CALIFORNIA ENERGY COMMISSION

CALIFORNIA NATURAL RESOURCES AGENCY

ENERGY RESEARCH AND DEVELOPMENT DIVISION

FINAL PROJECT REPORT

Accelerating Fleet Electrification in California

Fleet Analytics and EV Education Software

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PREFACE

The California Energy Commission's (CEC) Energy Research and Development Division supports energy research and development programs to spur innovation in energy efficiency, renewable energy and advanced clean generation, energy-related environmental protection, energy transmission, and distribution and transportation.

In 2012, the Electric Program Investment Charge (EPIC) was established by the California Public Utilities Commission to fund public investments in research to create and advance new energy solutions, foster regional innovation, and bring ideas from the lab to the marketplace. The EPIC Program is funded by California utility customers under the auspices of the California Public Utilities Commission. The CEC and the state's three largest investor-owned utilities—Pacific Gas and Electric Company, San Diego Gas and Electric Company, and Southern California Edison Company—were selected to administer the EPIC funds and advance novel technologies, tools, and strategies that provide benefits to their electric ratepayers.

The CEC is committed to ensuring public participation in its research and development programs that promote greater reliability, lower costs, and increase safety for the California electric ratepayer and include:

- Providing societal benefits.
- Reducing greenhouse gas emission in the electricity sector at the lowest possible cost.
- Supporting California's loading order to meet energy needs first with energy efficiency and demand response, next with renewable energy (distributed generation and utility scale), and finally with clean, conventional electricity supply.
- Supporting low-emission vehicles and transportation.
- Providing economic development.
- Using ratepayer funds efficiently.

For more information about the Energy Research and Development Division, please visit the CEC's research website (www.energy.ca.gov/research/) or contact the Energy Research and Development Division at ERDD@energy.ca.gov.

ABSTRACT

The California Energy Commission contracted with Lawrence Berkeley National Lab to create and launch MyFleetBuy, a fleet procurement system and online portal to help accelerate the adoption of electric vehicles (EVs). MyFleetBuy is a software solution that helps fleet owners evaluate their driving patterns to determine EV suitability and to make EV charging infrastructure decisions. The team worked with fleet owners in California to understand the challenges they face while making vehicle electrification decisions.

Initial fleet assessments and product development focused on improving fleet operators' familiarity with EV technology and determining if an EV could meet the operating needs of their existing vehicles. This led to the development of mapping and EV charger visualization tools to help fleet owners use a data-centric fleet procurement approach.

After extensive market development efforts, the MyFleetBuy team revised its approach to deploy solutions that reduced the cost and uncertainty for fleet advisors, including consultants and electric utilities, to provide transportation electrification recommendations. The team also realized the importance of addressing EV knowledge gaps and biases as a change management strategy to reduce internal pushback against fleet electrification. Consequently, the MyFleetBuy team launched Electrifyze, an EV learning management system, to systematically address EV education gaps and measure improvement in EV readiness across organizations.

By developing the MyFleetBuy fleet analytics software and the Electrifyze learning management system, the team evaluated more than 12,000 fleet vehicles for electrification and provided EV education to more than 3,600 employees throughout California.

Keywords: electric vehicles, fleet electrification, transportation electrification, cleantech

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Transportation from on-road vehicles accounts for more than 36 percent of all greenhouse gas (GHG) emissions in California (CARB 2021). An effective solution to this problem is the electrification of on-road vehicles because it reduces global warming emissions by more than 80 percent and eliminates harmful tailpipe emissions (U.S. DOE 2021). Therefore, replacing fossil-fueled vehicles with electric vehicles (EVs) is critical to achieve California's carbon neutrality goal by 2045.

Nevertheless, a major barrier to achieving the state's transportation electrification targets is that EVs are a new technology and vehicle owners struggle to determine if driving an EV will meet their transportation demands.

Fleet vehicles represent almost 1 in every 5 light duty vehicle registrations (Deloitte 2018) and account for more than 8 million vehicles in the United States (U.S. DOT 2020). Governments and private fleets operate thousands of vehicles that require constant replacement and present a unique opportunity to electrify a significant proportion of on-road vehicles in California. Nevertheless, transitioning a fleet to electric vehicles is a challenging proposition. It requires careful consideration of the viability and costs of deploying EVs and the accompanying charging stations. Fleet managers are often not equipped with the knowledge, data, and analytical tools to approach fleet electrification. They also face pushback from internal departments that may not be supportive of fleet electrification due to biases and EV knowledge gaps.

MyFleetBuy was created to simplify fleet electrification analysis and decision making. It is a software solution that leverages a fleet's existing telematics[1] data to provide clarity on the potential and pathway to deploy EVs across a fleet. Plug-in hybrid electric vehicles (PHEVs) are included in the MyFleetBuy tool. For simplicity, this report refers to both EVs and PHEVs as EVs.

To understand the opportunities to deploy EVs, fleet managers need answers to questions such as: How much of the fleet can be electrified? Which of my current vehicles can be replaced with EVs without encountering range adequacy issues? How can fleet electrification be approached in a systematic manner, with year-over-year deployments? What is the cost-benefit tradeoff for each EV deployment? What are the costs to operate EVs and deploy the necessary EV charging infrastructure?

Each of these decision steps requires fleet managers to spend time and effort. Each of the decision steps represents a barrier to EV adoption — an opportunity for people to choose the familiar alternative (gas cars). This project was funded by California ratepayers to provide the necessary tools and change management support for fleet owners to accelerate fleet electrification across the state.

[1] Telematics is a system that uses telecommunications components, sensors, wireless networking, and data dashboards to transmit data from moving vehicles.

Project Purpose

The MyFleetBuy project was intended to collect feedback and driving data from multiple fleet owners to better understand their travel needs and the challenges they face with electrification. By understanding the way fleet owners make decisions, the MyFleetBuy team intended to develop data visualization and other analytical tools to reduce the barriers to electrification, thereby accelerating the transition to EVs.

Specific project goals included the following:

1. Develop an analytics platform that collects real-world vehicle inventory and operating data from different fleet owners.
2. Utilize fleet driving data to simplify the electric vehicle recommendations.
3. Utilize fleet driving data and electric vehicle modelling to present charging infrastructure recommendations.
4. Create a learning management system to help employees learn about electric vehicles and prepare for the electrification of their fleet.

Project Approach

The MyFleetBuy team consisted of a former scientist from Lawrence Berkeley National Laboratory, several software engineers, user experience designers, and consultants who analyzed fleet data and collected customer feedback.

The MyFleetBuy team undertook over two years of market development efforts to create and test several prototypes and demonstrate the effectiveness of MyFleetBuy in real world applications. The team interacted with many fleet owners, fleet managers, and fleet managers' internal clients.[2] The MyFleetBuy team also engaged with electric utilities, industry consultants, nonprofits, OEMs, fleet software providers, California government agencies, and other stakeholders.

The team performed research in three phases:

- Phase 1: Interview fleet staff and develop the first prototype.
- Phase 2: Launch beta software.
- Phase 3: Enhance reports and launch the EV learning system.

During the three phases of development, the MyFleetBuy team recruited several technical advisors to inform technology development and product strategy. The technical advisory committee helped the MyFleetBuy team explore different market transfer strategies and connect with potential customers, partners, and other industry stakeholders.

[2] Internal client refers to the department that operates the fleet vehicles. In many public fleets, internal clients own the budget for fleet purchases and make the final decision on which vehicles to buy. Fleet managers, in contrast, are people who support departments with decision-making and vehicle procurements.

Project Results

At the beginning of the project, the MyFleetBuy team intended to develop data visualizations and other analytical tools to reduce barriers to fleet electrification. The project team's specific goals included:

1. Developing an analytics platform that collects real-world vehicle inventory and operating data from different fleet owners.
2. Utilizing fleet driving data to simplify and provide accurate EV recommendations.
3. Utilizing fleet driving data and electric vehicle modelling to deliver charging infrastructure recommendations.

As the project progressed, the MyFleetBuy team realized that fleet owners needed help to provide education and prepare employees for electrification. In turn, this led to the team developing a fourth goal:

1. To create a learning management system that helps employees learn about electric vehicles and prepare for the electrification of their fleet.

The MyFleetBuy team successfully accomplished its objectives by launching two solutions — *MyFleetBuy*, a fleet analytics software solution, and *Electrifyze*, an EV learning management system — and demonstrating their effectiveness with organizations across California. While the Electrifyze platform advances the objectives of CEC within this grant, its development was not funded by the present CEC grant.

MyFleetBuy software was used to evaluate the driving behavior of more than 12,000 fleet vehicles and Electrifyze was used to provide EV education to more than 3,600 employees across California. In the process of validating the team's approach, the MyFleetBuy team uncovered the following results:

- Fleet owners can reduce GHG emissions and operating costs by more than 80 percent and 50 percent, respectively, when they electrify.
- Fleet electrification often results in higher upfront costs that are recovered in fuel and maintenance savings over the life of the vehicle. However, for some use cases, fleet electrification can result in higher net operating costs when comparing EVs to similar fossil-fueled vehicle replacement alternatives.
- Calculating the cost-efficiency of GHG reductions from vehicle replacement candidates can help fleet owners reduce their upfront vehicle investment by millions of dollars while still achieving GHG emission reductions of over 40 percent.
- ZEV-first policies (meaning zero-emission vehicles are prioritized) are important but not sufficient. Many fleet managers experienced difficulty in addressing EV knowledge gaps and biases that result in internal pushback against vehicle electrification. Using the Electrifyze EV learning management platform, the project team measured a 6 percent

improvement[3] in EV readiness, on average, among thousands of participants and a 43 percent improvement in EV readiness among EV detractors.

With support from this CEC-funded project, MyFleetBuy has become a solution that is market tested and is currently in use by public and private organizations in California. In addition, Electrifyze has become a solution that is progressively scaling up across California.

Technology and Market Transfer Activities

The market for fleet electrification services in California is estimated to be worth $62 million USD per year. The main target markets for these services are government and private fleets, as well as electric utilities.

The MyFleetBuy team took several actions to build market awareness and promote adoption of the MyFleetBuy solution. The team undertook three market transfer strategies:

- Marketing — In addition to creating and distributing marketing collateral, the MyFleetBuy team also raised awareness of solutions by presenting at industry events, collaborating with nonprofits, and participating in industry working group meetings
- Sales — The MyFleetBuy team reached out directly to more than 200 prospective fleet customers in California and collaborated with community choice aggregators to secure warm introductions to fleet owners in their service territory. Additionally, the project team presented the MyFleetBuy solution to and participated in several competitive procurement processes with municipal and investor-owned utilities in California, Oregon, Texas, and Michigan.
- Business Development — With support from this project's technical advisory committee, the MyFleetBuy team explored go-to-market partnership opportunities with reputable consulting companies, electric utilities, and other vendors. The project team found that these organizations could use the MyFleetBuy software to complement their existing products and launch new fleet electrification services. By pursuing these collaborations, the team was successful at securing contracts with a variety of fleets.

Through extensive market development efforts, the MyFleetBuy team learned that the sales cycle for fleet electrification services can take several months or years and that most fleet owners were looking for trusted advisors who could provide a comprehensive solution that included fleet electrification analysis but also a host of other services like infrastructure planning and deployment. These insights led us to pursue go-to-market partnerships as the main strategy to distribute and grow adoption of the MyFleetBuy technology. For example, the project team established a software license agreement with an energy consulting firm to help it launch a fleet electrification practice. This go-to-market partnership allowed us to efficiently

[3] The MyFleetBuy team measures EV readiness by asking participants how strongly they agree (on a scale of 1 to 10) with a variety of statements such as "I would recommend an electric car to my best friend". Participants with a score below 5 at the beginning of a campaign are described as 'EV detractors' and those who score above 5 are described as 'EV Promoters'. Electrifyze asks the same questions at the beginning and end of each campaign to calculate changes in participants' scores. The MyFleetBuy team has measured a 6 percent and 43 percent increase in EV Readiness scores among average consumers and EV detractors who participate in Electrifyze campaigns, respectively.

reach multiple fleet owners while enabling a partner company that had previously focused on energy consulting (such as distributed energy resource feasibility studies and energy program design work), to offer fleet electrification assessments to their customers.

Lastly, the MyFleetBuy team interacted with several large enterprise, government, utility, and other organizations throughout California to grow adoption of the MyFleetBuy system for fleet procurement and the Electrifyze EV learning management system for EV education. At the time of this report writing, the project team had delivered EV education to more than 3,600 employees in California. Based on interactions with thousands of consumers, the MyFleetBuy team concluded that California state agencies, local governments, and large employers need to play a leadership role in distributing EV education if they want to reduce internal pushback when fleet owners try to electrify their fleet.

Benefits to California

The MyFleetBuy and Electrifyze technologies will accelerate adoption of EVs by providing fleet managers with the tools they need to procure EVs and address change management barriers. These technologies will result in ratepayer benefits of greater electricity reliability, increased safety, and lower costs.

The cumulative annual benefits of transportation electrification for the fleets evaluated will result in a reduction of 35,000 tons of CO_2 (carbon dioxide) emissions — equivalent to 7,600 passenger vehicles — and almost $15 million in annual cost savings when the fleets fully electrify. When scaled to all corporate and government fleets across California, these technologies pave the way for nearly 5 billion pounds of avoided CO_2 emissions and cost savings of over $200 million. By promulgating the use of smart charging versus uncontrolled charging by fleets across California, fleet electrification technology will also preserve greater reliability of grid systems by helping avoid as much as 1.1 gigawatts of electricity demand during peak hours.

CHAPTER 1: Introduction

Problem Statement

Transportation from on-road vehicles accounts for more than 36 percent of all greenhouse gas (GHG) emissions in California (CARB 2021). An effective solution to this problem is the electrification of on-road vehicles because it reduces global warming emissions by more than 80 percent, in addition to eliminating harmful tailpipe emissions (U.S. DOE 2021). Therefore, replacing fossil-fueled vehicles with electric vehicles (EV) is critical to achieve California's carbon neutrality goal by 2045.

Fleet vehicles represent almost 1 in every 5 light duty vehicle registrations (Deloitte 2018) and account for more than 8 million vehicles in the United States (U.S. DOT 2020). Governments and private fleets operate thousands of vehicles requiring constant replacement and present a unique opportunity to electrify a significant proportion of on-road vehicles in California. Not only do fleet vehicles represent a significant volume of vehicles, but they also tend to display driving patterns that make them ideally suited for electrification.

A major barrier to achieving the state's transportation electrification targets is that EV technology is not mainstream and vehicle owners struggle to determine if driving electric will meet their transportation demands. According to research from *Consumer Reports*, 71 percent of Americans said they would consider buying an EV (Preston 2020). Nevertheless, despite the signs of interest, annual electric and plug-in hybrid vehicle sales still represent less than 10 percent of total light duty vehicle sales in California (Kane 2021). It is essential to help vehicle owners determine if driving electric will meet their transportation demands, because every decision to purchase a fossil-fueled vehicle results in more than a decade of climate-change-inducing pollution (Beresford and Miller 2021).

EV technology has matured significantly in the last decade and the vehicle options available for purchase has expanded considerably. At the time of this report writing, there were over 70 light duty (Veloz 2021) and over 130 medium and heavy duty (California HVIP 2021) on-road EV models available for purchase in California. Nevertheless, fleet owners have a difficult time determining which of their vehicles are suitable candidates for electrification and they struggle preparing a business case for electrification. Furthermore, people who operate the fleet vehicles can become an important barrier to the adoption of EVs if they push back against management's recommendation to electrify the fleet. Fleet owners need effective decision-making tools to determine which vehicles to electrify, and they need education and support tools to support change management (prepare their workforce for transportation electrification).

Significant effort is being dedicated to increasing the general awareness of EVs — for example, telling people that driving electric is normal and that there are many options available for purchase. The problem is that improving general awareness does not directly lead to procurements. Awareness is not sufficient to resolve many of the knowledge gaps and biases that

people hold. To understand the opportunities to deploy EVs, fleet managers need answers to questions such as:

- How much of the fleet can be electrified?
- Which of my current vehicles can be replaced with EVs without encountering range adequacy issues?
- Which particular EVs will meet my fleet's driving needs?
- How can fleet electrification be approached in a systematic manner, with year-over-year deployments?
- How many EVs can be deployed each year in each portion of the fleet?
- What is the cost-benefit tradeoff for each EV deployment?
- What are the costs to operate electric vehicles and deploy the necessary EV charging infrastructure?

Each of these decision steps requires fleet managers to spend time and effort. Each of the decision steps represents a barrier to EV adoption — an opportunity for people to choose the familiar alternative (gas cars). Unfortunately, only a small percentage of the population (segments referred to as the Innovators and Early Adopters) is currently willing, or able, to dedicate the resources needed to determine which vehicles should be electrified (De Bruin 2020).

Fleet managers' main responsibility is to acquire and maintain vehicles that allow internal departments to fulfill their job duties. For example, employees at the sheriff's department need vehicles for different reasons than do employees who work for the department of child support services. It is difficult for fleet managers to make electrification recommendations because each vehicle in their fleet has a different driving cycle, and because many fleets lack the internal expertise to make EV and infrastructure decisions. Moreover, many fleet managers struggle to convince internal departments to adopt EVs when employees push back against fleet electrification.[4]

By funding this project, California ratepayers contributed towards the development of fleet analytics software and an EV learning management system that provide the necessary tools and change management support for fleet owners to accelerate EV adoption across the state.

Project Purpose

The MyFleetBuy project collected feedback and driving data from multiple fleet owners to better understand the challenges they face with electrification and to create software-based solutions that improve their ability to successfully transition their fleet.

By understanding the way fleet owners make decisions, the MyFleetBuy team intended to develop data visualization and change management tools that accelerate the transition to EVs.

[4] In many fleets, vehicle ownership and procurement budgets are owned by individual departments and fleet managers acts as a support organization. Hence, the final decision on whether to electrify is dependent on internal departments and their employees.

Plug-in hybrid electric vehicles (PHEVs) are included in the MyFleetBuy tools. For simplicity, this report refers to both EVs and PHEVs as EVs.

Specific project goals included:

1. Developing an analytics platform that collects real-world vehicle inventory and operating data from different fleet owners.
2. Utilizing fleet driving data to simplify EV recommendations.
3. Utilizing fleet driving data and EV modelling to present charging infrastructure recommendations.
4. Creating a learning management system to help employees learn about EVs and prepare for the electrification of their fleet.

California ratepayers benefit from this project because increasing adoption of EVs among fleet owners will result in greater electricity reliability, increased safety, lower costs, and the reduction of GHG emissions required to meet California's objective of achieving carbon neutrality by 2045.

CHAPTER 2:
Project Approach

Overview

The MyFleetBuy team consisted of a former tenured scientist at Lawrence Berkeley National Laboratory, several software engineers, user experience designers, and consultants who analyzed fleet data, created software products, and collected customer feedback.

The MyFleetBuy team undertook over two years of market development efforts to create and test several prototypes and demonstrate the effectiveness of fleet analytics software in real world applications. The MyFleetBuy team interacted with many fleet owners, fleet managers and their internal clients.[5] The team also engaged with electric utilities, industry consultants, nonprofits, original equipment manufacturers (OEMs), fleet software providers, California government agencies, and other stakeholders.

The team performed the research in several phases:

- Phase 1: Interview fleet staff and develop the first prototype.
- Phase 2: Launch beta software.
- Phase 3: Enhance reports and launch an EV learning system.

During Phase 1, the MyFleetBuy team undertook nearly a year of market development efforts to create and test several product concepts, launch an alpha software prototype, and create the first version of the MyFleetBuy technology platform. To understand the needs of fleet managers across California, the MyFleetBuy team interviewed employees of Alameda County, the California Department of Transportation, the City of Fremont, and several other government and corporate fleets across California. Through these interactions, the MyFleetBuy team collected fleet operations data and spent over 300 hours interviewing fleet managers and gathering feedback to develop the MyFleetBuy technology.

During Phase 2, the MyFleetBuy team collected feedback on the user interface of the alpha software prototype, to develop several product improvements, and integrated telematics[6] data from more than 9,000 vehicles. Across these fleets, integrations were performed using two different telematics providers — Verizon Fleet and GPS Insight. The MyFleetBuy team also realized that many fleet owners have a high proportion of vehicles that operate without

[5] Internal client refers to the department that operates the fleet vehicles. In many public fleets, internal clients own the budget for fleet purchases and make the final decision on which vehicles to buy. Fleet managers, in contrast, are people who support departments with their vehicle decisions and run procurements.

[6] Fleet telematics systems allow fleet operators to monitor the state and utilization of individual vehicles across their fleet. They allow tracking of vehicle locations, fuel usage, driving characteristics, safety incidents, maintenance, diagnostic information, and more. There are multiple telematics providers that provide analytics, typically by offering a small data logger that plugs into the on-board diagnostics port of each vehicle within the fleet. Data and analytics from these telematics systems are often integrated into essential business functions, like fuel cost reporting, scheduled maintenance, safety incident tracking, and compliance (e.g., for smog test certification).

telematics devices and decided to develop methodologies that integrate telematics data as well as odometer and fuel card data.

Phase 3 involved a refresh of the data visualization outputs from MyFleetBuy to make it easier for fleet managers to make decisions. As a parallel effort, Phase 3 included the creation of a learning management system to address an important roadblock to EV adoption: change management. Using the EV learning management system, the MyFleetBuy team reduced EV knowledge gaps and biases and improved the EV readiness of more than 3,600 employees.

