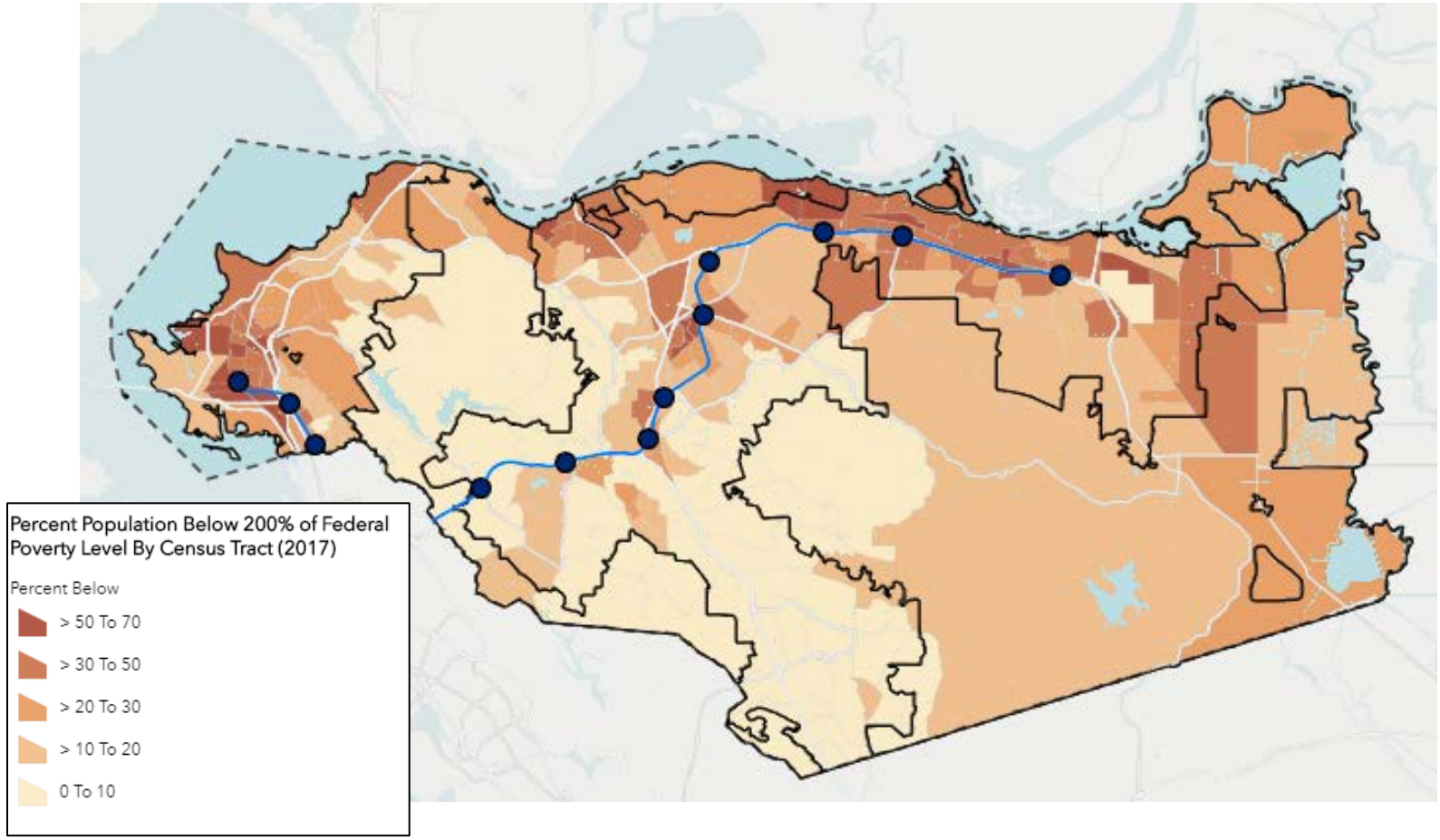


Figure 22. Asthma Rates in Contra Costa County[75]



[75] https://cocogis.maps.arcgis.com/apps/MapSeries/index.html?appid=fc2415bbdacb409baf0f19fe802a81f3

Figure 23. Low-Income Populations in Contra Costa County[76]



[76] https://cocogis.maps.arcgis.com/apps/MapSeries/index.html?appid=fc2415bbdacb409baf0f19fe802a81f3

5 Implementation Strategies

5.1 Background

The EV readiness implementation strategies included below were selected based on stakeholder discussions and on recognized best practices. This is not intended to be a comprehensive list of all strategies that CCTA and County departments could pursue, but, rather, they present a manageable set of high-priority strategies that provide a framework from which actions will be developed and implemented in the short-, medium-, and long-term. The strategies fall under one or more of the following categories, representing the impact levers CCTA and County departments have at their disposal.

	Provide technical assistance to constituents and cities
	Conduct outreach
	Conduct research
	Implement pilots
	Install EVSE
	Regulate and incent
	Fund EVSE or EV
	Set targets and maintain adaptable implementation plan
	Regional advocacy and engagement

These strategies should be viewed as an adaptable framework that ensures action is taken in each major influence sphere to positively affect EV adoption and EVSE deployment. Suggestions for entities that may serve in leading or partnership roles for implementation of the strategies have been included as well, based on recommendations made by the Cadmus consultant team. Their inclusion in this Blueprint does not entail that they must take on associated responsibilities, but rather that they serve as a starting point for engaging in conversations about the kinds of collaboration well suited to move the strategies forward. The strategies and associated actions will likely evolve over time, given the changing EV context and the diverse needs across the county.

Table 14 summarizes all strategies and indicates the impact categories in which they belong.

Table 14. Summary of Strategies

	Strategy									
Short	Continuously Assess Needs			■						
	Install Infrastructure in Priority Areas					■		■		
	Implement Low-Income Customer Outreach and Education Program		■							
	Amplify Regional Outreach to Consumers, Site Hosts, and Other Entities	■	■							
	Adopt and Promote EV Reach Codes						■			
	Adopt and Promote Streamlined Permitting	■					■			■
	Contribute to a Regional Charging Network and Engage in Statewide Policy			■						■
	Integrate EV Readiness with Growth Management						■			
	Track Progress	■	■	■	■	■	■	■	■	■
	Electrify County Fleets and Encourage Fleets Within Jurisdictions to Electrify					■			■	
Medium	Implement Scalable Shared, Electric, Connected, and Autonomous Vehicle Pilots				■					
	Expand Pilot Programs to Provide Electric Mobility Services to Underserved Populations				■					
	Integrate EV Carpool and Shuttle Services into County 511 Programs						■			
Long	Incorporate EV Resilience Planning into County Preparedness Strategies				■	■				
	Pilot Wireless Inductive Charging on Streets				■					
	Implement and Enhance Shared Mobility Hubs with Electric Options				■	■	■			
	Explore Options to Disincentivize Usage of ICE Vehicles and Incent Their Replacement						■			

The approximate effort levels and costs characterize each action, per three metrics:

1. Upfront investment: $=low; $$=moderate; $$$=high
2. Ongoing cost: $=low; $$=moderate; $$$=high
3. Staffing needs: Low, moderate, and high

5.2 Short-Term (1-2 years)

5.2.1 Strategy #1: Continuously Assess Needs

In developing this EV Readiness Plan, CCTA has gained a nuanced understanding of the county's *current* status of EV readiness, *current* barriers to increased EV adoption and increased EV readiness, and *current* needs of local EV stakeholders. It will be critical for CCTA to maintain and enhance its understanding of EV charging needs as conditions evolve within the county. For instance, it is anticipated that 190 additional EV ports will open in the near future at Bishop Ranch, and more jurisdictions and property owners within the county are developing plans to install their own infrastructure. CCTA must remain in contact with major players contributing to countywide EV readiness and must be prepared to adapt its implementation plans accordingly.

Additionally, local jurisdictions within the county are best suited to cater to the needs of their local EV stakeholders. CCTA and other County departments can assist these jurisdictions in developing processes to understand those needs. With enhanced understanding, each jurisdiction can be empowered to take actions to meet those needs and to build consideration of those needs into their ongoing planning.

CCTA would lead local jurisdictions to undertake stakeholder engagement and needs research. Additionally, it would also serve as a clearinghouse for foundational knowledge and resources (e.g., surveys, interview guides) to facilitate research and outreach.

Lead	CCTA
Partners	Local jurisdictions, PG&E, MCE, Contra Costa Department of Conservation and Development, the Contra Costa Sustainability Commission, and 511 Contra Costa
Barrier(s) Addressed	• Lack of understanding about specific, local EV stakeholder needs • Limited access to EV charging • Consumer perception barriers • Equitable adoption barriers
Impact on Barriers	Indirect, through the enhancement of other strategies
Key Metrics	• Number and quality of information gathering efforts undertaken by local jurisdictions • Frequency of stakeholder group convenings
Resources	• The ABCs of EVs: A Guide for Policy Makers and Consumer Advocates • Electric Vehicle Charging Guide • Greenlining EV Equity Toolkit • EV Infrastructure Planning Tool

Example Action 1.1: Update the CCTA EV infrastructure maps annually, using current data on locations with new charging infrastructure, increases in EV adoption, and changes to planned development areas. Take advantage of new information to recalculate block groups' scores and to reevaluate EV charging installation priorities.

Upfront Investment	Ongoing Cost	Staffing Effort
None	$	Low

Now that the map has been assembled and that the methodology and files have been shared with CCTA, GIS expertise of staff at CCTA or other County departments would be sufficient to periodically update the map, likely without substantial consultant support. A week of staff time each year may be more than enough.

Example Action 1.2: In collaboration with other agencies in the region, conduct research on potential EV site hosts and their willingness to pay to install EVSE among subgroups of MUD, retail, and workplace building owners. This research may take the form of surveys, focus groups, or interviews. The County can use its understanding of EV readiness planning's foundational aspects to inform specific questions to ask and target areas to discuss. With this greater understanding of a jurisdiction's local needs, the County can support or simply encourage the jurisdiction to assess what policies could catalyze EV adoption.

Upfront Investment	Ongoing Cost	Staffing Effort
None	$ (County Share)	Low

Market research is best conducted by firms with expertise in the appropriate methodology. BAAQMD, CCAs, and other entities in the region have historically sponsored research targeted to advance EVs and clean technologies. The County's share of costs could be zero if this research had already been planned by another agency, or the County may wish to contribute to a regional effort to commission research of particular interest. Staff involvement would include scoping research needs to help staff develop outreach or grant programs, review findings, and disseminate gathered information to other local agencies. Eventually, the need for research will subside as the market matures.

Example Action 1.3: In collaboration with other agencies in the region, conduct research on EV driver preferences and needs, including employee preferences for workplace charging policies and ways to best encourage employees to purchase an EV. This research could take the form of surveys, focus groups, or interviews, and would be used to assess payment schemes, levels, and types; desired availability of charging infrastructure; pain points; amenities located by charging infrastructure; different reliability thresholds of infrastructure; and rationales for purchasing an EV.

Upfront Investment	Ongoing Cost	Staffing Effort
None	$ (County Share)	Low

As above, research on driver preferences and needs probably could be outsourced and performed at a regional level. The County's involvement would again address scoping and application of findings.

Example Action 1.4: Convene a working group of local electricians and contractors to understand barriers faced in cost-effective and efficient EV charging installations as well as potential process improvements for permits and inspections. The County should recruit representatives from local jurisdictions to participate and listen to the working group, ensuring their perspectives are heard and considered along with those of electricians and contractors. Working group outcomes should focus on updates to local regulations around permitting, inspection, and ordinances related to EVs and

associated electrical infrastructure. The working group also could be leveraged to provide input to development of the recommended workforce training program to help ensure local electricians and contractors have the technical skills to support expansion of EV infrastructure and to benefit from the transition.		
Upfront Investment **None**	**Ongoing Cost** **None (Excluding Workforce Program)** **$ (Including Training Subsidies)**	**Staffing Effort** **$ (Excluding Workforce Program)** **$$ (With Workforce Program)**
Minor costs would be incurred for convening a working group, presuming a staff member within a County department could devote a few hours per month to outreach and planning facilitated agendas for the installer/contractor working group, which could meet quarterly or as needed. This role also could also be filled by the coordinator of the planned workforce training program. Workforce training program costs are estimated separately in the two training plans developed for this project.		

