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CALIFORNIA NATURAL RESOURCES AGENCY

California Energy Commission

CONSULTANT REPORT

2024 California Vehicle Survey

Volume Two, Appendix

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California Energy Commission

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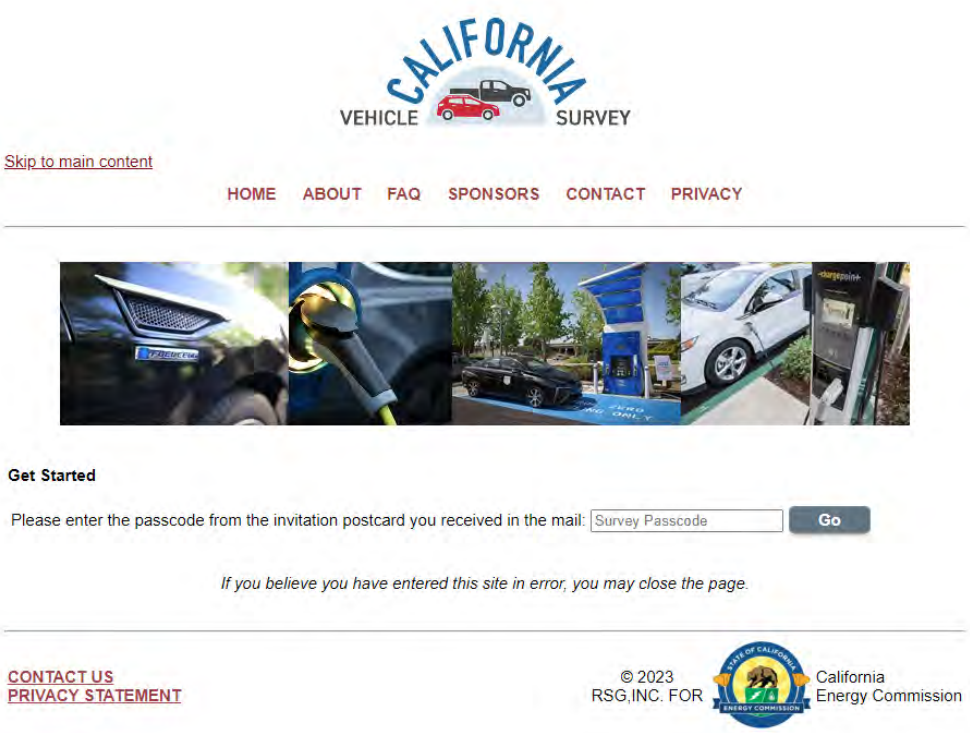
Appendix A:
Survey Website Screenshots

Figure 1: Survey Website Homepage



The homepage features a field to input the passcode found on invitation materials.

Source: 2024 California Vehicle Survey, California Energy Commission

Figure 2: About the Study

Skip to main content

HOME ABOUT FAQ SPONSORS CONTACT PRIVACY

About the study

The California Energy Commission conducts this important survey to understand transportation energy use in the state of California. New vehicles are introduced each year that use different types of fuel and vehicle technologies such as gasoline, diesel, hybrid, electric, and hydrogen. Furthermore, technological developments have led to the inclusion of various levels of autonomy in new vehicles. The study reaches out to state residents and commercial fleet owners and operators to understand how people drive around the state, how many vehicles they own, the factors affecting vehicle purchase decisions, and expectations around future driving and vehicle purchases. Understanding preferences for these vehicles will help the California Energy Commission and other state agencies plan for future energy and energy infrastructure needs in the state.

The data collected in this study will be used to inform state officials' outlook on future transportation-related energy demands, and it will inform a component of a statewide model that evaluates these demands from a multitude of sources. Reliable, safe, and viable energy options and energy infrastructure contribute to the state's quality of life and economic vitality, and this study will help agencies prioritize the future improvements to support the needs of California's communities in the future.

The California Vehicle Survey is conducted periodically to capture current vehicle preferences. It was last conducted in 2019. You can find study reports and data from previous waves here.

For more information about this study, please visit the FAQs or contact us.

CONTACT US
PRIVACY STATEMENT

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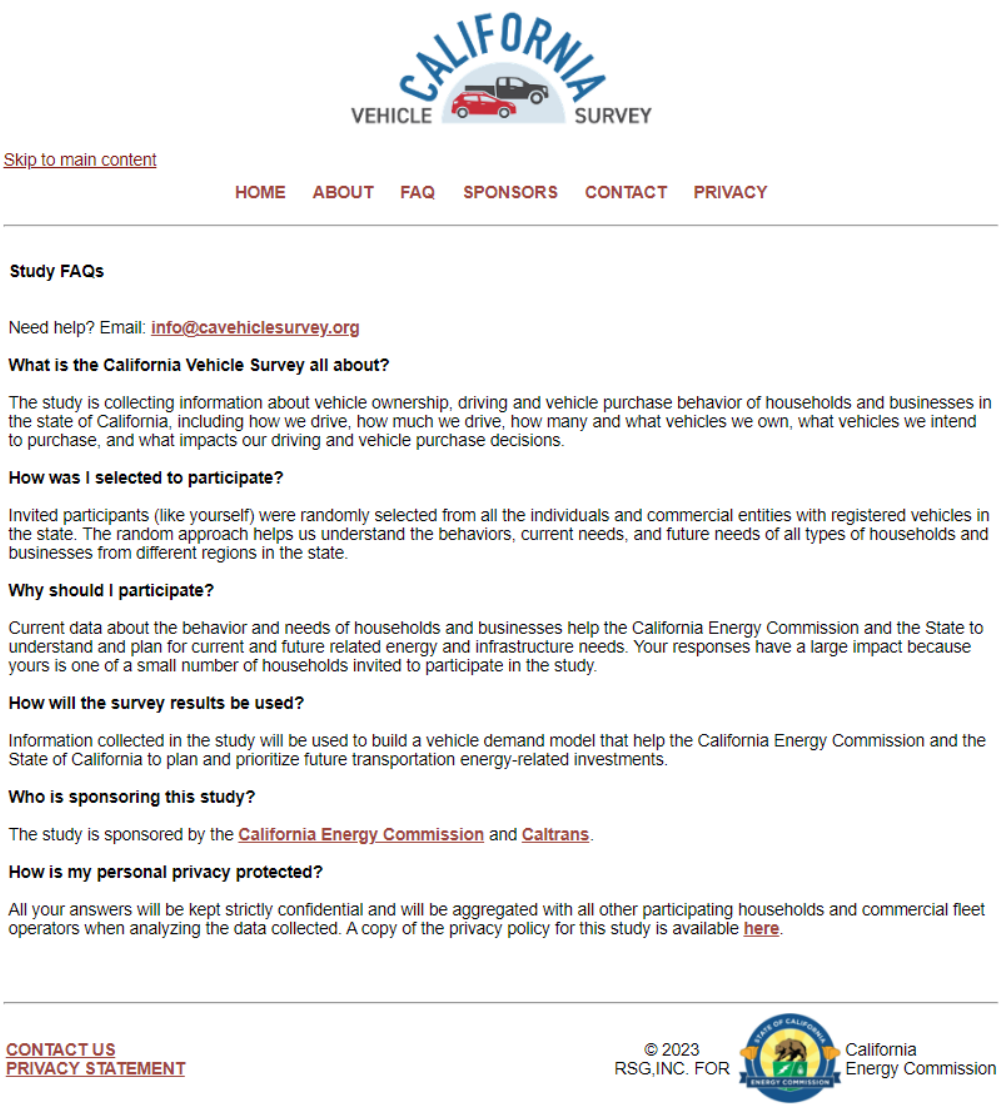
The About page features a general overview of the study.

Source: 2024 California Vehicle Survey, California Energy Commission

Figure 3: FAQs



The FAQs page includes answers to common questions about the study.

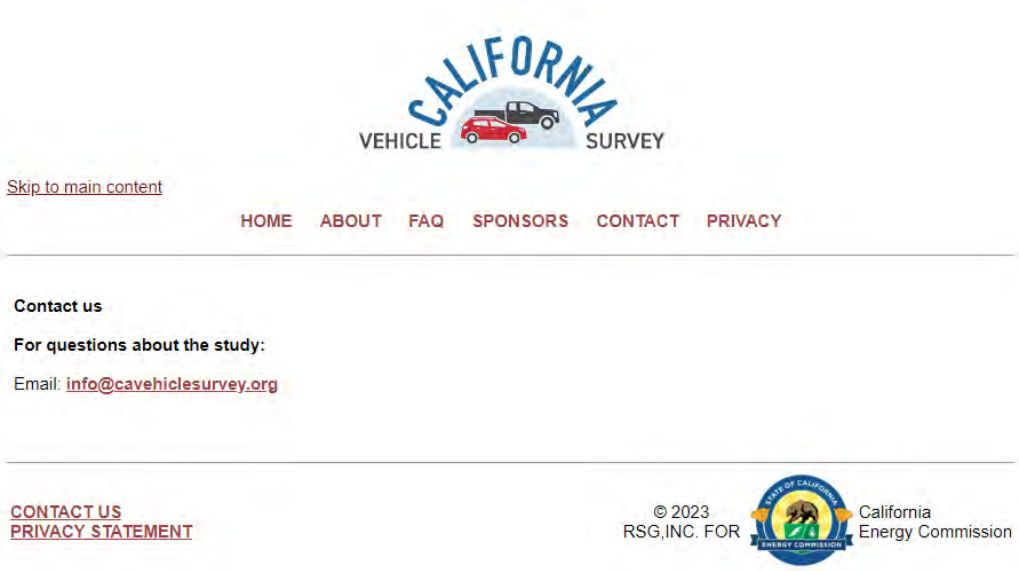
Source: 2024 California Vehicle Survey, California Energy Commission

Figure 4: Study Sponsors

The Sponsors page lists the California Energy Commission and links it to its website.

Source: 2024 California Vehicle Survey, California Energy Commission

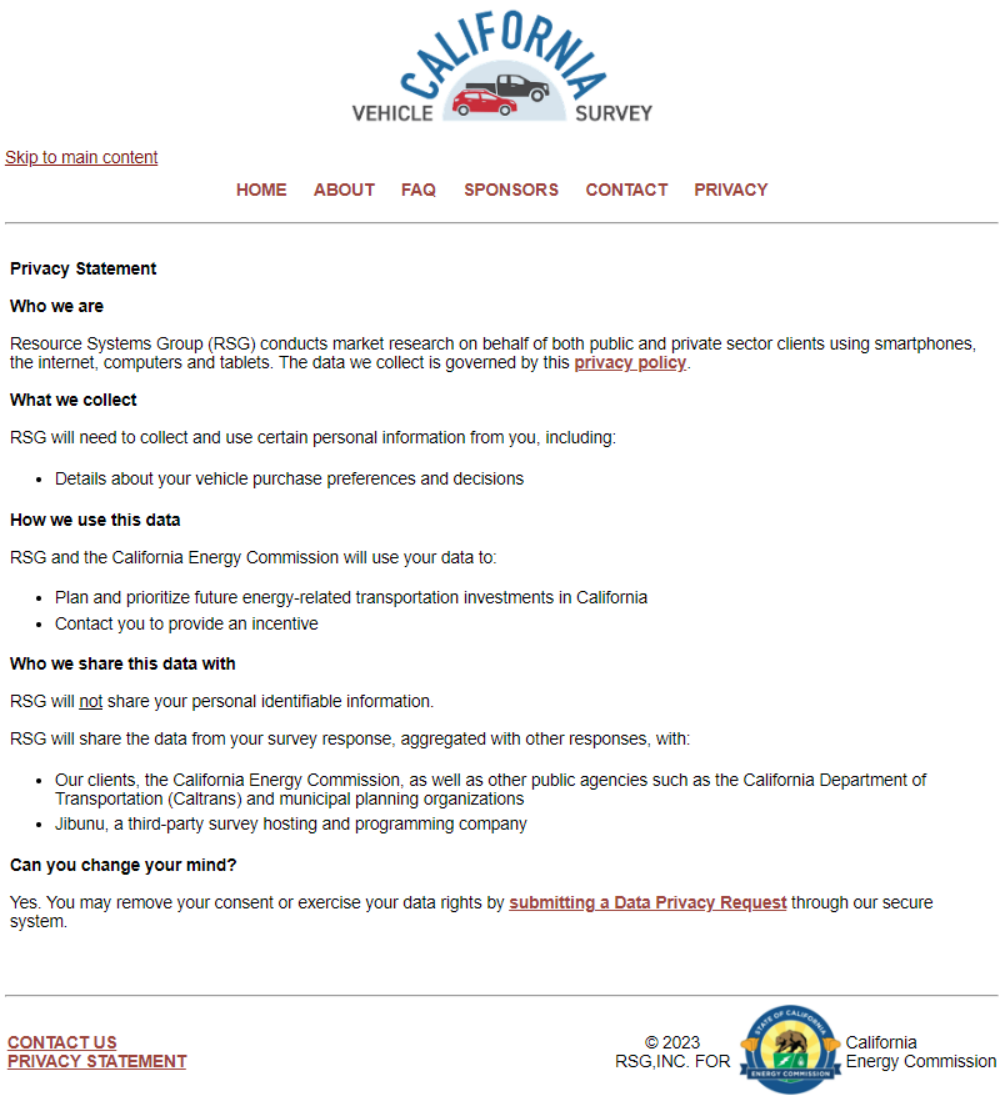
Figure 5: Contact Information



The Contact page includes a study-specific email address which respondents can contact, with any questions.

Source: 2024 California Vehicle Survey, California Energy Commission

Figure 6: Privacy Statement



The Privacy statement page features a detailed statement regarding data privacy as it relates to the study.

Source: 2024 California Vehicle Survey, California Energy Commission

Appendix B:
Survey Questionnaires

Residential Questionnaire (Including ZEV Questions)

Screener

[LANG_SELECT]

In which language would you prefer to take the survey?

¿En qué idioma prefiere para tomar la encuesta?

1. English
2. Español *Switch to Spanish*

[no_incentive]

If 2,300 complete surveys with email entered in [prize_email]

Thanks for your interest in the California Vehicle Survey!

We have had an enthusiastic response to this survey and have reached our target of 2,300 completed surveys. You can still participate, but unfortunately there are no additional $15 electronic gift cards available.

Would you still like to continue with the survey anyway?

1. Yes!
2. No thanks [terminate]

[intro]

Welcome to the California Vehicle Survey. Your answers will help the California Energy Commission, a State of California agency, understand your vehicle and fuel needs now and in the future. The information you provide will be kept confidential by the California Energy Commission and RSG (the company that is collecting the survey data), in accordance with the California Information Practices Act of 1977 and the non-disclosure agreement between RSG and the Energy Commission.

If you'd like to know more about the California Vehicle Survey, you can read the About and FAQ sections of this website.

(skip if Dynata) (skip if 2,300 complete surveys with valid email entered in [prize_email]) If you qualify to take the full survey, and then complete all the questions, you will have the option to **receive a $15 digital gift card** of your choice from Amazon.com or Walmart.

On average, answering all of the questions will take approximately *30* minutes.

Please use the **"Next"** button in the lower left-hand corner of the screen to go forward. To review and change a previous question, use the **"Previous"** button. It is important that you **do not use** your web browser's "forward" or "back" buttons because your new answers may not be recorded.

(skip if Dynata) If you can't finish the survey in one sitting, you can stop at any time and return to where you left off by re-entering your password.

Programmer: Link to cavehiclesurvey.org at "…this website."

[age]
The next few questions are to determine if you are eligible for this survey.

First, which of these four groups does your age fall into?

1. Under 18 years old *terminate*
2. 18 to 34
3. 35 to 64
4. 65 or older

[terminate] *if respondent is terminated. Skip if Dynata.*

Thank you for taking the time to participate in the California Vehicle Survey.

Unfortunately, your answers do not qualify you for this survey.

Thank you again for your time and interest in this study.

You may close your browser to exit.

[california]
Is your permanent residence in the state of California?

For the purpose of this survey, a permanent resident is someone who lives in California for at least 6 months out of the year and holds a State of California Driver's License or Identification Card.

1. Yes
2. No *[terminate]*

[zipcode]
What is the ZIP Code for your residence?

_____ *Must be 5 numbers; if not CA ZIP code, alert text: "This ZIP code is not located in California. Please make sure it was entered correctly"; after second try not CA ZIP code Terminate*

[county]

What county do you currently live in?

Select county from list: *<Drop-down list of counties>*

See options below for drop-down

1. Alameda County
2. Alpine County
3. Amador County
4. Butte County
5. Calaveras County
6. Colusa County
7. Contra Costa County
8. Del Norte County
9. El Dorado County
10. Fresno County
11. Glenn County
12. Humboldt County
13. Imperial County
14. Inyo County
15. Kern County
16. Kings County
17. Lake County
18. Lassen County
19. Los Angeles County
20. Madera County
21. Marin County
22. Mariposa County
23. Mendocino County
24. Merced County
25. Modoc County
26. Mono County
27. Monterey County
28. Napa County
29. Nevada County
30. Orange County
31. Placer County
32. Plumas County
33. Riverside County
34. Sacramento County
35. San Benito County
36. San Bernardino County
37. San Diego County
38. San Francisco County
39. San Joaquin County
40. San Luis Obispo County

41. San Mateo County
42. Santa Barbara County
43. Santa Clara County
44. Santa Cruz County
45. Shasta County
46. Sierra County
47. Siskiyou County
48. Solano County
49. Sonoma County
50. Stanislaus County
51. Sutter County
52. Tehama County
53. Trinity County
54. Tulare County
55. Tuolumne County
56. Ventura County
57. Yolo County
58. Yuba County
59. I don't know

Programmer: Skip this question and determine county using ZIP code.

[future decision role]

For your household, what will be the extent of your involvement in future vehicle purchase or lease decisions?

1. I will be the only decision maker
2. I will be the main decision maker with input from another household member
3. I will share equally in making the decision with another household member(s)
4. I will provide input into the decision, but I will not be the main decision maker *[terminate]*
5. Another person will be the only decision maker *[terminate]*
6. I do not expect my household to buy or lease a vehicle at any point in the future

[contact_info] *(skip if dynata)*

Can you provide an email address for us to contact you?

Your personal contact information will only be used to provide technical assistance, survey completion reminders or to gather feedback about the questionnaire and your experience. We will not sell or distribute your email address for any commercial marketing purposes.

[name] Name *(optional)*: _____

[email] Email *(optional)*: _____ *allow no answer, enforce a valid email if text is entered*

Current Vehicles

[hh_vehicle]

Now we'd like to know a little bit about the types of vehicles in your household.

How many vehicles are in your household?

Please include cars, SUVs, minivans, vans, or pick-up trucks that are used for general transportation of household members (including those that are employer/company owned). This does not include motorcycles, RVs, or vehicles owned/leased by household members who are away at school.

1. 0 (no vehicles in household)
2. 1
3. 2
4. 3
5. 4
6. 5
7. 6
8. 7
9. 8 or more vehicles

[vehicle_details] *if [hh_vehicles] > 0*

Please tell us about the vehicles in your household.

Vehicle <x> of <n> household vehicles.

Programmer: These x and n values come from [hh_vehicle]. The question will be asked for each vehicle the respondent owns and the dynamic text is there to remind the respondent how many vehicles they own and which number they are answering the questions about.

[year] drop-down menu (see below)

Model Year :

[make] drop-down menu (see below)

Make :

[model] drop-down menu (see below)

Model :

[fuel] drop-down menu (see below)

Engine / fuel type :

[type] drop-down menu (see below)

Vehicle type :

[obtain] drop-down menu (see below)

How did you obtain this vehicle?:

If [obtain] = Company Car/provided by employer or institution

[company_car] drop-down menu (see below)

Did a household member have significant influence in the purchase decision for this vehicle?

Programmer: The table below gives the values for each drop-down menu in the [vehicle_details] question.

Variable	Values
[year]	*"2024" to "1963" in annual increments*
[make]	*See vehicle database. Do not restrict based on [year]*
[model]	*See vehicle database. Do not restrict based on [year]*

[fuel]	*See vehicle database* 1. Gasoline 2. Hybrid (Gasoline) → **Flag as HEV** 3. Plug-in Hybrid Electric vehicle (PHEV) → **Flag as PHEV** 4. Gasoline - ethanol Flex Fuel vehicle (E85 FFV) 5. Diesel 6. Compressed Natural Gas (CNG) vehicle 7. Full Electric vehicle → **Flag as BEV** 8. Hydrogen fuel cell electric vehicle (FCV) → **Flag as FCEV** If there is only one fuel type available based on make, and model, autofill.
[type]	*See vehicle database* If there is only one vehicle type available based on make, and model, autofill.
[obtain]	1. Purchased new 2. Leased new 3. Purchased used or previously owned 4. Leased used or previously owned 5. Company car/provided by employer or institution 6. Other (e.g. gifted or inherited)
[company_car]	1. Yes 2. No

Programmer: Info Text:

[year] *info text*

Model year describes approximately when the manufacturer produced the vehicle. It may or may not match the year that you purchased the vehicle.

[make] *info text*

Vehicle make is the manufacturer name or brand of the vehicle.

[model] *info text*

A car model is the name used by a manufacturer to market a range of similar cars.

[fuel] *info text*

Fuel Type	*Description of Fuel Type*
Gasoline vehicle	*A vehicle that operates on gasoline only and has no hybrid components.*
Hybrid vehicle (HEV)	*A gasoline vehicle with hybrid components to increase fuel economy (e.g. Toyota Prius), but does not plug in for charging the battery.*
Plug-in Hybrid vehicle (PHEV)	*A gasoline vehicle with hybrid components and a battery that can be charged directly (e.g. Ford Escape Plug-in Hybrid or Toyota Rav4 Prime) which allows the vehicle to operate like a battery electric vehicle for a short distance (10-40 miles) and then operate on gasoline for longer distances (~300-400 miles).*
Flex Fuel vehicle (E85 FFV)	*A vehicle that will operate on gasoline, ethanol, or any blend of the two fuels and has no hybrid components.*
Diesel vehicle	*A vehicle that operates on diesel or biodiesel only and has no hybrid components.*
Battery Electric vehicle (BEV)	*A vehicle that operates on a battery only and charges by plugging in at home or at a station (e.g. Chevy Bolt, Mustang Mach-E, Nissan Leaf, Tesla).*
Hydrogen Fuel Cell vehicle (FCV)	*A vehicle that uses hydrogen fuel.*

[veh_type] *info text*

Vehicle Class Examples:

- *Subcompact Car: Mini Cooper, Kia Rio, Nissan Versa*
- *Compact Car: Honda Civic, Mazda 3, Hyundai Elantra, Volkswagen Jetta*
- *Midsize Car: Chevrolet Malibu, Honda Accord, Tesla Model 3, Toyota Camry*
- *Large Car: Dodge Charger, Chrysler 300, Audi A7, Tesla Model S*
- *Sports Car: BMW i8, Nissan Z, Ford Mustang, Porsche 911*
- *Subcompact Crossover: Buick Encore, Kia Soul, Ford EcoSport, Honda HR-V, Fiat 500*
- *Compact Crossover: Honda CR-V, Mazda CX-5, Tesla Model X, Ford Bronco*
- *Midsize Crossover/SUV: Chevrolet Traverse, Honda Pilot, Kia Sorento, Porche Cayenne*

- *Large SUV: Chevrolet Suburban, Ford Expedition, Chevrolet Tahoe, Lincoln Navigator*
- *Small Van (Minivan): Chrysler Pacifica, Honda Odyssey, Nissan Quest, Toyota Sienna*
- *Full-size/large Van: Chevrolet Express 1500, Ford Transit, Mercedes-Benz Sprinter, Nissan NV Cargo*
- *Small Pickup Truck: Chevrolet Colorado, Hyundai Santa Cruz, Ford Ranger, Toyota Tacoma*
- *Full-size/large Pickup Truck: Chevrolet Silverado, Ford F-Series, GMC Sierra, Toyota Tundra*

Household members
[household_members]

In order to help us understand your household's current and future vehicle needs, we first need to ask about the basic characteristics of your household. All identifying information you provide will be kept confidential.

How many people in the following age groups, including yourself, are part of your household either part-time or full-time?

Include in this number children, roommates, housemates, people living there most of the time while working, even if they have another place to live.

Do not include college students living away while attending college or people who live at another place most of the time.

Under the age of 5: _____ *Allow 0 to 10*

Between the ages of 5 to 11: _____ *Allow 0 to 10*

Between the ages of 12 to 15: _____ *Allow 0 to 10*

16 or older (including yourself): _____ *Allow 1 to 10*

Total Household Members: <automatic sum>

Programmer: Default to 0 if no number is input.

[member_details]
Please tell us about yourself.

Household member 1 of <n> member(s).

Programmer: The n value comes from [household_members]. It is the value of '16 or older (including yourself)'.

[name] skip if Total Household Members=1

Initials or nickname:

Text box entry – required to be unique across the household

[age] drop-down menu (see below)

Age:

Please tell us about the other people 16 years or older in your household.

Household member <i> of <n> member(s).

Programmer: The i and n values come from [household_members]. n is value of '16 or older (including yourself)', and i counts up to this value so that each household member 16 and older is included in the question.

[name]

Initials or nickname:

Text box entry – required to be unique across the household

[age] drop-down menu (see below)

Age:

[relationship] drop-down menu (see below)

Relationship to you:

Programmer: The table below gives the values of the drop-down menus in the [member_details] question.

Variable	Values (for dropdowns)
[age]	1. 16-17 2. 18-24 3. 25-34 4. 35-44 5. 45-54 6. 55-64 7. 65-74 8. 75 or older
[relationship]	1. Spouse or partner 2. Son or daughter (or child in-law) 3. Father or mother (or parent in-law) 4. Brother or sister (or sibling in-law) 5. Other relative 6. Roommate or friend 7. Other non-relative

Individual information
[individual_info]

Show for each household member of age 16 or older.

Please complete the form below with information about <yourself / Name>.

Programmer: First show <yourself>; for subsequent household members, the value for <Name> comes from [name] in [member_details]. Loop through [individual_info] until no more values for [name].

[gender] drop-down menu (see below)

What is <your/<Name's>> **gender?:**

[employment] drop-down menu (see below)

What is <your/<Name's>> **employment status?**

[employment_number] if [employment]≠ "do not work for pay"

How many jobs <do/does> <you/<Name>> ***have?*** _____ *text entry, limit to between 1 and 10*

[student] drop-down menu (see below)

<Are/Is> <you/<Name>> **currently enrolled in college/university?**

[education] drop-down menu (see below)

What is <your/<Name's>> **highest level of education completed?**

[license] drop-down menu (see below)

<Do/Does> <you/<Name>> **have a driver's license or permit?**

If [license] = yes

[drive_freq] drop-down menu (see below)

How often <do/does> <you/<Name>>**drive?**

[transit_freq]

How many one-way public transit trips per week for any purpose (bus, metro, etc.) <do/does> <you/<Name>> **take?**

(Please consider a round trip - for instance, from home to work and then back - as two one-way trips)

Text box entry – Allow 0 to 100 (allow decimals)

[tnc_freq]

How many one-way ridesharing (e.g. Uber/Lyft) trips per week for any purpose <do/does> <you/<Name>> **take?**

(Please consider a round trip - for instance, from home to work and then back - as two one-way trips)

Text box entry – Allow 0 to 100 (allow decimals)

If [employment] = 'full-time' OR 'part-time' OR 'both full- and part-time' OR 'self-employed'

[job_type] drop-down menu (see below)

What is <your/<Name's>> **primary work location?**

If [job_type] ≠ 'I work at home ONLY'

[commute_mode] If employment = 'full-time' OR 'part-time' OR 'both full- and part-time' OR 'self-employed'

What is <your/<Name's>> **usual way of commuting to primary workplace (mode used for greatest distance during usual commute)?**

If [job_type] ≠ 'I work at home ONLY'

[work_distance]

About how many miles is it one-way from your home to <your/<Name's>> **primary workplace?**

Text box entry – Allow 0 to 200

If [job_type] ≠ 'I work at home ONLY'

[work_days]

How many days per week <do/does> <you/<Name>> **travel to <your/their> primary workplace?**

Text box entry – Allow 0 to 7 whole numbers

If [school] ≠ 'Not currently enrolled'

[school_mode] drop-down menu (see below)

What is <your/<Name's>> **usual way of commuting to school (mode used for greatest distance during usual commute)?**

[school_distance] If [school] ≠ 'Not currently enrolled'

About how many miles is it one-way from your home to <your/<Name's>> **school? (If you do not commute to school, enter 0.)**

Text box entry – Allow 0 to 200

[ethnicity]

Are / Is <you/<Name>> **of Hispanic, Latino, or Spanish origin?**

- ☐ Yes
- ☐ No
- ☐ Prefer not to answer

[race]

What is <your/<Name's>> **race?**

Select all that apply.

- ☐ American Indian and Alaska Native
- ☐ Asian
- ☐ Black or African American
- ☐ Native Hawaiian and Other Pacific Islander
- ☐ White
- ☐ Other, please specify: _____
- ☐ Prefer not to answer

Programmer: The table below gives the values of the drop-down menus in the [individual_info] question.

Variable	Values (for dropdowns)
[gender]	1. Male 2. Female 3. Other 4. Prefer not to answer
[employment]	1. Full-time (total 35 or more hours per week) 2. Part-time (total less than 35 hours per week) 3. Both full- and part-time 4. Do not work for pay (e.g. retired, unemployed) 5. Self employed
[student]	1. Full-time on campus (including hybrid) 2. Part-time on campus (including hybrid) 3. Full-time or part-time online 4. Not currently enrolled

[education]	1. Less than high school 2. High school graduate/GED 3. Technical school/professional business school 4. Some college 5. Community college graduate (Associate degree, 2-year degree) 6. College graduate (4-year degree) 7. Post-graduate work 8. Post graduate degree
[license]	1. Yes (license or learner's permit) 2. No
[drive_freq]	1. Frequently (i.e. every day) 2. Sometimes (i.e. once or twice a week) 3. Rarely (i.e. once a month or less) 4. Never
[job_type]	1. Only work in one location outside of my home 2. Work location regularly varies (including hybrid remote, or working at different jobsites) 3. Work at home ONLY 4. Drive/travel for work (for instance: driver or travelling sales)
[commute_mode]	1. Drive alone using household vehicle *if has license and hh_veh > 0* 2. Carpool with family/household members only *if hhsize > 1 and hh_veh > 1* 3. Carpool with at least one person not in household 4. Walk (or jog/wheelchair) 5. Bicycle or electric bike (including bikeshare) 6. Motorcycle/moped 7. Scooter or electric scooter (including scooter share) 8. Bus (public transit) 9. Private shuttle bus (e.g., employer) 10. Paratransit 11. Subway 12. Light rail 13. Intercity rail (e.g., Amtrak) 14. Uber, Lyft, or other smartphone-app car service 15. Car from carsharing service (e.g., ZipCar, Car2Go). 16. Vanpool 17. Taxi (e.g., Yellow Cab) 18. Other mode

[school_mode]	1. Drive alone using household vehicle *if has license and hh_veh > 0* 2. Carpool with family/household members only *if hhsize > 1 and hh_veh > 1* 3. Carpool with at least one person not in household 4. Walk (or jog/wheelchair) 5. Bicycle or electric bike (including bikeshare) 6. Motorcycle/moped/scooter 7. Bus (public transit) 8. Private shuttle bus (e.g., employer) 9. Paratransit 10. Subway 11. Light rail 12. Intercity rail (e.g., Amtrak) 13. Uber, Lyft, or other smartphone-app car service 14. Car from carsharing service (e.g., ZipCar, Car2Go). 15. Vanpool 16. Taxi (e.g., Yellow Cab) 17. Do not commute to school 18. Other mode

Current Vehicle Details

Programmer: Ask this question for all vehicles in [vehicle_details] where [obtain]≠ "Company car provided by employer or institution" OR [obtain]= "Company car provided by employer or institution" AND [company_car]= "Yes"

[current_vehicle_info]

Next, we would like to get a little more information about your household vehicles.