During the three phases of development, the MyFleetBuy team recruited several technical advisors to inform technology development and product strategy. The technical advisory committee helped the MyFleetBuy team explore different market transfer strategies and connect with potential customers, partners, and other industry stakeholders.

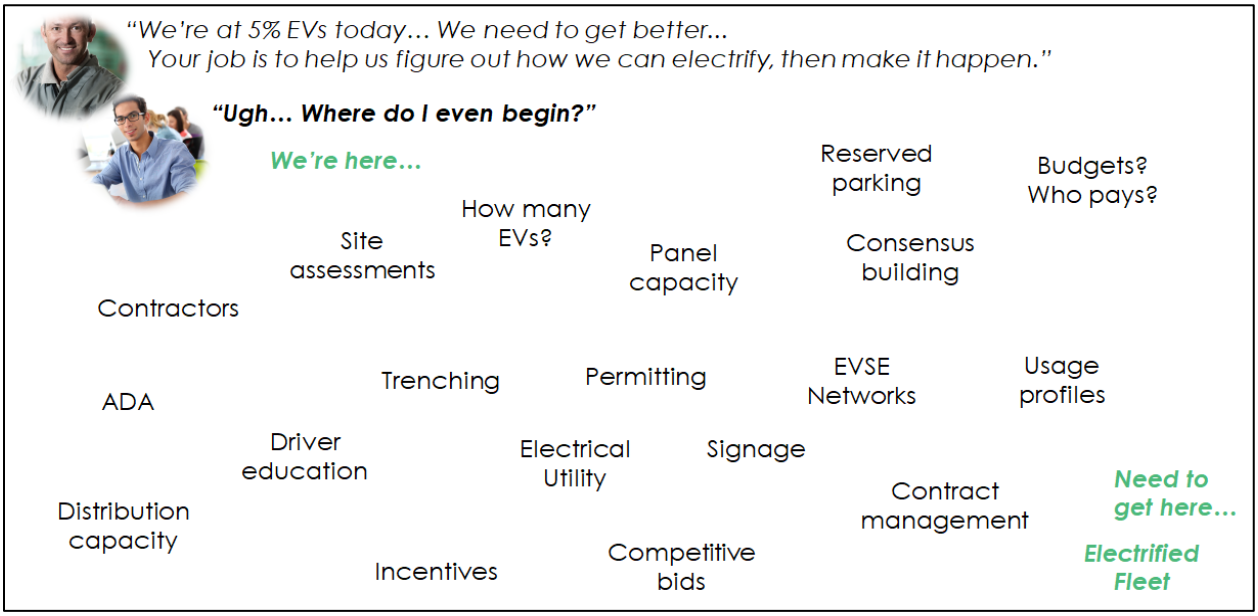
Phase 1: Interview Fleet Staff and Develop the First Prototype

To understand the needs of fleet managers across California, the MyFleetBuy team interviewed employees of Alameda County, the California Department of Transportation, the City of Fremont, and several other government and corporate fleets across California. Through these interactions, the MyFleetBuy team collected inventory and operations data from fleet vehicles to develop analytics systems and logged over 300 hours of interviews with fleet managers and industry experts to better understand their needs and develop prototypes of the MyFleetBuy technology.

Understanding Fleet Managers' Needs

Through deep-dive conversations and semi-structured interviews with fleet managers, the project team sought to understand the challenges that fleets face during their procurement and electrification processes. By synthesizing the information gathered from fleet managers, the MyFleetBuy team was able to develop a robust understanding of the barriers that organizations face when pursuing fleet electrification. As shown in Figure 1, navigating fleet electrification requires considerable specialized knowledge, making it difficult to delegate the planning and execution of these initiatives. As a result, progress on fleet electrification remains slow — often fleets maintain inertia by continuing to purchase conventional vehicles, the familiar choice.

Figure 1: Fleet Greening and Electrification Dilemma



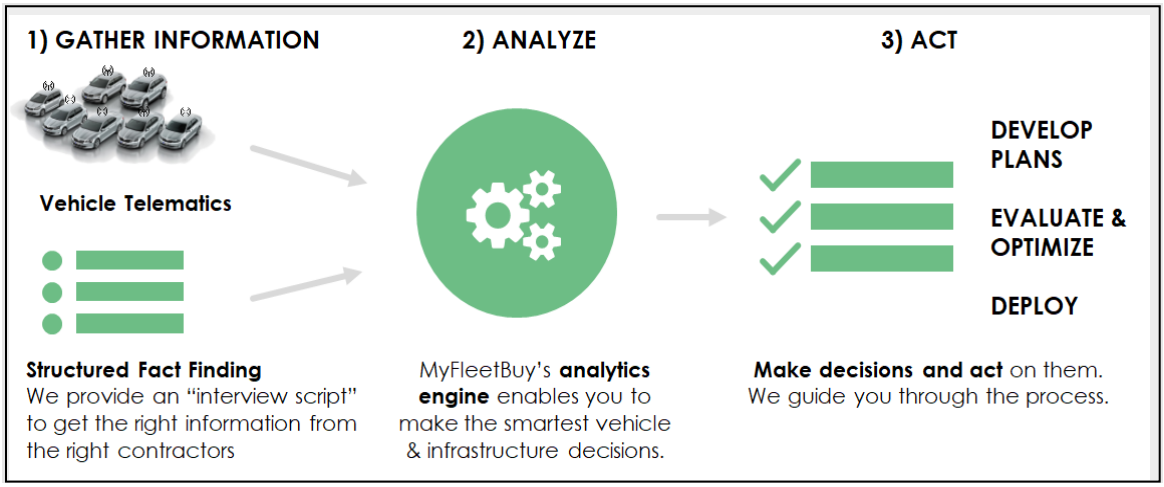
Making progress on fleet electrification requires resources and specialized expertise, making it difficult for fleet staff to make progress.

The early stages of fleet electrification, shown above, are critical since they present an opportunity to build consensus and educate an organization's key decision makers. The MyFleetBuy team identified many fleets that intended to electrify but lacked the internal expertise to successfully navigate the fleet electrification process.

Furthermore, many fleet managers operate as an internal support function that provides advice and support for different departments to make vehicle replacement decisions and procure their vehicles. In many cases, fleet managers can influence vehicle selections but are unable to make the final decision. This makes it important for fleet managers to be able to create convincing reports and effectively influence decision makers in each department — their internal clients.

Based on insights collected from interviews, the MyFleetBuy team decided to develop a technology solution to simplify fleet electrification assessments. The objective was to develop algorithms and a front-facing user interface to streamline data collection and equip fleet managers with the necessary tools and information to effectively convince internal clients to adopt EVs. The diagram in Figure 2 was a visual tool created to explain the concept of MyFleetBuy during interviews.

Figure 2: Simplifying Fleet Electrification



This diagram was used to explain the concept of MyFleetBuy during interviews. The MyFleetBuy data collection and analytics tool would allow users to complete steps 1 and 2, thereby setting the organization up for success in step 3.

Developing the First Prototype

Armed with a better understanding of the challenges and needs encountered by fleet managers, the MyFleetBuy team created its first software prototype. This prototype consisted of user, analytics, and data layers.

The user layer was accessible via web-browser and provided a front-facing interface to help fleet managers view information about their fleet and evaluate the feasibility of different EVs as replacement candidates.

The analytics layer consisted of: (i) algorithms to collect fleet inventory and operations data and to map travel demand against potential charging sites; (ii) vehicle physics-based analytics to quantify and predict energy consumption; (iii) and cost models to quantify overall operating costs. The analytics layer was also developed to integrate data from fleet telematics systems.

The data layer required database architecting and development of a cloud platform to store and efficiently retrieve temporo-spatial mobility data, vehicle physics models, market data (such as manufacturer's suggested retail price and battery range), and fleet profile data.

Prototype Overview

The first prototype of MyFleetBuy focused on validating the analytics and data layers and presented results in a web-based user layer that enabled fleet managers to search for specific vehicles in their fleet and assess the electrification potential of each vehicle. The search functionality and fleet analysis of this web-based tool consisted of four parts:

1. **Date:** The user could select specific date ranges of fleet telematics data (e.g., travel history data) to be used in the fleet electrification assessment.
2. **Filter your cars:** The user could narrow down the analysis to specific fleet vehicles by using a variety of filters (for example, body type, department, and vehicle age).

3. **Cars to compare:** The user could search for electric and plug-in hybrid EVs to be considered as replacement candidates for fleet vehicles.
4. **Charging stations:** The user could review and select physical locations where charging infrastructure could be deployed or publicly accessed to recharge the fleet vehicles once they became electric.

This prototype allowed users to visualize their fleet driving data and evaluate multiple EVs as replacement candidates. Fleet drivers could also look at individual trips to determine if an EV would fit their driving needs. Refer to Appendix A for an overview of the prototype.

Learning and Adjusting

Once the first software iteration was available for use, the MyFleetBuy team scheduled a series of user discovery sessions and analyzed travel data from fleet owners. Through these user discovery sessions, the MyFleetBuy team demonstrated the tool to fleet managers and took notes on the users' feedback.

While there were many lessons learned through this process, the MyFleetBuy team learned key insights that resulted in major adjustments to the product plan, as follows.

- **Fleets run annual procurement cycles.** While it was interesting to see multiple vehicles at once, the MyFleetBuy target user needed more effective ways to identify candidates for replacement, and the ability to save specific analyses.
- **Fleet managers provide support to internal departments.** It was not enough to identify vehicles that were good candidates for electrification; the MyFleetBuy target user needed to be able to create reports and share them with internal department leads[7] as a way to convince fleet drivers that EVs would make good replacement alternatives.
- **Fleet owners don't know which EVs and PHEVs are available for purchase.** The first prototype of MyFleetBuy required the user to search for EVs by name, but the MyFleetBuy target user found this approach cumbersome.

After gathering feedback from several discussions with fleet managers, the MyFleetBuy team had gained valuable insights to create a more effective fleet electrification tool.

Phase 2: Launch Beta Software

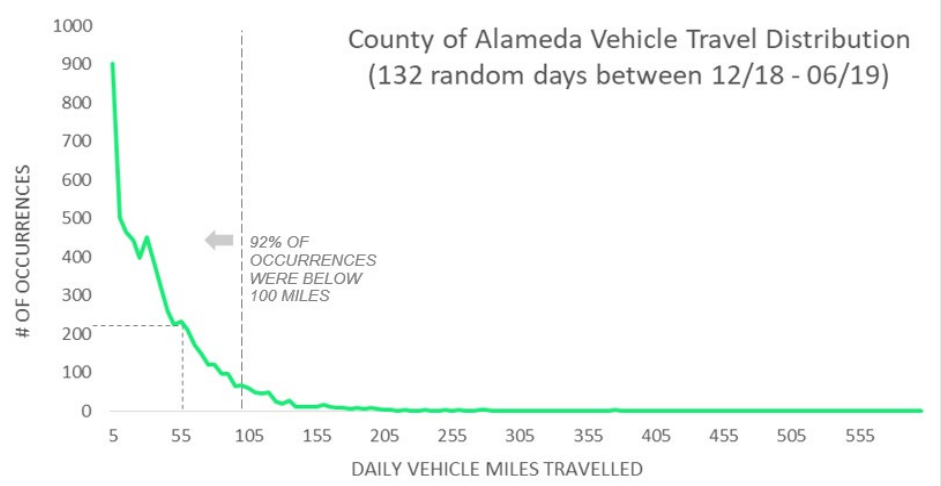
The MyFleetBuy team collected feedback on the alpha software prototype to develop several product improvements and integrated telematics data from more than 10,000 vehicles. In exchange, the project team provided access credentials to MyFleetBuy and created reports for fleet owners. Below are some examples of the reports and insights shared with fleet owners.

[7] In many fleets, the vehicle ownership and procurement budget are owned by individual departments and the fleet management team acts as a vehicle procurement support organization.

Data Analysis

One of the benefits of creating fleet reports is that it allowed the MyFleetBuy team to understand which data visualizations were valuable for fleet managers. Figures 3 and 4, as well as Tables 1 and 2, provide examples of the fleet data analytics that were provided to different fleet owners.

Figure 3: Daily Driving Events



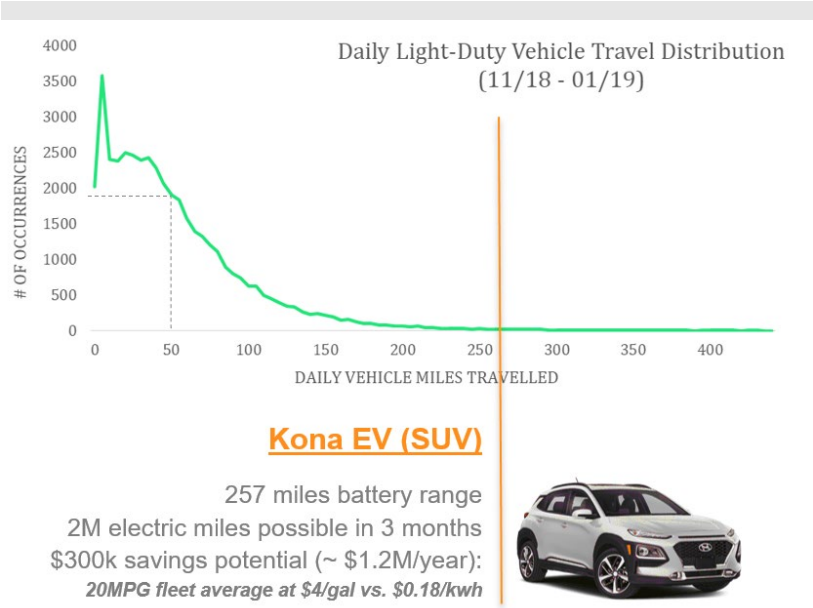
This histogram represents all daily driving events by 332 Alameda County vehicles over 132 days. The summary information helps to explain at a high level the potential for fleet electrification. For example, during the period of data analyzed, there were 232 occurrences where a vehicle travelled 50-55 miles in one day and 92 percent of occurrences had total daily travel under 100 miles (70 percent of all miles travelled). This meant that 92 percent of daily travel occurrences during the period studied could have been met with an EV with a battery range of 100 miles. There were many EVs available for sale with a driving range over 100 miles that could have been suitable candidates for this county.

Table 1: Individual Vehicle Results

#	GPS Insights Vehicle ID	# of active days	Total Miles Travelled	Days (<50 mi)	Days (50-100 mi)	Days (100-200 mi)	Days (200-300 mi)	Days (>300 mi)
1	[redacted]	126	10,795	23%	**34%**	**42%**	1%	0%
2	[redacted]	125	6,761	**51%**	**34%**	15%	0%	0%
3	[redacted]	123	6,645	**67%**	**15%**	14%	3%	2%
4	[redacted]	124	6,388	**50%**	**35%**	15%	0%	0%
5	[redacted]	124	5,886	**60%**	**29%**	10%	0%	0%
6	[redacted]	123	5,620	**52%**	**43%**	5%	0%	0%
7	[redacted]	123	5,497	**69%**	**15%**	10%	4%	2%
8	[redacted]	116	5,490	**52%**	**38%**	10%	0%	0%
9	[redacted]	124	5,227	**74%**	**14%**	7%	5%	0%
10	[redacted]	125	5,220	**62%**	**32%**	6%	0%	0%

This is a sample overview of vehicles recommended for electrification based on fleet travel data collected by GPS Insights telematics data. Most daily driving events for these vehicles were below 100 miles and almost all driving trips were below 200 miles.

Figure 4: Daily Driving Events



This histogram shows the daily vehicle miles travelled by a subset of vehicles operated by the California Department of Transportation (Caltrans). For example, there were 1,903 occurrences where a fleet driver travelled a total of 45-50 miles in one day. This visual was prepared to give Caltrans' staff a high-level view of their light duty vehicle fleet electrification potential. It showed that a vehicle like the Hyundai Kona Electric SUV had sufficient battery capacity to cover 99 percent of all driving events for the vehicles assessed.

Table 2: Electrification Recommendations

VIN #	Vehicle Description	Dist. (mi)	Alternative Vehicle	Annualized savings
[redacted]	2013 NISSAN Juke	3,053	2019 Hyundai Kona EV	$1,069
[redacted]	2014 CHEVROLET Cruze	2,787	2018 Chevrolet Bolt	$976
[redacted]	2014 CHEVROLET Cruze	2,713	2018 Chevrolet Bolt	$950
[redacted]	2014 CHEVROLET Cruze	2,689	2018 Chevrolet Bolt	$942
[redacted]	2014 CHEVROLET Cruze	2,594	2018 Chevrolet Bolt	$908
[redacted]	2014 CHEVROLET Cruze	2,461	2018 Chevrolet Bolt	$862
[redacted]	2014 CHEVROLET Cruze	2,398	2018 Chevrolet Bolt	$839
[redacted]	2013 NISSAN Juke	1,804	2019 Hyundai Kona EV	$632
[redacted]	2013 NISSAN Juke	1,738	2019 Hyundai Kona EV	$609
[redacted]	2014 TOYOTA RAV4 High	1,448	2019 Hyundai Kona EV	$635
Total		**23,685**		**$8,421**

Distance is based on the three month analysis period. Annualized savings is calculated assuming $4 per gallon, $0.18/kWh and assuming similar travel patterns for the remaining 9 months of the year.

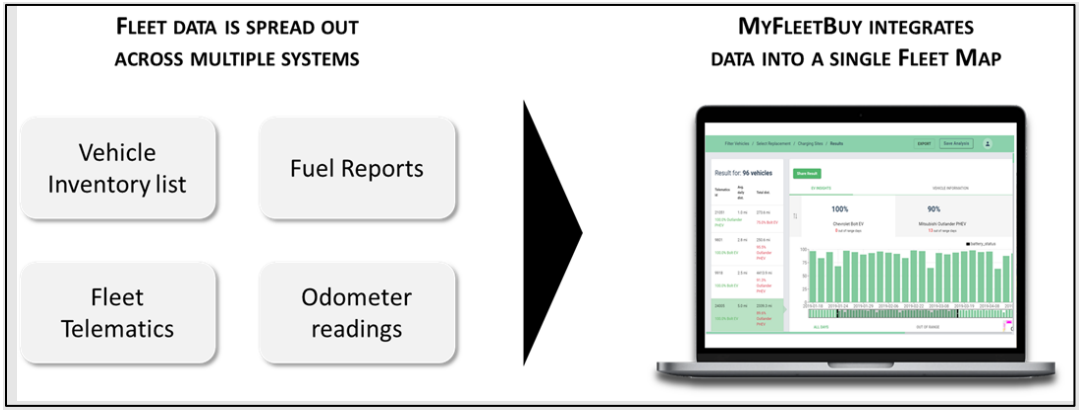
This example shows a subset of vehicles that were recommended for electrification, along with their annualized fuel savings potential. This table made it easier for fleet managers to demonstrate the financial benefits of electrification to their internal clients.

Refocusing on Usability

The asset managers at each organization provided feedback on the data analytics reports prepared by the MyFleetBuy team. This feedback was needed for the MyFleetBuy team to

determine how to visualize data in the MyFleetBuy platform, and to understand what information to make available as downloadable data reports. The MyFleetBuy team identified the need for consolidating data from multiple databases into one single ground truth called the 'Fleet Map,' shown in Figure 5.

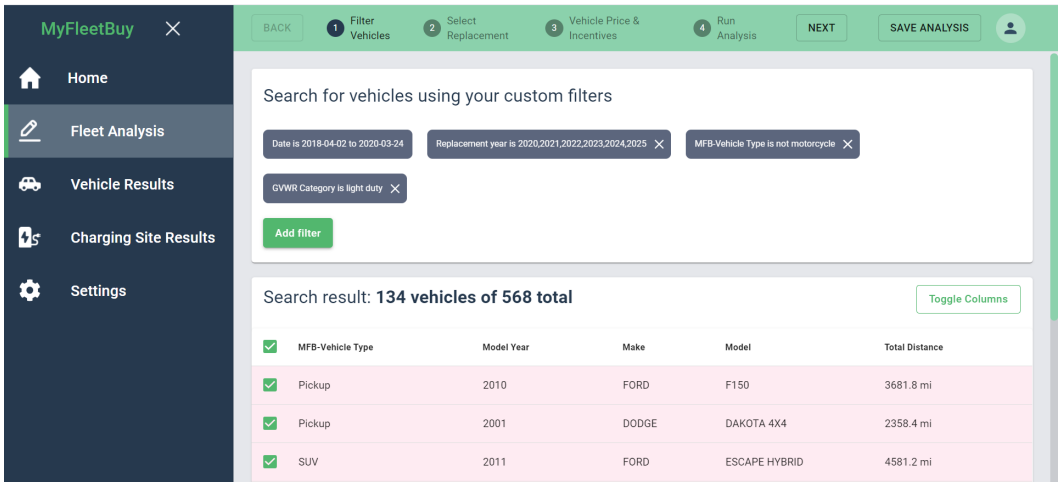
Figure 5: Creating a Fleet Map



The image displays how data is consolidated from multiple sources into a Fleet Map. Some examples of systems integrated include Assetworks & Faster for "vehicle Inventory" and "odometer readings," Verizon & GPS Insights for "fleet telematics," and Fuelmaster for "fuel reports."