Example Action 1.5: Convene transit agencies in the county and identify areas for collaboration and support to meet CARB's ICT regulation. CCTA can bring together local transit agencies to identify their needs to comply with ICT regulation. Establishing the transit agencies' needs can help CCTA refine other strategies and actions included here, such as ways to best plan charging infrastructure installations to optimize the process for multiple users.		
Upfront Investment **$$**	**Ongoing Cost** **None**	**Staffing Effort** **Moderate**
Transit agencies must produce plans for transitioning to procuring 100% zero-emissions buses within less than a decade, and these plans must be written by mid-2020 (for large agencies) or mid-2023 (for small agencies). Substantial value exists in coordinating planning efforts across all agencies operating in the county, as they can share analysis and lessons learned, and plan proactively for interoperability with agencies operating in the same geographies and possibly needing to use each other's charging infrastructure. Depending on the status of transit agency planning efforts and the degree that they have already assessed their facilities, a planning and engineering study would likely be required to assess the electrical infrastructure at existing sites, survey the landscape of existing chargers and bus models, and assess opportunities to appropriately manage electrification's costs and challenges to the agencies (e.g., whether to rely on depot, en-route charging, or a combination of these; how to procure buses and install infrastructure cost-effectively; how to manage demand charges; how to deploy buses optimally without impacting on-time performance and rider experiences; and how to account for resilience needs). Probably, this study would address energy storage and solar PV as opportunities to make the overall project more cost-effective. Staff time would be required to coordinate the transit agency group and to identify those who would pursue action items, but most costs associated with implementing outcomes from this action will be covered in other strategies.		

5.2.2 Strategy #2: Install Infrastructure in Priority Areas

As discussed, the amount of public, workplace, and residential/multifamily charging infrastructure currently installed in the county is less than 20% of the total projected to support the anticipated trajectory of EV adoption through 2025. County, local agencies, and jurisdictions cannot fill this entire gap on their own. **Strategic partnerships will be necessary to achieve this buildout.**

Through the mapping analysis, conducted as part of developing this EV Readiness Blueprint, CCTA identified priority areas for EV charging infrastructure investments of each type as well as areas suited for electric shared mobility. Many of these priority areas are located within incorporated jurisdictions located in Contra Costa County. In addition, transit agencies and other independent entities seek to electrify operations. CCTA can contribute to these efforts by partnering with jurisdictions and other entities to confirm priority locations and to pursue funding opportunities for EV charging infrastructure, particularly those that could best benefit the county's underinvested communities.

CCTA can coordinate with jurisdictions and other entities to hone priority areas identified through the mapping exercise, sharing information about available funding opportunities. Jurisdictions and entities themselves, however, would need to identify specific site hosts to accommodate charging infrastructure, apply for funding, and conduct installations.

Additionally, CCTA may use permitting, planning, and zoning mechanisms to encourage gap filling in priority areas not under control of County departments. Though these ways of supporting EV charging installations are not described here, they are addressed under other strategies within this plan.

Lead	CCTA
Partners	Permitting, planning, parking, and transportation departments in each jurisdiction; EVSPs; facility managers; transit agencies; Contra Costa County Public Works
Barrier(s) Addressed	• Limited access to EV charging • Equitable adoption barriers
Impact on Barriers	High
Key Metrics	• Funds obtained for EV charging infrastructure by jurisdictions within Contra Costa County • EV charging infrastructure installed by County departments, jurisdictions, transit agencies, and other entities within Contra Costa County • EV charging infrastructure installed within the County's DACs
Resources	• FHWA Alternative Fuel Corridors Webpage • CalCAP Electric Vehicle Charging Station Financing Program • California Electric Vehicle Infrastructure Project (CALeVIP) • EV Infrastructure Planning Tool • EVI-Pro Lite

Example Action 2.1: Coordinate with jurisdictions to install public EV charging in areas identified as high priorities.

Upfront Investment	Ongoing Cost	Staffing Effort
$$$	$$	Low to Moderate

Infrastructure installations in high-priority areas to meet needs for public charging in the county could be quite substantial, given 3,000 to 4,000 Level 2 and 300 to 700 DCFC stations expected to be required by 2025. Costs per charging port can vary tremendously, depending on settings, infrastructure requirements, whether requiring trenching, which Americans with Disabilities Act requirements are triggered, economies of scale, and many other factors. Although in extremely simple settings, Level 2 charging can be installed for as little as approximately $1,000; for public charging planning purposes, it would be prudent to assume at least $5,000 to $15,000 per port for Level 2 (PG&E regularly publishes its average cost for installations taking place as part of its EV Charge Network, and, as of spring 2019, costs were around the high end of this range). DCFC can be expected to cost significantly more per port (see Table 5 at the beginning of this document).

Notably, not all of chargers must be installed solely with public money or grants. Public-private partnerships can help the County leverage its investments and the private market would fill many EV charging needs. It is not expected that ongoing revenues from infrastructure users would fully cover ongoing maintenance and networking costs, hence an appetite for ongoing subsidy and/or business models may be necessary to overcome this challenge. Though not likely a good solution in many places in the county, options could be explored for curbside and/or streetlight-integrated charging to provide options for potential EV adopters who do not have reliable at home charging (such as MUD residents).

Example Action 2.2: Partner with jurisdictions to pursue funding opportunities for three EV charging infrastructures, particularly as the Volkswagen Settlement funding and California Energy Commission-funding opportunities become available. CCTA can notify jurisdictions of available funding opportunities for installation of EV charging infrastructure, providing a letter of support to include in the application.

Upfront Investment	Ongoing Cost	Staffing Effort
None	None	Low

The only cost incurred by this action would be staff time required to actively research funding programs, coordinate with partner agencies, and develop compelling grant applications. This cost could be more than offset by potential grant receipts, which would reduce the cost of Action 2.1.

Example Action 2.3: Establish partnerships with EVSPs to install charging infrastructure in the public right-of-way and at other highly visible and important locations. Explore concession arrangements that would enable the EVSP to install infrastructure in select locations at no cost to the site host.

Upfront Investment	Ongoing Cost	Staffing Effort
$ (Depends on Contract)	$ (Depends on Contract)	Low

If the county is fortunate enough to have sites sufficiently attractive to entice EV charging infrastructure vendors to offer no-cost infrastructure, the County's primary cost would be staffing time for development of a request for proposal (RFP), negotiation of contracts, and oversight of the contract. The County also would need to give concessions to the selected vendor to use space in the public right-of-way, and local rules and protocols would impact this feasibility. This strategy could be applied by cities and towns within the County, and the County could even create a joint RFP or

request for information with participating cities. Much would require negotiations (e.g., lease payments, tax implications, easements, cost sharing, revenue sharing, and much more). There may be intermediate arrangements, particularly if anticipated revenues are insufficiently high to warrant a no-cost option.

Example Action 2.4. Support grant applications for transit agencies and other entities trying to electrify operations, paying particular attention to those operating in the county's DACs.

Upfront Investment	Ongoing Cost	Staffing Effort
None	None	Low

Staff likely would not have the direct expertise in zero emission bus infrastructure, but they can provide letters of support and quantification of benefits associated with electrification. Staff can also help agencies leverage findings of the Contra Costa Renewable Resource Potential Study to help them think about an integrated approach to bus electrification that involves renewables and storage.

Example Action 2.5. Connect EV charging installation efforts with the workforce development program being planned in the county to use installations as training opportunities for students in vocational programs and the Contra Costa Community College District. Grants could be given to the site host (e.g., a school, community college, or a County agency-owned facility) to cover the equipment and compensation for the instructor overseeing the installation; the school would provide the labor (supervised by a qualified electrician with Electric Vehicle Infrastructure Training Program certification).

Upfront Investment	Ongoing Cost	Staffing Effort
$	$	Low

A grant that would cover procurement and installation of a few Level 2 ports could be set at approximately $25,000 per grant recipient, and the number of recipients could be determined based on available budget. Minimal staff time would be required, other than determining which sites received grants and administering the grants, though instructor time would be needed to provide hands-on training. It should be noted that participating students would not be qualified to install EVSE afterwards, but the experience may pique their interest in the electrical trades.

5.2.3 Strategy #3: Implement Low-Income Customer Outreach and Education Program

CCTA can help determine which entity would be best to leverage partnerships and existing efforts to develop an outreach program, tailored to low-income residents, or to determine if a new entity should be created to serve as a type of "cultural broker." It is important to note that the designated entity should *complement* its efforts by mobilizing existing outreach channels rather than duplicating the efforts of others in this space. County departments with existing relationships with community-based organizations working with underinvested communities may be well-equipped to share information coming out of initiatives such as GRID Alternatives' One Stop Shop. This would include efforts to make EVs more financially viable for low-income drivers and to dispel perceptions that EV usage is a privilege only for high-income populations. EV community carshares provides an important approach for addressing underinvested communities' needs while remaining sensitive to their limited resources; such actions will be discussed in other strategies presented in this plan.

Lead	As determined by CCTA
Partners	CCTA; Contra Costa County Employment and Human Services; County departments; local jurisdictions; community-based organizations
Barrier(s) Addressed	• Cost and financial barriers • Consumer perception barriers • Limited access to EV charging • Equitable adoption barriers
Impact on Barriers	Medium
Key Metrics	• Adoption of EVs in DACs • Number of outreach events held with targeted communities • Number of dealerships selling used EVs and the amount of advertising on the affordability of EVs
Resources	• Greenlining EV Equity Toolkit • Tahoe-Truckee Plug-in Electric Vehicle Toolkits • California Drive Clean Incentive Search • U.S. Department of Energy (DOE) EV Tax Credits and Other Incentives • Pacific Gas & Electric EV Tools • CALeVIP • PG&E Electric Vehicle Incentives

Example Action 3.1: Increase coordination and collaboration with community-based organizations to share their messages and incorporate their feedback on countywide EV planning and policy. Working with these organizations can help broaden the reach and impact and to better tailor county efforts toward real transportation needs in these communities.

Upfront Investment	Ongoing Cost	Staffing Effort
N/A	$	Medium

Staffing costs may include designation of a community liaison to build and continue partnerships with community organizations or to host key community outreach events with high-priority partners. Messaging and resource development are presumed to be taken care of by initiatives such as the One Stop Shop; so ongoing cost simply refers to the cost of hosting events and distributing materials.

Example Action 3.2: Take action to foster a secondary market for used EVs and to expand access to underinvested communities. This may include collaboration with dealerships, hosting more community outreach events (i.e., Ride and Drives), developing programs for EV owners replacing their EVs with a new vehicle purchase to donate used EVs to community groups, and demonstrating how affordable used EVs can be.

Upfront Investment	Ongoing Cost	Staffing Effort
N/A	$	Low

Events could be held quarterly throughout the county at a modest cost. Staffing needs would likely be handled by the same staff member(s) developing the partnerships in Action 3.1, and could be scaled up or down, depending on the efforts' effectiveness.

5.2.4 Strategy #4: Amplify Regional Outreach to Consumers, Site Hosts, and Other Entities

A rich network of outreach organizations are active in EV promotion in the Bay Area. This strategy encompasses outreach to potential EV drivers, potential site hosts, jurisdictions, homeowner associations (HOAs), and other stakeholders that would benefit from education.

MCE, CEC, BAAQMD, PG&E, Veloz, and numerous local and regional community groups have put together incredibly helpful outreach materials that the County can leverage. Still, research continues to show that awareness of EVs and their capabilities remains substantially limited, and increased awareness has mainly stalled, according to 2017 UC Davis research.[77] The County's departments have numerous touchpoints with consumers, contractors, real estate companies, and other entities that could provide new opportunities for information dissemination.

Lead	511 Contra Costa
Partners	Local jurisdictions; CCTA; Contra Costa County Department of Conservation and Development; other County departments; dealerships; industry
Barrier(s) Addressed	• Cost and financial barriers • Consumer perception barriers • Equitable adoption barriers
Impact on Barriers	Medium
Key Metrics	• Adoption of EVs in the county overall • Number of outreach events held with targeted communities • Number of businesses and other potential site hosts receiving information • Number of site hosts adopting charging • Number of public sector fleets assessing the EV suitability of each vehicle • Number of public sector fleets that have procured EVs
Resources	• Tahoe-Truckee Plug-in Electric Vehicle Toolkits • Greenlining EV Equity Toolkit • Community Plug-in Electric Vehicle (PEV) Readiness Toolkit • Advanced Electric Drive Vehicle Education Program

Example Action 4.1: Amplify existing education and outreach initiatives to **potential site hosts**, in partnership with PG&E, MCE, BAAQMD, and other agencies.		
Upfront Investment **None**	**Ongoing Cost** **$**	**Staffing Effort** **Low**
Potential site hosts need help understanding the business case for installing chargers. This effort would not involve development of any new resources; rather, it would focus on provision of existing resources and tools. Staff would keep track of the most useful analytical tools for prospective hosts, such as the Center for Climate and Energy Solutions EV Charging Financial Analysis Tool, and would		

[77] https://its.ucdavis.edu/blog-post/automakers-policymakers-on-path-to-electric-vehicles-consumers-are-not/

track current programs that hosts can use, such as PG&E's EV Charge Network, MCE's EV Charging Program for MUDs and workplaces, BAAQMD's Charge! program, and others. Staff would brainstorm ways to continually distribute information through mailer inserts on tax bills or other mailings, informational packets distributed at meetings with real estate developers, and mobilizing planning, development review, and inspectional staff to provide materials.

Example Action 4.2: Offer a County-sponsored technical assistance phone line for businesses and property owners, covering topics such as current incentives, how to use property assessed clean energy financing and/or CalCAP loans, and what types of charging, operational policies, and payment schemes would be best suited to their situation.