Please complete the form below focusing on your <vehicle x year> <vehicle x make> <vehicle x model>**.**

Programmer: <vehicle x year> comes from [year] in [vehicle_details]; <vehicle x make> comes from [make] in [vehicle_details]; <vehicle x model> comes from [model] in [vehicle_details]

Vehicle <x> **of** <n> **vehicles**

Programmer: <n> is the total number of vehicles for which [obtain] ≠ "Company car provided by employer or institution" OR [obtain] = "Company car provided by employer or institution" AND [company_car] = "Yes" in [vehicle_details]. <x> is a running count of these vehicles.

[acquired_year] drop-down menu (see below)

What year was this vehicle acquired?

If acquired_year = 2023 or 2024

[acquired_month] drop-down menu (see below)

What month was this vehicle acquired?

If acquired_year = 2023 or 2024 AND [obtain] = 1 or 3

[acquired_price]

Approximately how much did you pay for this vehicle when it was acquired?

$_____ *Text box entry – Allow 0 to 1,000,000*

1. I don't recall

[annual_mileage]

How many miles per year is this vehicle driven?

Text box entry – Allow 0 to 200,000

IF <1,000 or >99,999 show warning

Warning text: "You've entered a value outside the typical annual mileage for most vehicles. Please verify you've entered the correct number. Make sure you enter the full number (e.g., for ten thousand miles enter 10,000, not 10)."

[electric_percent] If [fuel] in [vehicle_details] = 'PHEV'

Approximately what percentage of these miles are in electric only mode?

Drop-down menu (see below)

[tnc_veh] drop-down menu (see below)

Is this vehicle used to work for ride-hailing companies such as Uber or Lyft?

If tnc_veh = 'yes'

[tnc_miles]

How many miles per year is this vehicle driven for ride-hailing companies?

Text box entry – Must be less than [annual_mileage]

IF <1,000 or >50,000 show warning

Warning text: "You've entered a value outside the typical annual millage for most vehicles. Please verify you've entered the correct number. Make sure you enter the full number (e.g., for ten thousand miles enter 10,000, not 10)."

[delivery] drop-down menu (see below)

Is this vehicle used for food or product delivery, including app-based services like Doordash, Uber Eats, Instacart, or Amazon Flex?

[delivery_miles] If delivery = 'yes'

How many miles per year is this vehicle driven for delivery purposes?

Text box entry – Must be less than ([annual_mileage] + [tnc_miles]).

[mpg]

About how many miles per gallon (MPG or MPGe) does this vehicle get?

If BEV: **You may also report this vehicle's miles per kilowatt hour (mi/kWh)**

Please enter the expected city/highway combine average.

MPG Text box entry – Allow 0.0 to 150.0

Warning text: "Your answer should be a number less than 150."

*mi/kWh Text box entry – Allow 0.0 to 10.0. Calculate MPG = kWh/mi * 33.71.*

Warning text: "Your answer should be a number less than 10."

Programmer: Only require MPG OR mi/kWh; do not force mpg if the respondent answers mi/kWh.

Programmer: If respondent enters both MPG and kwh/mi, display "Please enter only MPGe OR kWh/mi."

If licensed driver > 1

[primary_driver] drop-down menu (see below)

Who is the primary driver of this vehicle?

[replace_intent] drop-down menu (see below)

When do you expect to replace this vehicle?

Programmer: If a response needs to be adjusted, show that question in red.

Programmer: The table below gives the values of the drop-down menus in the [current_vehicle_info] question.

Variable	Values (for dropdowns)

[acquired_year]	• *IF [obtain] = 'Used' OR 'Other':*
	  o *AND IF [year] > 1982: 2024 to <[year] - 2>*
	  o *AND IF [year] <= 1982: 2024 to <1980 or earlier>*
	• *IF [obtain] = ' New':*
	  o *AND IF [year] > 1982: <[year] +2> to <[year] -2>*
	  o *AND IF [year] <=1982: <[year]+2> to <1980 or earlier>*
	Programmer: [obtain] and [year] come from [vehicle_details]

[acquired_month]	1. January 2. February 3. March 4. April 5. May 6. June 7. July 8. August 9. September *not if year=2024* 10. October *not if year=2024* 11. November *not if year=2024* 12. December *not if year=2024*

[electric_percent]	1. 10% or less 2. 20% 3. 30% 4. 40% 5. 50% 6. 60% 7. 70% 8. 80% 9. 90% 10. 100%
[tnc_veh]	1. Yes 2. No
[delivery]	1. Yes 2. No
[primary_driver]	1. I am the primary driver 2. <<nickname/initials> for HH member 1 with license> 3. <<nickname/initials> for HH member 2 with license> 4. ... n. <<nickname/initials> for HH member n with license> *Programmer: <nickname/initials> comes from [name] in [member_details]*
[replace_intent]	1. Less than 1 year 2. 1 to 2 years 3. 3 to 5 years 4. 6 to 10 years 5. More than 10 years 6. Never, I am going to keep it 7. Never, I am going to dispose of it and NOT replace it *Flag [not_replace]*

[mpg] *info text*

MPGe, or miles per gasoline gallon equivalent, is a measure of the average distance traveled per unit of energy consumed. It is used to compare energy consumption of alternative fuel vehicles and plug-in electric vehicles with conventional fuel (gasoline/diesel) vehicles.

Ask this question for all vehicles in [vehicle_details] in which [obtain] = "Company car provided by employer or institution" AND [company_car] = "No".

[company_vehicle_info]

Please complete the form below focusing on your <vehicle x year> <vehicle x make> <vehicle x model>**.**

Programmer: <vehicle x year> comes from [year] in [vehicle_details]; <vehicle x make> comes from [make] in [vehicle_details]; <vehicle x model> comes from [model] in [vehicle_details].

[acquired_year_alt] drop-down menu (see below)

What year was this vehicle acquired?

[personal_miles]

Approximately how many miles per week do you drive this vehicle for personal use?

Text box entry – Allow 0 to 2,000

[business_miles]

Approximately how many miles per week is this vehicle driven for business use?

Text box entry – Allow 0 to 2,000

Programmer: The table below gives the values of the drop-down menus in the [company_vehicle_info] question.

Variable	Values (for dropdowns)
[acquired_year]	• *IF [obtain] = 'Used' OR 'Other':* o *AND IF [year] > 1982: 2024 to <[year] - 2>* o *AND IF [year] <= 1982: 2024 to <1980 or earlier>* • *IF [obtain] = ' New':* o *AND IF [year] > 1982: <[year] +2> to <[year] -2>* o *AND IF [year] <=1982: <[year]+2> to <1980 or earlier>* • *[obtain] and [year] come from [vehicle_details]*

Programmer: The goal of the next question is to create a list of up to 3 vehicles that will be replaced the soonest. If [hh_vehicle] <=3, this list is all vehicles for which [replace_intent ≠ 'Never, I am going to keep it' OR 'Never, I am going to dispose of it and NOT replace it.' If [hh_vehicle] > 3, this list is the 3 vehicles the respondent will replace soonest based on their response in [replace_intent]. If the 3 vehicles the respondent will replace soonest cannot be identified based on their response in [replace_intent], a list of

all vehicles that will be replaced is displayed in this question, and the respondent will identify which 3 are likely to be replaced first.

[replace_soon]

Create list of 3 (max) HH vehicles from [replace_intent] that the respondent reported they will replace soonest. If we cannot generate a list of 3 vehicles from the information given in [replace_intent] (i.e. Respondent said 4 vehicles will be replaced in 3-5 years) then we need to create a list of HH vehicles for the respondent to choose which 3 will be replaced soonest. The list should include all HH vehicles where [replace_intent] was NOT Never

If list of 3 replacement vehicles cannot be determined: You indicated that <x> of your vehicles would eventually be replaced. Using the following list, please select the three vehicles that are likely to be replaced the soonest.

1. <year><make><model>
2. <year><make><model>
3. <year><make><model>

...

n. <year><make><model>

Programmer: <x> is the number of vehicles that are likely to be replaced soonest based on responses from [replace_intent] for all vehicles in [vehicle_details]. [year] [make] and [model] come from [vehicle_details].

Programmer:

Alternative Fuel Vehicles

[AFV_intro]

In these next questions, we would like to ask you about your level of past exposure and experiences related to alternative fuel vehicles.

Alternative fuel vehicles include:

Hybrid vehicles (HEV): A gasoline vehicle with a small battery that is charged inside the car and does not plug in for charging the battery (e.g. Toyota Prius).

Plug-in hybrid vehicles (PHEV): A gasoline vehicle with a larger battery than HEVs that can plug into an electrical outlet to charge (e.g. Ford Escape Plug-in Hybrid or Toyota Rav4 Prime), allowing the vehicle to operate like a battery electric vehicle for a short distance (10-50 miles) and then operate on gasoline for a much longer distance (~300-400 miles)

Fully electric vehicles (also called a battery electric vehicle, or BEV): A vehicle that operates only on electricity, with a battery that charges by plugging into an electrical outlet at home, at work, or at a fast charge station (e.g. Chevy Bolt, Mustang Mach-E, Nissan Leaf, Tesla).

Hydrogen fuel cell vehicles (FCVs): A vehicle that uses hydrogen to generate its own electricity in a fuel cell (e.g. Toyota Mirai). Hydrogen is stored in a tank onboard the vehicle and can be filled up at a hydrogen station.

Along the way, you can review descriptions using the available information icons, should you decide to. Place your cursor over the icon to be reminded of the definition of various alternative fuel vehicles.

Programmer: The info button at the end of questions in this section to display the descriptions for HEV, PHEV, BEV, and FCVs listed above.

If [fuel] ≠ "Hybrid (Gasoline)" for any vehicles in [vehicle_details]

[hybrid_experience]
Has your household ever owned or leased a **hybrid vehicle (HEV)?**

1. Yes
2. No

[past_hybrid] *if [hybrid_experience] = 'no'*
Which of the following best describes your past experience with HEVs?

I have…

1. … driven an HEV.
2. … not driven an HEV, but have ridden in one.
3. … not driven/ridden in an HEV, but know people who own them.
4. … noticed HEVs being driven or parked in my community.
5. … little or no experience with HEVs.

If [fuel] ≠ "Plug-in Hybrid Electric vehicle" for any vehicles in [vehicle_details]

[phev_experience]
Has your household ever owned or leased a **plug-in hybrid vehicle (PHEV)?**

1. Yes
2. No

[past_phev] *if [phev_experience] = 'no'*

Which of the following best describes your past experience with PHEVs?

I have…

1. … driven a PHEV.
2. … not driven a PHEV, but have ridden in one.
3. … not driven/ridden in a PHEV, but know people who own them.
4. … noticed PHEVs being driven or parked in my community.
5. … little or no experience with PHEVs.

If [fuel] ≠ "Full Electric vehicle" for any vehicles in [vehicle_details]

[bev_experience]
Has your household owned or leased a **fully electric vehicle** (also called a **battery electric vehicle**, or **BEV**)**?**

- o Yes
- o No

[past_bev] *if [bev_experience] = 'no'*
Which of the following best describes your past experience with BEVs?

I have…

1. … driven a BEV.
2. … not driven a BEV, but have ridden in one.
3. … not driven/ridden in a BEV, but know people who own them.
4. … noticed BEVs being driven on streets or parked in my community.
5. … little or no experience with BEVs.

If [fuel] ≠ "Hydrogen fuel cell electric vehicle" for any vehicles in [vehicle_details]

[fcv_experience]
Has your household owned or leased a hydrogen fuel cell vehicle (also called a **fuel cell vehicle**, or **FCV**)**?**

1. Yes
2. No

[past_fcv] *if [fcv_experience] = 'no'*
Which of the following best describes your past experience with FCVs?

I have…

1. … driven an FCV.
2. … not driven a FCV, but have ridden in one.
3. … not driven/ridden in a FCV, but know people who own them.
4. … noticed FCVs being driven on streets or parked in my community.
5. … little or no experience with FCVs.

[charge_spots] *[skip if any vehicles flagged as "bev" or "phev" in [vehicle_details]*
Plug-in vehicles such as BEVs or PHEVs have batteries that are recharged with electricity from electrical outlets or charging stations. Some people have charging options at home where they park their vehicles. However, vehicles can also be recharged away from home in public parking facilities, or at the workplace using chargers like those in the picture below.

Have you seen electric vehicle charging spots in any of the parking facilities that you frequent?

1. No, I haven't seen any.
2. Yes, in one place.
3. Yes, in a few places.
4. Yes, in several places.
5. I'm not sure whether I've seen any or not.

[charge_work] *if [charge_spots] = "yes" and [job_type] =" i only work in one location outside of my home" or [job_type] = "my work location regularly varies (including hybrid remote, or working at different jobsites)"*

Programmer: [job_type] comes from [individual_info]; only use the values for the respondent, not other hh members.

Is your workplace one of the places where you've seen electric vehicle charging spots?

1. Yes
2. No
3. I'm not sure

[hydrogen_station_awareness] *if flag_FCEV = no*

Fuel cell vehicles (FCVs) use hydrogen as their fuel. Are you aware of any hydrogen refueling stations in your area?

1. Yes
2. No

[hsa_distance] *if [hydrogen_station_awareness] = 'yes'*

Of the hydrogen stations you know about, about how far is the closest one from your home? (your best estimate, either in miles or minutes of driving time).

Text box entry – numbers only, allow 0 to 500, allow decimals

1. Miles
2. Minutes of driving time

Programmer: Create linked response options with selection of either miles or minutes of driving time as units.

ZEV Branch

Programmer: This branch of the survey will focus on one vehicle that is flagged as "PHEV," "BEV," or "FCEV," in [vehicle_details] AND which have data from [current_vehicle_info]. If there are multiple vehicles that are flagged, use the following logic to determine which vehicle will be the focus of these questions.

First, FCEV ≻ BEV ≻ PHEV. If [primary_driver] ≠ 'I am the primary driver,' flag 'Not Driver'

Second, IF there are multiple vehicles tied for highest priority, select the vehicle which respondent indicated they were primary driver of in [primary_driver].

Third, IF there are multiple vehicles tied for highest priority with the same primary driver status, let respondent choose between the tied vehicles with the following question.

[Zev_choice]

Please choose the vehicle you are most familiar with:

5. <Year> <make> <model> 1
6. <Year> <make> <model> 2
7. <Year> <make> <model> n

If PHEV or BEV continue; if FCEV skip to [fcev_intro]

Programmer: The dynamic text in the following questions <BEV or PHEV> is based on the selection in [zev_choice]; if the vehicle selected in [zev_choice] is flagged BEV, the dynamic text should say BEV, if the vehicle selected in [zev_choice] is flagged PHEV, the dynamic text should say PHEV.

[PEV Intro]
The next questions are specifically about your <year> <make> <model> <BEV or PHEV>, including how it is driven.

If flagged 'Not Driver': **Earlier, you indicated that <primary_driver> is the primary driver of the <BEV or PHEV>. Even though you may not be the primary driver, it is very important to us that you complete this survey. Please answer the questions as best you can, perhaps asking <primary_driver> for help *if it is convenient to do so*.**

If flagged 'Not Driver' AND [license] = 0 for all HH members: **Earlier, you indicated that you are not the primary driver of the <BEV or PHEV>. Even though you may not be the primary driver, it is very important to us that you complete this survey. Please answer the questions as best you can.**

Programmer: Show banner for remainder of ZEV supplement: ***Please focus on your*** *<Year> <Make> <Model>.*

[battery_miles]

IF [zev_choice] is BEV: **How many miles can you drive your BEV when starting with a fully-charged battery (on average)?**

IF [zev_choice] PHEV: **When starting with a fully-charged battery, how far can your PHEV be driven on electricity only?**

_____ Miles *Allow 0 – 500, no decimals*

[recharge_amount] *if bev*

When charging your <year> <make> <model> how much charge is typically left when you plug in (your best estimate)?

1. When the low battery warning comes on
2. Less than 10%
3. 10%-20%
4. 20%-50%
5. More than 50%

[home_charge]

Do you have the capability of recharging your <BEV or PHEV> when it is parked where you live?

1. Yes
2. No

[home_charge_timing]

Do you use a timer or an app to modify when your car charges?

1. Yes
2. No

[charging_tech_use] *if [home_charge] = 'yes'*

Which of the following charging technologies do you use most often at home?

Select all that apply.

1. Level 1 (standard 120-volt outlet)
2. Level 2 (240-volt outlet such as a dryer outlet)

[upgrade]

Did you pay to install a level 2 charging system at your home?

1. No, my home came with it (including access at an apartment complex)
2. No, a level 2 charging system cannot be installed at my home
3. No, I don't have level 2 charging, but it could be installed
4. Yes *if this response is selected the following textbox should appear*

   How much did the installation cost? $_____ *allow 0-20000*

[electricity_intro]

Next, we have a few questions about the electricity you use at home. Electricity providers offer multiple types of rate plans.

One type is called *Time-of-Use (TOU)* where the basic rate can vary depending on the time of day, and the time of year. Electricity on a TOU plan is typically more expensive during peak hours when demand is high (for example, 4 to 9 pm for May through October), and less expensive at other times (so-called off-peak or partial-peak times).

[variable_rates_usage]

Do you take advantage of the Time of Use rate your utility offers?

1. Yes
2. No

[ev_rate] *if [home_charge] = 'yes'*

Are you enrolled in an electric rate plan that is specifically designed for homes that include electric vehicle chargers?

1. Yes, and it applies to all my electricity usage
2. Yes, but it only applies to what is used on a separate EV meter
3. No
4. Not Sure/Don't Know

[charge_cost] *if [home_charge] = 'yes'*

Approximately how much do you pay (in cents per kilowatt-hour OR dollars per month) to charge your <BEV or PHEV>*at home*? (Your best estimate. If you don't know, you may select "Don't know".)

_____ cents per kilowatt-hour (kWh) *allow 0 – 100*

$_____ per month *allow 0-5000*

1. Don't know

Programmer: Only allow one box to be answered

[determine_cost] *if [charge_cost] ≠null*

How did you determine your answer to the cent-per-kilowatt-hour question?

1. I knew this off the top of my head
2. I looked at a bill (or asked someone in our household).
3. I made a rough guess

[weekday_charging] *if [home_charge] = 'yes'*

Over the last five weekdays (Monday-Friday), how often did you charge your <BEV or PHEV> at home during the following times? (Make your best estimate, and make a choice in each row.)

	1. Never	2. Less than once	3. 1 or 2 times	4. 3 or 4 times	5. Each of the last five days
1. Morning (7 am to 11 am)	o	o	o	o	o
2. Afternoon (11 am to 4 pm)	o	o	o	o	o
3. Evening (4 pm to 9 pm)	o	o	o	o	o
4. Overnight (9 pm to 7 am)	o	o	o	o	o

[weekend_charging] *if [home_charge] = 'yes'*

Over last two-day weekend, how often did you charge your <BEV or PHEV> at home during the following times (Saturday and Sunday)? (Your best estimate, and please make one choice in each row.)

	1. Never	2. Less than 1 time	3. 1 time	4. 2 times	5. 3 or more times
1. Morning (7am to 11 am)	o	o	o	o	o
2. Afternoon (11 am to 4 pm)	o	o	o	o	o
3. Evening (4 pm to 9 pm)	o	o	o	o	o
4. Overnight (9 pm to 7 am)	o	o	o	o	o

[home_importance] *if [home_charge] = 'yes'*

When deciding to purchase your <BEV or PHEV>, how important was the *availability* of *home charging*?

1. Not at all important
2. Slightly Important
3. Moderately Important
4. Very Important
5. Extremely Important

[park_work_school]

Many owners of plug-in vehicles use them for driving to work and/or to attend school, and park them there for extended periods of time. How often is your <BEV or PHEV> parked at a work or school location in a typical week?

1. Never
2. Less than 5 hours a week
3. 5 to 20 hours a week
4. 20 to 30 hours a week
5. 30 to 40 hours a week
6. More than 40 hours a week

[recharge_stations] *if [park_work_school] ≠'never'*

Which of the following types of recharging is available at the work/school locations where your <BEV or PHEV> is typically parked (your best estimate)?

	1. Available at multiple locations	2. Available at one location	3. Not Available	4. Not Sure
1. Level 1	o	o	o	o
2. Level 2 (240 V) (can be used for free)	o	o	o	o
3. Level 2 (240 V) (requires payment)	o	o	o	o
4. Direct Current (DC) fast charger (can be used for free)	o	o	o	o
5. Direct Current (DC) fast charger (requires payment)	o	o	o	o

[charging_freq] *if [recharge_stations] = 'available at multiple locations' or 'available at one location'*

For each available charging method, how often do you use it?

Programmer: These rows come from selections in [recharge_stations]	1. Never	2. Less than once per week	3. 1-2 times per week	4. 3-4 times per week	5. 5 or more times per week
Option 1					
Option 2					
Option n					

[work_school_importance] *if [recharge_stations] = 'available at multiple locations' or 'available at one location'*

When deciding to purchase your <BEV or PHEV>, how important were the following?

	1. Not at all important	2. Slightly important	3. Moderately Important	4. Very Important	5. Extremely Important
1. Availability of recharging at work/school					
2. Availability of ***free*** recharging at work/school					

[public_charging_intro]

Finally, we would like to ask about *public* chargers. These are chargers that are available to general public, located in gasoline stations, parking lots, parking garages, shopping malls, at hotels, hospitals, etc.

[public_pay]

About how much did you pay the last time you used a public charger?

$_____ *Allow 0-100; allow two decimal places*

[public_use]

About how many times have you used a *public charger* in the past month?

_____ times *allow 0 - 100*

[public_type] *if [public_use] > 0*

Please indicate which of the following types of public charging you have used over the past month.

Select all that apply.

1. Level 1 (120V)
2. Level 2 (240 V)
3. Direct Current (DC) Fast Charger
4. Other (please specify): _____

[public_wait] *if [public_use] > 0*

How often have you been unable to use public charging because all of the chargers were being used*?*

1. Never
2. Less than half of the time
3. About half of the time
4. Most or all of the time

[public_wait_time] *if public_type= "dc fast charger"*

How long did you have to wait the last time you used a public DC fast charger?

_____ minutes *allow 0-240*

[public_working] *if [public_use] > 0*

How often have you been unable to use public charging because the chargers were not working?

1. Never
2. Less than half of the time
3. About half of the time
4. Most or all of the time

[public_locations]

Last time you used a public charger, how many charging locations did you have to visit before you found one that was available and working?

1. 1 (the first location had a charger that was available and worked)
2. 2-5
3. More than 5

[public_importance]

When deciding to purchase your <BEV or PHEV>, how important was the availability of *public charging* in your decision?

1. Not at all important
2. Slightly Important
3. Moderately Important
4. Very Important

5. Extremely Important

[pev_incentives]

Over the past several years a variety of *incentives* have been available to buyers and leasers of plug-in vehicles. We would like to understand what role these might have played in *your* decision to buy or lease a <BEV or PHEV>. Please review the following descriptions of incentives, and indicate how important they were (or, if you were unaware of them, or they were not applicable).

[Randomize]	1. Not at all important	2. Slightly important	3. Moderately important	4. Very Important	5. Extremely important	6. Unaware	7. Not Applicable
1. Local or utility incentive (rebate or tax incentive, up to $5,000)	O	O	O	O	O	O	O
2. Federal tax incentives (up to $7,500)	O	O	O	O	O	O	O
3. California Clean Fuel Rewards program (up to $1000)	O	O	O	O	O	O	O
4. California state vehicle rebate (up to $2,500)	O	O	O	O	O	O	O
5. Manufacturer or dealer incentives (e.g. low interest rate, cash back)	O	O	O	O	O	O	O
6. Parking incentives (employer, business, or government)	O	O	O	O	O	O	O
7. Availability of carshare/car rental as part of purchase	O	O	O	O	O	O	O
8. HOV lane access	O	O	O	O	O	O	O
9. Free charging at your workplace or school	O	O	O	O	O	O	O

[V2G_pay]

The following questions are about your interest in "vehicle-to-grid integration" technology that draws power from an electric car's battery to power a home, tools or building, or the public electrical grid.

Programmer: For the dynamic text <$5 per hour / $10 per hour / $15 hour> below, randomize these three prices.

Would you consider participating in a program in which you are paid up to <$5 per hour / $10 per hour / $15 per hour> your <year> <make> <model> is plugged in at home and discharging energy from its battery to supply the public electrical grid?

1. Yes
2. No
3. Don't know

[V2H]

Would you be interested in discharging your vehicle's battery to power your home in the event of a power outage?

1. Yes
2. No
3. Don't know

[v2h_rates]

Would you be interested in discharging your vehicle's battery to power your home to avoid peak electricity rates?

1. Yes
2. No
3. Don't know

[pev_experience]

How would you judge your overall experience with your <BEV or PHEV>?

1. Very Poor
2. Poor
3. Neutral
4. Good
5. Very Good

[pev_charging_experience]

How would you judge your experience with charging your <BEV or PHEV>?

1. Very Poor
2. Poor
3. Neutral
4. Good
5. Very Good

[pev_recommend]
How likely are you to recommend your <BEV or PHEV> to a friend or family member?

1. Extremely Unlikely
2. Unlikely
3. Neutral
4. Likely
5. Extremely Likely

[solar_importance] *if [home_charge] = 'yes'*

When deciding to purchase your <BEV or PHEV>, how important was the *availability* of *solar panels*?

1. Not at all important
2. Slightly Important
3. Moderately Important
4. Very Important
5. Extremely Important
6. Solar panels are not available for my household

[battery_importance] *if [home_charge] = 'yes'*

When deciding to purchase your <BEV or PHEV>, how important was the availability of home battery storage devices (e.g., Tesla Powerwall)?

1. Not at all important
2. Slightly Important

3. Moderately Important
4. Very Important
5. Extremely Important
6. Home battery storage devices are not available to my household

[pev_confidence] *if flagged 'not driver'*

Thank you for answering these questions about your <BEV or PHEV> (even though you may not be the primary driver). Which of the following best describes your opinion about your answers to these questions:

1. Confident. I actually drive the vehicle frequently.
2. Confident. I got help from the primary driver.
3. Not as confident. I did my best based on my available knowledge.
4. Other, please specify: _____

If [zev_choice]=FCEV

[fcev_intro]

The next questions are specifically about your <year> <make> <model> Hydrogen Fuel Cell Vehicle (*FCV*), including how it is driven.

IF flagged 'Not Driver': **Earlier, you indicated that *<primary_driver>* is the primary driver of the *FCV.* Even though you may not be the primary driver, it is very important to us that you complete this survey. Please answer the questions as best you can, perhaps asking *[primary_driver]* for help *if it is convenient to do so*.**

*IF flagged 'Not Driver' **AND [license] = 0 for all HH members***: **Earlier, you indicated that you are not the primary driver of the *FCV.* Even though you may not be the primary driver, it is very important to us that you complete this survey. Please answer the questions as best you can.**

[fcev_refuel]

How frequently is your *FCV* refueled in a typical week/month?

_____ Times per

1. Week
2. Month

[fcev_refuel_when]

How low does the tank typically get before you refuel?

1. When the fuel light turns on
2. 1/4 tank
3. 1/2 tank
4. Other ___ *textbox, allow between 0 and 1*

[fcev_refuel_wait]

Last time you refilled your FCV, how long did you have to wait in line once you got to the station?

_____Hours *allow 0-5*

_____Minutes *allow 0-250*

Programmer: If one box is answered but the other is left blank, default the blank box to 0.

[fcev_refuel_locations]

How many hydrogen refueling locations have you visited to refuel your FCV in the past month?

0. Zero
1. One
2. Two
3. Three
4. Four or more

[fcev_station_convenience]

Which of the following statements best describe routine trips to a hydrogen refueling station?

Please select all that apply.

1. A station is conveniently located close to my home.
2. A station is conveniently located close to my workplace/school.
3. I must make a special trip just to refuel my FCV.

[fcev_refuel_distance]

What is the maximum distance you had to travel to get to a refueling station?

_____ miles

Or _____ minutes of driving time.

Programmer: Respondent should input miles OR minutes, not both.

[fcev_alternative]

Since owning your FCV, have you taken any trips that required *use of a different vehicle (or travel mode)* due to concerns about hydrogen station availability?

1. Yes
2. No

[fcev_alternative_2] *if [fcev_alternative] = 'yes'*

About how many times has this occurred?

_____ times during the past

1. Year
2. Month

Programmer: Show on same screen as [fcev_alternative].

Programmer: Respondent should select Year OR Month, not both.

[fcev_alternative_3] *if [fcev_alternative] = 'yes'*

Which of the following did you use instead?

Select all that apply.

1. Another household vehicle
2. Rental car paid for by the manufacturer
3. Rental car paid out of pocket
4. Taxi
5. Ridesharing service
6. Carsharing service (e.g. Zipcar, Car2Go)
7. Company/employer-owned car
8. Vehicle borrowed from relative/friend
9. Train
10. Bus

11. Rail/Subway
12. Airline
13. Other, please specify: _____

Programmer: Show on same screen as [fcev_alternative].

[fcev_fuel_cost]

What did the pump show for $/kg last time you filled up your car?

$_____ *allow 1-50*

[fcev_availability_importance]

When deciding to purchase your *FCV*, how important was *fuel availability* in your purchase decision?

1. Not at all important
2. Slightly Important
3. Moderately Important
4. Very Important
5. Extremely Important

[fcev_cost_importance]

When deciding to purchase your *FCV*, how important was *fuel cost* in your purchase decision?

1. Not at all important
2. Slightly Important
3. Moderately Important
4. Very Important
5. Extremely Important

[fcev_incentives]

Over the past several years a variety of *incentives* have been available to purchasers of hydrogen fuel cell electric vehicles. We would like to understand what role these might have played in *your* decision to purchase a *FCV*. Please review the following descriptions of incentives, and indicate how important they were (or, if you were unaware of them, or they were not applicable).

