The Shared Electric Vehicle Employer Demonstrator Project (SEED)

Final Report
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Led by: CALSTART

Primary Authors: Kasey Okazaki, Jonathan Norris, and Dan Welch

48 S. Chester Avenue, Pasadena, CA 91106

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List of Acronyms

Chevy: Chevrolet

CO_2: Carbon Dioxide

DC: Direct Current

EV: Electric Vehicle

GHG: Greenhouse gas

GREEN21: Greening for the 21st Century Project

HOV: high-occupancy vehicle

ICE: internal combustion engine

kWh: kilowatt-hour

LA Metro: Los Angeles County Metropolitan Transportation Authority

MPGe: miles per gallon equivalent

SEED: Shared Electric Vehicle Employer Demonstrator Project for Pasadena Employers

SOC: State-of-charge

1. Introduction

1.1 What is the SEED Project?

The Shared Electric Vehicle Employer Demonstrator Project for Pasadena Employers, or the SEED Project, was a project designed by the Los Angeles County Metropolitan Transportation Authority (LA Metro), the City of Pasadena, and clean transportation non-profit CALSTART to increase the education, acceptance, and adoption of electric vehicles (EVs) and workplace charging in the City of Pasadena. Initiated in December 2017, the project offers employers and employees in the City of Pasadena the opportunity to gain first-hand experience with EVs through consultation and guidance on charger installations and extended trials with the vehicles.

The goals of the SEED Project include:

- Increase acceptance and deployment of EVs in the regional consumer marketplace;
- Increase regional employer acceptance, adoption, and installation of workplace charging; and
- Educate at least 100 Pasadena employers and their employees about the benefits of EVs and workplace charging.

The SEED Project leverages the City of Pasadena's prior work, the Zero Emission Vehicle Charging Station Project[1]. The Zero Emission Vehicle Charging Station project was implemented by the City of Pasadena, managed by CALSTART, and funded by LA Metro. This 2011 project sought to install 43 new EV charging stations at public and private locations throughout the City. Prior installation of EV charging stations made the SEED Project possible because adequate, existing stations enabled new drivers to try driving electric.

CALSTART worked with its subcontractor, Green Commuter, to complete two phases: workplace charging support and extended trials with EVs. These two phases offer a unique opportunity for employers and employees in the City of Pasadena gain first-hand experience with EVs and obtain guidance on charger installations

1.2 Regional Policy Landscape

Many regulations and projects have influenced the creation of the SEED Project. Three initiatives directly impacted the SEED Project: The Greening for the 21st Century Project, the EV Everywhere Initiative, and South Coast Air Quality Management District's Rule 2202. Each of these initiatives are described in some detail below.

Greening for the 21st Century

California State Senator Carol Liu introduced Greening for the 21st Century Project (GREEN21) in 2014 for California's 25th State Senate District which includes the City of Pasadena. GREEN21 hoped to foster innovation, support the success of green enterprises, and accelerate the development of a sustainable future for the region. A few objectives of the GREEN21 Project that influenced the SEED Project include:

- Develop environmental and wellness education projects about green living and healthy lifestyles;

[1] Information on the Zero emission Vehicle Charging Station Project can be found at http://ww2.cityofpasadena.net/councilagendas/2011%20agendas/Dec_12_11/AR%209.pdf

- Provide climate change and air quality protection information and resources on ways to reduce greenhouse gas (GHG) and air pollution emissions;
- Promote the use of alternative transportation and low-carbon vehicles; and
- Adopt sustainable practices and develop Climate Change/Greening/Sustainability Plans to reduce the carbon footprint of communities throughout the District.

The SEED Project addresses these four objectives of Senator Liu's Project and helps to educate residents on environmental living and healthy lifestyles by introducing the idea of switching their personal vehicles to EVs. By introducing electric vehicle technology, the SEED Project decreases regional greenhouse gas and air pollution emissions and well as encourages participants to consider an EV as their next purchase. The SEED Project also helps employers understand their carbon footprint at their parking facilities.[2]

EV Everywhere

The Department of Energy's EV Everywhere Initiative was launched in 2012 with the intent to help the United States become more energy secure and environmentally sustainable. The goal of this initiative was to enable plug-in electric vehicles that are as affordable and convenient for the American family as gasoline-powered vehicles by 2022. EV Everywhere combines research, development, outreach, education, partnership-building and strategic planning to drive collaboration and promote deployment of charging stations at workplaces.[i] This project pushed technology to focus on cost reductions and performance improvements in the areas of batteries, electric drive systems including electric motors, efficient climate control, and plug-in electric vehicle charging.[3]

Rule 2202

South Coast Air Quality Management District's Rule 2202 is a current regulation that affects the SEED Project. Rule 2202 is designed to reduce mobile source emissions from employee commutes by providing employers of 250+ employees with a menu of emission reduction strategies that can be implemented to meet the designated emission reduction target for their worksite. As an alternative to meeting an emission reduction target, Rule 2202 also allows employers the option to implement an Employee Commute Reduction Project that meets the rule's exemption requirements. Rule 2202 pushes employers to achieve and maintain their employer's designated average vehicle ridership target.[4] Employers must report the number of vehicles that come into their facilities to determine the emissions that associated with their workplace. In the counting of vehicles, EVs are considered as a zero in the total number of vehicles report. Introducing the SEED Project to employers with 250+ employees could

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[2] Information on Greening for the 21st Century can be found at https://web.archive.org/web/20150626043702/http://sd25.senate.ca.gov/green21

[3] Information on EV Everywhere can be found at https://www.energy.gov/sites/prod/files/2016/05/f31/eveverywhere_road_to_success.pdf

[4] Information on Rule 2202 can be found at http://www.aqmd.gov/docs/default-source/rule-book/support-documents/rule-2202/rule-2202-employee-commute-reduction-program-guidelines-(ecrp).pdf

lead to a reduction in their vehicle counts and emissions. Thus, it is a benefit to workplaces to have more of their employees EVs.

2. Project Specifics

2.1 Phase 1: Workplace Charging

In Phase 1 of the SEED Project, or the Workplace Charging phase, CALSTART aimed to increase EV workplace charging and help employers install charging stations for employee use. The initial step to meeting the adoption goal was to identify cooperative workplaces and assess their EV charging capacity. CALSTART identified multiple locations that were interested in installing workplace charging or already had workplace charging that wanted to increase workplace charging utilization. One way that CALSTART identified these workplaces that participated in Pasadena Department of Transportation's Transportation Management Association meetings. Additional outreach was conducted with an Outreach Factsheet (shown in Appendix A). With workplaces that did not already have EV chargers at their facilities, CALSTART and Green Commuter worked together to help educate employers about the benefits of EVs and installing chargers at the workplace. Green Commuter would assist workplaces to install EV chargers by providing support with purchasing decisions, installation, and the rebate process. During this Project, Pasadena Water and Power, the local municipal utility, offered a rebate for commercial EV charging stations. CALSTART worked to educate these workplaces on the rebates that were available to them.

In addition to working with workplaces that did not have EV charging stations, the SEED Project collaborated with workplaces that already had charging stations. At these workplaces, CALSTART assisted each workplace with understanding their current charging capacity and how to better utilize the chargers. At many workplaces, CALSTART determined how many EVs needed to be introduced to have each workplace meet its maximum charging capacity. Introducing more EVs into each workplace created an additional benefit by showing employees how easy it is to use EVs to charge them at the workplace. CALSTART presented at multiple workplaces to garner support for workplace charging and EVs.

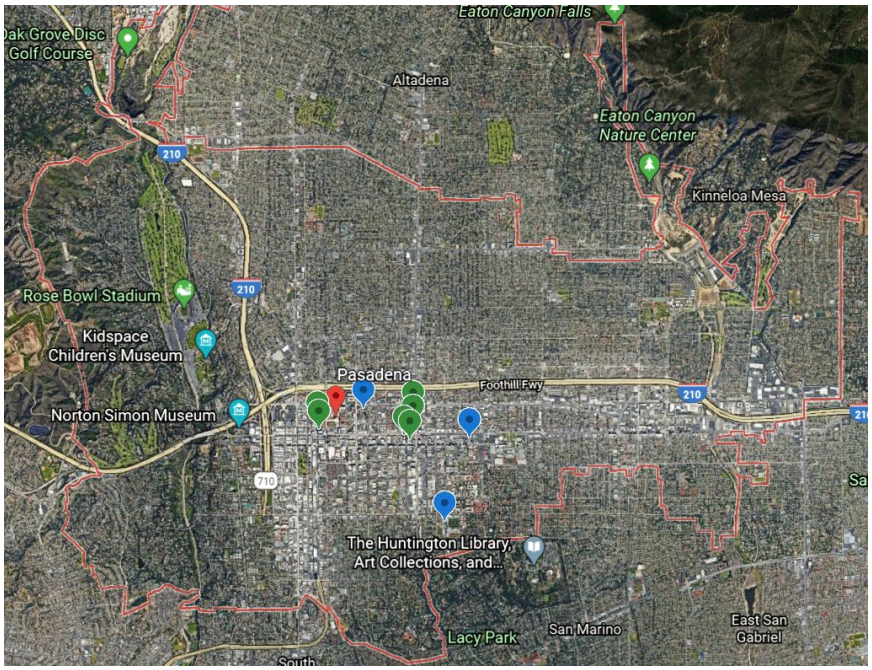
The workplaces that already installed EV chargers were eligible to participate in Phase 2, the extended trial phase of the Project. For a workplace to be eligible for extended trials, they were required to have EV chargers at their facilities that were accessible to their employees.

2.1.1. Workplace Charging Locations

The SEED Project worked with a variety of workplaces in the City of Pasadena. Each workplace had unique site characteristics that required different parking instructions, access, type of charging stations, and number of charging stations. At each location, there were also operational specifics that affected individual experiences at a charging station.

Figure 1 below is a map of the workplaces that the Project team collaborated with for both workplace charging and extended trials phases. The red border shows the borders of the City of Pasadena. Employers located in this region were eligible to participate in the Project. Of the nine workplaces that participated, three locations shown in blue had private parking access. The other six workplaces shown in green had public parking access. At these public parking access locations, all required payment to enter the facilities, however some required payment for the use of the electric charging stations while others had free charging.

Figure 1 Participating Locations of the SEED Project



Station accessibility at each location varied depending if businesses maintained public or private access points. Locations ranged from single business lots, schools, and multi-business parking structures. There was a variety of public and private access. In addition, some location that were public access required payment to park in the lots or structures. For example, at one public access location, charging a vehicle was free but required payment to enter the structure, and at other locations payment was required both to access the parking structure and to charge vehicles. If a location required payment for charging, each location had a different price to charge.

The EV charging supplier also varied depending on location. Charging suppliers included: ChargePoint, Tellus, SemaCharge, OpConnect, PowerFlex Systems. Most of the charging stations were 240-volt chargers (Level 2), however one location did have a DC Fast Charger (Level 3) available to their guests. Some of these facilities placed a four-hour time limit on charging.

2.2 Vehicle Selection

The EV model that was chosen to supply six vehicles for this Project was the 2018 Chevrolet Bolt EV seen in Figure 2. It is a fully-electrified vehicle that suits most consumer needs. This vehicle has an estimated 238-mile all-electric range, which gives flexibility to commuters who may not have the ability to charge every day. The Bolt provides additional flexibility because it can be charged with a conventional 120-volt outlet (Level 1), a Level 2 EV charging station, or a Direct Current Fast Charger (Level 3), where charging times varied depending on the power level of the charging port. As part of the purchasing plan, the Bolts came with Chevy Roadside Assistance that gave participants 24/7 assistance

Figure 2 The Chevrolet Bolt

in the event of having any questions or concerns about the vehicle. This support feature ensured that participants would have easily accessible assistance. The Bolt features regenerative braking, which allows the driver to release the accelerator letting the regenerative braking kick in to slow the vehicle. This mode helps to capture energy that would be used to slow down and return it to the battery, extending the vehicle's battery range.

The Bolt was also chosen because it is an accessible and well-equipped vehicle model. With four-door access, the Bolt allows for easy access to five passengers and the rear-seats can fold down to extend the trunk space. The Bolt has a center display touch screen that controls the standard functions of the car but also allows the driver to see energy usage and range analysis information. This vehicle is also compatible with Apple CarPlay and Android Auto.[5]

2.3 Phase 2: Extended Trials with Electric Vehicles

For the second phase of this Project, or the extended trial phase, CALSTART worked with eligible participants from the Workplace Charging phase to give employees the opportunity to participate in a no-cost extended two-week trial with an EV. Engaging employees at participating workplaces allowed them to gain first-hand experience with driving electric vehicles and using workplace charging. CALSTART supported this second phase by gaining access to the facilities and work through operational logistics for temporary EV charging by employees.

For the extended trials, Green Commuter operated the EV fleet and oversaw management, rotation, and operations of EVs. Six Bolts were procured in July 2018 to be used for the extended trials phase of the Project. Data loggers from FleetCarma, a company that manufacturers vehicle tracking software and devices, were installed into each of the vehicles to monitor charging patterns and vehicle use for data collection. Each vehicle had the required registration, insurance, high-occupancy vehicle (HOV) lane access stickers, and equipment arranged in advance with no additional effort from participants.

Each participant in the extended trials completed a registration application to ensure that every driver would be insured and approved to drive the vehicle. Participants registered through an online application by providing their name and driver's license number for a motor vehicle record history check. Each application was vetted and compared with Green Commuter's insurance company eligibility criteria. Once approved, each participant was covered through Green Commuter's insurance, though if participants did not have their own existing vehicle insurance, they would be required to pay a deductible in the event of an accident.

Figure 3 Hand off and Orientation

After each participant was approved to drive the vehicle, an orientation and hand-off was scheduled. For orientations, a factsheet was created as a resource for participants shown in Appendix B. The orientation trained the participants on how to properly operate the vehicle and charge the vehicle; upon completion of the orientation and a pre-trial survey to grasp their understanding of electric vehicles

[5] Information on the Chevy Bolt can be found at https://www.chevrolet.com/content/dam/chevrolet/na/us/english/index/shopping-tools/download-catalog/02-pdf/2018-chevrolet-bolt-ev-catalog.pdf

before the orientation, the Bolt keys were given to the participant to use as their personal vehicles for a period of two weeks.

At no cost, each participant was provided with a few charging cards for the more popular charging providers to allow for easy charging both at work and in their local community. However, if participants had to charge the vehicle at a charging station where a card was not provided, the participant had to pay for their own charging costs. Before the participants were handed the keys to the vehicle, each had to complete a pre-trial survey to grasp their understanding of electric vehicles before the orientation. The vehicle could not be driven by anyone other than the participant and it was required to stay in the state of California. There was no mileage limit enforced.

Throughout the extended trials phase, Green Commuter maintained a phone line for participants to call as a backup to roadside assistance. In addition, Green Commuter managed the maintenance of the vehicles. All the vehicles had preventative maintenance completed at least once and were regularly checked before orientations. This consisted for tire rotation and inspection as well as brakes maintenance.

After the two-week trial, each participant returned the vehicles to their workplaces. When the vehicles were returned, they were cleaned and prepared for the next participant. Each participant was sent a post-trial survey to gauge their feelings on EVs after the trial. If the vehicles needed to move to a different location for the ensuing trial, Green Commuter moved and prepared them for the next orientation. Each orientation and hand-off were conducted at each participant's workplace where the charging stations were located.

2.4 Outreach Opportunities

To raise more awareness for the Project, the CALSTART team held many outreach events. To garner support from the community and local business, the City of Pasadena and CALSTART hosted a Press Event with a Ride and Drive as shown in Figure 4. At the Press Event, the representatives from the City spoke how the SEED Project helped meet sustainable transportation goals and CALSTART described how local businesses and employers could participate in this innovative project. Ride and Drive attendees could drive a Bolt with a team member to experience what it was like to drive an EV.

Figure 4 Press Event at Pasadena City Hall

To gain participants in the extended trial phase of the Project, CALSTART employees attended two Earth Day events at two participating employers' workplaces. At these events, CALSTART brought a Bolt to display and set up a booth to share information about clean transportation, EVs, workplace charging, and details on how to participate in the Project.

The SEED Project engaged additional employers by attending and speaking at one of the City of Pasadena's Transportation Management Association meetings. At this meeting, Pasadena employers could learn more about the Project and how to participate.

3. Data Collection Methods

3.1 Overview

CALSTART collected two types of data during the SEED Project:

(1) Quantitative vehicle performance and charging data; and
(2) Qualitative survey data regarding participants' perceptions of the Project and the vehicle.

This data was collected for nearly one year, from July 17, 2018 to July 01, 2019 (350 days). During this time span, 126 Project participants each drove a Bolt for a two week trial period. The names of each participant were logged in addition to the dates on which each of them had ownership of an electric vehicle during the Project. CALSTART surveyed each participant at the beginning of their two-week trial to obtain their perceptions and experiences with EVs prior to participating in the Project. CALSTART also surveyed each participant at the end of each two-week trial to ascertain how the experience of driving the Bolt had changed their perceptions. Quantitative data was collected by FleetCarma for each vehicle throughout the duration of the Project. The following sections describe the quantitative data parameters collected.

3.2 Quantitative Vehicle Performance Data Collected

Quantitative data was collected via FleetCarma data loggers installed onto each of the six Chevrolet Bolts. The data loggers collected data and displayed it on FleetCarma's online portal. This portal made several data parameters available to CALSTART for review and analysis. Most crucially, the portal provided real-time information on each vehicle's position, state-of-charge (SOC), and driving status. FleetCarma's portal also provided fleet-level data, which was modifiable by date range and included three groupings of data that CALSTART used: fleet summary data, monthly comparison data, and utilization reports. Parameters for this data can be found in Appendix E.

Utilization report data provided a few vehicle-specific data parameters focused on vehicle utilization – how the vehicle was driven in terms of distance, trips, and drive time.

Along with fleet-level data, FleetCarma also provided vehicle-specific reports for each of the six vehicles that were part of the Project. Like the fleet summary data, this data was modifiable by date range. This grouping of data contained four sub-groupings:

- **Vehicle Overview:** An overview of key parameters for the date range selected;
- **Daily Summary:** A summary of driving and charging start times and durations daily, shown on a timeline;
- **Trip Log:** A log of every drive event per vehicle for the date range selected; and
- **Charge Log:** A log of every charging event per vehicle for the date range selected

The last grouping that FleetCarma provided was Charging Report data. This data was also vehicle-specific and was modifiable by date range.

Primarily, Microsoft Excel and the data analysis software project R was used to analyze quantitative data. When needed, any additional data preparation conducted to analyze the data adequately was explained in the respective and necessary sections of this report. Data parameters can be found in Appendix E.