Upfront Investment	Ongoing Cost	Staffing Effort
None	$	Low

An initial one-time staff effort could be invested to set up a website that would function as an EV landing page, complementing the technical assistance phone line. It is expected that the phone line would not create substantial work for the individual staffing it, as call volumes would likely begin low, but the resource could become very helpful for smaller property owners with less sophisticated understanding of the options.

Example Action 4.3: Conduct direct outreach and experiential events (such as Ride and Drives at farmers markets, community celebrations, and busy locations). Expand awareness of less expensive ways to purchase EVs (such as participating in programs like Bay Area SunShares, coupling EVs with residential solar, and more).

Upfront Investment	Ongoing Cost	Staffing Effort
None	$ to $$	Low to Moderate

Given the county's geographic breadth, EV promotion events could be offered with relative frequency without saturating the audience; therefore, staff time required could add to a moderate level. Participation in National Drive Electric Week and promotion of EVs throughout the calendar year would require maintaining active partnerships with OEMs, dealers, and cities and towns in which events would be held. OEMs may be more willing to contribute staff time in locations more likely to result in immediate upticks in their sales, so the design of these events would need to factor in a strategy to bring the events to parts of the county that have historically lagged in EV adoption.

Example Action 4.4: Enhance local knowledge of the network of DC fast-charging by achieving Federal Highway Administration's EV "Corridor-Ready" designation, and eventually installing signage for the remaining highway corridors in Contra Costa County not yet nominated (Routes 4 and 24).

Upfront Investment	Ongoing Cost	Staffing Effort
$ to $$$	Minimal	Low

This action would be taken in partnership with the California Department of Transportation, East Bay Clean Cities Coalition, and other regional entities, applying for a "Corridor-Ready" designation through FHWA's Alternative Fuel Corridors program. If the findings proved that these corridors did not need additional DCFC infrastructure to achieve designation, the costs would be minimal, but if a few new DCFC ports were required, costs could be significant. Maps developed for this project could provide a good starting point for self-assessment of these routes relative to FHWA criteria.

Example Action 4.5: Reinforce and educate HOAs and condo associations about the state's "right to charge" law (SB 1016). This allows homeowners to install EV chargers, subject only to "reasonable restrictions" from HOA.		
Upfront Investment **None**	**Ongoing Cost** **None**	**Staffing Effort** **Low**
Staff would need to work with planning and zoning offices in each jurisdiction within the county to obtain a list of HOAs and their contact information. This would be a one-time effort to compile information, after which outreach needs would be minimal. More targeted investigations and more active outreach could be conducted if it was known or suspected that certain HOAs were imposing unreasonable EV charging restrictions.		

Example Action 4.6: Incorporate considerations for EV charging etiquette in outreach efforts.		
Upfront Investment **$**	**Ongoing Cost** **$**	**Staffing Effort** **Low**
It is important for drivers charging their EVs to understand how to optimize charger use for themselves and for the rest of the EV community at large. For this action, 511 Contra Costa staff would integrate information within outreach materials about when to charge, how to keep track of active charging, and unplugging from charging ports once the vehicle battery is full. New materials may need to be created, incurring a low level of upfront investment. Ongoing costs could include updating existing materials and developing new materials as needed. Staff also would encourage jurisdictions to do the same, so all drivers receive consistent information.		

Example Action 4.7: Expose TNC drivers and riders to EVs through partnerships such as Uber's EV Champions Initiative and/or by providing incentives for riders to select EVs when requesting a ride through a TNC. The Sacramento Municipal Utility District offers one example of an entity providing a per-trip incentive to Uber drivers completing trips in a zero-emission vehicle within its service area.		
Upfront Investment **$**	**Ongoing Cost** **$**	**Staffing Effort** **Low**
Establishing an incentive would require upfront investments and ongoing costs to maintain, but the incentive need not be very large ($1-$2) as a large number of TNC trips are relatively low-cost. Staff time would be needed to coordinate with TNCs and manage the incentive program.		

Example Action 4.8: Target education and outreach investments toward critical consumer decision points, such as buying ads to promote EV initiatives to run at gas stations (as done by San Diego Gas and Electric) and/or convincing dealerships to offer discounts to residents who demonstrate they received EV education from the County.[78] Outreach and education provided by third parties can save time for dealers who do not have resources to provide the education themselves.		
Upfront Investment **$-$$**	**Ongoing Cost** **$-$$**	**Staffing Effort** **Low**

[78] An initiative by the University of Oregon, Eugene Water & Electric Board, and City of Eugene could serve as a model for dealer discounts. The three agencies hosted free workshops about buying and owning an EV and provided attendees with exclusive EV rebates at participating auto dealers.

Staff time would be required to coordinate advertising or in-person outreach and education efforts. The investment amount would vary, depending on how extensive the education campaign would be.

5.2.5 Strategy #5: Adopt and Promote EV Reach Codes

New construction offers a blank slate to provide adequate accommodations for EV charging as well as a great opportunity for substantial impacts as the infrastructure is much less expensive to install during construction than after the fact. The upcoming mandatory adoption of the California Green Building Standards Code (CALGreen Code) that goes into effect on January 1, 2020, will help ensure these savings are realized by requiring higher amounts of EV-capable parking spaces. However, jurisdictions have an opportunity to go beyond CALGreen Code requirements with their own reach codes, which is easiest to do during adoption of the new three-year cycle. Multiple levels of EV readiness exist, ranging from "EV Capable," which requires installations of raceway and panel capacity, to "EV Ready," which includes wiring, to fully requiring EVSE installations.

Research in support of reach code adoption for Oakland, San Francisco, and Fremont indicated that, depending on the scenario, building parking spaces to EV-ready standards could save $1,000 to $5,000 on later installation of EV charging, per port.[79] Therefore maximizing benefits of EV-ready codes should provide a critical component in the County's effort to cost-effectively expand its charging infrastructure.

Lead	As directed by the Public Managers' Association
Partners	CCTA; Contra Costa County Department of Conservation and Development – Application and Permit Center; local jurisdictions' permitting departments
Barrier(s) Addressed	• Limited access to EV charging • Soft costs associated with EV charging permitting and processes • Technological barriers • Equitable adoption barriers
Impact on Barriers	High
Key Metrics	• Number of jurisdictions with EV reach codes approved • Level of ambition of each EV reach code, in terms of percentage thresholds of EV-capable, EV-ready, and EVSE-installed parking stalls
Resources	• AB 1236 Tool Kit: EV Charging Stations Ordinance • Creating EV-Ready Towns and Cities: A Guide to Planning and Policy Tools • Solano Electric Vehicle Transition Program • AchiEVe: Model State & Local Policies to Accelerate Electric Vehicle Adoption

[79] https://energy-solution.com/wp-content/uploads/2016/08/PEV-Infrastructure-Cost-Effectiveness-Summary-Report-2016-07-20a.pdf

Example Action 5.1: Conduct, commission, or adapt findings of a cost-effectiveness study to provide support for the County and local jurisdictions in adopting more stringent EV-ready installation requirements. Coordinate an effort to encourage as many county jurisdictions as possible to align around standard and ambitious EV charging requirements. Peninsula Clean Energy (PCE) has conducted a study resulting in development of a new model reach code with ambitious EV ready, EV capable, and EVSE required thresholds for residential and nonresidential buildings.		
Upfront Investment **$ to $$ (Depending on Whether Conducting a New Study or Leveraging Recent Work by PCE)**	**Ongoing Cost** **None**	**Staffing Effort** **Low**
As cost-effectiveness studies have been conducted multiple times, staff could likely achieve this action with a relatively small upfront cost. For instance, the cost needed to adapt similar studies for local factors or different, desired EV ready and EV capable thresholds than studies already conducted. The cost-effectiveness study conducted by PCE for jurisdictions within its service territory will be a helpful resource, particularly if jurisdictions in Contra Costa County are interested in similar thresholds to those proposed for jurisdictions within PCE territory, which are presented in its model reach code that encourages jurisdictions to adopt.[80]		

Example Action 5.2: Act quickly to increase EV reach code requirements in this code cycle and spread awareness for local cities and towns to spur action.		
Upfront Investment **Covered Above**	**Ongoing Cost** **None**	**Staffing Effort** **Low**
Staff effort would involve customizing EV model reach code language, securing the buy-in for implementation, passing a City Council vote, and filing the new code with the State Buildings and Standards Commission. Each of these steps would need to be taken by October 2019 to take effect for January 1, 2020, with the new CALGreen Code cycle.		

5.2.6 Strategy #6: Adopt and Promote Streamlined Permitting

California Assembly Bill 1236 requires statewide streamlining of EV permit processes. However, due to a lack of understanding of requirements and/or lack of resources, many jurisdictions have been slow to adopt and enforce AB 1236, thereby slowing EV market saturation and inhibiting organic trends in EV adoption. To implement this strategy, Contra Costa County would coordinate a countywide effort to uniformly enforce the bill and streamline permitting processes more broadly. The County can work with jurisdictions to establish blanket strategies and, on an individual basis, diagnose and provide support to resolve barriers preventing timely adoption of AB 1236.

Lead	As directed by the Public Managers' Association
Partners	CCTA; Contra Costa County Department of Conservation and Development – Application and Permit Center; local jurisdictions' permitting departments

[80] https://peninsulareachcodes.org/

Barrier(s) Addressed	• Limited access to EV charging • Soft costs associated with EV charging permitting and processes • Equitable adoption barriers
Impact on Barriers	Depends on baseline permit procedures in each city and town – expected to be moderate
Key Metrics	• Number of permits processed • Number of jurisdictions adopting all AB1236 practices • Average number of days processing time
Resources	• AB 1236 Tool Kit: EV Charging Stations Ordinance • Creating EV-Ready Towns and Cities: A Guide to Planning and Policy Tools • Solano Electric Vehicle Transition Program • AchiEVe: Model State & Local Policies to Accelerate Electric Vehicle Adoption

Example Action 6.1: Host workshops with jurisdiction representatives to brainstorm and develop strategies for communicating about and enforcing California Assembly Bill 1236. Work with jurisdictions individually to diagnose barriers to enforcement, devise solutions to overcome these, and provide support in applying solutions. Aim for a uniform streamlined permitting process across the county.

Upfront Investment	Ongoing Cost	Staffing Effort
None	None	Moderate

This action primarily is expected to be a one-time effort. Staff time would be required to schedule workshops and meetings. Technical assistance could be provided to cities and towns with the least ability to directly invest efforts in reforming their practices. Low-cost ways of complying with AB1236 (e.g., adopting template checklists and allowing email permit submissions if an online permit database is cost-prohibitive) could be some of the first actions cities and towns could implement.

Example Action 6.2: Populate a database of EV permitting processes and submit these to the Governor's Office of Business Development (GO-Biz) to spread the word about newly streamlined processes, which may attract contractors' interest in performing more installs in county jurisdictions.[81]

Upfront Investment	Ongoing Cost	Staffing Effort
None	None	Moderate

The staff time required would be distributed among all municipalities in the county and would require a central County department to push this initiative forward, though the time investment is expected to be light.

[81] GO-Biz intends to create an AB1236 scorecard for every jurisdiction in the state. Contra Costa County volunteering its municipalities as a test case for this scorecard would provide impetus for each jurisdiction to make improvements to their processes and would support countywide efforts to show that the County is ready to receive grants to install more infrastructure.

Example Action 6.3: Leverage existing outreach and education campaigns to provide technical assistance directly to MUD management companies and developers that may struggle to understand and/or abide by technical requirements for EVSE permitting and installation. Schedule on-site consultations with MUD owners and connect them with local installers and technicians to bridge knowledge gaps and reduce effort/steps on behalf of owners.		
Upfront Investment **None**	**Ongoing Cost** **None**	**Staffing Effort (In-House or Outsourced)** **Moderate to High**
Technical assistance provision would likely be outsourced to an entity better equipped to do site visits, assemble cost estimates, and determine how to proceed with EVSE installations. In a large county, with valuable funding opportunities to be leveraged, demand for technical assistance could grow substantially in coming years. The program could be jointly developed with MCE or another organization and may not need to be paid for or administered directly using County funds.[82]		

Example Action 6.4: Provide incentives to new construction permit applications in cases where project developers planned to implement more EV charging stations than required by code. This could involve being bumped to the front of the queue for development review, or reducing or waiving permit fees.		
Upfront Investment **None**	**Ongoing Cost** **$**	**Staffing Effort** **None**
The policy's cost would come from reductions in permit revenues associated with discounts or waivers. No changes to staff time investments would be required.		

