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Accelerating beyond early adopters to achieve equitable and widespread electric vehicle use in the San Francisco Bay Area

Rebecca Fisher[1], Karen Schkolnick, Tin Le, Mark Tang, Karissa White, Deanna Yee, Ranyee Chiang

[1]1Bay Area Air Quality Management District, San Francisco, California, U.S.A., rfisher@baaqmd.gov

Summary

The San Francisco Bay Area (Bay Area) leads the United States and California in the rate of electric vehicle (EV) adoption. However, currently EVs represent 3% of vehicles and are concentrated in specific parts of the region. Widespread EV adoption requires that all Bay Area residents participate regardless of income, ethnicity, or geographical area. Equitable access to EVs will also ensure that all Bay Area residents benefit from lower fuel and maintenance costs as well as the improved driving experience. This paper shares case studies about government programs for clean transportation focused on achieving equitable access to EVs.

Keywords: BEV (battery electric vehicle), communication, EV (electric vehicle), incentive, electric vehicle (EV), government.

1 Background

1.1 San Francisco Bay Area Region

The Bay Area is home to more than 7.6 million people, making it the second-largest metropolitan area in California, and the fifth-largest in the United States. The region includes a diverse range of multicultural communities, spanning urban, suburban, and rural areas. The income inequality and high housing prices in the region are well-documented and provide the backdrop for transportation challenges in the region [1, 2]. Addressing the needs of diverse socio-economic communities are critical to sustainable transportation and reducing congestion.

1.2 Electric Vehicles in the Bay Area

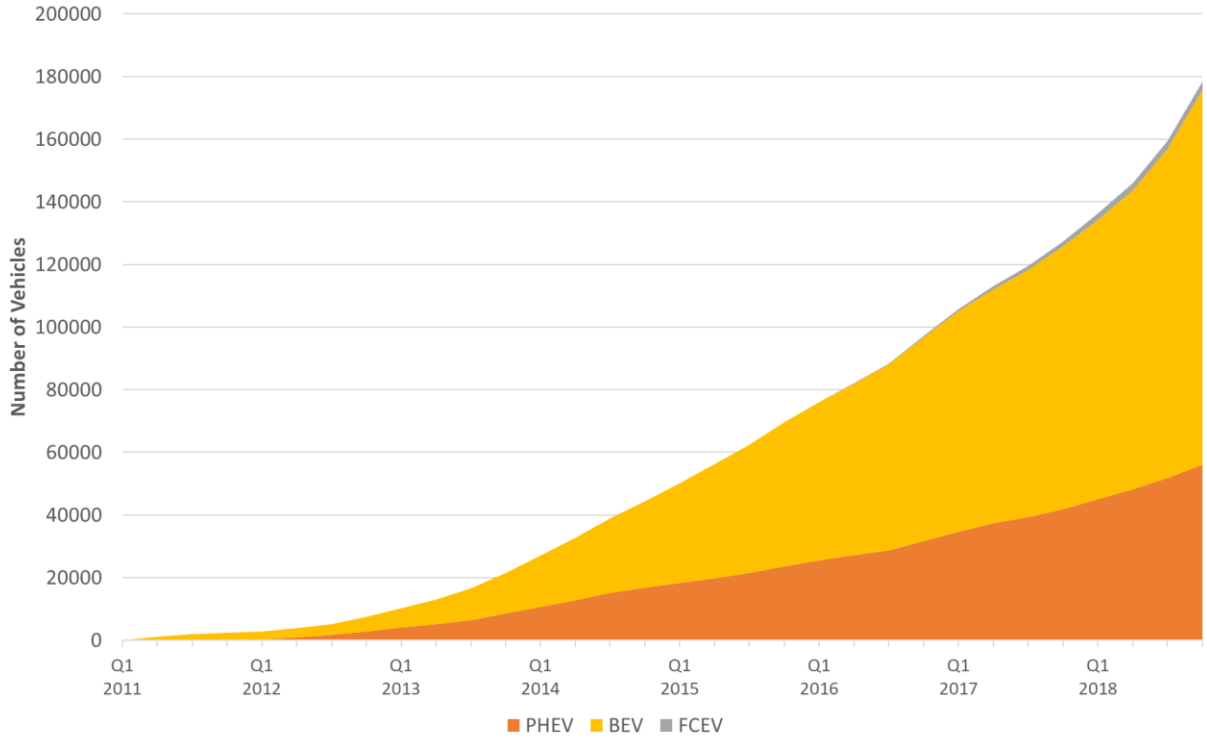
The nine-county Bay Area is home to approximately 7.6 million people [3] and 5.3 million light duty vehicles [4], with an additional 600,000 vehicles passing daily through the region from adjacent areas [5]. Three-quarters of Bay Area residents drive to work (64% drive alone and 10% carpool) and 12% take transit to work [6]. Tailpipe emissions from these light duty vehicles account for approximately 28% of greenhouse gas (GHG) emissions (CO2e) and a significant portion of other pollutants (31% of carbon monoxide and 12% of nitrogen oxide) in the Bay Area.

