Tackling Air Pollution and Climate Change Through

EV Workforce Solutions

Final Report

CE 105, UC Berkeley
Sumayia Hakim, Hsong-Chi Leong, Staten Maughan
May 10, 2022

Team mission statement

"We aim to identify equitable workforce pathways in electric vehicle maintenance and repair to welcome the anticipated implementation of electric vehicle projects in the Stockton community."

Table of Contents

Introduction

Between the heavily trafficked freeways, the Port of Stockton, and the freight locomotives surrounding Stockton, its AB 617 community experiences heavy health impacts as a result of the pollution. According to the CalEnviroScreen (CES) tool, the 16 square-mile AB 617 boundary area populated with 132,000 people ranks in the top 5% of most disadvantaged communities in California. Of all of the counties in the Northern Region, San Joaquin County holds the highest overall CES score which is represented by the following factors: asthma, cardiovascular disease, low birth weight, educational attainment, housing burdened low-income households, linguistic isolation, poverty, and unemployment (Valley Air District n.d.). AB 617, as mentioned previously in relation to the community, is a California Assembly Bill signed into law in 2017 which focuses on the air pollution impacts in disadvantaged communities. AB 617 provides mechanisms and resources to implement air quality monitoring networks on a local level. Its main goals are to develop, implement, and track emission reduction programs; to improve availability of data and other technical information; and to invest substantial funding in the community through voluntary incentive funding measures (Stockton CERP n.d.). More recently in March 2021, Stockton's Community Steering Committee (CSC) unanimously approved the Community Emissions Reduction Program or CERP which provides a technical analysis of pollution sources and sensitive receptors, strategies for reducing pollution impacts, and outlines an implementation schedule and metrics to monitor the reduction in emissions.

This CERP anticipates investing over $32 million in emission reduction incentives, and a variety of other clean air projects in the Stockton AB 617 community. Stockton's CERP includes several measures that feature electric vehicles, including a car share program, incentive funding for installation of public/commercial charging infrastructure, and electric vehicle mechanics training. All of these – the latter most directly – will have implications for Stockton's local and regional workforce. As Stockton approaches implementation for these and future electric vehicle projects, it would be helpful to understand the job trends and potential workforce pathways for installation of charging infrastructure and maintenance of vehicles. To support the community's plan to implement the electric vehicle related measures, the infrastructure must be upgraded with the backing of a workforce that is trained and educated on EVs and related systems. Currently, the only available electric vehicle mechanic training program located is a two-year certificate offered at Delta College. Although the program has seen some success, growth and expansion to other community colleges and trade schools will be required to meet the needs for future growth in Stockton's EV sector. In terms of physical infrastructure, there are few EV charging stations within Stockton and even fewer in the AB 617 community. With the measures to implement more electric vehicle usage, the

Stockton community must scale both the charging infrastructure and the workforce by promoting education and training programs. Focusing on the development of equitable access to workforce pathways in the electric vehicle sector will provide a glimpse into the long-term plan for the EV programs included in the CERP. This improved understanding may help the community to make more strategic decisions in investment, partnerships, advocacy, and economic/workforce development, relative to electric vehicles.

Our Vision for 2025 and Beyond

Establishing an holistic implementation of EVs and their infrastructure is important for Stockton's goals to enhance the EV workforce. By 2030, the city of Stockton should have a clear workforce strategy, air pollution mitigation targets, as well as a stronger EV infrastructure integration plan.

The preferred state for the EV workforce strategy is to target community colleges, such as Delta College, and introduce associate degrees for ZEV mechanics and other target jobs. It is also important to design an EV curriculum that has a variety of classes offered for ZEV maintenance for all levels of education. There also should exist apprenticeship and internship programs to accommodate disadvantaged communities that can create pathways to obtain EV technician jobs within various dealerships. By 2030, Stockton should aim to have greater wages for professions within the EV field, over the 60,000 median wage in California (City of Sacramento n.d.).

Once the workforce is established, it is important to expand the EV infrastructure, allowing chargers to be readily available. This comprehensive system of EV charging stations should be integrated into Stockton's transit system, such as buses and Amtrak. This bus network will rely on fully electric vehicles and a system of BRT lanes that have increased ridership by 100%. EV charging stations will be located at major bus stops to encourage less passenger vehicle travel within the city. Additionally, the addition of BRT lanes will coincide with the dieting of major roads within the AB 617 area. This dieting process will have helped to reduce the total VMT within the AB 617 area by 100% as well as adding a safe and effective bike lane system.These bike lanes will provide access to all schools, major medical centers, grocery stores, and several nature trails allowing a new community of cyclists who are very safe and wear their helmets all the time. Carsharing programs will also be prioritized, as the city's VMT will show an overall decrease. By 2030, Stockton will reach an electric vehicle share of 10% of the city's population.

We also envision the widespread use of the EV Knowledge Center for communities looking to implement EVs, communities looking to grow EV usage and infrastructure, and communities with a strong EV population and support. It is important to maintain and continually improve the knowledge base by sharing relevant and important information to the entire community.

Key Areas of Concern

Currently, the Stockton transportation sector suffers from several complicated issues which have contributed to high levels of air pollution, low levels of resident mobility, and a struggling labor force. The current issues of resident mobility and vehicle emissions have been attributed, in part, to the reliance on combustion engine personal vehicles. This has resulted in a large amount of vehicle miles traveled (VMT) within Stockton and high rate of pollution for each mile. To mitigate these issues the CERP has allocated large amounts of money towards electric vehicles (EV), including investments into EV car share and incentive programs for EV charger installations (Stockton CERP n.d.). Additionally, the U.S. Bureau of Labor statistics estimates that there will be an average of 69,000 job openings in automotive mechanics every year till 2030 (US BLS). With California employing the highest number of automotive mechanics in the country, Stockton will see a significant deficit in the mechanic industry in the next decade. As these EV investments begin implementation and in combination with the national trends, it is clear that the substantial void in the labor force to implement these projects has the potential to undermine the long-term success of EVs in Stockton.

