



California
Road Charge

APPENDIX A: **Independent Evaluation**



FINAL REPORT

Task 8: Four-Phase Demonstration Evaluation

Version: 1.0

Version Date: 12/30/2021

Prepared By:



The Highlands
Consulting Group



DOCUMENT CONTROL

File Name:	8.d.2 Four-Phase Demonstration Evaluation Report FINAL.docx	
Version Number:	1.0	
	Name	Date
Created By:	The Highlands Consulting Group	6/18/2021 (Outline of the report)
Reviewed By:	WSP	11/12/2021
Modified By:	The Highlands Consulting Group	9/1/2021 (Draft report)
	The Highlands Consulting Group	11/9/2021
	The Highlands Consulting Group	12/24/2021
Approved By:	Caltrans	12/30/2021

TABLE OF CONTENTS

Acronyms and Terms.....	v
1 Introduction.....	6
1.1 Demonstration Project Overview.....	6
2 Purposes of This Evaluation.....	8
2.1 Overall Demonstration Objectives.....	8
2.2 Evaluation Strategy Plan.....	8
3 Evaluation Process.....	9
3.1 Plan.....	9
3.2 Evaluate.....	9
4 Evaluation of Four-Phase Demonstration.....	11
4.1 Demonstration Overview.....	11
5 Findings.....	14
5.1 Improve the Functionality of User-Based Alternative Revenue Mechanisms.....	14
5.2 Provide Recommendations Regarding User-Based Revenue Mechanisms.....	28
5.3 Minimize the Administrative Cost of Any Potential User-Based Revenue Mechanisms and Associated Collection of Fees.....	29
5.4 Utilize Third-Party Business Partners to Administer or Operate Systems	32
5.5 Ensure Ease of User Compliance.....	33
5.6 Ensure User Privacy Protection.....	38
5.7 Ensure Data Security.....	42
5.8 Include Reliable and Secure Technology.....	48
5.9 Conduct Outreach to Increase Public Awareness of Need for Alternative Funding Sources.....	52
5.10 Address Potential Implementation and Public Acceptance Hurdles to Adoption.....	54
5.11 Identify Equity Concerns.....	57
6 Conclusions.....	63
Appendix A: Evaluation Criteria Matrix.....	71

List of Figures

Figure 1: Road Charge Demonstration Evaluation Process.....	9
Figure 2: Pay-at-the-Pump Monthly Road Charge Simulated Invoice Example.....	17
Figure 3: Pay-at-the-Charge Point Monthly Road Charge Simulated Invoice Example.....	17
Figure 4: Usage-Based Insurance Monthly Road Charge Simulated Invoice Example.....	18
Figure 5: Ride-sharing Road Charge Simulated Invoice Example.....	19
Figure 6: Automated Vehicle Road Charge Simulated Invoice Example.....	20

List of Tables

Table 1: Four Demonstration Phases.....	6
Table 2: Road Charge Mileage and Revenue Data, Including Vehicle Efficiency.....	16
Table 3: Survey Data – Improving Functionality.....	26
Table 4: Evaluation Outcomes – Improving Functionality.....	27
Table 5: Evaluation Outcomes – Recommendations.....	29
Table 6: Evaluation Outcomes – Administrative Costs.....	31
Table 7: Evaluation Outcomes – Third-Party Partners.....	33
Table 8: Survey Data – Ease of User Compliance.....	37
Table 9: Evaluation Outcomes – Ease of User Compliance.....	38
Table 10: Survey Data – User Privacy Protection.....	39
Table 11: Evaluation Outcomes – User Privacy Protection.....	41
Table 12: Unit Testing Compliance Status.....	44
Table 13: Interface Testing Compliance Status.....	44
Table 14: Acceptance Testing Compliance Status.....	45
Table 15: Evaluation Outcomes - Data Security.....	48
Table 16: Customer Service Inquiries.....	49
Table 17: System Uptime.....	50
Table 18: Survey Data – Participant Satisfaction with Data Security.....	50
Table 19: Evaluation Outcomes – Reliable and Secure Technology.....	51
Table 20: Evaluation Outcomes – Outreach to Increase Public Awareness..	53

Table 21: Survey Data – Potential Hurdles	55
Table 22: Evaluation Outcomes – Potential Hurdles	57
Table 23: Survey Data – Equity Concerns.....	60
Table 24: Evaluation Outcomes – Equity Concerns	62
Table 25: Evaluation Conclusion – Improving Functionality	63
Table 26: Evaluation Conclusion – Recommendations.....	64
Table 27: Evaluation Conclusion – Administrative Costs.....	65
Table 28: Evaluation Conclusion – Third-Party Partners.....	65
Table 29: Evaluation Conclusion – Ease of User Compliance	66
Table 30: Evaluation Conclusion – User Privacy Protection.....	67
Table 31: Evaluation Conclusion - Data Security.....	67
Table 32: Evaluation Conclusion – Reliable and Secure Technology.....	68
Table 33: Evaluation Conclusion – Outreach to Increase Public Awareness	69
Table 34: Evaluation Conclusion – Potential Hurdles.....	69
Table 35: Evaluation Conclusion – Equity Concerns	70

ACRONYMS AND TERMS

Acronym / Term	Definition
AD	Administration
AM	Account Manager
AV	Automated Vehicle
CCPA	California Consumer Privacy Act
CH	Data Clearinghouse
CP	Charge Point
DC	Data Collection
DSS	Data Security Standards
EI	Energy Installation
EPA	Environmental Protection Agency
EV	Electric Vehicle
FIPS	Federal Information Processing Standards
GPS	Global Positioning System
IEC	International Electrotechnical Commission
ISO	International Standards Organization
ICE	Internal Combustion Engine
KPI	Key Performance Indicators
MPG	Miles per Gallon
OBD	On-Board Diagnostic
PATP	Pay-at-the-Pump
PCI	Payment Card Industry
PII	Personal Identification Information
POS	Point of Sale
PRIME	Platform for Road Charge Innovation and Mobility Evolution
RCPP	Road Charge Pilot Program
RMF	Risk Management Framework
RTM	Requirements Traceability Matrix
SAE	Society for Automotive Engineering
TNC	Transportation Network Company
TP	Transaction Processing
UBI	Usage-Based Insurance
VIN	Vehicle Identification Number

1 INTRODUCTION

Caltrans conducted the California Road Charge Demonstration from January to June 2021. It was a four-part demonstration of methods to levy a road charge using advanced technologies. As part of this project, Caltrans has contracted with WSP/Highlands Consulting to conduct independent evaluations of each phase of this demonstration.

This evaluation assesses the performance of the entire Four-Phase Demonstration through a comprehensive set of criteria and measures to address the project goals and objectives established by Caltrans.

1.1 Demonstration Project Overview

California has been a leader in exploring the possibility of funding transportation infrastructure with a road charge, an alternative to fuel taxes that charges motorists by the mile driven, rather than by the gallons of fuel purchased. As vehicles become more fuel-efficient and as electric and hybrid vehicles become more prevalent, the revenue generated by the fuel tax will not keep up with the backlog of maintenance needs on California's roads because less tax is being collected per mile of travel.

Other states are also conducting demonstration projects to test the potential viability of a road charge. Two states, Oregon and Utah, are currently operating voluntary programs. Utah's program is aimed specifically at electric and hybrid vehicles, while Oregon initially enrolled a wide range of vehicle types but has recently limited the program to those with fuel efficiency of 20 miles per gallon (MPG) and above. The California Road Charge Demonstration Project has expanded the exploration of road charge practice by demonstrating how these levies can be collected by leveraging emerging, advanced technologies that measure vehicle miles traveled. This demonstration was designed to:

- Embrace innovation and Road Charge's user-centered design.
- Recognize the nexus between shared fleets, electrification, and vehicle automation.
- Provide regional interoperability.
- Reduce administrative costs.
- Provide collection options for motorists.

1.1.1 Demonstration phases and timeline

To demonstrate the technical viability of a potential road charge partnered with these advanced technologies, WSP conducted this demonstration in four phases, as shown in Table 1.

Table 1: Four Demonstration Phases

Phase	Timeline
Phase 1A: Pay-at-the-Pump Phase 1B: Pay-at-the-Charge Point	January – June 2021
Phase 2: Usage-Based Insurance	February – June 2021
Phase 3: Ride-sharing Companies	March – June 2021
Phase 4: Automated Vehicles	April – June 2021

1.1.2 Overall Road Charge Demonstration Goals

This report evaluates the performance of all four phases of the Road Charge Demonstration, which pursued the following purpose and goals.

Phase 1A: Pay-at-the-Pump and Phase 1B: Pay-at-the-Charge Point:

- **Purpose:** Demonstrate the technological device/point of sale (POS) options available for pay-at-the-pump/charge point road charge model.
- **Goal 1:** Test the viability of a pay-at-the-pump/charge point model through a demonstration and evaluation of new technology.
- **Goal 2:** Build partner and public awareness of this type of road charge model.

Phase 2: Usage-Based Insurance:

- **Purpose:** Demonstrate how the state and auto insurance companies could be business partners, allowing auto insurance companies to act as commercial business partners and facilitate accurate, user-friendly collection of a road charge.
- **Goal 1:** Demonstrate the feasibility of auto insurance companies (those currently utilizing usage-based insurance) acting as Commercial Account Manager (CAMs) in the collection of a road charge.
- **Goal 2:** Assess the cost-effectiveness of auto insurance companies (those currently utilizing usage-based insurance) acting as CAMs in the collection of a road charge.
- **Goal 3:** Build partner and public awareness of this type of road charge model.

Phase 3: Ride-sharing:

- **Purpose:** Demonstrate the viability of collecting a road charge using technology already incorporated in real-time ride-sharing vehicles and applications by ride-sharing companies.
- **Goal 1:** Demonstrate the feasibility of collecting a road charge through ride-sharing companies.
- **Goal 2:** Assess the cost-effectiveness of collecting a road charge through ride-sharing companies.
- **Goal 3:** Build partner and public awareness of this type of road charge model.

Phase 4: Automated Vehicles:

- **Purpose:** Partner with an automated vehicle operator, a commercial business partner, and one of the two in-state proving grounds to demonstrate the ability to collect vehicle and occupancy data from automated vehicles for road charge purposes.
- **Goal 1:** Identify road charge opportunities that stem from automated vehicle usage of California roadways.
- **Goal 2:** Build partner and public awareness of this type of road charge model

2 PURPOSES OF THIS EVALUATION

A project evaluation measures how well the project met its objectives by collecting and analyzing quantitative and qualitative data, evaluating the performance of the project and its significant participants, and reporting conclusions.

This is an independent evaluation conducted by WSP’s subcontractor, The Highlands Consulting Group LLC (Highlands Consulting), which was not involved in implementing or operating the California Road Charge Demonstration. The evaluation does not make recommendations; rather, it is a compilation of data and analysis related to the performance of the demonstration, designed to illustrate efforts and achievements directed at the demonstration’s objectives and goals.

2.1 Overall Demonstration Objectives

In addition to the demonstration phase-specific purpose and goals above, Caltrans defined overall objectives for the demonstration. These objectives serve as the basis for this evaluation of the Four-Phase demonstration:

- Improve the functionality of user-based alternative revenue mechanisms.
 - Conduct outreach to increase public awareness of need for alternative funding sources.
 - Provide recommendations regarding user-based revenue mechanisms.
 - Minimize the administrative cost of any potential user-based revenue mechanisms and associated collection of fees.
 - Address potential implementation and public acceptance hurdles to adoption.
 - Ensure user privacy protection and data security.
 - Utilize third-party business partners to administer or operate system.
 - Identify equity concerns.
 - Ensure ease of user compliance.
 - Include reliable and secure technology.
-

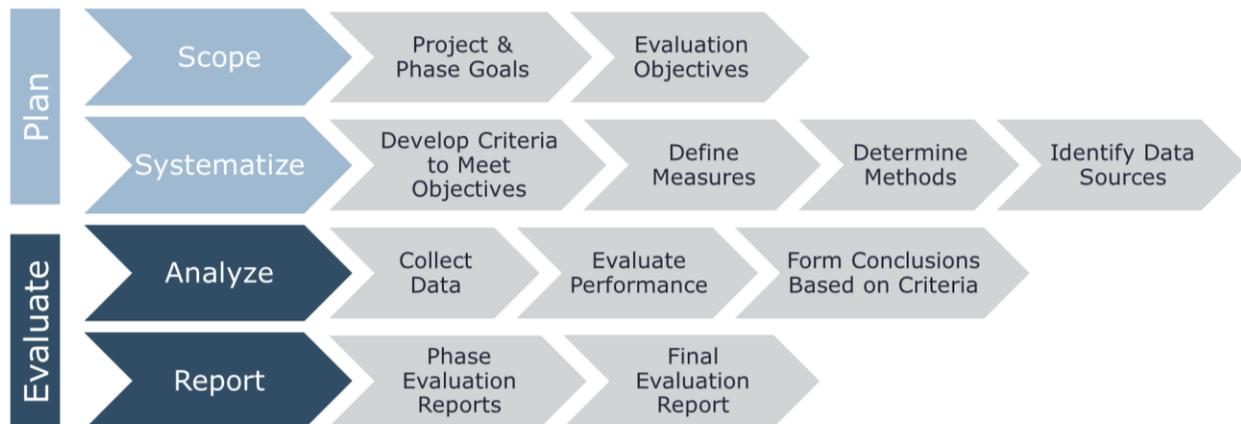
2.2 Evaluation Strategy Plan

This evaluation was guided by the *California Road Charge Demonstration Evaluation Strategy Plan* and uses the objectives above and detailed criteria linked to those objectives to assess how well the project met its objectives. Those criteria, with their associated measures and analytical methods are included in this document as **Appendix A: Evaluation Criteria Matrix**, and each section of the Evaluation Criteria Matrix has corresponding sections in this evaluation report.

3 EVALUATION PROCESS

Highlands Consulting followed a structured process to plan for and then conduct the evaluation. Figure 1: Road Charge Demonstration Evaluation Process summarizes the process, followed by a narrative description of each major step.

Figure 1: Road Charge Demonstration Evaluation Process



3.1 Plan

Evaluation planning began by understanding the scope of the evaluation – reviewing the goals and objectives established by Caltrans for the entire demonstration and each phase. To make these goals and objectives actionable and measurable, the evaluation team created a systematic structure for the evaluation: creating evaluation criteria for each objective, defining measures for each criterion, determining the analytical methods to develop each measure, and identifying data sources. Each of these elements is described below:

- Criteria are concepts used to judge whether an objective has been achieved.
- Measures are specific numerical or qualitative statements that determine how well the criteria are satisfied.
- Methods describe how the evaluation team obtained its measures – for example, from interviews and data analysis.
- Data sources identify where information was found for each measure – for example, specific reports produced by the project delivery team or reports of survey data.

Highlands Consulting developed an *Evaluation Strategy Plan* using these scoping and systematizing activities. The plan was reviewed by the Road Charge Technical Advisory Committee in February 2021 and finalized by Caltrans in March 2021 to guide this evaluation.

3.2 Evaluate

The active evaluation began with analyzing data and documentation collected and reported by the project delivery team and from interviews, surveys, polls, and other sources. The team evaluated the summaries of the collected data to determine whether the project was meeting criteria

established in the *Evaluation Strategy Plan*. The team then made conclusions that form the basis of this and the other evaluation reports. The overall evaluation effort is comprised of these five reports:

- Demonstration Evaluation of Phase 1A: Pay-at-the-Pump and Phase 1B: Pay-at-the-Charge Point
- Demonstration Evaluation of Phase 2: Usage-Based Insurance
- Demonstration Evaluation of Phase 3: Ride-sharing
- Demonstration Evaluation of Phase 4: Automated Vehicles
- Four-Phase Demonstration Evaluation Report (this document)

This evaluation is based on the nine information-gathering and analysis methods used to assess all four demonstration phases. More detailed descriptions of each of these are included in the *Demonstration Evaluation Strategy Plan* dated March 15, 2021.

- **Data analysis:** Review quantitative and qualitative data from periodic operational reports, surveys, polls, focus groups, and ad hoc data provided by the operational team.
- **Documentation review:** Review foundational project documents, including authorizing legislation, grant applications, contracts, operational and communications plans, participant instructions, email and other communications to participants, and other descriptive documents created during the demonstration.
- **Business partner compliance testing:** Review documentation of how each business partner met standards required by Caltrans and the project delivery team.
- **Independent security audit:** Review business partners' compliance with detailed standards for data and system security and reliability, conducted by an independent unit within WSP.
- **Business case revenue modeling:** A model created for Caltrans by the project team, projecting financial data through 2050, based on an array of parameters that can be adjusted to show how Road Charge would perform under various scenarios of adoption rates, policy choices, road charge rates, and other variables.
- **Interviews:** Conduct structured interviews with business partners, consultants, and Caltrans staff to probe questions about the demonstration's performance, successes, and challenges.
- **Focus groups:** Facilitate twelve focus groups with drivers from various regions of the state, drivers of EVs, ride-hailing drivers, rural drivers, long-distance commuters, and drivers fluent in Spanish and Mandarin.
- **Participant surveys:** A series of surveys for the three demonstration phases that involve participants (excluding autonomous vehicles), conducted before starting, at the mid-point, and at the conclusion of their participation.
- **Public opinion polls:** A series of three polls, conducted in 2020 and 2021, gauging California residents' opinions on road charge concepts and other related transportation issues.

4 EVALUATION OF FOUR-PHASE DEMONSTRATION

This evaluation report provides a summary of the findings of each of the four phased evaluation reports. While those reports provide greater detail, we have included the most important facts, analysis, and conclusions for each phase in this report, organized by evaluation objectives and criteria, with information on how well each phase achieved the demonstration’s objectives.

4.1 Demonstration Overview

4.1.1 *Phase 1A: Pay-at-the Pump and Phase 1B: Pay-at-the-Charge Point*

The Phase 1A: Pay-at-the-Pump Demonstration was operated in partnership with GasBuddy, a national gas price comparison and payment card provider. The company operates an app and website that help users find the best price on fuel. The app can also provide users information on driving habits and fuel usage. The company also provides a payment card that links to users’ bank accounts to pay for fuel, offering discounts and rewards.¹

The Phase 1A demonstration utilized the GasBuddy app and payment card, along with a device that plugs into the vehicle’s OBD port. The device was provided by Danlaw, a manufacturer of automotive electronics, including connected-car devices.² The plug-in device recorded individual trip information and mileage driven, using GPS location data, while the GasBuddy card recorded information from fueling transactions, including fuel quantity. The System Administrator processed data from the OBD devices through the Platform for Road charge Innovation and Mobility Evolution (PRIME) and calculated gross and net road charge amounts on behalf of GasBuddy, using fueling transaction data provided by GasBuddy from its payment card to report fuel purchased and the resulting credits for fuel taxes. GasBuddy received this data from PRIME and created monthly statements emailed to participants.