In addition to alternative transit modes that include walking, biking, mass transit, and shared transportation, wide-scale adoption of electric vehicles (EVs) and electrification of all types of transportation are essential to achieving local, State, and Federal emission reduction targets for greenhouse gases and criteria pollutants. California has set a goal of 5 million EV's sold by 2030, and the Bay Area has set a target of 90% of vehicles in the Bay Area being zero emissions by 2050. The Bay Area and California also share the goal to cut greenhouse gas emissions to 80% below 1990 levels by 2050. Rapid growth in the EV market will be a significant part of achieving these goals.

With the first introduction of commercially available light-duty EVs in 2010, Air District began programs to monitor the EV market and increase EV adoption in the Bay Area. The Air District's efforts have included development and implementation of region-wide EV plans, outreach and awareness activities, and direct financial incentives. This report includes an update of the EV ecosystem, ongoing Air District programs, and future areas of focus to further accelerate EV adoption.

Using a conservative estimate from data from the California's Clean Vehicle Rebate Program, at the end of 2018, the Bay Area had more than 180,000 EVs, representing 3% of the region's fleet. The Bay Area has generally had about 50% of EVs in California and one quarter of the EVs in the US. The Bay Area market saw a massive increase in EV sales, growing 68% from 2017 to 2018. (Figure 1) [7].