5.2.7 Strategy #7: Contribute to a Regional Charging Network and Engage in Statewide Policy

CCTA's approach to EV readiness acknowledges that Contra Costa County cannot successfully spur widespread EV adoption without a world-class regional charging network. Contra Costa's success hinges on success of the state as a whole and success of surrounding counties, as daily inter-county travel flows are substantial, and driver perceptions of widespread EV charging availability have not substantially improved in recent years.[83]

Lead	CCTA
Partners	BAAQMD, MCE, PG&E, Electrify America, California Governor's Office
Barrier(s) Addressed	• Limited access to EV charging • Technological barriers • Equitable adoption barriers
Impact on Barriers	Medium
Key Metrics	• Participation in regional and statewide charging discussions • Comments added to proposed policies • Origin-destination data from drivers charging in Contra Costa County

[82] Other CCAs have created and funded similar technical assistance programs, such as PCE. https://www.peninsulacleanenergy.com/ev-charging-incentives/

[83] https://its.ucdavis.edu/blog-post/automakers-policymakers-on-path-to-electric-vehicles-consumers-are-not/

Resources	• Alternative Fuel Toolkit • FHWA Alternative Fuel Corridors Webpage • AchiEVe: Model State & Local Policies to Accelerate Electric Vehicle Adoption • EV Infrastructure Planning Tool

Example Action 7.1: Join with counties and agencies across the Bay Area and beyond to assess how Contra Costa EV charging assets contribute to a regional network (particularly in the case of DCFC).		
Upfront Investment **None**	**Ongoing Cost** **None**	**Staffing Effort** **Low**
Staffing could include efforts to obtain data on utilization rates of DCFC and Level 2 charging regionwide and use the data to support arguments for increased investments, explore opportunities for enticing suppliers to expand the regional network, potentially through revenue floors, and other risk-transfer strategies. Staffing would include sending representatives to regional convenings, such as the Bay Area PEV Coordinating Council, and to conferences to continue harvesting best practices from around the country.		

Example Action 7.2: Join in specific topical discussions, such as how AB1236 compliance is evaluated, how local and regional entities can support the Clean Miles Standard (SB 1014), how utility programs are approved and designed, and other topics.		
Upfront Investment **None**	**Ongoing Cost** **None**	**Staffing Effort** **Low**
Staff time costs could include reviewing dockets, broadly scanning literature, pilot project reports, program evaluations, and other efforts to maintain a local database of knowledge and to disseminate that knowledge to key practitioners in the county, its jurisdictions, and surrounding counties.		

Example Action 7.3: Encourage standardization of EVSE technologies in certain vehicle segments. For instance, the county's transit agencies and school districts must navigate a landscape of proprietary chargers that only operate with certain OEMs, and software solutions that are not yet sufficiently sophisticated to consistently allow advanced management of charging patterns.		
Upfront Investment **None**	**Ongoing Cost** **None**	**Staffing Effort** **Low**
Staffing time required for this activity would include periodic listening tours with County departments to understand their opportunities and frustrations with current efforts to electrify, and discussions with peer counties to coordinate advocacy for standardization.		

5.2.8 Strategy #8: Integrate EV Readiness with Growth Management

CCTA's Growth Management Program (GMP) is designed to help Contra Costa County plan for and accommodate expected increases in population, households, and jobs through 2035. For jurisdictions within Contra Costa to become eligible to receive 18% Local Street Maintenance and Improvement and Transportation for Livable Communities program funds, they must demonstrate compliance through CCTA's GMP Compliance Checklist. The checklist can be used to encourage jurisdictions to incorporate EV readiness into their growth and development planning processes.

CCTA is best suited to coordinate efforts to update GMP requirements by engaging with jurisdictions to achieve a consensus on how requirements can be changed without causing undue burdens on the jurisdictions.

Lead	CCTA
Partners	Local jurisdictions
Barrier(s) Addressed	• Limited access to EV charging
Impact on Barriers	Medium
Key Metrics	• EV readiness elements integrated into GMP Compliance Checklist • Jurisdictional buy-in to the revised requirements • Compliance with the revised requirements
Resources	• Community PEV Readiness Toolkit • Zero-Emission Vehicles in California: COMMUNITY READINESS GUIDEBOOK • Electric Vehicle Readiness Plan for Ventura, Santa Barbara, and San Luis Obispo Counties (Central Coast) • Bay Area Plug-In Electric Vehicle Readiness Plan

Example Action 8.1: Revise the Compliance Checklist to include an item requiring jurisdictions to indicate how they contribute to a countywide EV charging network through direct EVSE installations.		
Upfront Investment **None**	**Ongoing Cost** **None**	**Staffing Effort** **Medium**
Staff time needed to coordinate with jurisdictions on new requirements to include in the GMP Compliance Checklist, update the GMP Compliance Checklist and all materials providing associated guidance, and determine if jurisdictions satisfy additional requirements during compliance checks.		

Example Action 8.2: Revise the Compliance Checklist to include an item requiring jurisdictions to indicate how they use zoning code and development levers to encourage EVSE installations (such as by counting EV spaces as multiple parking spaces toward parking minimums, awarding new developments with density bonuses for installing EV spaces, requiring fully operational EV spaces for new developments, or defining EV charging stations as an allowed accessory use).		
Upfront Investment **None**	**Ongoing Cost** **None**	**Staffing Effort** **Medium**
Staff time needed to coordinate with jurisdictions on new requirements to include in the GMP Compliance Checklist, update the GMP Compliance Checklist and all materials providing associated guidance, and determine if jurisdictions satisfy additional requirements during compliance checks.		

5.2.9 Strategy #9: Track Progress

Establish a process for tracking implementation progress of the EV Readiness Blueprint, including the reporting frequency and accountability to stakeholders. As market and policy conditions evolve, it will be important to revisit the Blueprint, report on progress, and refine strategies as needed to ensure effective and continued progress. Contra Costa County and jurisdictions within the county should

collaborate early in the implementation of the EV Readiness Blueprint to develop a clear and achievable process for tracking progress. This process would keep stakeholders on target and moving forward on planned components.

Lead	CCTA
Partners	511 Contra Costa, Contra Costa County Department of Conservation and Development, local jurisdictions
Barrier(s) Addressed	• Limited access to EV charging • Cost and financial barriers • Consumer perception barriers • Technological barriers • Soft costs associated with EV charging permitting and processes • Equitable adoption barriers
Impact on Barriers	Relative to each strategy
Key Metrics	• Process established for continued stakeholder engagement • Implementation of selected actions • Iteration on strategies as conditions shift
Resources	• The ABCs of EVs: A Guide for Policy Makers and Consumer Advocates • Greenlining EV Equity Toolkit • EV charging status: Plugshare and DOE Alternative Fuel Data Center station locator • EV adoption: DMV and California Clean Vehicle Rebate Project datasets

Example Action 9.1: Create a staff position for countywide EV readiness activities.		
Upfront Investment **$$**	**Ongoing Cost** **$$**	**Staffing Effort** **High**
Creating a new staff position would incur recruiting and personnel costs, but it could alleviate burdens from other staff members spending at least a portion of their time related to EV readiness. Someone in this position would serve as the point person for ongoing stakeholder engagement to keep momentum and progress going on the Blueprint. Note: the staffing effort level required for this action would not be strictly additive with staff efforts listed for other actions and could provide a way to fill these staffing needs.		

Example Action 9.2: Establish a central information clearinghouse about countywide EV planning efforts, and foster CCTA's reputation as the principal resource for coordinated EV planning.		
Upfront Investment **$$**	**Ongoing Cost** **$**	**Staffing Effort** **Low**
Setting up an information clearinghouse (such as through a website) would incur initial design and development costs, but ongoing costs to keep it maintained would be relatively low and would rely on staff support.		

Example Action 9.3: Set targets for countywide public EV charging infrastructure and EV registrations and synchronize EV readiness efforts across County and local planning efforts. Provide input and context for cities as they develop their CAPs or CAP updates, sustainability strategies, zoning, codes, and other policies that would impact EV readiness in the county.		
Upfront Investment **None**	**Ongoing Cost** **None**	**Staffing Effort** **Low**
Initial staff time would be required to coordinate with stakeholders in establishing suitable targets and interim milestones. Periodic staff support on the County's behalf would be necessary to ensure city-level efforts are coordinated with County efforts.		

5.2.10 Strategy #10: Electrify County Fleets and Encourage Fleets Within Jurisdictions to Electrify

Electrifying public fleets demonstrates leadership and can reduce vehicle lifecycle costs. The Contra Costa Public Works Fleet Services department can take the lead in maximizing opportunities for EVs within the County's fleet and to encourage other public fleets within the county to do the same by—for example—sharing lessons learned and coordinating on vehicle procurement.

Lead	Contra Costa Public Works Fleet Services
Partners	Local jurisdiction fleet managers
Barrier(s) Addressed	• Cost and financial barriers • Consumer perception barriers
Impact on Barriers	Medium
Key Metrics	• Proportion of EVs in fleets • EV charging infrastructure installed for fleet use
Resources	• Climate Mayors • Alternative Fuel Toolkit • AchiEVe: Model State & Local Policies to Accelerate Electric Vehicle Adoption • DriveClean Plug-In Electric Vehicle Resource Center • Alameda County Electric Vehicle Programs

Example Action 10.1: Establish or revisit fleet transition plans and evaluate if additional vehicles can be replaced with EVs. As more EV models became available on the market, additional opportunities may appear to replace ICE or hybrid vehicles.		
Upfront Investment **$$$**	**Ongoing Cost** **Negative (Savings)**	**Staffing Effort** **Moderate**
Upfront EV costs may be higher than those of conventional vehicles, but their total ownership cost is less, resulting in lower ongoing costs. Staff support would be needed to evaluate fleet needs and manage the procurement process.		

Example Action 10.2: Encourage jurisdictions to participate in the Climate Mayor's Electric Vehicle Purchasing Collaborative.		
Upfront Investment **None**	**Ongoing Cost** **None**	**Staffing Effort** **None**

Staff would inform and remind cities and towns in the county of no-cost perks offered by the Climate Mayor's group, enabling them to have a subset of their fleets reviewed for EV suitability and advising them on how to leverage cooperative EV procurement.

Example Action 10.3: Innovatively deploy electric school buses and other heavy vehicles as grid resources via managed charging and/or V2G pilots.

Upfront Investment	Ongoing Cost	Staffing Effort
$$$	$$	Moderate

As overgeneration of solar during midday continues to pose challenges for effective grid management, electric vehicles parked during midday can provide valuable resources. One way to do this is to respond to signals from the utility that request a load increase (at times of excess supply, as in PG&E's Excess Supply Program, which Pittsburg Unified School District participates in). Another way is to use V2G technologies to feed energy back to the grid at times when it is needed, such as that taking place in upstate New York, where a school district has collaborated with the local utility to establish a pilot project that utilizes electric school buses as mobile batteries during summer months to help manage grid needs.[84] Projects such as these take one capital asset and utilize it for two purposes—transportation and grid services. This project type could be especially valuable in a county like Contra Costa, where summer months are expected to see electricity demand spikes as the climate warms. School buses offer a particularly good match as they are generally parked during times of day when they may be called upon to charge and because replacing diesel school buses could drive air quality co-benefits targeted at youth, who are especially vulnerable to air pollution effects.

Upfront costs could be substantial for the entity procuring the vehicles and installing the chargers, but could be at least partially defrayed by regional and state grants and/or investments from partners.

Example Action 10.4: Integrate renewable energy sources into fleet electrification implementation.

Upfront Investment	Ongoing Cost	Staffing Effort
$$	Negative (Savings)	Moderate

On-site renewable energy sources (such as solar) can offset additional electricity needs that would be generated from an increase in EVs charging from the grid, and can especially offset costs associated with demand charges. Public sector entities that take service from PG&E (not MCE) can evaluate whether the Renewable Energy Self-Generation Bill Credit Transfer program would increase the value proposition of solar. Those public sector fleets taking service from MCE can explore what similar options may exist for applying excess generation credits to multiple benefiting accounts.[85]
Planning for and installing solar capacity would require dedicated staff time and substantial upfront investment, but, in the long-term, it can result in cost savings in comparison to a scenario without on-site renewables. There would be associated maintenance costs, but those would be relatively low. Many jurisdictions within the county may have the expertise and knowledge to evaluate solar and EV adoption projects, whereas others may need assistance and guidance.

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84 https://nyrevconnect.com/utility-profiles/consolidated-edison/

85 https://www.pge.com/en_US/for-our-business-partners/interconnection-renewables/export-power/distributed-generation-handbook/net-energy-metering/res-bct-program.page?ctx=business

5.3 Medium-Term (3-5 years)

5.3.1 Strategy #11: Implement Scalable Shared, Electric, Connected, and Autonomous Vehicle Pilots

The convergence of electrification and automation with shared mobility is predicted to have a transformative effect on mobility. Additionally, shared autonomous vehicles (SAVs) and shuttles have the potential to reduce private vehicle ownership and provide innovative opportunities to lower cost and offer flexible public transportation systems. To test and scale this concept, CCTA can fund pilots and support municipalities to develop and implement shared, electric, connected, and autonomous solutions. As these services scale, the cost will come down so more people can utilize them and become accustomed to the ease of travel without having to rely on their personal car for every trip. Combined, shared, connected vehicles with automation can provide traveler cost savings and reduce the need for parking. These solutions could also potentially reduce the number of vehicles in Contra Costa County, saving costs and opening land for other uses.

CCTA could leverage a variety of funding sources (e.g., CARB, USDOT, etc.) and work with other jurisdictions and County departments to apply for funding and forge partnerships to implement pilots targeting specific use cases, with a special emphasis on underserved users and communities (e.g., people with disabilities, shift workers requiring late night transportation, etc.).