	1. Not at all important	2. Somewhat important	3. Moderately important	4. Very important	5. Extremely important	6. Unaware	7. Not applicable
1. Local incentive (tax incentive or rebate, up to $3,000)	O	O	O	O	O	O	O
2. California state vehicle rebate (up to $5,000)	O	O	O	O	O	O	O
3. Federal tax incentives (up to $8,000)	O	O	O	O	O	O	O
4. Manufacturer or dealer incentives (e.g. low interest rate, cash back, favorable lease terms)	O	O	O	O	O	O	O
5. Free fuel card	O	O	O	O	O	O	O
6. Parking incentives (employer, business, or government)	O	O	O	O	O	O	O
7. Availability of carshare/car rental as part of purchase	O	O	O	O	O	O	O
8. HOV lane access	O	O	O	O	O	O	O

[fcev_fueling_experience]

How would you judge the fueling experience with your *FCV*?

1. Very Poor
2. Poor

3. Neutral
4. Good
5. Very Good

[fcev_recommend]
How likely are you to recommend your *FCV* to a friend or family member?

1. Extremely Unlikely
2. Unlikely
3. Neutral
4. Likely
5. Extremely Likely

[fcev_confidence] *if flagged 'not driver'*

Thank you for answering these questions about your *FCV* (even though you might not be the primary driver). Which of the following best describes your opinion about your answers to these questions?:

1. Confident. I drive the vehicle frequently.
2. Confident. I got help from the primary driver.
3. Not as confident. I did my best based on my available knowledge.
4. Other, please specify: _____

Future Mobility Choices
[future_mobility_intro]

The following summarizes your household's current situation for vehicles and commute modes (based on your answers to previous questions).

Programmer: In first table, each row is a HH member's information. In second table, each row is a vehicle's information.

Person	Vehicle Most Driven	Driving Frequency	Usual Commute Mode
<name> *Programmer: From [member_details]*	<year> <make> <model> *Programmer: [year], [make], and [model] of vehicle matching <name> in row with [primary_driver] in [current_vehicle_info]*	<drive_freq> *Programmer: From [individual_info] matching <name> in row*	<commute_mode> *Programmer: From [individual_info] matching <name> in row*
…	…	…	…

Household Vehicle	Vehicle type	Fuel type	Approximate cost per 100 miles based on reported fuel economy
<year> <make> <model> *Programmer: [year], [make], and [model] of each vehicle in [vehicle_details] per row*	<type> *Programmer: [type] from [vehicle_details]*	<fuel> *Programmer: [fuel] from [vehicle_details]*	<Calculated based on [mpg] & 2024 fuel cost> *Programmer: [mpg] from [current_vehicle_info]* *Programmer: For plug-in hybrid vehicles, first calculate share of gas used by 1-[electric_percent] and share of electric used by [electric_percent].Then multiply each share by respective fuel cost and add to find composite fuel cost.*
…	…	…	…

We have a few more sets of questions related to how your household might meet its future mobility needs.

[future_purchase] *if [hh_vehicles] = 0*
Which of the following best describes your household?

1. We are likely to purchase or lease a vehicle sometime in the future.
2. We will likely continue to meet our mobility needs without purchasing or leasing our own vehicle.

[next_purchase] *if [hh_vehicles] > 0*

Considering your current situation, which of the following best describes your household's next purchase or lease of another car, SUV, van, or pickup truck? The next vehicle will be…

1. a replacement for my <first vehicle from list created in [replace_soon]>
2. a replacement for my <second vehicle from list created in [replace_soon], if exists>
3. a replacement for my <third vehicle from list created in [replace_soon], if exists>
4. an additional vehicle for the household
5. We will not be purchasing another vehicle. *If list created in [replace_soon] is null*

[replace_soon1] *if more than 1 vehicle is being replaced in 'less than 1 year' in [replace_intent] and [next_purchase] = 'an additional vehicle for the household'*

Which vehicle will your household replace next?

1. <Vehicle 1 that will be replaced in less than 1 year from [replace_intent]>
2. <Vehicle 2 that will be replaced in less than 1 year from [replace_intent]>
3. <Vehicle n that will be replaced in less than 1 year from [replace_intent]>

[purchase_timing] *if [next_purchase] = 'an additional vehicle for the household' or [future_purchase] = "we are likely to purchase or lease a car, suv, van, or pickup truck sometime in the future."*

When is this purchase or lease most likely to occur?

1. Less than 1 year
2. 1 to 2 years
3. 3 to 5 years
4. 6 to 10 years
5. More than 10 years

[info_display1] *if [purchase_timing] < 3 years OR if [next_purchase] = 1, 2 or 3 AND [replace_intent] = 1 or 2 for that vehicle*

For the next set of questions, please assume that the purchase/lease decision you have been considering will occur in the year 2026. *flag dce_year = 2026*

[info_display2] *if [purchase timing] >= 3 years OR if [next_purchase] = 1, 2 or 3 AND [replace_intent] = 3, 4 or 5 for that vehicle*

For the next set of questions, please assume that the purchase/lease decision you have been considering will occur in the year 2030. *Flag dce_year = 2030*

[info_display3] *if [future_purchase] = 'we will likely continue to meet our mobility needs without purchasing or leasing our own vehicle' or [next_purchase] = 'we will not be purchasing another vehicle'*

Although you have indicated that you are unlikely to purchase or lease a vehicle in the future, we are still interested in your opinions (should you change your mind).

For the next set of questions, please <u>assume</u> that you have decided to purchase or lease a vehicle for your household in the year *<randomly assign 2026 or 2030 flag dce_year = <2026 or 2030>.*

[info_display4]

Programmer: Combine this with whichever previous info_display (1, 2, or 3) was identified.

At that time a wide range of alternative fuel vehicle types will be available, including plug-in vehicles (BEVs and PHEVs) as well as hydrogen fuel cell vehicles (FCVs), in both the new and used vehicle markets. Vehicles may (or may not) have improved on features such as range, recharging/refueling time, and purchase price.

Similarly, there may be a greater number and availability of recharging stations for BEVs and PHEVs, and hydrogen refueling stations than there are today.

In the next questions, we would like you to identify which vehicle/fuel types you would seriously *consider* purchasing or leasing, assuming their features turn out to be acceptable.

[vehicletype_consideration]

First, laying aside such issues as new versus used, specific make/model, price range, etc., which of the following vehicle types are you most likely to consider purchasing or leasing in <dce_year>.

Programmer: [dce_year] comes from either [info_display1], [info_display2], or [info_display3]

Please select up to four. *Must select at least one vehicle type.*

1. Subcompact Car
2. Compact Car
3. Midsize CarLarge Car
4. Sports Car
5. Subcompact Crossover
6. Compact Crossover
7. Midsize Crossover/SUV

8. Large SUV
9. Small Van (Minivan)
10. Full-size/large Van
11. Small Pickup Truck
12. Full-size/large Pickup Truck

Programmer: These examples should appear when the respondent's cursor hovers over the info icons

Vehicle Class Examples:

1. *Subcompact Car: Mini Cooper, Kia Rio, Nissan Versa*
2. *Compact Car: Honda Civic, Mazda 3, Hyundai Elantra, Volkswagen Jetta*
3. *Midsize Car: Chevrolet Malibu, Honda Accord, Tesla Model 3, Toyota Camry*
4. *Large Car: Dodge Charger, Chrysler 300, Audi A7, Tesla Model S*
5. *Sports Car: BMW i8, Nissan Z, Ford Mustang, Porsche 911*
6. *Subcompact Crossover: Buick Encore, Kia Soul, Ford EcoSport, Honda HR-V, Fiat 500*
7. *Compact Crossover: Honda CR-V, Mazda CX-5, Tesla Model X, Ford Bronco*
8. *Midsize Crossover/SUV: Chevrolet Traverse, Honda Pilot, Kia Sorento, Porche Cayenne*
9. *Large SUV: Chevrolet Suburban, Ford Expedition, Chevrolet Tahoe, Lincoln Navigator*
10. *Small Van (Minivan): Chrysler Pacifica, Honda Odyssey, Nissan Quest, Toyota Sienna*
11. *Full-size/large Van: Chevrolet Express 1500, Ford Transit, Mercedes-Benz Sprinter, Nissan NV Cargo*
12. *Small Pickup Truck: Chevrolet Colorado, Hyundai Santa Cruz, Ford Ranger, Toyota Tacoma*
13. *Full-size/large Pickup Truck: Chevrolet Silverado, Ford F-Series, GMC Sierra, Toyota Tundra*

[fueltype_consideration]

For each vehicle type you are considering, which of the following fuel types would you consider in <dce_year>.

Programmer: [dce_year] comes from [info_display1], [info_display2], or [info_display3]

<Fill in rows from answers chosen in [vehicletype_consideration]>	1. Gasoline only	2. Hybrid	3. PHEV (gas/elec)	4. Diesel	5. BEV (electric only)	6. Hydrogen	7. PFCV (hydrogen/elec)
<Vehicle type 1>	•	•	•	•	•	•	•
<Vehicle type 2>	•	•	•	•	•	•	•
…	•	•	•	•	•	•	•
<Vehicle type 4>	•	•	•	•	•	•	•

Programmer: The number of rows in this table will vary from 1 to 4 depending on the selections in [vehicletype_consideration]

Programmer: These definitions should appear when the respondent hovers over the info icons

Fuel Type Definitions:

Powertrain	***Fuel(s) Used***	***Description of Vehicle***
Gasoline vehicle	*-Gasoline*	*A vehicle that operates on gasoline only and has no hybrid components.*
Hybrid vehicle (HEV)	*-Gasoline*	*A gasoline vehicle with hybrid components to increase fuel economy (e.g. Toyota Prius), but does not plug in for charging the battery.*
Plug-in Hybrid vehicle (PHEV)	*-Gasoline* *-Electricity*	*A gasoline vehicle with hybrid components and a battery that can be charged directly (e.g. Ford Escape Plug-in Hybrid or Toyota Rav4 Prime) which allows the vehicle to operate like a battery electric vehicle for a short distance (10-40 miles) and then operate on gasoline for longer distances (~300-400 miles).*
Diesel vehicle	*-Diesel*	*A vehicle that operates on diesel or biodiesel only and has no hybrid components.*
Battery Electric vehicle (BEV)	*-Electricity*	*A vehicle that operates on a battery only and charges by plugging in at home or at a station (e.g. Chevy Bolt, Mustang Mach-E, Nissan Leaf, Tesla).*
Hydrogen Fuel Cell vehicle (FCV)	*-Hydrogen*	*A vehicle that uses hydrogen to generate its own electricity in a fuel cell (e.g. Toyota Mirai). Hydrogen is stored in a tank onboard the vehicle and can be filled up at a hydrogen station.*

Plug-in Fuel Cell vehicle (PFCV)	*-Hydrogen* *-Electricity*	*A fuel cell electric vehicle with a battery that can be recharged directly from an electrical outlet or charging station. This vehicle can be powered by hydrogen fuel or electricity.*

[new_used]
For each vehicle/fuel types you are considering in <dce_year>**, which vehicle age and brand type would you most likely consider?**

Programmer: [dce_year] comes from [info_display1], [info_display2], or [info_display3]

Brand type consists of standard brands and premium brands. Standard brands have more affordable vehicles; whereas, premium brands offer high-end, luxury vehicles. Please hover your cursor over the ℹ icon to see which brands are classified as standard or premium.

Prices shown represent the final vehicle purchase price before rebates or other incentives.

<Fill in rows with each checked box in [fueltype_consideration]>	**Standard Make/Brand** ℹ			**Premium Make/Brand** ℹ		
	1. New	**2. Used (2-3 Years)**	**3. Used (4-6 Years)**	**1. New**	**2. Used (2-3 Years)**	**3. Used (4-6 Years)**
<Vehicle-type fuel-type combination 1>	o *(Price Range)*	o *(Price Range)*	o *(Price Range)*	o *(Price Range)*	o *(Price Range)*	o *(Price Range)*
<Vehicle-type fuel-type combination 2>	o *(Price Range)*	o *(Price Range)*	o *(Price Range)*	o *(Price Range)*	o *(Price Range)*	o *(Price Range)*
…	o *(Price Range)*	o *(Price Range)*	o *(Price Range)*	o *(Price Range)*	o *(Price Range)*	o *(Price Range)*
<Vehicle-type fuel-	o	o	o	o	o	o

type combination 28>	*(Price Range)*	*(Price Range)*	*(Price Range)*	*(Price Range)*	*(Price Range)*	*(Price Range)*

Programmer: Vans and pickup trucks cannot be premium. The maximum number of rows in this table is 28. The rows are vehicle-type fuel-type combinations from [fueltype_consideration].

Programmer: Round prices to the nearest $100.

Standard/Premium info button:

Standard Makes	Premium Makes
Buick	Acura
Chevrolet	Audi
Chrysler	BMW
Dodge	Cadillac
Ford	Genesis
GMC	Hummer
Honda	Infiniti
Hyundai	Jaguar
Jeep	Land Rover
Kia	Lamborghini
Mazda	Lexus
Mini	Lincoln
Mitsubishi	Lucid
Nissan	Mercedes-Benz
Subaru	Polestar
Toyota	Porsche
Volkswagen	Rivian
	Tesla
	Volvo

Ferrari
Maserati

Vehicle Type Discrete Choice Experiments
[cbc_intro]

Thanks for providing all of this information! The details you shared will help us ask more relevant questions in this section of the survey.

For the next section of this survey, we have created eight sets of vehicle choices for you with each set including four vehicles. Please carefully review the features for each of the vehicles and select the ONE vehicle you would most likely buy or lease. Please choose one vehicle from each set of options.

We understand that some of the combinations of features and fuel types may not currently exist. But, **please assume the combinations of features do exist and you could buy any of the vehicles presented to you.**

Some features that you may find important are not listed here, such as warranty, safety, reliability, technology and entertainment features, etc. Please assume that these features are identical across the four vehicles and only focus on the features that are listed when making your decision.

We also understand that the vehicles offered may not completely suit your needs. For the purpose of this study, please assume the four vehicles on each page are the only four available and you must buy one.

If you put your cursor over the attributes of each vehicle, you will see a definition of those attributes. It is important that you take some time to read and consider the definitions of any unfamiliar terms before answering any questions.

Programmer: The SP design space is located in a separate excel spreadsheet.

Autonomous Vehicle Discrete Choice Experiments
[cbc2_intro]
You are almost done! Thanks for hanging in there!

In this section, you will be shown four of the vehicles you indicated you would purchase in the previous section. Here, we will present various levels of autonomy that this

vehicle may include. These features will come with an **additiona**l cost. For each vehicle, you will be shown three levels of autonomy (Levels 3, 4, and 5) beyond the base features and the total cost of the vehicle at each level. Please indicate which of the vehicles you would be most interested in purchasing at the costs provided.

Fully autonomous vehicles (Level 5) drive themselves, control all operations, and are even able to travel without a human inside. They are connected to the Internet and able to communicate with users and, to some degree, other vehicles. This technology allows riders to rest or perform other tasks while in the vehicle. Eventually, autonomous vehicles could also pick-up or drop-off people or things, fully operating without anyone inside.

The base level is assumed to include features like adaptive cruise control and automatic braking. As you consider the additional levels of autonomy, we ask that you **assume** that the technology that would power that level of autonomy is **safe** and **widespread**.

You will see that if you put your cursor over the level name, you will see its definition. It is important that you take some time to read and consider the definitions of these levels before answering any questions.

Programmer: The SP design space is located in a separate excel spreadsheet.

Travel Modes and Autonomous Vehicles
[modes_used]

Thank you for your answers on the *future vehicle choice* questions. In this section we would like to learn your opinions on the more general *mobility options* that could be used by your household now and in the future.

What is your experience with the following transportation options for trips in your local area?

Please select one answer per row.

Programmer: Randomize rows in this table

	1. I'm not familiar with it	2. Not available where I live	3. Available where I live, but I never use it	4. Available where I live, and I use it
1. Work/school provided shuttle				
2. Public bus				
3. Light rail/tram/subway (e.g., BART, LA Metro, Sacramento Light Rail)				
4. Commuter train (e.g. Amtrak, Caltrain)				
5. Taxi (e.g. Yellow Cab)				
6. Rental car				
7. Ride-hailing (Uber/Lyft)				
8. Shared ride-hailing (UberPool/LyftLine)				
9. Carsharing (e.g. Car2Go, ZipCar)				
10. Bikesharing (e.g. Bay Area Bike Share)				
11. Shared eBikes or eScooters (e.g., Jump)				
12. Peer-to-peer car rental (e.g., Getaround, Turo)				

[modes_freq] *skip if no rows in [modes_used] were answered "available where i live, and i use it."*

How frequently do you use these transportation options?

Please select one answer per row.

Programmer: Rows in this table come from [modes_used]. Each row should be a row for which the respondent selected "Available where I live, and I use it."

<Insert all 'I use it' modes from [modes_used] Same order as [modes_used]>	1. Less than once a month	2. 1-3 times a month	3. 1-2 times a week	4. 3 or more times a week
<Mode 1>				
<Mode 2>				
<Mode n>				

[av_experience]

Do you currently or have you ever driven a car with the following features?

Select all that apply.

1. Front collision warning
2. Automatic emergency braking
3. Front collision steering assistance
4. Adaptive cruise control
5. Blind spot warning
6. Active lane change assistance
7. Lane departure warning
8. Lane centering
9. Rear cross traffic alert
10. Parking assistance
11. None of these

Programmer: Info button text:

Feature	Description
Front collision warning	Alerts the driver if it detects a slow-moving or stopped car or other obstacle in the vehicle's path.
Automatic emergency braking	A safety system that can identify when a possible collision is imminent and respond by activating the brakes.

Front collision steering assistance	Monitors the space in front of the vehicle and automatically steers the vehicle to avoid a front collision. Rather than just warning the driver or applying the brakes, this feature controls the direction of the vehicle.
Adaptive cruise control	Creates an idea of how close the driver's vehicle is to other vehicles and automatically adjusts the speed of the driver's vehicle to maintain safe distance.
Blind spot warning	Alerts the driver if it detects a vehicle in the blind spot area of a lane adjacent to the driver's vehicle.
Active lane change assistance	Monitors areas in adjacent lanes and, when activated, automatically changes lanes when an opening in traffic emerges. Rather than just warning the driver of other vehicles, this system executes the lane change itself.
Lane departure warning	Alerts the driver if it detects that the vehicle has drifted out of its lane without signaling.
Lane centering	Automatically keeps the vehicle centered in the lane in which it is travelling. This system does not just warn the driver of a deviation from the lane, but it actively keeps the vehicle in the lane even through gentle turns.
Rear cross traffic alert	Monitors areas behind a vehicle in reverse and alerts the driver if it detects approaching traffic.
Parking assistance	Automatically drives the vehicle into a parking spot. The driver may or may not be required to sit in the driver seat, depress the accelerator or brake pedal, or shift the vehicle's transmission gears.

[av_ridehail_aware]

Have you heard of rideshare services that are operated entirely by self-driving vehicles (i.e., vehicles that drive passengers from one place to another with no driver) such as Waymo or Cruise?

1. Yes
2. No

[av_ridehail] *if av_ridehail_aware== 'yes'*

Have you ever used a self-driving vehicle rideshare service such as Waymo or Cruise?

1. Yes
2. No

Autonomous Vehicle Attitudes [autonomous_att]

For each of the following statements, please choose the response that best expresses your opinion about self-driving vehicles. Assume the self-driving vehicles are safe and affordable. Your impressions are important even if you're not sure about some of the topics mentioned.

Programmer: Randomize rows in this table

	1. Strongly disagree	2. Somewhat disagree	3. Neither agree nor disagree	4. Somewhat agree	5. Strongly agree
1. If I had a self-driving car I would miss driving and being in control of my car.					
~~2. With a self-driving car, I would accept longer travel times so the self-driving vehicle could drive at a speed low enough to prevent unsafe situations for pedestrians and bicyclists.~~					
3. If I had a self-driving car, I would reduce my time at work and work more in the car.					

4. I would send an empty self-driving car to pick up/drop off my child.					
5. I am concerned about the effect of autonomous vehicles on people who make their living delivering things or driving others in passenger vehicles.					
6. I would be more likely to ride in autonomous vehicle if there were more autonomous vehicles on the roads than there currently are.					
7. I am concerned that the computer systems in an autonomous vehicle could be easily hacked in ways that put riders' safety at risk.					
8. If autonomous vehicles become widespread, I expect that the number of people killed or injured in					

traffic accidents would DECREASE.					
~~9. I would feel more comfortable riding in a driver-less public transit vehicle (for instance, a city bus) than a driver-less light duty vehicle.~~					

[autonomous_hhveh]
Now, consider your current situation with the vehicles your household now owns (if any), and imagine that self-driving vehicles have become widely available for purchase. Which of the following scenarios best describes your household?

1. We would be one of the first to buy a self-driving vehicle (either as a replacement or additional household vehicle)
2. We would eventually buy a self-driving vehicle, but only after they are in common use
3. We would wait as long as possible and try to avoid ever buying a self-driving vehicle

[autonomous_hheffect] *if [hh_vehicles] > 0*

If your household had self-driving vehicle, which of the following best describes how using a self-driving vehicle would affect you?

1. In addition to the autonomous vehicle, I would still own/lease the same number of cars that I currently do and drive them about as much as I currently do.
2. In addition to the autonomous vehicle, I would still own/lease the same number of cars that I currently do, but drive them less than I currently do.
3. The autonomous vehicle would replace one of the vehicles I currently own/lease (i.e., including the autonomous vehicle, I would own/lease the same number of vehicles I currently own/lease).
4. Owning an autonomous vehicle would mean that I would need to own/lease fewer number of vehicles than I currently own/lease (i.e., if I owned/leased an autonomous vehicle I would not need to own/lease as many vehicles as I currently do.).

[autonomous_rideshare] *if [hh_vehicles] > 0*
In the future, companies (like Waymo and Cruise) could operate a large fleet of self-driving vehicles across the state of California to provide on-demand

ride-hailing services. When you and/or family members decide to make a trip, an app is used to notify the fleet.

If *on-demand self-driving ride-hailing services were widely available today*, which of the following best describes how your household would use these services and how it would impact the vehicle(s) you currently own?

1. Keep current vehicles and not use any self-driving services
2. Keep current vehicles, but also use these self-driving services whenever needed or convenient
3. Get rid of one (or more) household vehicles and use self-driving ride-hailing services instead

[autonomous_pref]
Overall, what would be your relative interest in owning a self-driving vehicle versus using on-demand self-driving ride-hailing services?

1. Much more interested in owning a self-driving vehicle
2. Somewhat more interested in owning a self-driving vehicle
3. Somewhat more interested in using on-demand self-driving services
4. Much more interested in using on-demand self-driving services
5. I have no preference

Final Household Questions

[long_distance_travel]

Which of the following do you use when you take a multiple-day trip to another part of the state or country?

Select all that apply.

1. Drive my own car *do not include if hh_vehicle=0*
2. Rental car
3. Train
4. Bus
5. Airplane
6. Other _____

[housing]
What type of housing do you live in?

Do you live in…

1. Single family house not attached to any other house
2. Single family house attached to one or more houses (townhouse, duplex, triplex) each with separate entry
3. Accessory dwelling unit (ADU) such as a guest house, converted garage, or in-law quarters
4. A mobile home
5. Building with 2-4 apartments/ condos / studios / rooms
6. Building with 5-19 apartments/ condos / studios / rooms
7. Building with 20 or more apartments/ condos / studios / rooms
8. Boat, RV, Van, etc.
9. Other, please specify: _____

[geography]

Which of the following best describes the area where you currently live?

1. In a city center, central district, or downtown
2. In a city, but not in the city center, central district, or downtown
3. In a suburb or small city or town near or part of a larger city
4. In a small city, town, or village that is not part of a larger city
5. In a rural area

[home_parking]
Which of the following parking options best describes your home?

Select all that apply.

1. *If hh_veh>0* Have an attached garage where I park my car
2. *If hh_veh>0* Have an attached garage, but I park on the street
3. *If hh_veh=0 Have an attached garage*
4. *If hh_veh>0* Have a detached garage where I park my car
5. *If hh_veh>0* Have a detached garage, but I park on the street
6. *If hh_veh=0 Have a detached garage*
7. Carport (covered, not fully enclosed)
8. Driveway (not covered)
9. Assigned parking in lot or garage
10. Assigned parking on the street
11. Unassigned parking in lot or garage

12. Unassigned parking on the street
13. Other, please specify _____
14. None of these are available at my home

[home_electricity_access] *if not 'none of these' in [home parking]*

Of the parking options available at your home, which of them has the best access to electricity for possibly charging an electric vehicle?

Choose one.

Programmer: Only display selections from [home_parking]

1. <Filtered choices from above>
2. None of them has reasonable access.

[levelone_access] *if bev_flag and PHEV_flag are false & hh_veh>0*

Do you have a standard electric outlet (120 volts) within 60 feet of where you typically park your vehicle at home?

1. Yes
2. No

[leveltwo_access] *if bev_flag and PHEV_flag are false & hh_veh>0*

Do you have a 240 volt electric outlet, such as a dryer outlet, within 60 feet of where you typically park your vehicle at home?

1. Yes
2. No

[solar]
Do you currently have solar panels installed on your residence?

1. Yes
2. No

[solar_timing] *if solar== 'yes'*

In what year did you install solar panels?

_____ *allow 1980-2024*

Programmer: Show on same screen as [solar] when yes is selected

[solar_why] *if solar== 'yes'*

Which of the following motivated you to install solar panels?

Select all that apply.

1. A government-sponsored incentive
2. A lower utility bill
3. Reducing your carbon footprint
4. A power source for charging your electric vehicle
5. Other _____ *text box, limit to 250 characters*
6. They were installed before I moved in *clears set*

Programmer: Show on same screen as [solar] when yes is selected

[solar_future] *if [solar]= 'no'*

Are you planning on installing solar panels for your residence within the next 5 years?

1. Yes
2. No

Programmer: Show on same screen as [solar] when no is selected

[backup]

Do you have a backup energy source to provide power to your home during a grid outage?

1. Yes
2. No

[backup_future] *if [backup]= 'no'*

Are you planning on purchasing a backup energy source to provide power to your home during a grid outage in the next 5 years?

1. Yes
2. No

[backup_specify] *if [backup] = 'yes'*

What kind of backup energy source do you have to provide power to your home?

Select all that apply.

1. Gasoline, diesel, propane, or natural gas backup generator
2. Self-standing solar generator for grid outage
3. Battery storage device (e.g., Tesla Powerwall)
4. ~~Battery storage device without rooftop solar~~
5. EV battery connected and able to power home (e.g., Ford F-150 Lightning/Sunrun set up)
6. Other, please specify:_____

[backup_number] *if [backup_specify]= "battery storage device"*

How many backup battery storage devices do you have? _____ *Allow whole numbers between 1 and 20*

[backup_purpose] *if [backup_specify]= "battery storage device"*

Which of the following are purposes of your battery storage device(s) (other than as a backup power source during an outage)?

Select all that apply.

1. Storing excess electricity produced by solar panels.
2. Reducing electricity cost, by charging it in the off peak (low cost) and use/discharge during the peak hours (high cost)
3. Charging my EV(s)

[V2G_aware]

Vehicle-to-grid integration technology can be used to draw power from an electric car's battery to power either a home, a building, or the public electrical grid. Which of the following best describes your awareness of vehicle-to-grid integration technology?

1. I had never heard of vehicle-to-grid technology before taking this survey.
2. I am somewhat aware of vehicle-to-grid technology.
3. I am aware of vehicle-to-grid technology, but I do not know anyone who has used it.
4. I am aware of vehicle-to-grid technology, and I know someone who has used it.
5. I am aware of vehicle-to-grid technology, and I have used it.

[V2G]

The following questions are about your interest in "vehicle-to-grid integration" technology that draws power from an electric car's battery to power either a home, a building, or the public electrical grid. For the following set of questions, imagine that you are considering purchasing a new vehicle and that if you purchase a plug-in electric vehicle it could be charged and/or discharged with vehicle-to-grid integration technology. Indicate how the following scenarios would <u>influence the likelihood that you would purchase a plug-in electric vehicle</u>.

	1. More likely to purchase a plug-in electric vehicle	2. No effect on the likelihood of purchasing an electric vehicle	3. Less likely to purchase a plug-in electric vehicle	4. Don't know
1. I would be able to use my electric vehicle				

to supply power to my home in the event of a power outage.				
2. I would be able to charge my vehicle's battery during off-peak times and then use the vehicle's battery to power my home during on-peak times.				
3. *If [job_type]= 'Only work in one location outside of home' in [individual_info]* I would be paid up to $20 per hour if I choose to discharge my vehicle's battery while at work.				
4. I would be paid up to $20 per hour if I choose to discharge my vehicle's battery into the public electrical grid at home with a level 2 charging system.				

[v2g_willing]

Which of the following would make you <u>more</u> willing to participate in a "vehicle-to-grid integration" program? Check all that apply.

1. Being paid to discharge extra vehicle battery charge
2. Desire to support the grid, making electricity cheaper for everyone
3. Other _____ *textbox; limit to 250 characters*
4. I would not participate in a program like this *clears set*

[v2g_lesswilling]

Which of the following would make you <u>less</u> willing to participate in a "vehicle-to-grid integration" program? Check all that apply.

1. Payment for discharging battery will not be enough to be worth the hassle
2. I worry I will wear out the car battery and have to replace it
3. I worry exporting energy will void my battery warranty
4. I do not want to give utility visibility or control of my usage
5. I worry about cybersecurity
6. I do not believe it can be done without interfering with my transportation needs
7. Other _____ *textbox; limit to 250 characters*

[income]

To make certain our survey represents all income groups in California please select your <u>household</u> income category.

1. Less than $9,999
2. $10,000 to $24,999
3. $25,000 to $34,999
4. $35,000 to $49,999
5. $50,000 to $74,999
6. $75,000 to $99,999
7. $100,000 to $149,999
8. $150,000 to $199,999
9. $200,000 to $249,999
10. $250,000 or more
11. Prefer not to answer

[prize_email] *if not dynata*

Skip if 2,300 complete surveys with email entered in [prize_email]

Thanks for participating in the survey! Before you finish, please enter an email address where we can send you a $15 electronic gift card from an online retailer of your choice.

Your email address will only be used to send along your prize.

- Email: _____ *Text entry; prepopulate with [contact_info] if provided; enforce a valid email address*
- No thanks

[prize] *if entered a valid email in [prize_email]*
Which online retailer would you like to have a $15 electronic gift card to spend at?
*You should receive your prize at the email address you provided in **10 to 12 weeks** with the subject line 'California Vehicle Survey'*

1. Walmart
2. Amazon.com

[comments]
Thank you for participating!

We really appreciate your feedback. If you have additional comments or suggestions either about the survey or the survey experience itself, please enter them in the box below and click the "Next" button.

Programmer: Add text box; 1000 character limit; do not force a response

[follow-up] *if not dynata*
Would you be interested in participating in a follow-up survey at a later date?