With a growing number of electric vehicles on the road there is simultaneous growth in the demand for a zero emission vehicles (ZEV) ready workforce. This includes individuals skilled in EV maintenance, charging station installation, customer service skills related to ZEV, and individuals with a variety of STEM backgrounds. Currently 15% of the San Joaquin County workforce are employed in the “Green" sector and only 0.6% of these can be related to ZEVs (this only includes technically skilled jobs) (City Systems n.d.). Assuming Stockton electric vehicles sales would follow statewide forecasts, and not experience higher sales rates due to AB 617 investments, the EVs would be 41% of the new vehicle share and about 3.5% of all vehicles by 2030, the state forecast can be seen in **Figure 1** (City Systems n.d.; EVAdoption n.d.). This doesn’t include EVs related to car share programs, or the electric buses expected to be adopted by Stockton public schools. The current Stockton labor force is not prepared for this influx of electric vehicles, and these workforce shortcomings could limit this potential growth. Without the proper skilled workers, the large amounts of EV car shares and other EV programs enabled by AB 617 investments will have little to no chance of success. What is further concerning is the lack of local data surrounding both the electric vehicle infrastructure as well as the current mechanic workforce. Furthermore, what data is available is difficult for the general public to access and understand. Without datasets specific to the Stockton area it is difficult to forecast the future for EVs and mechanics as well as conduct responsible and effective planning. This report serves as a document to fill the information gaps and collect the existing data into a place that can be both useful to decision makers and allow the public to better understand the state of Stockon.

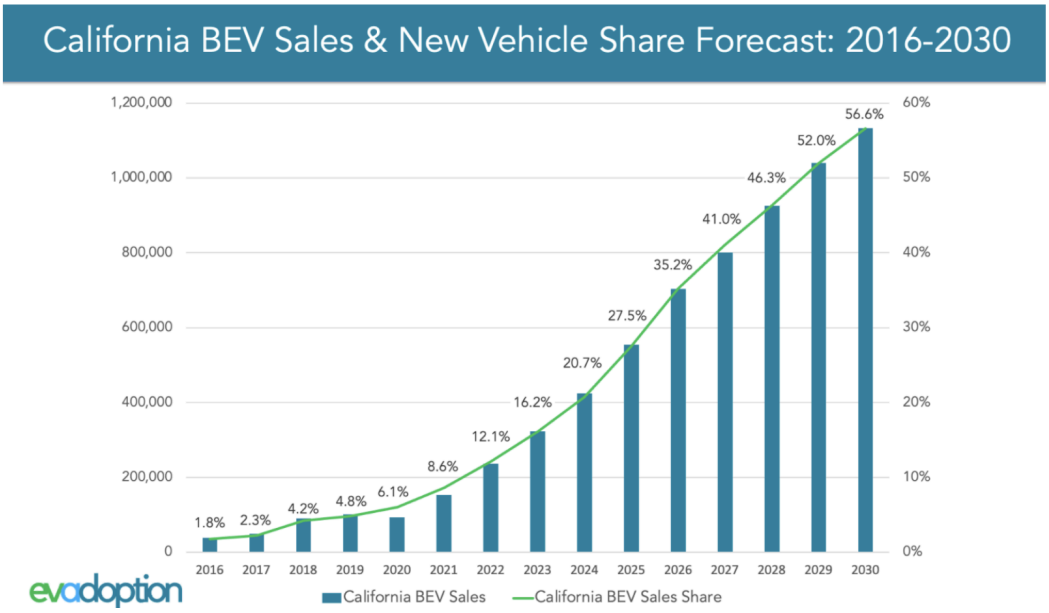

Figure 1: Projected California EV Vehicle Sales Share through 2030

Stockton has very few opportunities for individuals to be trained in the skills necessary for ZEV related jobs. Currently, Delta Community College is the only school out of the 5 colleges within Stockton offering a degree for EV mechanics (San Joaquin Delta College 2017). Additionally, none of the Stockton dealerships offer on-the job training programs or internship opportunities (Stockton Community Steering Committee n.d.). With ZEV related jobs being scarce in Stockton, the already small supply of technically trained graduates are likely to look outside of Stockton for work. This is an additional contributor to high levels of brain-drain experienced by Stockton. The jobs to employed residents ratio (J/ER) is currently 0.92, higher than the average for San Joaquin Valley which is only 0.72, but future forecasts expect this to decrease annually. The average for SJV is expected to increase 8% over the next 20 years, so Stocktons projected decrease is concerning **Figure 2** (City Systems n.d.). This J/ER ratio trend demonstrates a lack of quality jobs in Stockton and a problem of talent retention with many skilled residents looking to outside cities for work. This not only contributes to the ZEV workforce void but also the high levels of VMT within the city as many residents choose to utilize a personal vehicle for their long intercity commutes.This can be seen in **Figure 3,** which shows the distribution of distances traveled by Stockton residents for work (City Systems n.d.). There is a clear need for a better-defined educational pipeline to grow STEM skills throughout the academic experience and to increase the number of jobs in Stockton that retain these necessary workers. The growth of ZEV related jobs coinciding with increased accessibility to training programs for these jobs can hopefully kickstart the solutions to these problems.