3.3 Qualitative Project Participant Survey Data Collected

CALSTART also collected qualitative data regarding the SEED Project participants' perceptions and experiences with EVs, as well as the Project in general. These perceptions were recorded via surveys which were administered to every participant before and after their two-week trial with a Chevrolet Bolt. The surveys questioned participants on the following items:

- Demographics (gender, highest level of education);
- Primary mode of transportation;
- Primary vehicle model and year (if primary mode of transportation is personal car);
- Miles traveled per week;
- Length of daily commute to and from work;
- Amount of money spent on gas per month;
- Experiences driving electric vehicles;
- Awareness of local and state incentives for purchasing an electric vehicle;
- Assessment of workplace charging options;
- Considerations for purchasing an electric vehicle;
- Reasons for considering or not considering an electric vehicle purchase;
- Interest in purchasing an electric vehicle as a next vehicle;
- Rating of experience using the Chevrolet Bolt as their primary vehicle during the SEED Project;
- Benefits used while driving the Chevrolet Bolt during the SEED Project;
- Costs incurred to charge the Chevrolet Bolt during the SEED Project;
- Issues experienced during the SEED Project, with the vehicle or the Project itself;
- Comments and suggestions for improving the SEED Project;
- General comments and suggestions regarding their experiences with the Chevrolet Bolt

By administering pre- and post-participation surveys, CALSTART was able to assess the impact that the SEED Project had on participants' perceptions, interest in, and experiences with EVs. Copies of the surveys are provided in Appendix C and Appendix D.

4. Data Analysis and Results

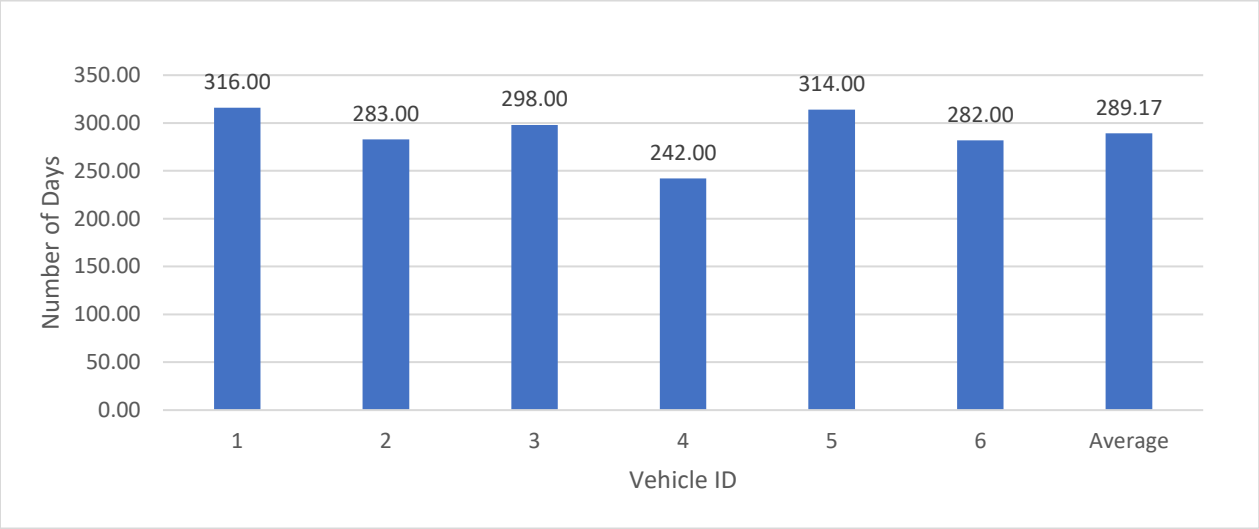
CALSTART collected and analyzed two types of data: qualitative survey data and quantitative vehicle performance data. The survey data was collected via SurveyMonkey by administering a pre-survey to each Project participant before the two-week EV trial and a post-survey after the trial EV; the quantitative data was recorded by FleetCarma instruments installed in each Bolt. The results and an analysis of CALSTART's data collection follow below. Both surveys asked questions with varying types of answer categories. Answers to the survey questions were analyzed both in and of themselves, and where appropriate they were analyzed as a comparison between the pre-survey and post survey. In instances when respondents chose "Other" and provided responses that were similar to pre-existing answer choices, those "Other" responses were included in the count of pre-existing answer choices.

4.1 Quantitative Vehicle Performance Data Analysis

4.1.1 Overview and Fuel and Emissions Reduction

126 people participated in the SEED Project constituting 126 two-week trials. In that time, the SEED Project deployed six Chevrolet Bolt EVs that operated from July 17, 2018 through July 01, 2019, totaling 350 days of operation. Each vehicle operated for a generally consistent total number of days during the Project, as shown in Figure 5.

Figure 5 Number of Driving Days per Vehicle Across the Duration of the Project



During the Project the vehicles made a total of 5,365 trips, equaling an average of about 42 trips per two-week trial. Through the entire Project, 59,765 miles were traveled, constituting an estimated displacement of 2,598 gallons of gasoline and reduction of about 23,100 kilograms of CO_2 emissions (see Table 1).[6] According to Environmental Protection Agency estimates that a typical passenger vehicle emits about 4.6 metric tons of CO_2 per year, the SEED Project's CO_2 reduction is equivalent to removing about 5 typical passenger vehicles from the road for a year.[7]

Table 1 Fuel and Emissions Reduction Estimates Across the Duration of the Project

Total Mileage Across All Vehicles (Miles)	59,765.82
Estimated Total Gallons of Gasoline Reduced Across All Vehicles (Gallons)	2,598.50
Estimated Total CO_2 Emissions Avoided Across All Vehicles (Kilograms)	23,100.00

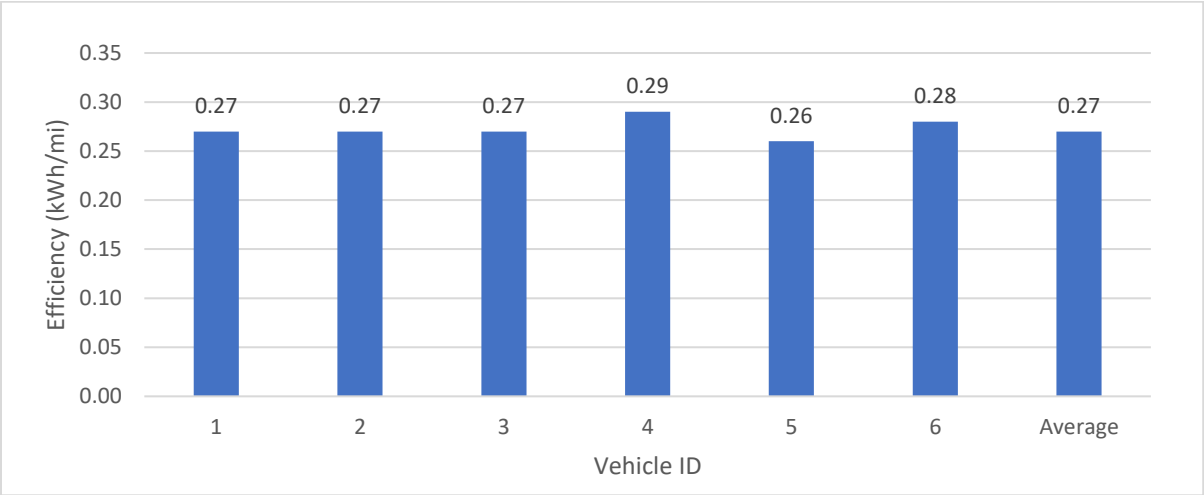
4.1.2 Efficiency

Figure 6 shows the average overall efficiency per vehicle across the entire timespan of the Project. Overall, the minimum average efficiency for the entire Project was 0.26 kilowatt-hour (kWh)/mile (129.62 MPGe) and the maximum average efficiency was 0.29 kWh/mile (116.21 MPGe), for an overall average of 0.27

[6] CALSTART assumes an average fuel economy of 23 miles per gallon and 8.89 kg of CO2 emitted per gallon of gasoline according to https://www.eia.gov/environment/emissions/co2_vol_mass.php
[7] https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle

kWh/mile (124.81 MPGe). For comparison, the conventionally fueled Chevrolet model with the best estimated fuel economy is the 2019 Chevrolet Cruze (diesel-fueled) with an estimated 37 MPG (0.91 kWh/mi)[8].

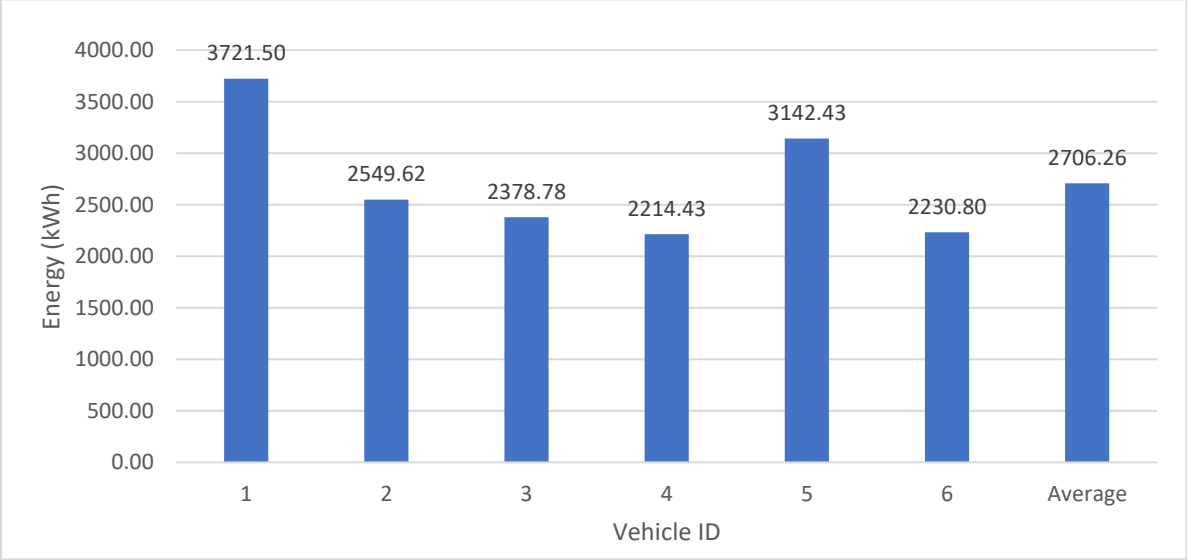
Figure 6 Average Efficiency per Vehicle Across the Duration of the Project



4.1.3 Energy Use

Figure 7 shows the total amount of energy consumed per vehicle across the duration of the SEED Project. The range of energy consumption varies from a maximum of 3721.50 kWh to a minimum of 2214.43 kWh. It is important to note that some vehicles were driven more days than others. The pattern of energy use per vehicle is similar to the pattern of driving day totals shown in Figure 5.

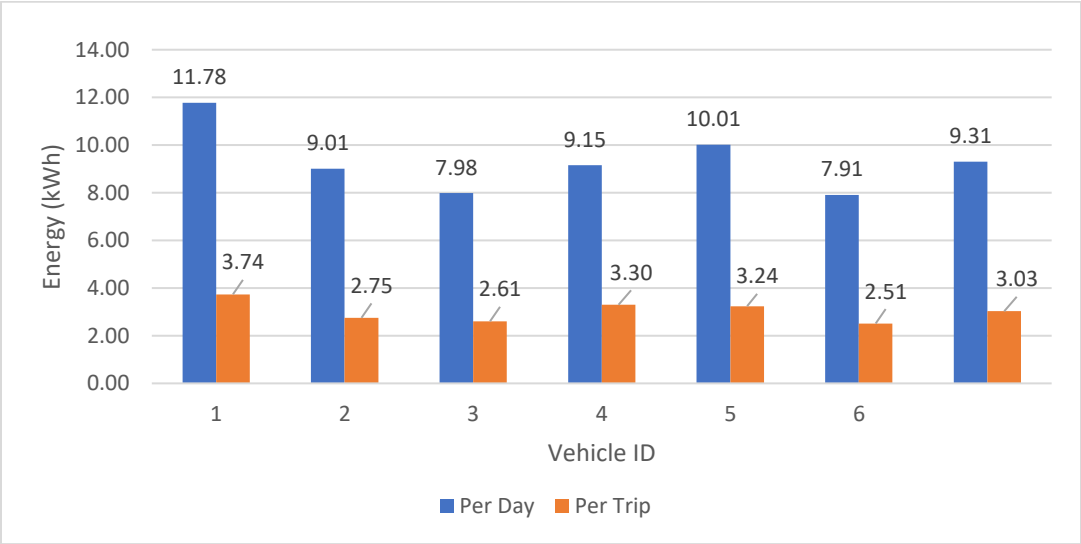
Figure 7 Total Energy Consumed per Vehicle Across the Duration of the Project



[8] https://www.fueleconomy.gov/feg/bymake/Chevrolet2019.shtml

Figure 8 also shows the amount of energy consumed per vehicle, but it is shown per day and per trip. Per day, the energy consumption ranged from 11.78 kWh to 7.98 kWh, with an overall average of 9.31 kWh. Per trip, it ranged from 3.74 kWh to 2.51 kWh, with an overall average of 3.03 kWh.

Figure 8 Average Energy Consumed per Vehicle per Day and per Trip



4.1.4 Charging

To better understand charging patterns among participants, CALSTART grouped charge events by time of day. In the table below, each category refers to the following time ranges.

Table 2 Time of Day Categories

Category	Time Range
Sunrise	5:00 AM to 7:59 AM
Morning	8:00 AM to 10:59 AM
Mid Day	11:00 AM to 1:59 PM
Afternoon	2:00 PM to 5:59 PM
Dusk	6:00 PM to 9:59 PM
Evening	10:00 PM to 12:59 PM
Late Night	1:00 AM to 4:59 AM

Figure 9 shows that most charging sessions occurred during Afternoon hours followed by Mid-Day and Morning. These results indicate that, for the most part, participants took advantage of workplace charging. Nearly all Project participants had never owned a personal EV, nor had they ever driven an EV prior to the SEED Project, so it is unlikely that participants had EV charging equipment at their homes.

Figure 9 Percentage of Charge Events by Time of Day

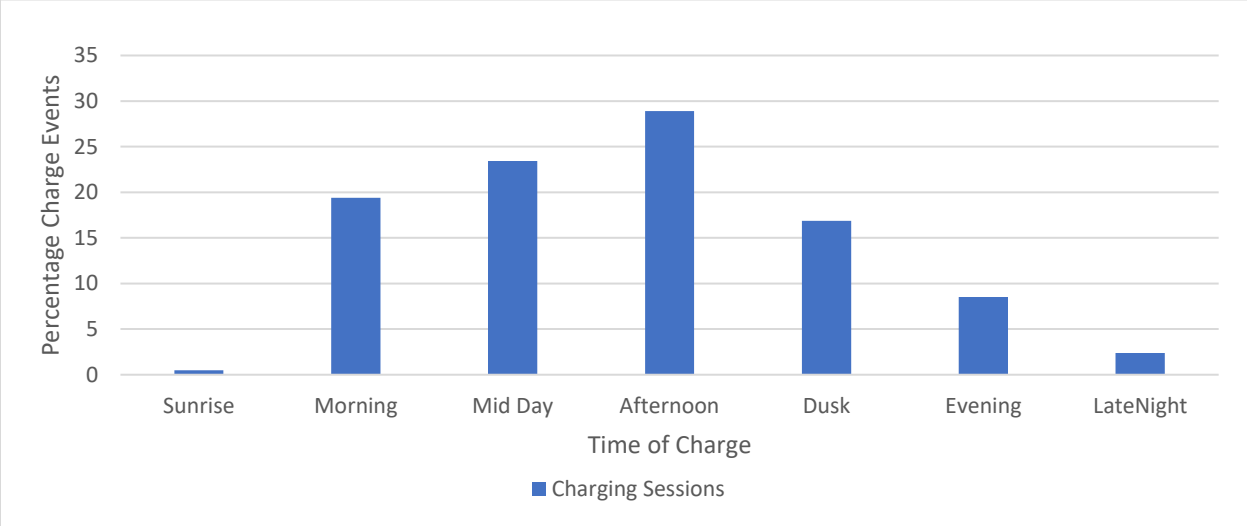


Table 3 shows that most charging sessions took place using Level 2 chargers. About 73% of all charging sessions were on a Level 2 charger, whereas Level 1 charging was used about 19% of the time, and Level 3 chargers were used only 8% of the time during the Project. In terms of net energy charged, Level 2 charging events accounted for 12,698.2 kWh across the duration of the Project, Level 1 accounted for 2,223.4 kWh, and Level 3 accounted for 1,837.2 kWh.

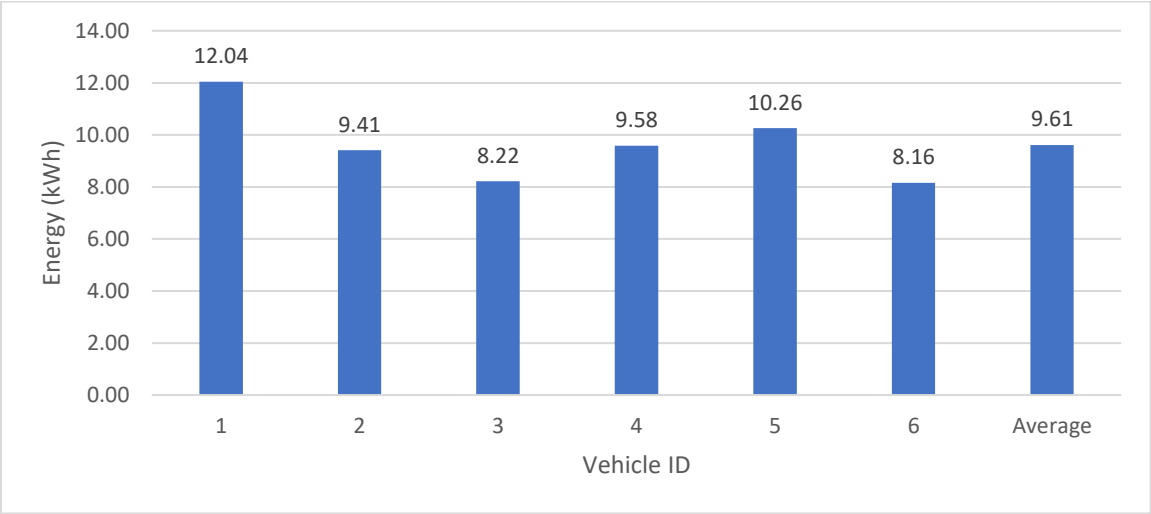
Table 3 Charging Activity by Charging Power Level Across the Duration of the Project

	Number of Charging Events	Percentage of Total Number of Charging Events	Net Energy Charged	Average Energy per Charge
Charge Level 1	294	18.6%	2,223.4 kWh	7.6 kWh
Charge Level 2	1,162	73.4%	12,698.2 kWh	10.9 kWh
Charge Level 3	128	8.0%	1,837.2 kWh	14.4 kWh
Totals:	1,584	100%	16,758.8 kWh	-

From survey results, it cost an average of $15.93 per participant to charge the EVs during their two-week trials. In total, $1,880 was spent by all participants to charge the EVs. Sixty-three of the participants (63% of all participants) spent $0 to charge the EVs, as many of them took advantage of the free charging cards provided during the Project. It is important to note that participants were given cards which allowed them to charge at no cost to them at ChargePoint, Blink, and EVgo chargers. In March 2019, GreenCommuter pulled the ChargePoint cards from the Project due their high demand charges. Many chargers in the area or at the workplaces are ChargePoint chargers thus much of the bulk of charging costs represented from this time period.