1. Yes _____ (please enter your email address) *enforce valid email address, prepopulate with [prize_email] if provided. If not, prepopulate with [contact_info] if provided.*
2. No

[end]
Thank you for participating! Your responses will help the California Energy Commission understand the future vehicle needs of California businesses and

residents. If you have any questions about the survey, please email us at info@cavehiclesurvey.org.

Commercial Questionnaire (Including ZEV Questions)

Screener

[no_incentive]

If 2,200 complete surveys with email entered in [incentive_contact]

Thanks for your interest in the California Vehicle Survey!

We have had an enthusiastic response to this survey and have reached our target of 2,200 completed surveys. You can still participate, but unfortunately there are no additional $40 electronic gift cards available.

Would you still like to continue with the survey anyway?

3. Yes!
4. No thanks [terminate]

[intro]

Welcome to the California Vehicle Survey of Commercial Vehicle Owners and Managers.

The purpose of this survey is to do research on light-duty commercial vehicles in California, to better understand:

What vehicle types are being used, and how much they are driven; and

What vehicle choices are likely to be made in the near future.

Your answers will help the California Energy Commission, a State of California agency, understand and address your organization's vehicle and fuel needs now and in the future. The information you provide will be kept confidential by the California Energy Commission and RSG (the company that is collecting the survey data), in accordance with the California Information Practices Act of 1977 and the non-disclosure agreement between RSG and the Energy Commission.

(skip if 2,200 complete surveys with valid email entered in [incentive_contact]) Complete this survey and you will have the option to receive a $40 e-gift card to spend at Amazon or Walmart.

If you'd like to know more about the California Vehicle Survey, you can read the About and FAQ sections of this website.

Please use the "**Next**" button in the lower left-hand corner of the screen to go forward. To review and change a question, use the "**Previous**" button. It is important that you do not use your web browser's "**Forward**" or "**Back**" buttons because your new answers will be lost.

Answering all the questions will take approximately *30* minutes. If you cannot finish the survey in one sitting, you can stop at any time and return to where you left off by re-entering your password on the survey website.

Please click "**Next**" to begin.

Programmer: Link to cavehiclesurvey.org at "…this website."

[decision_maker]

We are interested in learning about your company's light-duty vehicles (less than 10,000 pounds gross weight). Are you familiar with any of the following?

Select all that apply.

1. The types and number of vehicles used by your organization
2. How vehicle purchase decisions are made within your organization
3. Neither *[This clears other selections]*

[switch_respondent] *if "neither" in [decision_maker]*

This survey must be completed by a person familiar with the types of light-duty vehicles used by your company at this location. Please share the postcard or letter with someone more familiar with your company's vehicles so they have an opportunity to complete the survey. They may resume the survey using the same password. Thank you.

The "Next" button on this page should return respondents to the [intro] page so they can proceed from the beginning again with the same password.

[org_type]

Which option best describes your organization?

1. Religious organization
2. Car rental company *[terminate]*
3. Taxi-cab company *[terminate]*
4. Government agency *[terminate]*
5. Other for-profit organization
6. Other non-profit organization
7. Other, please specify: _____
8. I don't know *[terminate]*

[terminate] *if respondent is terminated. Skip if Dynata.*

Thank you for taking the time to participate in the California Vehicle Survey.

Unfortunately, your answers do not qualify you for this survey.

Thank you again for your time and interest in this study.

You may close your browser to exit.

[zipcode]

What is the zip code at your business's location?

_____ *Must be 5 numbers; if not CA ZIP code, alert text: "This ZIP code is not located in California. Please make sure it was entered correctly"; after second try not CA ZIP code Terminate*

[county]

Which county is your office or place of business located in?

Select county from list: *<Drop-down list of counties>*

Programmer: Put the list below in the drop-down menu

60. Alameda County
61. Alpine County
62. Amador County
63. Butte County
64. Calaveras County
65. Colusa County
66. Contra Costa County
67. Del Norte County
68. El Dorado County
69. Fresno County
70. Glenn County
71. Humboldt County
72. Imperial County
73. Inyo County
74. Kern County
75. Kings County
76. Lake County
77. Lassen County
78. Los Angeles County
79. Madera County
80. Marin County
81. Mariposa County
82. Mendocino County
83. Merced County
84. Modoc County
85. Mono County
86. Monterey County
87. Napa County
88. Nevada County
89. Orange County
90. Placer County
91. Plumas County
92. Riverside County
93. Sacramento County
94. San Benito County
95. San Bernardino County
96. San Diego County
97. San Francisco County
98. San Joaquin County
99. San Luis Obispo County
100. San Mateo County
101. Santa Barbara County
102. Santa Clara County
103. Santa Cruz County
104. Shasta County
105. Sierra County
106. Siskiyou County
107. Solano County
108. Sonoma County
109. Stanislaus County
110. Sutter County
111. Tehama County
112. Trinity County
113. Tulare County
114. Tuolumne County
115. Ventura County
116. Yolo County
117. Yuba County
118. I don't know

Programmer: Skip this question and determine county using ZIP code.

[contact] *(skip if dynata)*

Can you provide an email address for us to contact you?

Your personal contact information will only be used to provide technical assistance, survey completion reminders or to gather feedback about the questionnaire and your experience. We will not sell or distribute your email address for any commercial marketing purposes.

[name] Name (optional):_____ *[allow no answer]*

[email] Email (optional):_____ *[allow no answer; force a valid email if text entered]*

[business_type]
How would you describe the type of business activity or industry associated with your company?

Business type: Drop down menu (See below)

Drop down options:

1. Offices (non-medical, including professional services)
2. Restaurant/Food Service
3. Agricultural (farms, greenhouses)
4. Retail Stores (clothing, department stores, grocery stores, gas station)
5. Warehouse
6. Health Care (hospitals, medical offices, laboratories)
7. Education
8. Lodging (hotel/rooms)
9. Public Assembly (church, fitness, theatre, library, museum, convention)
10. Services (hair/nail, massage, spa, car/other repair)
11. Industrial (food processing plant, manufacturing)
12. Laundry (Coin Operated, Commercial Laundry Facility, Dry Cleaner)
13. Condo Assoc./Apartment Mgr (Garden Style, Mobile Home Park, High-rise, Townhouse)
14. Construction/Building Services (plumbing, HVAC, electrician, etc.)
15. Other *add text box with this selection*
16. Don't know

[business_type_specific]
Please briefly describe the kind of organization or business you work for.

_____ *[text box] [limit to 100 characters]*

[Title]
What is your title or role in the organization or business?

Title: *[text box] [limit to 50 characters]*

[cal_locations]

About how many business locations, in total, does your company have in California?

Business locations in California:_____ *[allow 1-500]*

[loc_amnt] *if [cal_locations]>1*

How many of these locations have company-owned commercial light-duty vehicles (less than 10,000 pounds gross weight) based there?

Locations with company-owned commercial light-duty vehicles: _____ *[allow 0 to value entered on [cal_locations]; if 0, terminate]*

[employee_num]

How many employees are there at the location where you work? Please include all shifts and all employees that work off-site but are based out of your location.

Number of employees: *[allow 1-100,000]*

[transportation]

Which of the following transportation services does your organization use, if any?

Select all that apply.

1. Ride hailing (such as a taxi)
2. Ride sharing (such as Uber or Lyft)
3. Courier services
10. Delivery hailing (such as Amazon)
4. Internal ride sharing
5. Public Transit
6. Rental Cars
7. Car Sharing (such as ZIP car, etc.)
8. None of the above *clears all selections*

[need_vehicles] *if [transportation] ≠ none of the above*

Do any of the transportation services that your organization uses reduce the need to add a vehicle or replace an existing vehicle?

1. Yes
2. No

3. Don't know

Fleet Information
[comm_veh]

Does your organization have any vehicles that meet ALL of the requirements below?

Vehicle Requirements:

- Must be based at your location
- Must be light-duty (weighing under 10,000lbs)
- Must be driven for business purposes 50% of the time or more.

1. Yes, my organization has at least one vehicle that meets all of these requirements
2. No *flag as not_qualifying skip to [fleet_personal]*

[vtype]

Which types of vehicles does your organization have that meet all of these requirements?

Remember to focus only on vehicles that are:

- Based at your location
- Registered to business, company, or employee
- Light-duty (weighing under 10,000lbs)
- Driven for business purposes 50% of the time or more

Select all that apply.

1. Car *flag has_cars*
2. SUV/Crossover *flag has_SUV_X*
3. Van/Minivan *flag has_Van*
4. Pickup Truck *flag has_Pickup*
5. None of these *flag not_vtype, skip to [fleet_personal]; clear selections*

[ftype]
For the vehicles that meet the requirements below, specify the number of vehicles in the following fuel type categories.

Remember to focus only on vehicles that are:

- Based at your location
- Registered to a business, company, or employee
- Light-duty (weighing under 10,000lbs)
- Driven for business purposes 50% of the time or more

Select all that apply.

Programmer: ONLY show vehicle types selected in [vtype]; respondents must select one fuel type for each vehicle type chosen in [vtype]; after each option, create a text box that allows whole numbers >0 and <10,000; enforce that a valid number must be entered on any line with a checked box; save the sum of all entered numbers in this question as [veh_sum]

_____

Cars

Gasoline (runs on gasoline only) #_____

Hybrid [HEV] (runs on gasoline) #_____ *flag hev*

Flex fuel [E85/FFV] (runs on gasoline or E85) #_____

Plug-in hybrid [PHEV] (runs on gasoline and/or electricity) #_____ *flag phev*

Diesel (runs on diesel and/or biodiesel fuel) #_____

Battery electric [BEV] (runs on electricity only) #_____ *flag bev*

Hydrogen fuel cell [FCV] #_____ *flag fcev*

Compressed natural gas [CNG] #_____

Other, please specify: _____ #_____

_____

SUVs / Crossovers

Gasoline (runs on gasoline only) #_____

Hybrid [HEV] (runs on gasoline) #_____ *flag hev*

Flex fuel [E85/FFV] (runs on gasoline or E85) #_____

Plug-in hybrid [PHEV] (runs on gasoline and/or electricity) #_____ *flag phev*

Diesel (runs on diesel and/or biodiesel fuel) #_____

Battery electric [BEV] (runs on electricity only) #_____ *flag bev*

Hydrogen fuel cell [FCV] #_____ *flag fcev*

Other, please specify: _____ #_____

_____

Vans / Minivans

Gasoline (runs on gasoline only) #_____

Hybrid [HEV] (runs on gasoline) #_____ *flag hev*

Flex fuel [E85/FFV] (runs on gasoline or E85) #_____

Plug-in hybrid [PHEV] (runs on gasoline and/or electricity) #_____ *flag phev*

Diesel (runs on diesel and/or biodiesel fuel) #_____

Battery electric [BEV] (runs on electricity only) #_____ *flag bev*

Hydrogen fuel cell [FCV] #_____ *flag fcev*

Other, please specify: _____ #_____

_____

Pickup Trucks

Gasoline (runs on gasoline only) #_____

Hybrid [HEV] (runs on gasoline) #_____ *flag hev*

Flex fuel [E85/FFV] (runs on gasoline or E85) #_____

Plug-in hybrid [PHEV] (runs on gasoline and/or electricity) #_____ *flag phev*

Diesel (runs on diesel and/or biodiesel fuel) #_____

Battery electric [BEV] (runs on electricity only) #_____ *flag bev*

Hydrogen fuel cell [FCV] #_____ *flag fcev*

Other, please specify: _____ #_____

_____

Error text: "You must select at least one fuel type for each category. If your business/organization doesn't own any vehicles within one of the categories shown please click the 'Previous' button and adjust your response to the last question. You must also enter the total number of vehicles that use each selected fuel type."

[Mpge] *if any responses in [ftype] are not gasoline*

Select one of your vehicles that does not run on gasoline, and indicate its average miles per gallon equivalent (MPGe).

If you are not sure, please give your best estimate.

_____ MPGe *textbox; allow 1-200*

Programmer: Error message: "Your answer should be a whole number between 1 and 200."

[fleet_verify]

Based on your responses there <are/is> <veh_sum> **total vehicle(s) meeting all of the requirements below. Is this correct?**

Programmer: <veh_sum> is the <sum of all entries> from [ftype]; if this sum = 1, the dynamic text should be <is>; if this sum >1, the dynamic text should be <are>

Vehicle Requirements:

- Must be based at your location
- Registered to a business or company OR must be driven for business purposes 50% of the time or more
- Must be light-duty (weighing under 10,000lbs)

1. Yes, this total is correct
2. No, bring me back so I can update my responses → *return back to [comm_veh]*

[fleet_personal]
Does your organization have any vehicles meeting the requirements below that are driven for personal use over 50% of the time?

Vehicle Requirements:

- Must be based at your location
- Registered to a business, company, or employee
- Must be light-duty (weighing under 10,000lbs)

Yes, we have vehicles meeting these criteria that are driven for personal use over 50% of the time. *If selected create a textbox: How many?* _____

If [comm_veh] = "Yes" and [vtpe] is not 5 No, all of the vehicles meeting these criteria are used for business purposes 50% of the time or more.

If [comm_veh] = "No" No, we don't have any vehicles meeting these requirements. *Terminate*

Programmer: Do not allow 0 in textbox.

[survey_focus]
From this point forward we ask that you focus ONLY on light-duty vehicles that meet the requirements below.

Please focus ONLY on vehicles that are:

- Based at your location
- Light-duty (weighing under 10,000lbs)
- Driven for business purposes 50% of the time or more

Click "**Next**" to continue.

[av_experience]

Does your company currently or has your company ever had cars with the following features?

Select all that apply.

1. Front collision warning
2. Automatic emergency braking
3. Front collision steering assistance
4. Adaptive cruise control
5. Blind spot warning
6. Active lane change assistance
7. Lane departure warning
8. Lane centering

9. Rear cross traffic alert
10. Parking assistance
11. None of these

Programmer: Info button text:

Feature	Description
Front collision warning	Alerts the driver if it detects a slow-moving or stopped car or other obstacle in the vehicle's path.
Automatic emergency braking	A safety system that can identify when a possible collision is imminent and respond by activating the brakes.
Front collision steering assistance	Monitors the space in front of the vehicle and automatically steers the vehicle to avoid a front collision. Rather than just warning the driver or applying the brakes, this feature controls the direction of the vehicle.
Adaptive cruise control	Creates an idea of how close the driver's vehicle is to other vehicles and automatically adjusts the speed of the driver's vehicle to maintain safe distance.
Blind spot warning	Alerts the driver if it detects a vehicle in the blind spot area of a lane adjacent to the driver's vehicle.
Active lane change assistance	Monitors areas in adjacent lanes and, when activated, automatically changes lanes when an opening in traffic emerges. Rather than just warning the driver of other vehicles, this system executes the lane change itself.
Lane departure warning	Alerts the driver if it detects that the vehicle has drifted out of its lane without signaling.
Lane centering	Automatically keeps the vehicle centered in the lane in which it is travelling. This system does not just warn the driver of a deviation from the lane, but it actively keeps the vehicle in the lane even through gentle turns.
Rear cross traffic alert	Monitors areas behind a vehicle in reverse and alerts the driver if it detects approaching traffic.
Parking assistance	Automatically drives the vehicle into a parking spot. The driver may or may not be required to sit in the driver seat, depress the accelerator or brake pedal, or shift the vehicle's transmission gears.

Vehicle Use and Refueling
[refueling_parking]

To improve our understanding of current and future energy use in California, we would like to learn more about how you use and refuel your vehicles.

Does your company have access to its own dedicated parking facilities where vehicles can be parked/stored (including overnight)?

Select all that apply.

1. Yes, at or near my location *Flag as "on-location"*
2. Yes, elsewhere (at other company owned location(s)) *Flag as "other-location"*
3. No *Skip to [refueling_future]*

[refueling_infrastructure]
Does your company currently have any onsite refueling capabilities (for example, gasoline, diesel or hydrogen pumps, electric vehicle recharging, etc.) at any of its dedicated parking facilities?

1. Yes
2. No *Skip to [refueling_possible]*

[refueling_types] *if [refueling_infrastrcutre] = "yes"*
Which types of onsite refueling are currently available at your company's dedicated parking facilities?

	1. At or near my current location *Show this column if "Yes, at or near my location" selected in [refueling_parking]*	2. At a company owned location elsewhere *Show this column if "Yes, elsewhere" selected in [refueling_parking]*
1. Gasoline		
2. Diesel		
3. Compressed Natural Gas (CNG)		
4. E85		

5. Level 1 (120 V) (standard outlet)	*Flag 'company charging'*	*Flag 'company charging'*
6. Level 2 (240 V)	*Flag 'company charging'*	*Flag 'company charging'*
7. DC Fast charger	*Flag 'company charging'*	*Flag 'company charging'*
8. Hydrogen	*Flag 'company hydrogen'*	*Flag 'company hydrogen'*

[refueling_possible] *if [refueling_infrastructure] = "no"*
Although your company's dedicated parking facilities do not currently have any on-site refueling, would it be physically possible to install onsite refueling or recharging in the future?

1. Yes, only refueling
2. Yes, only recharging
3. Yes, both refueling and recharging
4. No
5. Don't know

[refueling_future] if [refueling_infrastructure] = "yes" or [refueling_possible] = *"yes"*
Does your company plan on purchasing/installing any new or additional refueling capabilities at your current location in the next 5 years?

Select all that apply.

1. Gasoline fueling capabilities
2. Diesel fueling capabilities
3. E85 fueling capabilities
4. 120 V Level 1 Charger (standard outlet)
5. 240 V Level 2 Charger
6. DC Fast Charger
7. Solar panels
8. Hydrogen fueling capabilities
9. Compressed natural gas fueling capabilities
10. None of the above

[backup]

Do you have a backup energy source to provide power to your business during a grid outage?

1. Yes
2. No

[backup_specify] *if [backup] = 'yes'*

What kind of backup energy source do you have to provide power to your business?

Select all that apply.

1. Gasoline, diesel, propane, or natural gas backup generator
2. ~~Solar panels~~
3. Self-standing solar generator for grid outage
4. Battery storage device (e.g., Tesla Powerwall)
5. ~~Battery storage device without rooftop solar~~
6. EV battery connected and able to power business (e.g., Ford F-150 Lightning/Sunrun set up)
7. Other, please specify: _____

[backup_number] *if [backup_specify]= "battery storage device with rooftop solar" or "battery storage device without rooftop solar"*

How many backup battery storage devices do you have? _____ *Allow whole numbers between 1 and 20*

Programmer: Error message: "Your answer should be a whole number between 1 and 20."

[backup_purpose] *if [backup_specify]= "battery storage device with rooftop solar" or "battery storage device without rooftop solar"*

Which of the following are purposes of your battery storage device(s) (other than as a backup power source during an outage)?

Select all that apply.

1. Storing excess electricity produced by solar panels.
2. Reducing electricity cost, by charging it in the off peak (low cost) and use/discharge during the peak hours (high cost)
3. Charging our EV(s)
4. Other, please specify: _____

Alternative Fuel Vehicles

[AFV_intro]

In these next questions, we would like to ask you about your level of past exposure and experiences related to alternative fuel vehicles.

Alternative fuel vehicles include:

> **Hybrid vehicles (HEV):** A gasoline vehicle with a small battery that is charged inside the car and does not plug in for charging the battery (e.g. Toyota Prius).

Plug-in hybrid vehicles (PHEV): A gasoline vehicle with a larger battery than HEVs that can plug into an electrical outlet to charge (e.g. Toyota Prius Prime), allowing the vehicle to operate like a battery electric vehicle for a short distance (10-50 miles) and then operate on gasoline for a much longer distance (~300-400 miles).

Fully electric vehicles (also called a battery electric vehicle, or BEV): A vehicle that operates only on electricity, with a battery that charges by plugging into an electrical outlet at home, at work, or at a fast charge station (e.g. Nissan Leaf, Tesla).

Hydrogen fuel cell vehicles (FCVs): A vehicle that uses hydrogen to generate its own electricity in a fuel cell (e.g. Toyota Mirai). Hydrogen is stored in a tank onboard the vehicle and can be filled up at a hydrogen station.

Along the way, you can review descriptions using the available information icons, should you decide to.

Programmer: Link back to these descriptions with the info button in the following questions

[hybrid_experience] *if flag_hev is false*

Has your company ever owned or leased any hybrid vehicles (HEVs)?

1. Yes
2. No

[PHEV_experience] *If flag_phev is FALSE*

Has your company ever owned or leased any plug-in hybrid vehicles (PHEVs)?

1. Yes
2. No

[PHEV_consideration] *if [phev_experience] = 'no'*

Has your company ever *considered* purchasing light-duty PHEV?

1. Yes
2. No
3. Not Sure

[past_phev] *if [phev_experience] = 'no'*

Which of the following best describes your past experience with PHEVs?

I have…

1. … driven a PHEV.
2. … not driven a PHEV, but have ridden in one.
3. … not driven/ridden in a PHEV, but know people who own them.
4. … noticed PHEVs being driven or parked in my community.

5. … little or no experience with PHEVs.

[BEV_experience] *if flag_bev is false*
Has your company ever owned or leased any fully electric vehicles (also called battery electric vehicles, or BEVs)?

1. Yes
2. No

[BEV_consideration] *if [bev_experience] = 'no'*
Has your company ever *considered* purchasing light-duty BEVs?

1. Yes
2. No
3. Not Sure

[FCEV_experience] *if flag_fcev is false*
Has your company owned or leased any hydrogen fuel cell vehicles (also called fuel cell vehicles, or FCVs)?

1. Yes
2. No

[FCEV_consideration] *if [fcev_experience] = 'no'*
Has your company ever *considered* purchasing light-duty FCVs?

1. Yes
2. No
3. Not Sure

[past_fcev] *if [fcev_experience] = 'no'*
Which of the following best describes your past experience with FCVs?

I have…

1. … driven an FCV
2. … not driven a FCV, but have ridden in one
3. … not driven/ridden in a FCV, but know people who own them
4. … noticed FCVs being driven on streets or parked in my community
5. … little or no experience with FCVs.

[fcev_concerns] *if flag_fcev is false*

Suppose you were considering purchasing/leasing hydrogen fuel cell vehicles (FCVs) for use at your company. Please indicate your top concerns about these vehicles by selecting from the following list.

Select up to five concerns…
[Randomize list]

1. Too expensive
2. Limited seating capacity
3. Limited hauling capacity
4. Limited vehicle body/styling of vehicle
5. Safety of hydrogen tank
6. Uncertain gasoline/hydrogen price
7. Cost of installing fueling equipment at your work location
8. Lack of fueling infrastructure outside your work location
9. Uncertain resale value for vehicle
10. Technology is still too new/unreliable
11. Other, please specify: _____ *[anchor]*
12. I don't have any concerns because I don't know enough about this technology *[anchor]*
13. Nothing concerns me about this technology *[anchor]*

[fcv_station_awareness] *if flag_fcev is false*

Hydrogen fuel cell vehicles (FCVs) use hydrogen as their fuel. Are you aware of any hydrogen refueling stations in your region?

1. Yes
2. No
3. Don't know

BEV & PHEV questions [if flag_BEV OR flag_phev is TRUE]

[primary_chargeloc] *if flag_company_ charging is true*

Considering your company's plug-in electric vehicles, are they charged primarily using chargers on a company site, at a non-company location, or a mix of both company and non-company locations?

Programmer: Only show vehicle types from [ftype] that are flagged as phev or bev	1. Primarily company site chargers	2. Primarily non-company chargers	3. A mix of company and non-company chargers

1. <Cars>	o	o	o
2. <SUVs>	o	o	o
3. <Vans>	o	o	o
4. <Trucks>	o	o	o

[primary_chargetech] *if ('company' or 'mix' on [primary_chargeloc]) and multiple charging technologies on [refueling_types]*

For those vehicles charged on site, which charging technology is used most often?

Programmer: Only show vehicle types from [ftype] that are flagged as phev or bev	<Level 1 (120 V)> *If "Level 1" was selected in [refueling types]*	<Level 2 (240 V)> *If "Level 2" was selected in [refueling types]*	<DC Fast> *If "DC Fast" was selected in [refueling types]*
1. <Cars>	o	o	o
2. <SUVs>	o	o	o
3. <Vans>	o	o	o
4. <Trucks>	o	o	o

[plug_freq] *if 'company' or 'mix' on [primary_chargeloc]*

During weekdays (Monday-Friday), about how often are these vehicles plugged in on site?

Programmer: Only show vehicle types from [ftype] that are flagged as phev or bev	Never	Less than once a week	1 or 2 times per week	3 or 4 times per week	Daily
1. <Cars>	o	o	o	o	o
2. <SUVs>	o	o	o	o	o
3. <Vans>	o	o	o	o	o
4. <Trucks>	o	o	o	o	o

[electricity_intro]

Next, we have a few questions about the electricity you use at your business. Electricity providers frequently offer multiple types of rate plans.

One type is called *Time-of-Use* (TOU) where the basic rate can vary depending on the time of day, and also the time of year. Electricity on a TOU plan is typically more expensive during *peak hours* when demand is high (for example, 4 to 9 pm for May through October), and less expensive at other times (so-called *off-peak* or *partial-peak times*).

[variable_rates]

Does your electricity provider offer different rates for peak and non-peak usage?

1. Yes
2. No
3. Not sure/Don't know

[variable_rates_usage] *if [variable_rates] = 'yes'*

Do you take advantage of your electricity provider's program that offers different rates for peak and non-peak usage?

1. Yes
2. No

[ev_rate]

Are you enrolled in an electric rate plan that is specifically designed for buildings that include electric vehicle chargers?

1. Yes, and it applies to all my electricity usage
2. Yes, but it only applies to what is used on a separate EV meter
3. No
4. Not Sure/Don't Know

[chargetime_day] *if ('company' or 'mix' on [primary_chargeloc]) and [plug_freq] ≠ 'never'*

During weekdays (Monday-Friday), what time of day are these vehicles typically charging on site?

Programmer: Only show vehicle types from [ftype] that are flagged as phev or bev	1. Morning (7 am to 11am)	2. Afternoon (11 am to 4 pm)	3. Evening (4 pm to 9 pm)	4. Overnight (9 pm to 7 am)
1. <Cars>	☐	☐	☐	☐
2. <SUVs>	☐	☐	☐	☐
3. <Vans>	☐	☐	☐	☐
4. <Trucks>	☐	☐	☐	☐

[charge_weekend] *if 'company' or 'mix' on [primary_chargeloc]*

During weekends, what time of day are these vehicles typically charging on site?

Programmer: Only show vehicle types from [ftype] that are flagged as phev or bev	1. Morning (7 am to 11am)	2. Afternoon (11 am to 4 pm)	3. Evening (4 pm to 9 pm)	4. Overnight (9 pm to 7 am)	5. These vehicles are never charged on site during weekends
1. <Cars>	☐	☐	☐	☐	☐
2. <SUVs>	☐	☐	☐	☐	☐
3. <Vans>	☐	☐	☐	☐	☐
4. <Trucks>	☐	☐	☐	☐	☐

[electricity_rate] *if flagged as 'company charging' on [refueling_types]*

About how much does your company pay (in cents per kilowatt-hour) to charge plug-in electric vehicles at company charging locations?

_____ cents per kilowatt-hour (kWh)

1. I don't know

[charge_timing] *if flagged as 'company charging' on [refueling_types]*

Do you use a timer or an app to modify when your car charges?

1. Yes

2. No

[offsite_chargeloc] *if ('non-company' or 'mix' on [primary_chargeloc]) or not flagged as 'company charging' on [refueling_types]*

Based on your earlier responses, your company uses non-company chargers. Please indicate which of the following are used for charging your company's plug-in electric vehicles.

Programmer: nly show vehicle types from [ftype] that are flagged as phev or bev	1. Primarily at an Employee's / Owner's home(s)	2. Primarily at Public charging stations	3. A mix of home and public	4. Primarily at another location	5. Not Sure
1. <Cars>					
2. <SUVs>					
3. <Vans>					
4. <Trucks>					

[public_cost] *if "primarily at public charging stations" selected for any vehicle type in [offsite_chargeloc]*

About how much did you pay the last time you used a public charger?

$_____ *Allow 0-100; allow two decimal places*

Programmer: Error message: "Your answer should be a dollar amount with two or fewer decimal places."

[home_upgrade] *if 'primarily at home' or 'mix' on [offsite_chargeloc]*

Did your business incur any expense to upgrade your (or another employee's) electrical system at home to support recharging plug-in electric vehicles? Please select the following which best describes the upgrade expenses.

1. Yes, at 100% expense to the business
2. Yes, with shared payment from the business and the homeowner
3. No, it was paid for by the homeowner
4. No, the electrical system at the home was not upgraded for this vehicle
5. Other: _____
6. I don't know

[home_pay] *if 'primarily at home' or 'mix' on [offsite_chargeloc]*

Who pays for the electricity for recharging this vehicle when it is parked at your (or another employee's) home?

1. Our business
2. The homeowner
3. Partially by the business and partially by the homeowner
4. I don't know

[incentive_importance]

Over the past several years a variety of incentives have been available to buyers and leasers of plug-in vehicles. We would like to understand what role these might have played in your company's decision to buy or lease plug-in electric vehicles. Please review the following descriptions of incentives, and indicate how important they were (or, if you were unaware of them, or they were not applicable).

[Randomize]	Not at all important	Slightly important	Moderately important	Very important	Extremely important	Unaware	Not applicable
1. Local or utility incentive (rebate or tax incentive, up to $5,000)	O	O	O	O	O	O	O
2. Federal tax incentives (up to $7,500)	O	O	O	O	O	O	O
3. California Clean Fuel Rewards Program $1,000	O	O	O	O	O	O	O
4. California state vehicle rebate (up to $2,500)	O	O	O	O	O	O	O
5. Manufacturer or dealer incentives (e.g. low interest rate, cash back)	O	O	O	O	O	O	O
6. Parking incentives (business, or government)	O	O	O	O	O	O	O
7. Availability of carshare/car rental as part of purchase	O	O	O	O	O	O	O
8. HOV lane access	O	O	O	O	O	O	O

[BEV_experience2] *if flag_bev is true*

How would you judge your company's overall experience with battery electric vehicles?

1. Very Poor
2. Poor
3. Neutral
4. Good
5. Very Good

[BEV_fueling_experience]

How would you judge your company's experience with charging battery electric vehicles?

1. Very Poor
2. Poor
3. Neutral
4. Good
5. Very Good

[PEV_experience] *if flag_phev is true*

How would you judge your company's overall experience with plug-in hybrid vehicles?

1. Very Poor
2. Poor
3. Neutral
4. Good
5. Very Good

[V2H_interest]

Would you be interested in a technology that allows you to discharge your vehicles' batteries to power your business's physical location in the event of a blackout?

1. Yes
2. No

[V2V_interest]

Would you be interested in a technology that allows you to discharge one vehicle's battery to charge another vehicle's battery?

1. Yes
2. No

If flag_FCEV is TRUE

FCEV QUESTIONS [if flag_fcev is TRUE]

[fcev_offsite] *if flagged as 'company hydrogen' on [refueling_types]*

Does your company use off-site facilities (not owned by the company) to refuel your Hydrogen Full Cell Vehicle(s) (FCV)?