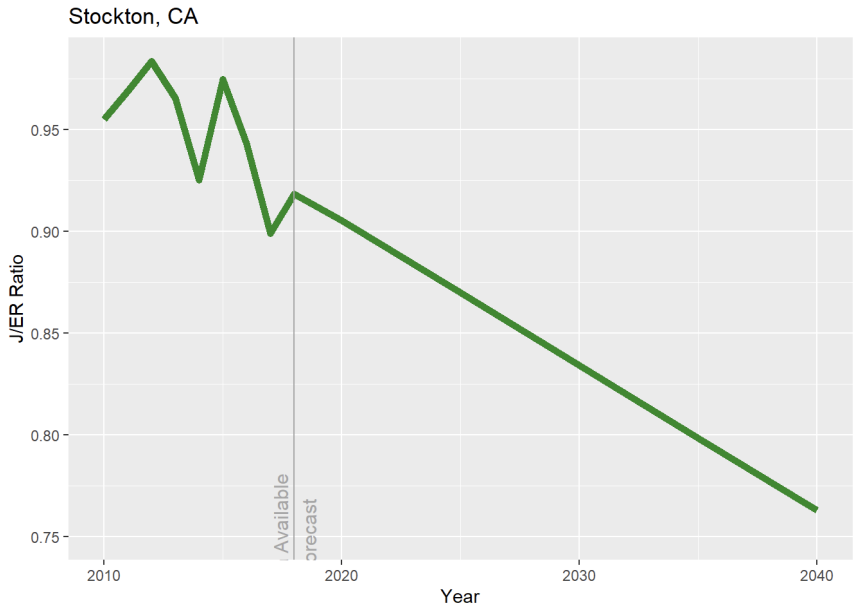

Figure 2: Forecasted Jobs to Employed Residents ratio through 2040

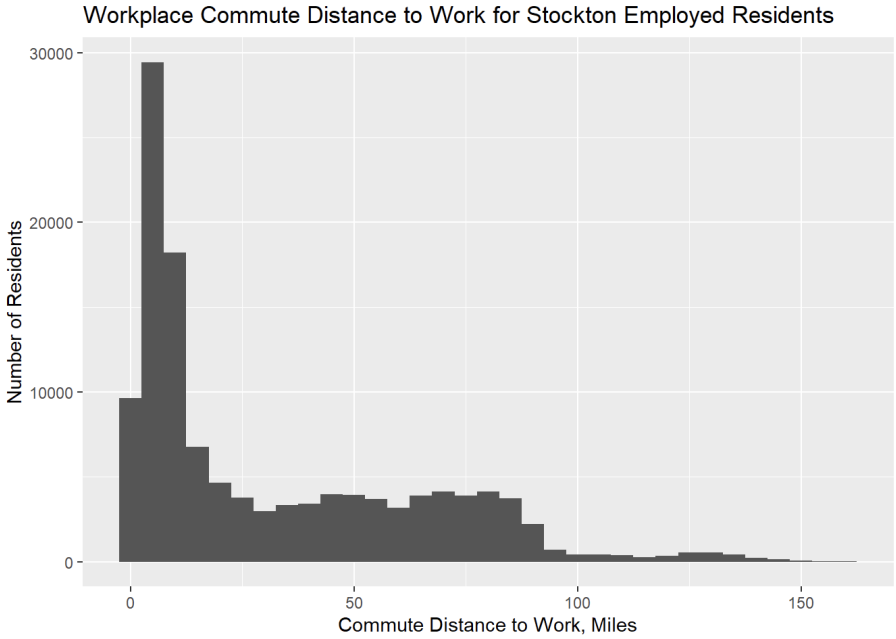

Figure 3: Workplace Commute Distance for Stokton Employed Residents

Systems map

Focusing specifically on electric vehicles as well as the related workforce and infrastructure, the AB 617 measures in Stockton's CERP have the potential to catalyze substantial growth of Stockton's EV sector. The EV measures within the emissions reduction plan both enable the community to build up the charging infrastructure, which leads to an increase in the number of electric vehicles the community is able to accommodate. This increase in EVs on the road would then lead to proportional growth in the EV workforce, including EV mechanics. Of the total share of vehicles in Stockton, the EV share of the total population would continue to increase and in turn, benefit the community's public health in the form of reducing emissions and improving air quality. The need for a larger supporting workforce would prompt nearby EV mechanic education and training programs to experience the same growth. If public health conditions suffer, there would be an opportunity to sway lawmakers to promote more legislation for EVs and then return to the top of the loop with infrastructure growth. This loop can be visualized below in **Figure 4**.

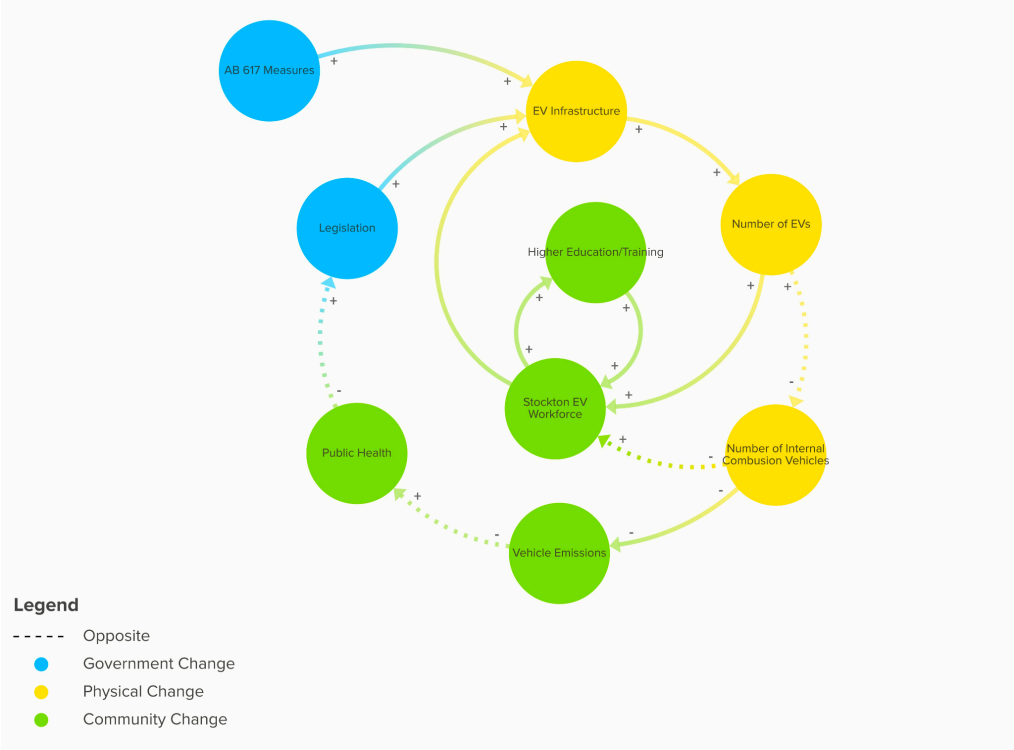

Figure 4: This system map highlights the effect that the implementation of EVs through AB 617 measures would have on Stockton's workforce as well as the community's health. (CE105 2022)
https://embed.kumu.io/bb4a2daef6b01cb90c28906489f45969

Data Visualization and Analysis

Currently, the AB 617 community suffers from major health impacts, mainly in relation to air quality. Using the CalEnviroScreen (CES) tool, the 16 square-mile area populated with 132,000 people ranks in the top 5% of most disadvantaged communities in California. Furthermore, of all of the counties in the Northern Region, San Joaquin County holds the highest overall CES score which is represented by the following factors: asthma rates, cardiovascular disease, low birth weight, educational attainment, housing burdened low-income households, linguistic isolation, poverty, and unemployment (Valley Air District n.d.). This shows a lack of advancement in increasing the quality of life for residents in the city. With the AB 617 as well as the CERP, $32 million is set to be invested to support the emissions reduction in the community. Some of the investment will be used for solidifying workforce pathways such as training and education programs for EV mechanics. However, it is unclear where the money is going and how much of the funds are being allocated. Presently, the only available training or education program is the 2-year certification program offered by Delta College. This emphasizes a lack of outreach of these programs to bodies of education such as high schools, and even 4 year universities. It is important to start mentioning that this is a career that many students can partake in if they wish.