Preparing a Fleet Map became a critical first step because it allowed the MyFleetBuy team to communicate with the same terminology that fleet owners used. It also became a useful tool to help fleet owners run different simulations to fit their needs. For example, the City of Fremont had adopted a set of rules to determine the annual replacement cycle of its fleet (for example, vehicle age and utilization), so the project team created filters, as shown in Figure 6, that allowed the fleet manager to find vehicles that met specific usage patterns.

Figure 6: Fleet Overview



This screenshot shows the MyFleetBuy display of the different types of filters that a fleet manager could activate to identify vehicles that needed to be assessed. For the City of Fremont, this is how its fleet manager could find vehicles that fit the city's annual replacement rule.

Through a series of in-depth user experience interviews, the project team launched the beta software of MyFleetBuy, a more robust fleet analytics platform. The beta software version improved the backend systems and delivered new features that were requested by the fleet managers interviewed. These features included a more user-friendly EV database and the ability to create and save reports (allowing users to easily prepare a report for internal department heads). Refer to Appendix B for more details.

In addition to working with fleet owners, the MyFleetBuy team established working relationships with consultants who were accustomed to providing services to local governments and fleets but who needed support to start a fleet electrification practice. Through these engagements, the MyFleetBuy team learned more about the government procurement process and how to streamline the software to simplify fleet electrification assessments.

The MyFleetBuy team also learned that many fleet owners, especially public fleets, had established a 'zero-emission vehicle (ZEV) first' procurement policy. This policy required that any vehicle replacement decision should consider the suitability of a ZEV as a replacement candidate before procuring a conventional vehicle powered by fossil fuels. While these types of policies were effective in enforcing an annual discussion about fleet electrification, many fleet managers experienced difficulty in enforcing the actual procurement of EVs when individual departments or fleet operators pushed back against fleet electrification. The source of push-back varied, depending on the internal client, and led to the MyFleetBuy team having several discussions about how to prepare a workforce for electrification.

The MyFleetBuy team applied the industry connections and lessons learned to develop more actionable fleet electrification reports and to launch an EV learning system.

Phase 3: Enhance Reports and Launch an EV Learning System

A critical lesson gained from phase 2 was that fleet managers had already established their internal reporting systems and were hesitant to sign up for another software tool — even if it simplified their annual electrification decisions.

The MyFleetBuy team quickly learned that fleet managers were often involved in fleet electrification planning but were not always leading the project. Sustainability departments often started the process of identifying the budget for fleet electrification assessments and needed to go through a competitive solicitation process to select their provider. The complex procurement process made it important for fleets to choose a 'trusted consultant,' someone with proven experience in their sector and who could create reports that would boost the credibility of their fleet electrification recommendations.

After collecting product feedback from users and market insights through sales and marketing efforts, it became evident that fleet managers were generally not looking for a self-serve solution but rather wanted to receive support from trusted experts. This meant the MyFleetBuy team would have to establish a consulting practice and build up the MyFleetBuy reputation, becoming a vendor to organizations that fleet owners already trust for advice — fleet and energy consultants, or electric utilities. To accelerate MyFleetBuy's technology market transfer,

the MyFleetBuy team decided to become a vendor for organizations that fleet owners already trust.

A Better Tool for Consultants

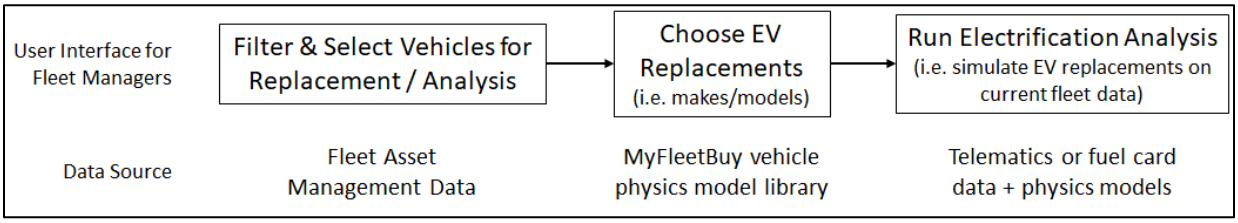
The purpose of this section is to describe the approach that Green Light Labs, the parent company of MyFleetBuy, took to establish a production-ready process of fleet data acquisition and modelling.

The MyFleetBuy team quickly realized that consultants would benefit from the ability to streamline data collection and simple reporting capabilities. This led the team to focus on three areas to help consultants deliver high-quality fleet electrification recommendations more efficiently.

1. **Standard templates for onboarding:** The project team created a four-step process for onboarding new fleets into MyFleetBuy that included templates for recording a fleet's vehicle inventory, operations data (odometer, fuel consumption, maintenance), parking locations, and dwelling schedule. Creating these templates significantly reduced the amount of time and resources that consultants required to onboard new clients.
2. **Fleet telematics data integration:** The project team created different methods to integrate telematics data from existing providers, including CSV exports, webhooks, and direct API queries. Once the data was collected, the project team developed data processing and integration steps, including data parsing (sorting and organizing data so that it can be integrated into MyFleetBuy), data cleansing (inspecting timestamp-resolved and trip-resolved data to remove outliers or erroneous data), and data correlation (matching telematics data to the fleet's vehicle inventory files).
3. **More effective reporting tools:** Working directly with fleet managers, the MyFleetBuy team developed a variety of reporting templates that boosted the credibility of their electrification recommendations. These templates were made available to MyFleetBuy consulting partners.

Based on the three focus areas listed above, the MyFleetBuy team created a solution that allowed fleet consultants to create electrification recommendations more efficiently. The process, which is shown in Figure 7, also provided more predictability in the vehicle assessment stage, which reduced the variability and costs of fleet electrification reports. By reducing the cost to create fleet electrification reports, the team made these assessments more accessible to fleet owners.

Figure 7: Fleet Electrification Process

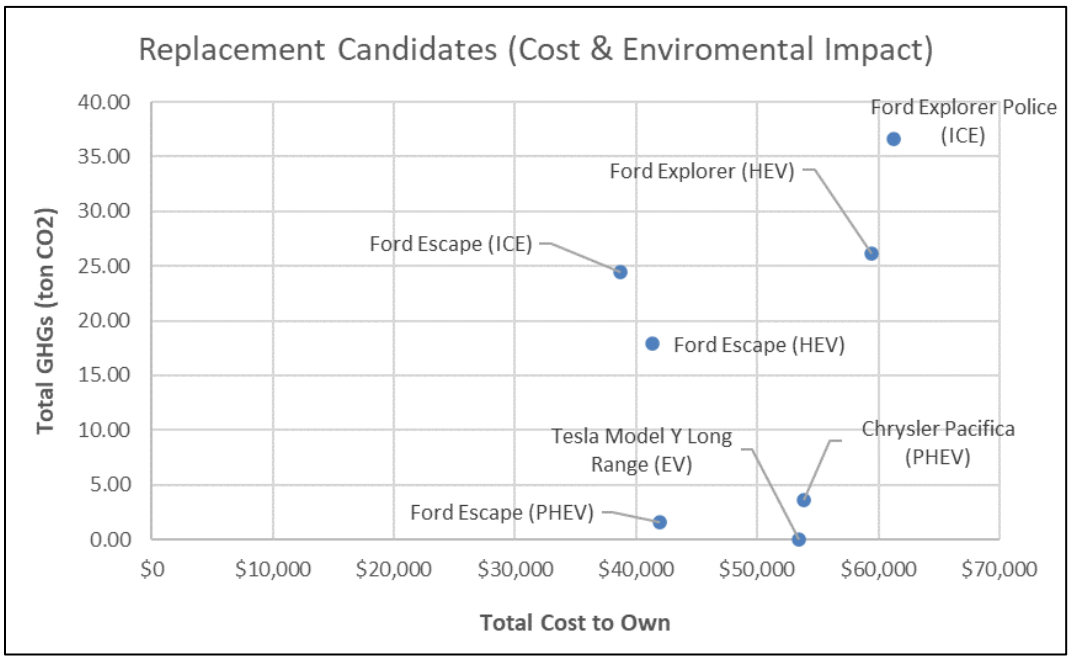


Once the above data sources are integrated into MyFleetBuy, fleet consultants can efficiently filter data and run a variety of simulations to calculate the viability, cost-benefit, and charging needs of different fleet electrification scenarios.

Reporting Capabilities

The MyFleetBuy team realized that fleet managers seemed to encounter more pushback when a fleet electrification report yielded a single vehicle recommendation. For example, a law enforcement department might object to the purchase of a Nissan Leaf as a replacement to a patrol vehicle but might be more amenable to the purchase of a Tesla Model 3 or a Ford Escape plug-in hybrid. This led the MyFleetBuy team to create report templates that enabled fleet owners to evaluate multiple vehicles for electrification, thereby encouraging an open dialogue about different paths to electrify a fleet. The chart in Figure 8 shows the user how a selected fleet-owned vehicle compares with multiple replacement candidates in terms of cost and GHG emissions.

Figure 8: Vehicle Replacement Alternatives



This scatter plot shows the vehicle replacement alternatives modeled for a 2011 Ford Escape hybrid. The chart maps total cost to own (x-axis) against the total expected GHG emissions (y-axis) for different fleet replacement candidates. The ideal vehicle is closest to the left and bottom of the chart. Users can select existing fleet vehicles using a dropdown button and visually compare multiple vehicles to prepare a more balanced discussion about fleet electrification with their internal clients.

During the COVID-19 global pandemic, the MyFleetBuy team also realized that many fleet owners were experiencing budget shortfalls and needed help to prioritize which vehicles to replace. This led us to create a GHG cost efficiency table, shown in Table 3. This report made it easier for fleet managers to determine which of their vehicles should be electrified first. GHG cost efficiency is a measure that calculates the costs (or savings) to reduce emissions. It is measured in dollars per ton of carbon dioxide ($/ton CO_2). The higher the cost, the more it will cost to reduce a ton of CO_2. In the "Recommendation Summary," we calculated the GHG cost efficiency for each of the vehicles evaluated for replacement.

Table 3: Greenhouse Gas Cost-Efficiency Table

Vehicle	Mi/yr.	GHGs (ton CO_2 /yr.)	Cheapest ICE[8]	TCO	GHGs (tCO_2 /yr.)	Cheapest Electric	TCO	GHGs (tCO_2 /yr.)	GHG Cost Efficiency
2018 Ford Expedition	37,295	19.5	Ford Escape HEV	$133,288	8.6	Ford Escape PHEV	$78,166	6.6	$9,393
2013 Toyota Camry	12,451	2.8	Toyota Prius	$63,224	2.2	Hyundai Ioniq PHEV	$39,020	1.5	$4,958
2015 Ford Explorer	17,309	2.5	Ford Escape	$62,078	1.5	Ford Escape PHEV	$44,968	0.6	$3,643
2011 Chevy Impala	583	0.3	Toyota Prius	$23,721	0.1	Hyundai Ioniq PHEV	$26,150	0.0	-$3,293
2008 Ford Escape	410	0.2	Ford Escape	$22,036	0.2	Ford Escape PHEV	$32,700	0.0	-$8,576

This table shows a subset of fleet vehicles assessed for electrification. A positive GHG cost-efficiency means that this fleet owner will reduce GHG emissions AND save money by choosing the 'Cheapest Electric' replacement option. A negative GHG cost-efficiency shows how much money the fleet owner will need to spend to reduce each additional ton of CO_2 compared to the emissions that would have been created by the 'Cheapest ICE' vehicle.

In addition to simplifying the vehicle selection process, the MyFleetBuy team also created an interactive tool that allows fleet owners to evaluate the charging infrastructure impacts of electrifying their fleet, shown in Figure 9. Using this reporting functionality, consultants can use a dropdown menu to select different charging locations and evaluate the capital investment and annual electricity costs expected to charge the vehicles evaluated for replacement. This tool made it easier for fleet owners to understand the benefits of managed charging[9] as well as to estimate how much charging infrastructure would be required to support electrification of the vehicles being considered for replacement.

[8] ICE stands for internal combustion engine. Gas- and diesel-powered vehicles use internal combustion to travel. By comparison, zero-emission vehicles travel by using electricity to power a motor. TCO stands for total cost of ownership.

[9] Fleets that operate EVs can choose to manage the charging schedule of their vehicles or to let them charge whenever their driver plugs the vehicle in. The former is called *managed charging* and the latter is called *unmanaged charging*. Fleets that invest in smart charging equipment and software that enables managed charging can reduce their electricity costs by recharging their vehicles when electricity is cheapest and by managing their peak electricity demand to reduce demand charges.

Figure 9: Charging Infrastructure ROI

Projected Annual MWh Demand Growth	305

Capital Expenditures	Managed Charging	Unmanaged Charging
L1 (1.8 kW)	$0.03 M	$0.05 M
L2 (7.2 kW)	$0.13 M	$0.08 M
L2 (9.6 kW)	$0.02 M	$0.02 M
DCFC (30 kW)	$0.09 M	$0.07 M
Total Capital Expenditure	**$0.27 M**	**$0.22 M**

	Managed Charging	Unmanaged Charging	Savings / (Cost)
Annual Electricity Costs	$0.14 M	$0.16 M	$0.02 M
CAPEX	$0.26 M	$0.21 M	-$0.05 M

ROI for Managed Charging	40%

The chart above shows the capital investment required to deploy charging infrastructure and estimates the ROI for a fleet to deploy managed charging infrastructure instead of uncontrolled (also known as 'unmanaged') charging.

The return on investment (ROI) in Figure 9 is calculated by comparing annual electricity costs and capital expenditures across the managed and unmanaged scenarios. For example, $0.02 million estimated annual cost savings from managed charging divided by $0.05 million additional capital expenditures to install managed charging equals 40 percent. Alternatively, this can be expressed in an inverted manner: $0.05 million divided by $0.02 million per year equals an estimated 2.5-year ROI time for choosing to deploy managed charging. The numbers presented in this table are illustrative for a particular fleet operation scenario; ROI percentages or ROI times vary based on circumstances.

The MyFleetBuy team created a report template that includes the interactive tools mentioned above and makes it easier for consultants to present more convincing recommendations. This approach should make fleet electrification reports more affordable (by reducing the costs to prepare them) and should thus lead to higher adoption of electrified[10] and fully electric vehicles (by presenting multiple options that encourage open dialogue).

A More Effective Approach to Deliver EV Education

The MyFleetBuy team collected feedback from many fleet managers who experienced difficulty in providing EV education to their internal department clients. Providing education and training to employees has not been a role for which fleet managers have traditionally been responsible. Furthermore, the project team learned that many fleet managers experienced internal push-back against fleet electrification due to the EV knowledge gaps and biases of their internal clients.

Based on these insights, the MyFleetBuy team decided to improve the ability for fleet managers to provide education and prepare their coworkers for electrification. This led to the parallel creation of *Electrifyze*, a content management platform dedicated to delivering EV education and to measuring the improvement in EV readiness across different departments.

[10] Electrified vehicles refer to hybrid and plug-in hybrid vehicles.

Using a software platform, the MyFleetBuy team provided the necessary resources for fleet managers to support change management within their organization. At the time of this report writing, Electrifyze had been used to provide EV education and resources to more than 3,600 employees in California.

The Problem With EV Education

Significant effort is being dedicated to increasing general awareness of EVs — for example, telling people that driving electric is normal and that there are over 70 models of EVs available for purchase. The problem is that improving general awareness does not directly lead to an EV purchase. It is not sufficient to resolve many of the biases that people hold. An average driver needs to successfully complete a series of decisions before becoming convinced to adopt an EV: (1) Is it important to consider an EV for purchase? (2) Will an electric car have sufficient range to meet my needs? (3) Is there one or more car models that fit my needs? (4) Can I afford an EV? (5) Is it better to choose electric versus gas? (6) How do I charge the electric car? (7) Will my coworkers and peers approve of my decision?

Each of these decision steps requires people to spend time and effort. Each of the decision steps represents a barrier to EV adoption — an opportunity for people to choose the convenient alternative (gas cars). People will make a decision at each of these steps and these decisions will be *informed by facts* or *clouded by bias*. Unfortunately, a small percentage of the population (i.e., the Innovators and Early Adopters) is currently willing, or able, to put in the effort to learn about EVs prior to purchasing a vehicle.

Effective EV education must be able to address each of these decision steps systematically while making it convenient for people. Using a content management platform, Electrifyze allows fleet owners to treat EV education as a problem that can be systematically addressed. By requiring employees to complete the Electrifyze EV learning program, fleet owners can ensure that their staff will make fleet electrification decisions that are informed by facts. They can also measure EV readiness across different departments and collect feedback from their employees on how to prepare for the EV transition.

At the time of this report writing, the MyFleetBuy team had collected over 1,100 survey responses from participants in the Electrifyze program, with overwhelmingly positive reviews.

CHAPTER 3:
Project Results

At the beginning of the project, the MyFleetBuy team intended to develop data visualizations and other analytical tools to reduce the barriers to fleet electrification. The team's specific goals were to:

1. Develop an analytics platform that collects real-world vehicle inventory and operating data from different fleet owners.
2. Utilize fleet driving data to simplify and provide accurate EV recommendations.
3. Utilize fleet driving data and EV modelling to deliver charging infrastructure recommendations.

As the project progressed, the project team realized that fleet owners needed help to provide education and prepare employees for electrification. In turn, this led to the project team developing a fourth goal:

1. To create a learning management system that helps employees learn about EVs and prepare for the electrification of their fleet.

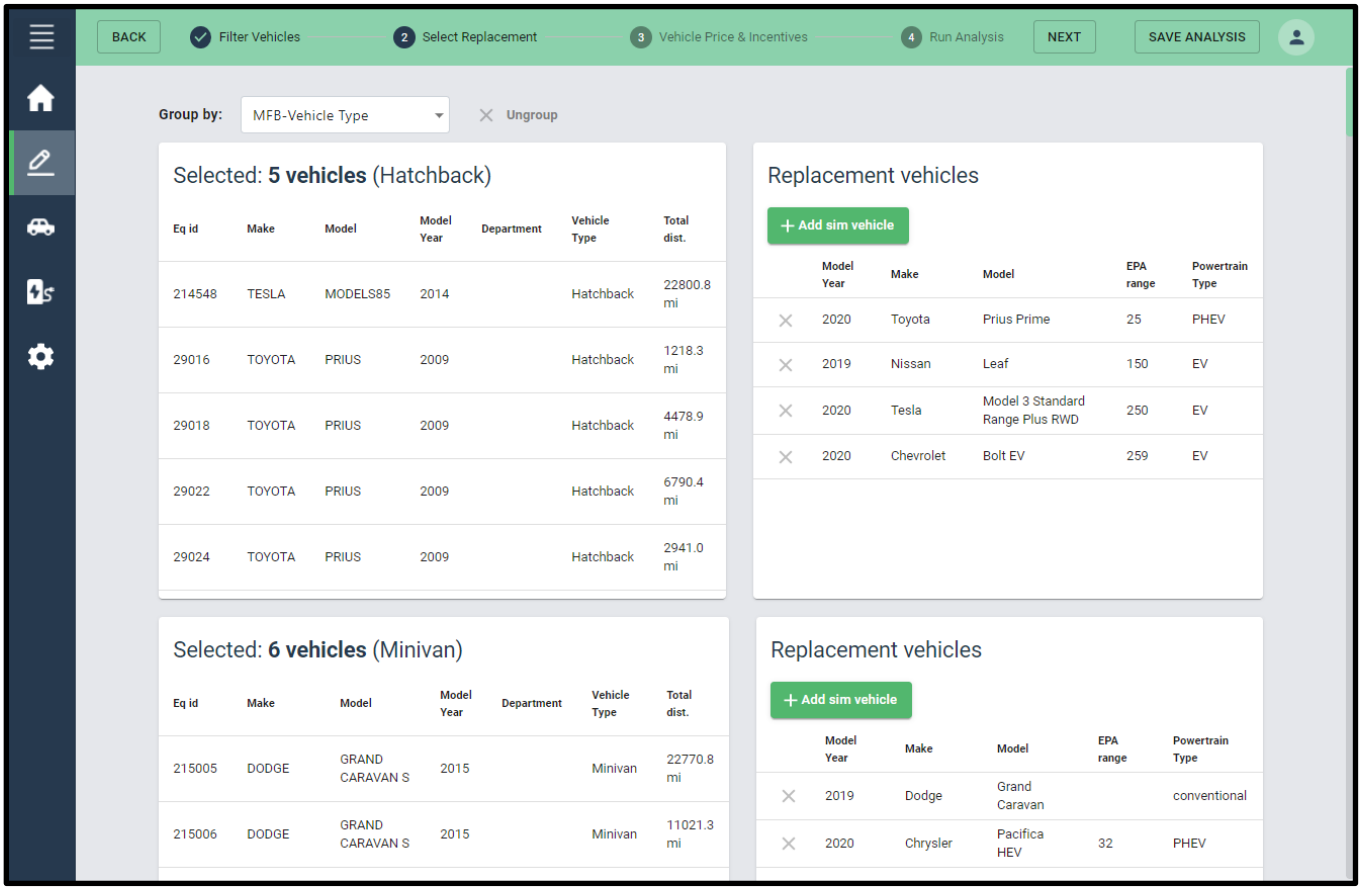
The MyFleetBuy team successfully accomplished its objectives by launching two solutions — *MyFleetBuy*, a fleet analytics software solution, and *Electrifyze*, an EV learning management system, and demonstrating their effectiveness with organizations across California.