On a per day basis, each vehicle charged between 12.04 kWh and 8.16 kWh on average. The overall per day average across all vehicles was 9.61 kWh of charging energy.

Figure 10 Average Energy Charged per Vehicle per Day



4.1.5 Distance, Drive Events, and Speed

Following the same time of day categories as i Figure 9, most drive events occurred during Dusk hours, followed by Afternoon and Morning hours. In terms of distance traveled, most miles were traveled during Dusk hours followed by Morning and Afternoon. Similar trends apply for the duration of drive events and the amount of energy used during drive events. These results are likely due to commuting drive events after and before the participants' work hours.

Figure 11 Percentage of Drive Events by Time of Day

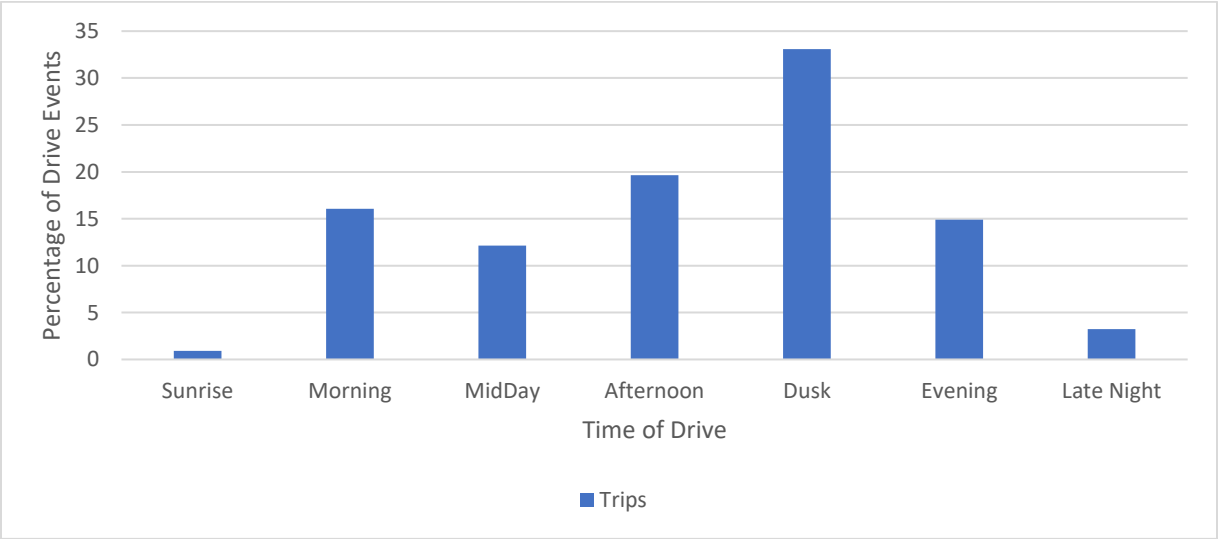


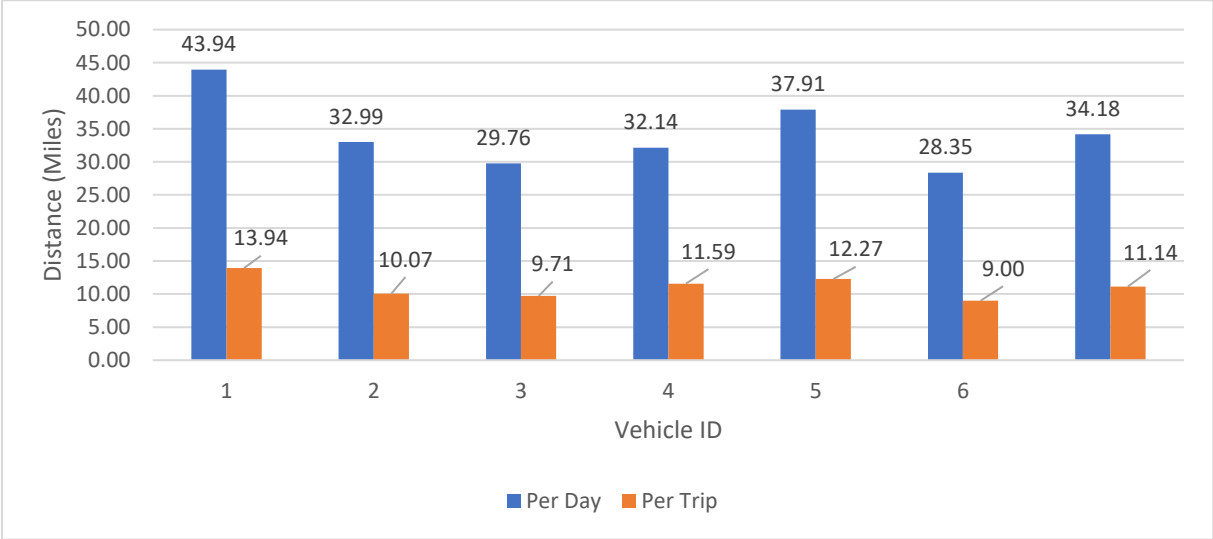
Table 4 shows the total distance driven per vehicle across the duration of the Project. Each vehicle logged between 13,884 and 7,778 miles across the duration of the SEED Project. The overall average across all vehicles was 9,961 miles. Each vehicle logged between 996 and 671 trips. The overall average number of trips across all vehicles was 894.

Table 41 Total Distance and Trips Driven per Vehicle Across the Duration of the Project

Vehicle ID	Distance (miles)	Total Trips
1	13,884	996
2	9,336	927
3	8,869	913
4	7,778	671
5	11,903	970
6	7,996	888
Average	9,961	894

Figure 12 shows the average distance driven per vehicle on a per day and per trip basis. On a per day basis, vehicles were driven between 43.94 and 28.35 miles per day, with an overall average of 34.18 miles per day. Per trip, vehicles were driven between 13.94 miles and 9.00 miles, with an overall average of 11.14 miles per trip.

Figure 12 Average Distance Driven per Vehicle per Day and per Trip



4.2 Qualitative Project Participant Survey Data Analysis

As mentioned previously, CALSTART administered a pre-survey to each participant before they drove the Chevrolet Bolt for a two week trial, and a post-survey after that trial. CALSTART received 124 responses to the pre-survey and 118 responses to the post-survey.

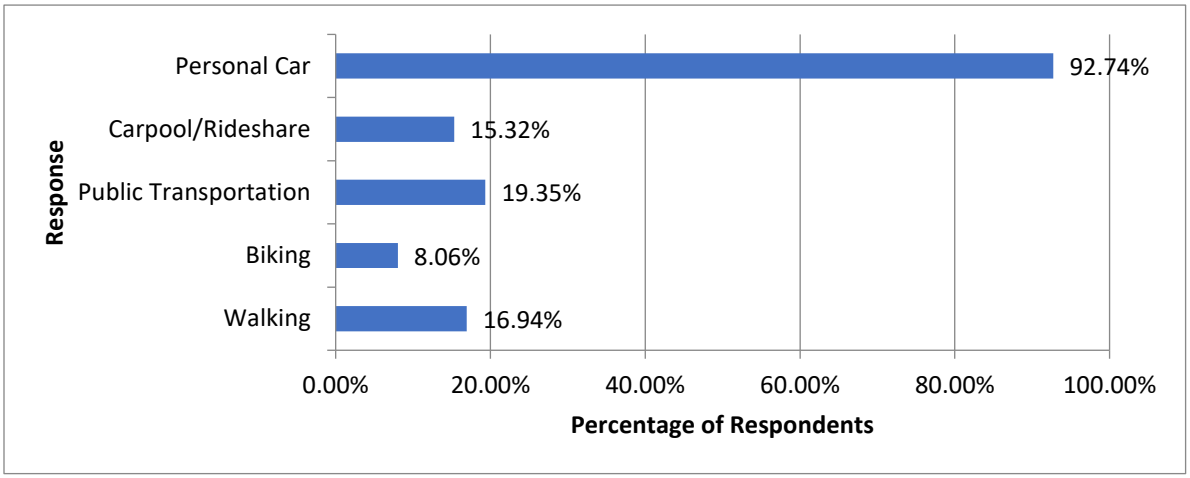
4.2.1 Pre-Survey Results

Participants were first asked a couple demographic questions. Regarding gender, 57% of the respondents to the pre-survey were male.

93% of SEED participants used a personal car as their primary source of transportation, followed by public transportation at 19%, walking at 17%, carpooling at 15%, and biking at 8%. It's important to note that several participants use multiple modes of transportation. While a personal car was the most

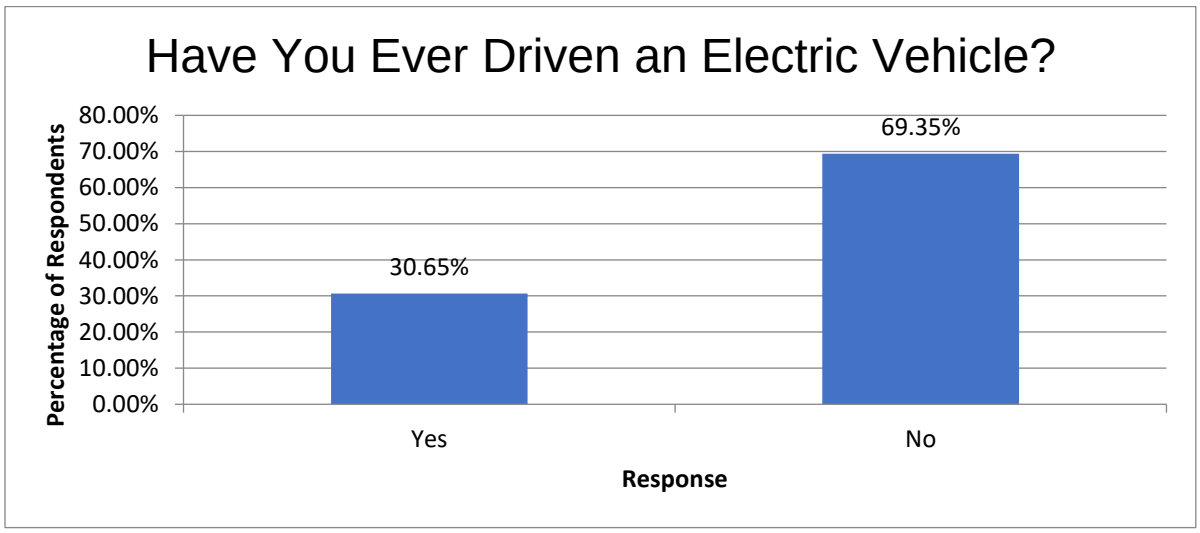
prevalent mode, several participants combine multiple modes together. Approximately 69% of the participants stated that the SEED Project was the first time they had ever driven an EV.

Figure 13 Primary Source of Transportation for SEED Participants



The average distance which participants reported driving per week was 219 miles with an average daily commuting distance of 33.5 miles. These participants reported spending an average of $145 per month on gasoline. At 33.5 miles per day, an average fuel economy of 23 miles per gallon, and an average of 8.89 kilograms of carbon dioxide (CO_2) emitted per gallon of gasoline, about 12.95 kilograms of carbon dioxide were estimated to be emitted per day per participant. Over the course of two weeks that equals about 129.5 kilograms of carbon dioxide, which is the amount reduced by replacing gasoline vehicles with electric vehicles over the same timeframe[9,10].

Figure 14 SEED Participants' Experience Driving Electric Vehicles

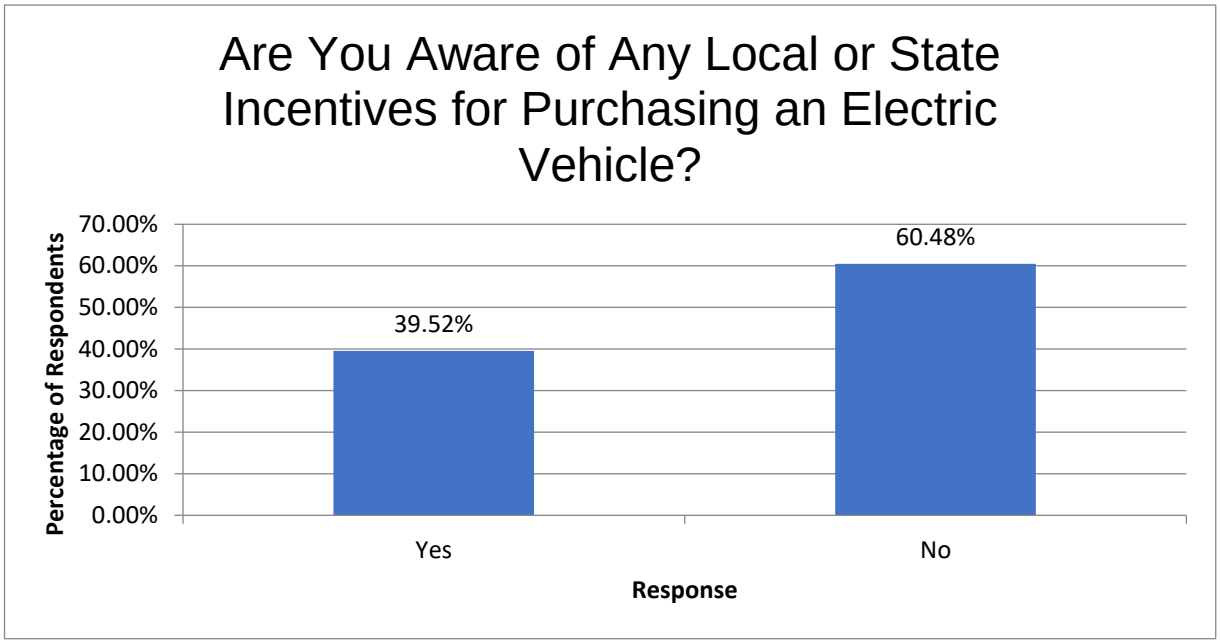


[9] 8.89 kg of CO_2 emitted per gallon of gasoline is per https://www.eia.gov/environment/emissions/co2_vol_mass.php. The calculations above assume 10 commuting days; if 14 days were used the estimated emissions per two weeks would be 181.30 kg CO_2

[10] CALSTART assumes average fuel economy of 23 miles per gallon.

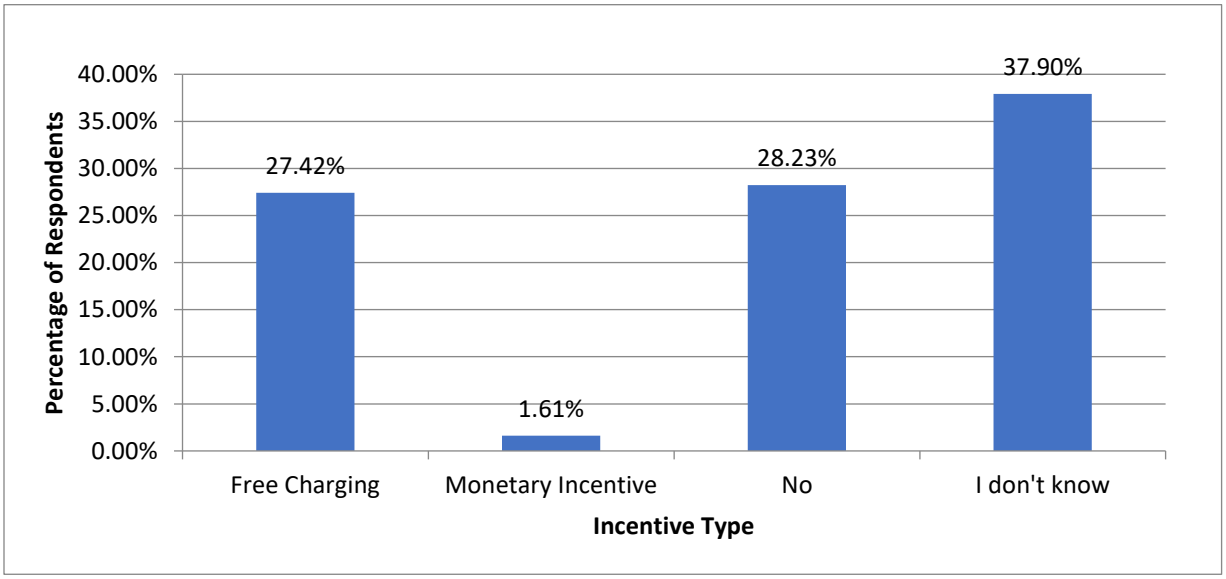
Additionally, prior to participating in the SEED Project, most participants stated that they were not aware of local and/or state incentives for purchasing an EV as seen in Figure 15.

Figure 15 SEED Participants' Awareness of Local and State Electric Vehicle Purchase Incentives



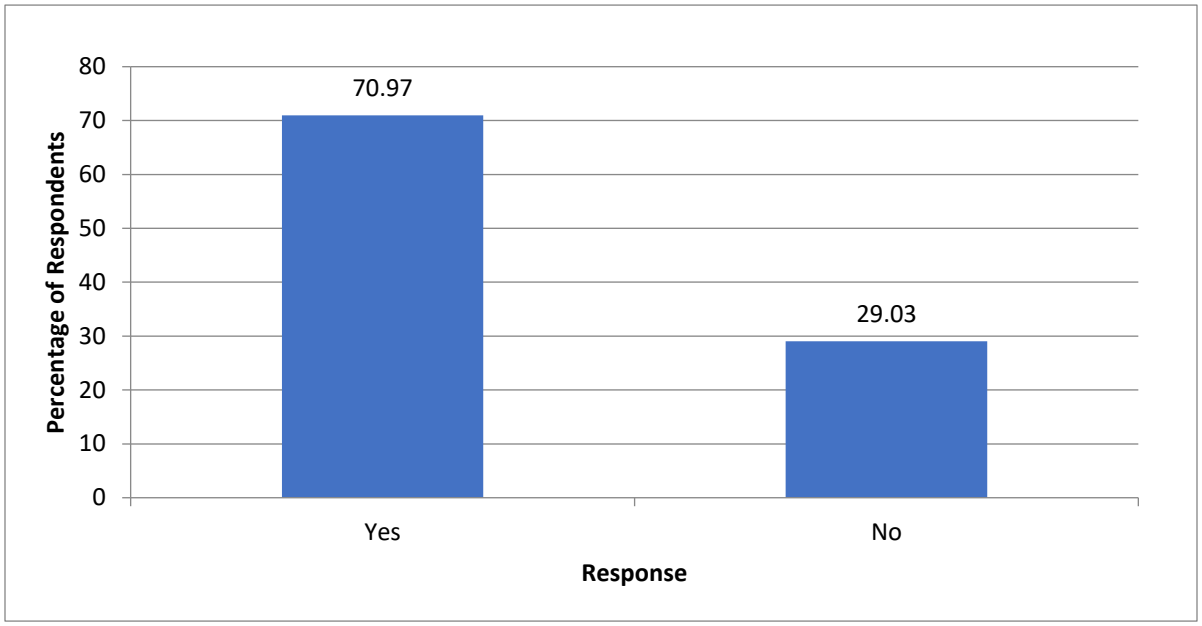
When asked to elaborate if they were aware of any workplace EV incentives offered by their employers, respondents provided a couple responses. Almost 38% of respondents stated that they did not know if their employers offered any EV incentives and 28% said that their employers offered no incentives. About 27% of respondents stated that they were aware that their employers offered free charging, and less than 2% of respondents stated that their employers offered a monetary incentive for EV usage.