There will also be funding allocated to growing the infrastructure in the form of EV chargers in the community. At the moment, there is certainly a lack of EV charging stations in Stockton; the city has 39 total charging stations with only 7 within the boundaries of the AB 617 community. **Figure 5** provides a map of these charging stations overlaid with the AB 617 boundaries and median household income.

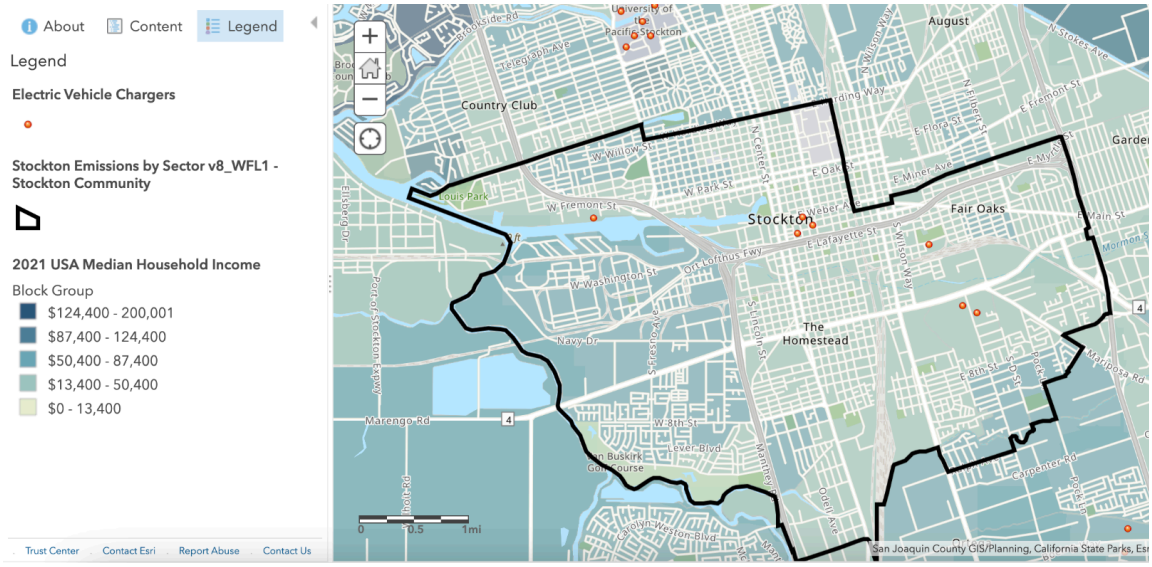

Figure 5: EV Charging Stations in Stockton

San Joaquin County has experienced a steady growth in the total population of electric vehicles and in the number of new ZEV sales and expects this growth trend to continue into the coming years. This growth can be visualized using data from the California Energy Commission to create **Figure 6 and 7**. As a result the infrastructure and workforce will need to scale proportionally. It is important for us to look at how the cities are performing in the county, and if they are on track with Newsom's initiatives for California and the increase of ZEVs. It is important to also understand the reasons why Stockton is at such low ZEV sales and make sure funding is appropriated to those initiatives.

In 2021 zero emission vehicles accounted for 6% of the new vehicles sales in Stockton **Figure 8**. Utilizing two different forecasting methods we predicted the future growth that would be consistent with these trends. With no drastic changes to the current EV infrastructure and sales practices in Stockton, the city will be almost 31% below the state goal of 100% ZEV sales by 2035. The projections developed for 2035 utilized two different methods to demonstrate the possible range of outcomes, however for the analysis the more favorable projection was used as this better represents the increasing growth of ZEVs that has been observed in Stockton zip codes the past 7 years. This visualization not only represents the current failures, but demonstrates that in order to reach this goal the city of Stockton would see rapid accelerations in the population of ZEVs, changes that the current infrastructure would not be ready for. In the worst case scenario, 2035 could see an additional 9,000 ZEV vehicles compared to the previous year, in order to meet the state goal.

Another State goal that has been set is the 2025 goal of 1.5 million zero emission vehicles. This goal breaks down to 27,000 zero emission vehicles for San Joaquin Valley. This was done by taking 1.8%, SJV's percentage of the state registrations, of the State goal of 1.5 million. Currently San Joaquin County is 8,000 vehicles off the pace, determined from data from the California Energy Commission, and the ZEV population is growing at a rate that will only increase this gap in the future **Figure 9**.

These differences between the State's goals and the realities of the county and Stockton show that there are real infrastructure issues that are inhibiting the growth of ZEVs. 2018 reports showed that the state is on track to achieve the goal of 1.5 million ZEVs. So, it is clear that these trends in Stockton represent local issues and not statewide problems.