Fleet Electrification Analytics

Throughout this project, the researchers evaluated the travel data from more than 12,000 fleet vehicles and secured contracts with fleet consultants as well as fleet owners. The MyFleetBuy team developed a functional software platform that empowered fleet managers to create, save, and share multiple vehicle electrification simulations. The MyFleetBuy flexible data modelling approach allowed users to prepare multi-year transition reports and/or provide recommendations for a small subset of their fleet (for example, vehicles that need to be immediately replaced) (Figure 10). This flexibility reduces the costs and uncertainty of providing fleet electrification recommendations, which in turn makes fleet electrification assessments more affordable for fleet owners.

MyFleetBuy users have the flexibility to customize fleet assessments to suit their audience — for example, a city fleet manager can use one software tool to: (a) prepare a 5-year fleet transition report for the city's finance department, (b) provide EV recommendations to support the police department's annual fleet procurement, and (c) recommend how much EV charging infrastructure to make-ready when the public works department is planning a construction project at a specific facility.

Figure 10: Screenshot of MyFleetBuy



MyFleetBuy software users can filter and determine which fleet vehicles to evaluate for replacement (on the left). They can also choose from a variety of internal combustion engine and battery electric powered vehicles (on the right). This approach provides maximum flexibility when a user needs to run different fleet electrification simulations and was intended to make EV decisions self-serve situations.

The intention of MyFleetBuy was to enable fleet managers to have data-driven conversations with their internal clients and prepare more convincing fleet electrification recommendations. Refer to Appendix B for more details on the software solution that was created.

Insights From Fleets

Throughout this project, the MyFleetBuy team provided EV recommendations to several fleet owners and identified opportunities for these organizations to save money while cutting emissions. Following are some examples of the insights delivered to fleet owners.

- **Costs and GHG emissions can be reduced:** Fleet owners in California can reduce GHG emissions and operating costs by more than 80 percent and 50 percent, respectively, when they electrify. GHG emission savings can be even higher if fleet owners use renewable energy to power the EVs. For example, when the MyFleetBuy team helped a city fleet develop a 5-year replacement plan for 134 light duty vehicles, the city staff learned that electrifying those vehicles by 2025 would help the city reduce annual

operating costs by $0.2 million (55 percent) and annual GHG emissions by 850 metric tons (100 percent).

- **Fleet electrification can result in higher costs:** Electrifying the fleet of 134 light duty vehicles discussed above would have resulted in a $1.4 million higher upfront investment for that city. It would also have resulted in a net increased cost of $0.1 million over the lifetime of the vehicles compared to similar fossil-fueled cars (many EVs 'repay' their higher upfront costs by reducing the cost of fuel and maintenance, but some fleet vehicles are not driven enough for the upfront cost to be recovered in savings).
- **Cost-efficient replacements should be prioritized:** As mentioned above, some fleet vehicles are not expected to reduce net costs for a fleet when electrified. Moreover, the MyFleetBuy team worked with many fleets that experienced significant budget shortfalls due to the COVID global pandemic. To alleviate their budget concerns, the MyFleetBuy team started calculating GHG cost-efficiency metrics for all the vehicles assessed and quickly learned that fleet owners can generate significant environmental benefits and reduce their upfront investment by prioritizing replacement of vehicles that are GHG cost-efficient.[11] For example, Table 4 demonstrates how a county fleet and a city fleet would have been able to reduce their capital expenditure by more than $1 million while achieving up to 45 percent of the available GHG emission reductions from electrification.
- **ZEV-first policies are important but not sufficient:** Many public fleet managers emphasized the importance of securing board approval for a 'ZEV first' policy to streamline internal decision-making and enforce fleet electrification. However, the MyFleetBuy team also encountered fleet owners who expressed concern about unintended consequences from ZEV-first and ZEV-purchase requirements.[12] For example, some of the fleet managers interviewed would achieve their ZEV-purchase requirements by deploying EVs in use cases with the lowest amount of pushback (such as in pooled vehicle applications) and later realized that these vehicles would be underutilized because drivers would choose to drive familiar vehicles (the gas cars) as much as possible. The MyFleetBuy team also interviewed a fleet manager who experienced difficulty in training employees on how to operate the EVs that had been recently purchased by the fleet. Based on this information, the MyFleetBuy team decided to

[11] A positive GHG cost-efficiency means that the fleet owner would be able to reduce GHG emissions AND save money by choosing the 'Cheapest Electric' replacement option. A negative GHG cost-efficiency shows how much money the fleet owner would need to spend to reduce each additional ton of CO2 compared to the emissions that would have been created by replacing that vehicle with the 'Cheapest ICE' vehicle. Cheapest is measured as the 'lowest TCO' among the vehicles being considered as replacement candidates.

[12] A ZEV-first policy forces internal departments to choose a ZEV as a replacement candidate first. If fleet operators demonstrate that a ZEV will not meet their travel demands, then they must consider a plug-in hybrid EV second, a hybrid option third, and can only choose an ICE vehicle after demonstrating that no other vehicle will meet their needs. A ZEV-purchase requirement demands that fleet owners replace a certain percentage of its fleet with ZEVs each year. Executive Orders B-16-2012 and N-79-20 require state fleets to increasingly electrify. California state fleets must meet a ZEV-first policy and ZEV-purchase requirements.

launch a software solution to improve EV education and help fleet owners prepare their workforce for electrification; refer to Appendix C for more details.

- **Planning for infrastructure pays off:** Using the MyFleetBuy EV simulations, the project team helped fleet owners understand the value of preparing smart charging infrastructure plans. Studies show that fleets that procure and install more than 6 EV chargers at a time can achieve a 36 percent cost reduction per charger (Nelder and Rogers, 2019). For a fleet with 300 vehicles, the average fleet size for small cities, planning for electrification and procuring in volume could represent more than half a million dollars in savings over the lifetime of the vehicles.

Table 4: GHG-Cost Efficiency Analysis for Two California Fleets

	COUNTY FLEET	CITY FLEET
Vehicles evaluated for replacement		
All vehicles	81	134
GHG cost-efficient vehicles	23	33
% of vehicles that are GHG cost-efficient	*28%*	*25%*
Annual GHG reduction potential (ton CO_2)		
Vehicles evaluated for replacement	220	420
GHG cost-efficient vehicles	100	150
% of emissions from vehicles that are GHG cost-efficient	*45%*	*36%*
Additional upfront vehicle cost to electrify		
Vehicles evalutated for replacement	($1.5 M)	($1.4 M)
GHG cost-efficient vehicles	($0.4 M)	($0.2 M)
Reduction in Capital Expenditure	*$1.1 M*	*$1.2 M*
Budgetary impact based on total cost of ownership		
All vehicles	($0.4 M)	($0.1 M)
GHG cost-efficient	$0.1 M	$0.4 M
Improvement in Total Cost of Ownership	*$0.5 M*	*$0.5 M*

The MyFleetBuy team helped a county fleet prepare an electrification plan for 81 light, medium, and heavy duty vehicles due for replacement at its next annual procurement cycle. The team also helped a city fleet prepare an electrification assessment for 134 light duty vehicles due for replacement in a 5-year time window. GHG cost-efficient vehicles are vehicles that deliver total cost savings while also eliminating emissions. Many EVs have a higher upfront price than comparable ICE vehicles, but they deliver cost savings from reduced fuel consumption and lower maintenance.

In the MyFleetBuy assessments, many vehicles were not GHG cost-efficient because the EV alternatives were much more expensive than their ICE counterparts, or because the vehicle being replaced did not travel enough annual miles to recover the upfront EV costs in fuel and maintenance savings. In many cases, the MyFleetBuy team recommended that fleet owners re-evaluate whether vehicles with a highly negative GHG cost-efficiency metric needed to be replaced at all, since they were not used very often.

Change Management With EV Education

During this project, the MyFleetBuy team heard from many fleet managers who experienced barriers to fleet electrification related to EV knowledge gaps and biases. Following are some examples of the problems identified.

- A city fleet manager in the California Bay Area explained that he had to spend a lot of time creating EV education resources and sharing them with city staff because the organization had purchased EVs and people were uncomfortable driving them. This fleet manager already had a full workload and found it difficult to find the time and resources to effectively educate his peers.
- The fleet manager at a large organization in Southern California mentioned that internal clients were opposed to EV procurement for a variety of reasons, including concerns about EV charging availability, high total costs of ownership, and the ability of EVs to meet drivers' operational needs. This fleet manager indicated that it was difficult to overcome these EV knowledge gaps because it required providing EV education to a wide audience of employees at different levels of their internal departments' organizations (such as employees in the finance department, fleet drivers, and management).
- A county fleet in Florida reported that one of its internal clients strongly opposed fleet electrification because employees believed that EVs would not have sufficient acceleration and torque to meet their driving needs. Some employees in the department had experienced hybrid vehicles with powertrains designed to be fuel efficient but not optimized for law enforcement operations; they did not realize that the acceleration and handling of many EVs is superior to those of comparable hybrid and conventional cars. The fleet managers at this organization were facing strong opposition to electrification based on an incorrect group bias.

It became clear to the MyFleetBuy team that there was a strong gap in the market for EV education tools that help fleet owners address employee change management. Therefore, in parallel to this project, the MyFleetBuy team created the Electrifyze learning management platform.

Progress With Electrifyze

At the time of this report writing, the MyFleetBuy team had already provided EV education to more than 3,600 employees in California. Since there are a lot of topics that people need to explore about electric cars, the MyFleetBuy team created a series of virtual campaigns that focused on one topic at a time — for example, the environmental benefits of electric cars, the driving range and how to charge, and financial costs and benefits. This approach has allowed us to increase participation rates and improve participant engagement.

Using a data science approach, the MyFleetBuy team also measured important metrics that allow us to determine the EV readiness of different internal departments. At the end of each campaign, the team would anonymize the data (to protect privacy) and present metrics to fleet owners.

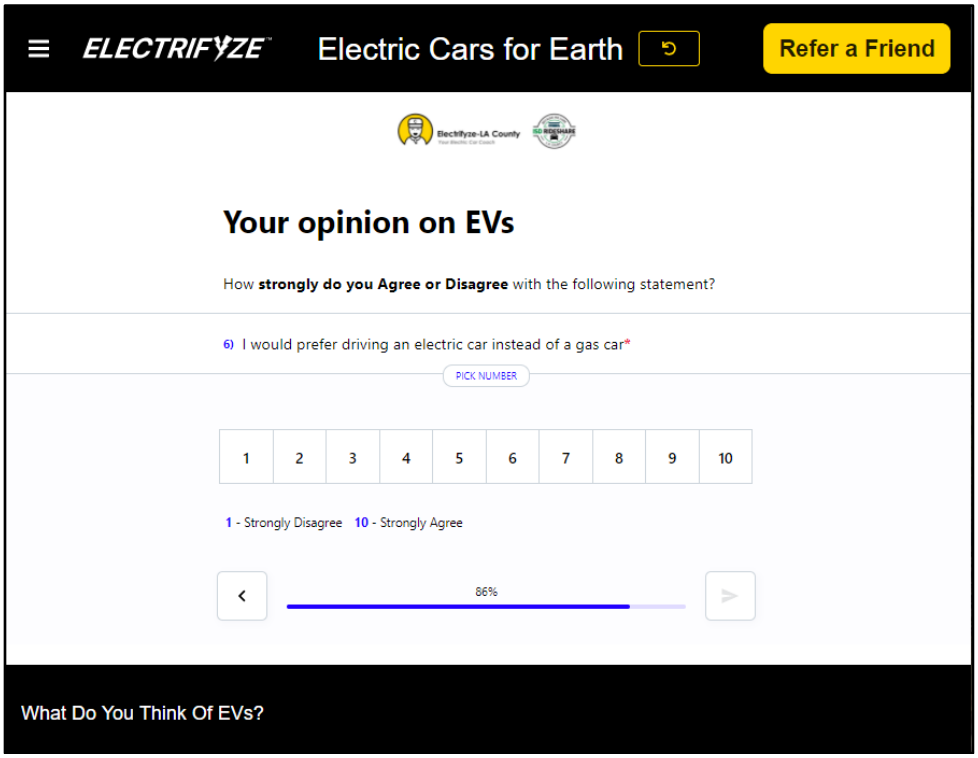
During this project, the MyFleetBuy team measured the following results.

- **Unique participants:** 3,644 employees participated in the MyFleetBuy EV education campaigns and more than 30 percent participated in multiple campaigns.
- **Total participation:** Over the course of four campaigns, there were 4,000 total participants.
- **EV contest completion rate:** 60 percent of participants completed an average of 30 minutes of EV learning content per campaign.[13]
- **Content mastery:** Using quizzes, the project team determined that 40 percent of participants became content masters (scored 100 percent on their quizzes). This helps organizations understand which internal departments are better prepared for the EV transition.
- **EV readiness:** Using rating scale questionnaires, the MyFleetBuy team measured a 6 percent improvement in EV readiness among all participants, and a 43 percent improvement in EV readiness among EV detractors.[14] Figure 11 shows an example of how Electrifyze measured improvements in EV readiness over time.
- **Survey feedback:** In addition to measuring quantitative learning data, Electrifyze collected survey data that helps fleet owners improve their employee change management practices. For example, several participants provided survey feedback on where they would like to see more workplace charging station availability.

[13] Note: these metrics were measured during quarterly EV education contests offered through employers. Participation in these events was voluntary.

[14] The MyFleetBuy team measured EV readiness by asking participants how strongly they agree (on a scale of 1 to 10) with statements such as "I would recommend an electric car to my best friend." Participants with a score below 5 at the beginning of a campaign were described as 'EV detractors' and those who scored above 5 were described as 'EV Promoters.' Electrifyze asked the same questions at the beginning and the end of each campaign to measure improvements in EV readiness based on changes in participants' responses.

Figure 11: Measuring EV Readiness



Electrifyze participants completed a set of learning modules, surveys, and quizzes during each EV education campaign, to measure EV readiness.

If Electrifyze can help employees get comfortable with electric cars, it will reduce internal pushback when the fleet vehicles they operate are recommended for electrification. While the project team encountered EV education and training programs in the marketplace, most of these programs seemed focused on technical topics (such as preparing technicians to maintain EVs or providing training on how to deploy charging infrastructure). The MyFleetBuy team believes that regulators should also prioritize improving the EV readiness of employees and the general public to ensure that knowledge gaps and biases that are important barriers to transportation electrification are reduced. The California Zero-Emission Vehicle Authority, to be created according to SB 551, might be a good organization to oversee a systematic, and measurable, program that provides EV education and improves EV readiness across the state.

The Electrifyze platform and content are quickly evolving and the MyFleetBuy team is looking for opportunities to partner with more organizations to deploy this solution as a valuable change management tool. The MyFleetBuy team would appreciate any guidance or support from the Governor's office to reach employees at large state agencies such as the Department of General Services, the California Natural Resources Agency, the Franchise Tax Board, and the Department of Corrections. Given the size of the MyFleetBuy organization, it has been difficult to navigate the procurement processes of large state agencies that can make a meaningful improvement in EV readiness across California.

CHAPTER 4:
Technology and Market Transfer Activities

Market Sizing

The MyFleetBuy team estimates that the value for fleet electrification services will be worth $62 million per year in California, as shown in Table 5.

Table 5: Market for Fleet Electrification Services in California

Target Markets in California	Est. Annual Value
Government fleets[15]	$4.4 M
Private fleets[16]	$56.0 M
Electric utilities[17]	$1.4 M
Total	$61.8 M

The near-term market for the MyFleetBuy technology includes local governments since they are facing strong regulatory and public pressure to reduce their carbon footprint and electrify their fleets. The mid-term market for fleet electrification software includes large private fleets and electric utilities with climate action targets and which stand to benefit financially from fleet electrification. The long-term goal is to become an integrated solution for fleet management service providers such as telematics, leasing, and asset management software vendors.

Market Transfer Activities

The MyFleetBuy team took several actions to build market awareness and adoption of the MyFleetBuy solution. The team began market transfer activities by offering free EV assessments as pilots to city and county fleets in the California Bay Area. Working with these fleets provided us with industry experience, improved MyFleetBuy's credibility in the market, and helped collect valuable user feedback to develop the first prototype of MyFleetBuy. Upon completing the pilots, the MyFleetBuy team dedicated efforts to marketing, sales, and business development.

[15] This target market includes 250 organizations (cities, counties, and state agencies in California) and the team assumes an average price of $70,000 per fleet electrification consulting assessment, paid every four years. Data sources include US Census Bureau annual estimates of resident population tables.

[16] The MyFleetBuy team estimates there are 3,200 private fleets in California and assumes an average price of $70,000 per fleet electrification consulting assessment, paid every four years (Deloitte 2018).

[17] This target market includes 28 utilities in California (investor-owned, municipal, and community choice aggregators) and the team estimates an annual contract for utility fleet electrification software of $50,000 per year (U.S. EIA 2018).

Marketing

The MyFleetBuy team hired a designer to develop marketing collateral and develop a website for the MyFleetBuy program. The team raised awareness about the company by presenting at industry events such as the Advanced Clean Transportation Expo, the International Association of Transportation Regulators, and the ClimateTech Marketplace conference, which is hosted by the Bay Area Air Quality Management District.

Four tactical outreach strategies to reach fleet owners were implemented. The first was to collaborate with DOE Clean Cities Coalitions in San Diego, Sacramento, and Northern Colorado to present MyFleetBuy and share collateral with fleet owners in their regions. The second was to seek introductions to local governments and fleet owners by collaborating with nonprofits such as Forth, U.S. Energy Foundation, Community Environmental Council, and the EV100 Group. The third was to present the MyFleetBuy approach and seek advice from air districts in Los Angeles, Ventura, and the Bay Area. The fourth marketing outreach strategy involved presenting directly to fleet managers by presenting at industry working group meetings such as the Department of General Services Office of Fleet and Asset Management (OFAM) virtual state equipment council meeting and at the American Association of State Highway Transportation Officials (AASHTO) Equipment Technical Working Group.

Sales

In addition to implementing the marketing approach described above, the MyFleetBuy team undertook direct sales efforts to reach local governments, electric utilities, and large organizations.

The MyFleetBuy team reached out directly to more than 200 prospective fleet customers in California via email or phone call and collaborated with vendors and community choice aggregators to secure warm introductions to fleet owners in their service territory. Many of the fleet owners the project team reached through these efforts had budget constraints and were not planning to pay for fleet electrification assessments. Some of the fleet owners contacted were planning to run a competitive solicitation to hire a fleet electrification consultant. At the time of this report writing, MyFleetBuy had secured direct contracts with two organizations through direct sales efforts.

While contacting fleet owners directly, the project team also approached several municipal and investor-owned utilities in California, Oregon, Texas, and Michigan. The MyFleetBuy team learned through a series of conversations that utilities are entering the fleet electrification space by providing knowledge and facilitating charging infrastructure deployments. Many of the utilities interacted with were also looking for solutions to help fleet owners evaluate which of their vehicles to electrify and invited us to submit proposals in their competitive solicitations. At the time of this report writing, MyFleetBuy had been unsuccessful at securing a contract for fleet electrification services directly with an electric utility.

The MyFleetBuy team learned two important lessons through direct sales and marketing efforts: the target clients had long sales cycles, and fleet owners needed a whole solution.

Long Sales Cycle

Selling directly to public fleets and electric utilities was difficult for a small organization because their procurement processes are long, require a high resource investment, and offer limited revenue potential. Since procurement cycles were so cumbersome, the MyFleetBuy team found that many target clients were risk averse and preferred working with a pre-approved list of consultants or organizations with a successful track record supplying services to that client.

Whole Solution

Fleet owners were typically looking to hire a consultant to prepare a report for senior leadership (reports tended to include multi-year fleet electrification and infrastructure plans), or they were looking for technical implementation support (for example, selecting, installing, and interconnecting charging infrastructure).

Through sales and marketing efforts, the project team decided that the market for MyFleetBuy as a standalone software solution was limited. These insights led us to pursue go-to-market partnerships with industry participants at different levels of the fleet industry value chain. For example, MyFleetBuy signed a software license agreement with an energy consulting firm to help it launch a fleet electrification practice. This go-to-market partnership allowed us to efficiently reach multiple fleet owners while enabling a partner company that had previously focused on energy consulting (such as distributed energy resource feasibility studies and energy program design work) to offer fleet electrification assessments to their customers.

Business Development

With support from this project's technical advisory committee, the MyFleetBuy team connected with several industry players, including fleet and energy consulting firms, OEMs, utility software and services vendors, fleet leasing and fleet management firms, nonprofits, and fleet software providers (including telematics companies). For example, the MyFleetBuy team had several product strategy discussions with the CEO, CSO, and other senior leadership at a global fleet telematics company valued at over $1 billion dollars.

The MyFleetBuy team found that these organizations could use the MyFleetBuy software to complement their existing products and launch a new solution — fleet electrification services — to their existing client base. Another advantage of establishing go-to-market partnerships with these organizations was that the small team at MyFleetBuy could focus on product development without incurring the staffing burden of navigating target clients' long sales cycles. The MyFleetBuy team has been successful at securing contracts for fleet electrification services through industry partners.

Market Development Challenges

The original intention of MyFleetBuy was to develop a software-as-a-service solution offered for a low annual fee. This approach would have allowed the MyFleetBuy team to reduce the barrier of access to EV analytics and decision-making tools. In pursuit of this objective, the

MyFleetBuy team subscribed several fleets to free and paid assessments and launched a software solution.