Figure 2 Workplace Incentives that SEED Participants Listed



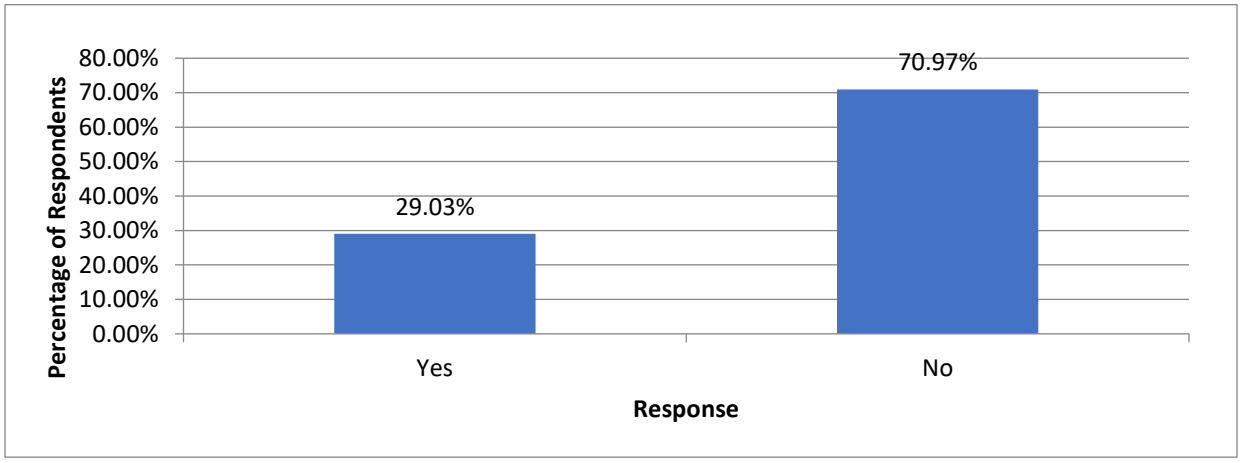
When asked if participants thought that their workplaces had a sufficient number of chargers, 71% of participants said yes and 29% of them said no.

Figure 3 SEED Participants' Perception of Sufficiency for Number of Chargers at Their Workplaces



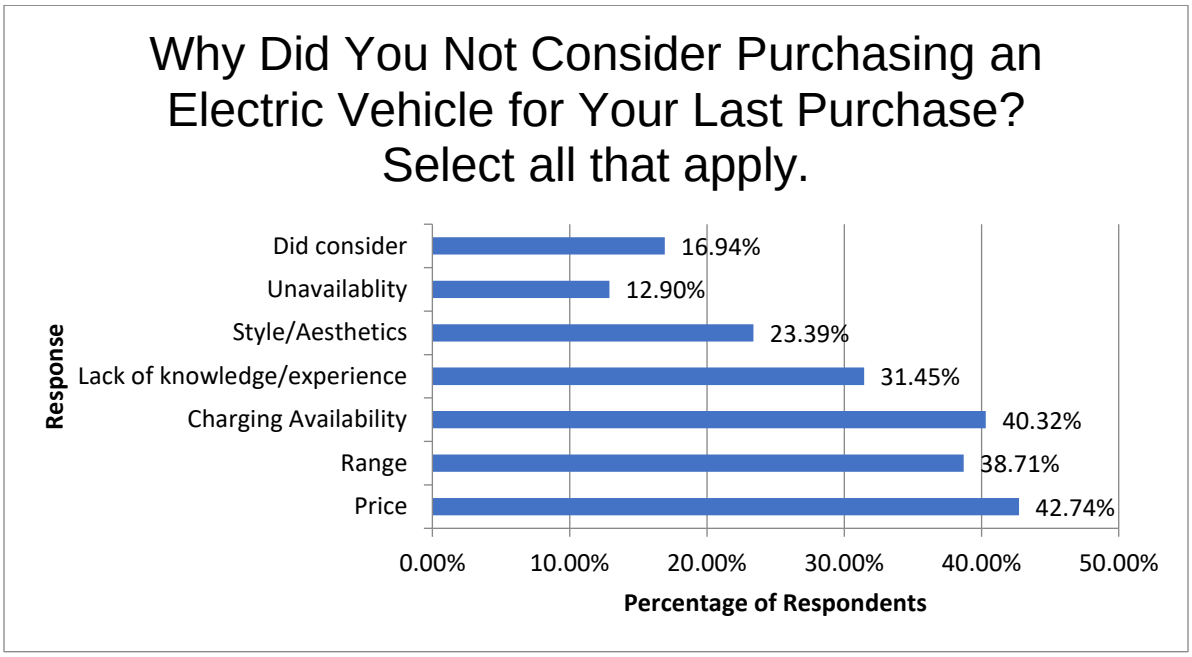
Most Project participants reported that they did not consider an EV for their last vehicle purchase. About 71% of participants stated this, while about 29% of participants stated that they did consider an EV for their last vehicle purchase. In their responses, some participants made comments stating that EVs were not widely available during the time when they made their last purchase.

Figure 4 Did SEED Participants Consider an Electric Vehicle Purchase at Last Vehicle Purchase



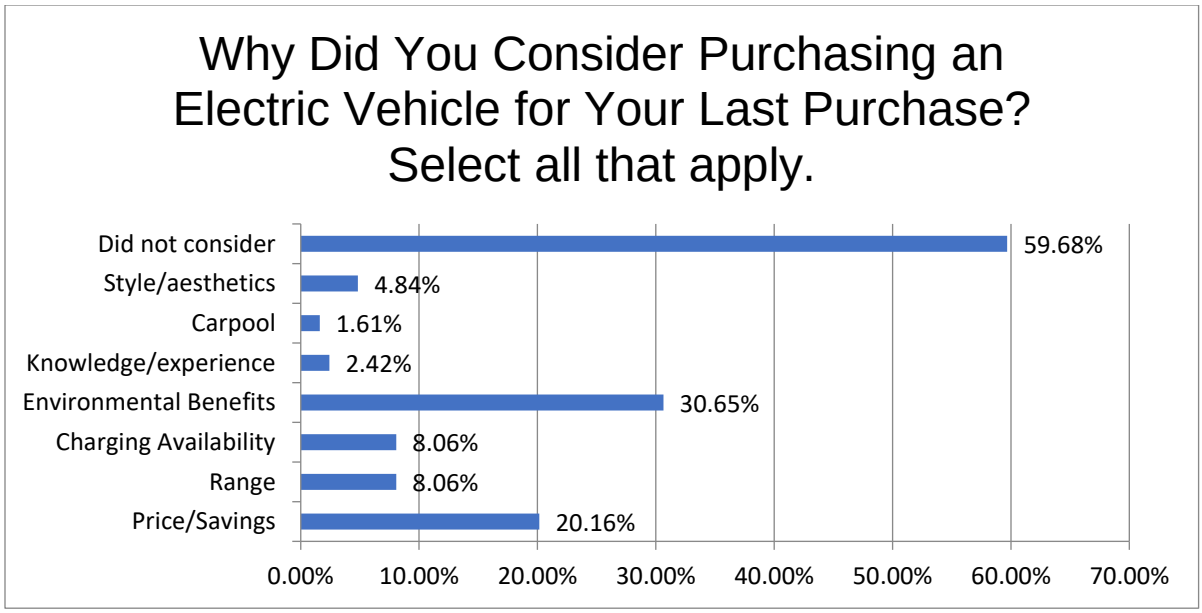
Of those participants who reported that they did not consider purchasing an EV for their last vehicle purchase, price and charging availability ranked as the top reasons for their lack of consideration. Concerns about vehicle range and charging availability followed closely.

Figure 5 SEED Participants' Reasons for Not Considering an Electric Vehicle Purchase at Last Vehicle Purchase



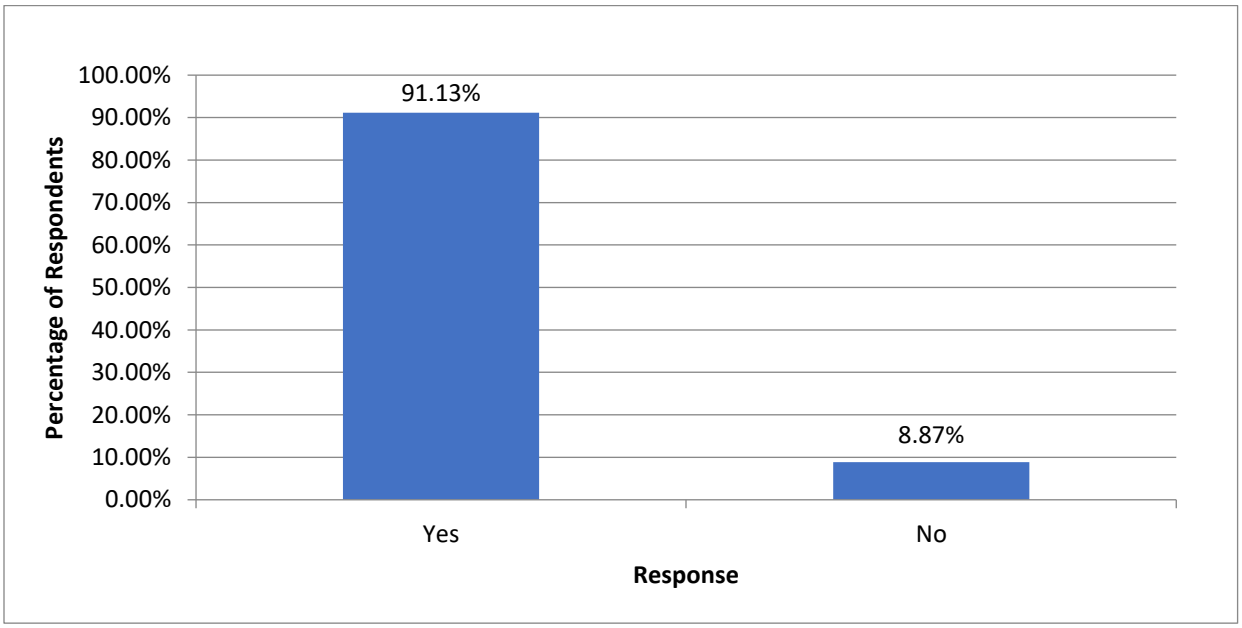
Of those respondents that stated that they did consider an EV for their last vehicle purchase, environmental benefits from using an EV ranked as the top reason for this consideration, followed by expected financial savings.

Figure 6 SEED Participants' Reasons for Considering an Electric Vehicle Purchase at Last Vehicle Purchase



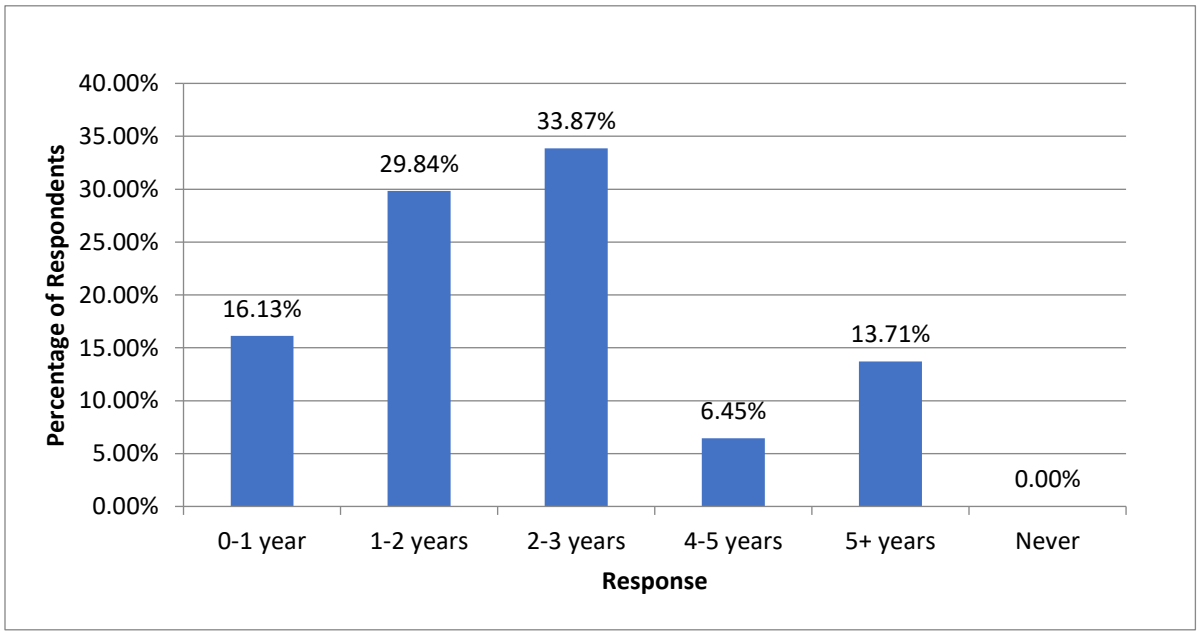
Prior to participating in the SEED Project, almost all participants stated that they would consider purchasing an EV for their next vehicle. This was the response for over 91% of participants, with only about 9% of respondents who stated that they would not consider an EV for their next vehicle purchase.

Figure 7 Would SEED Participants Consider Purchasing an Electric Vehicle at Their Next Vehicle Purchase



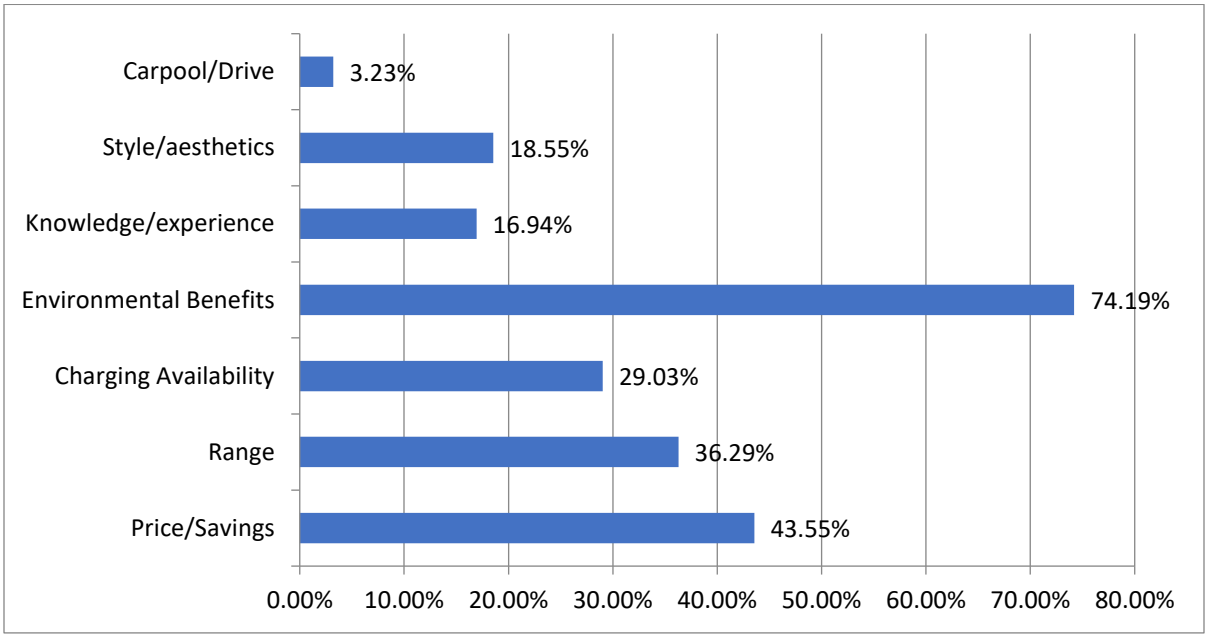
When asked when participants plan on purchasing their next vehicle, most respondents stated that they expect to make a vehicle purchase within three years.

Figure 8 When SEED Participants Plan on Purchasing Their Next Vehicle



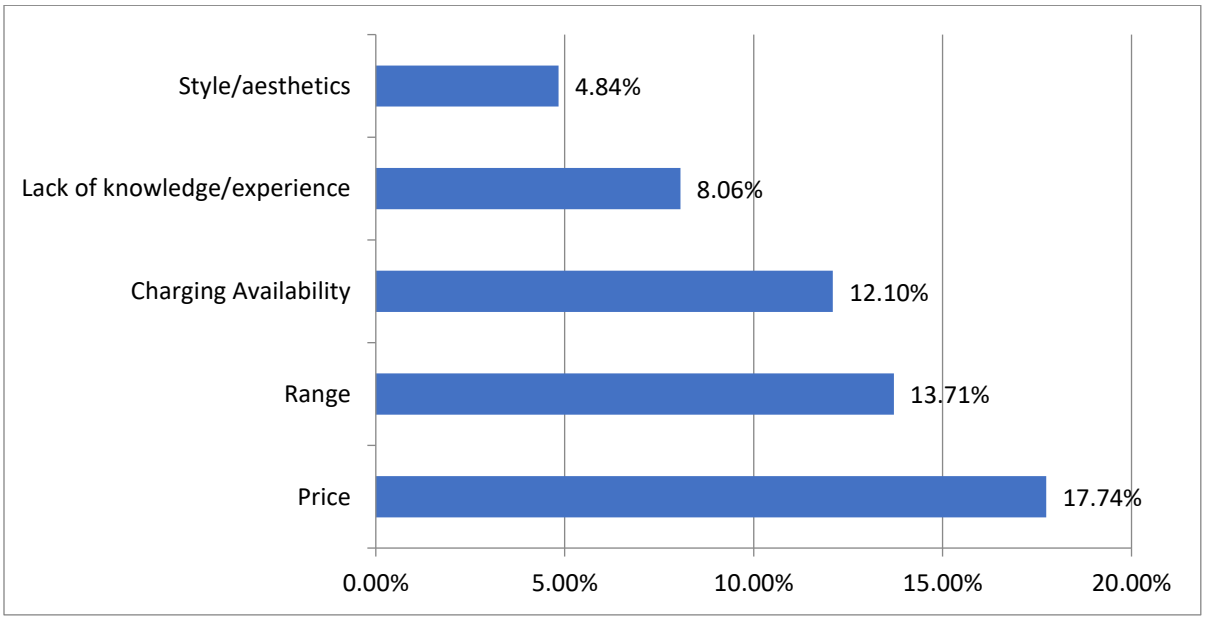
Of those participants which stated that they would consider an EV for their next vehicle purchase, environmental benefits from operating an EV was the top ranked reason for this consideration. Next in line was anticipated cost savings compared to an internal combustion engine (ICE) vehicle, followed by EV range and charging availability.

Figure 9 Reasons Why SEED Participants Would Consider Buying an Electric Vehicle



Of the respondents that stated that they would not consider an EV for their next vehicle purchase, price of EVs was the top ranked reason. This was followed by concerns about EV range, charging availability, lack of knowledge and experience with EVs, and EV aesthetics.