The System Administrator built, maintained, and operated the PRIME system, which stands for “Platform for Road charge Innovation and Mobility Evolution”. PRIME is a data clearinghouse subsystem that provides a central data repository for collecting and managing California Road Charge Demonstration data. PRIME is structured to allow for secure upload, transformation, processing, and reporting of demonstration data. The interactions between PRIME and each business partner’s subsystems demonstrate how a partnership between the State and commercial account managers could be structured.

The pay-at-the-pump demonstration enrolled 33 participants driving gas-powered vehicles that ranged from 15 to 34 MPG, with an average of 24 MPG. The participants logged miles across northern, central, and southern California, with the heaviest usage in the southern region.

The Phase 1B: Pay-at-the-Charge Point Demonstration was operated in partnership with ChargePoint, a national provider of electric vehicle charging stations, in-home charging equipment, and consumer apps that locate charging stations, track energy usage, and process payments for charging electric vehicles.³

¹ For more information on Gas Buddy’s services, see <https://www.gasbuddy.com/>.

² For more information on Danlaw’s products, see <https://www.danlawinc.com/>.

³ For more information on ChargePoint’s services, see <https://chargepoint.com/>.

The Phase 1B demonstration utilized Danlaw plug-in devices, like in the Pay-at-the Pump demonstration, to record trip information and overall mileage driven with GPS location data. The System Administrator processed data from the devices through PRIME and calculated road charge transactions on behalf of ChargePoint. ChargePoint processed charging session and payment data from the users' ChargePoint accounts and used road charge amounts calculated by PRIME to create simulated monthly invoices for road charge.

The pay-at-the-charge point demonstration enrolled nine participants logging miles across northern, central, and southern California, with the heaviest usage in the southern region.

4.1.2 Phase 2: Usage-Based Insurance

The Phase 2: Usage-Based Insurance Demonstration was operated in partnership with Mile Auto,⁴ a company that provides usage-based insurance products in several states across the country. Mile Auto's business model entails offering a relatively low monthly auto insurance premium, with charges based on monthly miles driven assessed on top of a base rate. They offer a range of auto insurance, from minimum liability insurance to full comprehensive and collision coverage. For demonstration participants, Mile Auto operated under the pseudonym "Road Charge Simulated UBI."

The usage-based insurance demonstration required participants to use an odometer image capture and upload process to calculate the number of miles traveled between odometer readings. Participants received text message notifications monthly to take and upload a new odometer photo. Then Mile Auto calculated the miles that the participants traveled based on the difference between the uploaded odometer readings.

Mile Auto also estimated the gallons of fuel consumed based on the EPA published fuel economy in miles per gallon (MPG) for the participant's enrolled vehicle – these calculations allowed the business partner to estimate fuel tax paid by the participants to calculate a fuel tax rebate, as well as the hypothetical road charge they would owe, net of fuel tax rebates. At the end of each monthly cycle, Mile Auto prepared and distributed a mock monthly invoice to each participant which included the simulated usage-based insurance premium and simulated per-mile road charges.

The Phase 2: Usage-Based Insurance Demonstration enrolled 29 participants, including 25 internal combustion engine (ICE) and hybrid vehicles and four electric vehicles. The ICE and hybrid vehicles ranged from 15 to 50 MPG, with an average efficiency of 29.1 MPG. Because miles reported were based on odometer readings, no information is available regarding where the miles were driven.

4.1.3 Phase 3: Ride-sharing

The Phase 3: Ride-sharing Demonstration was operated in partnership with Via, a company that provides transit, on-demand micro-transit, and ride-sharing services across the U.S. and internationally. For this demonstration, Via utilized its ride-sharing services fleet of company-owned, mini-van vehicles operating in West Sacramento.⁵

⁴ For more details on Mile Auto and how they operate, visit their website: <https://www.mileauto.com/#faqs>.

⁵ For more information about Via and its West Sacramento service, see <https://support.ridewithvia.com/hc/en-us/articles/360010694331-When-and-where-does-Via-operate>.

Participants scheduled, took, and paid for rides with Via in their West Sacramento area boundary of service. Via collected travel data from the rider mobile app and the driver mobile app for the mileage driven on each ride. Via calculated the simulated gross road charge for that ride, calculated a fuel tax credit based on the vehicle and its EPA MPG estimate, and calculated a net road charge after the credit. This information was provided to the rider on their Via mobile app shortly after each ride, with a summary report and email provided the next day for all rides taken each day. The road charge simulated transactions were provided separately from the actual receipt for the ride fare paid by the participant.

In total, the Phase 3: Ride-sharing Demonstration enrolled 12 participants. All miles were logged in West Sacramento.

4.1.4 Phase 4: Automated Vehicles

To accomplish the Phase 4: Automated Vehicle Demonstration, Caltrans partnered with EasyMile, an international automated vehicle technology and low-speed AV shuttle provider. EasyMile operates a shuttle service based in Dublin, California, on a pre-mapped route for the Livermore Amador Valley Transit Authority. This shuttle is an electric vehicle, and EasyMile indicates it is the first business to publicly deploy a Level 4 automated vehicle (fully driverless).⁶

This automated vehicle demonstration was unique in that it did not have participants – at least not directly. Since EasyMile’s shuttle was fully operational and available to the public, members of the population may have ridden the shuttle as part of its normal operations; however, no participants were enrolled, surveyed, or received any simulated road charge information. Effectively, the Phase 4: Automated Vehicle Demonstration was an exercise in data analysis. EasyMile transmitted several monthly datasets of their shuttle’s travels to Via, the Phase 3 ride-sharing business partner. Using the same demonstration subsystems and business processes that were used in the ride-sharing demonstration, Via processed the data provided by EasyMile and calculated a simulated road charge for the automated shuttle itself. Via simulated riders while processing the automated shuttle data to test how occupancy changes might impact a road charge.

⁶ From EasyMile’s website: <https://easymile.com/about-us>.

5 FINDINGS

The findings presented below are organized by the objectives, criteria, and measures described in the *Evaluation Strategy plan*. **Appendix A: Evaluation Criteria Matrix** contains the full Road Charge Demonstration Evaluation Criteria Matrix that illustrates which criteria relate to each phase. All findings contained in this Evaluation Report are descriptive in nature, linking the results of the demonstration to the project's goals, criteria, objectives, and performance measures.

Highlands Consulting independently conducted this evaluation. The System Administrator, WSP, implemented and operated the California Road Charge Demonstration without the assistance of the evaluation team. This evaluation presents a neutral view of the activities that took place during the California Road Charge Demonstration. This evaluation does not make recommendations regarding future implementation of a road charge or additional demonstration projects as those policy prescriptions will be included in the *2021 California Four-Phase Demonstration Final Report*.

5.1 Improve the Functionality of User-Based Alternative Revenue Mechanisms

This evaluation objective assesses whether the technologies used during the Four-Phase Demonstration could help improve the collection of potential road charge revenues. The following criteria are used to assess the achievement of this objective:

- Ability of a road charge to create more sustainable transportation revenue than fuel taxes.
 - Feasibility of demonstration methods for levying and collecting road charge.
 - Ability of demonstration to simplify the measurement and collection of user mileage compared to prior road charge pilots.
 - Road charges incurred, by distance traveled, relative to fuel taxes.
-

5.1.1 Ability of a road charge to create more sustainable transportation revenue than fuel taxes

Over time, fuel tax revenue has become unsustainable, as improving fuel efficiency of internal combustion vehicles and the increasing presence of electric and hybrid vehicles has lowered the amount of fuel tax collected per mile of travel. To measure how Road Charge addressed this criterion, the demonstration collected information on miles traveled by participant vehicles and the hypothetical road charge levied per mile, comparing by vehicle fuel efficiency categories and total miles traveled by individual ride-sharing users. The ultimate goal was to determine if a road charge can generate consistent, sustainable revenue per mile of travel, regardless of the type of vehicle driven or its fuel efficiency.

For each portion of the Four-Phase Demonstration, the level of achievement for this objective, according to the criterion, is based on data gathered by the System Administrator during the course of the demonstration. Each phase of the demonstration uniquely assessed the potential revenue that would be collected by a road charge and evaluated the method with which the charge would be applied, including an even application to vehicles based on miles traveled, or to individual participants based on the number of miles they traveled.

Because the Automated Vehicle portion of the demonstration did not include live participants, Phase 4 was omitted from assessments under this objective. The three remaining phases

successfully demonstrated individual collection methods and their capacity to collect a hypothetical road charge in comparison to fuel taxes.

The phases evaluated under this criterion include Phase 1A Pay-at-the-Pump, Phase 1B Pay-at-the-Charge Point, Phase 2 Usage-Based Insurance and Phase 3 Ride-sharing. Their methods for collecting data related to this criterion are:

- **Phase 1A Pay-at-the-Pump:** Utilized an OBD device to collect information on miles traveled for each participant's gas-powered vehicle, and calculated a simulated road charge levied per mile, comparing by vehicle fuel efficiency categories.
- **Phase 1B Pay-at-the-Charge Point:** Collected information through an OBD device on miles traveled for each participant's electric vehicle and calculated a simulated road charge levied per mile.
- **Phase 2 Usage-Based Insurance:** Gathered information on miles traveled by participant vehicles through odometer photos and calculated a simulated road charge levied per mile, comparing by fuel efficiency categories.
- **Phase 3 Ride-sharing:** Collected information on miles traveled by each participant per ride and calculated a simulated road charge levied per mile compared to estimated fuel taxes for the same mileage.

The ultimate goal was to determine if a road charge can generate consistent, sustainable revenue per mile of travel, regardless of the type of vehicle driven or its fuel efficiency. Based on data gathered by the System Administrator during the course of the Phase 1A and 1B demonstration, the revenue that would be collected by a hypothetical road charge was evenly applied to vehicles based on mileage driven.

Phases 1 and 2 had similar degrees of reliance on the participant and their cooperation to use the methods respective to their individual phase. In Phase 1A, participants were required to use their GasBuddy card for fuel purchases to log the number of gallons consumed, which was then used to compare the number of miles driven captured by their OBD mileage recording device. Phase 1B consisted of electric vehicles only, therefore, logging the number of gallons purchased was not necessary. Instead, the ChargePoint portion of the demonstration relied on the participant to ensure their OBD mileage recording device was plugged in and accurately recording mileage. Phase 2 relied on each participant to report their monthly mileage by responding to a text and uploading an image of the odometer through the online portal.

Compared to Phase 1 and Phase 2, Phase 3 Ride-sharing is unique. Due to the mechanics of Via's ride-sharing platform, participants may travel in multiple vehicles with different EPA MPG ratings during any given ride. Therefore, when reporting on participants' mileage and charges, there are no static MPG values in in Via's reports, only participant records that calculate the average MPG of all Via vehicles the rider rode in during the reporting period. This made calculating fuel tax per mile and comparing across varying vehicle efficiency ratings impractical, so this evaluation does not provide a comparison of fuel taxes per mile to road charges per mile, as was done in the Phase 1 and Phase 2 evaluations.

Each phase within the demonstration indicates that a road charge can be consistently applied through various methods while successfully demonstrating that each phase's methodology has the capacity to generate a more sustainable transportation revenue than fuel taxes. Table 2 provides an overview of mileage and road charge data collected from each phase of the demonstration. The table highlights that, while fuel taxes per mile vary depending on the efficiency of vehicles, a road charge can be applied as a per-mile rate that does not differ based on vehicle characteristics.

Table 2: Road Charge Mileage and Revenue Data, Including Vehicle Efficiency

Phase	Vehicle Efficiency Ranges	Total Miles Driven Jan-June 2021	Est. Total Fuel Taxes Paid	Total Gross Road Charge	Road Charge Per Mile	Avg. Fuel Taxes Per Mile
Phase 1	0 - 20 MPG	9,916	\$286.59	\$218.15	\$0.0220	\$0.0289
	21 - 25 MPG	8,100	\$174.00	\$178.19	\$0.0220	\$0.0215
	26 - 30 MPG	10,767	\$198.77	\$236.88	\$0.0220	\$0.0185
	31 - 35 MPG	1,429	\$21.23	\$31.45	\$0.0220	\$0.0149
	All Phase 1A Pay-at-the-Pump Vehicles	30,212	\$680.59	\$664.67	\$0.0220	\$0.0225
	All Phase 1B Pay-at-the-Charge Point Vehicles	21,763	N/A	\$478.81	\$0.0220	N/A
Phase 2	0 - 20 MPG	3,233	\$102.32	\$71.12	\$0.0220	\$0.0316
	21 - 25 MPG	16,842	\$377.85	\$377.85	\$0.0220	\$0.0224
	26 - 30 MPG	29,671	\$535.58	\$652.77	\$0.0220	\$0.0181
	31 - 35 MPG	457	\$7.44	\$10.05	\$0.0220	\$0.0163
	36 - 40 MPG*	0	\$0.00	\$0.00	N/A	N/A
	41 - 50 MPG**	16,614	\$174.23	\$365.50	\$0.0220	\$0.0105
	EVs	5,299	\$0.00	\$116.59	\$0.0220	\$0.0000
	All Phase 2 Usage-Based Insurance Vehicles	72,116	\$1,197.42	\$1,586.56	\$0.0220	\$0.0166
Phase 3	All Phase 3 Ride-sharing Participants	175	\$3.53	\$3.86	\$0.0220	\$0.0202
Phase 4	Phase 4 Automated Vehicle Shuttle	295	N/A	\$6.49	\$0.0220	N/A

For each phase, the method of collecting a road charge through a pay-at-the-pump, pay-at-the-charge point, or usage-based insurance mechanism makes the charge more transparent compared to the fuel tax, since the hypothetical road charge was presented on simulated monthly invoices received by all participants. See Figures 2 through 6 for each phase’s respective simulated invoice.

Figure 2: Pay-at-the-Pump Monthly Road Charge Simulated Invoice Example

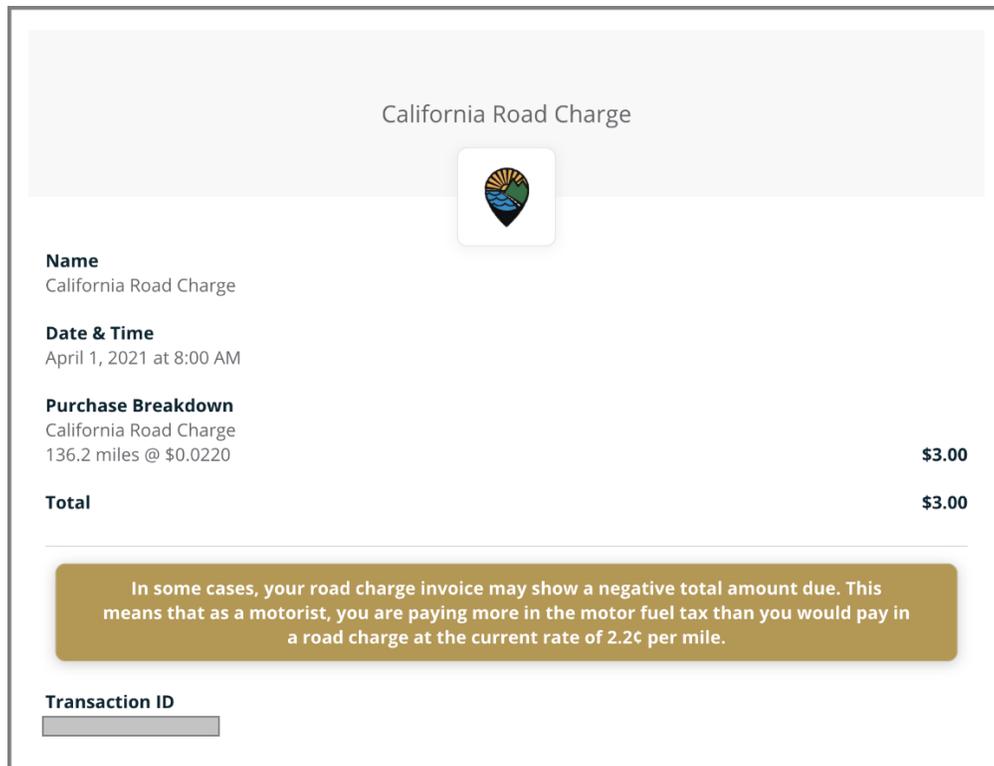


Figure 3: Pay-at-the-Charge Point Monthly Road Charge Simulated Invoice Example

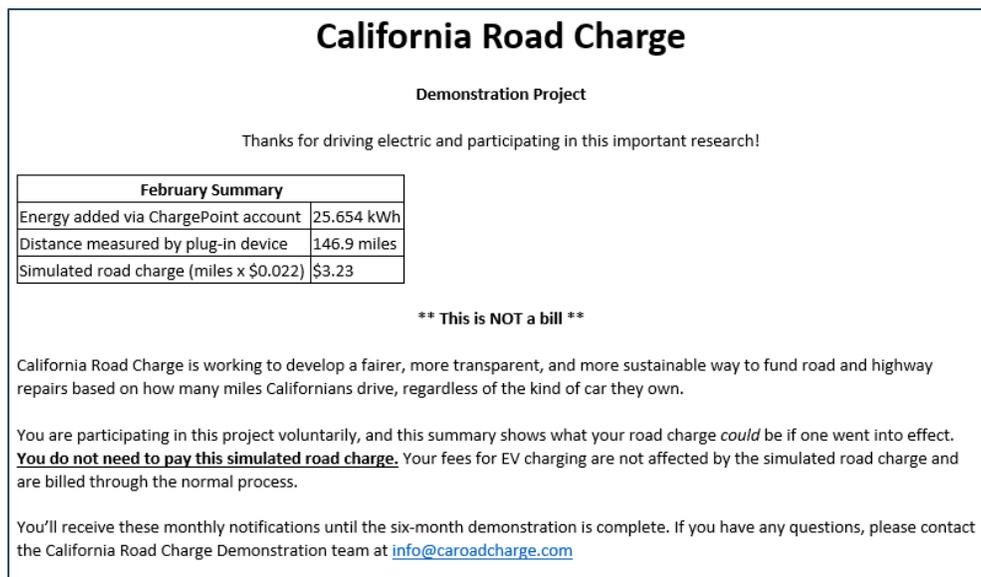


Figure 4: Usage-Based Insurance Monthly Road Charge Simulated Invoice Example

California Road Charge Demonstration Invoice



ROAD CHARGE ACCOUNT:

INVOICE NUMBER:

INVOICE DATE:

TOTAL DUE:



-01

MARCH 31, 2021

\$5.66

**** SIMULATED INVOICE – DO NOT PAY ****

Invoice Detail

VEHICLE #1 - [REDACTED] 3207)

Starting Odometer: 3,158 (Feb 27, 2021)

Ending Odometer: 3,634 (Mar 26, 2021)

Miles Driven: 476

Estimated Fuel Usage: 9.52 gallons (Based on EPA Combined 50 mpg)

Total Road Charge: (476 miles @ \$0.022 per mile) \$10.47

Fuel Tax Credit: (9.52 gallons @ \$0.505 per gallon) -\$4.81

VEHICLE #1 - NET ROAD CHARGE \$5.66

In some cases, your road charge invoice may show a negative total amount due. This means that as a motorist, you are paying more via the motor fuel tax than you would pay via a road charge, based on the current road charge rate of 2.2 cents per mile.