Lead	CCTA
Partners	Local jurisdictions and County departments
Barrier(s) Addressed	• Cost and financial barriers • Consumer perception barriers • Technological barriers • Equitable adoption barriers
Impact on Barriers	High
Key Metrics	• Vehicle miles traveled in pilot vehicles • Passenger miles traveled in pilot vehicles • Average occupancy of pilot vehicles • Demographic profile of passengers • Spatial/demographic distribution of locations served • Average cost per mile
Resources	• Greenlining EV Equity Toolkit • ReadySet Charge California! A Guide to EV-Ready Communities • The ABCs of EVs: A Guide for Policy Makers and Consumer Advocates

Example Action 11.1: Implement a pilot for campus applications. Electric SAVs could provide short-distance, point-to-point travel in campus environments that can be easily mapped by software. These locations include: theme parks, resorts, malls, business parks, college campuses, airport terminals, construction sites, downtown centers, real estate developments, gated communities, industrial centers, and others (e.g., Bishop Ranch, Diablo Valley College, Rossmoor, etc.).		
Upfront investment **$$$**	**Ongoing cost** **$$**	**Staffing effort** **Moderate**
Upfront investment would be needed to acquire pilot vehicles, mapping software, and dedicated charging infrastructure, and any of these expenses could be supported by grants and matching funds. The exact level of investment is dependent on the size and design of the pilot. Ongoing cost would potentially include safety drivers, program monitoring, and charging and maintenance of vehicles.		

Example Action 11.2: Implement a pilot for first mile/last mile connectivity in electric vehicles. Traditionally, public transit has been limited by fixed routes and fixed schedules. Due to these limitations, travelers may find it difficult to complete the first or last mile of their journey using public transit. SAVs may be able to help bridge first and last mile gaps in the public transportation network.		
Upfront investment **$$$**	**Ongoing cost** **$$**	**Staffing effort** **Moderate**
As described in Action 13.1.		

Example Action 11.3: Implement a pilot for low density service. SAVs have the potential to provide lower cost and more frequent or responsive transit solutions in rural, exurban, and low-density suburban areas where low ridership and high labor costs often contribute to inefficient or cost prohibitive fixed route service.		
Upfront investment **$$$**	**Ongoing cost** **$$**	**Staffing effort** **Moderate**
As described in Action 13.1.		

Example Action 11.4: Implement a pilot for off-peak/late night service. SAVs can complement public transit by providing service during off-peak times, especially late at night when service is difficult and costly to provide.		
Upfront investment **$$$**	**Ongoing cost** **$$**	**Staffing effort** **Moderate**
As described in Action 13.1.		

Example Action 11.5: Implement a paratransit pilot. Paratransit services could be provided by SAVs to meet the needs of people with disabilities; nevertheless, human assistance may still be required.		
Upfront investment **$$$**	**Ongoing cost** **$$**	**Staffing effort** **Moderate**
As described in Action 13.1.		

5.3.2 Strategy #12: Expand Pilot Programs to Provide Electric Mobility Services to Underserved Populations

Programs in this category are intended to provide EV mobility services to underinvested communities. This can include any policy or program that uses clean transportation options and either targets or only serves underinvested communities. Often these example actions help facilitate public transit access in the cases where the final destination of an individual or household who uses public transportation is located too far away to access public transportation without a private vehicle.

Precise roles and responsibilities would vary depending on the specific action implemented. CCTA could lead with potential partners such as state or federal programs and matching funds; PG&E and other utility and infrastructure partners to provide EV charging; and/or other public transportation services to implement or partner with private sector transportation services.

Lead	CCTA
Partners	511 Contra Costa, PG&E, MCE, local advocacy groups, public transit agencies
Barrier(s) Addressed	• Limited access to EV charging • Consumer perception barriers • Equitable adoption barriers
Impact on Barriers	Medium
Key Metrics	• Demographic profile of EV drivers or EV charger users • Availability of affordable transportation options for all users (including but not limited to people with disabilities, unbanked households, low-income households, low-density communities, and late-night shift workers) • Spatial distribution of service availability, costs, and wait times • Equivalent level of service (as defined by the Federal Transit Administration)
Resources	• Greenlining EV Equity Toolkit • Tahoe-Truckee Plug-in Electric Vehicle Toolkits • California Drive Clean Incentive Search • DOE EV Tax Credits and Other Incentives • Pacific Gas & Electric EV Tools • CALeVIP • PG&E Electric Vehicle Incentives

Example Action 12.1: Run a pilot program of EV carsharing in DACs.

Upfront investment	Ongoing cost	Staffing effort
$$	$$	Low

Investment types may vary but could include in-kind support to apply for state and federal funding, matching funds, and rights-of-way access for vehicles. Other investments could include charging infrastructure and grants for EV procurement.

Example Action 12.2: Pilot demand-responsive EV transportation services in DACs, such as microtransit, partnerships with TNCs, or others.		
Upfront investment **$$**	**Ongoing cost** **$$**	**Staffing effort** **Moderate**
Investment types may vary but could include in-kind support to apply for state and federal funding, matching funds, grants for EV procurement, charging infrastructure, per trip subsidies, and loading zones for services.		

Example Action 12.3: Provide custom solutions to alleviate financial barriers and "digital divide" barriers that preclude participation in existing and upcoming shared electric mobility services for underserved populations. This could include offering ways to pay with cash for unbanked customers, providing ways to summon Uber/Lyft/TNCs without the use of a smartphone (e.g., Go Go Grandparent), and providing ways to reserve shared vehicles or services without having Wi-Fi.		
Upfront investment **$**	**Ongoing cost** **$$**	**Staffing effort** **Low to Moderate**
Costs may vary but could include subsidies for income qualified participants, and coordination time to develop solutions in partnership with the operators of the shared electric mobility services.		

Example Action 12.4: Develop relationships with third parties providing free services through ad sponsorship and other innovative business models to enhance pilot affordability, particularly in underinvested communities. Several companies are currently testing ways to provide electric mobility to users for free using sponsors. For example, WaiveCar offers a fleet of shared EVs, Circuit (formerly "The Free Ride") provides electric shuttle service, and Volta delivers free charging through its stations, all for free. Using such models can lower barriers of adoption and increase participation from underinvested communities.		
Upfront investment **None**	**Ongoing cost** **None**	**Staffing effort** **Low**
Only staff time would be required to coordinate with the third-parties to determine where to deploy their services and to monitor implementation.		

5.3.3 Strategy #13: Integrate EV Carpool and Shuttle Services into County 511 Programs

The Metropolitan Transportation Commission (MTC) currently engages in numerous regional initiatives and partnerships to support carpooling and other transportation demand management, air quality, and climate action initiatives such as 511 Traveler Information, Guaranteed Ride Home, Spare the Air, and Park-and-Ride, among others. MTC manages the regional 511 Carpool Program to assist Bay Area commuters with finding carpool and vanpool partners. In recent years, employer shuttles and carpool matching apps have entered the Bay Area marketplace, potentially changing how commuters travel and how carpool matching is facilitated. Given the capacity limitations of the Bay Area's regional highway and public transit networks, increasing passenger occupancies in the county through ridesharing using EV carpools and shuttle services can be a quick and cost-effective way to provide more transportation capacity to Contra Costa commuters while reducing emissions.

A variety of stakeholders could play a crucial role in supporting EV carpooling. One of the most effective ways to support EV carpooling is through incentives (e.g., cash for commuters) and supporting employer transportation demand management programs. Potential partners could include MTC, BAAQMD, local jurisdictions, property managers (e.g., commercial buildings and office parks), and major employers.

Lead	511 Contra Costa
Partners	MTC, BAAQMD, local jurisdictions, property managers, and major employers
Barrier(s) Addressed	• Limited access to EV charging • Technological barriers • Consumer perception barriers • Equitable adoption barriers
Impact on Barriers	Medium
Key Metrics	• Average vehicle occupancy • Number of single-occupancy trips avoided by time and by origin/destination
Resources	• Alternative Fuel and Electric Vehicle Program • Fleets for the Future Procurement and Transition Planning Guides • Creating EV-Ready Towns and Cities: A Guide to Planning and Policy Tools

Example Action 13.1: Provide bonus incentives for carpool drivers that are using EVs, through a cash for commuters or similar program. The program could be administered internally or in partnership with a third party for program administration (e.g., Ride Amigos, Scoop, Waze Carpool, etc.).

Upfront investment	Ongoing cost	Staffing effort
$	$$	Low

If the bonus incentives are being conducted through an existing incentive program, upfront investment would be minimal and staff support would be needed to promote the program. Ongoing funding would be needed to continue distributing incentives and staff support would be needed to administer the program.

Example Action 13.2: Require employers to implement innovative new tools as part of trip reduction programs, which could include EV shuttles (e.g., circulator, first/last-mile to BART, etc.), subsidies for EV carpool participation, and preferential parking and reduced parking fees for EVs carpools and vanpools.

Upfront investment	Ongoing cost	Staffing effort
$	$	Moderate

Staff support would be needed to develop, implement, and promote the new policy, and enforce it.

5.4 Long-Term (5+ years)

5.4.1 Strategy #14: Incorporate EV Resilience Planning into County Preparedness Strategies

As EVs comprise an increasingly large proportion of the vehicle fleet within Contra Costa County, they must be accounted for when planning for emergencies such as grid failures. By integrating EVs into preparedness strategies, Contra Costa County can maximize the opportunities EVs provide by being mobile sources of power and ensure the resilience of operations relying on EVs during emergencies.

The Contra Costa County Office of Emergency Services may be well suited to lead implementation of this strategy as part of its responsibility to conduct planning, outreach, and training related to disaster management and emergency preparedness. The Office of Emergency Services would need significant input and buy-in from other stakeholders such as PG&E, MCE, renewable energy providers, emergency preparedness departments within individual jurisdictions, and fleet managers.

Lead	Contra Costa County Office of Emergency Services
Partners	PG&E, MCE, renewable energy providers, emergency preparedness departments within individual jurisdictions, and fleet managers
Barrier(s) Addressed	• Limited access to EV charging • Consumer perception barriers • Technological barriers
Impact on Barriers	Limited Access to EV charging (High) Consumer Perception Barriers (Medium) Technological Barriers (Medium)
Key Metrics	• Inclusion of EV considerations within the Contra Costa County Emergency Operations Plan • Inclusion of EV considerations within emergency preparedness exercises
Resources	• Enhancing Grid Resilience with Integrated Storage from Electric Vehicles

Example Action 14.1: Designate selected emergency response centers to provide EV charging via backup generators during grid failures and other emergencies.		
Upfront investment **$$**	**Ongoing cost** **$**	**Staffing effort** **Low**
Upfront investment would be needed to acquire backup generators where needed. Ongoing costs to test and maintain the backup generators are anticipated to be minimal. A staff member would need to coordinate with emergency response centers to establish procedures for the use of the backup generators.		

Example Action 14.2: Establish detailed contingency plans to continue critical operations of fleet EVs during grid failures and other emergencies. Resilience measures to incorporate within the plans include stand-alone electricity generation options, energy storage, and islandable microgrids that can operate connected to the utility grid or independently during.

Upfront investment	Ongoing cost	Staffing effort
$$$	$$	Moderate

Upfront investment for the resilience solutions could be high depending on the technologies selected, through ongoing operating costs (especially for renewable energy solutions) would be low. Additional costs may be incurred by the need to have backup non-electric vehicles for critical operations. Ongoing costs would also include funds to perform exercises to practice implementation of the plans. Staff time would be needed to develop contingency plans, create awareness of the plans, and perform exercises. The need to cope with frequent outages may increase as increased wildfire risks driven by a changing climate force PG&E to implement more Public Safety Power Shutoff events.

Example Action 14.3: Establish plans to deploy off-grid solar carports, solar and storage integration, and/or islandable microgrids that can operate connected to the utility grid or independently to provide power to private EV owners during grid failures and other emergencies.

Upfront investment	Ongoing cost	Staffing effort
$$$	$	Moderate

Upfront investment for the resilience solutions could be high depending on the technologies selected, through ongoing operating costs (especially for renewable energy solutions) would be low. Ongoing costs would also include funds to perform exercises to practice implementation of the plans. Staff time would be needed to develop plans, create awareness of the plans, and perform exercises.

Example Action 14.4: Use charged EVs to provide short-term power to critical facilities during grid failures and other emergencies. A prioritized list of facilities would need to be developed and updated as needed.

Upfront investment	Ongoing cost	Staffing effort
$$$	$	Moderate

Upfront investment could be high to establish vehicle-to-grid capabilities to allow for transfer of power between EVs and critical facilities. Ongoing costs include testing of the vehicle-to-grid capabilities with available EVs. Staff time would be needed to establish emergency plans and coordinate between EV owners and critical facilities during times of emergency.