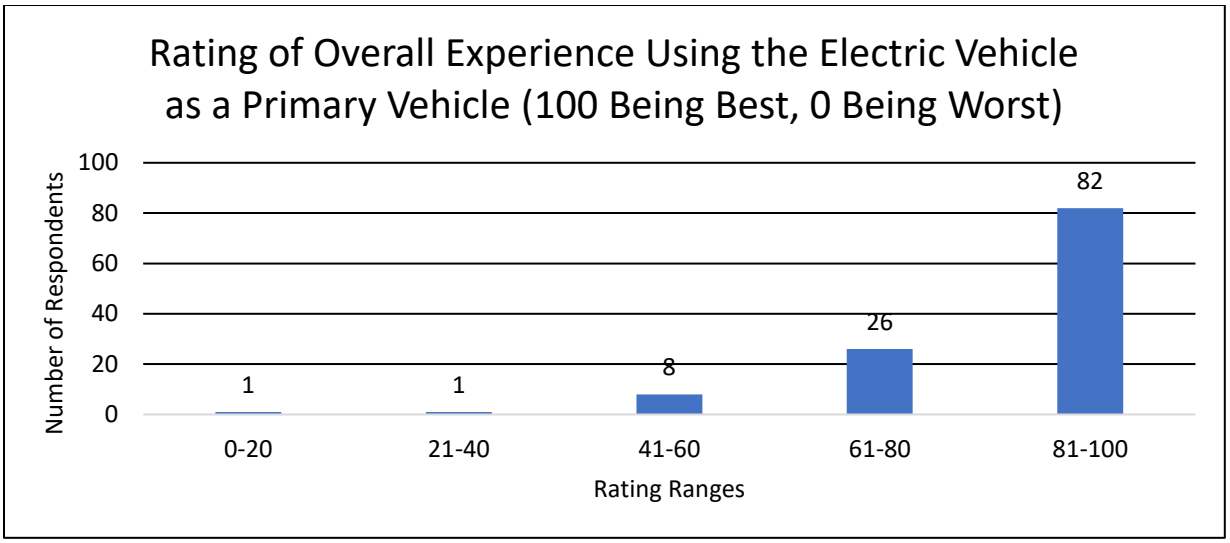
Figure 10 Why Would SEED Participants Not Consider Purchasing an Electric Vehicle



4.2.2 Post-Survey Results and Comparison with Pre-Survey Results

When asked to provide an overall rating of using the Chevrolet Bolt as a primary vehicle from 0 to 100, with 0 indicating a poor experience and 100 indicating an excellent experience, the average rating was 86.31. The most frequent rating, however, was 100. A total of 18 participants rated the Project at 100. When categorized, most participants rated the experience between an 81 and 100.

Figure 11 Rating of Overall Experience Using the Electric Vehicle



When asked to elaborate on their ratings, 58 of the comments were generally positive. Many participants highlighted that it was easy to drive the Bolt, that they did not need to use gas stations, that they were impressed with the vehicle's range, and that charging the vehicle was easy. Negative comments were focused primarily on charging issues. Some participants stated that they had issues with the amount of time it took to charge the EVs, and they had difficulty finding chargers outside of the workplace that were available. Other participants mentioned that they experienced range anxiety, and fewer stated that they had issues with the features of the car, such as the seats or display monitor.

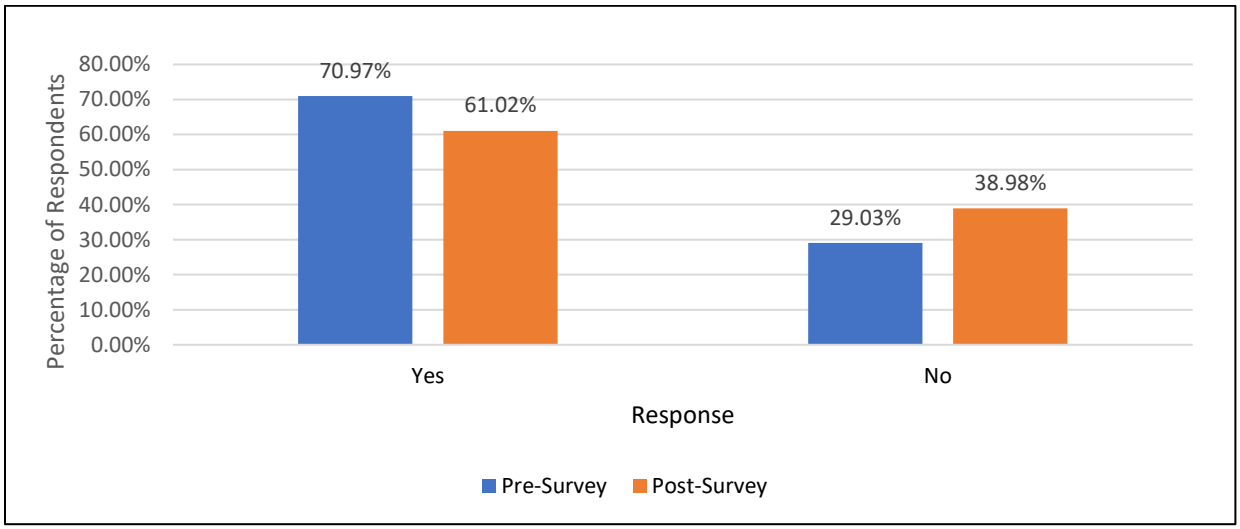
Some testimonials from the post survey include the following statements:

- "Great program. I have never considered getting an EV until now." – Andrea M.
- "Thank you for all your hard work and running this program. I definitely much more interested in purchasing an electric vehicle now." – James T.
- "I loved every second of driving it. The ride was so smooth and quiet. I loved having HOV access and the features in the car were great. It's only been a day, but I miss it already." – Alexandra B.
- "We actually bought a Bolt in the middle of our trial because we loved it so much!" – Floriane S.
- "I think it's a great program, and I'm considering leasing an electric car more seriously because of it." – Aleks G.
- "The experience was great overall and thanks to the program, my confidence level on electric vehicle has increased dramatically." Bernard C.
- "It was easy--the car drove well, I never experienced "charge stress," and I stopped even noticing gas stations while driving." – Nathan S.

- "Loved driving the Bolt for several reasons: the smoothness, knowing as I drove that I was having a much smaller carbon imprint, liked the car's features, a fun car to drive." – Rick C.

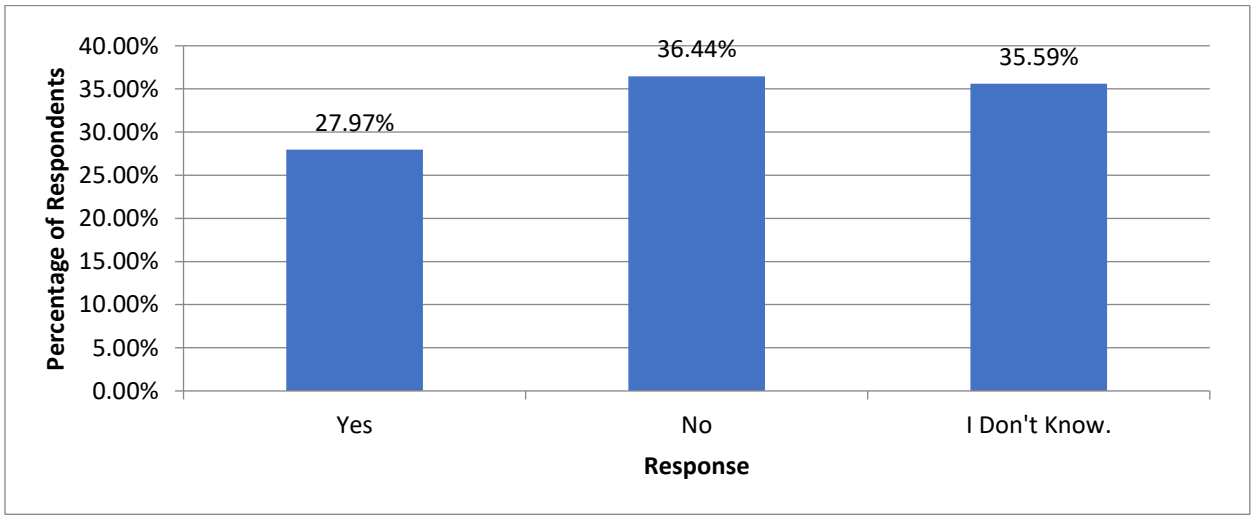
While in the pre-survey, about 71% of participants stated that they believed a sufficient number of chargers existed at their workplaces. This percentage dropped to 61% after all participants finished the SEED Project. This may be likely to new knowledge on EV charging requirements that the Project participants received as a result of participating in the Project.

Figure 12 Pre- and Post-Survey Comparison: SEED Participants' Perception of Sufficiency for Number of Chargers at Their Workplaces



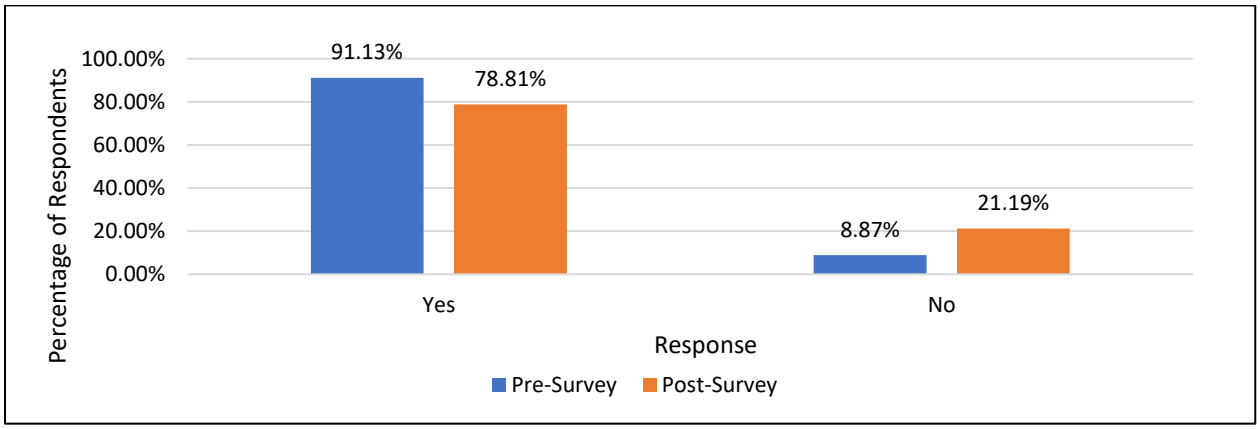
When asked if enough charging stations existed in the participants' areas to sufficiently charge the EV outside of the workplace, about 36% said no, while about 28% of participants said yes, and 36% of participants said that they did not know.

Figure 13 SEED Participants' Perception of Sufficiency for Number of Chargers Outside Their Workplaces



While about 91% of Project participants stated, before participating in the SEED Project, that they would consider an EV for their next vehicle purchase, that percentage dropped to about 79% after the Project. This drop could be attributed to new knowledge on the realities of owning and operating an EV as a result of participating in the SEED Project. While the responses to this question shows a drop in interest in EVs after participating in the SEED Project, there were several participants that were positively impacted by the Project. In the post-survey, three participants stated that they had already purchased or were in the process of purchasing an EV as a result of participating in the Project. Ten participants stated that they were seriously considering the purchase of an EV as a result of the Project. And, two participants stated that they had plans to lease EVs as a result of the Project.

Figure 14 Pre- and Post-Survey Comparison: Would SEED Participants Consider an Electric Vehicle for Their Next Vehicle Purchase?



After participating in the Project, participants were asked again to rank the reasons why they would consider purchasing an EV. In the pre-survey, environmental benefits ranked as the biggest factor in considering buying an EV, followed by anticipated financial savings, range, and charging availability. These results shifted in the post-survey with vehicle range ranking as the top reason for considering an EV, followed closely by environmental benefits, and then by price/cost savings, and charging availability.

Figure 15 Pre-Survey: Reasons Why SEED Participants Would Consider Buying an Electric Vehicle

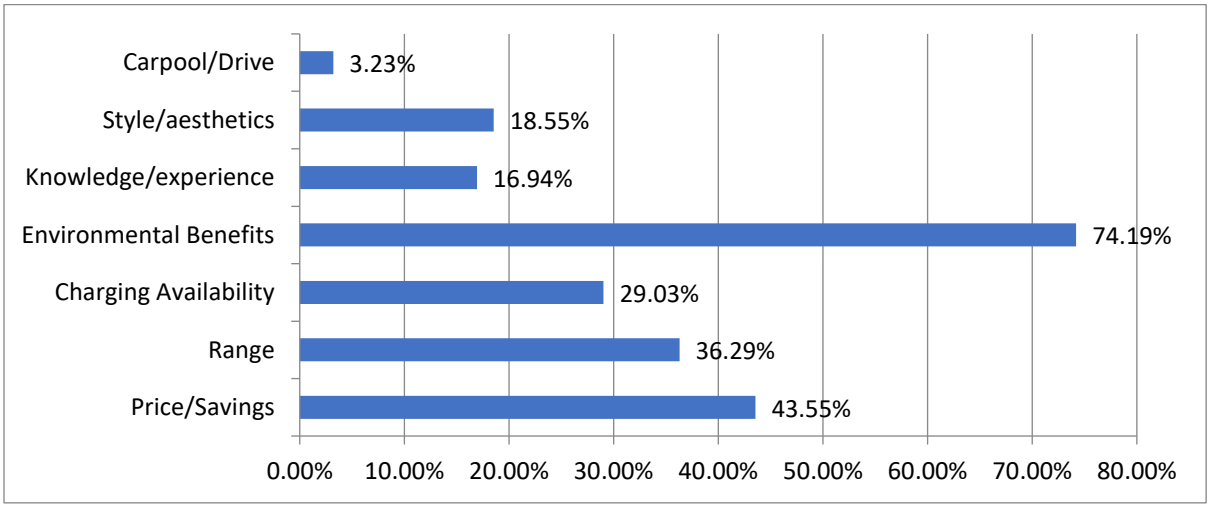
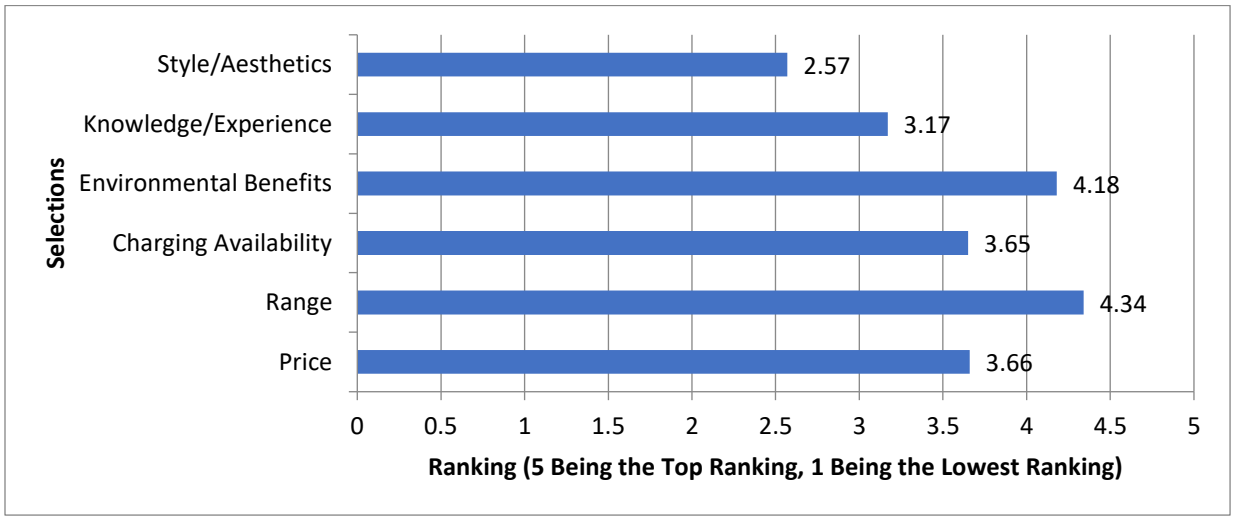


Figure 16 Post-Survey: Reasons Why SEED Participants Would Consider Buying an Electric Vehicle



Likewise, participants were asked to explain why they might not consider purchasing an EV after they took part in the SEED Project. In the pre-survey, concerns about EV prices ranked as the top reason hindering consideration of an EV purchase, followed by range, charging availability, lack of experience with EVs, and aesthetics. These rankings changed slightly in the post-survey. The top reason continued to be concerns regarding price, but the second biggest concern was then charging availability, followed by range, aesthetics, and lack of experience with EVs.