1. Yes
2. No

[fcev_fuelnumloc] *if not flagged as 'company hydrogen' on [refueling_types] or 'yes' on [fcev_offiste]*

How many different off-site hydrogen refueling locations has your company used in the past month?

1. One
2. Two
3. Three
4. Four or more

[fcev_refueldist] *if not flagged as 'company hydrogen' on [refueling_types] or 'yes' on [fcev_offiste]*

How far from your location is the hydrogen refueling station that's used most by your company?

Please select which value you prefer to answer.

_____ miles *allow 0-250*

_____ minutes of driving time *allow 0-250*

[fcev_refuel_wait] *if not flagged as 'company hydrogen' on [refueling_types] or 'yes' on [fcev_offiste]*

About how long (in minutes) do you typically have to wait in line to refuel your FCV once you get to the station?

_____minutes *allow 0-250*

[fcev_refuelfreq]

On average, how frequently are your FCVs refueled in a typical week/month?

_____ times per *allow 0-250*

week

month *force a choice in these check boxes*

[fcev_fuelrate]

What was the price at the pump last time you refueled your vehicle? (Your best estimate.)

_____ dollars per kilogram *allow 0-50*

1. I don't know

[fcev_miles]

On average, about how many miles are each of your company's FCVs driven in a typical week/month?

_____ miles per *allow 0-5,000*

1. week
2. month *force a choice in these check boxes*

[fcev_incentives]

We would like to understand what role purchase incentives might have played in your company's decision to purchase FCVs. Please review the following descriptions of incentives, and indicate how important they were (or, if you were unaware of them, or they were not applicable).

[randomize]	1. Not at all important	2. Slightly important	3. Moderately important	4. Very important	5. Extremely important	6. Unaware	7. Not applicable
1. Local or utility incentive (rebate or tax incentive, up to $5,000)	O	O	O	O	O	O	O
2. Federal tax incentives (up to $7,500)	O	O	O	O	O	O	O
3. California state vehicle rebate (up to $5,000)	O	O	O	O	O	O	O
4. Manufacturer or dealer incentives (e.g. low interest rate, cash back)	O	O	O	O	O	O	O
5. Parking incentives (employer, business, or government)	O	O	O	O	O	O	O
6. Availability of carshare/car rental as part of purchase	O	O	O	O	O	O	O
7. HOV lane access	O	O	O	O	O	O	O
8. Free hydrogen fuel from manufacturer or dealer	O	O	O	O	O	O	O

[fcev_why]

Why did your company choose to purchase an FCV(s) over other alternatives?

Please explain.

[fcev_advantages]

In your opinion, are there any advantages to using an FCV for business compared to other types of vehicles?

If yes, please explain below.

[fcev_challenges]

Are there any issues or challenges in owning and operating an FCV for business use?

If yes, please explain below.

[fcev_experience2]

How would you judge your company's overall experience with FCVs?

1. Very Poor
2. Poor
3. Neutral
4. Good
5. Very Good

[fcev_fueling_experience]

How would you judge you company's experience with refueling FCVs?

1. Very Poor

2. Poor
3. Neutral
4. Good
5. Very Good

[fcev_future]

How likely is your company to purchase or lease FCVs in the future?

1. Extremely Unlikely
2. Unlikely
3. Neutral
4. Likely
5. Extremely Likely

[fcev_confidence]

Thank you for answering these questions about your company's FCV(s). Which of the following best describes your confidence about your answers:

1. Confident. I drive or monitor the use of the vehicle(s) frequently.
2. Confident. I got help from the primary operator(s).
3. Not as confident. I did my best based on my available knowledge.
4. Other: _____

Future Mobility Choices

[replacement]

In this next section, we would like to explore what types of vehicles might be purchased/leased for your organization in the future.

Considering your current situation, which of the following best describes your company's next purchase/lease decision for light-duty vehicles (cars, SUVs/crossover, vans/minivans, or pickup trucks)?

The next vehicle(s) will most likely be…

1. a replacement for one or more current vehicles
2. additional vehicle(s)
3. our company is unlikely to ever obtain any other vehicles

[replacement_vehicle] *if [replacement] = 'a replacement for one or more current vehicles' and [ftype] includes more than one vehicle/fuel type combination.*

Which type of vehicle is most likely to be replaced next?

Programmer: This list comes from all vehicle/fuel types displayed in [ftype]

1. <fuel type> <vehicle type> 1
2. <fuel type> <vehicle type> 2

n. <fuel type> <vehicle type> n

Programmer: <Fuel type> text:

1. *Gasoline*
2. Hybrid
3. Plug-in hybrid
4. Flex fuel
5. Diesel
6. Electric
7. Hydrogen Fuel Cell

Programmer: <vehicle type> text:

1. Car
2. SUV
3. Van
4. Pickup truck

[purchase_timing] *if [replacement] ≠ 'our company is unlikely to ever obtain any other vehicles.'*
When is this purchase or lease most likely to occur?

1. Less than 1 year
2. 1 to 2 years
3. 3 to 5 years
4. 6 to 10 years
5. More than 10 years

[info_display1] *if [purchase_timing] < 3 years*
For the next set of questions, please assume that the purchase/lease decision being considered will occur in the year 2026. *Flag dce_year = 2026*

Programmer: Show on same screen as [info_display4]

[info_display2] *if [purchase_timing] >= 3 years*
For the next set of questions, please assume that the purchase/lease decision being considered will occur in the year 2030. *Flag dce_year = 2030*

Programmer: Show on same screen as [info_display4]

[info_display3] *if [replacement] = 'our company is unlikely to ever obtain any other vehicles'*
Although you have indicated that you are unlikely to be purchasing or leasing a vehicle in the future, we are still interested in your opinions (should you change your mind).

For the next set of questions, we are going to ask you to assume that you have decided to purchase or lease a vehicle for your company in the year <2026/2030>.

Programmer: Randomly assign 2026 or 2030

Flag dce_year = 2026 or 2030

Programmer: Show on same screen as [info_display4]

[info_display4]
At that time a wide range of vehicle types will be more available than today, including plug-in vehicles (BEVs and PHEVs) as well as hydrogen fuel cell vehicles (FCVs), and plug-in hydrogen fuel cell vehicles (PFCVs), in both the new and used vehicle markets. Vehicles may (or may not) have improved on features such as range, recharging/refueling time, and purchase price.

Similarly, there may be a greater number and availability of recharging stations for BEVs and PHEVs, and hydrogen refueling stations than there are today.

In the next questions, we would like you to identify which vehicle/fuel types you would seriously *consider* purchasing or leasing, assuming their features turn out to be acceptable.

[vehicletype_consideration]
First, laying aside such issues as new versus used, specific make/model, price range, etc., which of the following vehicle types are you most likely to consider purchasing in <dce_year>**.**

Programmer: [dce_year] comes from [info_display1], [info_display2], or [info_display3]

Please select up to four. For examples of each vehicle type hover your cursor over the ⓘ info button

Programmer: Force at least one selection.

1. Subcompact Car ⓘ
2. Compact Car ⓘ
3. Midsize Car ⓘ
4. Large Car ⓘ
5. Sports Car ⓘ
6. Subcompact Crossover ⓘ
7. Compact Crossover ⓘ
8. Midsize Crossover/SUV ⓘ
9. Large SUV ⓘ

10. Small Van
11. Full-size/large Van
12. Small Pickup Truck
13. Full-size/large Pickup Truck

Info button text:

Vehicle Class Examples:

1. *Subcompact Car: Mini Cooper, Kia Rio, Nissan Versa*
2. *Compact Car: Honda Civic, Mazda 3, Hyundai Elantra, Volkswagen Jetta*
3. *Midsize Car: Chevrolet Malibu, Honda Accord, Tesla Model 3, Toyota Camry*
4. *Large Car: Dodge Charger, Chrysler 300, Audi A7, Tesla Model S*
5. *Sports Car: BMW i8, Nissan Z, Ford Mustang, Porsche 911*
6. *Subcompact Crossover: Buick Encore, Kia Soul, Ford EcoSport, Honda HR-V, Fiat 500*
7. *Compact Crossover: Honda CR-V, Mazda CX-5, Tesla Model X, Ford Bronco*
8. *Midsize Crossover/SUV: Chevrolet Traverse, Honda Pilot, Kia Sorento, Porche Cayenne*
9. *Large SUV: Chevrolet Suburban, Ford Expedition, Chevrolet Tahoe, Lincoln Navigator*
10. *Small Van (Minivan): Chrysler Pacifica, Honda Odyssey, Nissan Quest, Toyota Sienna*
11. *Full-size/large Van: Chevrolet Express 1500, Ford Transit, Mercedes-Benz Sprinter, Nissan NV Cargo*
12. *Small Pickup Truck: Chevrolet Colorado, Hyundai Santa Cruz, Ford Ranger, Toyota Tacoma*
13. *Full-size/large Pickup Truck: Chevrolet Silverado, Ford F-Series, GMC Sierra, Toyota Tundra*

[fueltype_consideration]

For each vehicle type your company is considering, which of the following fuel types will be considered in <dce_year>**.**

For definitions of each fuel type, click the info button.

Programmer: [dce_year] comes from [info_display1], [info_display2], or [info_display3]; the first column includes all of the selections from [vehicletype_consideration]

<Fill in rows from answers chosen in[vehicletype_consideration]>	1. Gasoline only	2. Hybrid	3. PHEV (gas/ elec)	4. Diesel	5. BEV (electric only)	6. Hydrogen	7. PFCV (hydrogen/ elec)
<Vehicle type 1>	☐	☐	☐	☐	☐	☐	☐
<Vehicle type 2>	☐	☐	☐	☐	☐	☐	☐
…	☐	☐	☐	☐	☐	☐	☐
<Vehicle type 4>	☐	☐	☐	☐	☐	☐	☐

Info button text:

Vehicle Fuel Examples

Powertrain	***Fuel(s) Used***	***Description of Vehicle***
Gasoline vehicle	*-Gasoline*	*A vehicle that operates on gasoline only and has no hybrid components.*
Hybrid vehicle (HEV)	*-Gasoline*	*A gasoline vehicle with hybrid components to increase fuel economy (e.g. Toyota Prius), but does not plug in for charging the battery.*
Plug-in Hybrid vehicle (PHEV)	*-Gasoline* *-Electricity*	*A gasoline vehicle with hybrid components and a battery that can be charged directly (e.g. Toyota Prius Prime) which allows the vehicle to operate like a battery electric vehicle for a short distance (10-40 miles) and then operate on gasoline for longer distances (~300-400 miles).*
Diesel vehicle	*-Diesel*	*A vehicle that operates on diesel or biodiesel only and has no hybrid components.*
Battery Electric vehicle (BEV)	*-Electricity*	*A vehicle that operates on a battery only and charges by plugging in at home or at a station (e.g. Nissan Leaf).*
Hydrogen Fuel Cell vehicle (FCV)	*-Hydrogen*	*A vehicle that uses hydrogen to generate its own electricity in a fuel cell (e.g. Toyota Mirai). Hydrogen is stored in a tank onboard the vehicle and can be filled up at a hydrogen station.*
Plug-in Fuel Cell vehicle (PFCV)	*-Hydrogen* *-Electricity*	*A fuel cell electric vehicle with a battery that can be recharged directly from an electrical outlet or charging station. This vehicle can be powered by hydrogen fuel or electricity.*

[new_used]

For each vehicle/fuel types you are considering in <dce_year>, which vehicle age and brand type would you most likely consider?

Programmer: [dce_year] comes from [info_display1], [info_display2], or [info_display3]

Programmer: Prices come from base values sheet. Reference vehicle class, and fuel type for price values for each year and standard/premium

Brand type consists of standard brands and premium brands. Standard brands have more affordable vehicles; whereas, premium brands offer high-end, luxury vehicles. Please select the information ⓘ to see which brands are classified as standard or premium.

Prices shown represent the final vehicle purchase price before rebates or other incentives.

	Standard Make/Brand			Premium Make/Brand		
	1. New	**2. Used (2-3 Years)**	**3. Used (4-6 Years)**	**1. New**	**2. Used (2-3 Years)**	**3. Used (4-6 Years)**
Vehicle 1	o *(Price)*	o *(Price)*	o *(Price)*	o *(Price)*	o *(Price)*	o *(Price)*
Vehicle 2	o *(Price)*	o *(Price)*	o *(Price)*	o *(Price)*	o *(Price)*	o *(Price)*
…	o *(Price)*	o *(Price)*	o *(Price)*	o *(Price)*	o *(Price)*	o *(Price)*
Vehicle 28	o *(Price)*	o *(Price)*	o *(Price)*	o *(Price)*	o *(Price)*	o *(Price)*

Programmer: Vans and pickup trucks cannot be premium; see below:

Programmer: Round prices to the nearest $100.

Standard/Premium info button:

Standard Makes	Premium Makes
Buick	Acura
Chevrolet	Audi
Chrysler	BMW
Dodge	Cadillac
Ford	Genesis
GMC	Hummer
Honda	Infiniti
Hyundai	Jaguar
Jeep	Land Rover
Kia	Lamborghini
Mazda	Lexus
Mini	Lincoln
Mitsubishi	Lucid
Nissan	Mercedes-Benz
Subaru	Polestar
Toyota	Porsche
Volkswagen	Rivian
	Tesla
	Volvo
	Ferrari
	Maserati

Discrete Choice Experiments

[cbc intro]

Thank you for your answers so far!

For the next section of the survey, we have created eight sets of vehicle choices for you with each set including four vehicles. Please carefully review the features for each of the vehicles and select the ONE vehicle you would most likely buy or lease for your business. Please choose one vehicle from each set of options.

We understand that some of the combinations of features and fuel types may not currently exist. But **please assume the combinations of features do exist and you could buy any of the vehicles presented to you.**

Some features that you may find important are not listed here, such as warranty, safety, reliability, technology and entertainment features, etc. Please assume that these features are identical across the four vehicles and only focus on the features that are listed when making your decision.

We also understand that the vehicles offered may not completely suit your business needs. For the purpose of this study, please assume the four vehicles on each page are the only four available and you must buy one.

If you put your cursor over the attributes of each vehicle, you will see a definition of those attributes. It is important that you take some time to read and consider the definitions of any unfamiliar terms before answering any questions.

Autonomous Vehicle Discrete Choice Experiments [cbc2_intro]

You are almost done! Thanks for hanging in there!

In this section, you will be shown four of the vehicles you indicated you would purchase in the previous section. Here, we will present various levels of autonomy that this vehicle may include. These features will come with an **additional** cost. For each vehicle, you will be shown three levels of autonomy (Levels 3, 4, and 5) beyond the base features and the total cost of the vehicle at each level. Please indicate which of the vehicles you would be most interested in purchasing at the costs provided.

Fully autonomous vehicles (Level 5) drive themselves, control all operations, and are even able to travel without a human inside. They are connected to the Internet and able to communicate with users and, to some degree, other vehicles. This technology allows riders to rest or perform other tasks while in the vehicle. Eventually, autonomous vehicles could also pick-up or drop-off people or things, fully operating without anyone inside.

The base level is assumed to include features like adaptive cruise control and automatic braking. As you consider the additional levels of autonomy, we ask that you assume that the technology that would power that level of autonomy is **safe** and **widespread**.

You will see that if you put your cursor over the level name, you will see its definition. It is important that you take some time to read and consider the definitions of these levels before answering any questions.

Programmer: The SP design space is located in a separate excel spreadsheet.

Current Vehicle Information

Programmer: For the next questions:

- *If [veh_sum] <= 5, we ask them about all business vehicles (must be used over 50% for business)*
- *If [veh_sum] > 5 AND number of fuel type/vehicle type combinations in [ftype] = 5, then we ask about each vehicle/fuel combination.*
- *If [veh_sum] > 5 AND number of fuel type/vehicle type combinations in [ftype] < 5, then we ask about each combination and then the combinations that have a higher proportion of vehicles.*
    - *Example if there are 15 gas vans, 10 gas trucks and 1 electric car, then we ask the respondent about the electric car, 2 gas vans and 2 gas trucks*
    - *Step one: select one vehicle from each combination.*
    - *Step two: Calculate which additional vehicle(s) we will ask about.*
        - *Need to calculate proportionally.*
        - *((5 vehicle set) – (# of vehicle/fuel type combinations)) * (# of vehicles in that vehicle/fuel type combination)*

Vehicle/fuel type (a)	*# Of vehicles (b)*	*Fleet proportions (c) = (b)/(sum(b))*	*Number of additional vehicles needed (d) = 5 - count(a)*	*Additional vehicles we should ask about (c)*(d)*
Gas vans	*15*	*58%*	*2*	*1*
Gas truck	*10*	*38%*	*2*	*1*
Electric car	*1*	*4%*	*2*	*0*

- *If [veh_sum] > 5 AND number of fuel type/vehicle type combinations in [ftype] > 5, then choose which vehicle fuel type combinations to ask about based on which combination has the most vehicles, and randomly drop vehicle fuel type combinations with fewer vehicles.*
    - *For example if we had 15 gas vans, 10 gas trucks, 6 hybrid suvs, 2 hydrogen compact cars, 2 gas subcompact cars and 2 electric large car; then we would ask the respondent about one of their gas vans, one of their gas trucks, one of their hybrid suvs and then randomly select 2 fuel type/body type combinations from the gas subcompact car, electric car and hydrogen car.*

[vehicle_details_intro]
For the next part of this survey we'd like to know some additional information about your current vehicles to help us better understand energy usage by light-duty commercial vehicles in California.

In the table below we have listed the types of vehicles in your organization we would like to know more about.

Programmer: The table will have a maximum of 5 rows, but may have fewer based on responses to [ftype]; entries will match the combinations identified in [ftype] and following the rules in the notes above.

<vehicle type>	**<fuel type>**
<vehicle type>	**<fuel type>**
<vehicle type>	**<fuel type>**
<vehicle type>	**<fuel type>**
<vehicle type>	**<fuel type>**

Programmer: <Fuel type> text:

1. *Gasoline*
2. Hybrid
3. Plug-in hybrid
4. Flex fuel
5. Diesel
6. Electric
7. Hydrogen Fuel Cell
8. Compressed Natural Gas

Programmer: <vehicle type> text (plural when more than 1):

1. Car(s)
2. SUV(s)
3. Van(s)
4. Pickup truck(s)

If 1 selection in [ftype]

Please tell us about the <fuel type> <vehicle type> **in your fleet.**

Programmer: Dynamic text comes from [ftype] selection

If > 1 selection in [ftype]:

Please tell us about one of the <fuel type> <vehicle type>**s in your fleet.**

Programmer: Dynamic text comes from [ftype] selection; repeat this section for each row in the table above.

Please choose a particular vehicle from that group that is most similar to the other vehicles in that class and answer the following questions for that particular vehicle.

[year]

Model Year ⓘ**:** *drop-down menu*

[make]

Make ⓘ**:** *drop-down menu*

[model]

Model ⓘ**:** *drop-down menu*

[type] drop-down menu (see below)

Vehicle type ⓘ**:**

Programmer: If a response needs to be adjusted, show that question in red.

Programmer: See below

Variable	Values
[year]	*"2024" to "1963 or earlier"*
[make]	*See vehicle database. Do not restrict based on [year].*
[model]	*See vehicle database. Do not restrict based on [year].*
[type]	*See vehicle database. Note: only show sub-types of <vehicle type> being described. Car: 1-5, SUV: 6-9, Van: 10-11, Pickup: 12-13.* If there is only one type available for given make, model, then autofill.

Info Text:

[year] ⓘ *info text*

Model year describes approximately when the manufacturer produced the vehicle. It may or may not match the year that you purchased the vehicle.

[make] ⓘ *info text*

Vehicle make is the manufacturer name or brand of the vehicle.

[model] ⓘ *info text*

A car model is the name used by a manufacturer to market a range of similar cars.

Current Vehicle Details

[current_vehicle_info]

Next, we would like to get some additional information on your current vehicles.

Please complete the form below focusing on the <year> <make> <model>.

Programmer: [year], [make], and [model] comes from [vehicle_details_intro]

Vehicle <x> **of** <n> **vehicles**

Programmer: n is the number of vehicles identified in [vehicle_details_intro] (maximum 5) and x is a running count for the respondent

[how_acquired] drop-down menu

How was this vehicle obtained?

[acquired_year] drop-down menu

What year was this vehicle acquired?

[acquired_month] *If [acquired_year] = 2023 OR 2024 drop-down menu*

What month was this vehicle acquired?

If acquired_year = 2023 or 2024 AND [obtain] = 1 or 3

[acquired_price]

Approximately how much did you pay for this vehicle when it was acquired?

$_____ *Text box entry – Allow 0 to 1,000,000*

1. I don't recall

[annual_mileage]

How many miles per year is this vehicle driven? (please give us your best estimate)

Text box entry – Allow 0 to 500,000

IF <1,000 or >99,999 show warning

Warning text: "You've entered a value outside the typical annual mileage for most vehicles. Please verify you've entered the correct number. Make sure you enter the full number (e.g. For ten thousand miles enter 10,000, not 10)."

[electric_miles] if phev

Approximately what percentage of annual miles use electric only mode?

_____

Text box entry – Allow 0 to 100%

[MPG]

About how many miles per gallon (MPG or MPGe ⓘ) does this vehicle get?

If BEV: **You may also report this vehicle's kilowatt hours per mile (kWh/mi)**

Programmer: ⓘ Info button text: Please enter the expected city/highway combined average. For CNG, electric, and hydrogen vehicles, please provide the energy equivalent of a gallon of gasoline, or MPGe, if that is easier.

MPG Text box entry – Allow 0.0 to 150.0

Warning text: "Your answer should be a number less than 150."

kWh/mi Text box entry – Allow 0.0 to 10.0

Warning text: "Your answer should be a number less than 10."

Programmer: If respondent enters both MPG and kwh/mi, display "Please enter only MPGe OR kWh/mi."

[current_use]

What is this vehicle primarily used for? *Drop-down menu*

[tnc_replacement]

Could this vehicle be replaced by using ride-sharing (Uber/Lyft) services? *Drop-down menu*

[delivery_replacement]

Could this vehicle be replaced by using "delivery-hailing" services (e.g. Amazon Flex, Instacart)? *Drop-down menu*

[veh_home]

Is this vehicle often taken to your (or another employee's) home overnight? *Drop-down menu*

[personal_use] If yes in [veh_home]

Can this vehicle be used for personal purposes unrelated to the business? *Drop-down menu*

[personal_miles] If yes in [personal_use]

Approximately what portion of the miles driven by this vehicle are for personal use?

Text box entry – Allow 0 to 50%

[HV_replacement] If gas/flex or phev or diesel

If this vehicle were replaced by an electric or hydrogen vehicle, what would be the minimum range (in miles) required for it to meet your business needs?

Text box entry – Allow 10 to 1000

Programmer:

Variable	Values (for dropdowns)
[how_acquired]	1. Purchased new 2. Leased new 3. Purchased used or previously owned 4. Leased used or previously owned 5. Other (e.g. gifted or inherited)
[acquired_year]	*IF [obtain] = 'Used' OR 'Other':* • *AND IF [year] > 1982: 2024 to <[year] - 2>* • *AND IF [year] <= 1982: 2024 to <1980 or earlier>* *IF [obtain] = ' New':* • *AND IF [year] > 1982: <[year] +2> to <[year] -2>* • *AND IF [year] <=1982: <[year]+2> to <1980 or earlier>* *Programmer:* [how_acquired] comes from [current_vehicle_info] and [year] comes from [vehicle_details_intro]
[acquired_month]	1. January 2. February 3. March 4. April 5. May 6. June 7. July 8. August 9. September 10. October 11. November 12. December
[current_use]	1. Delivery/Pick Up 2. Employee / Customer Transportation 3. Making Sales Calls 4. Making Service Calls 5. Meeting with clients/partners 6. Transporting Materials or Equipment 7. Some other purpose, please specify show text box

[tnc_replacement]	1. Yes 2. No
[delivery_replacement]	1. Yes 2. No
[veh_home]	1. Yes 2. No
[personal_use]	1. Yes 2. No

Programmer: [mpg] info button: MPGe, or miles per gasoline gallon equivalent, is a measure of the average distance traveled per unit of energy consumed. It is used to compare energy consumption of alternative fuel vehicles and plug-in electric vehicles with conventional fuel (gasoline/diesel) vehicles.

Autonomous Vehicles
[autonomous_aware]

Which of the following best describes your familiarity with "autonomous" or "self-driving" (i.e., driverless) vehicles?

1. I have never heard of them
2. I have heard of them but am not familiar
3. I have heard of them and am somewhat familiar
4. I have heard of them and am very familiar

[autonomous_att]

For each of the following statements, please choose the response that best expresses your opinion about self-driving vehicles. Assume the self-driving vehicles are safe and affordable. Your impressions are important even if you're not sure about some of the topics mentioned.

Programmer: Randomize rows in this table

	1. Strongly disagree	2. Somewhat disagree	3. Neither agree nor disagree	4. Somewhat agree	5. Strongly agree
1. I am interested in adding self-driving vehicles to my company's fleet.					

2. Adding self-driving vehicles to my company's fleet would likely lower my operating costs in the long-run.					
3. Adding self-driving vehicles to my company's fleet would likely decrease the number of accidents my vehicles are involved in.					
4. I would be more likely to add self-driving vehicles to my company's fleet if there were more cars on the road that were also self-driving.					
5. I do not see a need for self-driving vehicles.					

End/Contact Information

[comments]

We really appreciate your feedback. If you have any comments or suggestions about the content of the survey or the survey experience itself, please enter them in the box below:

Limit to 1000 characters; do not force

[incentive_contact]

Skip if 2,200 complete surveys with email entered in [incentive_contact]

Thanks for participating in the survey! Before you finish, please enter an email address where we can send you a $40 electronic gift card from an online retailer of your choice.

Your email address will only be used to send along your prize.

1. Email: _____ *enforce a valid email address, prepopulate with [contact][email] if provided*
2. No thanks *send to [follow_up]*

[prize]

Which online retailer would you like to have a $40 electronic gift card to spend at?

*You should receive your prize at the email address you provided in **10 to 12 weeks** with the subject line 'California Vehicle Survey'*

1. Walmart
2. Amazon.com

[follow_up]

Would you be interested in participating in a follow-up survey at a later date?

1. Yes _____ (please enter your email address) *enforce valid email address, prepopulate with [incentive_contact] if provided. If not, prepopulate with [contact][email] if provided.*
2. No

[end]

Thank you for participating! Your responses will help the California Energy Commission understand the future vehicle needs of California businesses and residents. If you have any questions about the survey, please email us at info@cavehiclesurvey.org.

Appendix C:
Discrete Choice Experiment Design

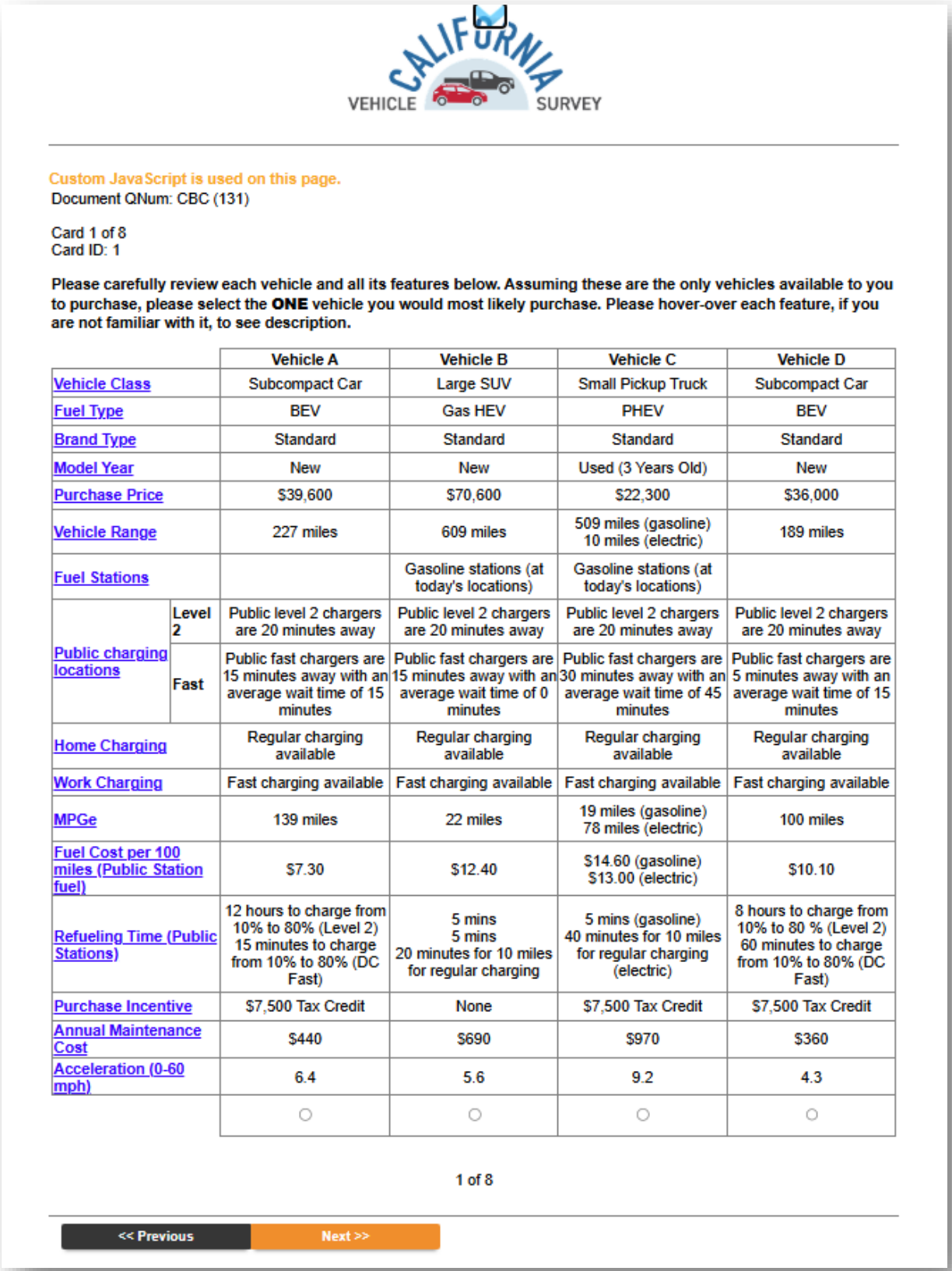
The survey included two stated preferences (SP) survey instruments; SP1 was used to derive stated preferences for any light duty vehicle and SP2 was used to derive stated preferences for autonomy levels of the autonomous vehicles. This appendix summarizes the stated preference (SP) survey instrument designs conducted under Task 4 of the 2024 California Vehicle Survey (CVS) project, starting with SP1. It includes 1) the attributes and levels used to create the alternatives presented in the eight Vehicle Choice DCEs; 2) the attributes and levels used to create the alternatives in the four Autonomous Vehicle DCEs, and 3) a brief description of the underlying experimental design for both sets of experiments.