Example Action 14.5: Adopt smart charging for new fleet charging infrastructure and replace existing infrastructure with smart charging as feasible. Smart charging is comprised of programs and technology that actively manage the EV charging in a way that pulls electricity when it is most efficient (i.e., not during peak demand hours) and that supports grid stability. Smart charging could take the form of one-way controlled charging, demand response, or vehicle-to-grid applications.		
Upfront investment **$$**	**Ongoing cost** **Possibly negative (savings)**	**Staffing effort** **Moderate**
Upfront investment would be needed to purchase smart chargers and replace existing charging infrastructure. Ongoing costs would be relatively low for maintenance of the infrastructure. Staff time would be needed to identify opportunities for new installations or charger replacement and monitor usage. Opportunities may exist to generate revenue by participating in PG&E's Excess Supply Program (XSP) or a future similar program through MCE.		

5.4.2 Strategy #15: Pilot Wireless Inductive Charging on Streets

Wireless inductive charging, in both stationary and dynamic applications, provides electricity to EVs without the car having to be plugged in. Stationary wireless inductive charging works to charge an EV's battery when the EV is parked on top of the inductive charging pad. These wireless parking pads are convenient for homes, but they could also be piloted at parking spots in public lots or on the street. Dynamic or "in-motion" wireless charging is a rapidly developing technology that could be deployed along stretches of road such as toll roads or HOV lanes. Dynamic wireless charging can charge an EV's battery while it is in motion above the inductive charger. As the technology advances, its efficiency is improving and the speeds at which an EV can be traveling and it still charge the vehicle are also increasing.

Wireless inductive charging has the potential to significantly ease EV operation and facilitate other technological breakthroughs and improvements. Notably, AVs could move indefinitely if dynamic wireless charging were available; even stationary wireless charging could mean an AV just needs to park on top of an inductive charging pad instead of requiring a human to plug it in. Wireless chargers also require minimal space, freeing up land for other uses. Additionally, with easier access to charging, EVs could have smaller battery units.

CCTA could lead this effort with significant support from Public Works, Department of Conservation and Development, and County Planning Commission. Ultimately, a wider range of County departments would likely want to be involved as the technology becomes more commonplace and proliferates throughout the region.

Lead	CCTA
Partners	County agencies such as Public Works, Department of Conservation and Development, and County Planning Commission
Barrier(s) Addressed	• Limited access to EV charging • Consumer perception barriers • Technological barriers

Impact on Barriers	High
Key Metrics	• Number of stationary wireless inductive pads; • Miles of wireless inductive charging; • Kilowatt hours (kWh) of wireless electricity transferred
Resources	• Wireless Charging for Electric Vehicles

Example Action 15.1: Pilot test stationary wireless charging pads on public street parking spots for general use by EV owners, coordinating with wireless charging technology providers (such as WiTricity, Plugless, or Qualcomm Halo) to select a wireless charging mat that functions with the greatest number of EVs possible.

Upfront investment	Ongoing cost	Staffing effort
$$$	$$	Moderate

Upfront investment in the chosen technology would be needed, as well as ongoing cost to power and maintain the charging mat. The exact level of investment is dependent on the size and design of the pilot. Staff time would be needed to plan, implement, and evaluate the pilot program.

Example Action 15.2: Pilot test stationary wireless charging at bus stops. Electric buses offer a prime opportunity to pilot test wireless EV charging since they drive a defined route and have periodic stops at specific locations. Wireless charging at bus stops would not fully replace the need for plugged-in charging at night, but it is a good opportunity to test the technology and it can add greater range to the buses during the day. As wireless charging becomes more prevalent, bus battery size can be reduced, reducing weight and ultimately efficiency. Other public entities are exploring wireless charging for electric buses, including in Washington State and Maryland.

Upfront investment	Ongoing cost	Staffing effort
$$$	$$	Moderate

Upfront investment would be needed to acquire and install wireless charging technology. The exact level of investment is dependent on the size and design of the pilot. Ongoing cost would include powering and maintain the charging mats. Staff time would be needed to plan, implement, and evaluate the pilot program.

Example Action 15.3: Undertake research to better understand dynamic wireless charging technology, its benefits, its limits, and ways in can be integrated into the streetscape. Dynamic wireless charging technology is still developing and pilot testing may be far off.

Upfront investment	Ongoing cost	Staffing effort
None	None	Low

No upfront investment or ongoing cost would be needed, but some staff time could be used to stay up to date on developments with this technology and prepare for a pilot if the technology matures.

5.4.3 Strategy #16: Implement and Enhance Shared Mobility Hubs with Electric Options

Shared mobility hubs can be an important strategy to connect different modes of travel and other services (e.g., goods delivery, traveler information services, etc.) in a single place to help travelers

quickly make connections. Influencing mobility hubs may include different policy strategies, features, and improvements. Each mobility hub can be customized to the unique needs of each Contra Costa community (both incorporated and unincorporated areas). For instance, some of these hubs may be conducive to extensive TNC services and micromobility services, while others may simply be connection points to transit with dedicated charging for users of the facility who park there.

With support from Caltrans, MTC, and public transit agency partners, CCTA could lead efforts to develop policies and improvements to support the development of mobility hubs that include electric options. Other stakeholders such as PG&E and BAAQMD could also have a role developing EV infrastructure that could be paired with mobility hubs.

Lead	CCTA
Partners	PG&E, BAAQMD, 511 Contra Costa
Barrier(s) Addressed	• Consumer perception barriers • Technological barriers • Limited access to EV charging • Equitable adoption barriers
Impact on Barriers	Medium
Key Metrics	• Number of electric mobility services at each hub • Number of jobs and housing units within walking distance of mobility hubs
Resources	• Shared Use Mobility Reference Guide • Greenlining EV Equity Toolkit • Twin Cities Shared Mobility Action Plan • ReadySet Charge California! A Guide to EV-Ready Communities • The ABCs of EVs: A Guide for Policy Makers and Consumer Advocates

Example Action 16.1: Provide charging infrastructure for carsharing, shared micromobility, TNCs, and other modes at each shared mobility hub. This could include multiple different levels of EV charging as well as charging docks for electric bikes and scooters and other mobility devices. The County could explore options to help site operators keep charging costs low, such as by providing the land for the site, capping operator profits, employing a revenue guarantee for the operator, or maximizing utilization by charging County-owned vehicles during non-peak hours. Having affordable DCFC options within or near shared mobility hubs could be particularly advantageous for TNC drivers with lower incomes or who experience other socioeconomic barriers to driving EVs. Data on TNC driver income varies, but even generous estimates for full-time work indicate an income below the national median, which is not complemented with any benefits.[86]

[86] https://www.forbes.com/sites/eriksherman/2018/03/06/uber-and-lyft-driver-income-study-was-flawed-but-gigs-are-still-a-problem/#4fc8026fef66

Upfront investment	Ongoing cost	Staffing effort
$$$	$$	Moderate
Upfront investment would be needed to acquire and install charging infrastructure, and ongoing cost would be incurred for maintenance and power. Staff time would be needed to develop guidance for its use and monitor the infrastructure.		

Example Action 16.2: Enhance shared mobility waiting areas through investments in seating, landscape architecture, lighting, covered areas, Wi-Fi, and real-time transit information. A more enjoyable experience can encourage greater use of mobility options.		
Upfront investment	**Ongoing cost**	**Staffing effort**
$$	$	Moderate
Upfront investment in physical infrastructure and technology would vary depending on which enhancements are selected but maintenance would be an ongoing cost in all cases. Staff support would be needed to plan and implement the enhancements.		

Example Action 16.3: Dedicate parking, curb space, and loading zone (and other rights-of-way) for shared mobility to enhance accessibility and mobility. Circulation at mobility hubs can be enhanced by providing designated curb space, parking, and pick up/drop off zones to facilitate shared micromobility, carsharing, TNCs, and other shared modes. Easy access can support multimodal connections.		
Upfront investment	**Ongoing cost**	**Staffing effort**
$$	$	Low
Upfront investment would be needed for any changes necessary to existing curb space and for signage development. Ongoing costs would include maintenance and enforcement. Staff support would be needed to select dedicated areas for shared mobility and publicize their repurposed use.		

Example Action 16.4: Locate EV pilots at shared mobility hubs to help increase exposure to EVs.		
Upfront investment	**Ongoing cost**	**Staffing effort**
$	$	Low
Upfront investment would be dependent on the pilot selected but integrating the pilot with the locations of shared mobility hubs would increase awareness of both. Ongoing cost would also be dependent on the selected pilot and location may not have a large impact. Likewise, the level of staff support associated with the pilot may not be influenced much by where the pilot is located.		

Example Action 16.5: Implement land use/zoning policies and joint development to help increase activity around mobility hubs and enable mixed-use, walkable destinations. Land use policies that support mixed-use development/redevelopment at and adjacent to mobility hubs, as well as joint development, are one way that Contra Costa County can help encourage shared mobility hubs to become mixed-use, multimodal activity centers.		
Upfront investment	**Ongoing cost**	**Staffing effort**
$$	$$	Moderate
Policy changes at the municipal and County level require minimal investment and cost. More investment may be needed for joint development (e.g. incentives, low-interest loans, and other public		

sector funding or support). In both cases, staff support is necessary for policy development, new initiative development, and implementation.

5.4.4 Strategy #17: Explore Options to Disincentivize Usage of ICE Vehicles and Incent Their Replacement

To complement incentives for EV usage, disincentives for ICE vehicle usage can greatly spur the transition to cleaner transportation. In addition to transitioning to EVs, disincentives for ICE vehicles may push people toward other sustainable options such as public transportation. Disincentives are needed as studies have shown that incentives, even when they completely cover the cost of a transportation option, are not always effective in influencing a person's transportation choices.

CCTA could spearhead this strategy, with support from the Department of Conservation and Development and Sustainability Commission and coordination with local jurisdictions.

Lead	511 Contra Costa
Partners	CCTA, Department of Conservation and Development, Sustainability Commission, local jurisdictions
Barrier(s) Addressed	• Cost and Financial Barriers
Impact on Barriers	High
Key Metrics	• New EVs registered • New ICE vehicles registered • Retired ICE vehicles that are replaced with an EV
Resources	• Survey of Global Activity to Phase Out Internal Combustion Engine Vehicles • Using Vehicle Taxation Policy to Lower Transport Emissions: An Overview for Passenger Cars in Europe

Example Action 17.1: Designate and encourage local jurisdictions to designate ICE-free zones. ICE-free zones are areas where ICE vehicles are banned from operating. EVs and other smaller forms of mobility (bicycles, scooters, etc.) would be allowed to enter these zones. Zones may be entire regions of the city or specific streets or areas such as parks and they could take place only on certain days of the week or month. These bans are typically enforced using tickets for any vehicle caught violating the ban.

Upfront investment	Ongoing cost	Staffing effort
$$	$$	Moderate

Upfront investment would include signage to mark designated ICE-free zones and ongoing cost would include continued enforcement. This action would result in revenue from ticket violations. Staff time would be needed to design, implement, promote, and monitor the initiative.

Example Action 17.2: Implement and encourage local jurisdictions to implement higher parking fees or otherwise make parking more restricted and limited. Raising parking fees for ICE vehicles, whether for a resident's street-parking permit, in public lots, or for street parking would in turn make the cost proposition for EVs look better by comparison. Higher parking rates may also push drivers to switch to public transportation or simply not take the trip, instead. Parking restrictions for ICE vehicles could take the form of reducing the number of parking spots overall, with any new parking spots becoming for EV use only.		
Upfront investment **$$**	**Ongoing cost** **$$**	**Staffing effort** **Moderate**
Upfront investment would include signage to reflect updated parking policies and new material development conveying updated fees and policies. Ongoing cost would include continued enforcement. This action would result in revenue from ticket violations. Staff time would be needed to design, implement, promote, and monitor the updated fees and policies.		

Example Action 17.3: Promote and advertise BAAQMD's Clean Cars for All program, which provides incentives for low-income Bay Area residents to retire their older vehicle and replace it with an EV, among other options. The program could be highlighted on social media, at events or through other existing communications channels. Furthermore, the County could contribute additional funding specifically for county residents who take advantage of the program, or replicate and administer a program of their own.		
Upfront investment **$ (promotion)** **$$$ (program replication)**	**Ongoing cost** **$ (promotion)** **$$$ (program replication)**	**Staffing effort** **Moderate**
Upfront investment and ongoing cost would be minimal to promote the program but would become more substantial if Contra Costa County provided additional funding on top of the existing program or replicated the program entirely. Likewise, minimal staff support would be needed to promote the Clean Cars for All program through existing channels but would increase if the program was added to or replicated.		

6 Conclusion

CCTA has laid the groundwork to establish Contra Costa County as an EV-ready community. Transitioning to EVs and broadly electrifying transportation is vastly beneficial and necessary. Through robust engagement with stakeholders, CCTA has developed an EV Readiness Blueprint that positions Contra Costa County to lead on EV adoption and EVSE deployment in ways that benefit all county residents. The implementation strategies included in the Blueprint offer a starting framework to use for building partnerships, verifying roles and responsibilities, and selecting actions to execute.