After collecting product feedback from users and market insights through sales and marketing efforts, it became evident that fleet managers were generally not looking for a self-serve solution but rather wanted to receive support from trusted experts. This meant that the project team would have to establish a consulting practice and build up the MyFleetBuy reputation, or MyFleetBuy would have to become a vendor to organizations that fleet managers already trusted for advice — fleet and energy consultants or electric utilities. The MyFleetBuy team chose to become a vendor and dedicated time and resources to building relationships with a variety of fleet and energy consultants, as well as electric utilities. The MyFleetBuy software was also adjusted to better address the needs of these organizations (for example, by developing new data visualizations and reporting capabilities to streamline assessments and better serve the needs of consultants and utilities).

At the time of this report writing, some of MyFleetBuy's consulting partners have successfully secured contracts with fleet owners, while others are still navigating long procurement cycles. The project team was invited to participate in competitive solicitations from many of the electric utilities that the project team approached during the sales cycle, but MyFleetBuy was unsuccessful at securing contracts with utilities. Most of the project team's utility sales targets opted to work with larger organizations or decided to offer simplified fleet electrification services that did not require the powerful analytics that the MyFleetBuy team had developed. The team plans to continue driving adoption of MyFleetBuy technology by pursuing go-to-market partnerships.

Following are other market development challenges that were encountered.

- **Direct sales efforts are expensive.** The MyFleetBuy team's sales cycles took years in some cases and most fleet owners did not have a clear budget available for a fleet electrification assessment. Furthermore, during the COVID 19 global pandemic, most of the fleets the team engaged were facing budget shortfalls and were not planning to spend money on fleet analytics. These factors prevented organizations like MyFleetBuy from scaling low-cost fleet electrification tools.
- **Personalization is cumbersome.** Loading data from fleet owners is cumbersome and time consuming, particularly telematics and building energy-profile data. Over time, the team developed data collection templates, webhooks and API integrations to streamline data onboarding, but these efforts still required a consultant to onboard fleet owners. The MyFleetBuy team recommends integrating fleet electrification analytics into existing software solutions that fleets already subscribe to, such as Assetworks, Fleetio, GeoTab, GPS insights, Verizon Connect, and FleetComplete.
- **Fleet electrification may lack an internal sponsor.** Many of the fleets engaged did not have a clear internal sponsor for fleet electrification. Fleet electrification requires involvement from three separate work functions: fleet managers, budget owners, and energy managers. To successfully electrify a fleet vehicle, the budget owner (for example, the department that will operate the vehicle) has to accept the EV

recommendation, the fleet manager needs to procure the vehicle, and the energy manager needs to oversee construction and interconnection of the charger. The MyFleetBuy team found that these separate work functions can operate in organizational silos, thereby making it difficult to complete the electrification process. In many cases, the MyFleetBuy team was engaged by the sustainability department, which played the role of 'match-maker' between the different work functions, but this approach was effective only while the consulting project was active. After the project was completed, the sustainability department focused on other work and the three different work functions continued to struggle with weak alignment. The MyFleetBuy team recommends that policy makers address this barrier by requiring public fleet owners to assign the responsibility for fleet electrification to a dedicated staff member with the ability to operate cross-functionally.

The MyFleetBuy team strongly believes that increasing access to fleet electrification analytics tools will make it easier for consultants across the state to deliver their recommendations. This will, in turn, make it more affordable for fleet owners to seek advice from the experts they trust.

The MyFleetBuy team recommends that future energy policy and planning provide support for the development of vehicle electrification tools that standardize fleet electrification assessments. This will make it easier for trusted advisors and fleet software providers to roll out affordable fleet electrification solutions. Some examples of the types of electrification tools that could be funded by policy makers include EV Fleet Tools,[18] developed with funding from the Bay Area Air Quality Management District, the Carbon Counter,[19] developed by the MIT Trancik Lab, and the DRVE tool,[20] developed by the Electrification Coalition.

Scaling EV Education Across California

In addition to pursuing opportunities to grow adoption of MyFleetBuy, the team explored different avenues to commercialize Electrifyze. As previously discussed, the team realized that EV knowledge gaps and biases represent a strong barrier to the adoption of EVs. Consequently, the project team set out to grow adoption of Electrifyze among employers in California by pursuing two different avenues:

- **Employee Training Departments:** As a learning management system, Electrifyze can be used to provide EV education seminars for large employers through well-established training departments managed by human resources. The MyFleetBuy team has organized different learning modules that employees can take to become EV 101 certified.[21] For example, fleet owners who are committed to accelerating EV adoption can request that their employees take the EV 101 certification, which would be offered through their training department.

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[18] https://evfleet.tools/about-this-project/

[19] https://www.carboncounter.com/#!/explore

[20] https://www.electrificationcoalition.org/drve/

[21] Some of the learning modules offered include *Understanding the basics about Electric Vehicles*, *How to drive and recharge an EV*, *Exploring the performance benefits*, and *Why EVs are better for the environment*.

- **Rideshare and Transportation Planning Departments:** Most large employers have a department dedicated to helping employees minimize single-occupancy trips and reduce commute emissions. The MyFleetBuy team helps these departments engage employees by offering quarterly contests that gamify the EV learning experience. Employees sign up for these contests voluntarily and compete for prizes.

At the time of this report writing, Electrifyze had been used to deliver EV education to more than 3,600 employees and the MyFleetBuy team was in several discussions with employers across California to encourage adoption of Electrifyze. The MyFleetBuy team also partnered with Forth, a leading nonprofit in the EV space, to propose a national workplace electrification program for the Department of Energy.

Based on interactions with thousands of consumers, the MyFleetBuy team now realizes that EV knowledge gaps and biases present a strong barrier to the adoption of EVs. Electrifyze can systematically address these knowledge barriers to ensure that people can make unbiased EV purchase decisions. The MyFleetBuy team believes that California state agencies, local governments, and large employers need to play a leadership role in distributing effective EV education to reduce internal pushback when fleet owners try to electrify their fleet.

CHAPTER 5: Conclusions/Recommendations

Transportation electrification will reduce global warming emissions by more than 80 percent in California and is a critical requirement to achieve the state's 2045 carbon neutrality objectives. Fleet vehicles represent almost 20 percent of annual light duty vehicle registrations and account for millions of vehicles across California. Improving access to fleet electrification assessments and deploying effective EV education will reduce important barriers to the electrification of fleets across the state.

Fleet Electrification Assessments

To deploy EVs, fleet managers need to answer complicated questions and then present convincing evidence to their internal clients. Unfortunately, most fleet managers lack the internal resources and expertise needed to determine which vehicles to electrify and how much charging infrastructure to deploy. This lack of expertise results in a sub-optimal adoption of EVs when fleets make vehicle procurement decisions.

The project team collected feedback and driving data from multiple fleet owners to develop a fleet analytics software solution called MyFleetBuy. Using MyFleetBuy, the project team evaluated the driving data from more than 12,000 fleet vehicles and delivered fleet electrification and charging infrastructure recommendations to several fleets across California.

After extensive market development efforts, the MyFleetBuy team learned that fleet owners can reduce GHG emissions and operating costs by more than 80 percent and 50 percent, respectively, when they electrify. Go-to-market partnerships with consulting firms were also established to accelerate adoption of the MyFleetBuy technology. By partnering with these organizations, the MyFleetBuy team has been able to reduce the uncertainty and costs associated with delivering fleet electrification assessments, which in turn makes it more affordable for fleet owners to get the support they need throughout the state of California and the rest of the United States.

Effective EV Education

During the product development process, the MyFleetBuy team collected feedback from fleet managers and industry vendors across multiple organizations. By listening to their concerns, the project team realized that many fleets were struggling to address change management within their organization. It turns out that most fleet managers provide a consultative role to internal departments that make vehicle procurement decisions. The project team learned that fleet managers across the state struggled to effectively address EV knowledge gaps and biases that create pushback against fleet electrification efforts. The project team decided to launch an EV learning management system to help organizations systematically address EV knowledge gaps and biases.

After providing EV education to more than 3,600 employees across California, the MyFleetBuy team was able to measure a 6 percent improvement in EV readiness, on average, among thousands of participants and a 43 percent improvement in EV readiness among EV detractors. Over a thousand survey responses from participants were collected and these have been overwhelmingly positive.

The MyFleetBuy team identified an opportunity to help fleet owners and large organizations prepare Californians for the EV transition by collaborating with human resource training departments and transportation planning departments to roll out Electrifyze as a solution for their employees. The project team encourages all public agencies and employers to recognize the importance in using a structured approach to reduce the EV knowledge gaps and biases that prevent rapid adoption of EVs for their fleet.

Recommendations

While delivering on the proposed scope of this project, the MyFleetBuy team encountered certain roadblocks and challenges that can be addressed by regulators, public agencies, and electric utilities.

Many fleet managers expressed the importance of securing approval from senior leadership for a 'ZEV first' policy to streamline internal decision-making and enforce fleet electrification. The MyFleetBuy team strongly recommend that California regulators develop templates and resources to help as many local governments and private companies as possible to quickly adopt ZEV first policies.

Due to the COVID 19 global pandemic, most of the fleets interviewed were experiencing significant budget shortfalls. This presented a procurement challenge since many EVs have a higher upfront cost than their fossil-fuel counterparts. To address this issue, the MyFleetBuy team helped fleet owners calculate the cost-efficiency of GHG reductions from electrifying different vehicles. The project team realized that fleet owners who prioritized the replacement of vehicles with a positive GHG cost-efficiency could reduce their budget shortfall by millions of dollars while still achieving significant GHG emission reductions. The MyFleetBuy team recommends that regulators take into consideration efficiency metrics, such as the cost-efficiency of GHG reductions, when determining which public fleet vehicles should be electrified first, which vehicles should not be replaced at all, and which vehicles should be electrified at a future date.

Many of the fleets engaged did not have a clear internal sponsor for fleet electrification. Fleet electrification requires involvement from three separate work functions: fleet managers, budget owners, and energy managers. To successfully electrify a fleet vehicle, the budget owner (for example, the department that will operate the vehicle) must accept the EV recommendation, the fleet manager needs to procure the vehicle, and the energy manager needs to oversee construction and interconnection of the charger. The MyFleetBuy team found that these separate work functions can operate in organizational silos, thereby making it difficult to complete the electrification process. In many cases, the MyFleetBuy team was engaged by the sustainability department, which played the role of 'match-maker' between the different work functions, but this approach was effective only while a consulting project was active. After the project was completed, the sustainability department typically moved on to other priorities and

the three different work functions continued to struggle with weak alignment. The MyFleetBuy team recommends that policy makers address this barrier by requiring public fleets to designate a specific department or individual to be accountable for accelerating fleet electrification.

Lastly, many of the fleet managers, consultants, and industry stakeholders interviewed indicated that there was a strong gap in the market for EV education tools that help fleet owners address employee change management. The majority of the population still experiences EV knowledge gaps and biases that prevent people from making fact-based decisions when deciding if an EV will fit their needs. The MyFleetBuy team strongly recommends that regulators and public agencies acknowledge the importance of providing structured EV education to close the EV knowledge gaps and biases that result in pushback from public and private sector employees. The California Zero-Emission Vehicle Authority, to be created according to SB 551, might be a good organization to oversee a systematic and measurable program that provides EV education and resources to fleet owners across California.

CHAPTER 6:
Benefits to Ratepayers

The MyFleetBuy and Electrifyze technologies will accelerate adoption of EVs by providing fleet managers with the tools they need to procure EVs and address change management barriers. These technologies will result in ratepayer benefits of greater electricity reliability, increased safety, and lower costs.

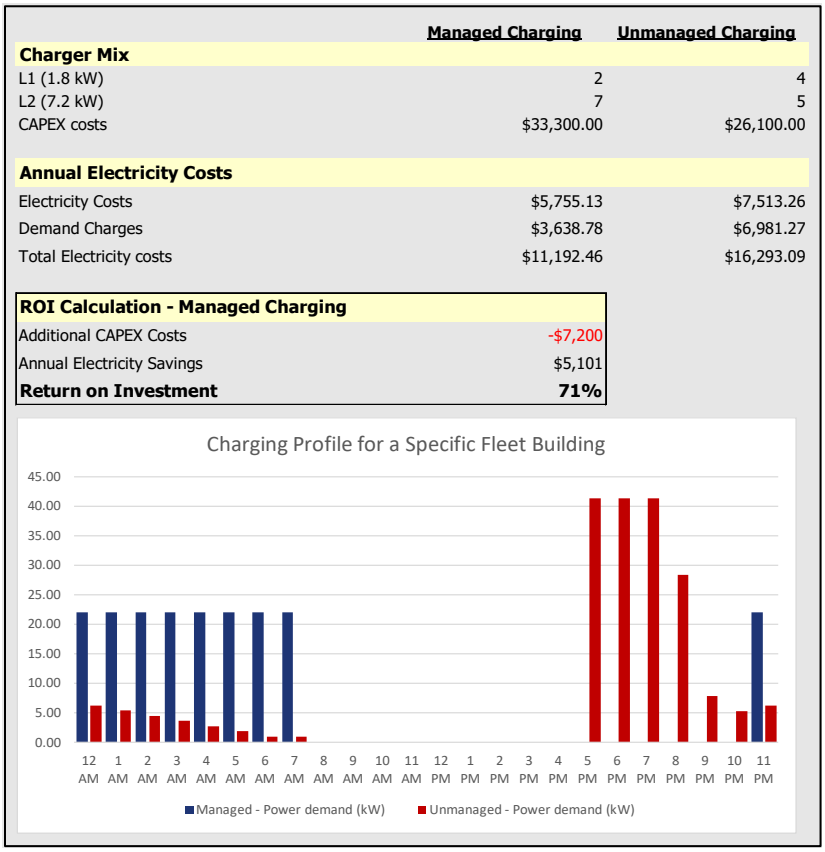
Reliability, Safety and Lower Costs

Greater reliability of utility distribution systems can be achieved by making fleet electrification assessments more affordable for fleet managers and encouraging the procurement of EVs with smart charging instead of uncontrolled charging. The shift toward EVs with smart charging will help to mitigate excessive demands at fleet charging hubs, thereby avoiding local grid faults, transformer overloading, and excessive voltage deviations.

Increased safety will be achieved by guiding fleet managers towards vehicle procurements that truly meet their needs, thereby avoiding situations where EV drivers become stranded from running out of charge. Increased safety will also be achieved by providing education and resources that reduce EV knowledge gaps and biases among employees.

Lower costs will be achieved for business customers and for ratepayers by encouraging fleet procurement that is GHG cost efficient and by helping fleet owners minimize expensive demand charges by using managed charging, as shown in Figure 12. The operating costs for public and private fleets are expected to reduce by 50 percent with the transition to an electric fleet. With increasing EV adoption, there is potential to lower costs for ratepayers overall, as off-peak charging allows the fixed costs of maintaining reliability of utility distribution systems to be spread over more units of output.

Figure 12: Managed Charging Analytics



	Managed Charging	Unmanaged Charging
Charger Mix		
L1 (1.8 kW)	2	4
L2 (7.2 kW)	7	5
CAPEX costs	$33,300.00	$26,100.00
Annual Electricity Costs		
Electricity Costs	$5,755.13	$7,513.26
Demand Charges	$3,638.78	$6,981.27
Total Electricity costs	$11,192.46	$16,293.09

ROI Calculation - Managed Charging	
Additional CAPEX Costs	-$7,200
Annual Electricity Savings	$5,101
Return on Investment	**71%**

This is an example of a solution developed by MyFleetBuy to encourage fleet owners to choose managed charging, which is a necessary technology to preserve greater reliability of grid systems across California. The chart shows the capital investment required to deploy charging infrastructure and estimates the return on investment for a fleet owner to deploy managed charging in a specific worksite. Fleet electrification service providers, like consultants and utilities, can select different locations using a dropdown button.

Environmental and Health Benefits

Electrifying fleet vehicles can have a significant impact to the health of local communities. Harmful pollutants like nitrogen oxides (NOx) and particulate matter have been linked to asthma and premature death in people with heart or lung diseases. Medium and Heavy-duty vehicles account for less than 10 percent of registered vehicles but account for more than 32 percent of NOx Emissions (California HVIP 2021).

In conclusion, the cumulative annual benefits of transportation electrification for the fleets evaluated will result in a reduction of 35,000 tons of CO_2 emissions and almost $15 million in annual cost savings when the fleets fully electrify. When scaled to all corporate and government fleets across California, these technologies pave the way for nearly 5 billion pounds of avoided CO_2 emissions and cost savings of over $200 million. By promulgating the use of smart charging versus uncontrolled charging by fleets across California, fleet electrification technology will also preserve greater reliability of grid systems by helping avoid as much as 1.1 gigawatts of electricity demand during peak hours.

GLOSSARY AND LIST OF ACRONYMS

Term	Definition
AASHTO	American Association of State Highway Transportation Officials
Caltrans	California Department of Transportation
CO_2	carbon dioxide
EV	electric vehicle
GHG	greenhouse gas
ICE	internal combustion engine
NOx	nitrogen oxides
OEM	original equipment manufacturers
OFAM	Department of General Services Office of Fleet and Asset Management
PHEV	plug-in hybrid electric vehicle
ROI	return on investment
TCO	total cost of ownership
ZEV	zero-emission vehicle

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CALIFORNIA ENERGY COMMISSION

CALIFORNIA NATURAL RESOURCES AGENCY

ENERGY RESEARCH AND DEVELOPMENT DIVISION

Appendix A: MyFleetBuy Alpha Prototype

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APPENDIX A:
MyFleetBuy Alpha Prototype

Overview

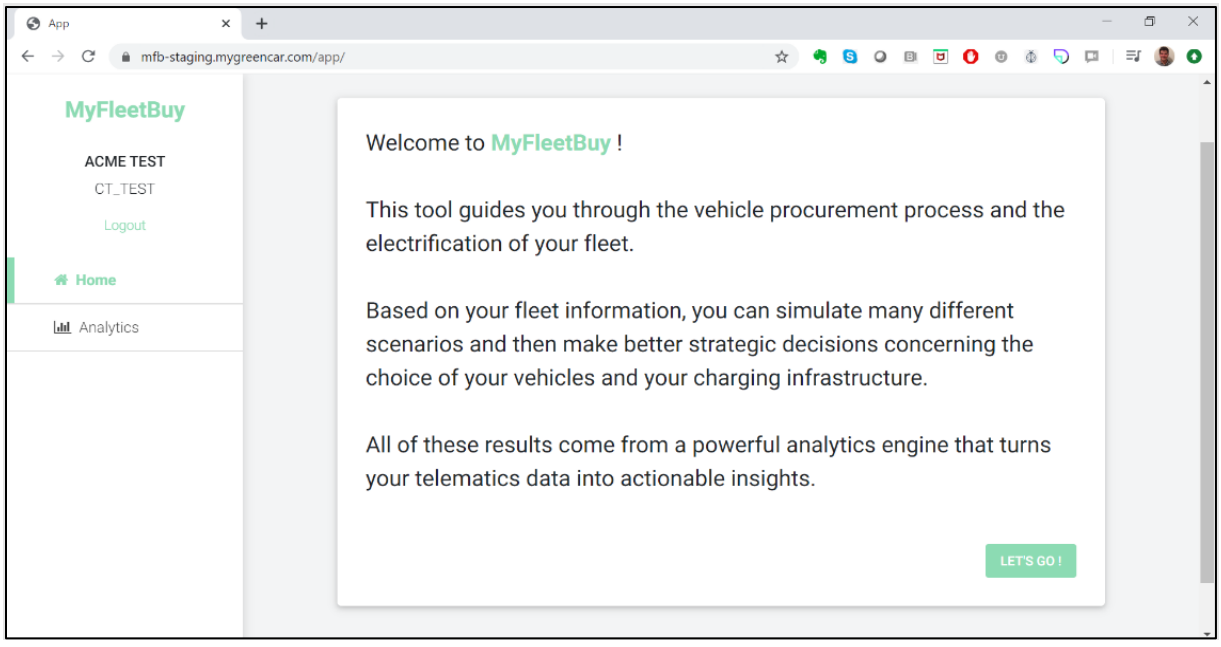
The first prototype of MyFleetBuy focused on validating the analytics and data layers and presented results in a web-based user layer that enabled asset managers to search for specific vehicles in their fleet and assess the electrification potential of each vehicle. The search functionality and fleet analysis of this web-based tool consisted of four parts:

2. **Date:** The user could select specific date ranges of fleet telematics data (for example, travel history data) to be used in the fleet electrification assessment.
3. **Filter your cars:** The user could narrow down the analysis to specific fleet vehicles by using a variety of filters (for example, Body Type, Department, Vehicle Age).
4. **Cars to compare:** The user could search for electric and plug-in hybrid EVs to be considered as replacement candidates for fleet vehicles.
5. **Charging stations:** The user could review and select physical locations where charging infrastructure could be deployed to recharge the fleet vehicles once they become electric.