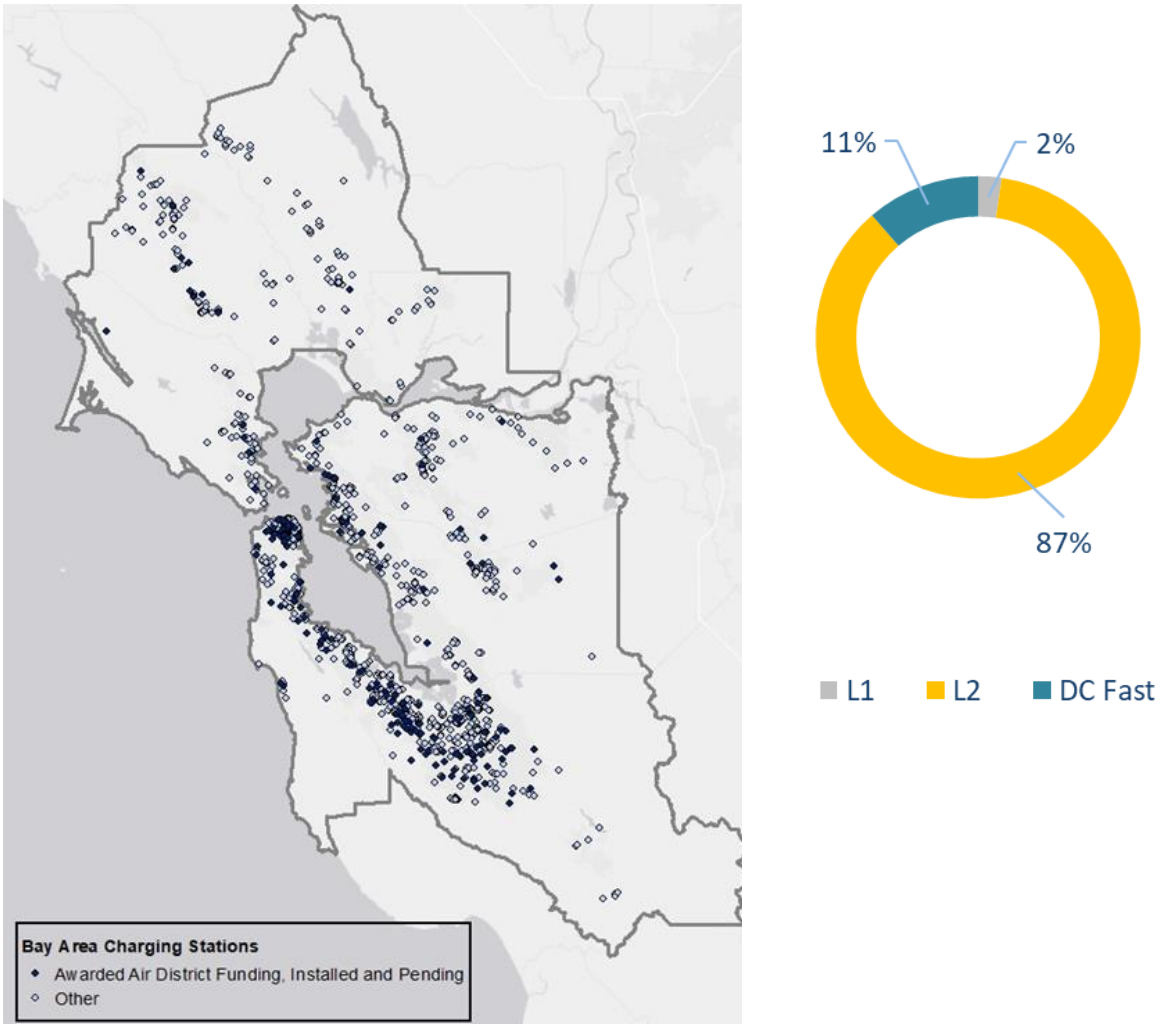
Figure 1: EVs (PHEV, BEV, and FCEV) in the Bay Area



Source: Clean Vehicle Rebate Program (January 2019)

There are currently 1,600+ charging locations with 7,500+ publicly available ports in the Bay Area (Figure 2 map). Of those publicly available ports, the vast majority are L2 charging ports (87%), which provides about 70 miles per hour of charging. A smaller portion (11%) are DC Fast charging ports, which provide 240 miles of range per hour (Figure 2 pie chart).