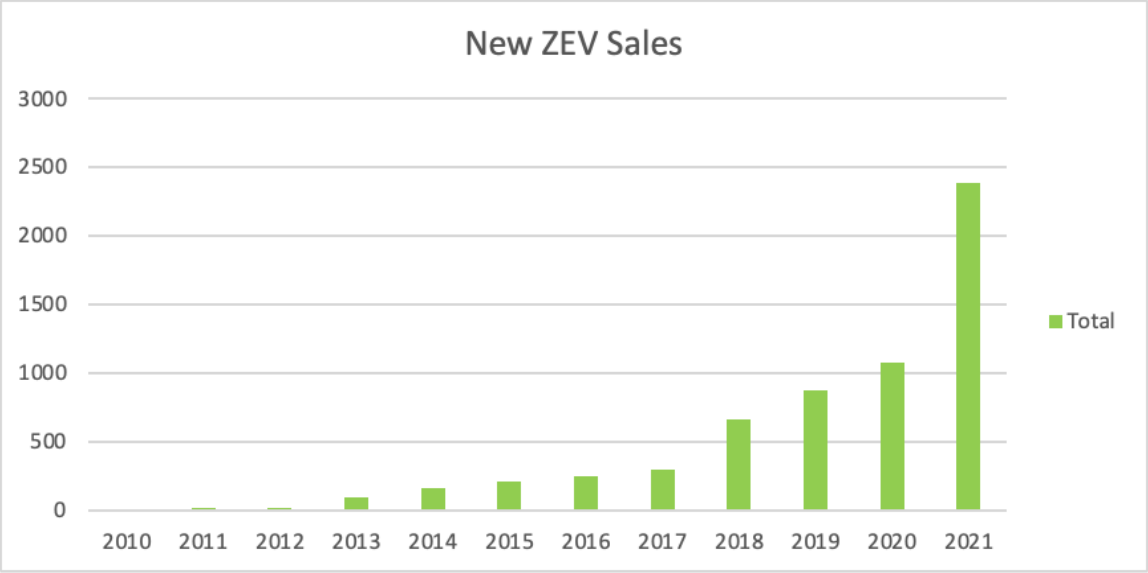

Figure 6: New ZEV Sales in San Joaquin County 2010 - 2021 (California Energy Commission)

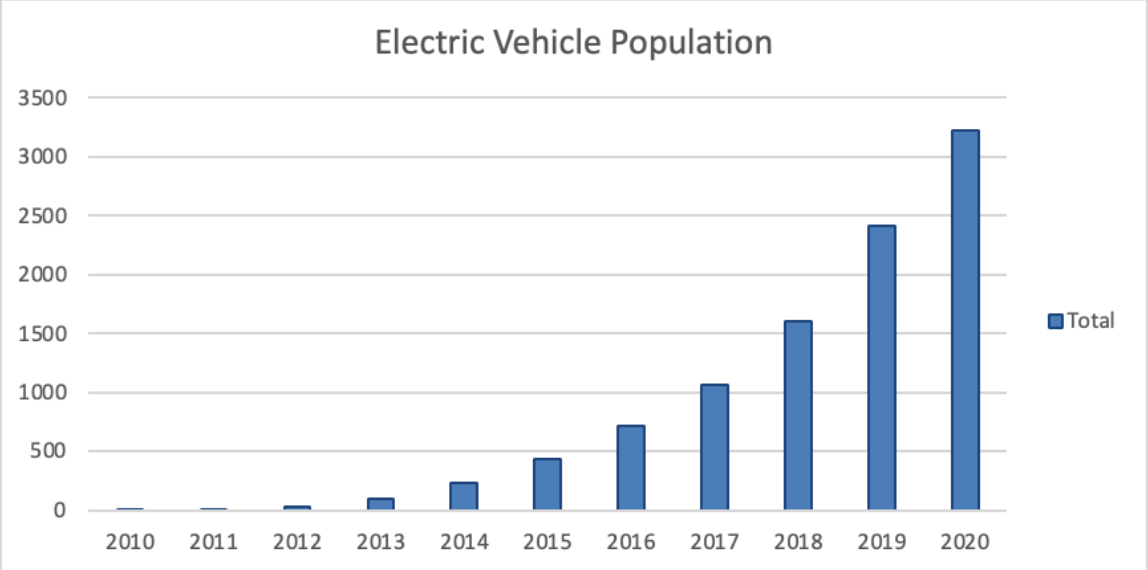

Figure 7: Electric Vehicle Population 2010 - 2020 (California Energy Commission)

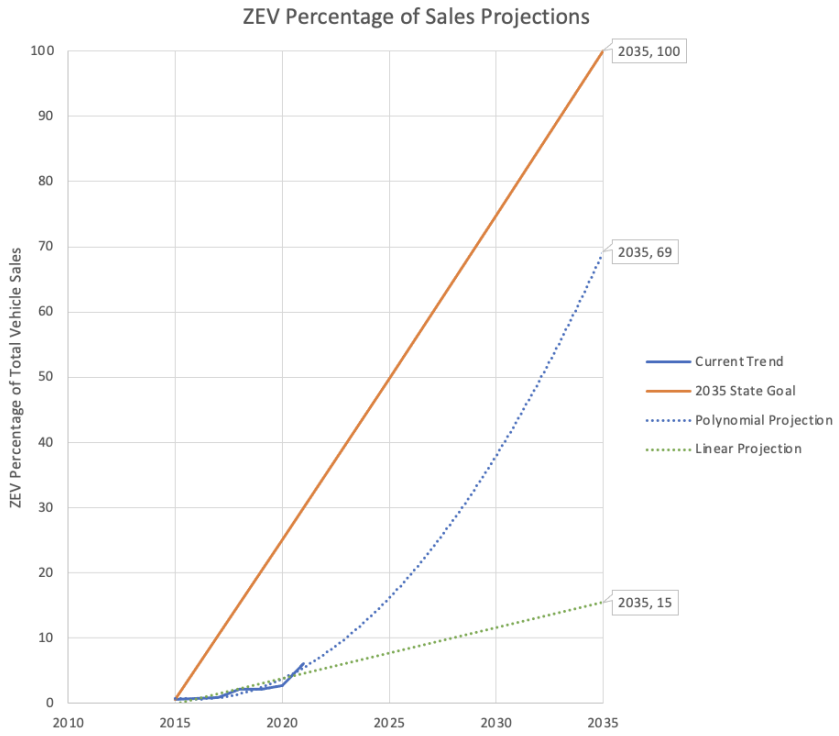

Figure 8: ZEV Percentage of Total Vehicle Sales Forecasted through 2035 for Stockton Zip Codes (California Energy Commission)