Your Account Services Provider:

roadchargesimulatedUBI™

help@roadchargeinsurance.com

Figure 5: Ride-sharing Road Charge Simulated Invoice Example

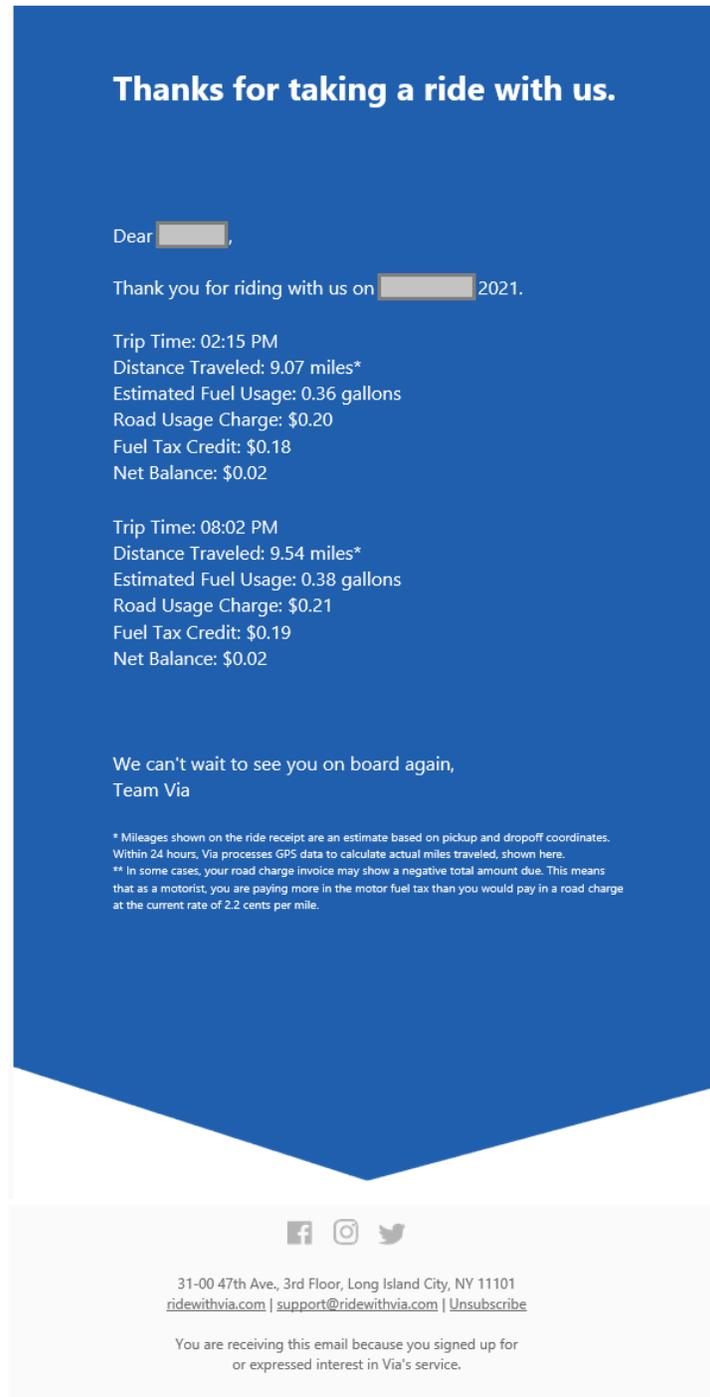


Figure 6: Automated Vehicle Road Charge Simulated Invoice Example



Thanks for taking a ride with us.

Dear Brandon,

Thank you for riding with us on June 30, 2021.

Trip Time: 11:16 AM
Distance Traveled: 0.27 miles*
Estimated Fuel Usage: 0 gallons
Road Usage Charge: \$0.01
Fuel Tax Credit: \$0
Net Balance: \$0.01

Trip Time: 12:16 PM
Distance Traveled: 0.27 miles*
Estimated Fuel Usage: 0 gallons
Road Usage Charge: \$0.01
Fuel Tax Credit: \$0
Net Balance: \$0.01

Trip Time: 01:16 PM
Distance Traveled: 0.11 miles*
Estimated Fuel Usage: 0 gallons
Road Usage Charge: \$0
Fuel Tax Credit: \$0
Net Balance: \$0

Trip Time: 02:16 PM
Distance Traveled: 1.08 miles*
Estimated Fuel Usage: 0 gallons
Road Usage Charge: \$0.02
Fuel Tax Credit: \$0
Net Balance: \$0.02

We can't wait to see you on board again,
Team Via

* Mileages shown on the ride receipt are an estimate based on pickup and dropoff coordinates. Within 24 hours, Via processes GPS data to calculate actual miles traveled, shown here.
** In some cases, your road charge invoice may show a negative total amount due. This means that as a motorist, you are paying more in the motor fuel tax than you would pay in a road charge at the current rate of 2.2 cents per mile.

31-00 47th Ave., 3rd Floor, Long Island City, NY 11101
ridewithvia.com | support@ridewithvia.com | [Unsubscribe](#)

You are receiving this email because you signed up for or expressed interest in Via's service.

5.1.2 Feasibility of demonstration methods for levying and collecting road charge

To gauge the success or error rate of each phase's road charge transaction processing, the evaluation team reviewed the demonstration's monthly Progress Reports, interviewed business partners, reviewed survey results, and interviewed the System Administrator.

In Phase 1A, the pay-at-the-pump participants were instructed to use the GasBuddy card (which linked to their bank account) to pay for fuel. GasBuddy collected data on the quantity of fuel purchased. GasBuddy also received data from PRIME on miles traveled and road charge amounts incurred as described in Section 4.1.1. This process created a gross road charge, an offsetting fuel tax credit, and a net road charge for each participant.

As noted previously, some participants did not consistently use their GasBuddy card to pay for fuel, creating gaps in the fuel quantities purchased. This prevented an accurate calculation of the simulated fuel tax credit. If used for actual collection of a road charge, this could result in overpayment of road charges because they would not be consistently offset by credits for fuel taxes paid.

Similar to Phase 1A, the Phase 1B demonstration's simulated road charge transactions were calculated by PRIME from mileage recorded and submitted by the Danlaw OBD device. However, the pay-at-the-charge point demonstration followed a much simpler process, without the need to calculate for fuel tax credits. During the demonstration, participants utilized ChargePoint stations and paid incurred charges through a "wallet" account that maintained a minimum balance to deduct charging fees from. If participants charged their vehicle outside the ChargePoint network, it did not affect the OBD device, or the calculation of road charge based on miles driven.

For the Phase 2 usage-based insurance portion of the demonstration, participants were asked to upload photos of their odometer monthly, which Mile Auto used to calculate the number of miles traveled per month based on the difference in odometer readings. Mile Auto then used EPA data on each vehicle's MPG rating to estimate the gallons of fuel consumed for each participant's vehicle, thus allowing for an estimate of the fuel tax paid by participants.

Over the course of the Phase 2 demonstration, one error involving road charge transaction processing occurred in March 2021. Mile Auto used the incorrect road charge rate for one monthly invoice (see Figure 4 for invoice details). To address this issue, Mile Auto changed the rate (from 2.3 cents to 2.2 cents) in the system, regenerated invoices, and reissued invoices to participants to reflect the correct rate for their miles traveled in February 2021. No additional incidents related to road charge transaction processing were reported for the remainder of the demonstration.

For the Phase 3 ride-sharing portion of the demonstration, participants requested a ride through the Via app and paid for the ride using a linked payment card. Separate from the payment transaction, Via recorded miles traveled and calculated fuel consumed based on the vehicle profile and EPA efficiency rating. Via then calculated the gross road charge, an offsetting fuel tax credit, and net road charge, providing this information in a simulated invoice to the participant (see Figure 5).

The ride-sharing portion of the demonstration had limited participation and therefore few transactions, however, business partner Via indicated that the technology used in Phase 3 has successfully logged close to 100 million rides in over 200 deployments, all which utilize the same technology. No errors were reported by the participants or the System Administrator over the

course of the demonstration, indicating that levying a road charge through a ride sharing platform with these methods and technology is feasible.

Similar to the ride-sharing demonstration, Phase 4 also utilized Via’s data processing technologies, in which no errors were reported. Business partner EasyMile continued operating its automated vehicle shuttle service as it had previously and transmitted monthly datasets of its shuttle’s travels to Via, the Phase 3 Ride-sharing business partner. As described in Section 4.1, Via processed data from the EasyMile shuttle to calculate simulated road charge transactions. Figure 6 provides an example of the simulated automated vehicle invoices used in the demonstration.

Overall, three out of the four phases in the demonstration successfully demonstrated that their respective methods for levying and collecting a road charge are feasible under the demonstrated technologies.

5.1.3 Ability of demonstration to simplify the measurement and collection of user mileage compared to prior road charge pilots

The current system of fuel taxes is simple for taxpayers to understand and pay – the tax is included in the price of the fuel, and motorists would not be able to drive without paying the tax. Levying a road charge will involve greater complexity, because the measurement of miles traveled may not be as conveniently connected to a routine transaction like filling up with fuel.

Washington and Oregon conducted the first significant road charge demonstrations between 2005 and 2007, pioneering the use of GPS-enabled on-board units in participant vehicles. Oregon’s pilot attempted to make the collection of the charge as similar to paying gas taxes as possible by outfitting two gas stations with special software that could read mileage from participating vehicles’ on-board units and essentially replace the fuel tax with a mileage-based road charge during the fill-up transaction. This was convenient, but implementing the system was quite complicated, requiring custom software and devices for vehicles and fuel pumps, specialized customer support to help users adapt to the new technologies, and other time-intensive support activities. This level of complexity and customization limited the broader applicability of that approach, and Oregon moved to using different payment methods when conducting its second pilot and its currently operating program.

The California Road Charge Pilot Program (RCPP) in 2016-2017 took some steps toward simplifying the road charge process compared to other states’ pilots. The RCPP allowed participants to choose from seven methods of mileage reporting and one option to pay for unlimited miles for a specified time. The reporting methods included odometer readings, plug in devices with or without GPS, a smartphone app with or without GPS, and built-in vehicle telematics. Some of these were fairly simple methods, and many utilized technologies that may have been new to the participants.

One of the goals of this four-phase road charge demonstration was to simplify the measurement of mileage by using technologies that are already available in the marketplace, reliable, and familiar to the public. By using existing technologies with currently operating business processes, these demonstrations sought to move road charge toward a more readily implementable program.

For Phases 1, 2, and 3 all participants volunteered to follow the enrollment process and onboarding activities required by their phase’s business partner in the following manner.

Phase 1A Pay-at-the-Pump: Participants onboarded into the GasBuddy system for the demonstration or existing GasBuddy customers who added the Road Charge Demonstration to their account. The enrollment process included ten main steps:

1. Express interest through an online form
2. Receive an invitation to participate
3. Log in to the Road Charge Demonstration participant portal with credentials supplied in the invitation
4. Acknowledge a participant agreement and privacy policy
5. Complete a form with VIN, mobile phone number, and mailing address
6. Receive an emailed invitation to create a GasBuddy account
7. Log in at GasBuddy and complete the enrollment, including providing driver license number and linking to a checking account for payment with the GasBuddy card
8. Download and install the GasBuddy mobile app
9. Receive and install mailed plug-in device for mileage recording
10. Receive the GasBuddy card in the mail

After enrollment, participants were instructed to use their GasBuddy card each time they fueled their participating vehicle. They received a monthly invoice with simulated road charge transactions, based on the information recorded by the OBD device, with offsetting fuel tax credits calculated by the recorded fuel purchases with the GasBuddy card.

Heading into the demonstration, participants rated their overall satisfaction with their respective process with a mean score of 5.4 on a scale where 1 indicated it was not easy at all and 7 extremely easy. When it came to setting up their device, respondents reported that it was generally easy, with a mean rating of 6.1 on the same scale of ease.

For survey results about participant satisfaction with their respective methods see Table 3 and for ease of use see Table 8.

Phase 1B Pay-at-the-Charge Point: Participants onboarded into the ChargePoint system for the demonstration or existing ChargePoint customers who added the Road Charge Demonstration to their account. The enrollment process included ten main steps:

1. Express interest through an online form
1. Receive an invitation to participate
2. Log in to the Road Charge Demonstration participant portal with credentials supplied in the invitation
3. Acknowledge a participant agreement and privacy policy
4. Complete a form with VIN and mailing address
5. Receive an emailed invitation to create a ChargePoint account or connect the demonstration to an existing ChargePoint account
6. Log in at ChargePoint and complete the enrollment, including providing driver license number and linking to a credit or debit card for payment at ChargePoint stations

7. Download and install the ChargePoint mobile app
8. Receive and install mailed plug-in device for mileage recording
9. Receive the ChargePoint card in the mail, which was used to initiate charging sessions (which was optional, because they could also be initiated by the mobile app)

After enrollment, participants would charge their vehicles at a ChargePoint station or another station that participates in a reciprocity network. The OBD device recorded miles driven, and ChargePoint emailed a monthly statement showing energy added to the vehicle from ChargePoint sessions, miles traveled for the month, and a simulated road charge.

Heading into the demonstration, participants rated their overall satisfaction with their respective process with a mean score of 5.4 on a scale where 1 indicated it was not easy at all and 7 extremely easy. When it came to setting up their device, respondents reported that it was generally easy, with a mean rating of 6.1 on the same scale of ease (this includes Phase 1A - both portions of Phase 1 were considered together in participant survey reports).

For survey results about participant experience with their respective methods see Table 3 and for ease of use see Table 8.

The enrollment processes for both the Pay-at-the-Pump and Pay-at-the Charge Point demonstration include several steps where user inaction could cause an incomplete enrollment. Consequently, in Phase 1, only 33 of the 113 participants invited to enroll completed the process. In Phase 2, the ratio of incomplete to complete enrollments was much smaller than in the GasBuddy demonstration. Of the 18 individuals invited to enroll, nine completed the process.

Phase 2 Usage-Based Insurance: Participants onboarded into Mile Auto’s systems solely for the demonstration. The enrollment process included six main steps:

1. Express interest through completing an online form
2. Receive an invitation to participate
3. Log in to the Road Charge Demonstration participant portal with credentials supplied in the invitation
4. Acknowledge a participant agreement and privacy policy
5. Complete a form with vehicle identification number (VIN) and phone number
6. Receive an email from Mile Auto to finish enrollment, create a mock insurance policy, and submit the first odometer reading photo

After enrollment, participants received a monthly reminder to upload an odometer photo and then received a monthly mock invoice for road charges (as described above, including calculated fuel tax credits) and mock usage-based insurance premiums. This process includes several steps where user inaction could cause an incomplete enrollment. Of the 102 individuals invited to enroll, 29 completed the process.

Heading into the demonstration, participants rated their overall satisfaction with their respective mileage reporting method with a mean score of 6.6 on a scale where 1 indicated very unsatisfied and 7 very satisfied. To set up their road charge reporting account online, respondents reported that it was generally easy, with a mean rating of 6.1 on a scale where 1 indicated not easy at all and 7 very easy.

For survey results about participant experience with their respective methods see Table 3 and for ease of use see Table 8.

Phase 3 Ride-sharing: Participants were either volunteers onboarded into Via’s systems for the demonstration or existing customers flagged as participants in the demonstration. The enrollment process included six main steps:

1. Express interest through completing an online form
2. Receive an invitation to participate
3. Log in to the Road Charge Demonstration participant portal with credentials supplied in the invitation
4. Acknowledge a participant agreement and privacy policy
5. Download and install the Via mobile app (if not an existing customer) including linking a credit or debit card for payment of rides taken
6. Email the System Administrator to complete account setup, including connecting an existing Via account to the demonstration if already a Via customer

Overall, this process appeared to be feasible for a ride-sharing customer. Of the 56 individuals that expressed interest and were invited to enroll, 12 completed the process. After enrollment, participants received mock invoices after each ride showing simulated road charge transactions and fuel tax credits.

For Phases 1-3 of the demonstration, EMC, one of the demonstration’s communications partners, conducted a series of three online surveys to gather information and provide feedback on whether participants viewed their process as simple.

Heading into the demonstration, respondents reported that setting up their road charge reporting account through a mobile app was extremely easy, with a mean rating of 7 on a scale where 1 indicated not easy at all and 7 extremely easy.

For survey results about participant experience with their respective methods, see Table 3 and for ease of use see Table 8.

5.1.4 Road charges incurred, by distance traveled, relative to fuel taxes

This measure compares simulated road charges levied with the fuel taxes paid per mile of travel. Because fuel taxes are inversely related to the vehicle’s efficiency (that is, the less fuel efficient the vehicle, the greater amount of fuel taxes paid), the difference between fuel taxes and road charges will also vary, since all vehicles pay the same road charge, regardless of their fuel efficiency. Significant findings related to each of the demonstration phases are summarized below.

- **Phase 1A Pay-at-the-Pump:** As noted in Section 5.1.1, the data on fuel taxes for the pay-at-the-pump demonstration are incomplete, due to participants fueling without the GasBuddy card. However, the review of limited data shown in that section illustrated that a road charge would successfully levy a constant rate per mile, while under the fuel tax, vehicles with lower fuel efficiency pay a higher rate per mile and vehicles with higher efficiency pay a lower rate per mile.
- **Phase 1B Pay-at-the-Charge Point:** This phase included fully electric vehicles with a road charge applied evenly per mile (see Table 2 in Section 5.1.1 for details).