Product Screenshots

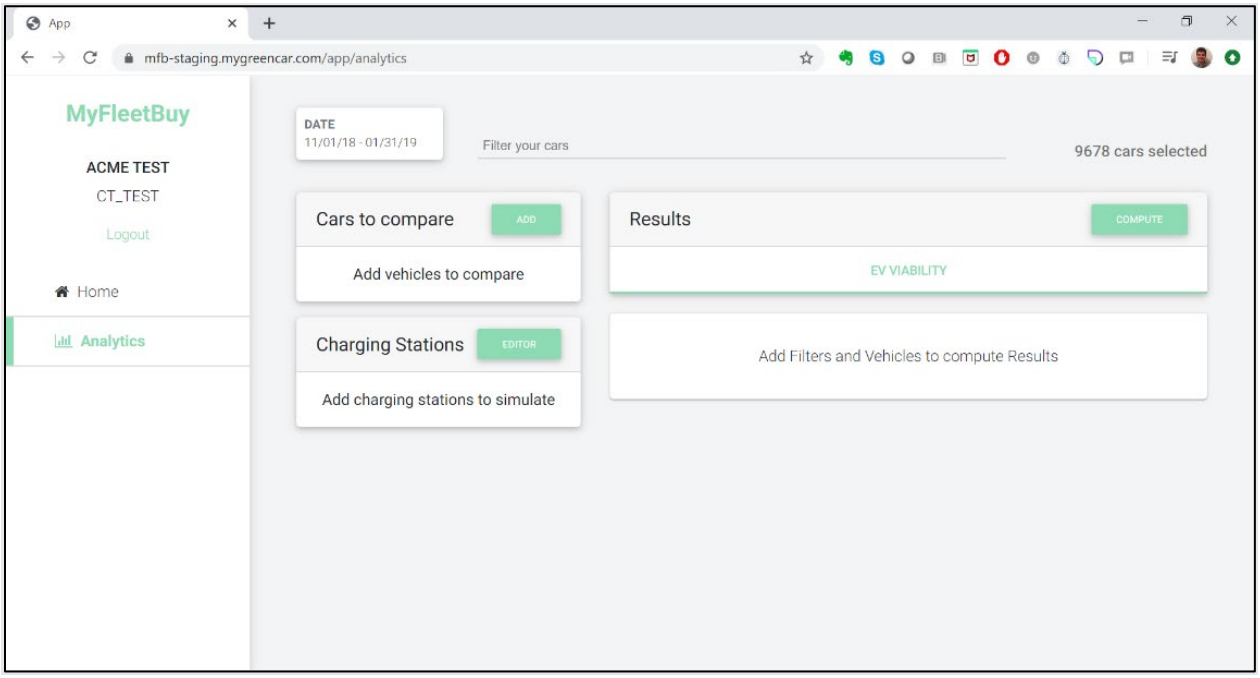
The images below demonstrate the user interface that was developed for the first software iteration (Figures A-1 through A-8).

Figure A-1: Welcome Screen



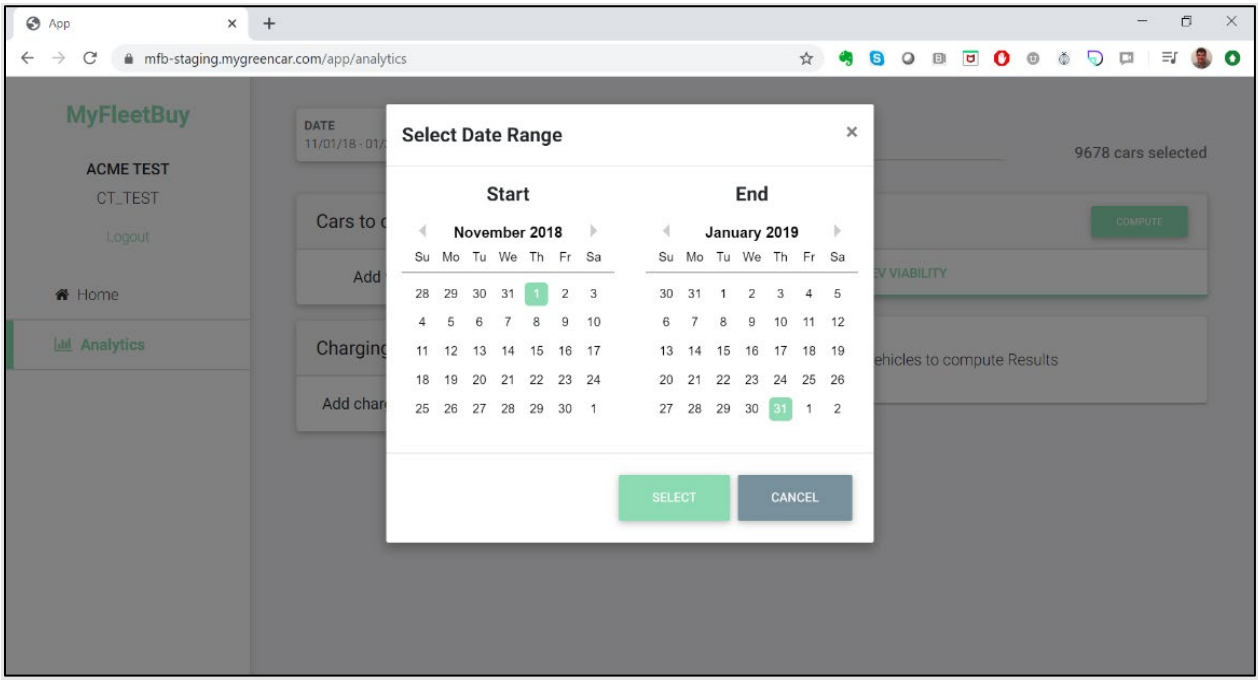
This is the first screen a user would see after logging in to MyFleetBuy.

Figure A-2: Search Functionality



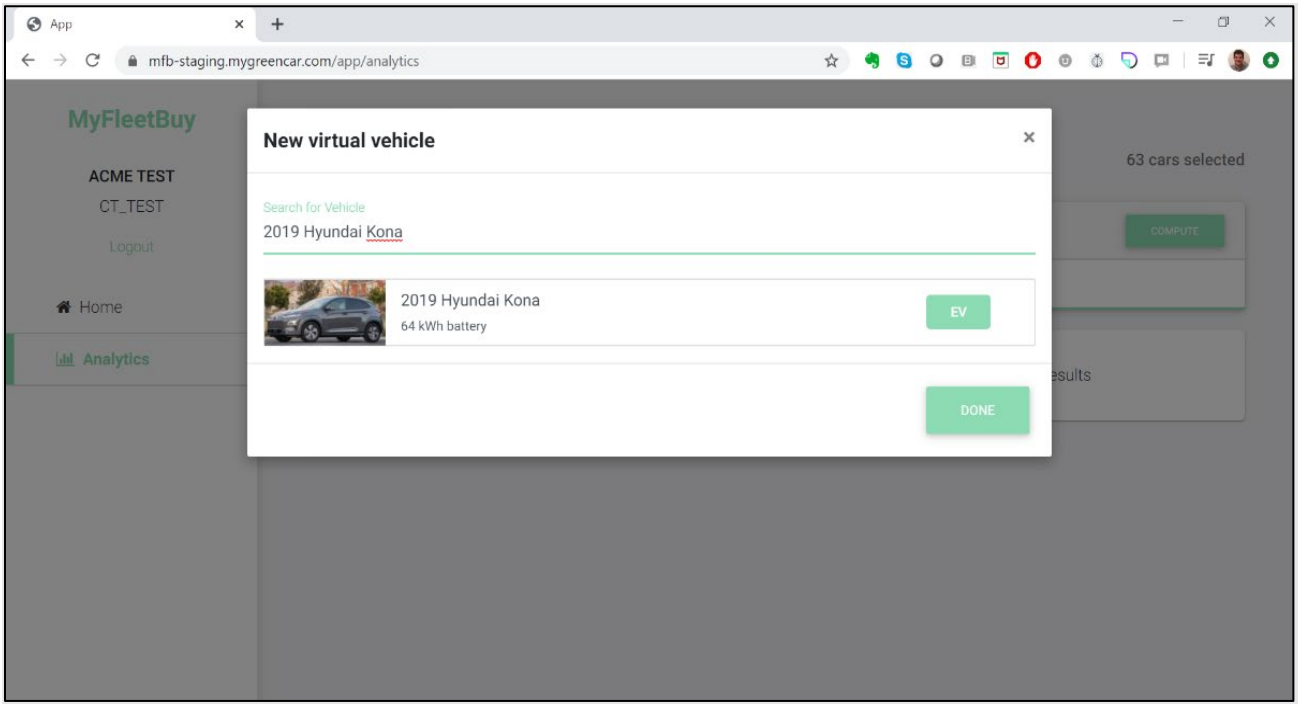
The search functionality allowed a user to develop different fleet electrification scenarios. It consisted of four parts: Date, Cars to compare, Charging stations, and Filters.

Figure A-3: Date Selector



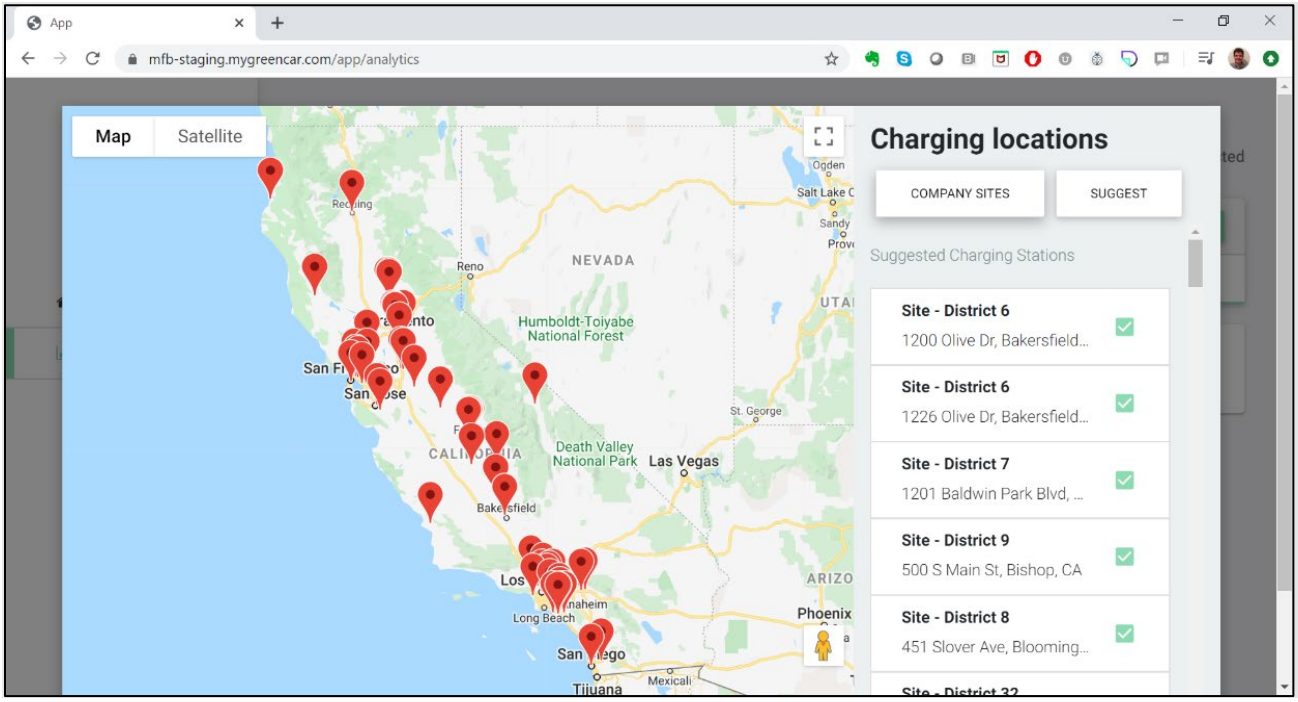
The user could specify a date range to determine which travel data would be used for the analysis.

Figure A-4: Searching for Cars



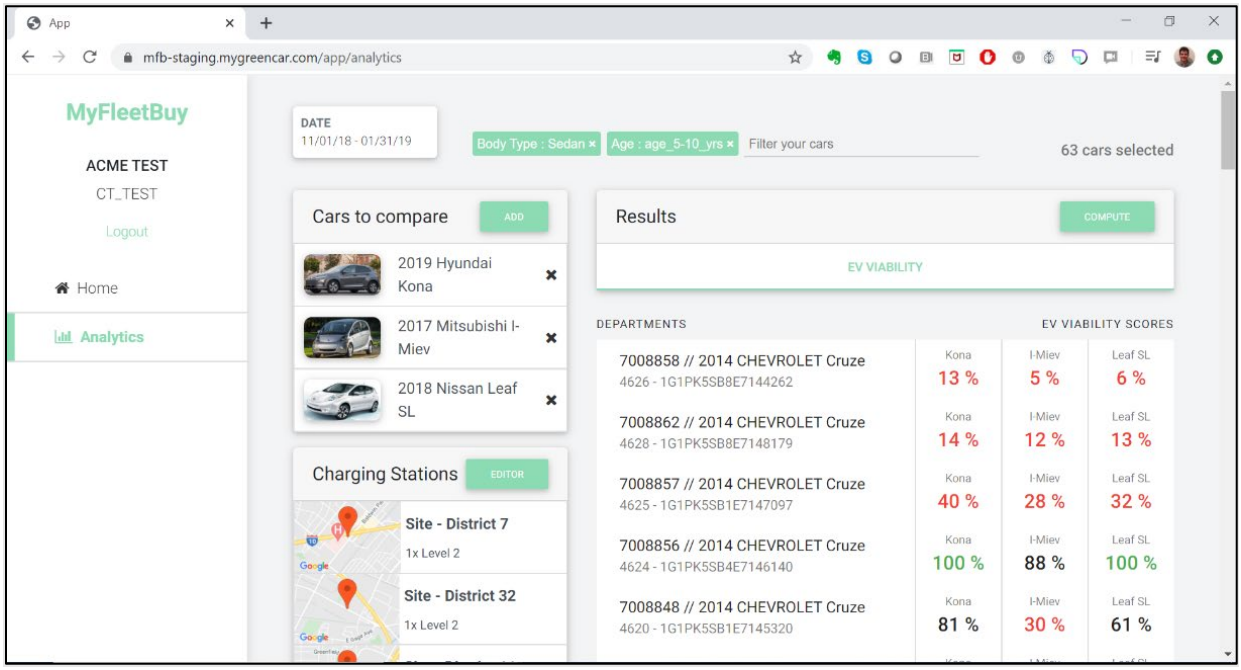
The user could access vehicle inventory data to search for electric and plug-in hybrid EVs that could be considered as replacements for the existing fleet.

Figure A-5: Charging Locations



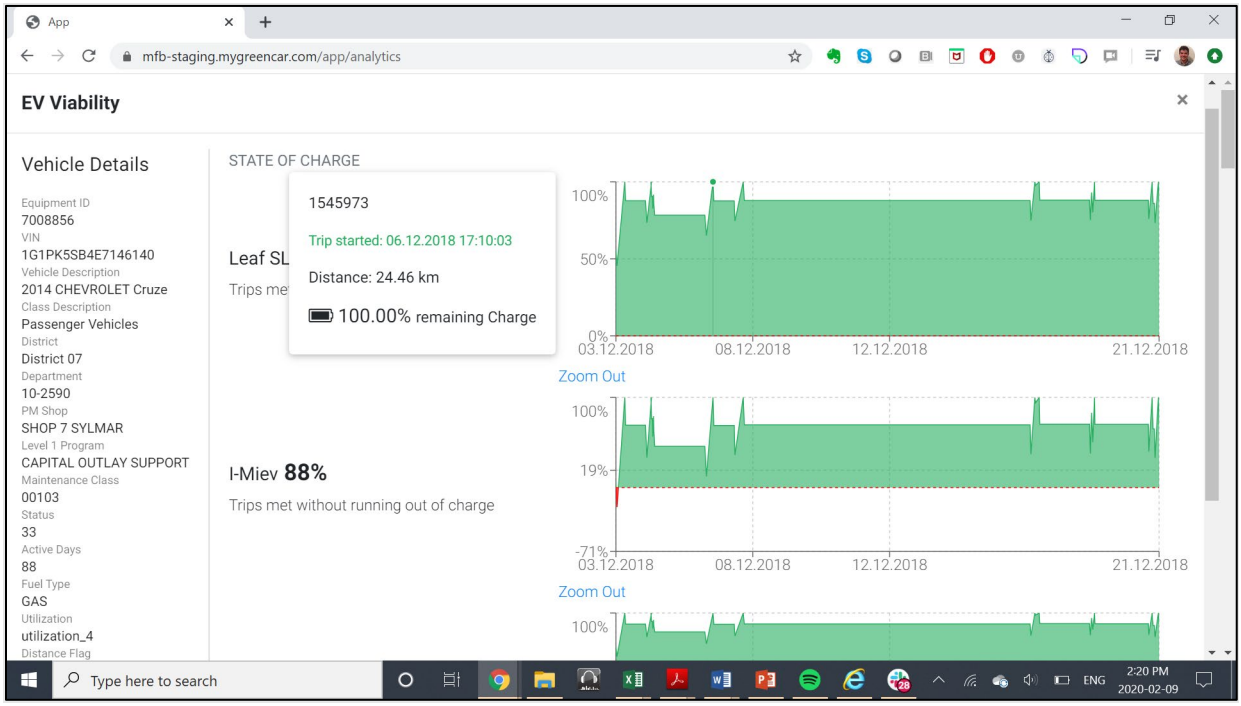
The user could review and select physical locations where fleet vehicles could charge when electrified. Using real life vehicle dwell patterns, the MyFleetBuy platform adjusted the EV viability score of potential replacement vehicles based on the location and quantity of charging stations selected by the user.

Figure A-6: Fleet Assessment Results



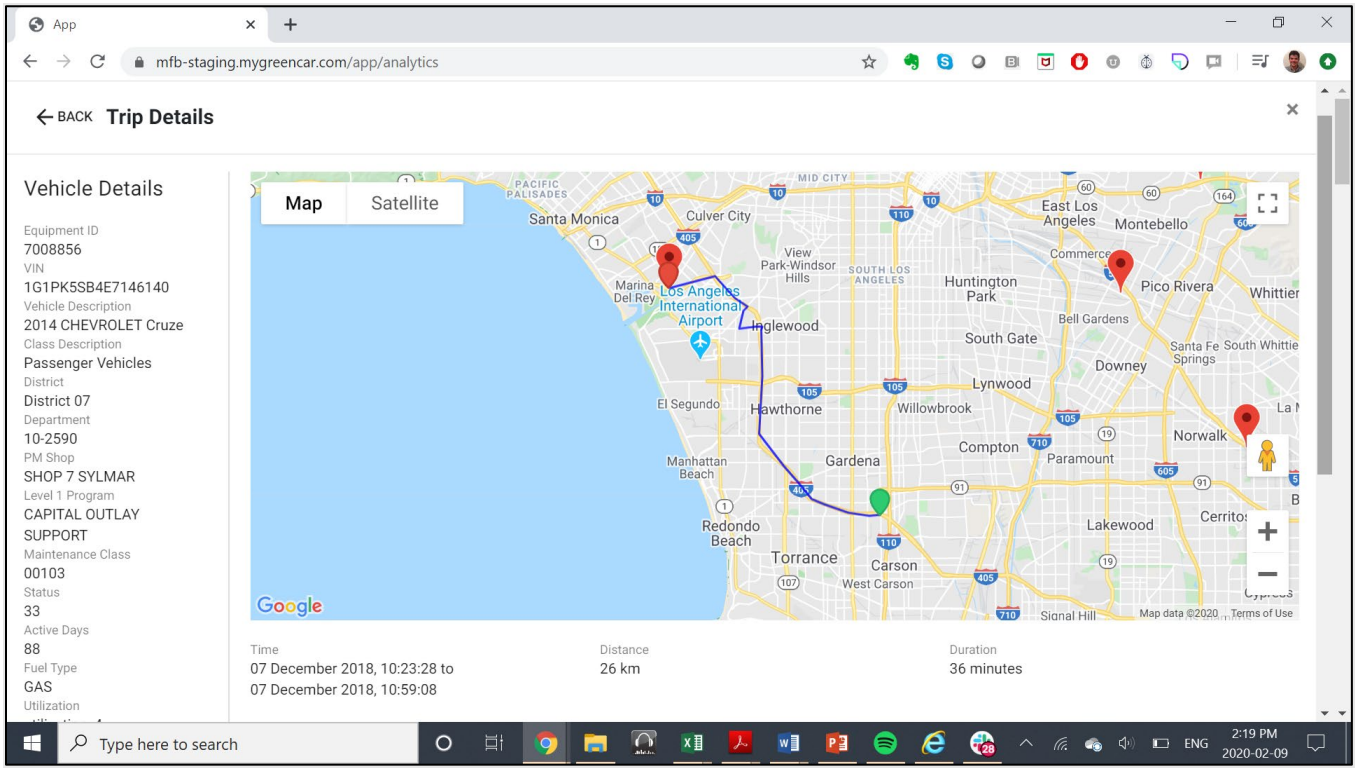
The user could view the electrification potential of different fleet vehicles. Under "Departments", users could see their fleet vehicles. Under "EV Viability Scores", users could see how many actual trips could have been completed by the EVs or PHEVs selected as replacement candidates. For example, given the charging stations selected by this MyFleetBuy user, the Hyundai Kona or Nissan Leaf SL could have completed 100 percent of the trips taken by the fourth fleet vehicle in this department's list.