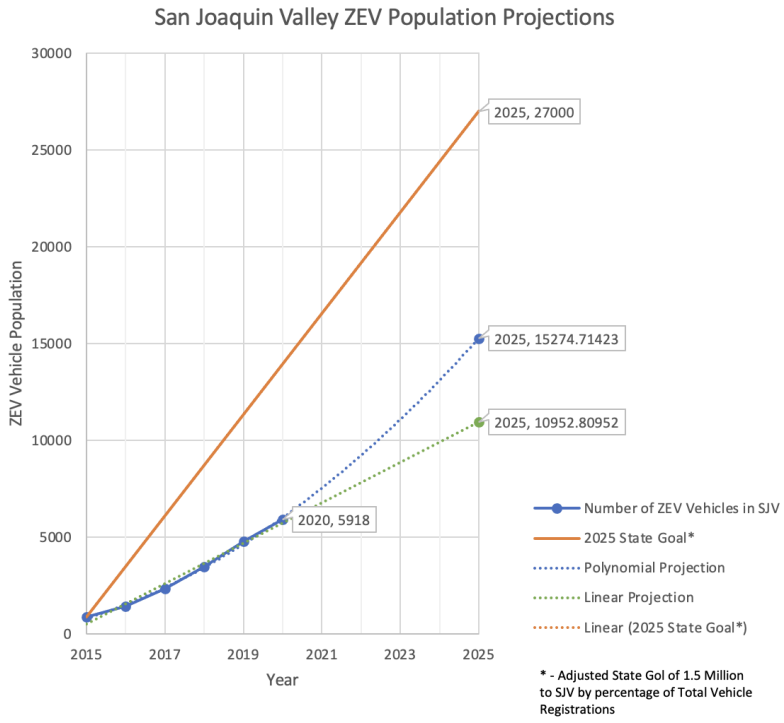

Figure 8: ZEV Population Projections Compared to the 2025 State Goal for San Joaquin Valley (California Energy Commission)

Design Plan for Stockton 2025

In order to reach our preferred state, which involves achieving the 2035 goal of 100% new car sales being EVs, the majority of electric vehicle growth will come from new vehicles purchased from major dealerships. With an estimated 40% of new car dealerships revenue coming from maintenance (V12), these dealerships will be the most motivated stakeholders to grow their EV mechanic workforce. For this reason, our preferred system sees immediate growth in the hiring of EV mechanic interns at these new car dealerships. Focusing on-the-job opportunities growth in areas that are projected to have the highest increases in EVs is the easiest way to efficiently meet the future demands for mechanics. Additionally, using dealership specific mechanics ensures new mechanics will be expertly trained on the unique aspects of their dealerships specific type of vehicle. With the repair of EVs often being unique to the manufacturer, having this more focused training for specific vehicles will result in better mechanics than those trained in a general EV mechanic course offer. A complication with this plan, is that the growth of the BEV population has been mostly seen in wealthier zip codes, with the most BEVs seen in North Stockton. (EMFAC) **Figure 10 and 11**. In addition, we see areas which have had a historical lack of EV investment, such as the AB 617 area, have some of the lowest total BEV populations **Figure 11**.The major new car dealerships are currently more concentrated in areas which have not seen the same growth of BEVs. Additionally, these new car dealerships are not generally located in the low income areas. Due to this it would also be essential to consider how on the job training programs proposed at new car dealerships could be adapted for used car dealerships and general mechanic shops, so the areas with the highest areas of BEV growth, and the highest need for EV infrastructure, will have the same network of EV mechanics. Major equity concerns arise when planned EV mechanic distribution is in line with planned electric vehicle growth. This will further intensify the current socio-economic disparities of EV infrastructure. As shown by **Figure 5**, current EV infrastructure is in wealthier areas allowing for EVs to be more accessible in these areas. Allowing EV mechanic distribution to grow in the same way will force lower-income areas to travel further distances for repairs. To combat this potential reality EV mechanics should be prioritized in areas with the highest levels of internal combustion engine emissions (e.g. NOx emissions **Figure 12)**, ensuring the areas with the most need for EVs will have the sufficient infrastructure to support them.

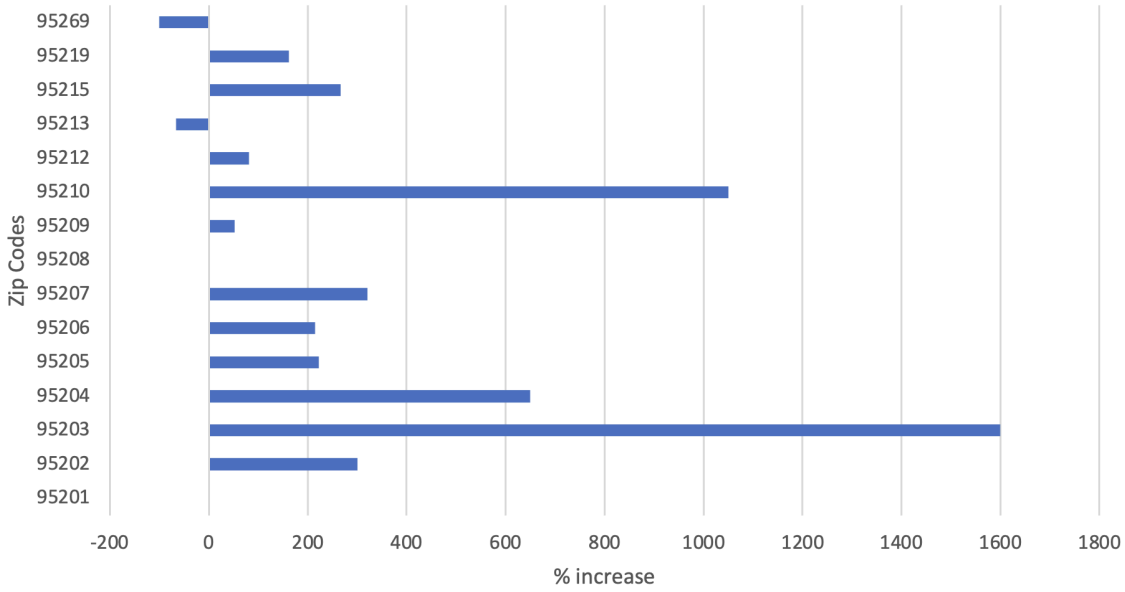

Figure 10: Percentage increase of BEVs in Stockton Zip Codes from 2015 to 2020 (California Air Resources Board)