- **Phase 2 Usage-Based Insurance:**
- Table 2: in Section 5.1.1 illustrates the variation of effective fuel taxes per mile based on a vehicle’s efficiency compared to the flat road charge assessed per mile. When comparing taxes per mile for this group, it is apparent that the drivers of these relatively low-efficiency vehicles current pay more in fuel taxes (\$0.0337/mile) than they would with the demonstrated road charge (\$0.0220/mile). The data in Table 2 show that this demonstration successfully illustrated the difference between a road charge and fuel taxes, with the road charge levying a constant rate per mile, while fuel taxes per mile vary based on the vehicle type.
- **Phase 3 Ride-sharing:** The small number of vehicles used in this demonstration phase did not provide useful variation in fuel efficiency to test this expectation. Nevertheless, as shown in
- Table 2 in Section 5.1.1, the road charge assessed was slightly higher than the estimated fuel taxes paid. This is because the ride-sharing vehicles had moderately high fuel efficiency, which results in lower fuel tax per mile. The data indicate, as expected, when vehicles have higher-than-average fuel efficiency, a road charge based *on the state’s average fuel efficiency* will result in a higher charge to those vehicles than the fuel tax.

5.1.5 Survey data: improving functionality

EMC Research conducted a series of three online surveys with California Road Charge Demonstration participants. EMC administered the first survey to participants before they began active participation in the Demonstration (the Pre-Test), administered the second survey in the middle of their participation (the Mid-Test), and administered the last survey immediately following their participation (the Post-Test).

The three surveys asked several questions related to participant satisfaction and whether or not respondents perceived their respective mileage reporting methods and processes as easy, as summarized in Table 3.

Table 3: Survey Data – Improving Functionality

Phase	Pre-Survey	Mid-Survey	Post-Survey
Question: Please rate how satisfied you were regarding your experience with... the overall experience. (1 = very unsatisfied, 7 = very satisfied)			
1A Pay-at-the-Pump & 1B Pay-at-the-Charge Point	5.44	5.27	5.67
2 Usage-Based Insurance	5.96	6.57	6.38
3 Ride-sharing	5.67	4.33	6.50
Question: Please rate how satisfied you were regarding your experience with... the process of reporting your mileage. (1 = very unsatisfied, 7 = very satisfied)			
1A Pay-at-the-Pump & 1B Pay-at-the-Charge Point	n/a	6.15	5.67
2 Usage-Based Insurance	n/a	6.65	6.54

Phase	Pre-Survey	Mid-Survey	Post-Survey
3 Ride-sharing	n/a	5.00	5.75
Question: Please rate how satisfied you were regarding your experience with... the mileage reporting method you used. (1 = very unsatisfied, 7 = very satisfied)			
1A Pay-at-the-Pump & 1B Pay-at-the-Charge Point	5.04	5.12	5.33
2 Usage-Based Insurance	6.56	6.65	6.73
3 Ride-sharing	The three respondents all answered “don’t know”	5.00	6.25

5.1.6 Evaluation outcomes: improving functionality

The level or degree of achievement for this objective, according to the criteria, is shown by the icons displayed in Table 4. A full circle indicates the objective was fully achieved, according to that criterion, while the half-full circle indicates a rating of partially achieved. The “n/a” entries show criteria that were not applicable to the automated vehicle demonstration phase.

Table 4: Evaluation Outcomes – Improving Functionality

Objective	Criterion	Outcomes by Phase			
		1A PATP 1B Charge Point	2 UBI	3 Ride-sharing	4 AV
5.1 Improve the functionality of user-based alternative revenue mechanisms	Ability of a road charge to create more sustainable transportation revenue than fuel taxes				n/a
	Feasibility of demonstration methods for levying and collecting road charge				

Objective	Criterion	Outcomes by Phase			
		1A PATP 1B Charge Point	2 UBI	3 Ride-sharing	4 AV
	Ability of demonstration to simplify the measurement and collection of user mileage compared to prior road charge pilots				
	Road charges incurred, by distance traveled, relative to fuel taxes				n/a

Notes:
 = fully achieved
 = partially achieved

Phase 1 received some partially achieved ratings because some pay-at-the-pump participants were inconsistent in using the provided GasBuddy payment card, which created gaps in data regarding fuel usage, and some users disconnected their OBD devices at times, resulting in incomplete mileage recording. Phase 3 received some partially achieved ratings because data reported on participants’ rides averaged the fuel efficiency of the vehicles in which they traveled, making it unclear how the road charge compared to fuel taxes by vehicle efficiency or on a per-mile basis.

5.2 Provide Recommendations Regarding User-Based Revenue Mechanisms

This objective seeks to describe whether the overall demonstration led to specific road charge recommendations related to utilizing methods from the demonstration’s four phases.

5.2.1 Ability of demonstration to generate recommendations

Each portion of the demonstration provided key insights related to the future processes and potential challenges within a future road charge program or further demonstration projects. These findings resulted in a robust set of recommendations contained in the *2021 California Four-Phase Demonstration Final Report*, categorized by the following groups:

- Participant and Public Perspectives
- Business Model Integration
- Participant Management
- Business Partner Management

5.2.2 Evaluation outcomes: recommendations

The level or degree of achievement for this objective, according to the evaluation criteria, is shown in Table 5. Each of the four phases successfully generated recommendations to consider in road charge programs, fully achieving the objective.

Table 5: Evaluation Outcomes – Recommendations

Objective	Criterion	Outcomes by Phase			
		1A PATP 1B Charge Point	2 UBI	3 Ride- sharing	4 AV
5.2 Provide recommendations regarding user-based revenue mechanisms	Ability of demonstration to generate recommendations	●	●	●	●
Notes: ● = fully achieved ◐ = partially achieved					

5.3 Minimize the Administrative Cost of Any Potential User-Based Revenue Mechanisms and Associated Collection of Fees

This objective assesses the costs associated with administering and collecting road charges from the perspective of both the state agency and business partner.

5.3.1 Estimated agency and business partner costs of administering a road charge based on relevant cost data from the demonstration

The *Evaluation Strategy Plan* proposed measuring this objective, according to the criteria, by the cost of collecting road charge as a percent of simulated revenue for the agency and the business partners. Given that this was a small-scale demonstration it is difficult to infer specific administrative costs for this demonstration or for a statewide road charge operation.

Upon completion of the Four-Phase Road Charge Demonstration, we invited the System Administrator and each business partner to participate in separate interviews. We asked all interviewees questions regarding their operating costs and the potential financial impacts associated with implementing a full-scale operation.

- **Phase 1A Pay-at-the-Pump:** When asked to estimate administrative costs, GasBuddy was unable to provide specific details regarding their operating costs and the potential financial impacts associated with implementing a full-scale operation. However, GasBuddy provided valuable insights on their technical ability and administrative

capacity to scale its operations, generate revenue, minimize operating costs, and utilize current incentives to promote user compliance.

- **Phase 1B Pay-at-the Charge Point:** Due to the limited ability of their staff, ChargePoint was unable to participate in interviews.
- **Phase 2 Usage-Based-Insurance:** When asked about their estimated operating costs and potential financial obligations to implement a full-scale operation, Mile Auto estimated that its operating costs would be between 5-10 percent of road charge revenues. Additionally, Mile Auto noted that the transactional costs associated with a full-scale program could be much lower because the photo-submission process for mileage reporting does not require any hardware, software, or the use of any on-board device.
- **Phase 3 Ride-sharing:** The business partner Via was unable to provide specific percentages regarding their operating costs and the potential financial impacts associated with implementing a full-scale program. However, Via enthusiastically described their technical ability to provide quality services, noting that their only concern with implementing a future mandatory program would be the administrative and political hurdles associated with a road charge.
- **Phase 4 Automated Vehicles:** Both business partners, EasyMile and Via, were unable to provide an estimation of their operating costs as a percentage of the hypothetical road charge revenue collected during this phase of the demonstration. During the interview, both business partners indicated that a future statewide program would require additional costs associated with transaction fees and other technological costs related to accessing and storing data.
- **System Administrator:** The System Administrator highlighted three main factors that could ensure a state-wide program reduce its administrative costs.
 1. Reduce the level of response time provided to the public. The time to answer inquiries and questions could be reduced from this demonstration's requirement of 24 hours to 7-10 business days. Full-time staff is not necessary to manage day-to-day operations.
 2. Implementing a direct relationship between the participant and the respective business partner could reduce the costs associated with the system administrator and staff administrative responsibilities.
 3. Utilize existing agency platforms such as the DMV, through scaling up their existing customer service and tax/fee collection capabilities.

To summarize, it was not possible to estimate exact percentages of administrative costs in this small demonstration, and definitive business partner costs are likely small but remain unknown.

5.3.2 *Estimated cost of revenue collection using these demonstration methods compared to other road charge demonstrations*

Since the first road charge demonstrations in Washington and Oregon, a growing number of states and regions have conducted demonstration projects. These have used a wide range of processes and technologies to report mileage and levy road charges. Most have involved third-party operators or account managers, which has proven advantageous in utilizing their technological expertise as well as creating processes that can shield participants' private location data from public agencies involved in the programs.

One primary concern for potential road charge programs is the cost of administering revenue collection activities, including compensation for business partners operating technology solutions and collecting funds. The two operating programs in Oregon and Utah are small in scale, and the compensation provided to their business partners does not likely represent the costs of a full-scale road charge program in a large state like California.

This Four-Phase Road Charge Demonstration partnered with technology operators that already collect mileage data or have a presence in the automotive services market that would easily allow mileage data collection. This unique approach should lead to lower administrative costs, because business processes, technologies, and customer relationships already exist with partners like these. While we cannot estimate administrative costs at this time, the information obtained from business partners and described in the previous section implies that costs could be low, especially for business partners that view the privilege of providing road charge services as a promising strategy for marketing their other services to motorists. Therefore, this demonstration partially achieves this objective – it identified promising strategies and partnerships that should reduce costs, although they cannot be quantified at this time.

5.3.3 Evaluation outcomes: administrative costs

The level or degree of achievement for this objective, according to the evaluation criteria, is shown in Table 6.

Table 6: Evaluation Outcomes – Administrative Costs

Objective	Criterion	Outcomes by Phase			
		1A PATP 1B Charge Point	2 UBI	3 Ride-sharing	4 AV
5.3 Minimize the administrative cost of any potential user-based revenue mechanisms and associated collection of fees	Estimated agency and business partner costs of administering a road charge based on relevant cost data from the demonstration				
	Estimated cost of revenue collection using these demonstration methods compared to other road charge demonstrations				
Notes:  = fully achieved  = partially achieved					

Each of these phases are rated as partially achieved on these criteria because the size of this demonstration was too small to create a realistic estimate of administrative costs. Most of the partners expressed a desire to participate in a future road charge program, and some said they would do so with a small administrative charge (or none at all) in order to gain exposure for marketing their other services to the large market of motorists California can provide. However, these statements were conjecture, and it was not feasible to estimate administrative costs from the demonstration or to predict costs for future programs.

5.4 Utilize Third-Party Business Partners to Administer or Operate Systems

This objective assesses whether the demonstrations made use of third-party business partners in the operation and administration of road charge systems.

5.4.1 Use of third-party business partners to administer or operate systems

Each portion of the Four-Phase Road Charge Demonstration met the objective of using third-party business partners to administer or operate systems. See Section 4.1 for details on all business partners.

- **Phase 1A Pay-at-the-Pump and Phase 1B Pay-at-the-Charge Point:** For Phase 1 of the Four Phase Road Charge Demonstration, Caltrans subcontracted with two business partners, GasBuddy and ChargePoint, to operate the demonstration. Each partner was described in Section 4.1 of this report.
- **Phase 2 Usage-Based-Insurance:** For Phase 2, Caltrans subcontracted with business partner, Mile Auto, to operate the demonstration. Mile Auto is an insurance company that offers pay-by-the mile auto insurance in multiple states.⁷
- **Phase 3 Ride-sharing:** For Phase 3, Caltrans subcontracted with business partner, Via, which operated the demonstration's ride-sharing services in a fleet of company-owned, shared vehicles in West Sacramento.⁸
- **Phase 4 Automated Vehicle:** In the Phase 4 portion of the demonstration, Caltrans subcontracted with two business partners, EasyMile and Via, to operate the demonstration. Easy mile was described in Section 4.1 of this report.

For all four phases, the contract between Caltrans and WSP USA Inc with the use of subcontracted business partners illustrates that existing technologies have a key role in the future administration and collection of a statewide road charge program.

⁷Currently, Mile Auto insurance coverage is available in Arizona, Georgia, Illinois, and Oregon: <https://www.mileauto.com/#faqs>.

⁸ For more information about Via and its West Sacramento service, see <https://support.ridewithvia.com/hc/en-us/articles/360010694331-When-and-where-does-Via-operate>.

5.4.2 Evaluation outcomes: third party partners

The level or degree of achievement for this objective, according to the evaluation criteria, is shown in Table 7.

Table 7: Evaluation Outcomes – Third-Party Partners

Objective	Criterion	Outcomes by Phase			
		1A PATP 1B Charge Point	2 UBI	3 Ride-sharing	4 AV
5.4 Utilize third-party business partners to administer or operate systems	Use of third-party business partners to administer or operate systems	●	●	●	●
Notes: ● = fully achieved ◐ = partially achieved					

Each of the phases fully achieved this objective, because third-party partners were an integral part of each demonstration phase.

5.5 Ensure Ease of User Compliance

This operational objective describes the ease with which users of the Road Charge systems can comply with the stated business processes. The achievement of this objective is measured by the following criteria:

- Effectiveness of methods for encouraging voluntary compliance
- Resistance of methods to tampering and fraud
- Users' ease of recording and reporting mileage
- Quality/accuracy of road use data reported

5.5.1 Effectiveness of methods for encouraging voluntary compliance

This evaluation criterion applied to only Phase 1 and Phase 2 of the demonstration, as Phase 3 (ride-sharing) tested a mandatory charge added to rides that did not allow discretion by users to avoid compliance, and Phase 4 (Automated Vehicles) did not test charges to users. To measure the rate of voluntary compliance by participants, the evaluation team interviewed business partners, reviewed survey results, and interviewed the System Administrator. Since demonstration participants signed up voluntarily, the rates of voluntary compliance were expected to be higher than they might be if road charge were a mandatory program.

Significant findings gathered from interviews with the business partners and the System Administrator are summarized below (see each individual phase evaluation report for more details).

- **Phase 1A Pay-at-the-Pump:** GasBuddy suggested that the mechanics of how their payment card is used encourages voluntary compliance because people will not receive a

credit or reimbursement for fuel taxes paid if they choose not to comply or use another form of payment to purchase fuel. However, a significant number of demonstration participants did not consistently use the GasBuddy card for payment or disconnected their OBD device for recording mileage, resulting in incomplete data on fuel tax credits and on chargeable miles. In surveys, participants in the GasBuddy and ChargePoint demonstrations (which were combined in survey results) registered moderate concern about the potential for cheating. However, their level of concern declined toward the end of the demonstration, from a mean rating of 4.78 at the start to a mean rating of 4.17 at the conclusion on a scale where 1 indicated not all concerned and 7 indicated very concerned about the ability to cheat.

- **Phase 1B Pay-at-the-Charge Point:** ChargePoint did not make a team member available for interview after the demonstration concluded. Because this demonstration with electric vehicles did not involve fuel purchases, no compliance issues arose with the use of fuel payment cards. The pay-at-the-charge point demonstration relied on the same OBD devices as the GasBuddy effort, which could lead to similar compliance issues with users disconnecting their devices and not recording chargeable miles.
- **Phase 2 Usage-Based Insurance:** Mile Auto suggested the ease and transparency of their process increases its users' trust, improves voluntary compliance, prevents tampering, and promotes overall compliance. To simplify compliance, Mile Auto opted for a mobile web interface for mileage reporting, rather than creating a custom phone app. By using odometer readings for mileage recording, no GPS device is used, eliminating a possible source of noncompliance when a device could be disconnected. During the demonstration, a few users did not report miles at the end of a month. Mile Auto used reports from the following month to assess the road charge for both months when the user reported. If this were to occur in an operational road charge program, a nonreporting user would be at risk of losing their auto insurance policy, which would provide an incentive to continue reporting on a monthly basis.

Fuel tax credits in Phase 2 were calculated by using the vehicle model's EPA MPG rating and dividing total miles driven by MPG to estimate fuel consumed. This also avoided noncompliance issues with reporting fuel purchases. Participant surveys showed a moderate level of concern that people could cheat such a system. Their concern was lower than those in the pay-at-the-pump demonstration, and similarly, the concern diminished over time, falling from an initial 4.48 in the pre-participation survey to 3.62 in the post-participation survey, where 1 indicated not at all concerned and 7 indicated very concerned about the ability to cheat.

Reviewing the experience of these demonstrations, the common factor that could diminish voluntary compliance is the use of processes or technologies that can be easily disconnected, ignored, or otherwise go unused.

5.5.2 Resistance of methods to tampering and fraud

This evaluation criterion also applied to only Phase 1 and Phase 2 of the demonstration, as the other phases either did not allow discretion by users that could lead to fraud or did not have individual users. This criterion was measured by the number and description of detected instances of attempted tampering or fraud. As expected in a demonstration based on volunteers, the System

Administrator and business partners reported no instances of fraud or evidence of tampering. Additional observations from the two relevant phases are provided below.

- **Phase 1A Pay-at-the-Pump and Phase 1B Pay-at-the-Charge Point:** Both of these phases depended on users keeping an OBD device active in their vehicle to record mileage. Both GasBuddy and the System Administrator recommend that a future mandatory program incorporate some form of mileage verification to reduce the temptation for fraud. For example, participants could combine their current method with photos of their odometer at the end of a particular time period (as was done in the Usage-Based Insurance Demonstration) to verify that their reported mileage was accurate.
- **Phase 2 Usage-Based Insurance:** There are limited ways that potential future users of a usage-based insurance road charge program could attempt to tamper with the process or commit fraud, including tampering with their vehicle's odometer, editing the odometer photo prior to uploading, submitting a photo of an earlier odometer reading, or knowingly submitting a photo of another vehicle's odometer. Mile Auto uses a validation process in both their active usage-based insurance business as well as in the demonstration, in which they confirm odometer photos are readable, the file is not corrupted, and photos submitted represent the dashboard of the correct type of vehicle.

To summarize, no tampering or attempted fraud was discovered in the demonstration, but the nature of some of the technologies or processes used could lead to fraud in a future operational program if precautionary measures are not implemented.