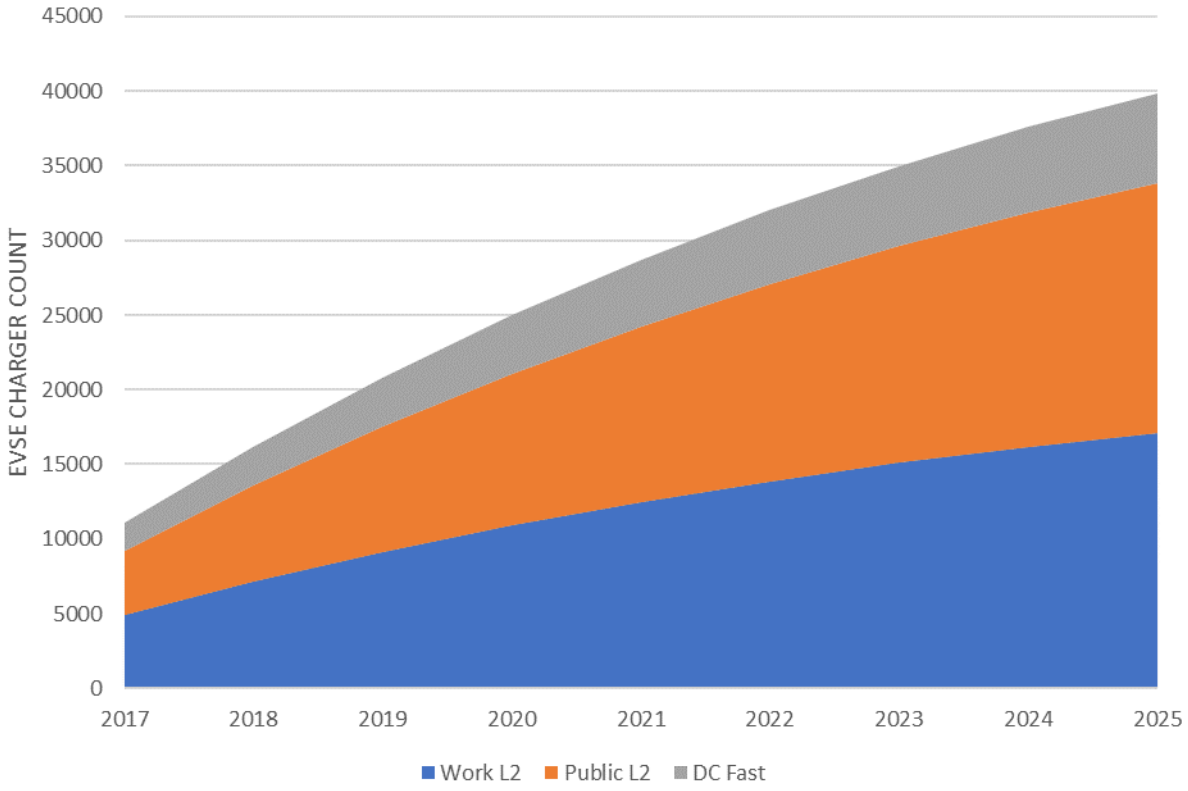
Figure 2: Publicly Accessible EV Charging Stations and Charging Ports by Type in the Bay Area



Source: Alternative Fuels Data Center and Charge! Program (BAAQMD)

Additional charging stations will be needed to accommodate future growth in the EV market, especially to achieve the ambitious Bay Area goals and to accommodate a wider range of Bay Area residents. There have also been anecdotal reports that current charging stations are often full, which indicates that additional charging station capacity is needed even for the current number of EV drivers. The National Renewable Energy Laboratory (NREL) and California Energy Commission (CEC) developed a computer simulation tool, Electric Vehicle Infrastructure Projection (EVI-Pro), which uses the results of a state-wide transportation habits survey to quantify the charging infrastructure needed to ensure that future EV drivers can meet their transportation needs. This analysis accounts for projections for vehicle and charger technologies, user demographics and market adoption conditions, the shared-use of chargers, and travel and charging preferences [8]. Over 20,000 public charging ports are estimated to be needed in 2019 (9100 workplace L2, 8400 public L2, and 3300 DC Fast) (Figure 3). To stay on track with our goals, by 2025, the Bay Area is estimated to need about 40,000 public charging ports (17,000 workplace L2, 17,000 public L2, and 6000 DC Fast).

Figure 3: Projected Need for PHEV and BEV Charging Infrastructure in the Bay Area



Source: National Renewable Energy Laboratory, CEC EV Infrastructure Projection Tool (EVI-Pro)

Widespread charging infrastructure will be key to overcoming current and future barriers to electric vehicle adoption. An individual or household's need for public charging infrastructure is related to home type, with drivers in single-family homes being much more likely to have home charging than those in apartments or multi-unit dwellings. Electric vehicle owners so far tend to live in single-family homes [9]. To extend the EV market beyond those living in single-family homes, we will have to expand charging available at multi-unit dwellings and public charging infrastructure. In the Bay Area, over one-third (36%) of housing units are in multi-unit dwellings [10]. Installing charging infrastructure has been more challenging for multi-family housing, requiring away-from-home charging options for a significant portion of the Bay Area population. The need for drivers to take longer-distance trips and with a wide range of transportation patterns also requires public charging.