Figure A-7: Vehicle Data



Users were able to select one specific fleet vehicle at a time to understand its EV viability. The MyFleetBuy prototype showed state-of-charge plots to demonstrate how much battery capacity would remain after specific trips were taken.

Figure A-8: Trip Details



Users were able to view specific trips to review in more detail the EV viability of each vehicle. This map was intended to help employees who drive fleet vehicles to better understand their driving behavior and view a physical representation of the fleet vehicle's travel patterns as well as the charging stations available for the vehicle.

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Appendix B: MyFleetBuy Software

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APPENDIX B:
MyFleetBuy Software

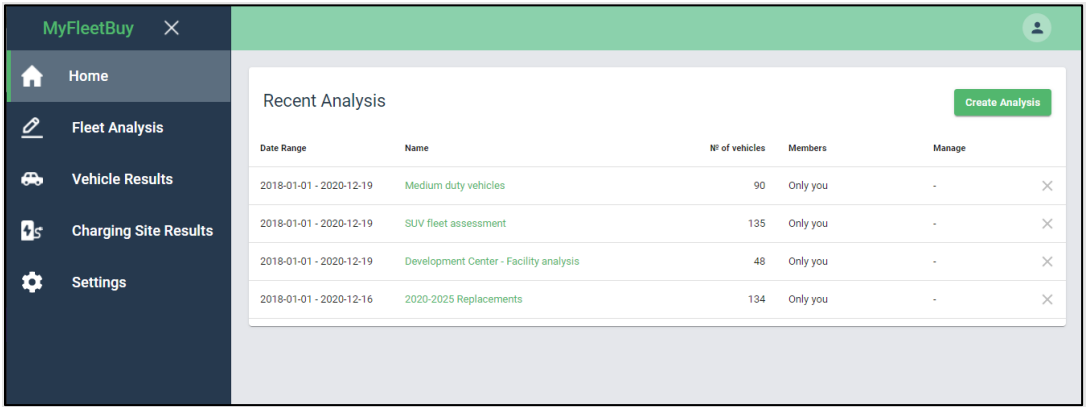
Overview

The MyFleetBuy system is a production-ready analytics solution that enables fleet owners and fleet consultants to consolidate relevant data, evaluate historical driving patterns, and run simulations to make annual EV procurement decisions.

Product Screenshots

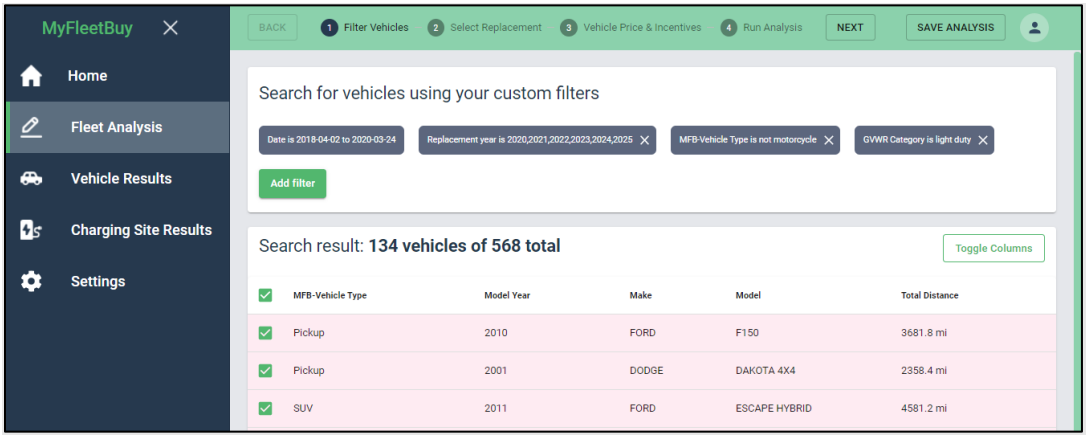
The key functionalities of MyFleetBuy software are outlined below (Figures B-1 through B-11).

Figure B-1: Saved Analyses



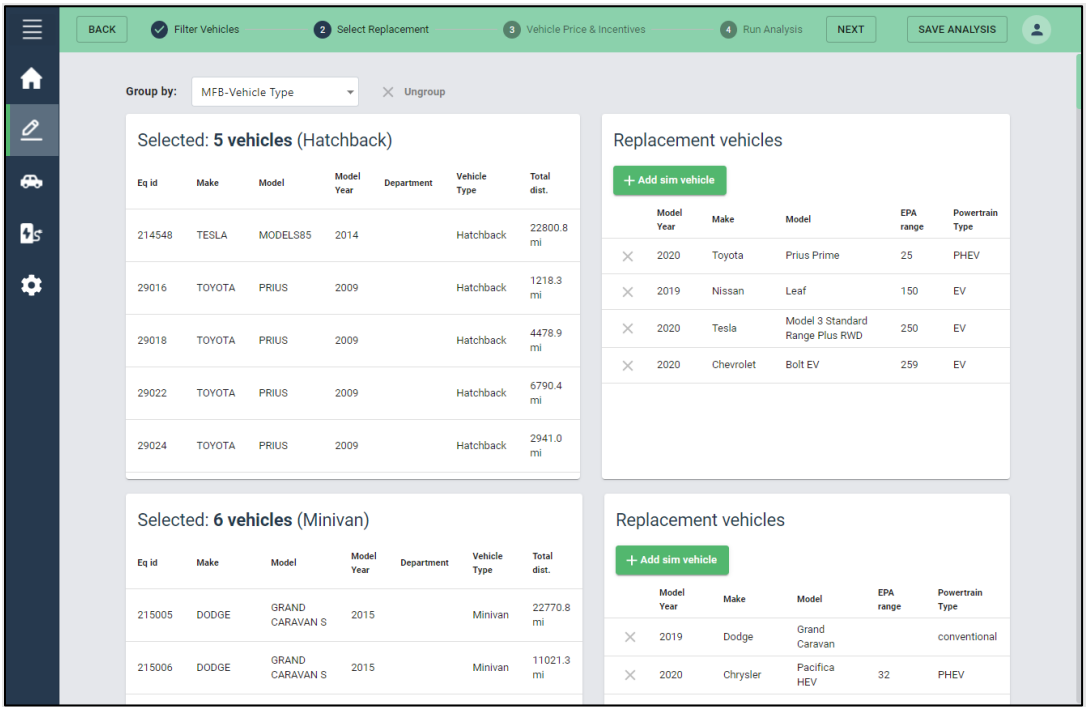
Users can create and save multiple simulations to fit the needs of the internal client they are electrifying.

Figure B-2: Select Vehicles for Replacement



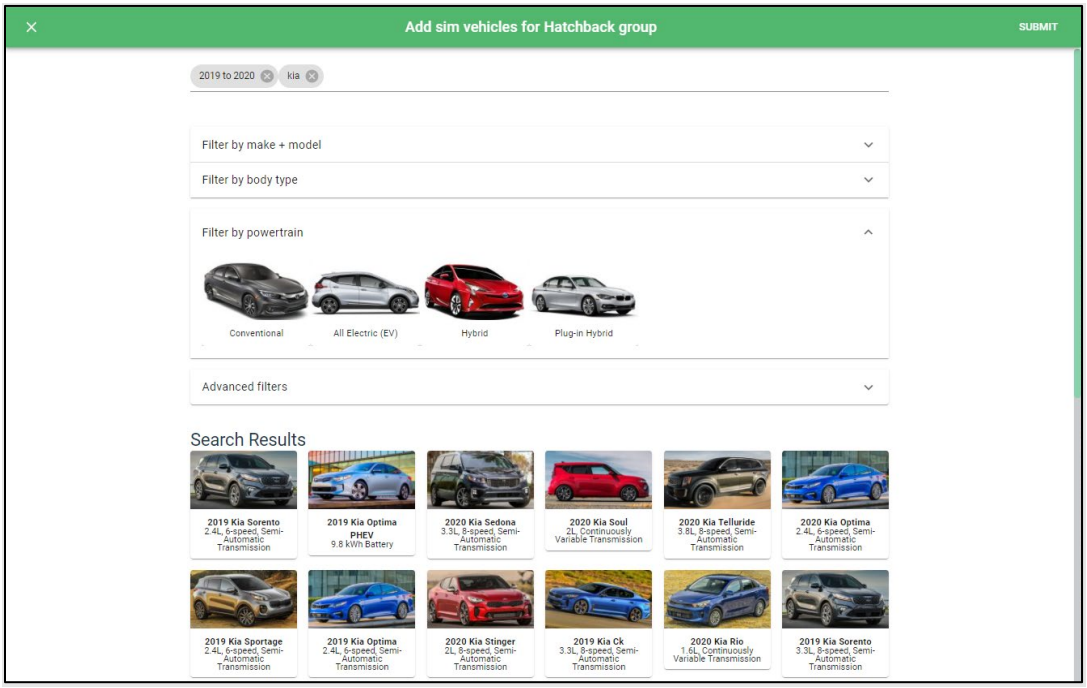
MyFleetBuy users can apply filters to efficiently locate the vehicles that need to be replaced. This provides flexibility for the user to create multi-year fleet replacement plans and also to evaluate a small subset of vehicles that are due for replacement in the following year.

Figure B-3: Vehicle Candidates



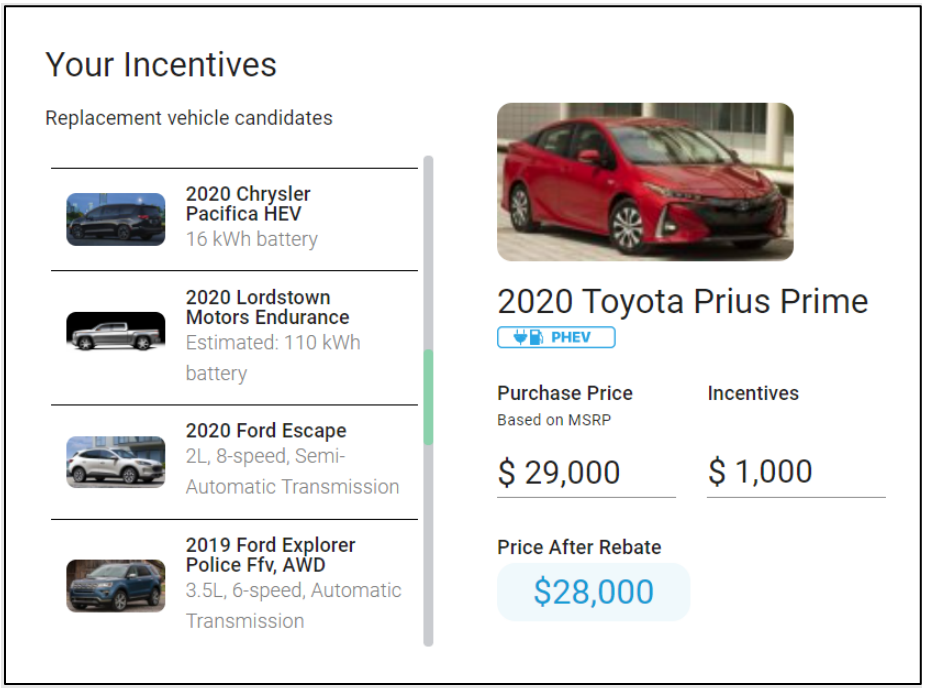
Users can simulate multiple vehicles as replacement candidates for each fleet vehicle. They can choose from the MyFleetBuy database of internal combustion engine and battery electric powered vehicles. (The existing fleet is shown on the left, while vehicle candidates are shown on the right.)

Figure B-4: Database of Vehicles



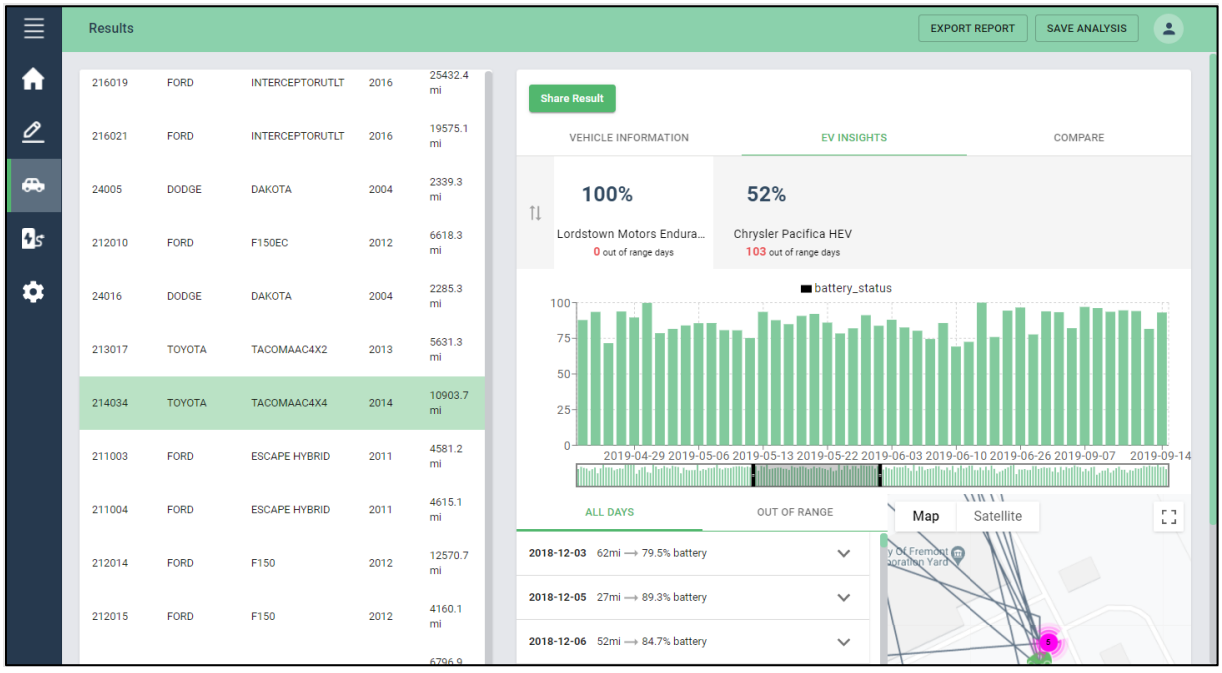
User-friendly search functionality makes it easy for MyFleetBuy users to browse the vehicle inventory and find the ideal candidates for their fleet.

Figure B-5: Vehicle Pricing



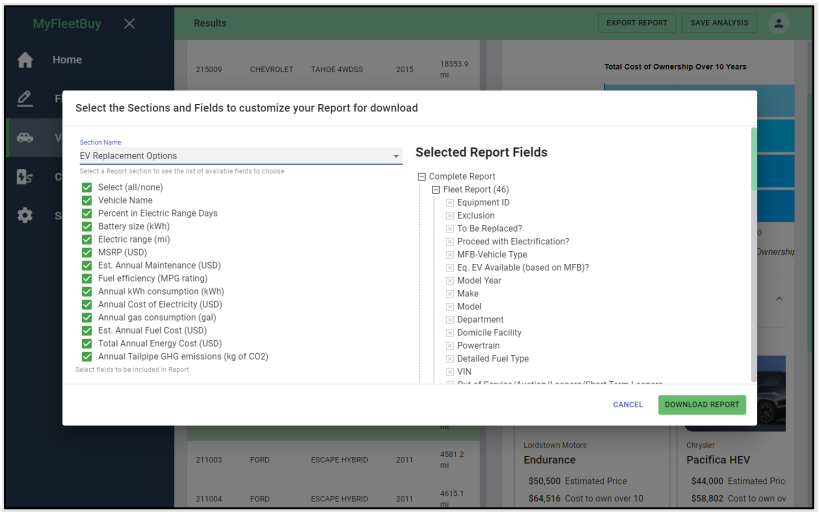
MyFleetBuy presents MSRP and incentive data that can be edited by the user to calculate the total cost of ownership for each vehicle candidate.

Figure B-6: EV Viability Results



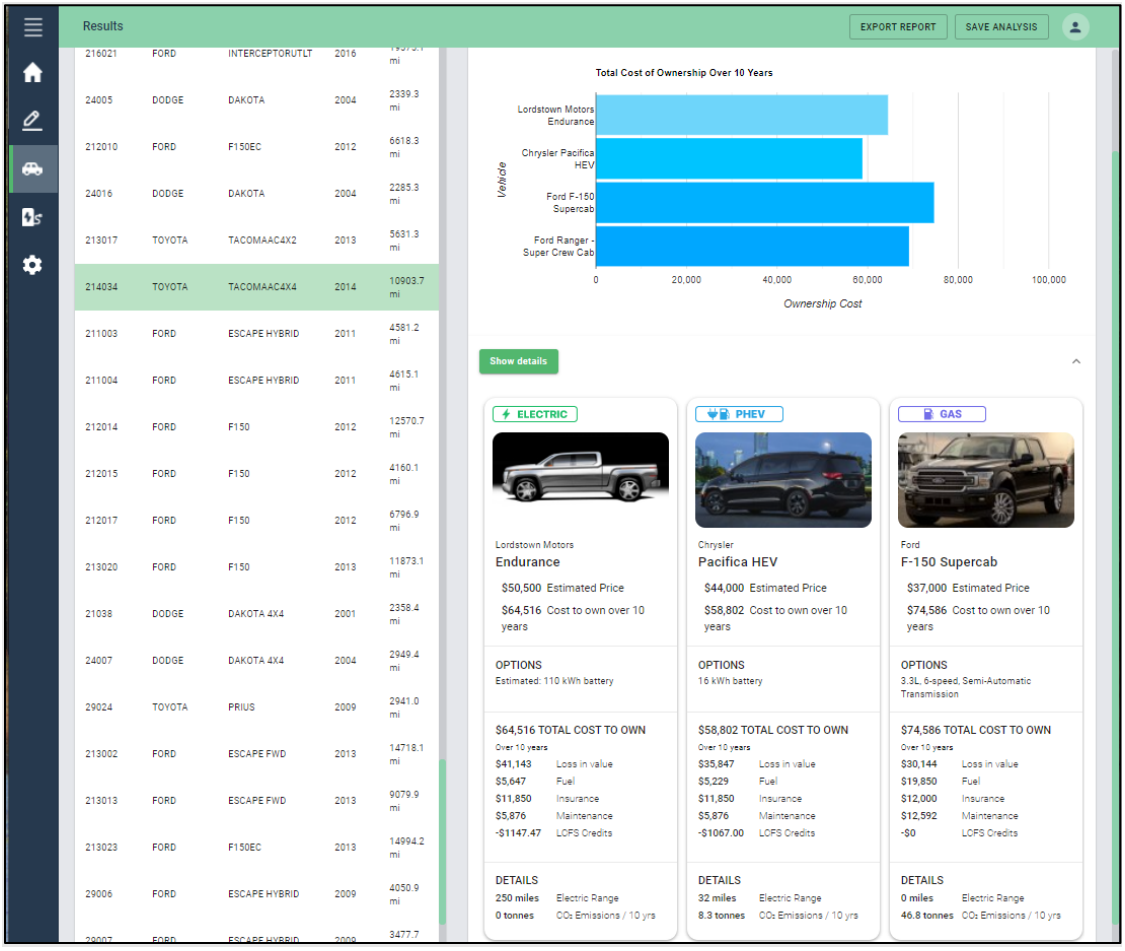
MyFleetBuy users can evaluate the electrification potential of each fleet vehicle by simulating different replacement candidates. This example shows that a 2014 Toyota Tacoma would be a good candidate for replacement by an electric pickup truck, as shown by the predicted battery state of charge (displayed by the green vertical bars).

Figure B-7: Download Reports



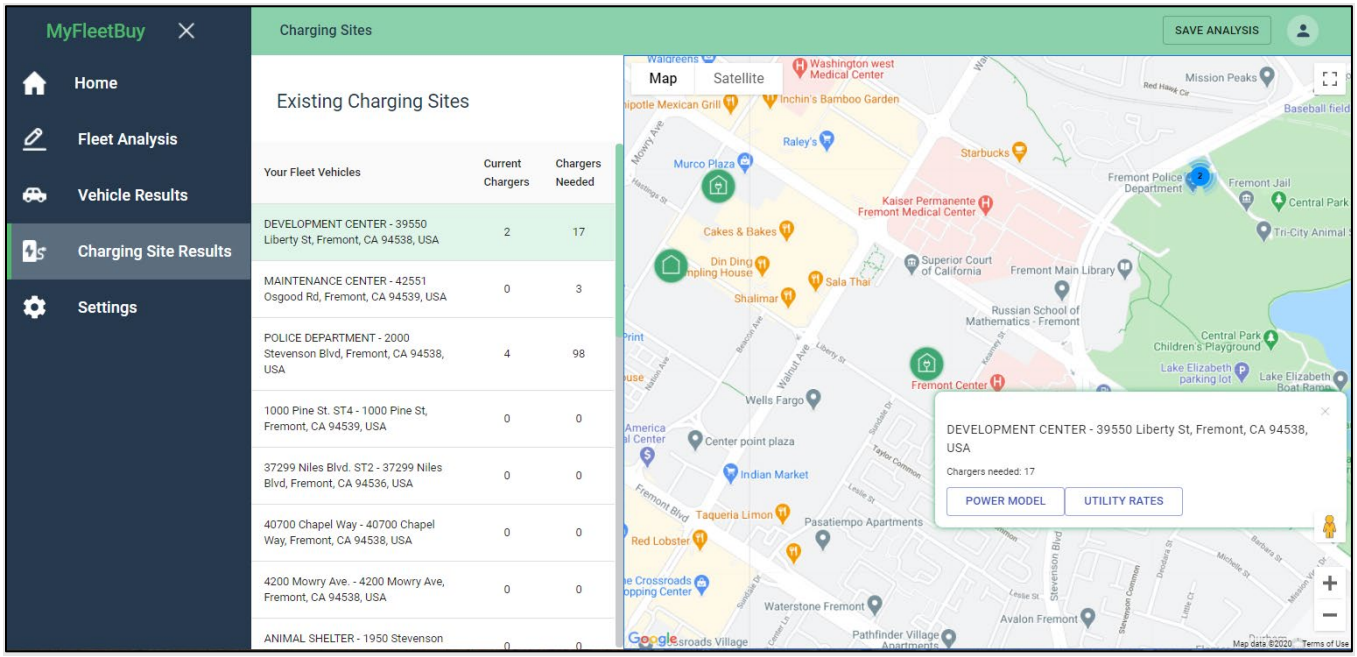
MyFleetBuy users can create and download custom reports to present their findings to internal clients.