5.5.3 *Users' ease of recording and reporting mileage*

This evaluation criterion also applied to only Phase 1 and Phase 2 of the demonstration, as the other phases either did not require user recording or reporting of mileage. To measure the level of achievement for this criterion, the evaluation team reviewed the reported level of participant satisfaction, as measured by the mid- and post-demonstration participant surveys. A summary of each phase's findings is provided below:

- **Phase 1A Pay-at-the-Pump and 1B Pay-at-the-Charge Point:** To gauge the ease with which participants could engage in this demonstration, pre-participation surveys asked how easy it was initially to install and setup a mobile app and the vehicle's OBD device. In mid-participation and post-participation surveys, participants were asked how easy it was to report their mileage. Table 8 in Section 5.5.5 summarizes the results from these surveys, showing this phase rating between 5.5 and 6 on a scale of 1-7, with 7 signifying extremely easy. Despite the level of satisfaction reported, a few participants reported some confusion related to the pay-at-the-pump process, and whether or not they were tracking their mileage correctly. Additional confusion among participants triggered requests for more detailed instructions and a feedback mechanism to ensure they are using their process correctly.
- **Phase 2 Usage-Based Insurance:** The pre-participation survey asked users how easy it was to set up their online road charge reporting account. In the mid- and post-participation surveys, respondents were asked about how easy it was to report their mileage under their respective process. Over the duration of the demonstration, usage-based insurance participants reported significant satisfaction with their respective mileage reporting process. Survey results indicate that 95 percent of participants found their mileage reporting process either easy or extremely easy. The survey's open-ended

comments verify user satisfaction with several participants noting they are particular pleased with the convenience and ease of the usage-based reporting process. Generally, participants felt their process was as simple as receiving a text and responding with a photo.

Participants generally found these processes to be somewhat easy, with the usage-based insurance demonstration scoring higher on the scale of ease and participants in both demonstration phases expressing more positive ratings about the ease of use as the demonstration progressed to the end. See Table 8 in Section 5.5.5 for more details about these survey results.

5.5.4 *Quality/accuracy of road use data reported*

To measure the level of achievement for this criterion, the evaluation team analyzed data and errors reported by each of the technology platforms. Data about operations and instances of errors were obtained primarily through the System Administrator’s monthly progress reports and interviews with the System Administrator. Several interviews with participants also provided insight on data quality and errors. Highlights of findings regarding data quality are provided by phase, below.

- **Phase 1A Pay-at-the-Pump:** This phase experienced the largest number of errors, because accurate data depended on users complying with two significant instructions: keeping the OBD device active in their vehicle and purchasing fuel with the GasBuddy payment card. This dependence on voluntary compliance led to many instances of incomplete data collection as users inconsistently used the provided payment card, and some users disconnected their OBD devices. Nevertheless, 30 of the 42 devices were connected between 80-100 percent of the time, collecting more than 93,000 miles of data (92 percent of all miles counted) for the combined pay-at-the-pump and charge point demonstrations.
- **Phase 1B Pay-at-the-Charge Point:** Participants in this phase were consistent with the use of their OBD devices to record mileage. This phase also did not suffer from noncompliance in fuel payment cards, since the demonstration with electric vehicles did not have a fuel tax rebate component.
- **Phase 2 Usage-Based Insurance:** This phase was fairly simple, requiring only odometer reading submissions at the end of each month, with no devices that could be disconnected or payment methods that could go unused. A billing error occurred in March 2021, when Mile Auto applied the wrong rate to simulated road charge invoices; this was corrected, and invoices were reissued for February travel.
- **Phase 3 Ride-sharing:** The System Administrator and Via reported no major discrepancies or errors in the data. One finding in this demonstration, while not an error, is worth noting. When sharing the vehicle with other riders, trips were sometimes longer than originally estimated by the app, when the driver needed to modify the route to pick up or drop off the additional passengers. This could cause the final road charge to differ from the initial estimate in the app.
- **Phase 4 Automated Vehicles:** During the demonstration, no major discrepancies or errors in the data were reported by the System Administrator or the business partners, EasyMile, and Via. While not a data error, it was noted that the automated vehicle shuttle participating in this phase was offline for a total 6.5 days during the demonstration for routine maintenance.

In addition to these findings, see the systems, integration, and acceptance testing described in later sections for information about the business partners’ adherence to technical standards that promoted high quality data collection.

5.5.5 Survey data: ease of user compliance

As described above, participant surveys provided a useful assessment of how well the demonstration met the objective of ensuring ease of user compliance, including concern about the potential for cheating in a future program and the ease of reporting mileage, including startup activities. These data are reported for Phases 1 and 2, because the other phases tested processes that either do not depend on users for compliance or do not involve end users.

Table 8: Survey Data – Ease of User Compliance

Phase	Pre-Survey	Mid-Survey	Post-Survey
Question: If road charge were to replace the gas tax, how concerned would you be that the reporting system you are using would allow people to cheat? (1 = not at all concerned, 7 = very concerned)			
1A Pay-at-the-Pump & 1B Pay-at-the-Charge Point	4.78	4.65	4.17
2 Usage-Based Insurance	4.48	3.70	3.62
Question: How was your experience installing and setting up the mobile app or account? (1 = not easy at all, 7 = extremely easy)			
1A Pay-at-the-Pump & 1B Pay-at-the-Charge Point	5.59	n/a	n/a
2 Usage-Based Insurance	6.12	n/a	n/a
Question: How was your experience installing and setting up the device? (1 = not easy at all, 7 = extremely easy)			
1A Pay-at-the-Pump & 1B Pay-at-the-Charge Point	6.09	n/a	n/a
2 Usage-Based Insurance	n/a	n/a	n/a
Question: How easy has it been to report your mileage? (1 = not easy at all, 7 = extremely easy)			
1A Pay-at-the-Pump & 1B Pay-at-the-Charge Point	n/a	5.73	5.92
2 Usage-Based Insurance	n/a	6.65	6.73

5.5.6 Evaluation outcomes: ease of user compliance

Table 9 summarizes the outcomes of this evaluation for each of the criteria used to measure how well the demonstration ensured ease of user compliance. The pay-at-the-pump demonstration phase experienced the most challenges in achieving this objective, largely because of user

discretion allowing mileage-recording devices to be disconnected and users choosing other methods to pay for fuel than the GasBuddy payment card. The pay-at-the-charge point portion of Phase 1 had fewer problems, but the evaluation considered both portions of Phase 1 together. The usage-based insurance demonstration phase had more positive outcomes, with all criteria signifying achievement of the objective. The “n/a” entries show criteria that were not applicable to those demonstration phases.

Table 9: Evaluation Outcomes – Ease of User Compliance

Objective	Criterion	Outcomes by Phase			
		1A PATP 1B Charge Point	2 UBI	3 Ride-sharing	4 AV
5.5 Ensure ease of user compliance	Effectiveness of methods for encouraging voluntary compliance			n/a	n/a
	Resistance of methods to tampering and fraud			n/a	n/a
	Users’ ease of recording and reporting mileage			n/a	n/a
	Quality/accuracy of road use data reported				

Notes:
 = fully achieved
 = partially achieved

Partially achieved ratings for these criteria were noted because of difficulties in Phase 1A: Pay-at-the-Pump. Users could choose to pay for fuel without the GasBuddy card, leading to missing information regarding fuel consumed, and some users disconnected their OBD devices, leading to missing data for miles traveled. This led to inaccuracies in road use data reported for the demonstration and recognition that such a business model could allow tampering or fraud in a future road charge program. Both Phase 1 and Phase 2 rated well on users’ ease of recording and reporting mileage, based on participant surveys. Regarding quality/accuracy of data reported, Phases 2, 3, and 4 did not experience difficulty with road use data and rated fully achieved.

5.6 Ensure User Privacy Protection

This objective assesses user privacy protection during the demonstration measured by the following criteria:

- User perception of privacy protections

- Protection of privacy (including PII), including implementation and operation of industry standard procedures

Each participant in the demonstration was provided a participant agreement and privacy policy during enrollment. The privacy policy described privacy concepts in the demonstration, including:

- Personally identifiable information (PII) would not be shared with Caltrans or State employees.
- Details about the types of information that were collected by the business partner.
- Information needed to complete participation surveys.
- A pledge that third parties who need participant information for the demonstration would also abide by this privacy policy.
- Information about how to inspect their information collected for the demonstration.
- A commitment that PII would be destroyed within 30 days of the end of the demonstration.

5.6.1 User perception of privacy protections

Concerns about privacy have been among the most significant challenges for road charge demonstration projects. The concept of using GPS technology to record mileage driven leads to suspicion about whether public agencies could track drivers’ whereabouts. This and other demonstration projects have attempted to reduce privacy concerns when GPS technology is used by having third-party account managers collect location data, with pledges that the State would not have access to the location data collected by those parties – only to chargeable miles driven. In addition, this demonstration tested the ability to measure mileage through odometer reading submissions in the usage-based insurance phase, which required no location data whatsoever.

Table 10 provides data on participants’ confidence in the demonstration’s privacy protections and on their reception of information regarding the demonstration’s privacy protections. Overall, their ratings were positive, with scores higher than a neutral four. The usage-based insurance demonstration scored best in user privacy perceptions, probably because it was evident that submitting photos of their odometers did not entail concerns about location data. The ride-sharing demonstration phase also scored well in this regard. Users with GPS devices in the pay-at-the-pump and charge point demonstration rated these protections lower, but still on the positive end of the scale, with a 5.33 rating (where 7 signifies they were very confident in the protections) in the post-participation survey.

Many participants did not review information provided about data and privacy protection, but those who did rated the information positively, with scores close to or at 7, signifying they were very satisfied.

5.6.2 Survey data: user privacy protection

Table 10: Survey Data – User Privacy Protection

Phase	Pre-Survey	Mid-Survey	Post-Survey
Question: How confident are you in the privacy protections provided during the demonstration? (1 = not confident at all, 7 = very confident)			

Phase	Pre-Survey	Mid-Survey	Post-Survey
1A Pay-at-the-Pump & 1B Pay-at-the-Charge Point	5.41	5.58	5.33
2 Usage-Based Insurance	5.72	6.14	6.19
3 Ride-sharing	6.00	5.00	6.00
Question: Have you received or seen any information about how your data and privacy will be protected during your participation in the demonstration? (% responding “yes”)			
1A Pay-at-the-Pump & 1B Pay-at-the-Charge Point	48%	50%	n/a
2 Usage-Based Insurance	60%	52%	n/a
3 Ride-sharing	33%	67%	n/a
Question: How would you rate your satisfaction with this communication regarding your data and privacy? (only those responding “yes” above; 1 = very unsatisfied, 7 = very satisfied)			
1A Pay-at-the-Pump & 1B Pay-at-the-Charge Point	5.92	6.31	n/a
2 Usage-Based Insurance	6.40	6.42	n/a
3 Ride-sharing	7.00	7.00	n/a

5.6.3 Protection of privacy (including PII), including implementation and operation of industry standard procedures

To evaluate whether the demonstration satisfied this objective, according to the criteria, the evaluation team reviewed compliance of the business partner and demonstration technology systems with requirements based on standards identical or similar to ISO 27001 or PCI DSS 3.2.1. The next section describes the results of compliance testing and a security audit, as those efforts were more related to data security, although they did provide some benefits regarding privacy protection.

Per the Business Requirements Document for the Four-Phase Road Charge Demonstration, all business partners were required to “comply with all applicable State of California laws and regulations regarding data protection and retention including but not limited to the CCPA [California Consumer Privacy Act].”⁹ Additionally, this document included a reporting requirement that each business partner must purge any and all demonstration data and reports containing personally identifiable information (PII) no later than one calendar month following completion of the final month of the demonstration operations period. Each business partner has attested to the System Administrator that they deleted PII in accordance with this contract provision.

⁹ Refer to the full California Consumer Privacy Act (CCPA) text here: <https://oag.ca.gov/privacy/ccpa>.

5.6.4 Public perception of road charge privacy protections

Separate from the four-phase demonstration activities themselves, EMC research conducted two public polls and two waves of focus groups comprised of California residents and drivers. The public polls focused on the messaging surrounding the road charge program and the technical feasibility of the State to implement such a program. A third poll is scheduled to be conducted in early 2022. The two waves of focus groups were comprised of drivers defined by geographical regions, ethnic backgrounds, and various types of drivers.

The public polls indicate Californians are generally very concerned about the privacy of data that would need to be collected for a road charge program. In total, poll results indicate that 74 percent of respondents are either very concerned or concerned with the State collecting personal data to administer a road charge. Additional questions related to the collection of location information, data accuracy, and people finding ways to steal data indicate the majority of the population remains very concerned about data collection and overall privacy of their information.

Similar results emerged from the focus groups, which indicate the majority of participants had significant concerns about data recording and reporting accuracy, data privacy and tracking issues, and people finding ways to steal personal information. Participants raised additional concerns about onboard devices being able to track vehicle locations in order to collect mileage information. In general, focus group participants were most familiar with the mileage-based insurance and odometer reading concepts and prefer those mechanism over an onboard device. Similar to the demonstration’s survey results, which indicate that participants using the usage-based insurance method of uploading a picture of their odometer were significantly less concerned with data privacy when compared to the use of other devices and collection methods. Overall, the notion of being “tracked” by the government in order to be taxed or charged raises significant concern across the State’s population.

While this assessment shows significant efforts are needed to improve the public’s perception of privacy protections, this demonstration was not designed to specifically change public opinion. It included methods to understand public opinion to aid in future road charge efforts. Accordingly, the evaluation team considers this criterion to show full achievement of the objective.

5.6.5 Evaluation outcomes: user privacy protection

The level or degree of achievement for this objective, according to the evaluation criteria, is shown in Table 11. The “n/a” entries show criteria that were not applicable to the automated vehicle demonstration phase.

Table 11: Evaluation Outcomes – User Privacy Protection

Objective	Criterion	Outcomes by Phase			
		1A PATP 1B Charge Point	2 UBI	3 Ride-sharing	4 AV
	User perception of privacy protections				n/a

Objective	Criterion	Outcomes by Phase			
		1A PATP 1B Charge Point	2 UBI	3 Ride-sharing	4 AV
5.6 Ensure user privacy protection	Protection of privacy (including PII), including implementation and operation of industry standard procedures	●	●	●	n/a
	Public perception of road charge privacy protections	● (not specific to demonstration phases)			
Notes:					
● = fully achieved					
◐ = partially achieved					

The partially achieved ratings for user perception of privacy protections are due to participant concerns expressed in surveys regarding the privacy of their location data. However, no privacy policy violations or breaches occurred during the demonstration, and industry standard procedures were adopted and followed, resulting in fully achieved ratings for protection of privacy. Public perception of privacy does face some challenges, but the demonstration was not intended to influence public opinion, and in gaining a greater understanding of public concerns, the demonstration achieved the objective.

5.7 Ensure Data Security

This objective addresses the security of the data collected from participants and transmitted, stored, analyzed, or otherwise used in the demonstration, using the following criteria:

- Ability of system to withstand breaches or attacks
- Business partner compliance with data security requirements and operation of industry standard procedures

5.7.1 Ability of system to withstand breaches or attacks

To measure the ability of demonstration systems to withstand breaches or attacks, the evaluation team explored whether any data security breaches occurred. The team interviewed business partners, reviewed events reports, and interviewed the System Administrator. No breaches or concerns with data security were reported.

5.7.2 Business partner compliance with data security requirements and operation of industry standard procedures

The measures of success for this criterion are the business partners’ compliance with:

- Relevant requirements as listed in the business, system, and interface requirements documents defined for the demonstration.
- Requirements based on standards identical or similar to ISO 27001 or PCI DSS 3.2.1.

To confirm business partner compliance with the demonstration requirements the System Administrator oversaw initial compliance testing for each demonstration’s business, system, and interface requirements. The results of these compliance tests are categorized as Unit Testing, Integration Testing, and Acceptance Testing defined as follows.

- **Unit testing:** verifies component-level functionality and compliance with requirements.
- **Integration testing:** verifies interface connectivity and compliance with requirements and interface controls.
- **Acceptance testing:** verifies end-to-end functionality of demonstration systems and processes.

Each business partner conducted unit, integration, and acceptance testing on the components and systems related to their phase in the Four-Phase Road Charge Demonstration.¹⁰ All results from each business partner’s unit, integration, and acceptance tests were documented in the Requirements Traceability Matrix (RTM), in which the business partners described their testing process and included evidence to support their assessment of compliance with each line item. The System Administrator reviewed and validated the RTM to verify every business partner’s compliance with each demonstration requirement. Note that some line items have been waived for a given business partner if the line item did not apply to the business partner’s service offering/technology or to the business partner’s interfaces or integration of subsystems and components.

Once each demonstration went live, the System Administrator oversaw a Data Security Audit on each business partner’s demonstration systems, to ensure “that Personally Identifiable Information (PII) is protected, data is encrypted and secure both in transit and at rest, and that the integrity of data is being upheld through the entire process.”¹¹ The report resulting from the audit assessed the component subsystems of the Four-Phase Road Charge Demonstration for data security and described the processes, findings, and recommendations related to each technology subsystem.

5.7.2.1 Unit Testing

For each portion of the Four-Phase Road Charge Demonstration, various simulated environments were created by each business partner to conduct specific test cases aimed at verifying compliance with the demonstration requirements. As shown in Table 12 all participating business partners’ unit testing was deemed compliant and verified by the System Administrator.

For additional details on unit testing and each business partner’s certification of compliance see Section 5.7 in the evaluation reports for Phases 1-3 and Section 5.6 of the Phase 4 evaluation report.

¹⁰ For the full report, refer to the Technical Memorandum of Vendor Unit Test Activities (WSP).

¹¹ From the California Road Charge Demonstration Data Security Audit Report (WSP).

Table 12: Unit Testing Compliance Status

Phase	Partner	Total	Compliant	Non-Compliant	N/A - Waived	Remaining
1A	GasBuddy	209	134	0	75	0
1B	ChargePoint	209	121	0	88	0
2	Mile Auto	209	184	0	25	0
3 & 4	Via	209	204	0	5	0
4	EasyMile	209	14	0	195	0

5.7.2.2 Integration Testing

For each of the four phases, all participating business partners conducted integration testing activities to verify interface connectivity and compliance with the requirements of the demonstration.¹² As summarized in Table 13, all participating business partners integration components were deemed compliant, and verified by the System Administrator as “certified.”

Table 13: Interface Testing Compliance Status

Phase	Partner	Total	Compliant	Non-Compliant	N/A - Waived	Remaining
1A	GasBuddy	209	19	0	190	0
1B	ChargePoint	209	19	0	190	0
2	Mile Auto	209	38	0	171	0
3 & 4	Via	209	38	0	171	0
4	EasyMile	209	14	0	195	0

5.7.2.3 Acceptance Testing

All five businesses partners conducted acceptance testing activities to verify the end-to-end functionality of demonstration systems and processes for each portion of the demonstration.¹³

¹² From the California Road Charge Demonstration Data Security Audit Report (WSP).

¹³ For the full report, refer to the Technical Memorandum of Vendor Acceptance Test Activities (WSP).