2 Public Incentives to Expand from Early Adopters to Early Majority

Since 2010, the Air District's Board of Directors has awarded over $19 million through incentive programs to target the identified barriers to EV adoption. Many of these incentives have leveraged additional investments from other organizations such as PG&E's Charge Network, Marin Clean Energy's MCEv Charging Program, California's Clean Vehicle Rebate Program, and the federal EV tax credit. Air District staff continue to identify other opportunities to leverage other incentive programs to reduce the costs for Bay Area residents, businesses, and local government. To date, the Air District has awarded projects that support the installation of more than: 1,500 passenger electric vehicles, 4,400 publicly available Level 2 and DC Fast chargers (as shown in Figure 2 above), and over 1,400 residential chargers.

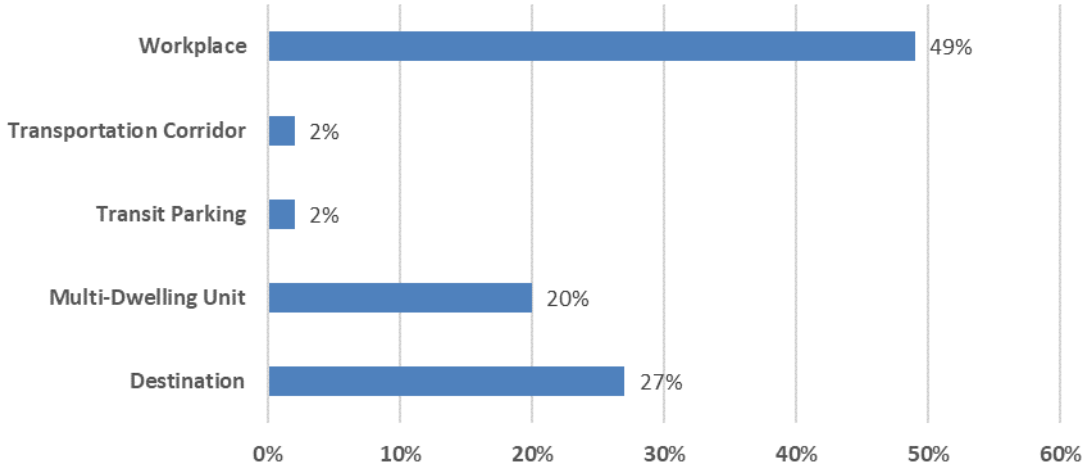
Since 2016, the Air District has administered the Charge! Program, which provides funding for the purchase and installation of publicly accessible charging stations in the Bay Area. This Program is open to organizations including government entities, non-profits, and businesses. The Charge! Program provides fixed award amounts per each charging unit installed. For example, a Level 2 charging station is eligible for

up to $3,000 in funding and a DC fast charging station is eligible for up to $18,000. Additional "plus-up" funding is available to promote ancillary benefits and reduce costs at project locations where there are higher barriers to implementation. These plus-up categories have included co-locating renewal energy generation such as wind or solar or installing charging at multi-unit dwellings.

The Clean Fleets Program opened in August 2018. This program provides funding to purchase or lease new zero-emission vehicles such as EVs (including electric motorcycles) and fuel cell vehicles. Similar to the Charge! Program, the Clean Fleets Program is open to government entities, non-profits, and businesses. Up to $2,500 is available in incentive funds per vehicle and up to $5,000 per motorcycle because emissions from conventional motorcycles are high.

Both the Charge! and Clean Fleets Programs are supported by funding from the Transportation Fund for Clean Air (TFCA), a $4 surcharge on California Department of Motor Vehicle registrations in the Bay Area. Since 2016, over $7.6 million has been awarded to Charge! Program projects to support the installation of over 2,900 publicly accessible charging stations in the Bay Area. Most chargers funded through the Charge! Program were installed or planned at workplace facilities, with other projects at transportation corridors, transit parking and multi-unit facilities (Figure 4). Future iterations of the Charge! Program may include additional incentives to increase EV charging station installations at underrepresented facility types or in impacted communities.