This Blueprint establishes CCTA as the lead entity in Contra Costa to align stakeholders on a common clean transportation vision and to enable them to achieve greater results through coordination and collaboration. In the short term, this Blueprint suggests continuing to assess EV readiness needs, installing infrastructure in priority areas, implementing low-income customer outreach and education, amplifying outreach done by regional partners, adopting and promoting EV reach codes, adopting and promoting streamlined permitting for EV charging, engaging in regional and state policy and plans, integrating EV readiness with growth management, tracking progress, and electrifying local public sector fleets. Additional medium- and long-term strategies relate to pilots on connected autonomous vehicle electrification, electrification of mobility as a service and mobility on demand, embracing new technologies and business models, and incorporating climate resilience into EV planning. In addition, the Blueprint has developed recommendations, ideas, and analysis to support development of a workforce training program and development of electric shared mobility hubs.

I'm excited to be part of the County's EV readiness journey because there's tremendous potential for jurisdictions around the County to develop innovative partnerships with emerging and established transportation technology companies, as we have done in Richmond with EVgo and Volta. It is important that we future-proof our infrastructure, leverage our public resources such as the public right of way appropriately, and plan our EV charging models proactively to anticipate and mitigate maintenance and ongoing costs. - Denee Evans, Transportation Services, Office of the City Manager, City of Richmond

Collectively, these efforts will require substantial investment and collaboration. The charging infrastructure needs and EV adoption rates needed to achieve ambitious climate goals and reduce pollution require transforming our transportation systems. CCTA, County departments, jurisdictions, regional coordination entities, and other key stakeholders are all part of this solution and can build on the momentum initiated through the Blueprint development process to significantly ramp up efforts to realize a substantial transition to EVs.

Effective implementation of the Blueprint through proper funding and support would have lasting, significant impacts in Contra Costa County and beyond. Realizing the vision laid out by CCTA and its stakeholders can result in improved health, avoidance of climate impacts, and more equitable access to mobility options.

Appendix A. Stakeholder Workshop Participants

The following agencies and organizations engaged in the EV Blueprint development process through participation in the stakeholder workshops.

Regional Agencies:

- Bay Area Air Quality Management District
- East Bay Regional Park District

County Agencies:

- 511 Contra Costa
- Contra Costa County Department of Conservation and Development
- Contra Costa County Board of Supervisors
- Contra Costa County Sustainability Commission
- Contra Costa County Public Works Department
- Contra Costa Transportation Authority
- Workforce Development Board of Contra Costa County

Local Jurisdictions:

- City of Brentwood
- City of Clayton
- City of Concord
- City of El Cerrito
- City of Richmond
- City of San Pablo
- City of Walnut Creek
- Town of Danville

Transit Agencies

- Alameda-Contra Costa Transit District
- County Connection
- Tri Delta Transit

Other Public Entities:

- CivicSpark
- MCE

- Pittsburg Unified School District and Pittsburg Adult Education Center
- Transportation Partnership and Cooperation (TRANSPAC)

Private Sector Companies and Organizations:

- Bishop Ranch
- Contra Costa Centre Transit Village
- Energy Solutions
- ChargePoint
- ELIX Wireless
- EVBox
- Greenlots
- Pacific Gas and Electric Company
- SolEnergy Consulting
- Tesla

Appendix B. **Best Practices Tool Box**

To help standardize EV deployment guidance for jurisdictions within Contra Costa County, CCTA developed a Best Practices Tool Box. The Tool Box was developed through a review of existing EV and EVSE resources including tools, toolkits, calculators, websites, plans, guides, and templates. CCTA organized the resources within categories of interest most relevant to stakeholders within the county working to advance EV deployment:

- Site Selection/Analysis
- Incentives/Rebates
- EV Cost Forecasting or Analysis (Financial and/or Environmental)
- Funding
- Financing
- Charging Infrastructure
- Outreach/Education
- Regulatory/Permitting
- Municipal Fleet Electrification
- Equity
- Model Ordinances or Codes

For each resource, the Tool Box includes the resource name, a short description, the authoring organization, the year in which the resource was developed, a link to the resource, the audiences the resource targets, and shading corresponding to each of the 11 categories above to indicate to what level of depth the resource addresses the category topic. In addition, the Tool Box includes links to and descriptions of other EV readiness plans and a list of EV readiness strategies accompanied by examples of where the strategies have been implemented.

Based on stakeholder feedback, CCTA selected the top resource in each category so users could quickly refer to the best guidance available. CCTA selected the resources most pertinent for jurisdictions within the county, those that were developed relatively recently, and those that provide straightforward and comprehensive guidance.

The top resources are shown below and are also available online at https://www.ccta.net/.

Table 15. Top Resources from Best Practices Tool Box

Category	Recommended Reading	What's Included
Site Selection/Analysis	NYSERDA Best Practice Guides for Charging Stations	NYSERDA provides three guides detailing best practices for site selection focused on (1) factors for good EV charging locations, (2) key siting and design issues, and (3) EV parking spaces.
Incentives/ Rebates	PG&E Electric Vehicle Incentives	This resource lets users input information and display personalized results for incentives they are eligible for, including at the utility, federal, state, and local levels.
EV Cost Forecasting or Analysis (Financial and/or Environmental)	AFLEET Tool	The Alternative Fuel Life-Cycle Environmental and Economic Transportation (AFLEET) Tool compares petroleum use, greenhouse gas emissions, air pollutant emissions, and cost of ownership of light-duty and heavy-duty vehicles.
Funding	CARB Funding Wizard	The Funding Wizard is a searchable database of grants, rebates and incentives to help government agencies and other entities pay for sustainable projects, including for EVs and EV charging stations.
Financing (EVs)	Fleets for the Future Guide to Financing Alternative Fuel Vehicle Procurement	This document lays out the common strategies available for public and private fleets attempting to finance an investment in alternative fuel vehicles
Financing (EVSE)	EV Charging Financial Analysis Tool	This tool uses the discounted cash flow (DCF) analysis method to determine the expected financial returns for EV charging infrastructure investments over the expected lifetime of the charging equipment based on inputs provided by the user.

Category	Recommended Reading	What's Included
Charging Infrastructure	Zero emission Vehicles in California: COMMUNITY READINESS GUIDEBOOK	This guidebook provides information on identifying EV charging infrastructure needs in communities.
Outreach/ Education	Literature Review of Electric Vehicle Customer Awareness and Outreach Activities	This document reviews the literature on consumer awareness and describes exemplary outreach campaigns and strategies from the leading EV markets in the US and around the world. It concludes with a set of principles that EV outreach programs should apply. In addition to reviewing this literature review and the case studies it references, consumer outreach efforts of entities that are active in EV education locally (e.g. PG&E, MCE, BAAQMD) should be reviewed to understand how municipal outreach can complement existing efforts. Additionally, numerous organizations have substantial experience in EV promotion and should be monitored as they disseminate lessons from their ongoing outreach (e.g. Veloz, Plug-in America, Forth, Clean Cities Coalitions, Electric Drive Transportation Association, MidwestEVOLVE, Sierra Club, Center for Sustainable Energy).
Regulatory/ Permitting	Electric Vehicle Charging Station Permitting Guidebook	This guidebook focuses primarily on the permitting process, detailing obstacles and emerging challenges and spotlighting best practices from jurisdictions and station developers across California.
Municipal Fleet Electrification	Fleets for the Future Procurement and Transition Planning Guides	Fleets for the Future has several alternative fuel vehicle resources for fleets on topics such as the benefits of deploying EVs, EV-specific considerations involved in the procurement process, strategies to finance an investment in alternative fuel vehicles, and planning a coordinated bulk procurement of alternative fuel vehicles.

Category	Recommended Reading	What's Included
Equity	Greenlining EV Equity Toolkit	This toolkit is intended for stakeholders interested in creating equitable EV policies and programs and provides tools, tips, and resources to make passenger EVs accessible to underserved communities.
Model Ordinances or Codes	AB 1236 Tool Kit: EV Charging Stations Ordinance	These resources provided by the California Building Officials are templates written for either City or County jurisdictions which must adopt an ordinance with an expedited, streamlined process for permits for electric vehicle charging stations.

Appendix C. PG&E Distribution System Capacity at Key Shared Mobility Hubs

Shared mobility hubs are prime locations to provide charging for EVs and support electrification of transportation services. Central to understanding the potential is identifying the capacity of the local distribution grid to absorb additional demand. The following tables provide key technical specifications that describe the grid capacity and charger equivalencies for the three main types of shared mobility hubs covered in this analysis. The images illustrate the layout of parking and grid infrastructure at specific sites. The colored lines in the images indicate existing distribution infrastructure, except for the yellow-gold lines, which are our additions that indicate parking lots (outlined by yellow rectangles), the most direct route for interconnection lines (lines connecting parking to local feeders).[87] We have included feeder ID numbers in yellow and have labeled existing charging facilities where possible.

Park & Rides

Table 16. Distribution System Capacity: Park & Rides

Site Name	Substation Name	Feeder ID	Feeder Nominal Voltage (kV)	Lowest Minimal Impact of Line Segments (kW)	Greatest Minimal Impact of Line Segments (kW)	L2 at 6.6kW - Worst (rolled up to location)	L2 at 6.6kW - Best (rolled up to location)
Alhambra	ALHAMBRA	14101105	12	90	3392	13	513
Bethaney Baptish Ch	ALHAMBRA	14101101	12	79	2021	11	306
Brentwood	BRENTWOOD	14592108	21	34	4012	22	1386
Brentwood	BRENTWOOD	14592106	21	117	5144		
Breuner	EL_CERRITO_G	12501109	12	0	0	0	0
Breuner	EL_CERRITO_G	12501113	12	0	0		
Concord	MEADOW_LANE	14302109	21	411	3601	80	1256
Concord	MEADOW_LANE	14302110	21	119	4698		
Concord Elk's Lodge	WILLOW_PASS	13911101	12	99	2161	15	327
Crockett	FAIRVIEW	13432207	21	51	6276	7	950
Danville	RESEARCH	14692101	21	348	3601	52	545
Discovery Bay	BRENTWOOD	14592105	21	23	5144	3	779
Good Shep.Lutheran C	CLAYTON	12022217	21	130	3601	19	545

[87] Feeders contain many line segments, each of which may have unique capacity limitations. The lowest Minimal Impact kW data characterizes the capacity available on the most constrained line segment on a particular feeder, while the greatest Minimal Impact kW data characterizes the capacity available on the least constrained line segment. Since the map does not show specific line segments, we always used the Minimal Impact kW to be conservative in our estimate of the available capacity, presenting the worst-case situation according to the 2015 data.

Site Name	Substation Name	Feeder ID	Feeder Nominal Voltage (kV)	Lowest Minimal Impact of Line Segments (kW)	Greatest Minimal Impact of Line Segments (kW)	L2 at 6.6kW - Worst (rolled up to location)	L2 at 6.6kW - Best (rolled up to location)
Hillcrest	CONTRA_COSTA	13652110	21	220	4698	33	711
Hilltop	SAN_PABLO	14371105	12	148	3025	22	458
Ignacio Val.Bap.Chrc	CLAYTON	12022215	21	135	5144	20	779
Lafayette Christian	ROSSMOOR	14161101	12	77	2325	17	919
Lafayette Christian	ROSSMOOR	14161104	12	45	3745		
Oak Park Assbly Of G	LAKEWOOD	13532225	21	61	2423	9	367
Orinda	MORAGA	13801101	12	206	1583	31	239
Pacheco	TIDEWATER	14652107	21	136	4012	20	607
Pittsburg	KIRKER	14452103	21	29	17427	4	2640
Raleys Supermarkets	CONTRA_COSTA	13652115	21	206	3429	31	519
Rudgear	LAKEWOOD	13532224	21	218	2971	33	450
Saint Mark's Meth Ch	MORAGA	13801102	12	0	2164	0	327
Shadelands	CLAYTON	12022216	21	183	4698	41	1230
Shadelands	LAKEWOOD	13532112	21	98	3429		
Valley Masonic Templ	CLAYTON	12022217	21	130	3601	19	545
Willow	FRANKLIN	13921101	12	103	4942	24	1641
Willow	FRANKLIN	13921104	12	62	5900		
					Total	526	18039
					Average	22	752