Table 14: Acceptance Testing Compliance Status

Phase	Partner	Total	Compliant	Non-Compliant	N/A - Waived	Remaining
1A	GasBuddy	209	134	0	75	0
1B	ChargePoint	209	121	0	88	0
2	Mile Auto	209	184	0	25	0
3 & 4	Via	209	204	0	5	0
4	EasyMile	209	76	0	133	0

5.7.2.4 Data Security Audit Report

WSP conducted a desktop-based data security audit on all of the Four-Phase Road Charge Demonstration subsystems, using an independent unit from the company to assess security measures and make recommendations. The audit focused on ensuring that Personally Identifiable Information was protected, encrypted, and integrity confirmed through the entire process of operating the demonstration. The audit approach was informed by project reference documents, including the Concept of Operations, System Requirements Specifications, High-Level Functional Architecture, System Architecture Diagrams, and the Business Requirements Document.

The audit reviewed all systems listed below and rated them as Moderate impact according to the starting impact rating of Energy, Installations and Environment (EI&E) Risk Management Framework (RMF) Facility Related Control System Master List,¹⁴ and Federal Information Processing Standard (FIPS) 199, Standards for Security Categorization of Federal Information and Information Systems.¹⁵

- Platform Network
- Data Collection (DC) Subsystem
- Transaction Processing (TP) Subsystem
- Account Management (AM) Subsystem
- Administration (AD) Subsystem
- Data Clearing House (CH) Subsystem, or PRIME

The audit cited a wide range of industry best practices and measures to reduce risks. However, as the Four-Phase Road Charge Demonstration was a small operation with a limited set of participants, the information in the audit has been recommended as a guide for a future, fully operational program, rather than a set of changes that were to be currently implemented.

5.7.2.5 Business Partner Data Audit

WSP commissioned a data audit to review the different datasets (transactions, VIN Summary Reports, participant reports, and travel records) to validate consistency and flag any anomalies in

¹⁴ For additional information, refer to the EI&E RMF FRCS Master List webpage: <https://www.serdp-estcp.org/serdp-estcp/Tools-and-Training/Installation-Energy-and-Water/Cybersecurity/Resources-Tools-and-Publications/Resources-and-Tools-Files/EI-E-RMF-FRCS-Master-List-Current>.

¹⁵ For additional information, refer to the NIST FIPS 199 webpage: <https://www.nist.gov/privacy-framework/fips-199>.

data collected, processed, and simulated revenue reported to Caltrans, and to ensure business partners followed required procedures.

At the outset of the audit process, WSP consolidated and organized the multiple datasets available for each business partner. For each participating business partner, WSP analyzed and reconciled summary reports and datasets to determine if they were correctly captured, calculated, and reported.¹⁶ Each phase's respective business partner datasets were assessed to check for any overlaps, gaps, and anomalies. Unique vehicle/account identifiers were randomly selected and checks, and balances were implemented using complementary metrics to cross-validate the overall robustness of the reports.

- **GasBuddy (Phase 1A) and ChargePoint (Phase 1B):** The audit revealed minor data discrepancies that were easily remedied.¹⁷ Overall, the audit concluded that “in aggregate, the overall data collection and reporting by all [business partners] generally follow expected guidelines. However, there are some gaps and anomalies in the datasets which should be duly considered and resolved for future implementations.”
- **Mile Auto (Phase 2):** The audit report for the Phase 2 portion of the demonstration revealed minor discrepancies with the “date range” parameter, which allows the demonstration administration system to pull data only for certain reporting periods, was not filtering dates correctly, and simply providing all travel records instead of filtering on the requested date range. Overall, Mile Auto followed the expected guidelines with only minor reporting issues and inconsistencies that should be considered for future implementations.
- **Via (Phase 3):** The audit for Phase 3 revealed some inconsistencies between the road charge levied and fuel tax credits that were caused by simple rounding variations because the Via trips were so short that transactions consisted of fractions of a gallon of fuel and limited miles., The audit concluded that “the collection, processing and reporting for Via follows expected guidelines with some minor inconsistencies for due consideration for future implementations.”
- **Phase 4 Easy Mile:** The Phase 4: Autonomous Vehicle portion of the demonstration was not in operation at the time of the business partner audit.

To summarize, the audit identified several minor inconsistencies for each participating business partner. In general, each business partner followed the demonstration guidelines with some minor discrepancies and inconsistencies for due consideration for future implementations.

5.7.2.6 ISO/IEC 27001 Compliance

The international standard for information security, ISO/IEC 27001, describes the requirements for “establishing, implementing, monitoring, and continually improving”¹⁸ an organization's information security management system. The purpose of the ISO/IEC 27001 standard is to help organizations improve the security of the information they have access to. Organizations can opt to apply for certification through an accredited certification body, which requires the organization successfully pass an independent audit.

¹⁶ For additional detail, refer to the individual phase evaluation reports.

¹⁷ For the full report, refer to the Pay-at-the-Pump and Pay-at-the Charge Point Evaluation Report.

¹⁸ From ISO/IEC 27001 – 2013: <https://www.iso.org/standard/54534.html>.

For this demonstration, Caltrans and WSP required business partners to document compliance with system requirements based on ISO 27001 standards (even if they were not officially ISO/IEC certified). All five business partners successfully provided documentation to the System Administrator of such compliance.

5.7.2.7 PCI DSS 3.2.1 Compliance

The Payment Card Industry Data Security Standard (PCI DSS) consists of standards for information security relating to cardholder data and reducing credit card fraud. The PCI DSS is required by all major card brands and administered by PCI Security Standards Council. At a high level, the PCI DSS identifies 12 requirements for compliance, which are organized into the following six (6) categories:

- 1.** Build and maintain a secure network and systems
- 2.** Protect cardholder data
- 3.** Maintain a vulnerability management program
- 4.** Implement strong access control measures
- 5.** Regularly monitor and test networks
- 6.** Maintain an information security policy

Each participating business partner provided documentation to the System Administrator that either they or their third-party payment processor is certified as DSS 3.2.2 compliant.

Based on all the measures described above and the data made available to the Evaluation Team, all five business partners and their respective demonstration systems were compliant with data security requirements and operation of industry standard procedures.

5.7.3 Evaluation outcomes: data security

The level or degree of achievement for this objective, according to the evaluation criteria, is shown in Table 15.

Table 15: Evaluation Outcomes - Data Security

Objective	Criterion	Outcomes by Phase			
		1A PATP 1B Charge Point	2 UBI	3 Ride-sharing	4 AV
5.7 Ensure data security	Ability of system to withstand breaches or attacks	●	●	●	●
	Business partner compliance with data security requirements and operation of industry standard procedures	●	●	●	●
Notes: ● = fully achieved ◐ = partially achieved					

Because participant data was kept secure during the demonstration and industry standard procedures were adopted and used by all parties involved, each phase fully achieved the objective of ensuring data security.

5.8 Include Reliable and Secure Technology

This objective seeks to assess the reliability and security of the technologies used during the demonstration by the following criteria:

- Reliability of road charge systems
- Availability of road charge systems
- Security of road charge systems

5.8.1 Reliability of road charge systems

The measures used to assess this criterion include:

- Number of instances of technical support
- Average time to resolve technical issues
- Description of technical support instances

The System Administrator provided Tier 1 customer service. Tier 2 signifies a handoff of a service request to the business partner in the event that Tier 1 activities could not resolve the issue. The customer service report provided by the System Administrator does not differentiate between inquiries for each phase of the demonstration, except when exceptions are noted. The number of

customer service inquiries for all demonstration phases and their resolution status are provided in Table 16.

Table 16: Customer Service Inquiries

Item	Jan	Feb	Mar	Apr	May	Jun	TOTAL
# of total Tier 1 customer inquiries	12	12	14	7	7	10	62
# of inquiries escalated (to business partner or Caltrans)	2	0	1	1	0	2	6
# of inquiries resolved within 3 business days	12	12	13	7	7	10	62
# of inquiries NOT resolved within 3 business days	0	0	0	0	0	0	0

Regarding to the average time to resolve technical issues, all participant customer service tickets opened from January through June 2021 were reported as resolved and closed within 3 business days, which complies with the key performance indicators (KPIs) set by Caltrans.

For all phases with participants, survey results indicated there were more concerns about technical support issues:

- **Phase 1A Pay-at-the-Pump and Phase 1B Pay-at-the-Charge Point:** Survey results indicate that 31 percent of participants said they needed to contact customer support. The majority of issues for this portion of the demonstration were mainly about confusion with the overall GasBuddy process, issues with logging in, or not receiving invoices.
- **Phase 2 Usage-Based Insurance:** Survey results indicate that 35 percent of participants said they needed to contact customer support. The majority of issues for this portion of the demonstration were mainly about account set up during the enrollment process and some questions related to the Mile Auto web portal.
- **Phase 3 Ride-sharing:** For the Phase 3 portion of the demonstration, all respondents reported they were aware of how to contact customer support for any questions they might have. Throughout the demonstration only one participant indicated they had a question, and it was resolved within three business days.
- **Phase 4 Automated Vehicles:** There were no participants for the Phase 4 portion of the demonstration.

To summarize, the customer support team successfully resolve participants’ issues within the expected timeframe. No additional issues were reported by survey respondents.

5.8.2 Availability of road charge systems

This criterion is measured by the percentage up-time for each phase’s demonstration subsystems and user account management features. The System Administrator reported up-time percentages on a monthly basis for all demonstration phases. Table 17 is an excerpt from the System Administrator’s final monthly progress report, which includes the uptime across all phases during the demonstration.

Table 17: System Uptime

KPI / Metric	JAN	FEB	MAR	APR	MAY	JUN	AVERAGE
(%) of System uptime:	99.96%	99.96%	100%	100%	100%	100%	99.98%
(%) of System uptime less than 99.9%:	0.04%	0.057%	0.0%	0.0%	0.0%	0.0%	0.02%
Justification if not in compliance with KPI	<p>JAN: 0.04% downtime for GasBuddy HTTP404 error for new enrollments 1/29/21</p> <p>FEB: 0.057% downtime for caroadcharge.com website crash on 2/1/21, Nextiva service outage 2/24/21</p> <p>MAR: N/A – no downtime</p> <p>APR: N/A – no downtime</p> <p>MAY: N/A – no downtime</p> <p>JUN: N/A – no downtime</p>						

Based on the metrics above, all four phases met the criterion for availability of Road Charge systems during the demonstration.

5.8.3 Security of road charge systems

The measures used to assess this criterion include:

- Number of instances of participant data being compromised, if any
- Description of data compromising events, if any
- Percentage of participants satisfied with data security

The information on data compromising events, if any, was to be provided through ad-hoc communications, events reports, and business partner interviews. As of the completion of the demonstration, no data compromising events were reported.

5.8.4 Survey data: reliable and secure technology

Across all three surveys, respondents were asked about their level of satisfaction with the security of the data being collected. Table 18 represents the survey results related to the participants perceived level of data security for all phases of the demonstration.

Table 18: Survey Data – Participant Satisfaction with Data Security

Phase	Pre-Survey	Mid-Survey	Post-Survey
Question: Please rate how satisfied you were regarding your experience with... the security of the data being collected. (1 = very unsatisfied, 7 = very satisfied)			
1A Pay-at-the-Pump & 1B Pay-at-the-Charge Point	5.48	5.62	5.54

Phase	Pre-Survey	Mid-Survey	Post-Survey
2 Usage-Based Insurance	6.22	6.48	6.31
3 Ride-sharing	6.00	5.00	5.50
Question: How confident are you in the data security of the demonstration? (1 = not confident at all, 7 = very confident)			
1A Pay-at-the-Pump & 1B Pay-at-the-Charge Point	5.52	5.38	5.33
2 Usage-Based Insurance	5.88	6.00	6.19
3 Ride-sharing	6.00	6.00	6.00

In participant surveys, perceived satisfaction with the security of the data being collected was generally positive over the course of the demonstration. When it came to data security, the respondents from the Usage-Based insurance portion of the demonstration had the greatest level of satisfaction, while the other respondents from the remaining phases were also positive.

5.8.5 Evaluation outcomes: reliable and secure technology

The level or degree of achievement for this objective, according to the evaluation criteria, is shown in Table 19. The “n/a” entries show criteria that were not applicable to the automated vehicle demonstration phase.

Table 19: Evaluation Outcomes – Reliable and Secure Technology

Objective	Criterion	Outcomes by Phase			
		1A PATP 1B Charge Point	2 UBI	3 Ride-sharing	4 AV
5.8 Include reliable and secure technology	Reliability of road charge systems				
	Availability of road charge systems				
	Security of road charge systems				n/a
Notes:					
● = fully achieved					
◐ = partially achieved					

Phase 1 received a partially achieved rating for reliability because some participants had difficulty using the GasBuddy payment card. In fact, surveys showed that one-third of pay-at-the-pump participants had issues with the GasBuddy payment card. Several participants in Phase 2 stated they had customer service issues that were not resolved, resulting in a partially achieved rating for

that criterion. The overall availability and security of road charge systems was rated fully achieved for all phases, as the systems were available nearly 100% of the time and no security breaches were noted.

5.9 Conduct Outreach to Increase Public Awareness of Need for Alternative Funding Sources

This communications objective describes the number of opportunities for the general public to provide feedback, the number of individuals who have provided feedback, and information about their feedback. Achievement of this objective is measured by the following criteria:

- Opportunities for general public feedback
 - Public messaging on the need for a road charge
-

5.9.1 Opportunities for general public feedback

Over the course of the demonstration, the general public could participate, provide feedback, and engage with the program through several methods including:

- California Road Charge website, www.caroadcharge.com
- Three public opinion polls (one yet to be implemented) with California adults across the state
- Twelve focus groups with California adults across the state

The California Road Charge website provides key information about the Four-Phase Demonstration and provides various ways for the public to engage and participate in the project. When accessing the website, the engagement tab provides multiple links to sign up for the project's newsletter, read recent project news, take a survey, and a "contact us" portal that enables the public to ask questions or input ideas and comments about road charge policy.

The first two public polls contained information regarding basic attitudes about road charge, the issue environment, and demographics. The third and final poll is slated to take place early in 2022 and will use the same methodology to ensure comparability over time. The first public poll was conducted in July 2020, which included 603 respondents and focused on the messaging and context of the demonstration. The second poll was conducted in April 2021 with 615 respondents and focused on the technical feasibility of a road charge.

The focus groups were conducted in two waves, and each consisted of about eight respondents. The first wave of focus groups was conducted online in February 2021, and the second was conducted two months later in April 2021. First wave participants were defined geographically and recruited based on their place of residence, with separate groups for the Bay Area, Central Valley, Northern California, Los Angeles, and Orange County/San Diego. The second wave was also conducted online in April 2021 and targeted specific driver populations across the state, with separate groups for super commuters, electric vehicle drivers, ride-sharing drivers, Spanish-speaking drivers, Mandarin-speaking drivers, Central Valley rural drivers, and Northern California rural drivers.

5.9.2 Public messaging on the need for road charge

The Four-Phase Demonstration utilized three main channels devoted to public messaging, including a series of short online videos, four newsletters, and a user-friendly website. Each channel includes a wide range of descriptive information on transportation funding mechanisms, project history, national road charge news, and how fuel taxes compare to a “user pays” system, and other pertinent road charge information.

To assist the public in learning more about road charge, a series of three educational videos were created and made available to the public on the California Road Charge website in both English and Spanish.¹⁹ There are educational video links from demonstrations in other states also readily viewable. Each California educational video is approximately 90 seconds long and uses voice over animation to help illustrate and answer three main questions:

- How is transportation funded now?
- Why is California studying road charge?
- What is road charge?

The number of views for each video is unclear, however, progress reports indicate there were 18,433 website hits in total, in which 12,326 came before the launch of the demonstration. The demonstration team developed and distributed four newsletters including a Fall 2020, Spring 2021, Summer 2021, and Fall 2021. The general public was able to sign up to receive newsletters via the California Road Charge website. Each newsletter provided key project information and consisted of multiple sections to inform the reader of upcoming public meetings and encourage participation, comments, and a portal for the public to ask any road charge related questions.

The California Road Charge website uses a user-friendly platform that is simple and easy to navigate. The educational content on the website presents and answers many frequently asked questions, with several sections dedicated to road charge history, project news, and other road charge policy information. In addition, the website contains an entire section devoted to public engagement, commonly asked questions, a comment portal, and a simulated road charge calculation tool that allows individuals to calculate their vehicles road charge in comparison to fuel taxes.

5.9.3 Evaluation outcomes: outreach to increase public awareness

The level or degree of achievement for this objective, according to the evaluation criteria, is shown in Table 20.

Table 20: Evaluation Outcomes – Outreach to Increase Public Awareness

Objective	Criterion	Outcomes (not specific to phases)
5.9 Conduct outreach to increase public	Opportunities for general public feedback	●

¹⁹ California Road Charge <https://caroadcharge.com/about>

Objective	Criterion	Outcomes (not specific to phases)
awareness of need for alternative funding sources	Public messaging on the need for road charge	

Because public outreach was not specific to any of the demonstration phases, achievement is rated overall for the entire four-phase demonstration. The objective was fully achieved, as ample opportunities were provided for public feedback, and important messaging on the need for road charge was provided through videos, the website, and other means.

5.10 Address Potential Implementation and Public Acceptance Hurdles to Adoption

This communications objective describes potential hurdles to implementation and public acceptance of a large-scale California Road Charge program. Achievement of this objective is measured by the following criteria:

- User acceptance of methods available
- Opportunities for participant feedback
- Participant satisfaction with interactions and feedback opportunities

5.10.1 User acceptance of methods available

Issues of user acceptance were discussed above in Section 5.1, reviewing participant satisfaction with the overall experience, the process of reporting mileage, and their mileage reporting method. Additional insight on user acceptance was provided in Section 5.5, reviewing survey findings on how easy it was to report mileage.

Participants were positive about their satisfaction with the overall experience and their mileage reporting method in the demonstration, and their satisfaction ratings increased as they developed more experience with the technologies. At the end of the demonstration, Phase 1 participants rated their satisfaction at 5.67, Phase 2 at 6.38, and Phase 3 at 6.50, where a 7 signified “very satisfied.” Phase 1A had the most challenges, including inconsistent use of the GasBuddy payment card and some users disconnecting their OBD devices, yet the overall satisfaction rating is in the positive range. Phases 2 and 3 clearly generated higher satisfaction. In addition, as the demonstration progressed to the end, participants became less concerned about the potential for cheating with that technology and they reported greater ease of reporting mileage.

5.10.2 Opportunities for participant feedback

This measure describes how many opportunities were provided to participants to offer feedback on the demonstration and what proportion of participants utilized those methods.

For participants in each portion of the demonstration, opportunities for participant feedback included three participant surveys, a toll-free customer service number, and a “contact us” form on the participant portal website.

Since participants were eligible for incentives if they completed the demonstration surveys, the participation rate for Phases 1 and 3 were expected to be higher (see Table 21). The lower-than-expected participation rate may be a result of participants not receiving or ignoring email notifications, not logging into the application or web portal for more detailed instructions, or the \$15 offered to complete the survey was not enough incentive.