Figure 4: Awarded Charge! Projects by Facility Type from 2016-2018



Source: Bay Area Air Quality Management District (February 2019)

3 Equitable Access to Electric Vehicles

Effectively reducing emissions from light duty vehicle will require wide-scale EV adoption in which all Bay Area residents participate regardless of income, ethnicity, or geographical area. Equitable access to EVs ensures that all Bay Area residents can benefit from lower fuel and maintenance costs as well an improved driving experience. This is the goal of the Air District's new Clean Cars for All Program, which provides qualifying low-income residents up to $11,500 for scrapping and older vehicle and switching to a clean transportation option. Participants will have the option to purchase or lease new and used hybrid vehicles, PHEVs, BEVs, or receive a transportation card for transit and car-sharing. The incentive funding is based on participants' income level and which clean transportation or vehicle option they select. This program is currently in a soft launch to test the program's systems and processes and will fully launch in Spring 2019. The incentive program will include stakeholder engagement and outreach to impacted communities, case managers to support participants through the application process, and partnerships with dealers, vehicle scrappers, and community organizations around the Bay Area.

Providing opportunities for the public to interact with EVs can improve their perception of accessibility and availability and encourage them to consider an EV for their next vehicle purchase or lease. The Air District has offered incentives for vehicle fleets such as municipal jurisdictions, taxi companies. transportation

network companies (TNC), and car sharing businesses and will be increasing outreach for these programs. These programs result in emissions reductions benefits by transitioning those fleets to cleaner vehicles while also increasing the number of EVs that the public may encounter in their daily lives, increasing public awareness of EVs and associated benefits.

4 EV Outreach and Education

Based on recent studies and surveys, as well as anecdotes from our partners, the Air District staff has identified three concerns that significantly influence consumer sentiment (or lack of knowledge) related to EVs: cost, range anxiety, and availability of vehicles and infrastructure.

The upfront cost (MSRP) for most EVs is higher than similar conventional vehicles, and only slightly competitive when incentives and total cost of ownership is considered. The higher upfront cost of EVs turns off many cost-sensitive consumers who may have originally considered an EV.

For consumers who are not EV drivers, range anxiety is one of the most common concerns, particularly for consumers living in buildings without charging options. Consumers often overestimate the range they need in a vehicle and are therefore understandably cautious when considering fully electric models. Increases in battery range and the number of charging stations will help address range anxiety, but to truly shift consumer sentiment, more EV education, understanding actual transportation needs, and charging station signage are needed.

The previous concerns are seen among people who are aware of the availability of EVs and changing infrastructure. A recent study of Californian consumers found that despite a near doubling in the number of EV models in California between 2014 and 2017, fewer survey respondents were able to name an EV for sale in 2017 than in 2014 [11]. The study concluded that Californians are not actively avoiding EVs, they are simply unaware of EVs, which speaks to the importance of increased EV marketing and outreach.

The Air District is aware that cost, range, and awareness are not the only considerations for consumers and businesses. To better understand the underlying sentiments that form barriers to EV adoption, and identify the best solutions to addressing those barriers, the Air District is starting work to develop a survey of consumers and businesses in the Bay Area. Currently, Air District staff have collected anecdotal information on barriers to EV adoption and charging infrastructure, and this effort will help us collect statistically significant data sets across a diversity of EV market actors (e.g. low-income consumers, property owners, ride-hailing drivers, dealerships, fleet managers, etc.).

This work will help us update incentive programs to better address the economic and phycological barriers to EV adoption and infrastructure expansion. The Air District will also use the survey and focus group data to develop new, tailored outreach programs and materials. Informed by the statistically significant survey sample, these outreach and education materials will help the Air District target geographic and socioeconomic regions of our jurisdiction where EV adoption is particularly low. The survey and research will also help inform the Air Districts current and future funding programs to ensure they are addressing appropriate barriers and economic levers within sectors of the EV market.