The 2024 CVS included both revealed preference (RP) and SP surveys for the residential light-duty vehicle (LDV) sector and the commercial LDV sector in California. Respondents began the survey by completing the RP component of the survey before moving on to the SP component of the survey. Stated preferences were derived from the trade-offs in a set of discrete choice exercises (DCE).

In the RP survey, respondents were asked to generate a set of vehicle class/fuel type combinations to be considered for their next vehicle purchase in either 2026 or 2030 (referred to as the consideration set). For each fuel type, the set of associated vehicle classes was displayed, and the respondent was asked to choose one combination of prestige level (described as standard or premium) and model year (described as new, 2-3 years old, and 4-6 years old). Using this approach, the set of selected vehicle class-fuel type combinations was systematically reviewed by iterating through each fuel type that was present in the set. Data from the RP survey consideration sets were used to construct a set of eight DCE trade-off exercises for the survey.

The discrete choice experiments included a purchase year for the respondent's next vehicle purchase, either 2026 or 2030. Respondents were assigned a purchase year at random and asked to assume they would purchase a vehicle for their household in the purchase year. Each DCE presented respondents with four hypothetical vehicles as options. One of the vehicle options in each experiment—referred to as the reference vehicle—was a vehicle selected from the consideration set. The attributes that described this reference vehicle were consistent with what the respondent reported in the RP survey. The next three alternatives were presented as vehicles of different vehicle classes, fuel types, prestige levels, age, and fuel efficiency, among other varying attributes. The four alternatives, including the reference vehicle, for a given respondent were assigned in random order to options labeled Vehicle A, Vehicle B, Vehicle C, and Vehicle D for each choice situation.

Figure 7: Vehicle Type ChoiceDiscrete Choice Experiment (SP1) Example



CALIFORNIA VEHICLE SURVEY

Custom JavaScript is used on this page.
Document QNum: CBC (131)

Card 1 of 8
Card ID: 1

Please carefully review each vehicle and all its features below. Assuming these are the only vehicles available to you to purchase, please select the ONE vehicle you would most likely purchase. Please hover-over each feature, if you are not familiar with it, to see description.

		Vehicle A	Vehicle B	Vehicle C	Vehicle D
Vehicle Class		Subcompact Car	Large SUV	Small Pickup Truck	Subcompact Car
Fuel Type		BEV	Gas HEV	PHEV	BEV
Brand Type		Standard	Standard	Standard	Standard
Model Year		New	New	Used (3 Years Old)	New
Purchase Price		$39,600	$70,600	$22,300	$36,000
Vehicle Range		227 miles	609 miles	509 miles (gasoline) 10 miles (electric)	189 miles
Fuel Stations			Gasoline stations (at today's locations)	Gasoline stations (at today's locations)	
Public charging locations	Level 2	Public level 2 chargers are 20 minutes away	Public level 2 chargers are 20 minutes away	Public level 2 chargers are 20 minutes away	Public level 2 chargers are 20 minutes away
	Fast	Public fast chargers are 15 minutes away with an average wait time of 15 minutes	Public fast chargers are 15 minutes away with an average wait time of 0 minutes	Public fast chargers are 30 minutes away with an average wait time of 45 minutes	Public fast chargers are 5 minutes away with an average wait time of 15 minutes
Home Charging		Regular charging available	Regular charging available	Regular charging available	Regular charging available
Work Charging		Fast charging available	Fast charging available	Fast charging available	Fast charging available
MPGe		139 miles	22 miles	19 miles (gasoline) 78 miles (electric)	100 miles
Fuel Cost per 100 miles (Public Station fuel)		$7.30	$12.40	$14.60 (gasoline) $13.00 (electric)	$10.10
Refueling Time (Public Stations)		12 hours to charge from 10% to 80% (Level 2) 15 minutes to charge from 10% to 80% (DC Fast)	5 mins 5 mins 20 minutes for 10 miles for regular charging	5 mins (gasoline) 40 minutes for 10 miles for regular charging (electric)	8 hours to charge from 10% to 80 % (Level 2) 60 minutes to charge from 10% to 80% (DC Fast)
Purchase Incentive		$7,500 Tax Credit	None	$7,500 Tax Credit	$7,500 Tax Credit
Annual Maintenance Cost		$440	$690	$970	$360
Acceleration (0-60 mph)		6.4	5.6	9.2	4.3
		○	○	○	○

1 of 8

<< Previous Next >>

Source: 2024 California Vehicle Survey, California Energy Commission

The four vehicle options in each exercise were described by a set of 13 to 17 attributes, including the vehicle class and fuel type presented. Respondents were asked to select the vehicle they would most prefer to purchase based on the attribute values presented for each hypothetical vehicle option. The values of each attribute varied according to an experimental design, requiring respondents to value attributes against each other. **Figure 7** presents an example of one of the eight DCEs for a respondent.

RSG worked closely with the California Energy Commission to finalize the attributes and levels used to describe each alternative. Respondents can become overwhelmed if too many attributes are presented in each choice exercise; therefore, only the most important attributes that have the greatest influence on vehicle choice behavior were presented, in addition to those that help with policy assessment. The survey also retained similar attributes and levels from the previous SP surveys conducted for this study for consistency and comparison purposes.

Vehicle Type Choice DCE

The DCE trade off exercises were designed around a 'consideration set' of vehicles provided by each respondent in the RP portion of the survey.

Consideration Set

Respondents were asked to identify the vehicle types they would consider purchasing or leasing for their next vehicle, described across the following four attributes:

- Vehicle class
- Fuel type
- Prestige level
- Model year

The procedure began by asking which vehicle classes would be considered by each respondent for their next vehicle purchase. Respondents were asked to select up to a maximum of four vehicle classes they would consider for their next vehicle purchase. Vehicle class described the body type and size of the vehicle, and included the following 13 possible values:

- Subcompact Car
- Compact Car
- Midsize Car
- Large Car
- Sports Car
- Subcompact Crossover
- Compact Crossover/SUV
- Midsize Crossover/SUV
- Full-Size/Large SUV
- Small Van
- Full-size/large Van
- Small Pickup Truck
- Full-size/large Pickup Truck

Next, respondents were asked to identify which fuel types they would consider for each of the vehicle classes selected. Fuel type described the type of fuel and powertrain used to propel the vehicle, and included the following eight possible values:

- Gasoline
- Gasoline Hybrid Electric Vehicle (HEV)
- Gasoline Plug-in Hybrid Electric Vehicle (PHEV)
- Diesel
- Battery Electric Vehicle (BEV)
- Hydrogen Fuel Cell Electric Vehicle (FCEV)
- Hydrogen Plug-in Fuel Cell Electric Vehicle (PFCEV)

Using this approach, the number of possible vehicle class-fuel type combinations could vary anywhere from 1 to 28 (four vehicle classes by seven fuel types).

Finally, respondents were asked to select the most likely prestige level and model year for each vehicle class-fuel type combination in the consideration set.

Prestige level described the type of vehicle brand and included up to two possible values:

- Standard Make/Brand
- Premium Make/Brand

Standard brands were described as brands offering more affordable vehicles and premium brands were described as brands offering high-end, luxury vehicles. Premium brands were not available for vans and pickup trucks as few vehicle manufacturers offer these types of vehicles under luxury brands in the market currently.

Model year described the age of the vehicle at the time of purchase and included the following three possible values:

- New
- Used (2-3 years)
- Used (4-6 years)

Price ranges were included for each combination of vehicle class, fuel type, prestige level, and model year to aid in the selection.

Upon completion of this procedure, each respondent had defined a consideration set consisting of between one and 28 vehicles described by vehicle class, fuel type, prestige level, and model year. While each respondent could have up to 28 vehicles in their individual consideration set, there were a total of 462 possible consideration set vehicles—a combination of 13 vehicle classes, 7 fuel types, 3 model years, and 2 prestige levels (except one prestige level for vans and trucks). The DCEs were customized for each respondent depending on the vehicles in their consideration set.

Vehicle Attributes and Levels

This section summarizes the attributes and levels used to create the four options in the DCEs, presented as Vehicle A, Vehicle B, Vehicle C and Vehicle D. Many of the attributes—except vehicle class, fuel type, prestige level, and model year—varied around base values that represent average values for all vehicles of a vehicle type, fuel type, prestige level, and model

year. The values for these remaining attributes varied according to an efficient experimental design.

Vehicle Class, Fuel Type, Prestige Level, and Model Year

The first four attributes presented for each vehicle alternative were the attributes used to build the vehicle consideration set: vehicle class, fuel type, prestige level, and model year. These attributes were assigned to the four vehicle choice alternatives using the following approach.

Reference Vehicle

Reference vehicle—was selected from one of the vehicles in the respondent's consideration set according to the following procedure:

- The fuel types in the consideration set (up to seven possible values) were loaded into a randomized array and the first value was selected.
- The vehicle classes in the consideration set (up to four possible values) were loaded into a randomized array and the array was incremented sequentially until a valid fuel type-vehicle class combination was found in the consideration set.
- One vehicle was selected from the consideration set with the fuel type-vehicle class combination determined above. This selection from the consideration set was made at random without replacement.
- The fuel type array was incremented to the second position and the entire process was repeated.
- Once the consideration set was exhausted, the fuel type and vehicle class arrays were reloaded, and the process resumed.

This process was repeated until Reference Vehicle was determined for all eight experiments. Reference vehicle was randomly assigned as option A, B, C, or D in each DCE, for each respondent

Vehicle Class

For the remaining three vehicle options in each experiment, vehicle class was drawn from one of the following 13 values:

1. Subcompact Car
2. Compact Car
3. Midsize Car
4. Large Car
5. Sports Car
6. Subcompact Crossover
7. Compact Crossover/SUV
8. Midsize Crossover/SUV
9. Full-Size/Large SUV
10. Small Van
11. Full-size/large Van
12. Small Pickup Truck
13. Full-size/large Pickup Truck

The selection of vehicle class was made using weighted draws based on the reference vehicle class selected from the respondent's consideration set (any vehicle could be selected for the three alternative vehicles). Weighted draws were used because it was expected that respondents would have relatively strong preferences for at least a broad category of vehicle (e.g., small or large); as a result, presenting a respondent with a choice between a reference subcompact car and a large van made little sense. In that situation, vehicle type would dominate the choice process and little or no information could be gained for the sensitivities to other attributes. On the other hand, it was also not seen as appropriate to completely restrict the different combinations of vehicle types presented to a respondent.

A set of weights was developed for each reference vehicle type. **Table 1** on the following page presents the weights that were used for the vehicle class selection for the three alternative vehicles, with the reference vehicle types presented in the table's header. With these weights, all vehicle classes had a nonzero probability of being included in an exercise, but the probability was higher for vehicles that are more like the reference vehicle class. An especially high weight of over 50% was used for the reference vehicle class, which ensured that, at least for one pair of alternatives, the relative preference was not influenced by vehicle class. The reference vehicle could repeat in one other alternative, allowing respondents to compare attributes other than vehicle class. No other vehicle classes were repeated across alternatives within a single exercise.

Table 1: Vehicle Type Weights

Vehicle Type (reference vehicle across, alternative vehicles down)	Car-Subcompact	Car-Compact	Car-Midsize	Car-Large	Car-Sport	SUV-Subcompact	SUV-Compact	SUV-Midsize	SUV-Large	Van-Compact	Van-Std	Pickup-Compact	Pickup-Std	Total
Car-Subcompact	0.52	0.05	0.03	0.03	0.05	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.93
Car-Compact	0.05	0.52	0.05	0.03	0.05	0.05	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.97
Car-Midsize	0.05	0.05	0.52	0.05	0.05	0.03	0.05	0.04	0.03	0.04	0.03	0.04	0.03	1.01
Car-Large	0.03	0.04	0.05	0.52	0.03	0.04	0.04	0.05	0.05	0.03	0.04	0.04	0.04	1.00
Car-Sport	0.05	0.05	0.05	0.03	0.52	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.95
SUV-Subcompact	0.05	0.05	0.04	0.04	0.04	0.52	0.05	0.04	0.04	0.04	0.04	0.03	0.04	1.02
SUV-Compact	0.04	0.04	0.05	0.04	0.04	0.05	0.52	0.05	0.05	0.04	0.04	0.04	0.04	1.04
SUV-Midsize	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.52	0.05	0.05	0.04	0.04	0.04	1.06
SUV-Large	0.03	0.03	0.03	0.04	0.03	0.05	0.05	0.05	0.52	0.05	0.05	0.05	0.05	1.03
Van-Compact	0.04	0.04	0.04	0.03	0.04	0.04	0.04	0.05	0.04	0.52	0.05	0.05	0.05	1.03
Van-Std	0.03	0.03	0.03	0.05	0.03	0.03	0.03	0.04	0.05	0.05	0.52	0.05	0.05	0.99
Pickup-Compact	0.04	0.03	0.04	0.04	0.04	0.03	0.04	0.04	0.04	0.05	0.05	0.52	0.05	1.01
Pickup-Std	0.03	0.03	0.03	0.05	0.03	0.03	0.03	0.03	0.04	0.04	0.05	0.05	0.52	0.96
Total	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	13.0

Source: 2024 California Vehicle Survey, California Energy Commission

Fuel Type

The fuel types for each of the three Vehicle options, in each experiment, were derived from the following list:

- Gasoline
- Gasoline Hybrid Electric Vehicle (HEV)
- Gasoline Plug-in Hybrid Electric Vehicle (PHEV)
- Diesel
- Battery Electric Vehicle (BEV)
- Hydrogen Fuel Cell Electric Vehicle (FCEV)
- Hydrogen Plug-in Fuel Cell Electric Vehicle (PFCEV)

The selection of fuel type was also made using weighted draws based on the reference fuel type as in the case of the vehicle class attribute. It was expected that respondents would have relatively strong preferences for their reference fuel type; therefore, presenting respondents with a choice between a reference gasoline car and a PFCEV car was not deemed appropriate. On the other hand, it was also not seen as appropriate to completely restrict the different combinations of fuel types presented to a respondent. As a result, a set of weights was developed for each reference fuel type. **Table 2** on the following page presents the weights that were used for the fuel type selection for the three alternative vehicles, with the reference fuel types presented in the table's header.

Table 2: Fuel Type Weights

Fuel Type (reference vehicle across, alternative vehicles down)	Gasoline Vehicle	Hybrid Electric Vehicle (HEV)	Plug-in Hybrid Electric Vehicle (PHEV)	Diesel Vehicle	Battery Electric Vehicle (BEV)	Hydrogen Fuel Cell Electric Vehicle (FCEV)	Plug-in Fuel Cell Electric Vehicle (PFECV)	Total
Gasoline vehicle	0.25	0.125	0.125	0.125	0.125	0.125	0.125	1.00
Hybrid Electric vehicle (HEV)	0.125	0.25	0.125	0.125	0.125	0.125	0.125	1.00
Plug-in Hybrid Electric vehicle (PHEV)	0.125	0.125	0.25	0.125	0.125	0.125	0.125	1.00
Diesel vehicle	0.125	0.125	0.125	0.25	0.125	0.125	0.125	1.00
Battery Electric vehicle (BEV)	0.125	0.125	0.125	0.125	0.25	0.125	0.125	1.00
Hydrogen Fuel Cell Electric vehicle (FCEV)	0.125	0.125	0.125	0.125	0.125	0.25	0.125	1.00
Plug-in Fuel Cell Electric vehicle (PFCEV)	0.125	0.125	0.125	0.125	0.125	0.125	0.25	1.00
Total	1.00	1.00	1.00	1.00	1.00	1.00	1.00	7.00

Source: 2024 California Vehicle Survey, California Energy Commission

The reference vehicle fuel type could repeat in one (at most) of the three alternative vehicles; this allowed respondents to compare attributes other than fuel type. No other fuel types could repeat across alternatives within a single choice exercise.

Prestige Level

The prestige levels for Vehicles B, C, and D were derived from the following list:

- Standard
- Premium

The selection was made using weighted draws from the distribution of standard and premium vehicles in each respondent's consideration set. A minimum weight of 0.25 and a maximum weight of 0.75 was set for each level to increase the likelihood that both standard and premium prestige levels were presented in each experiment even if the consideration set only included one prestige level.

Model Year

The model year for Vehicles B, C, and D were derived from the following list:

- New
- Used (2-3 years)
- Used (4-6 years)

The model year selection was made using weighted draws from the distribution of model years in each respondent's consideration set. **Table 3** presents the base weights for each reference vehicle model year, with the reference vehicle model year in the table's header. The appropriate set of weights based on the reference vehicle model year was then multiplied by the actual distribution of model years in each respondent's consideration set to develop the final weighted draws.

Table 3: Model Year Draw Weights

Alternative Vehicle Model Year	Reference Vehicle Model Year: New	Reference Vehicle Model Year: Used 2-3 Years	Reference Vehicle Model Year: Used 4-6 Years
New	0.7	0.2	0.1
Used 2-3 Years	0.2	0.6	0.2
Used 4-6 Years	0.1	0.2	0.7

Source: 2024 California Vehicle Survey, California Energy Commission

Other Vehicle Attributes

The remaining vehicle attributes were dependent on the vehicle class, fuel type, prestige level, and model year selected for each choice alternative. The values for the remaining attributes varied according to an efficient experimental design.

Many of these remaining vehicle attributes varied around a base value. In the cases of vehicle purchase price, maintenance cost, range, fuel economy, and acceleration, the Energy Commission provided tables of base values, and RSG worked with the Energy Commission to

refine the base values for use in the survey. These base values represent average values for all vehicles of a vehicle class, fuel type, and model year.

Vehicle Purchase Price

The purchase price of each vehicle varied around a base value that was dependent on the vehicle class, fuel type, prestige level, and model year. The base price values were varied using the following levels:

- Base price -20%
- Base price -10%
- Base price
- Base price +10%
- Base price +20%

Purchase Incentives

The purchase incentives levels varied based on the fuel type. Gasoline, diesel, and HEV vehicles were presented with no purchase incentive, shown as "None," while the remaining alternative fuel vehicles had one of the following levels:

PHEV or BEV:

- None
- HOV lane access for 3 years
- $2,500 Tax Credit
- $5,000 Tax Credit
- $7,500 Tax Credit
- $1,000 Rebate
- $1,500 Rebate
- $2,500 Rebate

FCEV or PFCEV:

- None
- HOV lane access for 3 years
- $2,500 Tax Credit
- $5,000 Tax Credit
- $7,500 Tax Credit
- $1,000 Rebate
- $1,500 Rebate
- $2,500 Rebate
- $5,000 Rebate
- $10,000 Rebate

Purchase incentives remained constant for each fuel type across alternatives in each experiment.

Vehicle Range

Vehicle range represented the maximum distance a vehicle could travel on a full tank of fuel or a full charge without refueling. This attribute had five levels for each fuel type. Vehicles that operate on a single fuel (gasoline, diesel, BEV, and FCEV) were presented with a single range for that fuel. Dual fuel vehicles (PHEV and PFCEV) were presented with two ranges – one for the primary fuel (gasoline or hydrogen) and another for the electric range. The levels for gasoline, diesel, and HEV vehicles pivoted off the base range distance according to the following values:

- Base range -10%
- Base range -5%
- Base range
- Base range +5%
- Base range +10%

BEV and FCEV vehicles pivoted off the base range distance according to the following values:

- Base range -25%
- Base range -10%
- Base range
- Base range +10%
- Base range +25%

Dual fuel vehicles (PHEV and PFCEV) used the appropriate levels for the primary fuel (gasoline and hydrogen) and the following fixed levels for the vehicle's electric range:

- 10 miles
- 20 miles
- 30 miles

Fuel Availability

Fuel availability represents the availability of vehicle refueling infrastructure expressed relative to gasoline refueling stations (for diesel vehicles), distance from home or work (for hydrogen vehicles), or as a percentage of public parking facilities with Level 2 and DC fast charging available (for electric vehicles). Electric vehicles had additional attributes to indicate whether recharging infrastructure was available at home, at workplace/school locations, or both.

Gasoline vehicles were always presented with gasoline stations at today's locations for the availability of fuel. Diesel vehicles were presented with one of the following three levels relative to gasoline:

- 30% of today's gasoline locations
- 50% of today's gasoline locations
- 70% of today's gasoline locations

Hydrogen vehicles were presented with one of the following five levels for distance to the nearest refueling station:

- 1 mile to station from home/work
- 5 miles to station from home/work

- 10 miles to station from home/work
- 20 miles to station from home/work
- 30 miles to station from home/work

Electric vehicles were presented with one of the following four levels for time to regular (Level 2) charging:

- Public level 2 chargers are 5 minutes away.
- Public level 2 chargers are 10 minutes away.
- Public level 2 chargers are 15 minutes away.
- Public level 2 chargers are 20 minutes away.

In addition to regular charging, electric vehicles were presented with one of the following eight levels for fast (DC) charging availability:

- Public fast chargers are 5 minutes away with an average wait time of 0 minutes.
- Public fast chargers are 5 minutes away with an average wait time of 15 minutes.
- Public fast chargers are 15 minutes away with an average wait time of 0 minutes.
- Public fast chargers are 15 minutes away with an average wait time of 15 minutes.
- Public fast chargers are 15 minutes away with an average wait time of 30 minutes.
- Public fast chargers are 30 minutes away with an average wait time of 30 minutes.
- Public fast chargers are 30 minutes away with an average wait time of 45 minutes.
- Public fast chargers are 30 minutes away with an average wait time of 60 minutes.

Electric vehicles were also presented with an attribute describing whether home charging was available that included the following two levels:

- Not Available
- Regular charging available

Finally, electric vehicles were presented with an attribute indicating whether or not regular or fast charging was available at their primary work or school location. This attribute included the following three levels:

- Not Available
- Regular charging available
- Fast charging available

Fuel availability remained constant for each fuel type across alternatives in each experiment.

Miles per Gallon Equivalent (MPGe)

A base value for miles per gasoline gallon equivalent (MPGe) was estimated for each vehicle type, fuel type, prestige level, and model year combination. This value varied according to the following five levels:

- Base MPGe -25%
- Base MPGe -10%
- Base MPGe
- Base MPGe +10%

- Base MPGe +25%

Dual-fuel vehicles varied presented the MPGe value for each fuel type and varied both using the same levels described above.

Fuel Cost per 100 Miles

The cost to drive a vehicle 100 miles was calculated as a function of the fuel cost in gasoline gallon equivalent and the vehicle fuel efficiency in miles per gallon equivalent. The fuel cost per gasoline gallon equivalent was not shown to respondents; however, this value was used to calculate the fuel cost per 100 miles of driving. The fuel cost in gasoline gallon equivalent was estimated for each type of fuel and varied according to three levels:

- Low fuel price scenario
- Medium fuel price scenario
- High fuel price scenario

The fuel price scenarios were defined for each fuel type and each purchase year (either 2026 or 2030). The low, medium, and high fuel costs values for each fuel type and purchase year are presented in **Table 4**.

Table 4: Fuel Price per Gasoline Gallon Equivalent

Fuel Type	Purchase Year	High	Medium	Low
Gasoline	2026	5.593776	4.294513	2.776952
Gasoline	2030	6.278088	4.361141	2.724594
Diesel	2026	6.133245	4.714986	3.544137
Diesel	2030	6.866435	4.765791	3.379983
Electricity	2026	10.15213	9.330831	8.518903
Electricity	2030	10.92121	9.785063	8.667723
Hydrogen	2026	19.35633	18.00000	16.66026
Hydrogen	2030	14.99500	13.59000	12.24500

Source: 2024 California Vehicle Survey, California Energy Commission

Fuel cost per 100 miles remained constant for each fuel type across alternatives in each experiment.

Refueling Time

Refueling time represents the time needed to refuel a vehicle. This attribute had different levels based on fuel type as with the fuel availability attribute. All gasoline, diesel, HEV, and FCEV vehicles were presented with a fixed refueling time of 5 minutes. Dual-fuel vehicles (PHEV and PFCEV) were presented with a refueling time of 5 minutes for the primary fuel and an electric recharging time that varied according to the following three levels:

- 20 minutes for 10 miles for regular charging
- 30 minutes for 10 miles for regular charging
- 40 minutes for 10 miles for regular charging

All BEVs were presented with both regular (Level 2) and fast (DC Fast Charging) refueling times. The regular charging times varied according to the following three levels:

- 4 hours to charge from 10% to 80%
- 8 hours to charge from 10% to 80%
- 12 hours to charge from 10% to 80%

The fast charging times varied according to the following four levels:

- 15 minutes to charge from 10% to 80%
- 30 minutes to charge from 10% to 80%
- 45 minutes to charge from 10% to 80%
- 60 minutes to charge from 10% to 80%

Refueling time remained constant for each fuel type across alternatives in each experiment.

Wait Time at the Station

In addition to refueling time fast charging also included an average wait time attribute which varied according to the following five levels

- Average wait time of 0 minutes
- Average wait time of 15 minutes
- Average wait time of 30 minutes
- Average wait time of 45 minutes
- Average wait time of 60 minutes

Annual Maintenance Cost

The annual maintenance cost represents the cost to maintain a vehicle over the course of a year. Maintenance costs include all costs associated with normal routine maintenance during a year including oil and filter changes. It does not include insurance, registration, fees, or unexpected repairs. A base maintenance cost per year for each vehicle was estimated based on the vehicle type, fuel type, prestige level, and model year. These annual maintenance costs were varied according to the following three levels:

- Base annual maintenance cost -20%
- Base annual maintenance cost
- Base annual maintenance cost +20%

Acceleration

The acceleration attribute represents the amount of time (in seconds) it takes a vehicle to accelerate to 60 mph. A base acceleration time for each vehicle was estimated based on the vehicle type, fuel type, prestige level, and model year. The base acceleration value was varied according to the following three levels:

- Base acceleration -20%
- Base acceleration

- Base acceleration +20%

Table 5 on the following two pages provides a complete summary of the attributes and levels described above.

Table 5: Full Table of Attributes and Levels

Level	1	2	3	4	5	6	7	8	9	10
Home Recharging (if available)	Not Available	Regular charging								
Workplace/ School Recharging	Not Available	Regular charging	Fast charging	Regular charging	Fast charging					
MPGe Fuel 1 (see lookup table)	-25%	-10%	0%	10%	25%					
MPGe Fuel 2 (see lookup table)	-25%	-10%	0%	10%	25%					
Fuel Cost per 100 miles (Public Station)	High	Medium	Low							
Refueling, Gasoline/ Diesel/ Flex Fuel	5 mins									
Charging per 10 miles: L2 PHEV/ PFCV	20 mins	30 mins	40 mins							

Level	1	2	3	4	5	6	7	8	9	10
Charging: L2 BEV	4 hours	8 hours	12 hours							
Fast Charging: BEV	15 mins	30 mins	45 mins	60 mins						
Incentive: Gas/Diesel/ Flex/HEV	None									
Incentive: PHEV/BEV	None	HOV lane access, 3 years	$2,500 Tax Credit	$5,000 Tax Credit	$7,500 Tax Credit	$1,000 Rebate	$1,500 Rebate	$2,500 Rebate		
Incentive: FCV/PFCV	None	HOV lane access, 3 years	$2,500 Tax Credit	$5,000 Tax Credit	$7,500 Tax Credit	$1,000 Rebate	$1,500 Rebate	$2,500 Rebate	$5,000 Rebate	$10,000 Rebate
Annual Maintenance Cost	-20%	0	20%							
Acceleration (0-60 mph)	-20%	0	20%							

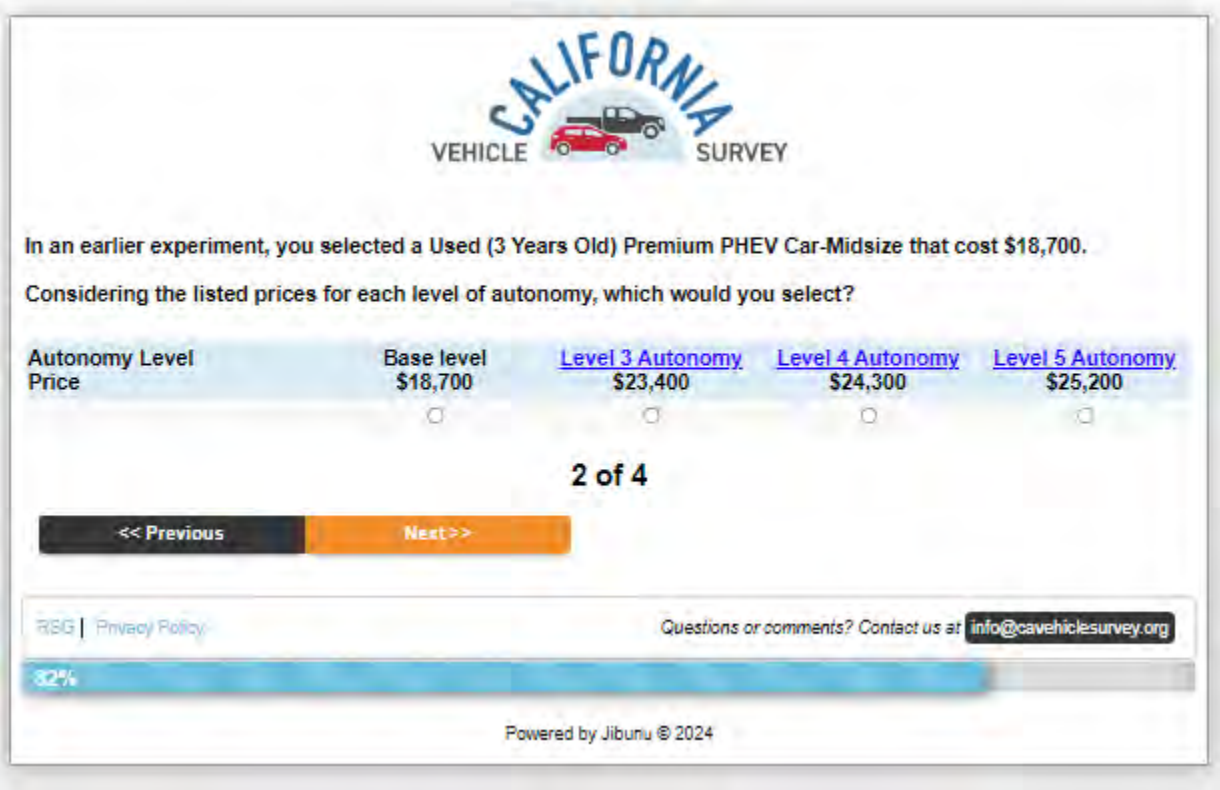
Charging times are at public stations. BEV charging measured in minutes to charge from 10% to 80% battery capacity.

Source: 2024 California Vehicle Survey, California Energy Commission

Autonomous Vehicle (SP2) Experiments

Compared to the eight vehicle choice DCEs, the four autonomous vehicle DCEs were relatively simple. In these experiments, respondents were shown one of the eight vehicles that they selected in the vehicle type choice DCEs. This reference vehicle was randomly selected from the eight vehicles chosen in the vehicle choice experiments without replacement. Respondents were told to select one of four alternative autonomy levels for the selected vehicle, and each alternative autonomy level was defined only by a price attribute. **Figure 8** shows an example of what these experiments looked like in the programmed survey instrument.