Throughout the demonstration, participants seldomly used the toll-free customer service number, with the majority of months reporting less than five calls per month. Monthly progress reports indicate March was the most active month with seven calls. The higher activity in March was likely the result of participant inquiries related to the enrollment process.

For the duration of the demonstration, a “contact us” form was available on the participant web portal. In total, 125 inquiries were made over the demonstration period. Reports indicate the project team responded within one day for 100 percent of all inquiries.

5.10.3 Participant satisfaction with interactions and feedback opportunities

As described earlier, each participant was invited to take three surveys including a pre-participation, mid-participation, and post-participation survey. Upon successful completion of the surveys, each participant received a \$15 incentive payment. Since participants received incentives if they completed the demonstration surveys, the participation rate was expected to be higher than results show. See Table 21 for participation rates and responses to questions about satisfaction with feedback opportunities and user acceptance of methods available.

5.10.4 Survey data: potential hurdles

Table 21: Survey Data – Potential Hurdles

Phase	Pre-Survey	Mid-Survey	Post-Survey
Survey completion rates			
1A Pay-at-the-Pump & 1B Pay-at-the-Charge Point	64%	62%	57%
2 Usage-Based Insurance	86%	79%	90%
3 Ride-sharing	50%	33%	42%
Question: Please rate how satisfied you were regarding your experience with... the number and quality of opportunities you had for feedback on your participation in the demonstration. (1 = very unsatisfied, 7 = very satisfied)			
1A Pay-at-the-Pump & 1B Pay-at-the-Charge Point	5.67	5.12	5.54
2 Usage-Based Insurance	6.32	6.35	6.31
3 Ride-sharing	6.0	5.00	6.50

Overall, the survey results indicate that participants were generally satisfied with the number and quality of their opportunities for feedback. However, due to each phase’s small survey sample size, the reported average level of satisfaction could be heavily influenced by a few disappointed participants.

5.10.5 Understanding of potential risks and roadblocks to implementation of a road charge in California

In addition to the three participation surveys, EMC research conducted two public polls and two waves of focus groups comprised of California residents and drivers. The public polls focused on the messaging surrounding the road charge program and the technical feasibility of the State to implement such a program. Based on their place of residence, the two waves of focus groups were comprised of drivers defined by geographical regions, ethnic backgrounds, and various types of drivers.

In general, the public polling results indicate that the vast majority of Californians have strong negative opinions about a future mandatory program, with just one in five Californians responding positively to the concept of a road charge. Both polls reveal similar results, indicating several concerns among residents including the potential increase in costs/taxes, privacy, equity, accuracy, and several other significant potential barriers.

Overall, the majority of Californians understand that the state needs more funding for road maintenance but have limited understanding of where that revenue currently comes from. As a result, drivers know they pay fuel taxes, but the actual cost of the tax versus the cost of fuel is unclear, adding a level of uncertainty and fear when the notion of imposing additional charges on California drivers is raised.

During the focus groups, similar to the poll results, awareness of road maintenance funding and the gas tax was limited among participants. In general, participants agreed that those who drive more should pay more towards road maintenance, but that the current gas tax model makes more sense. However, some participants noted that implementing a road charge would present numerous equity issues, especially for drivers with lower incomes and those who live in rural areas or may have longer than average commutes. Additional fears and a general distrust for government led participants to assume they, along with nearly every other driver, would pay more under a road charge.

Several participants felt that the cost burden of road maintenance should be shared across all classes and types of drivers, however, many respondents noted that implementing a road charge on those who drive electric vehicles feels punitive and could actually hinder the state’s future electric vehicle adoption goals.

Over the course of the demonstration’s business partner interviews, several common themes emerged from all partners, expressing that the success of a future mandatory program is centered on the political acceptance and the administrative feasibility of the state. In total, each business partner expressed confidence by explaining that they have the resources and the capacity to scale their technologies to meet the demands of a statewide program but have concerns about the complex political dynamics of imposing a road charge on California drivers.

5.10.6 Evaluation outcomes: potential hurdles

The level or degree of achievement for this objective, according to the evaluation criteria, is shown in Table 22. The “n/a” entries show criteria that were not applicable to the automated vehicle demonstration phase.

Table 22: Evaluation Outcomes – Potential Hurdles

Objective	Criterion	Outcomes by Phase			
		1A PATP 1B Charge Point	2 UBI	3 Ride-sharing	4 AV
5.10 Address potential implementation and public acceptance hurdles to adoption	User acceptance of methods available				n/a
	Opportunities for participant feedback				n/a
	Participant satisfaction with interactions and feedback opportunities				n/a
	Understanding of potential risks and roadblocks to implementation of a road charge in California	 (not specific to demonstration phases)			
Notes:					
 = fully achieved  = partially achieved					

Phase 1 participants rated their acceptance of the methods used lower than the participants in other phases. Much of this was related to frustration with the GasBuddy payment card, leading to a partially achieved rating for that phase. Phase 1 participants also rated their satisfaction with interactions and feedback opportunities lower than the other phases, with a decline in satisfaction over time. Participants in other phases were more satisfied, providing a fully achieved rating. The opportunities for participant feedback were ample, with that criterion rated fully achieved. The public polling and focus groups provided greater understanding of the potential risks and roadblocks facing a road charge program, and that criterion earned a fully achieved rating.

5.11 Identify Equity Concerns

This objective seeks to evaluate demonstration participants’ perceptions of the fairness of a road charge as well as current public perspectives on road charge fairness. Achievement of the objective is measured by the following criteria:

- User and public perception of road charge fairness, relative to fuel taxes
- User and public perception of fairness for drivers of EVs and fuel-efficient vehicles
- User and public perception of fairness for drivers of varying distance (e.g., urban, suburban commuter, rural)

Participant surveys gauged their opinions about these and other aspects of the fairness of road charge. Highlights from the surveys are included in each criteria section below, with details in the survey data table in Section 5.11.4. A summary of public opinion about these fairness questions is also included in each section below.

Because the objective was to identify equity concerns, rather than to solve them, this demonstration should be considered successful in developing a more complete understanding of these concerns and why they exist.

5.11.1 User and public perception of road charge fairness, relative to fuel taxes

Participants in the first two demonstration phases generally thought a road charge was more fair than fuel taxes, but those in the ride-sharing demonstration were quite negative about fairness. However, the ride-sharing participant surveys were only completed by 3-4 people, making any inference about the results impossible. Overall, participant opinions about fairness did not show significant change through the pre, mid, and post-participation surveys.

Over the course of the demonstration, two public polls were conducted to gain insight on Californians' general perception of road charge relative to the current fuel tax. In contrast to the participants' views on road charge fairness, the public's perception of a road charge relative to fuel taxes is significantly more negative. When asked about the perceived fairness of replacing the state gas tax with a road charge, the majority (55%) of respondents feel that paying based on the miles you drive is less fair than paying based on the amount of gas you buy. Overall, the impression of a road charge replacing the gas tax is not well received, with 66 percent of participants reporting a negative response.

Focus group results reveal mixed feelings related to the perceived fairness of replacing the gas tax with a per mile fee. Open-ended comments from the focus group participants show a wide range of perceived issues including administrative feasibility, accuracy, fairness, general mistrust of the government, privacy and tracking issues, and major concerns related to additional taxes. Other concerns reported by respondent's stem from a common assumption that every individual driver will pay more under a road charge versus the current fuel tax.

The majority of respondents felt that a road charge would be a way for the government to get more out of every resident and shift more burden to individual drivers and away from corporations, as opposed to a way to rebalance the existing burden. While most respondents generally were aware that taxes fund road maintenance in California, many respondents were unaware about how the funding works or the adequacy of current funding levels. Overall, the majority of focus group respondents generally agreed that the cost burden of road maintenance should be shared as equally as possible.

5.11.2 User and public perception of fairness for drivers of EVs and fuel-efficient vehicles

Participants felt more positive about the fairness of a road charge for electric vehicles and hybrids than they did regarding gasoline and diesel-powered vehicles. This appears to show some understanding of the concept that these vehicles contribute less (or no) tax revenue per mile driven. This stands in contrast to public opinion from focus groups and polls, provided below, showing a perception that a road charge on electric vehicles and hybrids would be less fair. Overall, participants' opinions about fairness did not show significant change through the pre, mid, and post-participation surveys.

Focus group results reveal mixed opinions centered around the notion that electric vehicle drivers should not be punished for their choice to drive fuel efficient vehicles. For many respondents, the idea of creating a new system to impose a fee specifically on electric vehicle drivers felt misplaced. The perception was that electric vehicle drivers purchased their vehicles to save on fuel costs and to do something positive for the environment and that a road charge would slow or even reverse the rate of California's electric vehicle adoption.

During the two types of focus groups (regional sessions and groups with specific types of drivers), several respondents raised concern related to the fairness among different classes of low-efficiency vehicles such as pick-up trucks and SUVs, noting that a road charge would be essentially an incentive to keep low-efficiency vehicles (which would pay less than they do in fuel taxes), which could undermine California's clean air goals and efforts to phase gasoline powered vehicles out of the state's fleet.

In contrast, respondents in a focus group specifically with electric vehicle drivers acknowledged that drivers of electric vehicles and fuel-efficient vehicles are not sharing enough of the burden and agree they should have to pay more. One respondent in the electric vehicle focus group suggested that fuel efficiency should be a factor in determining the rate at which the road charge is paid, to ensure all vehicles are contributing to road maintenance while still incentivizing lower levels of carbon emissions.

In the two public polls, respondents were asked multiple questions about their perceived fairness of a mandatory road charge specifically for electric vehicles and hybrid vehicles. For both polls, results indicate that the majority of respondents believe it is less fair to charge electric vehicle and hybrid vehicle owners based on the number of miles they drive versus the amount of fuel purchased. Overall, respondents' perception of a road charge for electric vehicles and hybrid vehicles remained negative throughout both polls, scoring a 3.8 on the same scale of fairness described above.

5.11.3 User and public perception of fairness for drivers of varying distance (e.g., urban, suburban commuter, rural)

One of the clearest takeaways from participant and public opinion in this demonstration is that people perceive a road charge to be less fair for rural drivers or those who drive long distances. The concept that those drivers already pay higher taxes based on fuel consumption does not seem to affect their opinion. Participant surveys show this sentiment across each of the surveys and for each demonstration phase.

Public poll results and focus group responses indicate that respondents are more concerned about fairness for people who drive long distances or live in rural areas compared to people who mostly drive in cities and urban areas.

Overall, respondents’ perception of a road charge related to people who drive long distances to get to work was very negative, scoring a 2.87 on a scale where 1 meant not fair at all and 7 meant very fair. When asked about their perceived fairness of a road charge for those who mostly drive in rural areas, respondents continue to express concern, scoring a mean rating of 3.01 on the same scale of fairness.

However, respondents indicate that they are less concerned about people who drive in cities and urban areas, scoring a mean rating of 3.60 on the same scale. The difference in perceived fairness between urban and rural drivers is likely driven by equity concerns and the lack of public transportation available in rural areas.

5.11.4 Survey data: equity concerns

Participant survey responses described above are presented in this section to allow comparison across each of the equity related questions and demonstration phases.

Table 23: Survey Data – Equity Concerns

Phase	Pre-Survey	Mid-Survey	Post-Survey
Question: Would you say that paying for road and freeway maintenance and repair based on the miles you drive is more fair or less fair than paying based on the amount of gas you buy? (% responding “about as fair” or “more fair”)			
1A Pay-at-the-Pump & 1B Pay-at-the-Charge Point	100%	92%	96%
2 Usage-Based Insurance	96%	95%	92%
3 Ride-sharing	66%	33%	50%
Question: How fair do you think a road charge is for... drivers of vehicles that run only on gasoline or diesel fuel (1 = not fair at all, 7 = very fair)			
1A Pay-at-the-Pump & 1B Pay-at-the-Charge Point	5.19	5.65	5.46
2 Usage-Based Insurance	5.88	5.32	5.46
3 Ride-sharing	3.33	2.67	4.00
Question: How fair do you think a road charge is for... drivers of hybrid gas-electric vehicles (1 = not fair at all, 7 = very fair)			
1A Pay-at-the-Pump & 1B Pay-at-the-Charge Point	5.81	5.85	5.79
2 Usage-Based Insurance	5.92	5.74	6.19
3 Ride-sharing	5.00	1.67	4.00

Phase	Pre-Survey	Mid-Survey	Post-Survey
Question: How fair do you think a road charge is for... drivers of fully electric vehicles (1 = not fair at all, 7 = very fair)			
1A Pay-at-the-Pump & 1B Pay-at-the-Charge Point	6.04	6.15	5.83
2 Usage-Based Insurance	5.60	5.70	5.92
3 Ride-sharing	5.67	3.33	4.00
Question: How fair do you think a road charge is for... people who mostly drive in cities and urban areas (1 = not fair at all, 7 = very fair)			
1A Pay-at-the-Pump & 1B Pay-at-the-Charge Point	5.67	5.88	5.58
2 Usage-Based Insurance	5.80	5.35	5.85
3 Ride-sharing	6.00	3.33	4.00
Question: How fair do you think a road charge is for... people who mostly drive in rural or remote areas (1 = not fair at all, 7 = very fair)			
1A Pay-at-the-Pump & 1B Pay-at-the-Charge Point	4.93	5.23	5.29
2 Usage-Based Insurance	5.56	4.74	5.04
3 Ride-sharing	5.67	3.33	3.25
Question: How fair do you think a road charge is for... people who drive in a mix of types of areas (1 = not fair at all, 7 = very fair)			
1A Pay-at-the-Pump & 1B Pay-at-the-Charge Point	5.74	5.88	5.79
2 Usage-Based Insurance	6.00	5.39	5.81
3 Ride-sharing	6.00	4.00	4.75

5.11.5 Evaluation outcomes: equity concerns

The level or degree of achievement for this objective, according to the evaluation criteria, is shown in Table 24. The “n/a” entries show criteria that were not applicable to the automated vehicle demonstration phase.

Table 24: Evaluation Outcomes – Equity Concerns

Objective	Criterion	Outcomes by Phase			
		1A PATP 1B Charge Point	2 UBI	3 Ride-sharing	4 AV
5.11 Identify equity concerns	User and public perception of road charge fairness, relative to fuel taxes	●	●	●	n/a
	User and public perception of fairness for drivers of EVs and fuel-efficient vehicles	●	●	●	n/a
	User and public perception of fairness for drivers of varying distance (e.g., urban, suburban commuter, rural)	●	●	●	n/a
Notes: ● = fully achieved ◐ = partially achieved					

Because the objective was to identify equity concerns, rather than to solve them, this demonstration should be considered successful in developing a more complete understanding of these concerns and why they exist. Therefore, the objective is rated fully achieved for each of the criteria.

6 CONCLUSIONS

The Road Charge Demonstration provided much experience and information that will be useful in developing future road charge programs. This evaluation report discusses significant findings, data, and experiences organized by the objectives and criteria established in the *Evaluation Strategy Plan*. To summarize the information presented throughout this report, **Error! Reference source not found.** shows whether each objective was achieved, partially achieved, or not achieved for each phase of the demonstration, according to each evaluation criterion.

None of the ratings show inadequate outcomes – all objectives were either achieved or partially achieved. Most of the partially achieved outcomes are the results of errors caused by user discretion in the conduct of the demonstration, such as Phase 1A users not using their GasBuddy payment card consistently or disconnecting their OBD devices. In other instances, it was due to a small number of participants responding to surveys, making it impossible to report the findings with any ability to infer broader conclusions. Reasons for these achievement ratings for each objective are explained below following each summary in Tables 25 through 35.

Overall, the Four-Phase Demonstration successfully satisfied 66 out of 87 objectives (represented by a full circle), according to the criteria, and partially achieved 21 out 87 (represented by a half-circle in Tables 25 through 35.

Table 25: Evaluation Conclusion – Improving Functionality

Objective	Criterion	Outcomes by Phase			
		1A PATP 1B Charge Point	2 UBI	3 Ride-sharing	4 AV
5.1 Improve the functionality of user-based alternative revenue mechanisms	Ability of a road charge to create more sustainable transportation revenue than fuel taxes				n/a
	Feasibility of demonstration methods for levying and collecting road charge				
	Ability of demonstration to simplify the measurement and collection of user mileage compared to prior road charge pilots				

Objective	Criterion	Outcomes by Phase			
		1A PATP 1B Charge Point	2 UBI	3 Ride-sharing	4 AV
	Road charges incurred, by distance traveled, relative to fuel taxes				n/a
Notes:  = fully achieved  = partially achieved					

For this objective, Phase 1 received some partially achieved ratings because some pay-at-the-pump participants were inconsistent in using the provided GasBuddy payment card, which created gaps in data regarding fuel usage, and some users disconnected their OBD devices at times, resulting in incomplete mileage recording. Phase 3 received some partially achieved ratings because data reported on participants’ rides averaged the fuel efficiency of the vehicles in which they traveled, making it unclear how the road charge compared to fuel taxes by vehicle efficiency or on a per-mile basis.

Table 26: Evaluation Conclusion – Recommendations

Objective	Criterion	Outcomes by Phase			
		1A PATP 1B Charge Point	2 UBI	3 Ride-sharing	4 AV
5.2 Provide recommendations regarding user-based revenue mechanisms	Ability of demonstration to generate recommendations				
Notes:  = fully achieved  = partially achieved					

This objective was fully achieved for each phase of the demonstration, because recommendations were provided by the project team in the *2021 California Four-Phase Demonstration Final Report*.

Table 27: Evaluation Conclusion – Administrative Costs

Objective	Criterion	Outcomes by Phase			
		1A PATP 1B Charge Point	2 UBI	3 Ride- sharing	4 AV
5.3 Minimize the administrative cost of any potential user-based revenue mechanisms and associated collection of fees	Estimated agency and business partner costs of administering a road charge based on relevant cost data from the demonstration				
	Estimated cost of revenue collection using these demonstration methods compared to other road charge demonstrations				
Notes:					
● = fully achieved					
◐ = partially achieved					

Each of these phases are rated as partially achieved on these criteria because the size of this demonstration was too small to create a realistic estimate of administrative costs. Most of the partners expressed a desire to participate in a future road charge program, and some said they would do so with a small administrative charge (or none at all) in order to gain exposure for marketing their other services to the large market of motorists California can provide. However, these statements were conjecture, and it was not feasible to estimate administrative costs from the demonstration or to predict costs for future programs.