Lessons Learned

The Air District's investments and efforts have, and will continue to, play a significant role in catalyzing the Bay Area's shift towards zero emission transportation. In recent years, other organizations have also expanded programs to support the EV market. To meet the region's aggressive EV adoption goals, these regulatory, incentive, and outreach programs are all important and these efforts need to be coordinated to have maximum impact on driving EV adoption. For example, the EV Coordinating Council will be the opportunity to leverage funding while also ensuring that incentives and awareness programs are impacting as many communities as possible. Another coordination challenge will be on how regulations and incentives can be appropriately timed and coordinated. The Air District and MTC are working to update the purpose of the EV Coordinating Council to better tap into its coordinating power. At the first meeting of 2019, four new sub-working groups were established to tackle specific problem statements. Each group defined the problem, developed resources needed to "move the needle" in addressing the challenge, and came up with a list of

action-oriented solutions for further consideration later in the year. This effort will feed into the Bay Area EV Acceleration Plan, mentioned earlier in this document.

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Authors

Karen M. Schkolnick is the Director of the Strategic Incentives Division at the Bay Area Air Quality Management District, overseeing teams that annually administer $100 million in incentive program funding for projects that improve air quality. Since 2008, she has managed programs that support the accelerated adoption of zero-emission vehicles and equipment and previously served as co-chair for the California PEV Collaborative's working group (2012-2016). Ms. Schkolnick holds a BA in Environmental Studies from Oberlin College and is a registered environmental health specialist in California.

Ranyee Chiang is the Technology Implementation Officer at the Bay Area Air Quality Management District, overseeing programs to accelerate the adoption of climate technologies for the industrial and transportation sectors. Prior to joining the Air District, Ranyee Chiang led programs at the U.S. Department of Energy and United Nations Foundation, to evaluate, improve, and increase access to clean energy technologies in the United States and in developing countries. Ranyee earned her Ph.D. in Biological and Medical Informatics from the University of California, San Francisco and holds an Bachelor's degree in Computational Biology from Brown University.

Rebecca Fisher is a Staff Specialist for electric vehicle partnerships and outreach. She previously served as an Environmental Economist at the U.S. Treasury Department, where she managed an international sustainable development trust fund and negotiated financial components of international climate agreements. She holds a Bachelor of Arts in Environmental Science from Brandeis University and a Master of Environmental Economics from Duke University.

Tin Le is a Staff Specialist, leading the Clean Cars For All incentive program for clean transportation for low-income consumers. He started his career at the Air District worked on many of the incentive programs in the Strategic Incentives Division. He also has over five years of experience managing federal technology grants in the private sector. He holds a bachelor's degree in Sociology - Organizational Studies and a minor in Community and Regional Development from UC Davis.

Mark Tang is a Staff Specialist, leading the Charge! And Clean Fleets grant programs for electric vehicles and EV infrastructure. He has worked in the air quality industry for over 15 years in various roles including stationary source permitting, enforcement and implementing mobile source incentive programs. He sits on the Citizens' Advisory Committees in the City and County of San Francisco advocating for affordable housing and clean energy access. Mark has a Bachelor of Arts in Environmental Studies from California State University, Sacramento and a Master of Liberal Arts in Sustainability & Environmental Management from Harvard University.

Karissa White is an Assistant Staff Specialist focused on electric vehicle outreach and data analysis. Karissa previously worked in the Climate and Clean Energy and Healthy People & Thriving Communities programs at the Natural Resource Defense Council (NRDC) on transportation projects including congestion pricing policy and clean vehicle advocacy. Karissa holds a Bachelor's degree in Environmental Studies from the University of San Diego.

Deanna Yee is an Air Quality Technician working on electric vehicle incentives programs. Prior to joining the Technology Implementation Office, Deanna worked at Sutter Health, coordinating community outreach programs designed to promote health equity in underserved communities in the East Bay. Deanna has widespread experience in administrative support, project management, stakeholder engagement, and event planning and coordination. She holds a Bachelor's degree in Public Health from UC Berkeley.