Figure 17 Pre-Survey: Reasons Why SEED Participants Would Not Consider Buying an Electric Vehicle

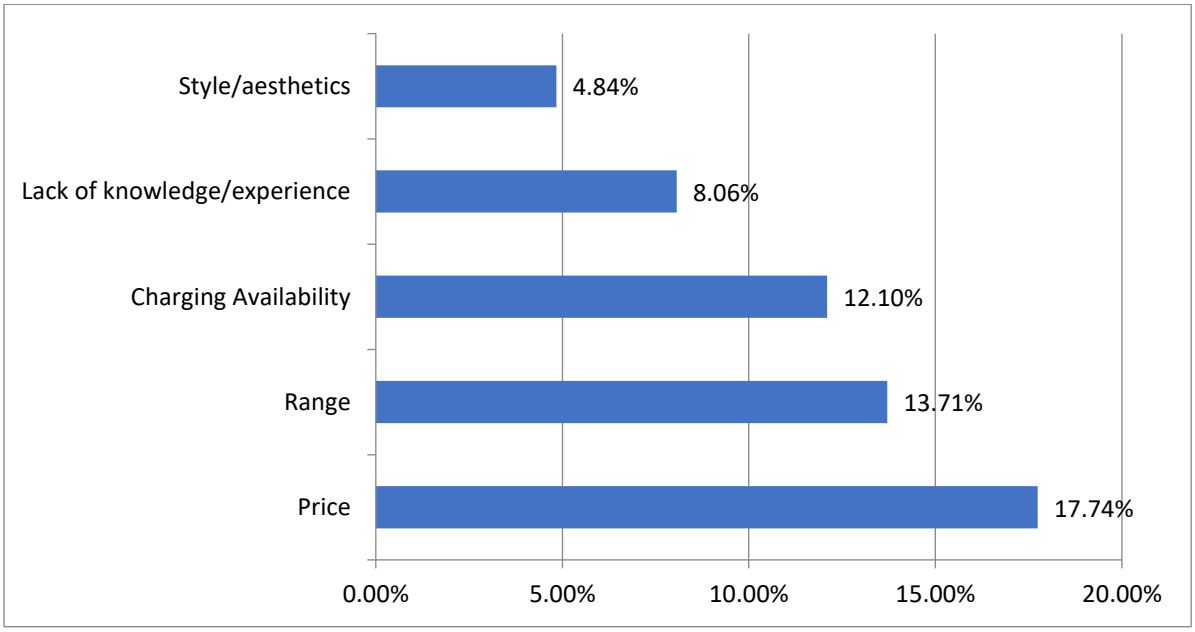
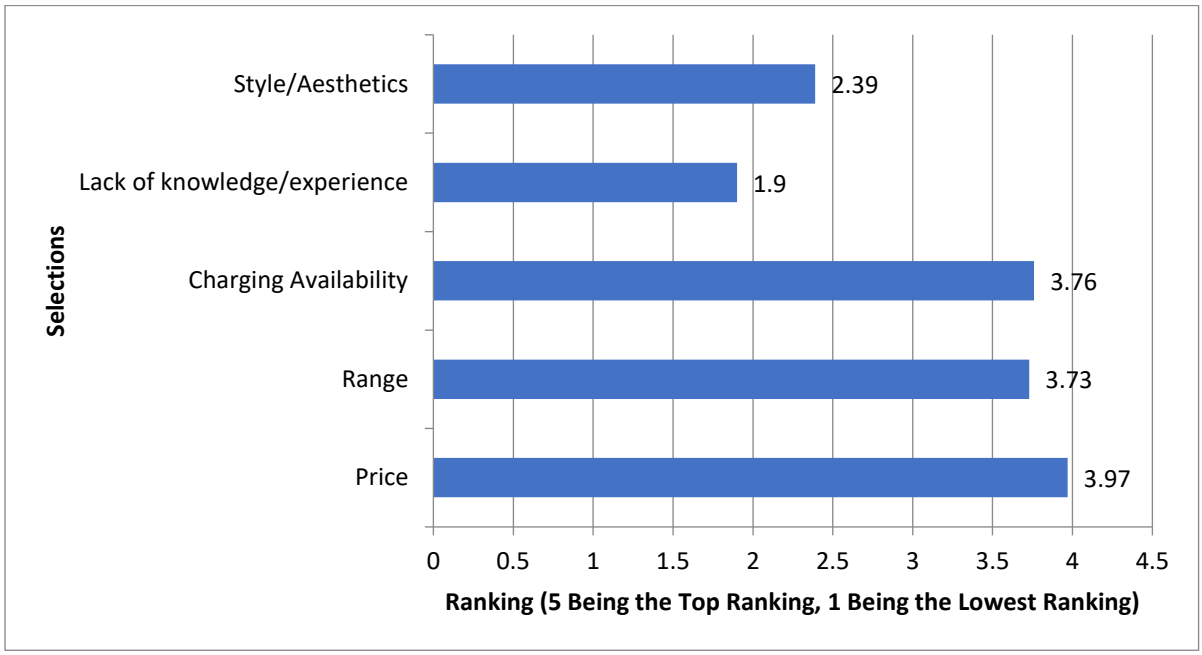
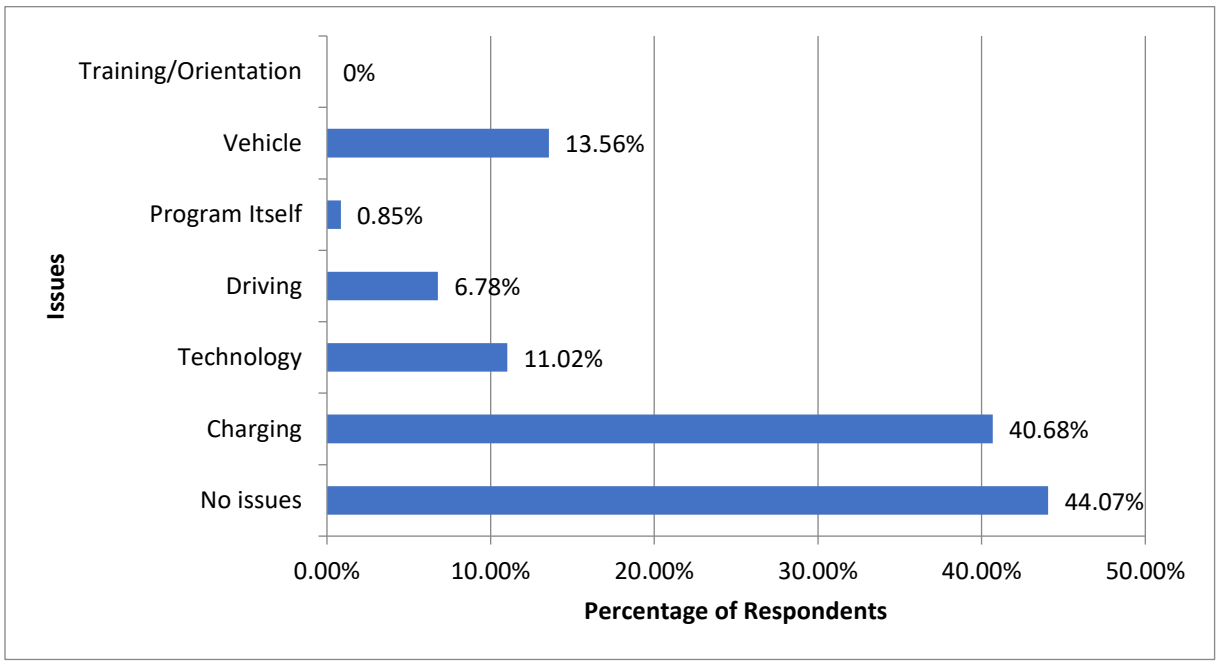


Figure 18 Post-Survey: Reasons Why SEED Participants Would Not Consider Buying an Electric Vehicle



When asked if participants had any issues during the SEED Project, participants gave various answers. While most participants reported no issues, of the issues experienced, many were due to vehicle charging. Respondents stated issues regarding the amount of time it took to charge the EV, charging interruptions, and difficulty finding available charging stations. Other commonly reported issues were focused on the vehicle and its technology, such as issues with the radio and with the interior's display screen.

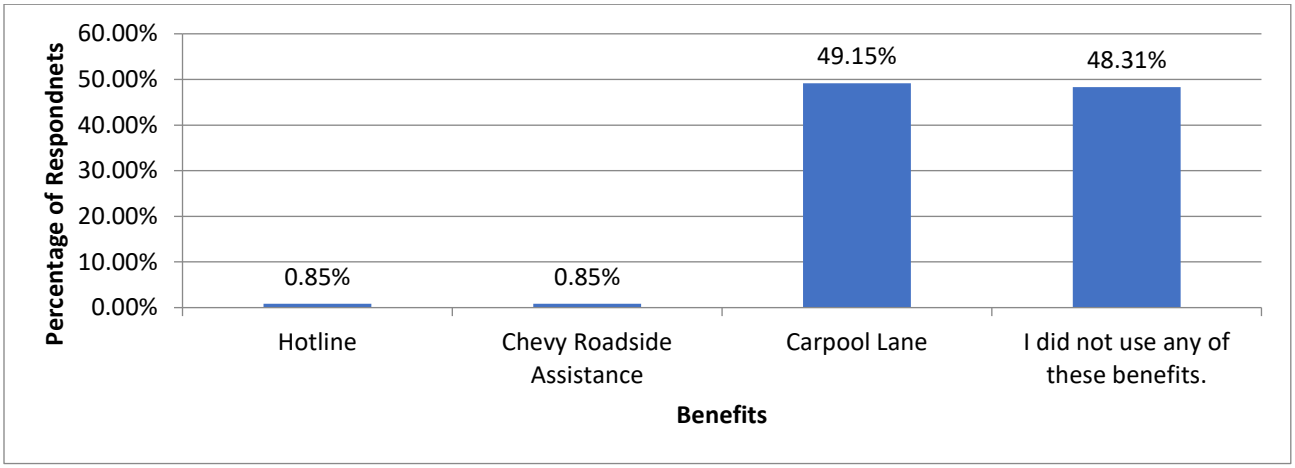
Figure 19 Issues Experienced by Participants During SEED Project



When asked to provide additional comments regarding the SEED Project, after taking part in it, 63 participants provided generally positive comments. Three participants were so impressed with the Project that they had either purchased or were in the process of purchasing an EV after they finished the Project. In the post-survey, three participants stated that they had already purchased or were in the process of purchasing an EV as a result of participating in the Project. Ten participants stated that they were seriously considering the purchase of an EV as a result of the Project. And, two participants stated that they had plans to lease EVs as a result of the Project.

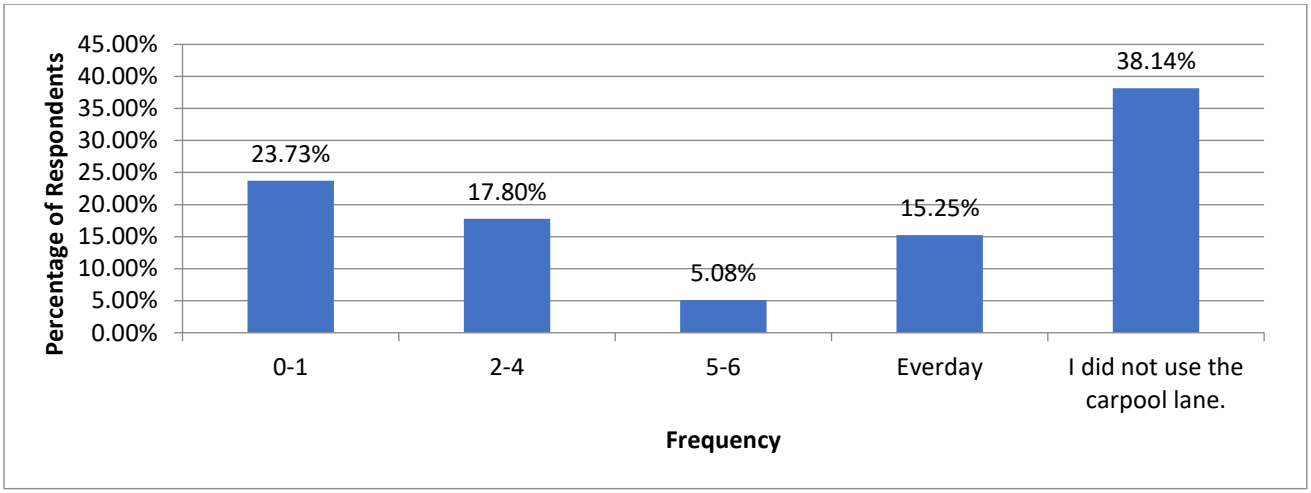
During the SEED Project, almost half of the participants used the carpool lanes, and took advantage of the California state sanctioned ability for EVs to drive in those lanes without multiple vehicle occupants. Less than 1% used the Project's help hotline, and less than 1% of participants used Chevrolet Roadside Assistance. About 48% of participants did not use any of the Project benefits offered to them.

Figure 20 SEED Project Benefits Used by Participants



Of those participants who used carpool lanes, about 24% of them used them about once a week%. About 18% of participants used carpool lanes two to four times per week, about 5% used them five to six times per week, and about 15% of participants used them every day during their trial.

Figure 21 Frequency of Carpool Lane Use by SEED Participants



Additional data analysis on survey and vehicle telematics that were not relevant to this Project can be found in Appendix F.

5. Conclusions

The SEED Project had three distinct goals, which are restated below with an assessment of their progress:

1) Increase acceptance and deployment of EVs in the consumer marketplace

Acceptance of EVs was generally high and positive, as the overall interest in buying or leasing an EV exceeded 75 percent in both the pre-trial and post-trial survey. The percentage of participants indicating interest in EVs for their next vehicle dropped from 91.1 percent in the pre-trial survey to 78.8 percent of in the post-trial survey. This drop could be attributed to a better understanding that participants developed on owning and operating EVs. Respondents who indicated that they would not consider buying an EV were asked to elaborate on their reasons, the top three reasons were high vehicle prices, concerns regarding charging availability, and concerns about range. There is reason for optimism that each of these concerns will be allayed shortly, however, as battery prices (and consequently new EV model prices) drop and the City of Pasadena with Pasadena Water and Power continue to expand vehicle and charging station rebates and installations. For example, the City of Pasadena now hosts the largest publicly available DC fast charging hub in the United States,[11] with a total of 44 fast-charging stations (of which 24 are reserved for Tesla drivers) openly accessible in downtown Pasadena. Continued efforts by the City of Pasadena and Pasadena Water and Power will help ease drivers' transitions to EVs.

The remaining 78.8 percent of respondents indicating a positive opinion of EV ownership provide reason for optimism. After operating an all-electric vehicle for two weeks as their personal vehicle, nearly four out of every five respondents would still consider EV ownership with the benefit of having a greater understanding of the vehicle technology and the infrastructure requirements than before their trials. Though the SEED Project does not track follow-on purchases for participants, it could reasonably be expected that the Project influenced some percentage of participants to lease or purchase an EV as their next vehicle.

2) Increase employer acceptance, adoption, and installation of workplace charging

Participating drivers in the trial phase came to realize and highlight the importance of abundant workplace charging. In the pre-trial survey, 71 percent of participants stated that they believed there were enough chargers at their workplace, but in the post-trial survey the percentage of responses indicating adequate capacity dropped to 61. A few of the workplaces that participated in both phases realized that there was a need to expand the charging stations at their facilities. These workplaces are currently in the process of installing more chargers at their facilities. They are also taking advantage of Pasadena Water and Power's Commercial EV Charging Station Rebates.

Large workplaces in Pasadena with employee EV programs should assess their current workplace charging and determine if more chargers are necessary to accommodate current use and encourage increased EV adoption. Employers benefit from their employees' uptake of EV commutes – the City of Pasadena

[11] Information on the City of Pasadena's new DC fast charger deployment can be found at https://www.pasadenastarnews.com/2019/03/11/pasadena-approves-agreement-with-tesla-for-largest-fast-charging-site-in-western-u-s/

requires large employers that provide parking facilities to report the number of vehicles that come into their facilities to SCAQMD under Rule 2202. Each employer is required to control or reduce the number of passenger vehicle commutes to the workplace, and EVs are not counted as commuter vehicles for the purposes of accounting under Rule 2202. Therefore, investing in workplace charging gives every employer the opportunity to reduce polluting commutes that negatively impact their regional clean air obligations by supporting their employees' adoption of EVs.

3) Educate at least 100 Pasadena employers and their employees about the benefits of EVs and workplace charging

The third goal of this Project was surpassed with 126 employees participating in the extended trials. This point is presented below as a key takeaway from the SEED Project, along with a couple other important conclusions.

The SEED Project gave 126 people the opportunity to "test-own" an EV, with 86 of them having their first experience driving an EV.

As just described, 126 SEED participants drove a Chevrolet Bolt for two weeks each. This surpassed the original goal for this Project to educate at least 100 Pasadena employers and employees about the benefits of EVs and workplace charging. Additionally, 86 of those 126 participants experienced driving an EV for the first time based on survey responses. While 126 employees participated in the extended trials, the SEED Project was able to reach a larger audience when conducting employer outreach.

The average overall rating for the SEED Project was high at 86.31 out of 100. Most comments on the Project and the EVs were positive, and negative comments were generally focused on charging issues.

On average, the overall rating for driving the Chevrolet Bolt by SEED Project participants was an 86.31 out of 100. This indicates that the Project was seen favorably by most participants. Most comments about the Project and the vehicle were positive, with most comments focused on how easy participants thought it was to drive the EVs, how impressed they were with the range of the EVs, and how they enjoyed not stopping for gasoline. Negative comments focused primarily on charging issues, specifically the amount of time it took to charge the EV as well as the lack of chargers available outside of the workplace. Additionally, as seen in the survey results, the amount of people who thought their workplaces had enough chargers dropped in the post-survey compared to the pre-survey, although the percentage of those respondents still represented many Project participants.

Most participants stated that they would consider purchasing an EV, both before and after the Project, however the percentage of participants with this view dropped in the post-survey.

In both the pre-survey and the post-survey, most Project participants stated that they would consider purchasing an EV. In the post-survey, however, the percentage of participants stating that they would consider purchasing an EV dropped from 91.13% to 78.81%. While this drop did occur, there is also empirical evidence that the Project had a positive impact on some participants. In the post-survey, three participants stated that they had already purchased or were in the process of purchasing an EV as a result

of participating in the Project. Ten participants stated that they were seriously considering the purchase of an EV as a result of the Project. And, two participants stated that they had plans to lease EVs as a result of the Project.

For participants that would consider purchasing an EV, the top three reasons for doing so were impressions of vehicle range, environmental benefits, and anticipated financial savings. For participants that would not consider purchasing an EV, the top three reasons were concerns about the vehicle's price, charging availability, and concerns about range.

6. Discussion

6.1 Recommendations to City of Pasadena

The SEED Project provided valuable real-world information about everyday drivers and commutes in the City of Pasadena. Based on the experiences reported and the data recorded, CALSTART recommends that the City of Pasadena and Pasadena Water & Power review the following strategies and considerations to prepare for and enable EV uptake in workplaces.

These strategies and considerations address the three principal reasons that participants listed when considering adopting an EV in the future: charging availability, range, and price. Though some of the recommended actions may take months or years to enact, the survey results indicate that many drivers will not be considering a new vehicle for at least one to three years, giving the city and utility ample time to scope and implement plans.

Additional to the following strategies, CALSTART recommends continuing or otherwise replicating aspects of the SEED Project. This Project brought awareness to the benefits of EVs and workplace charging to many that were unaware of the technology, and in a way that would benefit employees, employers, and the greater Pasadena community. Additional regions of Pasadena may benefit from a hands-on introduction to EVs and the charging infrastructure associated with the vehicles. At a smaller scale than a full replication of the SEED Project, hosting a free workshop for residents and workplaces can highlight the benefits and the ease of switching over to an EV. An effective workshop would educate the audience about the technology and the process of purchasing an EV, how to charge an EV, and how to purchase and install a charging station. Having an EV to showcase, and preferably to drive, enabled the Project to gain a large participation pool for the extended trials.

Charging Availability: Participants indicated that charging availability was the single biggest concern during their two-week trial of operating an EV as their personal vehicle. Before the Project, most participants thought that there were enough charging stations at their workplace; after the trial, a larger percentage of participants thought that number of charging stations was inadequate. At the end of the trial, fewer than 30 percent of participants felt that publicly available charging fit their needs. These attitudes signal a need to increase the charging availability at workplaces and within the Pasadena community. During the second half of the Project, Pasadena Water & Power began offering an incentive to install commercial and residential charging stations. The City has also facilitated public-private partnerships to install large-scale DC fast charging. Continued efforts to make workplace, residential, and public charging more affordable and accessible will directly reduce one of the most persistent barriers to local commuter EV adoption. The City and utility should continue to offer EV infrastructure incentives and

monitor the usage of publicly available charging to ensure that charging access is readily available to all drivers and is affordable.

To strategically locate these stations with an emphasis on supporting clean commutes, additional workplace charging assessments may be needed to determine new locations to install chargers and existing locations where charging can be expanded. The City can continue to engage with regional workplaces on educating employees on EV benefits to build demand for EV charging at workplace parking facilities.

Vehicle Range: Most EV trial participants use personal vehicles as their main source of transportation, but the ranges driven indicate that the all-electric Bolt's range of greater than 200 miles was more than enough for commuter needs. When participants used the SEED Project EVs, they drove an average of 34.18 miles and used approximately 9.31 kWh per day. Clearly participants that are concerned about range are mostly fixated on the rarer use cases, such as road trips. Typically, DC fast-charging stations are the technological solution that is used for long-distance travel because they most approximate the current gas station model. To enable any long journeys, or to help drivers complete their journeys, Pasadena Water & Light should review travel corridors within the city and ensure that any gaps are serviced by adequate numbers of DC fast-charging stations with enough charging capacity.