Table 28: Evaluation Conclusion – Third-Party Partners

Objective	Criterion	Outcomes by Phase			
		1A PATP 1B Charge Point	2 UBI	3 Ride- sharing	4 AV
5.4 Utilize third-party business partners to administer or operate systems	Use of third-party business partners to administer or operate systems				
Notes:					
● = fully achieved					
◐ = partially achieved					

Each of the phases fully achieved this objective, because third-party partners were an integral part of each demonstration phase.

Table 29: Evaluation Conclusion – Ease of User Compliance

Objective	Criterion	Outcomes by Phase			
		1A PATP 1B Charge Point	2 UBI	3 Ride- sharing	4 AV
5.5 Ensure ease of user compliance	Effectiveness of methods for encouraging voluntary compliance			n/a	n/a
	Resistance of methods to tampering and fraud			n/a	n/a
	Users' ease of recording and reporting mileage			n/a	n/a
	Quality/accuracy of road use data reported				
Notes:					
● = fully achieved					
◐ = partially achieved					

Partially achieved ratings for these criteria were noted because of difficulties in Phase 1A: Pay-at-the-Pump. Users could choose to pay for fuel without the GasBuddy card, leading to missing information regarding fuel consumed, and some users disconnected their OBD devices, leading to missing data for miles traveled. This led to inaccuracies in road use data reported for the demonstration and recognition that such a business model could allow tampering or fraud in a future road charge program. Both Phase 1 and Phase 2 rated well on users' ease of recording and reporting mileage, based on participant surveys. Regarding quality/accuracy of data reported, Phases 2, 3, and 4 did not experience difficulty with road use data and rated fully achieved.

Table 30: Evaluation Conclusion – User Privacy Protection

Objective	Criterion	Outcomes by Phase			
		1A PATP 1B Charge Point	2 UBI	3 Ride-sharing	4 AV
5.6 Ensure user privacy protection	User perception of privacy protections				n/a
	Protection of privacy (including PII), including implementation and operation of industry standard procedures				n/a
	Public perception of road charge privacy protections	 (not specific to demonstration phases)			

Notes:
 = fully achieved
 = partially achieved

The partially achieved ratings for user perception of privacy protections are due to participant concerns expressed in surveys regarding the privacy of their location data. However, no privacy policy violations or breaches occurred during the demonstration, and industry standard procedures were adopted and followed, resulting in fully achieved ratings for protection of privacy. Public perception of privacy does face some challenges, but the demonstration was not intended to influence public opinion, and in gaining a greater understanding of public concerns, the demonstration achieved the objective.

Table 31: Evaluation Conclusion - Data Security

Objective	Criterion	Outcomes by Phase			
		1A PATP 1B Charge Point	2 UBI	3 Ride-sharing	4 AV
5.7 Ensure data security	Ability of system to withstand breaches or attacks				
	Business partner compliance with data security requirements and operation of industry standard procedures				

Objective	Criterion	Outcomes by Phase			
		1A PATP 1B Charge Point	2 UBI	3 Ride-sharing	4 AV

Notes:

- = fully achieved
- ◐ = partially achieved

Because participant data was kept secure during the demonstration and industry standard procedures were adopted and used by all parties involved, each phase fully achieved the objective of ensuring data security.

Table 32: Evaluation Conclusion – Reliable and Secure Technology

Objective	Criterion	Outcomes by Phase			
		1A PATP 1B Charge Point	2 UBI	3 Ride-sharing	4 AV
5.8 Include reliable and secure technology	Reliability of road charge systems	◐	◐	●	●
	Availability of road charge systems	●	●	●	●
	Security of road charge systems	●	●	●	n/a

Notes:

- = fully achieved
- ◐ = partially achieved

Phase 1 received a partially achieved rating for reliability because some participants had difficulty using the GasBuddy payment card. In fact, surveys showed that one-third of pay-at-the-pump participants had issues with the GasBuddy payment card. Several participants in Phase 2 stated they had customer service issues that were not resolved, resulting in a partially achieved rating for that criterion. The overall availability and security of road charge systems was rated fully achieved for all phases, as the systems were available nearly 100% of the time and no security breaches were noted.

Table 33: Evaluation Conclusion – Outreach to Increase Public Awareness

Objective	Criterion	Outcomes (not specific to phases)
5.9 Conduct outreach to increase public awareness of need for alternative funding sources	Opportunities for general public feedback	●
	Public messaging on the need for road charge	●

Because public outreach was not specific to any of the demonstration phases, achievement is rated overall for the entire four-phase demonstration. The objective was fully achieved, as ample opportunities were provided for public feedback, and important messaging on the need for road charge was provided through videos, the website, and other means.

Table 34: Evaluation Conclusion – Potential Hurdles

Objective	Criterion	Outcomes by Phase			
		1A PATP 1B Charge Point	2 UBI	3 Ride-sharing	4 AV
5.10 Address potential implementation and public acceptance hurdles to adoption	User acceptance of methods available	◐	●	●	n/a
	Opportunities for participant feedback	●	●	●	n/a
	Participant satisfaction with interactions and feedback opportunities	◐	●	●	n/a
	Understanding of potential risks and roadblocks to implementation of a road charge in California	<div style="text-align: center;">●</div> (not specific to demonstration phases)			

Notes:

- = fully achieved
- ◐ = partially achieved

Phase 1 participants rated their acceptance of the methods used lower than the participants in other phases. Much of this was related to frustration with the GasBuddy payment card, leading to a partially achieved rating for that phase. Phase 1 participants also rated their satisfaction with interactions and feedback opportunities lower than the other phases, with a decline in satisfaction over time. Participants in other phases were more satisfied, providing a fully achieved rating. The opportunities for participant feedback were ample, with that criterion rated fully achieved. The

public polling and focus groups provided greater understanding of the potential risks and roadblocks facing a road charge program, and that criterion earned a fully achieved rating.

Table 35: Evaluation Conclusion – Equity Concerns

Objective	Criterion	Outcomes by Phase			
		1A PATP 1B Charge Point	2 UBI	3 Ride- sharing	4 AV
5.11 Identify equity concerns	User and public perception of road charge fairness, relative to fuel taxes	●	●	●	n/a
	User and public perception of fairness for drivers of EVs and fuel-efficient vehicles	●	●	●	n/a
	User and public perception of fairness for drivers of varying distance (e.g., urban, suburban commuter, rural)	●	●	●	n/a
Notes: ● = fully achieved ◐ = partially achieved					

Because the objective was to identify equity concerns, rather than to solve them, this demonstration should be considered successful in developing a more complete understanding of these concerns and why they exist. Therefore, the objective is rated fully achieved for each of the criteria.

APPENDIX A: EVALUATION CRITERIA MATRIX

Each of the four demonstration phases will be evaluated against these objectives, except where an objective doesn't apply (for example, the AV phase does not include participants, so goals related to users will not apply). The four distinct demonstration phase reports will then be rolled into one master, combined report at the end of the evaluation period.

Objectives, Criteria, Measures, and Methods for the Four Demonstration Phases

Category	Objectives	Criteria	Measures	Analysis Methods	Relevant Phases
Revenue	Improve the functionality of user-based alternative revenue mechanisms	<ul style="list-style-type: none"> Ability of a road charge to create more sustainable transportation revenue than fuel taxes 	<ul style="list-style-type: none"> Simulated revenue generated per mile of participant travel compared to vehicle types and fuel efficiency 	<ul style="list-style-type: none"> Data analysis Business case revenue modeling 	<ul style="list-style-type: none"> ✓ P@P/CP ✓ UBI ✓ TNC
		<ul style="list-style-type: none"> Feasibility of demonstration methods for levying and collecting road charge 	<ul style="list-style-type: none"> Success or error rate of road charge transaction processing 	<ul style="list-style-type: none"> Data analysis 	<ul style="list-style-type: none"> ✓ P@P/CP ✓ UBI ✓ TNC ✓ AV
		<ul style="list-style-type: none"> Ability of demonstration to simplify the measurement and collection of user mileage compared to prior road charge pilots 	<ul style="list-style-type: none"> Description of complexity of demonstration mileage reporting options Description of complexity of prior pilot mileage reporting options 	<ul style="list-style-type: none"> Documentation review (including prior CA and other state's pilot project reports) 	<ul style="list-style-type: none"> ✓ P@P/CP ✓ UBI ✓ TNC ✓ AV
		<ul style="list-style-type: none"> Road charges incurred, by distance traveled, relative to fuel taxes 	<ul style="list-style-type: none"> Average hypothetical road charge paid by participants, by distance traveled Average fuel tax paid by participants, by distance traveled 	<ul style="list-style-type: none"> Data analysis Business case revenue modeling 	<ul style="list-style-type: none"> ✓ P@P ✓ UBI ✓ TNC

Category	Objectives	Criteria	Measures	Analysis Methods	Relevant Phases
	Provide recommendations regarding user-based revenue mechanisms	<ul style="list-style-type: none"> Ability of demonstration to generate recommendations 	<ul style="list-style-type: none"> Summary of recommendations made 	<ul style="list-style-type: none"> Documentation Review 	<ul style="list-style-type: none"> ✓ P@P/CP ✓ UBI ✓ TNC ✓ AV
Cost	Minimize the administrative cost of any potential user-based revenue mechanisms and associated collection of fees	<ul style="list-style-type: none"> Estimated agency and business partner costs of administering a road charge based on relevant cost data from the demonstration 	<ul style="list-style-type: none"> Cost of collecting road charge as percent of simulated revenue 	<ul style="list-style-type: none"> Interviews Data analysis Business case revenue modeling 	<ul style="list-style-type: none"> ✓ P@P/CP ✓ UBI ✓ TNC ✓ AV
		<ul style="list-style-type: none"> Estimated cost of revenue collection using these demonstration methods compared to other road charge demonstrations 	<ul style="list-style-type: none"> Cost of collecting road charge in other states' pilot projects Cost of collecting road charge in operating programs 	<ul style="list-style-type: none"> Documentation review Interviews 	<ul style="list-style-type: none"> ✓ Overall (in combined evaluation report)
Operations and Compliance	Utilize third-party business partners to administer or operate systems	<ul style="list-style-type: none"> Use of third-party business partners to administer or operate systems 	<ul style="list-style-type: none"> Number of business partners used Description of business partners used 	<ul style="list-style-type: none"> Documentation review 	<ul style="list-style-type: none"> ✓ P@P/CP ✓ UBI ✓ TNC ✓ AV
	Ensure ease of user compliance	<ul style="list-style-type: none"> Effectiveness of methods for encouraging voluntary compliance 	<ul style="list-style-type: none"> Rate of voluntary compliance by participants 	<ul style="list-style-type: none"> Interviews Participant surveys Data analysis 	<ul style="list-style-type: none"> ✓ P@P/CP ✓ UBI
		<ul style="list-style-type: none"> Resistance of methods to tampering and fraud 	<ul style="list-style-type: none"> Number and description of detected instances of attempted tampering or fraud 	<ul style="list-style-type: none"> Interviews Data analysis 	<ul style="list-style-type: none"> ✓ P@P/CP ✓ UBI

Category	Objectives	Criteria	Measures	Analysis Methods	Relevant Phases
		<ul style="list-style-type: none"> • Users' ease of recording and reporting mileage 	<ul style="list-style-type: none"> • Percentage of participants satisfied with reporting methods 	<ul style="list-style-type: none"> • Participant surveys 	<ul style="list-style-type: none"> ✓ P@P/CP ✓ UBI
		<ul style="list-style-type: none"> • Quality/accuracy of road use data reported 	<ul style="list-style-type: none"> • Analysis of data and errors reported by each of the technology platforms. 	<ul style="list-style-type: none"> • Data analysis 	<ul style="list-style-type: none"> ✓ P@P/CP ✓ UBI ✓ TNC ✓ AV
User Privacy	Ensure user privacy protection	<ul style="list-style-type: none"> • User perception of privacy protections 	<ul style="list-style-type: none"> • Percentage of participants who are satisfied with privacy protections in the demonstration • Description of privacy concerns expressed by participants 	<ul style="list-style-type: none"> • Documentation review • Participant surveys • Interviews 	<ul style="list-style-type: none"> ✓ P@P/CP ✓ UBI ✓ TNC
		<ul style="list-style-type: none"> • Protection of privacy (including PII), including implementation and operation of industry standard procedures 	<ul style="list-style-type: none"> • Compliance with requirements based on standards identical or similar to ISO 27001 or PCI DSS 3.2.1 	<ul style="list-style-type: none"> • Data analysis • Independent Security Audit 	<ul style="list-style-type: none"> ✓ P@P/CP ✓ UBI ✓ TNC
		<ul style="list-style-type: none"> • Public perception of road charge privacy protections 	<ul style="list-style-type: none"> • Percentage of public who believe that a road charge program could keep their data secure and confidential • Description of privacy concerns expressed by poll respondents and focus group participants 	<ul style="list-style-type: none"> • Public opinion polls • Focus groups 	<ul style="list-style-type: none"> ✓ Overall (in combined evaluation report)

Category	Objectives	Criteria	Measures	Analysis Methods	Relevant Phases
Data and Systems Security	Ensure data security	<ul style="list-style-type: none"> Ability of system to withstand breaches or attacks 	<ul style="list-style-type: none"> Number of instances and characterization of instances of data security breaches 	<ul style="list-style-type: none"> Documentation review Interviews 	<ul style="list-style-type: none"> ✓ P@P/CP ✓ UBI ✓ TNC ✓ AV
		<ul style="list-style-type: none"> Business partner compliance with data security requirements and operation of industry standard procedures 	<ul style="list-style-type: none"> Compliance with relevant requirements as listed in the business, system, and interface requirements documents defined for the demonstration Compliance with requirements based on standards identical or similar to ISO 27001 or PCI DSS 3.2.1 	<ul style="list-style-type: none"> Documentation review Independent Security Audit 	<ul style="list-style-type: none"> ✓ P@P/CP ✓ UBI ✓ TNC ✓ AV
	Include reliable and secure technology	<ul style="list-style-type: none"> Reliability of road charge systems 	<ul style="list-style-type: none"> Number of instances of technical support Average time to resolve technical issues Description of technical support instances 	<ul style="list-style-type: none"> Data analysis Participant surveys Interviews 	<ul style="list-style-type: none"> ✓ P@P/CP ✓ UBI ✓ TNC ✓ AV
		<ul style="list-style-type: none"> Availability of road charge systems 	<ul style="list-style-type: none"> Percentage up-time of all demonstration subsystems and user account management features 	<ul style="list-style-type: none"> Interviews Data Analysis 	<ul style="list-style-type: none"> ✓ P@P/CP ✓ UBI ✓ TNC ✓ AV

Category	Objectives	Criteria	Measures	Analysis Methods	Relevant Phases
		<ul style="list-style-type: none"> • Security of road charge systems 	<ul style="list-style-type: none"> • Number of instances of participant data being compromised, if any • Description of data compromising events, if any • Percentage of participants satisfied with data security 	<ul style="list-style-type: none"> • Documentation review • Interviews • Participant surveys 	<ul style="list-style-type: none"> ✓ P@P/CP ✓ UBI ✓ TNC
Communications	Conduct outreach to increase public awareness of need for alternative funding sources	<ul style="list-style-type: none"> • Opportunities for general public feedback 	<ul style="list-style-type: none"> • Number of opportunities for general public to provide feedback • Number of members of the general public providing feedback 	<ul style="list-style-type: none"> • Interviews • Data analysis • Public opinion polls • Focus groups 	<ul style="list-style-type: none"> ✓ Overall (in combined evaluation report)
		<ul style="list-style-type: none"> • Public messaging on the need for road charge 	<ul style="list-style-type: none"> • Number of email newsletters on road charge topics distributed to public audience • Number of visits to website pages and YouTube videos describing the need for road charge • Description of key messages disseminated • Public and participant opinion shift, if any, on road charge 	<ul style="list-style-type: none"> • Documentation review • Public opinion polls • Focus groups 	<ul style="list-style-type: none"> ✓ Overall (in combined evaluation report)
	Address potential implementation and	<ul style="list-style-type: none"> • User acceptance of methods available 	<ul style="list-style-type: none"> • Percentage of participants satisfied with demonstration method 	<ul style="list-style-type: none"> • Participant surveys 	<ul style="list-style-type: none"> ✓ P@P/CP ✓ UBI ✓ TNC

Category	Objectives	Criteria	Measures	Analysis Methods	Relevant Phases
	public acceptance hurdles to adoption	<ul style="list-style-type: none"> • Opportunities for participant feedback 	<ul style="list-style-type: none"> • Number of opportunities for participants to provide feedback, including evaluation surveys • Number and percentage of participants providing feedback 	<ul style="list-style-type: none"> • Participant surveys • Documentation review 	<ul style="list-style-type: none"> ✓ P@P/CP ✓ UBI ✓ TNC
		<ul style="list-style-type: none"> • Participant satisfaction with interactions and feedback opportunities 	<ul style="list-style-type: none"> • Percentage of participants satisfied with quality of feedback opportunities • Reasons for satisfaction or dissatisfaction with feedback opportunities 	<ul style="list-style-type: none"> • Participant surveys 	<ul style="list-style-type: none"> ✓ P@P/CP ✓ UBI ✓ TNC
		<ul style="list-style-type: none"> • Understanding of potential risks and roadblocks to implementation of a road charge in California 	<ul style="list-style-type: none"> • Public opinion trends on road charge feasibility • Describe identified administrative, financial, or other hurdles to adopting a statewide road charge 	<ul style="list-style-type: none"> • Public opinion polls • Focus groups • Documentation review • Data analysis • Interviews 	<ul style="list-style-type: none"> ✓ Overall (in combined evaluation report)
	Identify equity concerns	<ul style="list-style-type: none"> • User and public perception of road charge fairness, relative to fuel taxes 	<ul style="list-style-type: none"> • Participants’ and public’s perception of fairness of road charge relative to fuel tax 	<ul style="list-style-type: none"> • Participant surveys • Focus groups • Public opinion polls 	<ul style="list-style-type: none"> ✓ P@P ✓ UBI ✓ TNC

Category	Objectives	Criteria	Measures	Analysis Methods	Relevant Phases
		<ul style="list-style-type: none"> User and public perception of fairness for drivers of EVs and fuel-efficient vehicles 	<ul style="list-style-type: none"> Participants' and public's perception of fairness of road charge for these drivers 	<ul style="list-style-type: none"> Participant surveys Focus groups Public opinion polls 	<ul style="list-style-type: none"> ✓ P@P/CP ✓ UBI ✓ TNC
		<ul style="list-style-type: none"> User and public perception of fairness for drivers of varying distance (e.g., urban, suburban commuter, rural) 	<ul style="list-style-type: none"> Participants' and public's perception of fairness of road charge for these drivers 	<ul style="list-style-type: none"> Participant surveys Focus groups Public opinion polls 	<ul style="list-style-type: none"> ✓ P@P/CP ✓ UBI ✓ TNC