Figure 24. Breuner

Figure 25. Lafayette Christian

Figure 26. Brentwood

Figure 27. Shadelands

Figure 28. Concord

BART Stations

Table 17. Distribution System Capacity: BART Stations

Site Name	Substation Name	Feeder ID	Feeder Nominal Voltage (kV)	Lowest Minimal Impact of Line Segments (kW)	Greatest Minimal Impact of Line Segments (kW)	L2 at 6.6kW - Worst (rolled up to location)	L2 at 6.6kW - Best (rolled up to location)	DCFC at 150kW - Worst (rolled up to location)	DCFC at 150kW - Best (rolled up to location)
BART - Antioch Station	CONTRA_COSTA	13652203	21	0	4012	0	607	0	26
BART - Concord	TIDEWATER	14652109	21	111	4698	256	1300	10	56
BART - Concord	MEADOW_LANE	14302102	21	1587	3893				
BART - El Cerrito del Norte	RICHMOND_R	13471128	12	59	3025	8	800	0	35
BART - El Cerrito del Norte	EL_CERRITO_G	12501112	12	0	2263				
BART - El Cerrito Plaza	EL_CERRITO_G	12501108	12	0	0	0	395	0	17
BART - El Cerrito Plaza	EL_CERRITO_G	12501113	12	0	2613				
BART - Lafayette	SOBRANTE	14671101	12	124	2407	29	791	0	34
BART - Lafayette	SOBRANTE 1102	14671102	12	74	2819				
BART - North Concord/Martinez	TIDEWATER	14652104	21	28	4012	4	607	0	26
BART - Orinda	MORAGA	13801102	12	0	2164	0	837	0	36
BART - Orinda	MORAGA	13801101	12	0	3367				
BART - Pittsburg Center	KIRKER	14452103	21	0	17559	0	2660	0	117
BART - Pittsburg/Bay Point	WILLOW_PASS	13912107	21	106	4012	16	607	0	26
BART - Pleasant Hill	LAKEWOOD	13532225	21	61	2423	39	1067	1	46
BART - Pleasant Hill	LAKEWOOD	13532107	21	200	4623				
BART - Richmond	RICHMOND_R	13471130	12	116	2263	18	684	0	30
BART - Richmond	RICHMOND_R	13471119	12	11	2263				
BART - Walnut Creek	LAKEWOOD	13532226	21	27	4698	4	1490	0	65
BART - Walnut Creek	LAKEWOOD	13532108	21	0	5144				
					Total	374	11845	11	514
					Average	31	962	1	42

Figure 29. Lafayette BART

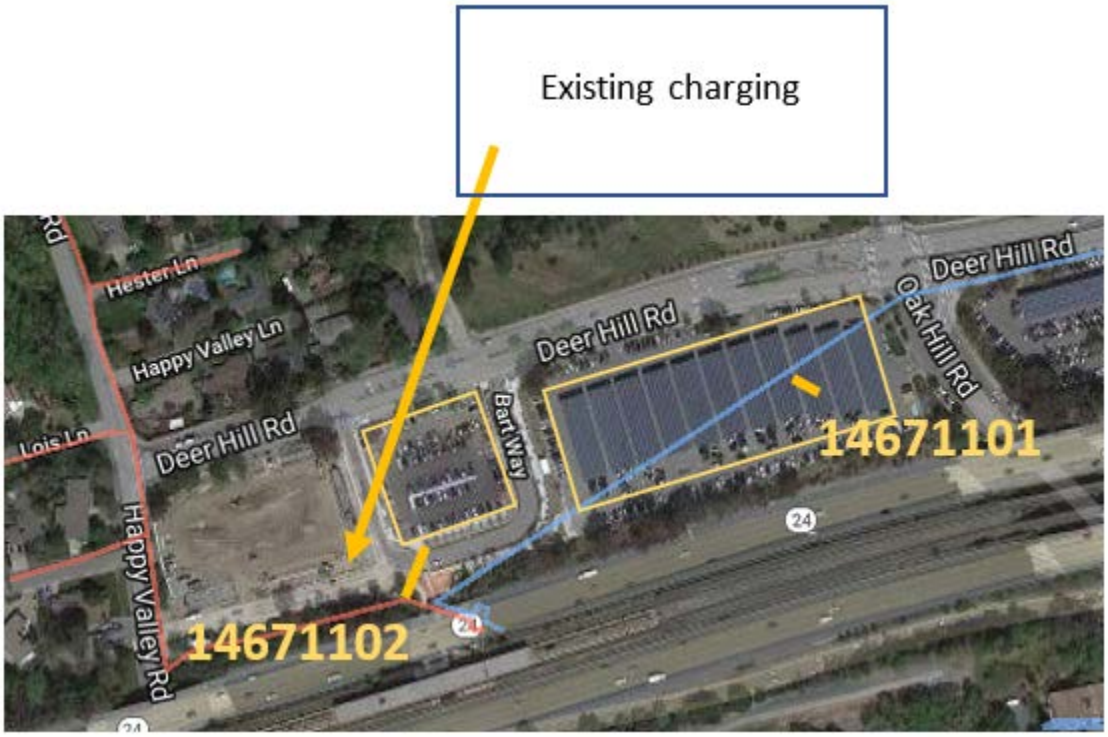


Figure 30. North Concord/Martinez

Figure 31. Orinda BART

Figure 32. Pittsburg Center BART

Figure 33. Pittsburg/Bay Point BART

Figure 34. Richmond BART

Figure 35. El Cerrito Plaza BART

Figure 36. Walnut Creek BART

Figure 37. El Cerrito Del Norte BART

Figure 38. Concord BART

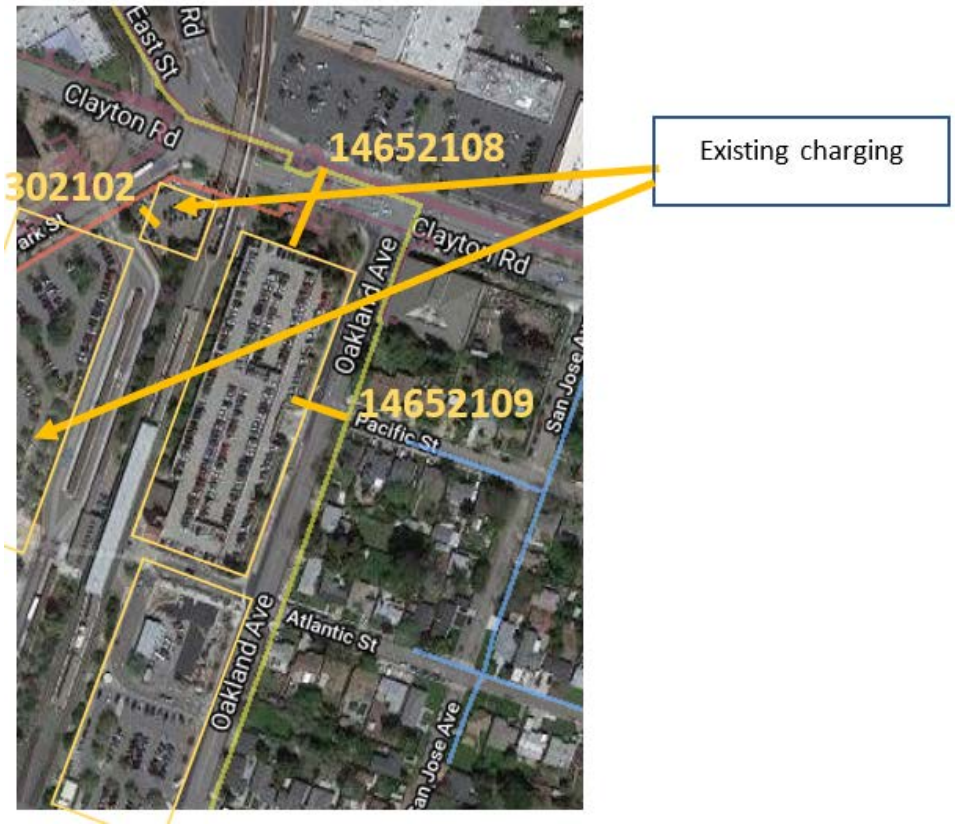
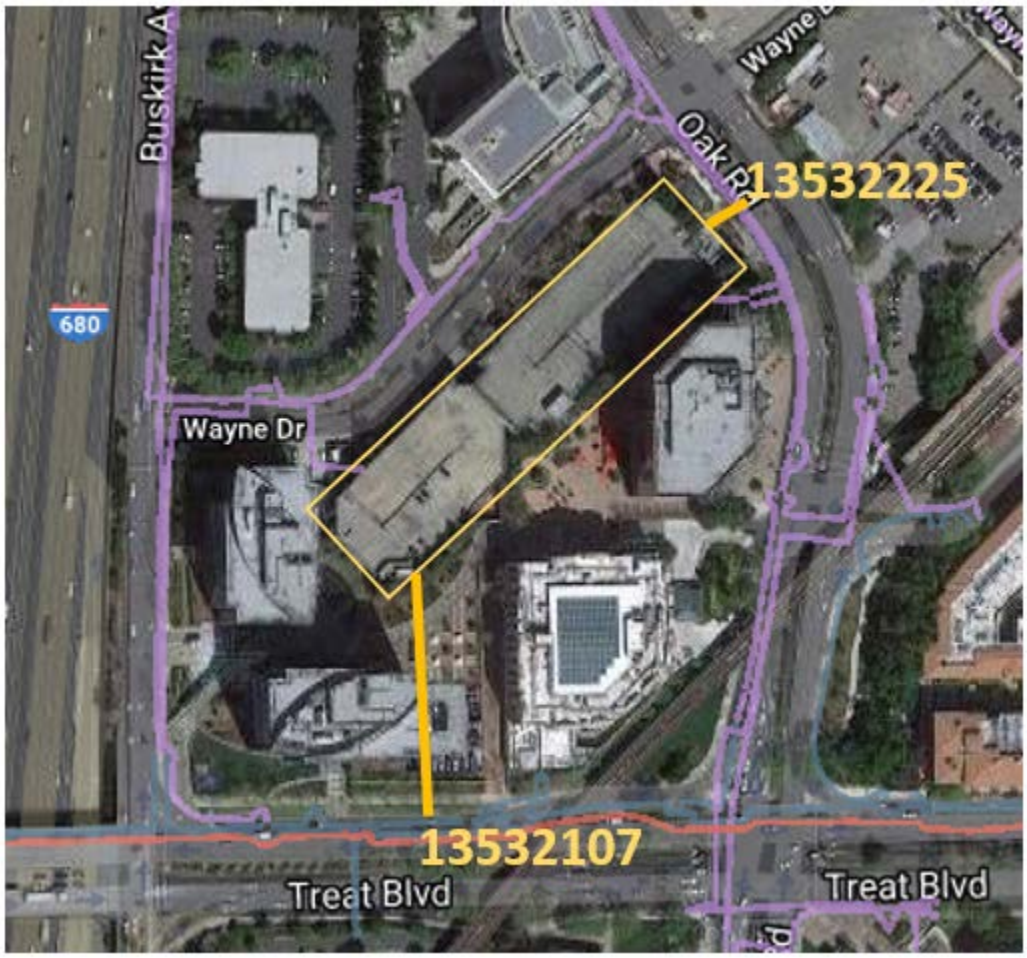


Figure 39. Pleasant Hill BART



Transit Centers

Table 18. Distribution System Capacity: Transit Centers

Site Name	Substation Name	Feeder ID	Feeder Nominal Voltage (kV)	Lowest Minimal Impact of Line Segments (kW)	Greatest Minimal Impact of Line Segments (kW)	L2 at 6.6kW - Worst (rolled up to location)	L2 at 6.6kW - Best (rolled up to location)	DCFC at 150kW - Worst (rolled up to location)	DCFC 150kW - Best (rolled up to location)
Pacheco Transit Center	TIDEWATER	14652107	21	136	4012	20	607	0	26
San Ramon Transit Center	SAN_RAMON	14232116	21	328	3601	88	1256	3	55
San Ramon Transit Center	SAN_RAMON	14232105	21	261	4698				
DVC Transit Center	TIDEWATER	14652110	21	127	4012	19	607	0	26
Richmond Parkway Transit Center	SAN PABLO	14371106	12	3	3025	0	458	0	20
Hercules Transit Center	FRANKLIN	13921103	12	0	3292	15	1764	0	75
Hercules Transit Center	FRANKLIN	13921101	12	103	4942				
Hercules Transit Center	FRANKLIN	13921102	12	0	3422				
					Total	142	4692	3	202

Figure 40. DVC Transit Center

Figure 41. Pacheco Transit Center

Figure 42. Richmond Transit Center

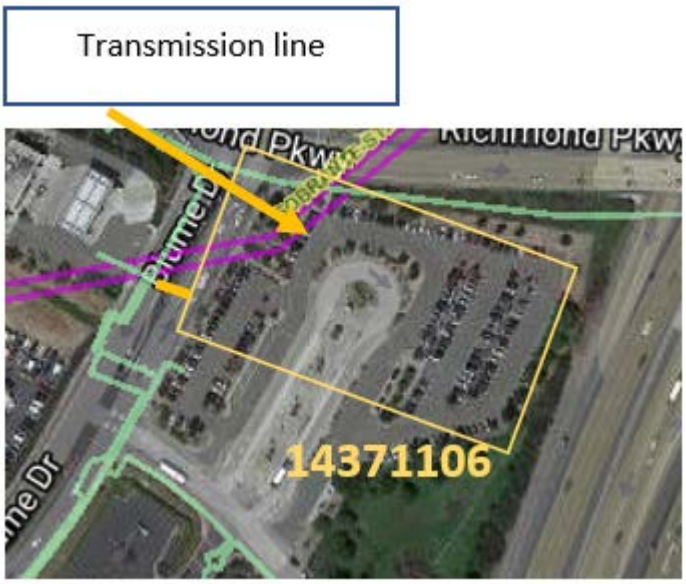


Figure 43. San Ramon Transit Center

Figure 44. Hercules Transit Center