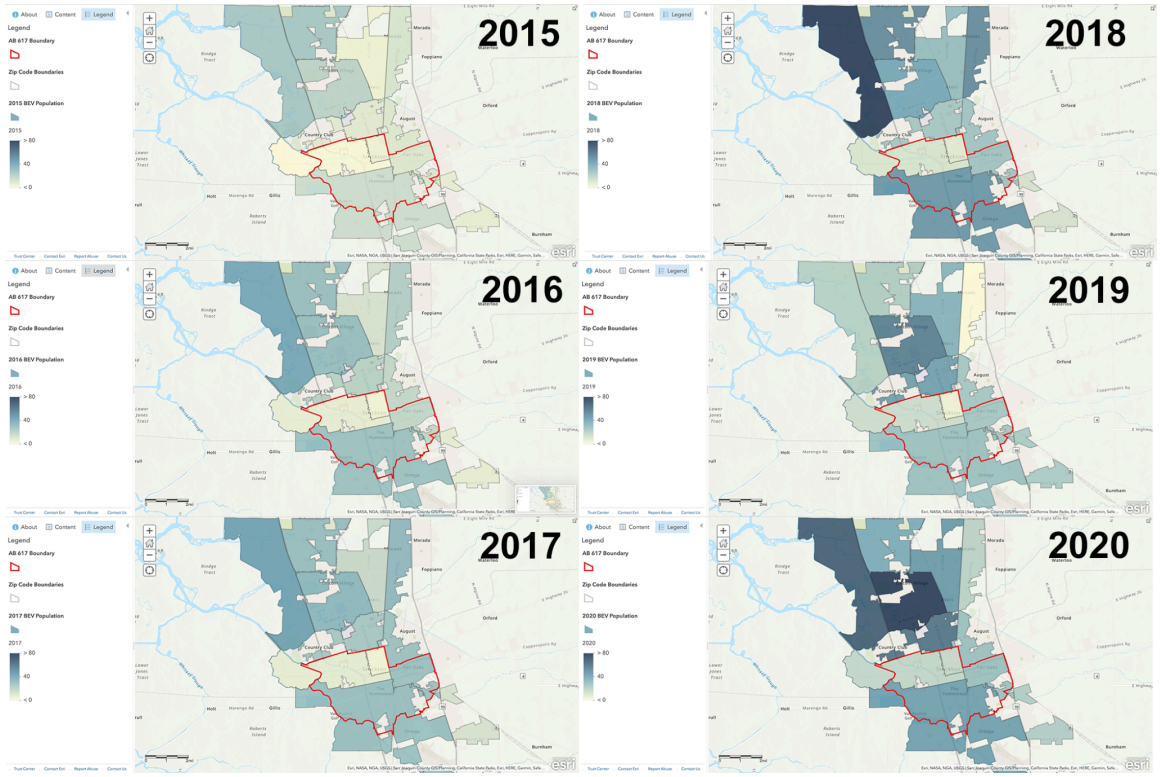

Figure 11: Map of Total Population of BEVs in Stockton Zip Codes from 2015 to 2020 (California Air Resources Board) (Stockton City GIS Data)

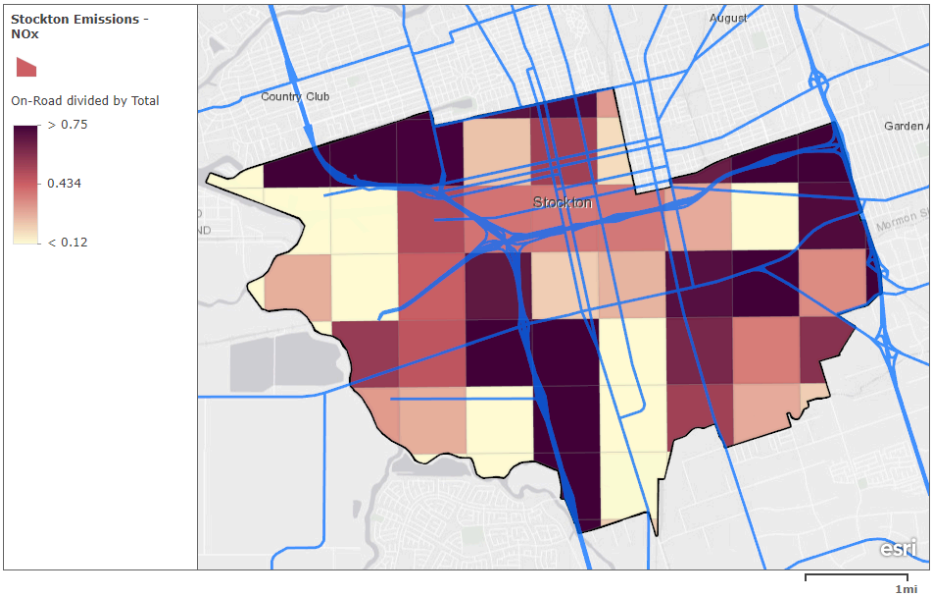

Figure 12: Total On-Road nitrogen oxide emissions (NOx) in Stockton AB 617 Community

Currently, General Motors is partnering with community colleges to expand visibility of ZEV workforce training in the San Joaquin Valley. This project is called Valley CAN (Valley Clean Air Now) and hopes to promote a new generation of green technology careers, by prioritizing how important it is for the county to take clean air initiatives. This program will expand to Delta College, and to 5 other schools in the county. Also, to increase accessibility this program will be free for community college students to support how demanding this new field will be. In a preferred system, more dealerships should be making affordable programs for college students. Also, it is important for Stockton to increase visibility and awareness of such programs in the educational pathway. For example, guest lectures and info sessions from high school would encourage more students to follow this path.

At the moment, the only EV mechanic training program we are aware of is the two-year certificate offered at Delta College. In the preferred system, there would be a structured process for people to join the workforce through accessible training programs. Colleges, labor unions, and Employment and Training Agencies like Sacramento Works should all be available avenues for individuals looking to find the necessary training and education to pursue work in EV servicing and maintenance. An employment and training agency should have a website which consolidates all the information for users including a list of local training providers along with details about certifications/degrees, costs, and time commitments. Having all of this information readily available would make the pathway into the EV mechanic industry more accessible and could even provide more exposure to those looking for work.