Because charging in the SEED Project predominantly took place during standard business hours and residential charging was limited, most drivers preferred to charge their vehicles in the morning, midday, and afternoon. As EV adoption grows, the City of Pasadena and the municipal utility, Pasadena Water & Power should be able to forecast regular charging activities and prepare for this energy demand from commercial locations, in addition to supply the electricity for the more rarely used corridor DC fast-charging stations.[12]

Lastly, as the SEED Project fleet was comprised exclusively of all-electric Chevy Bolts, drivers were not able to explore the range of EV models, particularly for plug-in hybrid EVs that do not create range anxiety because they have auxiliary gasoline tanks. Future education projects could be expanded to include more diverse types of EVs, such as SUV models that are recently and soon arriving to market that fit consumers' growing demand for larger passenger vehicles. A few of the participants of this Project were not fond of the specific vehicle and introducing them to various brands of EVs could help them find the right EV for their daily lives.

Vehicle Price: EVs typically cost more to purchase or lease than an equivalent gasoline-powered vehicle. With purchase incentives and the lower cost of electricity as a fuel relative to gasoline, however, EVs can be extremely cost-effective. One persistent difficulty for transitioning the vehicle-buying public to electric drive is helping consumers understand the various options that will make EVs more affordable. Currently Pasadena Water & Power offers a vehicle incentive to residents in the City of Pasadena, which is offered

[12] Studies have shown that even when residential charging is readily accessible, workplace charging remains highly used for "topping off" or fully charging EVs. Therefore, even though participants in this study are typically obligated to charge during standard business hours because they likely had limited access to residential charging, it can be inferred that the demand for EV charging at workplaces should not be expected to fall even when commuters are able to charge their vehicles at home. In many cases, workplace charging can act as a substitute for residential charging, further enabling regional EV adoption. Where workplace and residential charging are available, public charging is rarely needed, typically used only when absolutely needed to complete a journey. https://avt.inl.gov/sites/default/files/pdf/arra/PluggedInSummaryReport.pdf

on top of any state and federal incentives for purchasing or leasing a qualifying EV. Unfortunately, 60.5 percent of Project participants did not know of any local or state vehicle purchase incentives and 38 percent of participants did not know if their workplaces offered any additional incentives.

Both before and after their driving trials, participants rated the higher cost of EVs as the single biggest barrier to their willingness to adopt EVs for their next vehicle purchase or lease. To overcome this barrier, the City of Pasadena and Pasadena Water & Light may provide greater outreach and education to residents that provide simple explanations of the various ways to save money on purchasing or leasing an EV, and separately to provide estimates for residential, daytime, and DC fast-charging energy prices on a rough per-gallon-of-gasoline equivalent that shows the potential savings of switching to EVs.

6.2 Recommendations for Other Entities Interested in a Similar Project

Project Specifics: To have another project like the SEED Project, it is recommended to make the process of installing workplace charging and extended trials with EVs as easy as possible. Employers need to have assistance with installing workplace charging. In addition to workplace charging, it is helpful to have further charging accessibility in the region.

If the region is large, then having a larger fleet of six vehicles can cover more of the area if there is a working charging network. A larger fleet allows for more participants in extended trials and more potential to accommodate Ride and Drive opportunities. In addition to a larger fleet, a region may want to consider a more diverse fleet. Depending on the region, it is important to pick the right vehicle or vehicles for the project. Having a variety of vehicles allows participants to find the right fit for their lives. While each participant in the extended trials received the EV for two-weeks, trial phase timeline or the project timeline may need to be altered to accomplish their goals.

Outreach: A successful project similar to the SEED Project, requires a significant outreach effort. The project must gain the support from employers and their employees. To gain interest from employers, it is recommended to host to attend a meeting with local businesses to discuss transportation issues at their facilities. The City of Pasadena has a Transportation Management Association that hosts meetings, where the SEED Project presented on the benefits of EVs and EV chargers. These meetings were beneficial so that the project can find employers that have emission goals and were interested in EVs. These workplaces were easily convinced to participate in the project because they already had some interest.

Attending workplaces' events to gain participation was extremely critical to gain awareness and participation from employees. The Project attended a few Earth Day events that were hosted by the workplaces. Employees were often encouraged to attend with a food incentive or a raffle where they had to attend each of the booths to be eligible. Having a table at these events brought awareness to the Project and in general EV technology, it garnered support and participation from those who were open to the technology.

Incentives: Lastly, incentives are critical to awareness building and adoption. When outreaching to potential participants it was extremely useful to have information on incentives available to participants. Incentives that were readily available to the participants made adopting an EV a reality for many of them. Incentives encouraged people to participate to see if the vehicle could fit in their regular activities. The Project showed not only the environmental benefits but the financial ones as well.

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7. Appendix A: Outreach Factsheet

Shared EV Employer Demonstrator (SEED) Program

The **SEED Pasadena Program** is a joint project between LA Metro, Pasadena Department of Transportation, and CALSTART designed to increase the education, acceptance, and adoption of Electric Vehicles (EVs) and workplace charging in the City of Pasadena.

The program is ***free*** to participate and offers a unique opportunity for employers & employees in Pasadena to gain first-hand experience with EVs through extended trials and to obtain consultation and guidance on charger installations at no cost!

Extended trials with EVs

- CALSTART will hand off up to 6 brand new Chevy Bolts to each employer for a 2-6 week period (vehicles will be fully registered, insured, and prepped for the program).
- Each participant will use the vehicle as their primary mode of transportation for 2 weeks. (Vehicles can also be used as a company car.)
- Participants will use workplace chargers as their primary charging source. The workplace must have chargers available (in their parking lot or nearby) in order to qualify, or must be willing to install chargers.

Charger Installation Support

- CALSTART will provide informational materials about the benefits of EVs and installing chargers at the workplace. CALSTART can present on this information to help garner support.
- CALSTART will guide workplaces through choosing the right chargers, finding the right electrician, and utilizing rebates to make the process as easy and simple as possible.
- CALSTART's partner, GreenCommuter, will manage the entire purchasing, installation, and rebate process at a discounted rate through the program.

What is Expected of You?

- Each participant and ETC must complete a survey before and after their participation. Each survey may take up to 10 minutes to complete.
- Participating workplaces must have chargers installed or must be willing to install chargers.

Metro | PASADENA DEPARTMENT OF TRANSPORTATION | CALSTART

Kasey Okazaki | kokazaki@calstart.org | 626 744 5630

8. Appendix B: Orientation Factsheet

PASADENA DEPARTMENT OF TRANSPORTATION

CALSTART

greencommuter It's how we roll.

SEED Pasadena

Shared Electric Vehicle Employee Demonstrator Program

SEED

Your Car & Charging

Charging Outside of Work
We highly recommend you download the PlugShare mobile app, which shows you all of the charging stations near you. This is the best way to ensure there's always a charger when you need it.

Chevy Roadside Assistance
1-888-811-1926
Chevrolet's Roadside Assistance can be used for light services (jump-starts, flat tire and lock- outs) or make arrangements to tow your vehicle to the nearest Bolt EV Authorized Chevrolet dealer.

Program Information

- Only YOU can drive the program vehicle. The program insurance will not qualify for other drivers.
- The vehicle CANNOT leave the state of California.
- Please keep the car clean for the next participant.
- There's no mileage limit! Feel free to drive as much as you'd like, but please be sure to plan out your charging if you take a long trip.
- Please keep track of any charging expenses you incur during the program!

SEED Prize Competition

Enter for a free chance to win great prizes including Visa gift cards, gift baskets, and others. Follow these easy steps for a chance to win:

- Take a picture of / with your program vehicle during your 2-week trial
- Post the picture on our Facebook page (https://fb.me/SEEDPasadena) @SEEDPasadena

That's it! Feel free to post more than one photo. We will be selecting winners throughout the program.

SEED Pasadena

Contact Information

Vehicle Concerns or Questions

For questions or concerns regarding your vehicle, including service issues, charging issues, etc. please reach out to GreenCommuter: carshare@greencommuter.org / 844-474-3342

- Agustin Occhiuzzo, Operations Manager, GreenCommuter
  - aocchiuzzo@greencommuter.org

Program Concerns or Questions

For questions or concerns regarding the program including your vehicle start and end dates, communications with your workplace / building, and anything else that doesn't apply directly to the vehicle, please reach out to CALSTART staff:

- Kasey Okazaki, SEED Project Manager, CALSTART
  - kokazaki@calstart.org / 626-744-5630

9. Appendix C: Shared EV Employer Demonstration Pre-Survey

1. What is your name?
2. Please select your gender.
    a. Male
    b. Female
    c. I do not wish to answer
3. Please select your highest level of education.
    a. Less than High School
    b. High School
    c. Associates Degree/Trade School
    d. Bachelors Degree
    e. Higher Education
    f. I do not wish to answer
4. Zip Code of Residence
5. What is your Primary Vehicle?
    a. Make
    b. Model
    c. Year
    d. Please put N/A, if you do not have a primary vehicle
6. Estimated Miles Traveled Per Week
7. What are your primary sources of transportation? Select all that apply.
    a. Walking
    b. Biking
    c. Public Transportation
    d. Carpool/Rideshare
    e. Personal Car
8. How long (miles) is your daily commute to and from work?
9. How much (dollars) do you spend on gas per month?
10. Have you ever driven an Electric Vehicle?
    a. Yes
    b. No
11. Are you aware of any local or state incentives for purchasing an electric vehicle?
    a. Yes
    b. No
12. If you are aware of any incentives, please write them in below. If not applicable, please write N/A.
13. Does your workplace currently offer benefits/incentives for driving an electric vehicle?
    a. Free charging
    b. Better parking
    c. Monetary incentive
    d. No
    e. I don’t know
    f. Other (please specify)
14. Do you believe that there are enough chargers at your workplace?

    a. Yes
    b. No
15. For your last vehicle purchase, did you consider an electric vehicle?
    a. Yes
    b. No
16. Why did you not consider purchasing an electric vehicle for your last purchase? Select all that apply.
    a. Price
    b. Range
    c. Charging Availability
    d. Lack of knowledge/experience
    e. Style/Aesthetics
    f. I did consider purchasing an electric vehicle.
    g. Other (please specify)
17. Why did you consider purchasing an electric vehicle for your last purchase? Select all that apply.
    a. Price
    b. Range
    c. Charging Availability
    d. Environmental Benefits
    e. Knowledge/experience
    f. Style/aesthetics
    g. I did not consider purchasing an electric vehicle.
    h. Other (please specify)
18. When do you plan on purchasing your next vehicle?
    a. 0-1 year
    b. 1-2 years
    c. 2-3 years
    d. 4-5 years
    e. 5+ years
    f. Never
19. Would you consider purchasing an electric vehicle for your next vehicle?
    a. Yes
    b. No
20. If you are considering to purchase an electric vehicle, please select why. Select all that apply.
    a. Price
    b. Range
    c. Charging Availability
    d. Environmental Benefits
    e. Knowledge/experience
    f. Style/aesthetics
    g. I am not considering to purchase an electric vehicle.
    h. Other (please specify)
21. If you are not considering to purchase an electric vehicle, please select why. Select all that apply.
    a. Price

b. Range
c. Charging Availability
d. Lack of knowledge/experience
e. Style/aesthetics
f. I am considering to purchase an electric vehicle.
g. Other (please specify)

22. By clicking “I Agree”, you understand that participating in this project may require some time from you during work hours (less than 1 hour total for orientation & vehicle pick up / drop off). We highly recommend that you discuss this with your employer to ensure they are aware of the time commitment.
    a. I Agree

10. Appendix D: Shared EV Employer Demonstration Post-Survey

1. What is your name?
2. Please select your gender.
    a. Male
    b. Female
    c. I do not wish to answer.
3. Please select your highest level of education.
    a. Less than High School
    b. High School
    c. Associates Degree/Trade School
    d. Bachelors Degree
    e. Higher Education
    f. I do not wish to answer.
4. Zip Code of Residence
5. Please rate your overall experience using the electric vehicle as your primary vehicle. (0 being a bad experience and 10 being a great experience)
    a. Slider provided ranging from 0 to 10
6. Please explain why you picked the number in the previous question.
7. Please select any of the project's benefits that you used during the project.
    a. Hotline
    b. Chevy Roadside Assistance
    c. Carpool Lane
    d. I did not use any of these benefits.
    e. Other (please specify)
8. How often did you use the carpool lane each week?
    a. 0-1
    b. 2-4
    c. 5-6
    d. Everyday
    e. I did not use the carpool lane.
9. Approximately, how much did it cost to charge the vehicle during the trial?
10. Do you believe that your workplace has enough charging stations?
    a. Yes
    b. No
11. Do you believe that there were enough charging stations in your area to sufficiently charge the vehicle outside of the workplace?
    a. Yes
    b. No
    c. I Don't Know.
12. Would you consider purchasing an electric vehicle for your next vehicle?
    a. Yes
    b. No
13. If you are considering to purchase an electric vehicle please rank why. (1 as top reason and 5 as least reason)

    a. Price
    b. Range
    c. Charging Availability
    d. Environmental Benefits
    e. Knowledge/Experience
    f. Style/Aesthetics
14. If you are not considering to purchase an electric vehicle, please rank why. (1 as top reason and 5 as least reason)
    a. Price
    b. Range
    c. Charging Availability
    d. Lack of knowledge/experience
    e. Style/Aesthetics
15. Please select any of the following issues that you experienced during the project. Select all that apply.
    a. I did not encounter any issues.
    b. Charging
    c. Technology
    d. Driving
    e. Project Itself
    f. Vehicle
    g. Training/Orientation
    h. Other (please specify)
16. Please elaborate on any of the issues you selected above.
17. Would you like to be made aware of local and state benefits regarding electric vehicles?
    a. Yes
    b. No
18. Do you have any comments/suggestions regarding the pick-up and drop-off of the vehicle?
19. Please leave any other comments you have about your experience with the vehicle.

11. Appendix E: Fleet Carma Data Parameters

Table 5 FleetCarma Fleet Summary Data Parameters

Parameter Name	Parameter Unit	Parameter Description
First Odometer	Miles	First odometer reading for the time-period selected
Last Odometer	Miles	Last odometer reading for the time-period selected
Total Distance	Miles	Total distance driven for the time-period selected
Average Daily Distance	Miles	Average daily distance driven within the time-period selected
Number of Days Driven	Days	Number of days driven in the time-period selected
Fuel Efficiency	Miles per Gallon Equivalent	Average fuel efficiency in the time-period selected
Fuel Usage	Gallons	Gallons of fuel used in the time-period selected
Idle	Percentage	Percentage of time spent idle in the time-period selected
Idle Fuel Usage	Gallons	Gallons of fuel used while idle in the time-period selected
Electricity Usage	Kilowatt-hours	The total amount of kilowatt-hours used by the vehicle in the time-period selected
Standard Charge	Kilowatt-hours	The total amount of kilowatt-hours charged into the vehicle's battery using standard Level 2 charging during the time-period selected
Quick Charge	Kilowatt-hours	The total amount of kilowatt-hours charged into the vehicle's battery using Level 3 quick charging during the time-period selected
GHG Emissions	Pounds	Estimated tailpipe greenhouse gas emissions emitted during the time-period selected
Hard Acceleration	Percentage	Percent of total acceleration deemed "Hard Acceleration" which occurred in the time-period selected
Hard Braking	Percentage	Percent of total braking deemed "Hard Braking" which occurred in the time-period selected
State-of-health (battery)	Score (0-100)	State-of-health of the battery, as measured over time.
EV Fraction	Percentage	The percentage of miles driven on the battery versus the total number of miles driven.
Powertrain	N/A	A listing of the powertrain type used during the time-period selected (e.g. battery electric)

Table 6 FleetCarma Fleet-level Monthly Comparison Data Parameters

Parameter Name	Parameter Unit	Parameter Description
Number of Vehicles	Number	Number of vehicles for which data is compared
Average End SOC	Percentage	Average SOC at the end of driving events per month during the time-period specified

Average Start SOC	Percentage	Average SOC at the start of driving events per month during the time-period specified
Quick Charge	Kilowatt-hours	Total amount of energy charged into the vehicles using Level 3 quick charging per month during the time-period specified
Standard Charge	Kilowatt-hours	Total amount of energy charged into the vehicles using Level 1 or Level 2 charging per month during the time-period specified
Daily Distance for Fleet	Miles	Average daily distance traveled by all vehicles per month during the time-period specified, based on calendar day.
Total Distance	Miles	Total distance traveled by all vehicles per month during the time-period specified
Total Distance per Vehicle	Miles	Average distance traveled by vehicle per month during the time-period specified
Battery Energy Consumption	Kilowatt-hours	Total amount of energy from the battery consumed by all vehicles per month during the time-period specified
Charger Loss	Kilowatt-hours	Total amount of energy lost while charging all vehicles
Energy	Miles per Gallon Equivalent	Average fuel efficiency for all vehicles per month during the time-period specified, with energy converted to its equivalent gasoline
Fuel Consumed	Gallons	Total amount of fuel consumed by all vehicles per month during the time-period specified
Intensity of Emissions	Pounds per Mile	Average emissions intensity for all vehicles per month during the time-period specified
Tailpipe Emissions	Pounds	Total amount of tailpipe emissions emitted by all vehicles per month during the time-period specified
Total Emissions	Pounds	Total amount of all emissions emitted by all vehicles per month during the time-period specified
Upstream Electricity	Pounds	Estimated total amount of all emissions emitted by upstream electricity generation for all vehicles per month during the time-period specified, calculated by multiplying supplied factor by total number of kWh charged
Upstream Fuel	Pounds	Estimated total amount of all emissions emitted by upstream fuel production for all vehicles per month during the time-period specified, calculated by multiplying supplied factor by the total number of L used.
Average Speed	Miles per Hour	Average speed of all vehicles per month during the time-period specified
Availability	Percentage	Average availability of all vehicles (expressed as a percentage of time available) per month during the time-period specified, based on 24 hour clock
Charging Hours	Hours	Total number of hours that all vehicles spent charging per month during the time-period specified
Daily On Hours	Hours	Average number of hours that all vehicles were turned on per day for each month during the time-period specified
Driving Hours	Hours	Total number of hours that all vehicles spent driving per month during the time-period specified
Idle Hours	Hours	Total number of hours that all vehicles spent idle per month during the time-period specified

Idle Time	Percentage	Average percentage of time that all vehicles spent idle per month during the time-period specified
Off Hours	Hours	Total number of hours that all vehicles were turned off per month during the time-period specified
On Hours	Hours	Total number of hours that all vehicles were turned on per month during the time-period specified