Figure B-8: TCO Assessments



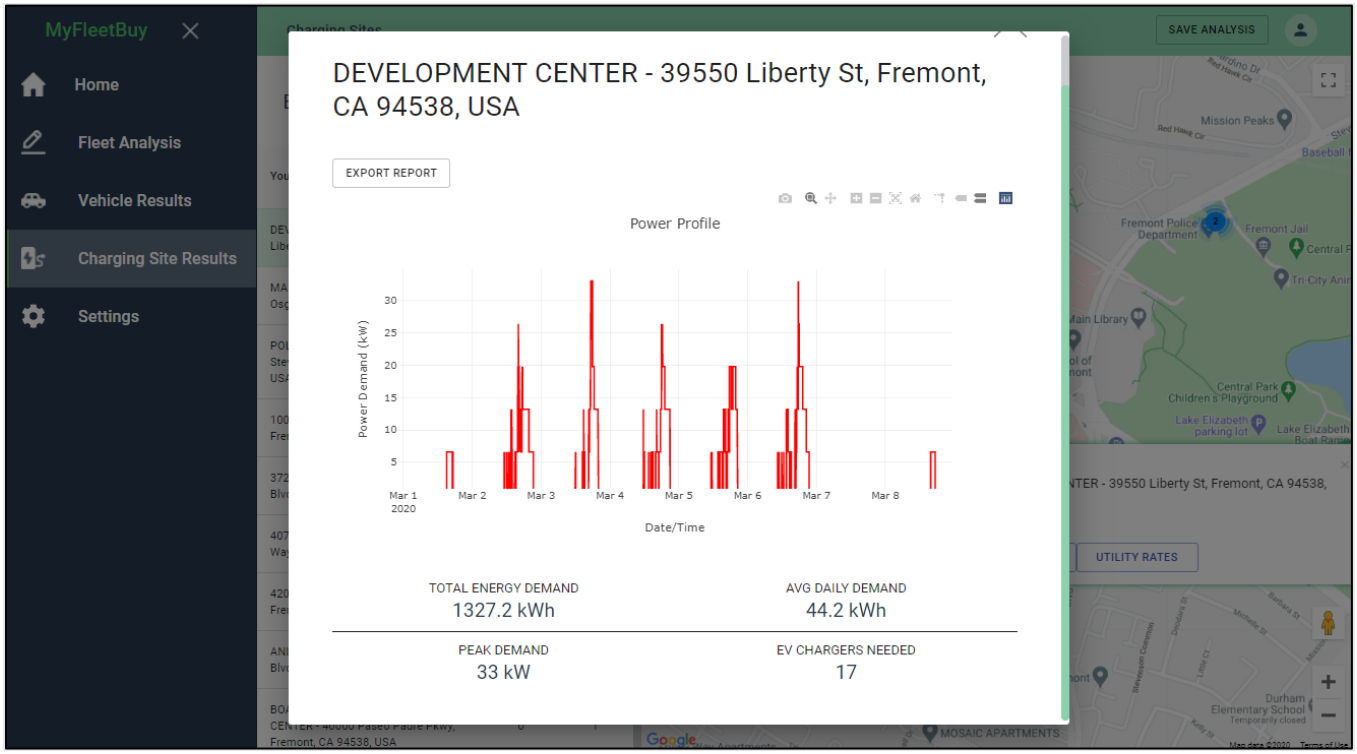
The total cost of ownership (TCO) comparison tool allows users to compare gas versus EV candidates to identify the best replacement option. In this example, the Lordstown Endurance was projected to be more cost effective compared to gas powered vehicle candidates.

Figure B-9: Charging Infrastructure Maps



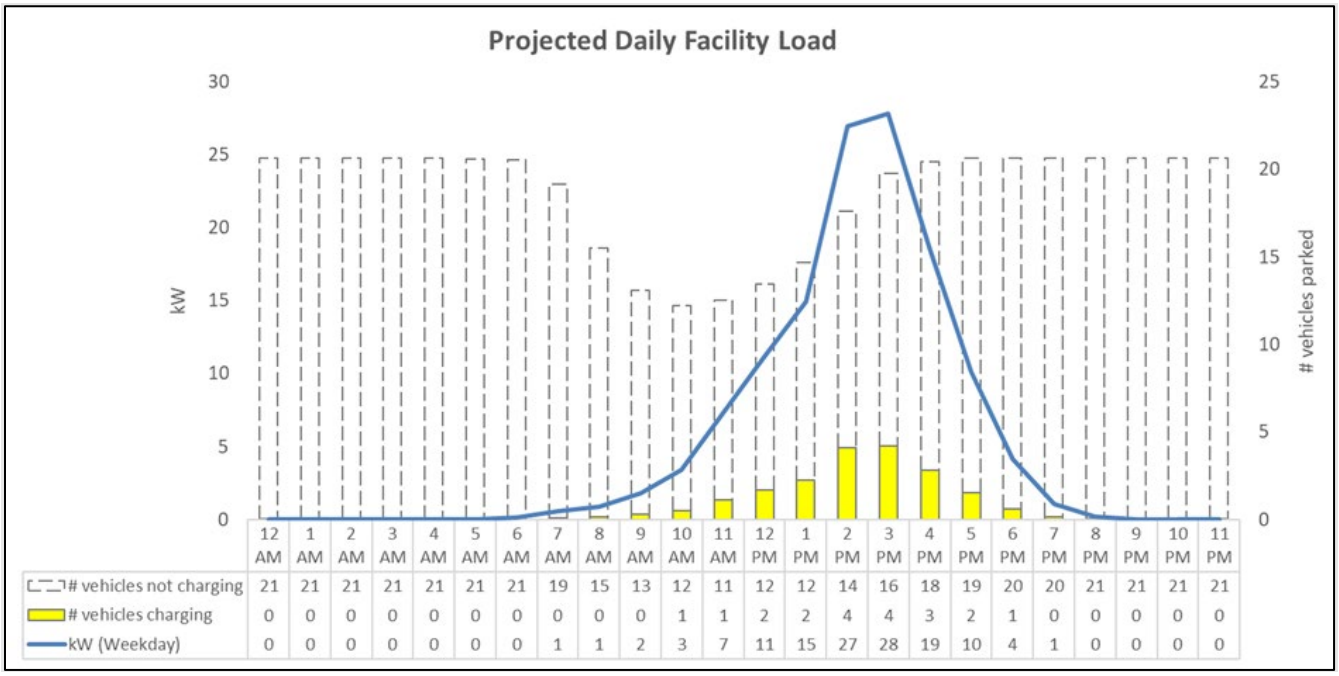
Based on the vehicles simulated and their dwelling patterns, MyFleetBuy presents a list of locations and the number of level 2 charging stations that will need to be deployed to facilitate electrification. Users can download data to perform more detailed charging infrastructure assessments.

Figure B-10: Power Profiles



MyFleetBuy predicts the energy consumption and power profile at each facility, based on the fleet's driving behavior, and presents unmanaged charging profiles for each facility. Users can export 8760 power models to prepare detailed EV charging analyses.

Figure B-11: Sample Power Plot



This is an example of a 24-hour power profile, created after analysis of one year's worth of data for 25 vehicles operating out of a facility owned by a fleet in California.

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Appendix C: Electrifyze Software

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APPENDIX C:
Electrifyze Software

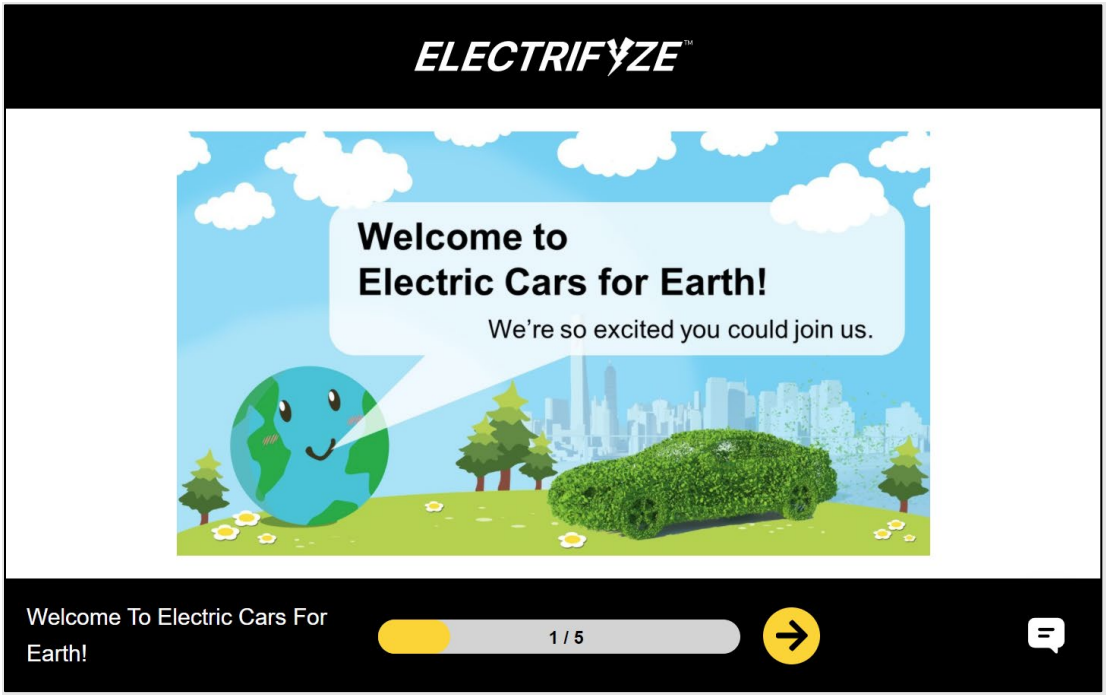
Overview

Green Light Labs, the parent company of MyFleetBuy, launched a program called Electrifyze, which pairs software with expert support to simplify the EV transition for private and public fleets. These tools have already been used by more than 3,600 employees in California and are proven to be effective change management tools for organizations that want to electrify their fleet. Improving employees' knowledge of EVs can reduce internal department pushback when a fleet manager recommends that their vehicles be electrified.

Product Screenshots

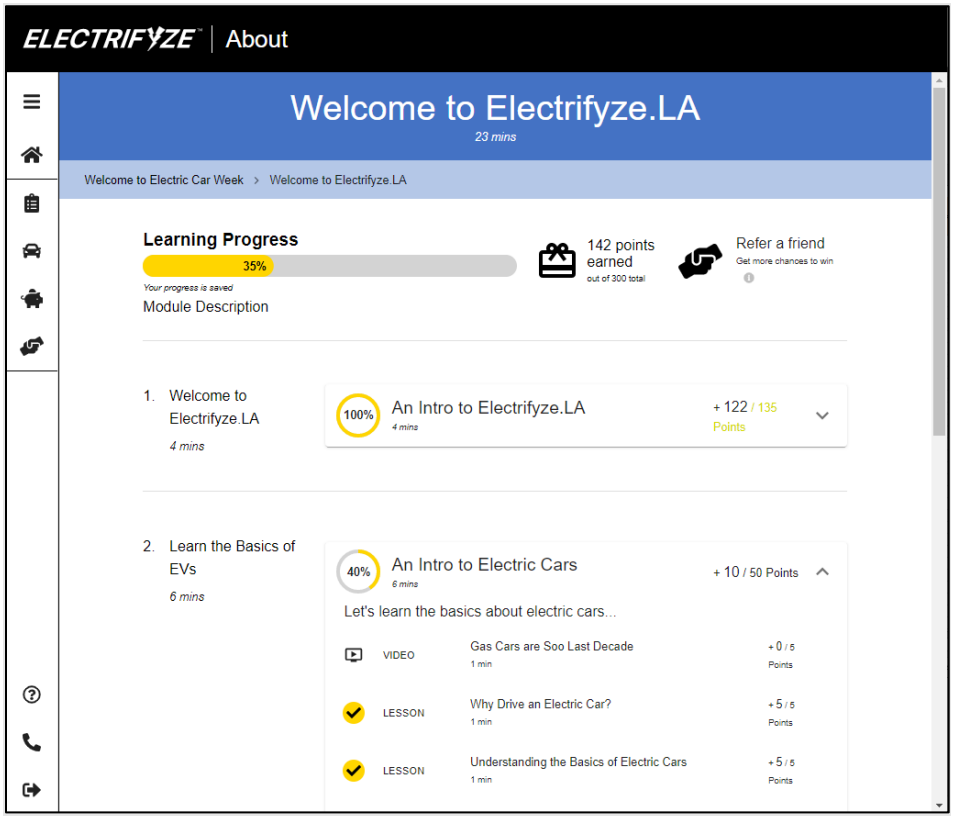
The key functionalities of Electrifyze EV learning software are outlined below (Figures C-1 through C-6).

Figure C-1: Introduction



Electrifyze makes EV education more approachable for employees. It creates a series of virtual EV learning campaigns that last 10-20 minutes and address one barrier to electrification at a time. Employees can get certified for completing the different modules. Figure C-1 is an example of a learning campaign that addressed education gaps about the environmental benefits of electric cars. Other educational sessions focused on financial cost-benefits, driving range, how to charge electric cars, and other topics.

Figure C-2: EV Learning Structure



Each virtual learning campaign includes a variety of modules (Figure C-2). The Electrifyze learning platform gamifies the learning experience and measures participant completion rates. This system has been used to provide EV learning to more than 4,000 participants over four virtual learning campaigns. The number of participants has grown quickly.

Figure C-3: Video Content Example

Content varies between presentations, videos, activities, quizzes, and surveys. Figure C-3 is an example of a training video that shows participants how to charge electric cars. One of the participants said: "I liked that they showed how to use a public charging station. I think that

many people are not familiar with how to do that, and the video helped explain how simple it is." These training videos are needed to help employees become comfortable with the transition to electric mobility.

Figure C-4: Activity Content Example

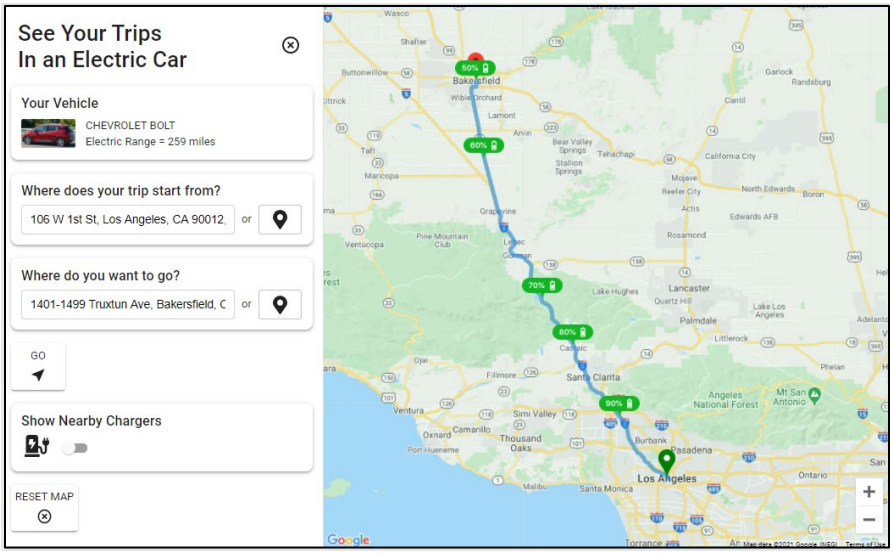
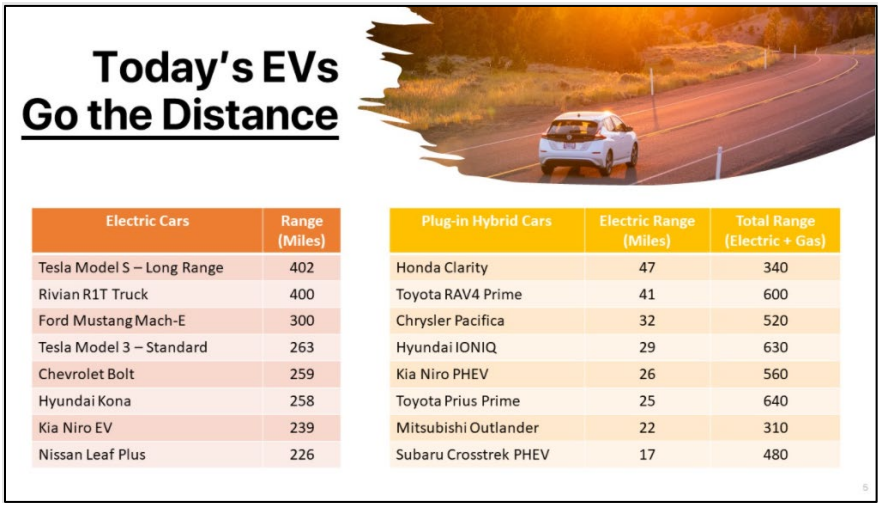


Figure C-4 is an example of a trip planner activity that helps employees determine if an electric car has enough battery to meet their travel needs. It also displays public charging stations available along the route. The MyFleetBuy team found that many people avoid purchasing EVs because they suffer 'range anxiety' bias — a concern that the EV driver is likely to run out of battery and get stranded. Many consumers are unaware of their driving habits (the average person drives less than 40 miles per day [Electrify America 2020]), are unaware that many EVs offer a driving range of over 200 miles (Figure C-5), and that there are thousands of publicly available EV charging stations (over 100,000 outlets in the United States [U.S. DOE 2021]).

Figure C-5: Presentation Content Example

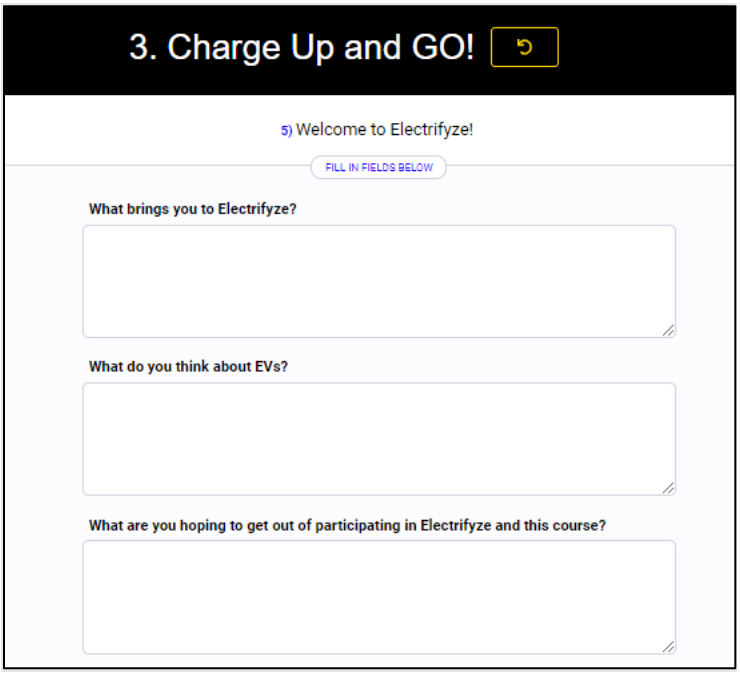


Electric Cars	Range (Miles)
Tesla Model S – Long Range	402
Rivian R1T Truck	400
Ford Mustang Mach-E	300
Tesla Model 3 – Standard	263
Chevrolet Bolt	259
Hyundai Kona	258
Kia Niro EV	239
Nissan Leaf Plus	226

Plug-in Hybrid Cars	Electric Range (Miles)	Total Range (Electric + Gas)
Honda Clarity	47	340
Toyota RAV4 Prime	41	600
Chrysler Pacifica	32	520
Hyundai IONIQ	29	630
Kia Niro PHEV	26	560
Toyota Prius Prime	25	640
Mitsubishi Outlander	22	310
Subaru Crosstrek PHEV	17	480

Simple and engaging presentations help employees learn the basics of EVs. This is an example of a presentation slide that shows a list of popular EVs and PHEVs, along with information on their driving ranges.

Figure C-6: Community Participation



Customizable surveys are embedded in the learning platform and help large employers, government agencies, and nonprofits collect feedback from Electrifyze participants. This is an example of open survey feedback that informs charging infrastructure and EV program decisions for the County of Los Angeles.