Implementation Plan

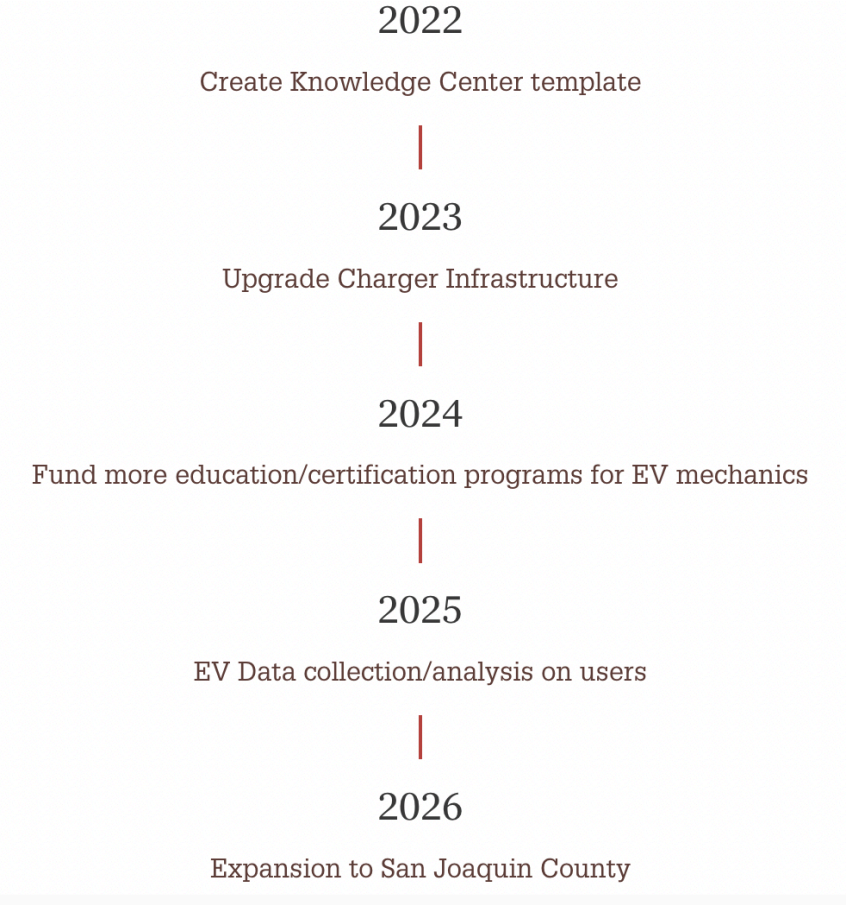

Figure 9: Implementation Plan for Stockton EVs 2022-2025

The Implementation Plan for Stockton EVs is outlined above in Figure 9. It begins with EV data collection to fill the gap in EV related data we discovered while researching EVs and EV maintenance information. Analyses could then be done on this data to be added to the knowledge center and to give better insight on the state of EVs in Stockton. EV servicing information as well as EV user experiences could help to show Stockton leaders the demand for more EV infrastructure and servicing as more EVs join the local vehicle population. Information such as servicing schedules and the number and frequency of vehicles needing maintenance and repair could better inform leaders about EV mechanic demand. This knowledge center would also include information on where one can earn education/training/certification for EV maintenance and servicing as well as rebate information for those looking into EV ownership. The knowledge center will also provide information such as available rebates, state and community EV goals along with progress, and the distribution of EVs and Chargers in the community. As other communities begin to adopt a similar knowledge center, the communities can together compare different strategies to implement infrastructure and workforce development most effectively.

Strategies to Share Beyond Stockton

With the lack of data found for electric vehicle maintenance and even more general data on electric vehicles in Stockton, a program to collect data from electric vehicle users as well as existing service providers would be a great way to begin a preliminary analysis of the community's present state. Servicing information from organizations such as the California New Car Dealerships Association would significantly aid in determining and forecasting demand for EV mechanics. From this baseline community leaders can interpret the demand for electric vehicles, servicing, and infrastructure to make decisions in investments, partnerships, and development. This new data that is collected can then be combined with existing information that is then incorporated into a knowledge center for the greater community. With the steady growth of electric vehicles and the Governor's executive order to sell only electric vehicles by 2035, demand for electric vehicle maintainers will need to grow. Using Stockton's knowledge center as a base, community leaders can highlight analyses done in their own communities and even build upon the center with their own unique information. Implementation of this center to places with a more developed electric vehicle infrastructure may also help communities like Stockton discover additional approaches to developing an electric vehicle industry.

Acknowledgments

Our team would like to express our gratitude for the clear guidance and extensive support provided to our team by our professor Tina Chow and Jennifer Hoody. We also would like to thank Rebecca Sugrue, Casey Finnerty and our fellow classmates for their advice and feedback throughout our project's development.

A special thank you to Taylor Williams who took the time to meet monthly with our team and provided us with detailed insight into the Stockton community and electric vehicle industry. Additionally, we are grateful to the team at Edge collaborative, the authors of the Sacramento EV Blueprint, and especially the community members of Stockton who provided us insight into the deeply-rooted environmental and social issues residents of Stockton face day to day. We are appreciative of everyone's contributions to this project and are inspired to be a part of a group of people who are so dedicated to the future success of Stockton.

References

California Energy Commission. current-date. “ZEV and Infrastructure Stats Data.” California Energy Commission. California Energy Commission. current-date. https://www.energy.ca.gov/files/zev-and-infrastructure-stats-data.

City of Sacramento. n.d. “5-2_EV-Blueprint_Final-EV-Economic-Pathways.Pdf.” Accessed March 4, 2022. https://www.cityofsacramento.org/-/media/Corporate/Files/Public-Works/Electric-Vehicles/5-2_EV-Blueprint_Final-EV-Economic-Pathways.pdf?la=en.

City Systems. n.d. *2.10 GHG Forecast | Green Economy Analysis: Opportunities for Stockton*. Accessed March 4, 2022. https://city.systems/stockton-greeneconomy/ghg-forecast.html.

EVAdoption. n.d. “EV Sales Forecasts – EVAdoption.” Accessed March 4, 2022. https://evadoption.com/ev-sales/ev-sales-forecasts/.

Gabel, Medard, and David Heeney. 2015. *Design Science Primer: Tools for Changing the World*.

San Joaquin Delta College. 2017. “Automotive Electric Technology.” San Joaquin Delta College. November 3, 2017. https://www.deltacollege.edu/program/automotive-electric-technology.

Stockton CERP. n.d. “Final-Stockton-Cerp-No-Appendix-with-Cover.Pdf.” Accessed March 4, 2022. https://community.valleyair.org/media/2487/final-stockton-cerp-no-appendix-with-cover.pdf.

Stockton Community Steering Committee. n.d. “[Notes] Information Gathering.” Google

Docs. Accessed March 4, 2022. https://docs.google.com/document/d/1JODq3XKKqABkgDVkdweKUrUDNSlUp7dSPlUn7Xlsg0k/edit?usp=embed_facebook.

Valley Air District. n.d. “Stockton.” Valley Air District. Accessed March 4, 2022. https://community.valleyair.org/selected-communities/stockton/.