Table 7 FleetCarma Fleet-level Utilization Report Data Parameters

Parameter Name	Parameter Unit	Parameter Description
Vehicle ID	Vehicle ID	Unique vehicle ID
Vehicle	Make, Model, and Model Year	Make, model, and model year of each vehicle
Total Distance	Miles	Total distance traveled by each vehicle during the time-period specified
Average Distance per Day	Miles	Average distance traveled per day by each vehicle during the time-period specified
Average Distance per Week Day	Miles	Average distance traveled per week by each vehicle during the time-period specified
Number of Days Driven	Days	Total number of days driven by each vehicle during the time-period specified
Average Distance per Driving Day	Miles	Average distance traveled per the number of days driven by each vehicle during the time-period specified
Number of Trips	Number	Total number of trips made by each vehicle during the time-period specified
Average Number of Trips per Day	Number	Average number of trips made by each vehicle per day during the time-period specified
Average Number of Hours Driven per Day	Number	Average number of hours spent driving by each vehicle per day during the time-period specified

Table 8 FleetCarma Vehicle-level Vehicle Report Data Parameters

Vehicle Overview		
Parameter Name	**Parameter Unit**	**Parameter Description**
Calculated Odometer	Miles	Miles on the odometer by the end of the time-period specified, as counted up in the FleetCarma system (not measured from vehicle)
Distance Logged	Miles	Miles driven during the time-period specified
Idle Fraction	Percentage	Percent of time that the vehicle spent idling during the time-period specified
Total CO2 Emissions	Pounds per Mile	Estimated total CO2 emissions rate during the time-period specified
Electricity Consumed	Kilowatt-hours	Amount of electricity consumed while driving during the time-period specified

Electricity Consumption	Watt-hours per Mile	Average efficiency (in Watt-hours per Mile) during the time-period specified
Charger Loss	Kilowatt-hours	Amount of electricity lost during charging during the time-period specified
Battery Health	Percentage	Health of the battery at the end date specified
Daily Summary of Driving and Charging Activity		
Parameter Name	**Parameter Unit**	**Parameter Description**
Running	Shown on a Timeline	On a daily basis, the span of time during which the vehicle was on and running
Bulk Charge	Shown on a Timeline	On a daily basis, the span of time the vehicle was charging between 2 trips in one calendar day
Opportunity Charge	Shown on a Timeline	On a daily basis, the span of time the vehicle was charging after the last trip of one calendar day, and before the next trip of a different calendar day
Trip Log		
Parameter Name	**Parameter Unit**	**Parameter Description**
Date	Date and Time	The start date and time for each drive event
Duration	HH:MM:SS	The duration of each drive event
Trip Distance	Miles	The distance of each drive event
Starting Odometer	Miles	The odometer reading at the start of each drive event
Ending Odometer	Miles	The odometer reading at the end of each drive event
Electricity Consumed	Kilowatt-hours	The amount of electricity consumed by the vehicle during each drive event
Total Energy Consumption	Miles per Gallon Equivalent	The average efficiency of the vehicle during each drive event
Start State-of-Charge (SOC)	Percentage	The SOC at the start of each drive event
End State-of-Charge (SOC)	Percentage	The SOC at the end of each drive event

Parameter Name	**Parameter Unit**	**Parameter Description**
Ambient Temperature	Degrees Fahrenheit	The average ambient temperature during each drive event
Average Speed	Miles per Hour	The average speed during each drive event
Max Speed	Miles per Hour	The maximum speed reached during each drive event
Auxiliary Load	Kilowatts	The amount of power demanded by auxiliary features of the vehicle during each drive event
% Hard Acceleration	Percentage	Percentage of total acceleration deemed “Hard Acceleration” which occurred during each drive event
% Hard Braking	Percentage	Percentage of total braking deemed “Hard Braking” which occurred during each drive event
% Time Idle	Percentage	Percentage of time idle during each drive event
Charge Log		
Parameter Name	**Parameter Unit**	**Parameter Description**
Start Date	Date and Time	The start date and time for each charging event

Duration	HH:MM:SS	The duration of each charging event
Charging Power	1, 2, or 3	The power level of the charger used during each charging event
Charger Energy	Kilowatt-hours	The amount of energy transferred from the charger to the battery during each charge event
Charger Loss	Kilowatt-hours	The amount of energy lost while charging during each charge event
Start SOC	Percentage	The SOC at the start of each charge event
End SOC	Percentage	The SOC at the end of each charge event
Latitude	Latitude	The latitude where each charging event took place
Longitude	Longitude	The longitude where each charging event took place

Table 9 FleetCarma Vehicle-level Charging Report Data Parameters

Vehicle Overview		
Parameter Name	**Parameter Unit**	**Parameter Description**
Total Charging	Kilowatt-hours	Total amount of energy charged into the vehicle during the time period specified
Electricity Consumption	Watt-hours per Mile	Average driving efficiency (in Watt-hours per Mile) during the time-period specified
Average Starting SOC	Percentage	Average SOC at the start of driving events during the time-period specified
Average Ending SOC	Percentage	Average SOC at the end of driving events during the time-period specified
Charging by Level		
Parameter Name	**Parameter Unit**	**Parameter Description**
Level 1	Percentage	Percentage of all energy charged into the vehicle that was from Level 1 charging during the time-period specified
Level 2	Percentage	Percentage of all energy charged into the vehicle that was from Level 2 charging during the time-period specified
Quick Charge	Percentage	Percentage of all energy charged into the vehicle that was from Level 3 quick-charging charging during the time-period specified

12. Appendix F: Additional Data Analysis on Survey Questions

Regarding the amount of time that the vehicles were driven throughout the Project, it ranged from 478.10 hours (19.9 days) to 293.36 hours (12.2 days), as shown in Figure 22. The overall average time driven per vehicle across the duration of the Project was 380.94 hours (15.9 days).

Figure 22 Total Time Driving per Vehicle Across the Duration of the Project

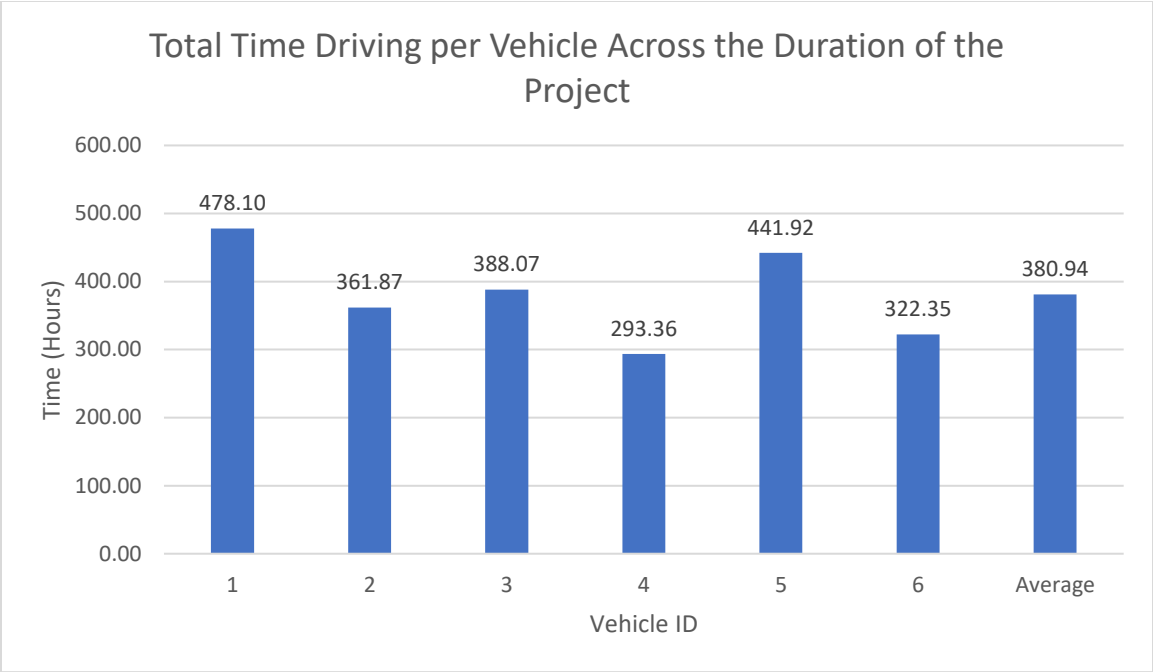
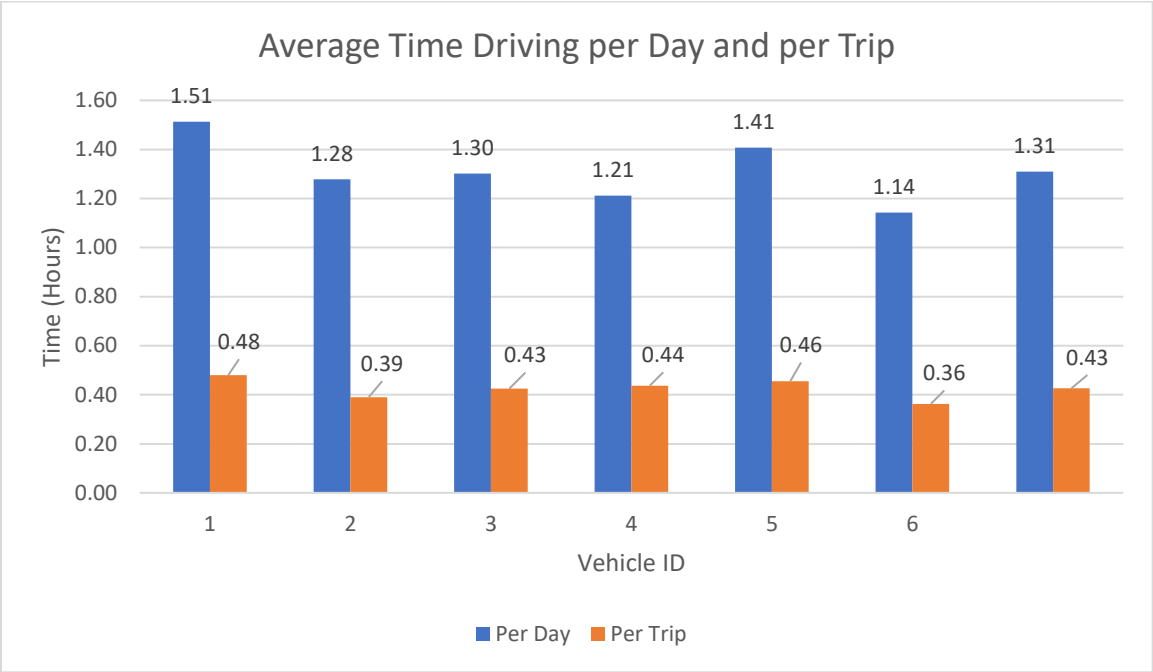


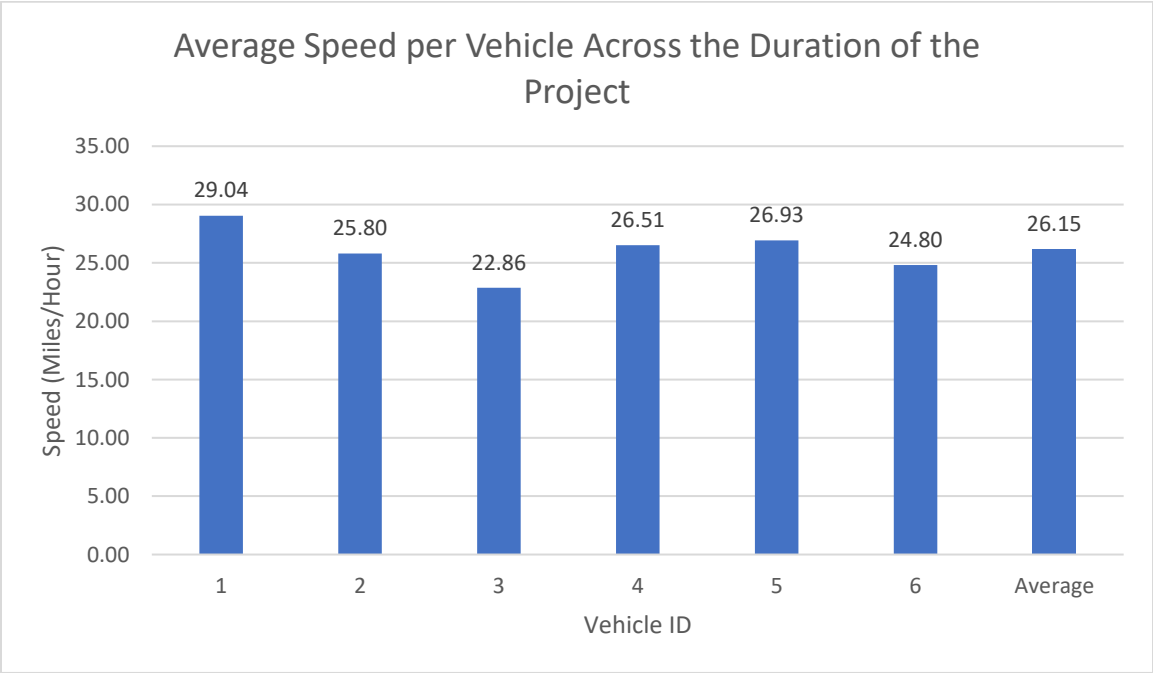
Figure 23 shows the same information on a per day and per trip basis. Per day, each vehicle was driven in between 1.51 and 1.14 hours, with an overall average of 1.31 hours. Per trip, each vehicle was driven between 0.48 and 0.36 hours, with an overall average of 0.43 hours.

Figure 23 Average Time Driving per Vehicle per Day and per Trip



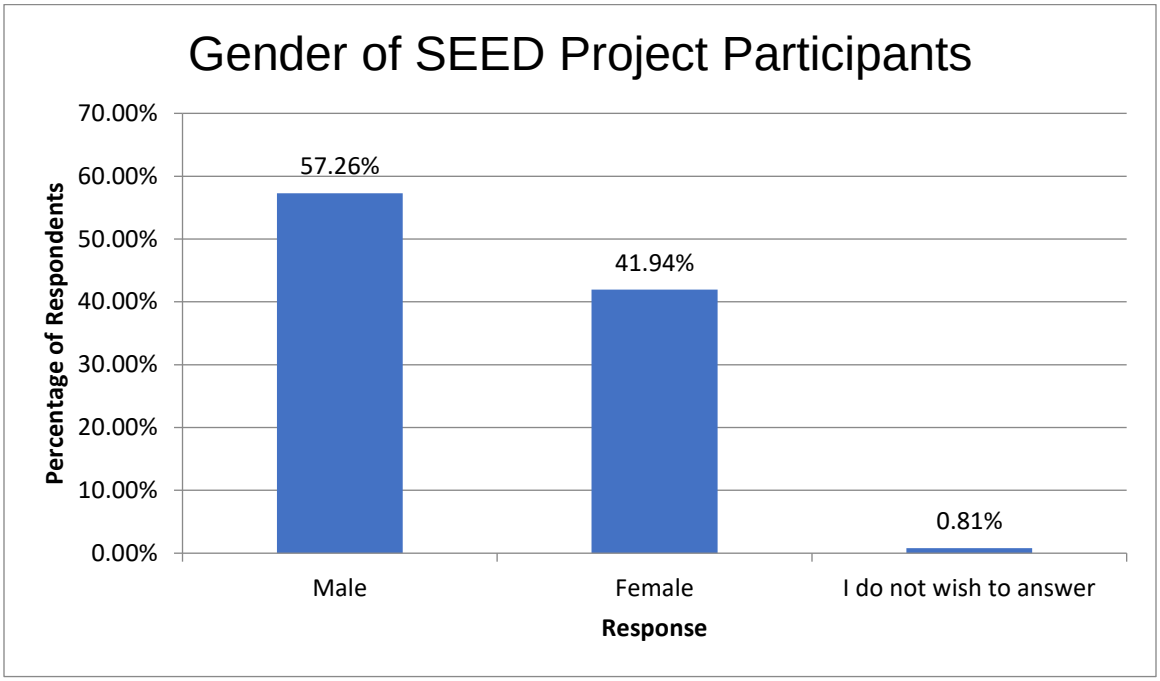
Regarding speed, the vehicles averaged between 29.04 miles per hour to 22.86 miles per hour, with an overall average of 26.15 miles per hour, as shown in Figure 24.

Figure 24 Average Speed per Vehicle Across the Duration of the Project



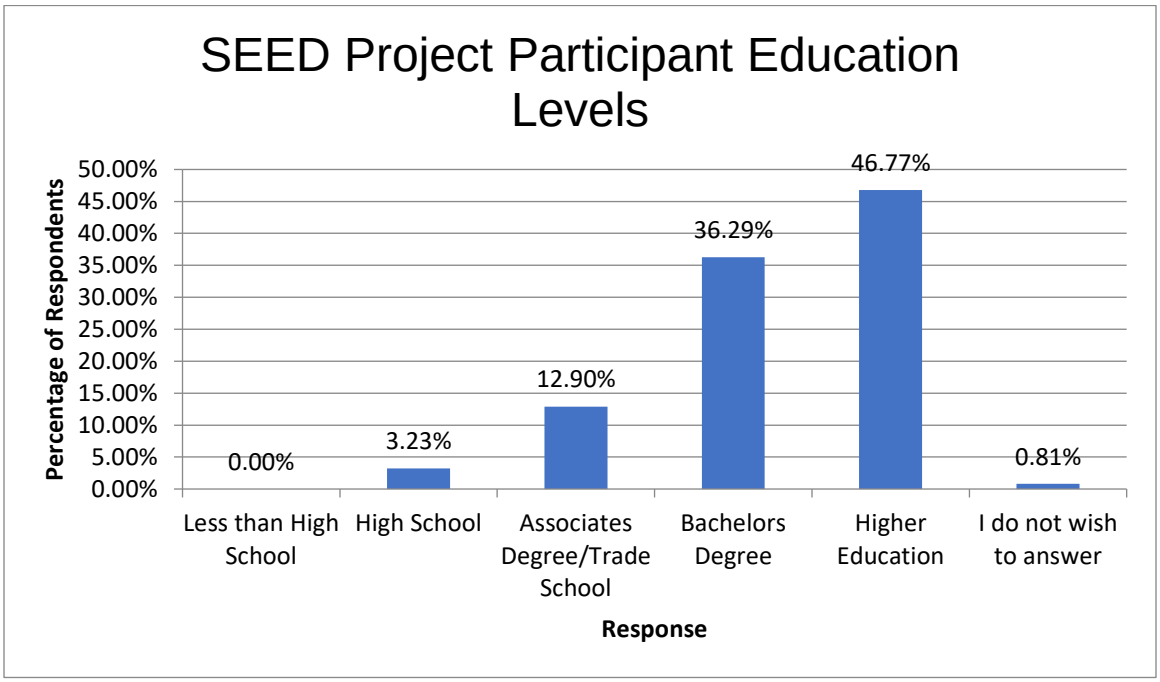
57.26% of the SEED participants identified as male, while 41.94% of the participants identified as female. 0.81% of the participants choose to not answer the question. This diversity of participants allowed for no gender bias on the answers to the survey questions.

Figure 25 Gender of SEED Project Participants



The participants of the SEED Project were relatively well educated with about 36% holding bachelor's degrees and about 47% of them holding graduate degrees.

Figure 26 SEED Project Participant Education Levels



Of those participants that use a personal car as their primary source of transportation, they stated a variety of car models which they use. The majority of participants use Toyota or Honda vehicles.

Figure 27 SEED Participants' Personal Car Models