Figure 8: Autonomous Vehicle Discrete Choice Experiment (SP2) Example



Source: 2024 California Vehicle Survey, California Energy Commission

The introductory text for the autonomous vehicle DCEs primed respondents to think about what an autonomous vehicle can do. The full text of this introductory text is below.

"Fully autonomous vehicles drive themselves, control all operations, and are even able to travel without a human inside. They are connected to the Internet and able to communicate with users and, to some degree, other vehicles. This technology allows riders to rest or perform other tasks while in the vehicle. Eventually, autonomous vehicles could also pick-up or drop-off people or things, fully operating without anyone inside.

The base level is assumed to include features like adaptive cruise control and automatic braking. As you consider the additional levels of autonomy, we ask that you assume that the technology that would power that level of autonomy is ***safe*** *and* ***widespread****."*

Autonomy Level

The autonomous vehicle DCEs included four autonomy level options:

- Base level autonomy

- Level 3 autonomy
- Level 4 autonomy
- Level 5 autonomy

As the introductory text for the DCEs states, respondents were to assume that the base autonomy level includes features such as adaptive cruise control and automatic braking. The following descriptions for each subsequent autonomy level were also provided:

- Level 3: The vehicle is capable of fully driving by itself under specific conditions, but the driver may be required to take control of the vehicle if conditions change. A level 3 autonomous vehicle will always need a driver who is paying attention to the road and the vehicle's operation, though for brief periods it may be possible for the driver to safely take their hands off the wheel to eat, assist a passenger, take a phone call, or write a text message.
- Level 4: The vehicle is capable of fully driving by itself under specific conditions, and the car will not operate outside of these conditions unless the driver is in control. Along specific routes and in good weather, these vehicles can drive entirely by themselves. This means that these vehicles could be used to transport children or other people who cannot drive without the need for a driver. It could also transport equipment or workers in the commercial setting. If conditions become unsafe (e.g., weather conditions deteriorate, or a mechanical issue develops in the vehicle) the vehicle will pull over and not operate without a driver.
- Level 5: The vehicle is capable of fully driving by itself under all conditions. These vehicles never need a driver and may or may not come equipped with a steering wheel or pedals. They can always be used to transport anyone or anything without the need for a driver.

Vehicle Price

Each autonomy level was defined by one attribute—price. Prices pivot around the price of the selected vehicle from the vehicle type choice experiment, referred to here as the base vehicle price. Each autonomy level option had the following five possible price levels that were randomly selected for each experiment:

- Level 3 autonomy
    - Base price +5%
    - Base price +10%
    - Base price +15%
    - Base price +20%
    - Base price +25%
- Level 4 autonomy
    - Base price +15%
    - Base price +20%
    - Base price +25%
    - Base price +30%
    - Base price +35%

- Level 5 autonomy
    - Base price +25%
    - Base price +30%
    - Base price +35%
    - Base price +40%
    - Base price +45%

Experimental Design

The experimental design for both SP surveys was based on an underlying efficient design. In contrast to an orthogonal design, which was used in previous iterations of CVS, an efficient design does not merely minimize the correlation between attribute levels but also aims to result in a design that generates coefficient estimates with minimum possible standard errors.

In the vehicle type choice SP survey, vehicle class, fuel type, prestige level, and model year were not included directly in the design. Instead, they were added to the design in a second stage after the generation of the base efficient design. This reduced the complexity of the efficient design and obviated the need to generate a large number of different designs for different combinations of vehicle classes and fuel types. The final design combined the efficient design with weighted random allocations of vehicle class, fuel type, prestige level, and model year.

Base Efficient Design

The base design for the vehicle type choice SP survey was split into twenty blocks of eight choices. The blocking was used to avoid any correlation between the attributes and the blocks (e.g., avoiding the situation where one respondent gets all the high-priced options). The design contained the levels for all attributes other than vehicle class, fuel type, prestige level, and model year across four alternatives.

In both the vehicle type choice and autonomous vehicle SP surveys, each respondent was presented with one block of eight choice situations. The different blocks were presented the same number of times and there was minimal correlation between sample subgroups and blocks. In the vehicle choice SP survey, the choice experiments were constructed based on the set of vehicle class/fuel type/prestige level/model year combinations drawn for that respondent, and the block of eight choice situations used from the experimental design for that respondent. The order in which the eight choice situations from a given block were presented to a respondent was also randomized across respondents. In the autonomous vehicle SP survey, the choice experiments were constructed based on the price of the four randomly selected from the eight vehicle choices made during the vehicle choice SP survey.
Ordering of Alternatives

Several steps were taken to eliminate potential ordering effects in the design. In each choice set, a respondent was faced with four alternatives: the reference alternative—either the reference vehicle or the base autonomy level—and three remaining alternatives. All four alternatives in each of the eight vehicle choice experiments and each of the four autonomous vehicle choice experiments were assigned in random order. In this way, each alternative had an equal probability of being assigned the reference vehicle or base autonomy type.

Ordering of Alternatives

Several steps were taken to eliminate potential ordering effects in the design. In each choice set, a respondent was faced with four alternatives: the reference alternative and three remaining alternatives. All four alternatives in each of the eight choice situations were assigned in random order. In this way, each alternative had an equal probability of being assigned the reference vehicle type or base autonomy level.

Appendix D:
Recruitment Materials

Below are the invitation postcard and letter designs for both the residential and commercial surveys.

Residential Materials

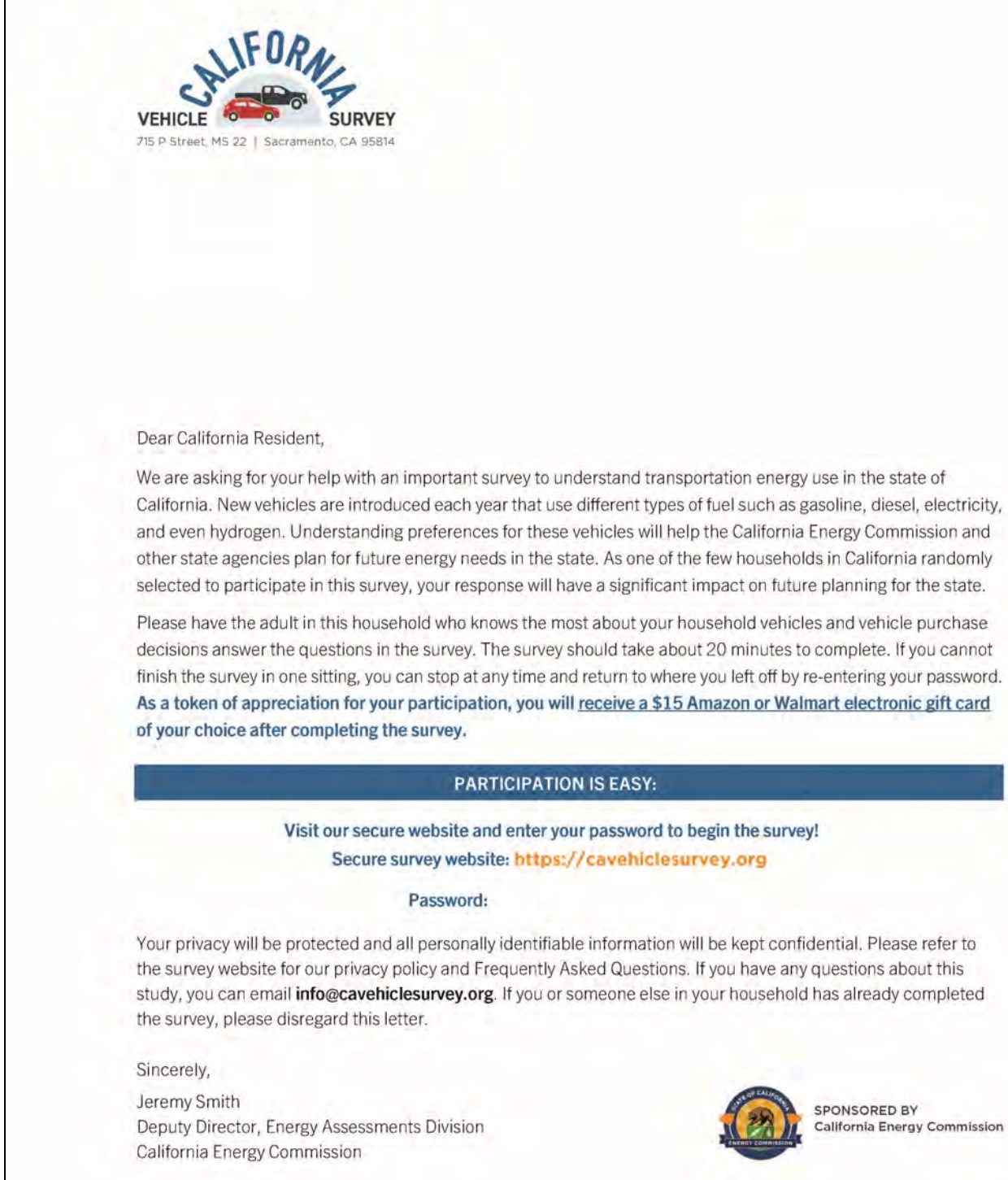
Figure 9: Residential Postcard (Front)

Source: 2024 California Vehicle Survey, California Energy Commission

Figure 10: Residential Postcard (Back)

Source: 2024 California Vehicle Survey, California Energy Commission

Figure 11: Residential Letter (Front)



CALIFORNIA VEHICLE SURVEY

715 P Street, MS 22 | Sacramento, CA 95814

Dear California Resident,

We are asking for your help with an important survey to understand transportation energy use in the state of California. New vehicles are introduced each year that use different types of fuel such as gasoline, diesel, electricity, and even hydrogen. Understanding preferences for these vehicles will help the California Energy Commission and other state agencies plan for future energy needs in the state. As one of the few households in California randomly selected to participate in this survey, your response will have a significant impact on future planning for the state.

Please have the adult in this household who knows the most about your household vehicles and vehicle purchase decisions answer the questions in the survey. The survey should take about 20 minutes to complete. If you cannot finish the survey in one sitting, you can stop at any time and return to where you left off by re-entering your password. **As a token of appreciation for your participation, you will receive a $15 Amazon or Walmart electronic gift card of your choice after completing the survey.**

PARTICIPATION IS EASY:

Visit our secure website and enter your password to begin the survey!

Secure survey website: https://cavehiclesurvey.org

Password:

Your privacy will be protected and all personally identifiable information will be kept confidential. Please refer to the survey website for our privacy policy and Frequently Asked Questions. If you have any questions about this study, you can email **info@cavehiclesurvey.org**. If you or someone else in your household has already completed the survey, please disregard this letter.

Sincerely,

Jeremy Smith
Deputy Director, Energy Assessments Division
California Energy Commission

SPONSORED BY
California Energy Commission

Source: 2024 California Vehicle Survey, California Energy Commission

Figure 12: Residential Letter (Back)

CALIFORNIA VEHICLE SURVEY

715 P Street, MS 22 | Sacramento, CA 95814

Estimado(a) residente de California:

Nos comunicamos con usted para pedirle ayuda con una importante encuesta para comprender el uso de la energía en el transporte en el estado de California. Los nuevos vehículos que se presentan cada año usan distintos tipos de combustible, como gasolina, diésel, electricidad e incluso hidrógeno. Comprender las preferencias por estos vehículos permitirá que la Comisión de Energía de California y otros organismos del estado prevean las futuras necesidades del mismo en cuanto a la energía. Por ser uno de los pocos hogares de California que fueron seleccionados al azar para participar en esta encuesta, su respuesta influirá significativamente en la previsión a futuro del estado.

La persona adulta del hogar que tenga más conocimientos acerca de los vehículos del hogar y las decisiones de compra de vehículos deberá ser quien responda las preguntas de la encuesta. Completar la encuesta debería tomar unos 20 minutos. Si no puede finalizar la encuesta en una sola sesión, puede detenerse en cualquier momento y reanudarla volviendo a ingresar su contraseña. **A modo de agradecimiento por su participación, recibirá, después de terminar la encuesta, una tarjeta de regalo electrónica por un valor de $15 de Amazon o Walmart, a su elección.**

PARTICIPAR ES FÁCIL:

Visite nuestro sitio web protegido e introduzca su contraseña para comenzar la encuesta.
Sitio web protegido de la encuesta: https://cavehiclesurvey.org

Contraseña:

Protegeremos su privacidad y toda la información de identificación personal será confidencial. Visite el sitio web de la encuesta para consultar nuestra política de privacidad y las preguntas frecuentes. Si tiene alguna pregunta acerca de este estudio, envíe un correo electrónico a **info@cavehiclesurvey.org**. Si usted u otra persona en su hogar ya completó la encuesta, ignore esta carta.

Atentamente,

Jeremy Smith
Deputy Director, Energy Assessments Division
California Energy Commission

PATROCINADO POR
California Energy Commission

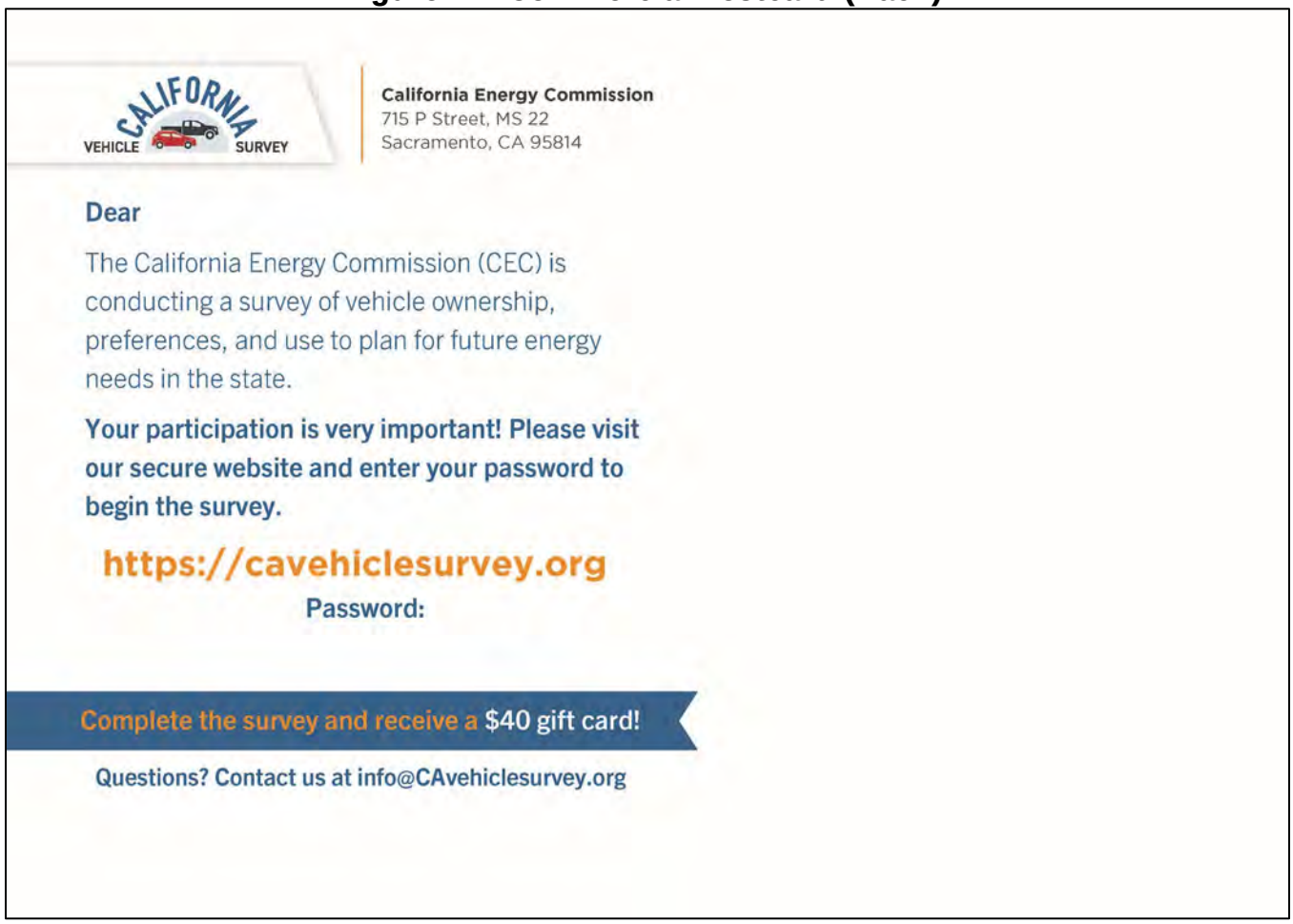
Source: 2024 California Vehicle Survey, California Energy Commission

Commercial Materials

Figure 13: Commercial Postcard (Front)

Source: 2024 California Vehicle Survey, California Energy Commission

Figure 14: Commercial Postcard (Back)



Source: 2024 California Vehicle Survey, California Energy Commission

Figure 15: Commercial Letter

CALIFORNIA VEHICLE SURVEY

715 P Street, MS 22 | Sacramento, CA 95814

Dear California Business,

We are asking for your help with an important survey to understand transportation energy use in the state of California. New vehicles are introduced each year that use different types of fuel such as gasoline, diesel, electricity, and even hydrogen. Understanding preferences for these vehicles will help the California Energy Commission and other state agencies plan for future energy needs in the state. As one of the few businesses in California randomly selected to participate in this survey, your response will have a significant impact on future planning for the state.

Please have an employee who knows the most about your business vehicles and vehicle purchase decisions answer the questions in the survey. The survey should take about 20 minutes to complete. If you cannot finish the survey in one sitting, you can stop at any time and return to where you left off by re-entering your password. **As a token of appreciation for your participation, you will receive a $40 Amazon or Walmart electronic gift card of your choice after completing the survey.**

PARTICIPATION IS EASY:

Visit our secure website and enter your password to begin the survey!

Secure survey website: https://cavehiclesurvey.org

Password:

Your privacy will be protected and all personally identifiable information will be kept confidential. Please refer to the survey website for our privacy policy and Frequently Asked Questions. If you have any questions about this study, you can email **info@cavehiclesurvey.org**. If you or another employee at your business has already completed the survey, you make disregard this letter.

Sincerely,

Jeremy Smith
Deputy Director, Energy Assessments Division
California Energy Commission

SPONSORED BY
California Energy Commission

Source: 2024 California Vehicle Survey, California Energy Commission

Appendix E:
Residential Focus Group Moderator Guide

Objectives and Approach

The goal of these focus groups is to gather information to assist in the design of the pretest survey, understand factors that affect vehicle purchase behavior, and explore the public's attitudes toward and knowledge of AVs, their features, and policies that affect them.

All the focus group protocols will explore participants' current vehicle ownership, vehicle purchase decision-making, and awareness of alternative fuel and AV technologies. Participants will also react to draft text from the pretest questionnaire to describe each of the vehicle technologies/fuel types in the SP survey and will discuss the extent to which these descriptions provide the types of information that they would need to evaluate each of the vehicle options as well as their general reactions to each of the alternatives.

The focus group protocols will conclude with respondents completing the pretest SP survey element and debriefing to determine potential areas for improvement in the SP survey questions.

Introduction language for moderator (adjust as needed):

Thank you all for joining us this evening. These focus groups are meant to help the California Energy Commission better understand what Californians think about as they purchase vehicles. We will discuss how you use your vehicles, vehicle features that are important to you, vehicle fuel types, and emerging autonomous technologies. This focus group is being observed by staff from the California Energy Commission, and it is being recorded. To make the recording as clear as possible, please speak one at a time and clearly. All information gathered in this focus groups will remain confidential as provided by the California Public Records Act. You are free to leave at any time, including if you need to excuse yourself to use the restroom. The session will last no longer than 2 hours.

Focus Group Introduction (10 minutes)

1. Purpose and ground rules (see above)
2. *Ask all participants to respond* Personal Introductions: Please provide some information about yourself
3. Name, residence (town/city), household size, employment status, employer location (town/city); do you currently have solar panels and/or a backup power source for your home?

Current Vehicles and Driving Habits (10 minutes)

Note to moderator: write these questions on flip chart and document answers

1. *Ask all participants to respond* Now let's go around the room and discuss the vehicles that you drive. For each of you, please tell me about:
    a. The number of vehicles that you have in your household, what kind of vehicles are in your household (vehicle and fuel type), how long you've had each of them, which one you use the most, which one you use the least, and why?
    b. Whether you own or lease them, and whether you purchased it new or used
    c. How do you use your vehicles? How much time do you spend in your car(s)? Where do you go? What is your vehicle for? How many people/things do you typically have with you in the vehicle?
2. As warranted, probe with the following:
    a. Tell me about how much you typically drive
3. Who here has used:
    a. Uber or other ride share service? How frequently?
    b. Rental car? Why? How frequently?
    c. Transit bus/rail? How frequently?
    d. What are those like?

Future Car Purchase Needs and Desired Attributes (30 minutes)

4. Now I want to talk about what steps you took to purchase your current vehicle and factors you will consider when purchasing your next vehicle.
5. What factors influenced your decision to purchase your current vehicle?
6. Do any of you have plans to replace your current vehicle?
    a. If yes, why? If no, why not?
    b. Probe: How long do you typically plan to keep a vehicle? Why?
    c. Probe: Are you considering any alternative to replacing your current vehicle such as an e-bike, a motorcycle, or increased transit/ridesharing use?
7. *Ask all participants to respond* When are you planning to purchase your next vehicle?
8. Tell me about the kind of vehicle you are planning to purchase. Probe:
    a. Do you expect it to be larger/smaller/the same size as your current vehicle?
    b. Do you expect your next vehicle to have worse, the same, or better fuel economy than your current vehicle?
    c. Do you expect to buy a vehicle that runs on a different fuel type?
9. What types of changes do you expect might happen in the world that would affect the kind of vehicle you will want to be driving 3-5 years from now?
10. *Ask all participants to respond* Would you consider buying a vehicle that does not run on gas/petroleum? Why or why not?
    a. Has the recent decrease in fuel prices changed your consideration of electric vehicles?

b. Has the recent increase in electricity prices changed your consideration of alternative fuel vehicles?

11. *For flipchart* What factors would you take into consideration before purchasing a new vehicle? I'm curious what you will be looking for in your next vehicle.
    a. What are your "must haves" for your next vehicle?
    b. What are the "nice to haves" for your next vehicle?
    c. (if it is not brought up, probe for autonomous features such as automatic braking and adaptive cruise control)
12. How did you determine whether something went into one category or the other?
13. What makes these "must haves" so important?

Moderator note: These questions are to be asked if the group has spent less than 30 minutes on this topic.

14. When it comes to purchasing a new vehicle, how much do you consider each of the following costs:
    a. Purchase price
    b. Maintenance/repair cost
    c. Fuel cost
    d. Insurance
    e. Depreciation/Resale value

Alternative Fuel Vehicle Perceptions – Aided (30 minutes)

15. There are a variety of fuel types that you can choose from when making the decision to purchase a new vehicle. In this section, we will discuss how you decide which fuel type is right for you. In addition to standard gasoline vehicles, we will focus on the following fuel types.
    a. Hybrid electric vehicle
    b. Plug-in hybrid vehicle
    c. Battery electric vehicle
    d. Hydrogen Fuel cell vehicle
16. *Note to moderator: present each term separately and ask the following questions:*
    a. *Ask participants to raise their hands and count the number of raised hands* Who is familiar with this fuel type?
    b. What do you know or what do you think it is? Why?
    c. Has anybody driven a vehicle that uses this type of fuel?
    d. What would you like about driving a vehicle that ran on this type of fuel? What would you not like?
    e. Are there features that matter to you that you are worried may not be present in a vehicle with this fuel type?

f. If Diesel, plug-in hybrid, fuel cell, or battery: Have you noticed the availability of charging stations, alternative fuel or diesel at gas stations in your area? If so, what kind?

17. *After the participants have responded, hand out the definitions.*

    a. Are you surprised by the definition? If so, what surprises you? Probe:

        i. After hearing the definition, is this what you thought it was? Why or why not?

        ii. Is the definition/description clear? Is it missing something? If so, what would you add to it? Why?

        iii. What comments or concerns do you have about this fuel type?

18. *As a group, ask the participants to develop a list on the flip chart of the strengths and weakness of the fuel types discussed.*

19. *By show of hands*, go through each vehicle type and ask if the vehicle would be considered for the next purchase. Probe:

    a. Why/why not?

    b. How have recent changes in gas prices affected your consideration of this type of vehicle?

    c. How have recent changes to electricity prices affected your consideration of this type of vehicle?

20. If there was an incentive available to consumers who purchase an alternative fuel or high efficiency vehicle, would this motivate you to consider buying this type of vehicle? Why or why not? Probe:

    a. What kind of incentives?

21. *Ask all participants to respond Explain that alternative vehicle types could have trade-offs in fuel economy, price, cargo capacity and other features*. How would your preference for these vehicle types change based on changes to factors such as price, fuel economy, and cargo capacity?

22. Vehicle-to-Grid (V2G) questions

    a. *Ask all participants to respond* Would you be more likely to purchase an electric vehicle if you could use its battery to power your home in the event of a power outage?

    b. *Ask all participants to respond* Would you be more likely to purchase an electric vehicle if you could be paid to discharge your EV's battery into the public electrical grid?

Moderator note: These questions are to be asked if the group has spent less than 30 minutes on this topic.

23. Imagine it is 5 years or 10 years from now. What factors might change that would cause you to consider these elements differently?

    a. What if gas costs $7, $10, or even $15 a gallon?

        iv. Potential probes:

            1. What if you have solar panels? Do you have any plans for getting solar panels?

            2. What if you gain access to HOV lane?

            3. What if parking was free or cheaper?

4. What happens when electric re-charge stations become more common?

24. *Refer to "must haves" and "nice to haves" above*.
    a. Which of these "must have" features that you previously identified would you likely have to forgo if you purchased an alternative fuel vehicle? What about the "nice to haves"?
    b. Which of these "must have" features that you previously identified would you be willing to compromise on in order to purchase an alternative fuel vehicle? What about the "nice to haves"?
25. In terms of all the costs of ownership (including purchase price, maintenance, fuel, and resale value) how do you think each of these fuel types compare to your current vehicles?
26. What factors other than price do you consider when shopping for a car?
27. Discuss as a group:
    a. How far would you like or expect each of these fuel types to be able to drive without refueling?
    b. What trade-offs do you make among these factors when deciding on a vehicle to purchase?
    c. What features are also important that we missed? What makes these important?
    d. Are there any other "nice to haves" that would be important to compare?

Autonomous Features (20 minutes)

In addition to alternative fuel vehicles, fully autonomous or self-driving vehicles are likely to become increasingly available in California. In this section we want to understand how the availability of these vehicles might impact your driving habits and vehicle purchase decisions.

Autonomous features include automatic braking, adaptive cruise control, and a variety of driver assistance features.

28. *Ask all participants to respond* Have you heard of autonomous vehicles? How about self-driving vehicles?
29. How important are autonomous vehicle features to you?
30. Here is a list of some common autonomous features:

Feature	Description
Front collision warning	Alerts the driver if it detects a slow-moving or stopped car or other obstacle in the vehicle's path.
Automatic emergency braking	A safety system that can identify when a possible collision is imminent and respond by activating the brakes.
Front collision steering assistance	Monitors the space in front of the vehicle and automatically steers the vehicle to avoid a front collision. Rather than just warning the driver or applying the brakes, this feature controls the direction of the vehicle.
Adaptive cruise control	Creates an idea of how close the driver's vehicle is to other vehicles and automatically adjusts the speed of the driver's vehicle to maintain safe distance.
Blind spot warning	Alerts the driver if it detects a vehicle in the blind spot area of a lane adjacent to the driver's vehicle.
Active lane change assistance	Monitors areas in adjacent lanes and, when activated, automatically changes lanes when an opening in traffic emerges. Rather than just warning the driver of other vehicles, this system executes the lane change itself.
Lane departure warning	Alerts the driver if it detects that the vehicle has drifted out of its lane without signaling.
Lane centering	Automatically keeps the vehicle centered in the lane in which it is travelling. This system does not just warn the driver of a deviation from the lane, but it actively keeps the vehicle in the lane even through gentle turns.
Rear cross traffic alert	Monitors areas behind a vehicle in reverse and alerts the driver if it detects approaching traffic.
Parking assistance	Automatically drives the vehicle into a parking spot. The driver may or may not be required to sit in the driver seat, depress the accelerator or brake pedal, or shift the vehicle's transmission gears.

a. *Ask all participants to respond* Which of these are features that are included in your current vehicle(s)?

b. Which of these features are most important to you? Why?

c. *Ask all participants to respond* How much are you willing to pay for each of these features?

31. *Ask all participants to respond* If you were to own a fully autonomous vehicle, how would that impact your driving habits and patterns? Probe:

a. Would you trust the vehicle's safety?

b. Would you use the car more frequently than your current vehicle because you would not need to actively drive (e.g., you could sleep, work, or use the vehicle to transport members of your household who cannot drive)?

c. If you have two or more cars currently, would owning an autonomous vehicle reduce your need for another vehicle (e.g., it could drop you off and then be used by other members of your household until you need it again)?

32. *Ask all participants to respond* If fully autonomous ride share services were to become widely available, how would that impact your driving habits and patterns? Probe:

    a. Would you reduce the number of cars you currently own?

    b. Would you reduce the time you spend in the cars you currently own?

33. ***San Francisco only***: How many of you have seen fully autonomous vehicles on the road? How many of you have ridden in one?

34. *Ask all participants to respond* How much would you be willing to pay for your car to be fully autonomous? Probe:

    a. Would it make a difference if the cost of full autonomy were paid upfront or as a subscription each month?

Survey Review (15 minutes)

Further explain survey portion of our study, and explain trade-offs. Ask respondents to read instruction page, evaluate a set of 3 experiments, and open discussion:

35. Were the introduction and instructions clear? What would you change to make them clearer?

36. Was it easy to choose a vehicle from the list? What was confusing or difficult about the choice exercises?

37. Were there any aspects of the exercise that were difficult to understand?

38. What additional information, if any, would be helpful to complete the choice exercises? What did you understand as the instructions?

As time allows:

39. Why did you choose the vehicle you did? Which attributes were important? Which did you ignore?

40. How did you approach the vehicle trade-offs?

41. Were there any important aspects of your purchase decisions that were missing?

Client Questions and Follow-up (5 minutes)

42. Any questions or clarification requested by observers

43. Thank you for your time!

Appendix F:
Commercial Focus Group Moderator Guide

Objectives and Approach

The goal of focus groups is to gather information to assist in the design of the pretest survey, understand factors that affect vehicle purchase behavior, and explore the public's attitudes toward and knowledge of AVs, their features, and policies that affect them.

All the focus group protocols will explore participants' current vehicle ownership, vehicle purchase decision-making, and awareness of alternative fuel and AV technologies. Participants will also react to draft text from the pretest questionnaire to describe each of the vehicle technologies/fuel types in the SP survey and will discuss the extent to which these descriptions provide the types of information that they would need to evaluate each of the vehicle options as well as their general reactions to each of the alternatives.

The focus group protocols will conclude with respondents completing the pretest SP survey element and debriefing to determine potential areas for improvement in the SP survey questions.

Introduction language for moderator (adjust as needed):

Thank you all for joining us this evening. These focus groups are meant to help the California Energy Commission better understand what Californians think about as they purchase vehicles. We will discuss how you use your vehicles, vehicle features that are important to you, vehicle fuel types, and emerging autonomous technologies. This focus groups is being observed by staff from the California Energy Commission, and it is being recorded. To make the recording as clear as possible, please speak one at a time and clearly. All information gathered in this focus groups will remain confidential as provided by the California Public Records Act. You are free to leave at any time, including if you need to excuse yourself to use the restroom. The session will last no longer than 2 hours.

Focus Group Introduction (10 minutes)

1. Purpose and Ground Rules (see above)
2. Personal Introductions: Please provide some information about your company Ask all participants to respond
    a. Name, job title, kind of business, industry, kind of goods carried (if applicable), and number of employees.
    b. How frequently does your company use ride sharing, taxi, rental cars, courier services, delivery services, etc.?

Company and Fleet Background (10 minutes)

3. I want to start by understanding a bit about each of the organizations where you work and what types of vehicles are owned and operated by your companies. Ask all participants to respond

a. Let's go around, and I'd like you to tell me about the type of business that your company is in, the size of your company, how many vehicles your company owns/leases and operates in California, and what types of vehicles those are (for example, mostly cars, trucks, SUVs? All gasoline, or any hybrids or other types?

4. Probe:
    a. Do you typically buy new or used vehicles? Why?
    b. How often do you purchase/lease new vehicles?
    c. Why would you replace a company vehicle (age, repair cost, VMT criteria), and how frequently do you replace them?
5. How many miles does your company tend to put on its vehicles before they are replaced or retired? Ask all participants to respond
6. What are the typical driving patterns for these vehicles? What are they used for? Ask all participants to respond
7. What are the costs associated with vehicles in your fleet? Ask all participants to respond
8. Probe: How do you think about fuel costs (e.g. cost per fill-up, cost per week, cost per month, cost per year)

Future Car Purchase Needs and Desired Attributes (30 minutes)

9. Now I want to talk about what steps you took to purchase your company's most recent vehicle and factors you will consider when purchasing your company's next vehicle.
    a. What factors influenced your decision to purchase your most recent vehicle?
    b. Do any of you have plans to replace a vehicle?
    c. If yes, why? If no, why not?
10. Probe:
    a. When are you planning to purchase the next vehicle for your company? Will it add to vehicles/fleet or replace one? Why?
    b. What kind of vehicle are you planning to purchase?
    c. What vehicle are you planning to replace first? Why?
    d. If you could replace any vehicles in your fleet tomorrow, what would you buy? Why?
    e. Do you expect your next vehicle to be larger/smaller/the same size as others in your fleet?
    f. Will you be likely to purchase a vehicle with better/worse/same fuel economy as your other vehicles?
11. Would you consider buying a vehicle that does not run on gas/petroleum? Why or why not? Ask all participants to respond
    a. Has the recent decrease in fuel prices changed your consideration alternative fuel vehicles?
    b. Has the recent increase in electricity prices changed your consideration alternative fuel vehicles?

12. What factors would you take into consideration before purchasing a new vehicle? I'm curious what you will be looking for in your next vehicle. For flipchart:
    a. What are your "must haves" for your next vehicle? Are there any "must not haves"?
    b. What are the "nice to haves" for your next vehicle? (if it is not brought up, probe for autonomous features such as automatic braking and adaptive cruise control)
13. How did you determine whether something went into one category or the other?
14. What makes these "must haves" so important?

Moderator note: These questions are to be asked if the group has spent less than 30 minutes on this topic.

15. How much are you thinking about the changes that might happen in the world, California, or the economy that would affect the kind of vehicle you will want your company to be using 3-5 years from now?
    a. How dramatic do you expect these changes to be?
16. What costs do you consider as the cost of owning a vehicle?
17. How much do you track your cost of ownership on your existing vehicles?
    a. What is your sense of fuel costs as a percentage of total ownership costs?
18. When it comes to purchasing a new vehicle, how much do you consider each of the following costs:
    a. Purchase price
    b. Maintenance
    c. Repair cost
    d. Fuel cost
    e. Insurance
    f. Depreciation/Resale value

Alternative Fuel Vehicle Perceptions – Aided (30 minutes)

19. There are a variety of fuel types that you can choose from when making the decision to purchase a new vehicle. In this section, we will discuss how you decide which fuel type is right for you. In addition to standard gasoline vehicles, we will focus on the following fuel types.
    e. Diesel vehicle
    f. Hybrid electric vehicle
    g. Plug-in hybrid vehicle
    h. Battery electric vehicle
    i. Fuel cell vehicle
20. Note to moderator: present each fuel type separately and ask the following questions:
    a. Who is familiar with this term? (Ask participants to raise their hands and count the number of raised hands)
    b. What do you know or what do you think it is? Why?

c. Have any of you used this type of vehicle in your businesses?

d. What do/would you like about having this type of vehicle in your company's fleet? What do/would you not like?

e. Are there features that matter to you that you are worried may not be present in a vehicle with this fuel type?

f. If diesel, plug-in, or fuel cell: Have you noticed the availability of charging stations, alternative fuel or diesel at gas stations in your area? What kind?

21. After the participants have responded, hand out the definitions.

    a. Are you surprised by the definition? If so, what surprises you? Probe:

        i. After hearing the definition, is this what you thought it was? Why or why not?

        ii. Is the definition/description clear? Is it missing something? If so, what would you add to it? Why?

        iii. Do you have any comments or concerns about this type of vehicle? If so, what are your concerns?

        iv. How about the definitions? Are they clear?

22. As a group, ask the participants to develop a list on the flip chart of the strengths and weakness of the fuel types discussed.

23. By show of hands, go through each vehicle type and ask if the vehicle would be considered for the next purchase. Probe:

    a. Why/why not?

    b. How have recent changes in gas prices affected your consideration of this type of vehicle?

    c. How have recent changes to electricity/hydrogen prices affected your consideration of this type of vehicle?

24. If there was an incentive available to consumers who purchase an alternative fuel or high efficiency vehicle, would this motivate you to consider buying this type of vehicle? Why or why not? Probe:

    a. What kind of incentives?

25. Explain that alternative vehicle types could have trade-offs in fuel economy, price, cargo capacity, range, maintenance costs, and other features. How would your preference for these vehicle types change based on changes to factors such as price, fuel economy, and cargo capacity?

26. V2G questions

    a. Would you be more likely to purchase an electric vehicle if you could use it to power your home or business in the event of a power outage? Ask all participants to respond

    b. Would you be more likely to purchase an electric vehicle if you could be paid to discharge your vehicle's battery into the public electrical grid? Ask all participants to respond

Moderator note: These questions are to be asked if the group has spent less than 30 minutes on this topic.

27. Imagine it is 5 years or 10 years from now. What factors might change that would cause you to consider these elements differently?

a. What if gas costs $7, $10, or even $15 a gallon?

i. Potential probes:

1. Do you have solar panels and/or Power walls in your business? What if you have solar panels at your business? Do you have any plans for getting solar panels and/or power walls?
2. Do you have /use any generators in your business? If yes any solar?
3. What if you gain access to HOV lanes?
4. What if parking was free or cheaper for ZEV vehicles?
5. What happens when electric charging stations become more common?

28. Refer to "must haves" and "nice to haves" above.
    a. Which of these "must have" features that you previously identified would you likely have to forgo if you purchased an alternative fuel vehicle? What about the "nice to haves"?
    b. Which of these "must have" features that you previously identified would you be willing to compromise on in order to purchase an alternative fuel vehicle? What about the "nice to haves"?
29. In terms of all of the costs of ownership (including purchase price, maintenance, fuel, and resale value) how do you think each of these fuel types compare to your current vehicles?
30. Discuss as a group:
    a. What ranges are acceptable for each of these fuel types? What ranges are ideal?
    b. What trade-offs do you make among these factors when deciding on a vehicle to purchase?
    c. What features are also important that we missed? What makes these important?
    d. Are there any other "nice to haves" that would be important to compare?

Autonomous Features (20 minutes)

In addition to alternative fuel vehicles, fully autonomous or self-driving vehicles are likely to become increasingly available in California. In this section we want to understand how the availability of these vehicles might impact your driving habits and vehicle purchase decisions.

Autonomous features include automatic braking, adaptive cruise control, and a variety of driver assistance like parking, steering, or braking features.

31. How important are these features to you and your fleet drivers?
32. How much more are you willing to pay to ensure that your vehicle(s) has/have these features? Ask all participants to respond
33. Here is a list of some common autonomous features:

Feature	Description
Front collision warning	Alerts the driver if it detects a slow-moving or stopped car or other obstacle in the vehicle's path.
Automatic emergency braking	A safety system that can identify when a possible collision is imminent and respond by activating the brakes.
Front collision steering assistance	Monitors the space in front of the vehicle and automatically steers the vehicle to avoid a front collision. Rather than just warning the driver or applying the brakes, this feature controls the direction of the vehicle.
Adaptive cruise control	Creates an idea of how close the driver's vehicle is to other vehicles and automatically adjusts the speed of the driver's vehicle to maintain safe distance.
Blind spot warning	Alerts the driver if it detects a vehicle in the blind spot area of a lane adjacent to the driver's vehicle.
Active lane change assistance	Monitors areas in adjacent lanes and, when activated, automatically changes lanes when an opening in traffic emerges. Rather than just warning the driver of other vehicles, this system executes the lane change itself.
Lane departure warning	Alerts the driver if it detects that the vehicle has drifted out of its lane without signaling.
Lane centering	Automatically keeps the vehicle centered in the lane in which it is travelling. This system does not just warn the driver of a deviation from the lane, but it actively keeps the vehicle in the lane even through gentle turns.
Rear cross traffic alert	Monitors areas behind a vehicle in reverse and alerts the driver if it detects approaching traffic.
Parking assistance	Automatically drives the vehicle into a parking spot. The driver may or may not be required to sit in the driver seat, depress the accelerator or brake pedal, or shift the vehicle's transmission gears.

   d. Which of these are features that are included in your current vehicle(s)?

   e. Which of these features are most important to you? Why?

   f. How much are you willing to pay for each of these features? Ask all participants to respond

34. How much more would pay to get a fully self-driving vehicle? Ask all participants to respond

35. If your business were to own one or more fully autonomous vehicles, how would that impact your business' driving/work habits and patterns? Ask all participants to respond Probe:

   a. Would owning an autonomous vehicle reduce the number of vehicles or change the types of vehicles your business would need (e.g., it could do work outside normal business hours, it

could deliver materials to a job site ahead of workers, or it could allow workers to work in between job sites)?

Survey Review (15 minutes)

Further explain survey portion of our study and explain trade-offs. Ask respondents to read instruction page, evaluate a set of experiments (4), and open discussion:

36. Were the introduction and instructions clear? What would you change to make them clearer?
37. Is it easy to choose a vehicle from the list? What is confusing or difficult about the choice exercises?
38. Why did you choose the vehicle you did? Which attributes were important? Which did you ignore?
39. What additional information, if any, would be helpful to complete the choice exercises? What did you understand as the instructions?
40. How did you approach the vehicle trade-offs?
41. Were there any aspects of the exercise that were difficult to understand?
42. Were there any important aspects of your purchase decisions that were missing?

Client Questions and Follow-up (5 minutes)

43. Any questions or clarification requested by observers
44. Thank you for your time!

Appendix G:
ZEV Focus Group Moderator Guide

Objectives and Approach

The goal of focus groups is to gather information to assist in the design of the pretest survey, understand factors that affect vehicle purchase behavior, and explore the public's attitudes toward and knowledge of AVs, their features, and policies that affect them. This session is specifically focused on the experience of ZEV vehicle owners and operators.

All the focus group protocols will explore participants' current vehicle ownership, vehicle purchase decision-making, and awareness of alternative fuel and AV technologies. Participants will also react to draft text from the pretest questionnaire to describe each of the vehicle technologies/fuel types in the SP survey and will discuss the extent to which these descriptions provide the types of information that they would need to evaluate each of the vehicle options as well as their general reactions to each of the alternatives.

The focus group protocols will conclude with respondents completing the pretest SP survey element and debriefing to determine potential areas for improvement in the SP survey questions.

Introduction language for moderator (adjust as needed):

Thank you all for joining us this evening. These focus groups are meant to help the California Energy Commission better understand what Californians think about as they purchase vehicles. We will discuss how you use your vehicles, vehicle features that are important to you, vehicle fuel types, and emerging autonomous technologies. This focus groups is being observed by staff from the California Energy Commission, and it is being recorded. To make the recording as clear as possible, please speak one at a time and clearly. All information gathered in this focus groups will remain confidential as provided by the California Public Records Act. You are free to leave at any time, including if you need to excuse yourself to use the restroom. The session will last no longer than 2 hours.

Focus Group Introduction (10 minutes)

1. Purpose and ground rules (see above)
2. Personal Introductions: Please provide some information about yourself
    a. Name, residence (town/city), household size, employment status, employer location (town/city); do you currently have solar panels and/or a backup power source for your home? Ask all participants to respond

Current Vehicles and Driving Habits (10 minutes)

Note to moderator: write these questions on flip chart and document answers

3. Now let's go around the room and discuss the vehicles that you drive. For each of you, please tell me about:

a. The number of vehicles that you have in your household, how long you've had each of them, which you use the most, which you use the least, and why? Ask all participants to respond

b. Whether you own or lease them, and whether you bought them new or used Ask all participants to respond

c. How do you use your vehicles? How much time do you spend in your car(s)? Where do you go? What is your vehicle for? How many people/things do you typically have with you in the vehicle? Ask all participants to respond

4. As warranted, probe with the following:
    a. Tell me about how much you typically drive
5. Who here has used:
    a. Uber or other ride share service? How frequently?
    b. Rental car? Why? How frequently?
    c. Transit bus/rail? How frequently?
    d. What are those like? How frequently?

Future Car Purchase Needs and Desired Attributes (30 minutes)

6. Now I want to talk about what steps you took to purchase/lease your electric vehicle (if commercial or residential with >1 PEV– most recent PEV) and factors you will consider when purchasing/leasing your next vehicle.
7. What factors influenced your decision to purchase your current plug-in vehicle? Did you buy it new or used?
8. Do any of you have plans to replace your current vehicle?
    d. If yes, why? If no, why not?
    e. Probe: Are you considering any alternative to replacing your current vehicle such as an e-bike, a motorcycle, or increased transit/ridesharing use?
9. When are you planning to purchase your next vehicle?
10. Tell me about the kind of vehicle you are planning to purchase. Probe:
    a. Do you expect it to be larger/smaller/the same size as your current vehicle?
    b. Do you expect better/worse/same fuel economy?
    c. If not mentioned, probe for the following: Would you consider buying another plug-in electric vehicle and/or hydrogen fuel cell vehicle? Why or why not? Ask all participants to respond
    d. How has the recent decrease in fuel prices changed your consideration of alternative fuel vehicles?
    e. How has the recent increase in electricity prices changed your consideration of alternative fuel vehicles?
11. What factors would you take into consideration before purchasing a new vehicle? I'm curious what you will be looking for in your next vehicle. For flipchart:

a. What are your "must haves" for your next vehicle?

b. What are the "nice to haves" for your next vehicle? (if it is not brought up, probe for autonomous features such as automatic braking and adaptive cruise control)

12. How did you determine whether something went into one category or the other?

13. What makes these "must haves" so important?

Moderator note: These questions are to be asked if the group has spent less than 30 minutes on this topic.

14. When it comes to purchasing a new vehicle, how much do you consider each of the following costs:

    a. Purchase price

    b. Maintenance/repair cost

    c. Fuel cost

    d. Insurance

    e. Depreciation/Resale value

15. How much are you thinking about the changes that might happen in the world that would affect the kind of vehicle you will want to be driving 3-5 years from now?

    a. How dramatic do you expect these changes to be?

PEV Decision and purchase Experience (10 minutes)

For this next part of our discussion, we are going to talk about what led to your decision to purchase an electrified vehicle, and what your experiences were throughout the purchase process.

16. What types of vehicle did you consider at the same time as you looked at purchasing/leasing your electric vehicle(s)? Ask all participants to respond

17. What most influenced your decision to ultimately purchase an electric vehicle?

    j. What were the major drawbacks in your mind?

    k. What do you wish was different about your purchase experience when buying your current vehicle?

Charging Behavior (20 Minutes)

For this next part of our discussion, we are going to talk about how you use your electric vehicle, and in particular about charging your vehicle.

18. Tell me about the types of chargers that are available to you and which one(s) you have at your home. Ask all participants to respond

19. Tell me about when and where you typically charge. Probe:

    a. What is that experience like?

    b. How long does it typically take?

    c. Does the time to charge change based on your charging location?

    d. At public charging stations, how often are there no chargers available due to either other users or chargers that need repair?

20. How do you think about how much it costs to charge your vehicle?
    a. When do you choose to charge at home or at public charging stations?
        i. When you charge at public charging stations, how do you think about where you will charge? For instance, do you primarily consider time, distance, availability, price, charging speed, charger brand?
    b. Have you changed your electricity usage at home since purchasing an electric vehicle?
    c. Do you have solar panels? How have these affected your charging habits and electricity usage? Ask all participants to respond
    d. Do you have a Tesla Power Wall? How does it affect your charging habits and electricity usage? Ask all participants to respond
21. Would you be interested in participating in a program in which you are paid to discharge some of your EV battery's electricity while it is plugged in either at home or at a public charging station? Ask all participants to respond
    a. Probe: For how long, at what price, and under what conditions?
22. Would you be interested in a home electrical system that can draw power from your vehicle in the event of a blackout? Ask all participants to respond
23. Do any of you own a Tesla Powerwall or a similar technology that collects and stores solar energy to power your home or charge your vehicle's battery?
    a. If yes, why did you purchase the Powerwall? How do you use it? What do you like about it? What do you not like about it?

Moderator note: These questions are to be asked if the group has spent less than 20 minutes on this topic.

24. When your vehicle is fully charged, how much electric range do you typically have?
25. What are your pain points with respect to charging and driving your electric vehicle?
    a. Are these pain points more common when you charge at home or at a public charging station?
26. What are you pleasantly surprised by with respect to charging and/or vehicle range?
27. How does your vehicle's range affect your driving decisions/behavior? How does your vehicle's range affect your charging behavior?
    a. Probe: Does it affect the number of miles you drive, long distance trips/commutes, use of carshare or rental cars, use of active transit modes or public transit, etc.?

Autonomous Features (20 minutes)

In addition to alternative fuel vehicles, fully autonomous or self-driving vehicles are likely to become increasingly available in California. In this section we want to understand how the availability of these vehicles might impact your driving habits and vehicle purchase decisions.

Autonomous features include automatic braking, adaptive cruise control, and a variety of driver assistance features.

28. Have you heard of autonomous vehicles? How about self-driving vehicles? Ask all participants to respond
29. How important are autonomous vehicle features to you?
30. Here is a list of some common autonomous features:

Feature	Description
Front collision warning	Alerts the driver if it detects a slow-moving or stopped car or other obstacle in the vehicle's path.
Automatic emergency braking	A safety system that can identify when a possible collision is imminent and respond by activating the brakes.
Front collision steering assistance	Monitors the space in front of the vehicle and automatically steers the vehicle to avoid a front collision. Rather than just warning the driver or applying the brakes, this feature controls the direction of the vehicle.
Adaptive cruise control	Creates an idea of how close the driver's vehicle is to other vehicles and automatically adjusts the speed of the driver's vehicle to maintain safe distance.
Blind spot warning	Alerts the driver if it detects a vehicle in the blind spot area of a lane adjacent to the driver's vehicle.
Active lane change assistance	Monitors areas in adjacent lanes and, when activated, automatically changes lanes when an opening in traffic emerges. Rather than just warning the driver of other vehicles, this system executes the lane change itself.
Lane departure warning	Alerts the driver if it detects that the vehicle has drifted out of its lane without signaling.
Lane centering	Automatically keeps the vehicle centered in the lane in which it is travelling. This system does not just warn the driver of a deviation from the lane, but it actively keeps the vehicle in the lane even through gentle turns.
Rear cross traffic alert	Monitors areas behind a vehicle in reverse and alerts the driver if it detects approaching traffic.
Parking assistance	Automatically drives the vehicle into a parking spot. The driver may or may not be required to sit in the driver seat, depress the accelerator or brake pedal, or shift the vehicle's transmission gears.

    g. Which of these are features that are included in your current vehicle(s)?
    h. Which of these features are most important to you? Why?
    i. How much are you willing to pay for each of these features?

31. How much are you willing to pay to ensure that your vehicle(s) has/have these features? Ask all participants to respond

32. If you were to own a fully autonomous vehicle, how would that impact your driving habits and patterns? Ask all participants to respond Probe:
    d. Would you use the car more frequently than your current vehicle because you would not need to actively drive (e.g., you could sleep, work, or use the vehicle to transport members of your household who cannot drive)?
    e. If you have two or more cars currently, would owning an autonomous vehicle reduce your need for another vehicle (e.g., it could drop you off and then be used by other members of your household until you need it again)?
33. If fully autonomous ride share services were to become widely available, how would that impact your driving habits and patterns? Ask all participants to respond Probe:
    a. Would you reduce the number of cars you currently own?
    b. Would you reduce the time you spend in the cars you currently own?
34. How much would you be willing to pay for your car to be fully autonomous? Ask all participants to respond Probe:
    a. Would it make a difference if the cost of full autonomy were paid upfront or as a subscription each month?

Survey Review (15 minutes)

Further explain survey portion of our study, and explain trade-offs. Ask respondents to read instruction page, evaluate a set of experiments (4), and open discussion:

35. Were the introduction and instructions clear? What would you change to make them clearer?
36. Is it easy to choose a vehicle from the list? What is confusing or difficult about the choice exercises?
37. Why did you choose the vehicle you did? Which attributes were important? Which did you ignore?
38. What additional information, if any, would be helpful to complete the choice exercises? What did you understand as the instructions?
39. How did you approach the vehicle trade-offs?
40. Were there any aspects of the exercise that were difficult to understand?
41. Were there any important aspects of your purchase decisions that were missing?

Client Questions and Follow-up (5 minutes)

42. Any questions or clarification requested by observers
43. Thank you for your time!

Appendix H:
Handouts for Focus Group Participants

Descriptions of Fuel Types

Fuel Type	Description
Gasoline only vehicle	A vehicle that operates on gasoline only and has no hybrid components.
Gasoline Hybrid Electric vehicle (HEV)	A gasoline vehicle with hybrid components to increase fuel economy (e.g. Toyota Prius) but does not plug in for charging the battery.
Gasoline Plug-in Hybrid Electric vehicle (PHEV)	A gasoline vehicle with hybrid components and a larger battery (e.g. Chevrolet Volt) which allows the vehicle to operate like a battery electric vehicle for a short distance (10-40 miles) and then operate on gasoline for a much longer distance (~300-400 miles).
Diesel only vehicle	A vehicle that operates on diesel or biodiesel only and has no hybrid components.
Battery Electric vehicle (BEV)	A vehicle that operates on a battery only and charges by plugging in at home or at a station (e.g. Nissan Leaf).
Hydrogen Fuel Cell Electric vehicle (FCEV)	A hybrid electric vehicle that uses hydrogen to generate its own electricity in a fuel cell. The fuel cell powers the electric motor that drives the wheels and recharges the battery. Hydrogen is stored in a tank onboard the vehicle.

Descriptions of Autonomous Features

Feature	Description
Front collision warning	Alerts the driver if it detects a slow-moving or stopped car or other obstacle in the vehicle's path.
Automatic emergency braking	A safety system that can identify when a possible collision is imminent and respond by activating the brakes.
Front collision steering assistance	Monitors the space in front of the vehicle and automatically steers the vehicle to avoid a front collision. Rather than just warning the driver or applying the brakes, this feature controls the direction of the vehicle.
Adaptive cruise control	Creates an idea of how close the driver's vehicle is to other vehicles and automatically adjusts the speed of the driver's vehicle to maintain safe distance.
Blind spot warning	Alerts the driver if it detects a vehicle in the blind spot area of a lane adjacent to the driver's vehicle.
Active lane change assistance	Monitors areas in adjacent lanes and, when activated, automatically changes lanes when an opening in traffic emerges. Rather than just warning the driver of other vehicles, this system executes the lane change itself.
Lane departure warning	Alerts the driver if it detects that the vehicle has drifted out of its lane without signaling.
Lane centering	Automatically keeps the vehicle centered in the lane in which it is travelling. This system does not just warn the driver of a deviation from the lane, but it actively keeps the vehicle in the lane even through gentle turns.
Rear cross traffic alert	Monitors areas behind a vehicle in reverse and alerts the driver if it detects approaching traffic.
Parking assistance	Automatically drives the vehicle into a parking spot. The driver may or may not be required to sit in the driver seat, depress the accelerator or brake pedal, or shift the vehicle's transmission gears.

Appendix I:
Example Discrete Choice Experiments

The following pages provide two examples of discrete vehicle choice experiments displayed to survey respondents, and an example follow-up experiment concerning autonomous vehicles based on a particular response.

Please carefully review each vehicle and all its features below. Assuming these are the only vehicles available to you to purchase, please select the ONE vehicle you would most likely purchase.

Vehicle Choice 1	Vehicle A	Vehicle B	Vehicle C	Vehicle D
Vehicle Class	Mid-size Car	Compact Crossover/SUV	Mid-size Crossover/SUV	Mid-size Car
Fuel Type	Gasoline only vehicle	Battery Electric Vehicle	Gasoline Hybrid Electric vehicle (HEV)	Diesel only vehicle
Brand Type	Premium	Premium	Standard	Standard
Model Year	New (2024)	New (2024)	Used (2019)	Used (2022)
Vehicle Price	$48,393	$58,793	$27,193	$17,952
Vehicle Range	465 miles	349 miles	450 miles	528 miles
Fuel stations	Gasoline Station (at today's locations)		Gasoline Station (at today's locations	50% of today's gasoline locations
Home Charging		Regular charging available		
Work/School Charging		Fast charging available		
MPG/Fuel Economy	30.5	106.6	31.9	39.5
Fuel Cost per 100 miles (Public Station fuel)	$13.54	$5.84	$12.94	$15.77
Refueling Time (Public Station)	5 minutes	2 hours for 100 miles for regular charging 15 minutes for 100 miles for fast charging	5 minutes	5 minutes
Purchase Incentive	None	$5,000 Tax Credit	None	None
Annual Maintenance	$1613	$1338	$1959	$1008
Acceleration Rate (0-60 mph)	6.6 seconds	4.7 seconds	9.3 seconds	8.1 seconds
Select One:	○	○	○	○

Please carefully review each vehicle and all its features below. Assuming these are the only vehicles available to you to purchase, please select the ONE vehicle you would most likely purchase.

Vehicle Choice 2	Vehicle A	Vehicle B	Vehicle C	Vehicle D
Vehicle Class	Compact	Small Pick-up truck	Compact	Subcompact Car
Fuel Type	Hydrogen Fuel Cell vehicle (FCV)	Gasoline only vehicle	Gasoline Plug-in Hybrid Electric vehicle (PHEV)	Battery Electric vehicle (BEV)
Brand Type	Premium	Standard	Standard	Standard
Model Year	New (2024)	New (2024)	Used (2022)	Used (2019)
Vehicle Price	$63,137	$30,141	$23,681	$20,981
Vehicle Range	380 miles	385 miles	493 miles	265 miles
Fuel Stations	5 miles to station from home/work	Gasoline stations (at today's locations)	Gasoline stations (at today's locations)	
Home Charging			Not available	Regular charging available
Work Charging			Regular charging available	Fast charging available
MPG/Fuel Economy	70.3	21.5	54.5	98.4
Fuel Cost per 100 miles (Public Station fuel)	$17.75	$19.21	$7.58	$6.33
Refueling Time (Public Stations)	5 minutes	5 minutes	5 minutes for gasoline refueling; 30 minutes for 10 miles for regular charging	2 hours for 100 miles for regular charging; 25 minutes for 100 miles for fast charging
Purchase Incentive	$5,000 rebate	None	$5,000 Tax Credit	$1,000 Rebate
Annual Maintenance	$922	$922	$1453	$1081
Acceleration Rate (0-60 mph)	5.8 seconds	7.6 seconds	5.7 seconds	8.5 seconds
Select One:	○	○	○	○

Now, assume that you chose Vehicle B in the Vehicle Choice 1 worksheet. Further, assume that this vehicle can be purchased at each of the five levels of autonomy that are described below. Thinking only about these levels of autonomy and their associated prices, select ONE option below.

Autonomous Vehicle Choice 1	Vehicle A	Vehicle B	Vehicle C	Vehicle D	Vehicle E
Vehicle Type	*See Vehicle B on the Vehicle Choice 1 worksheet	*See Vehicle B on the Vehicle Choice 1 worksheet	*See Vehicle B on the Vehicle Choice 1 worksheet	*See Vehicle B on the Vehicle Choice 1 worksheet	*See Vehicle B on the Vehicle Choice 1 worksheet
Autonomy Level	1	2	3	4	5
Vehicle Price	$36,452	$40,097	$43,742	$45,565	$47,387
Select One:	○	○	○	○	○

Source: 2024 California Vehicle Survey, California Energy Commission

Survey participants could hover over the selected vehicle from the vehicle type choice experiment (vehicle B on the vehicle choice 1, in the above example) to see all of the attributes listed for that choice. They could also hover over “Autonomy Level” in the autonomy level choice set to see the definitions of each autonomy level, if they did not know the differences, to facilitate their informed choices.

Autonomy Level Definitions

Level 1 Autonomy	Either steering OR brake/acceleration support for the driver such as lane centering OR adaptive cruise control.
Level 2 Autonomy	Both steering AND brake/acceleration support for the driver such as lane centering AND adaptive cruise control.
Level 3 Autonomy	The vehicle is capable of fully driving by itself under specific conditions, but the driver may be required to take control of the vehicle if conditions change.
Level 4 Autonomy	The vehicle is capable of fully driving by itself under specific conditions, and the car will not operate outside of these conditions unless the driver is in control.
Level 5 Autonomy	The vehicle is capable of fully driving by itself under all conditions.

Source: 2024 California Vehicle Survey, California Energy Commission

California Vehicle Survey: Definitions and Examples

Survey participants could hover over any vehicle attribute in the vehicle type choice experiment, to see examples or definition and measurement of that attribute to facilitate their informed choices.

Vehicle Class Examples

	Examples
Subcompact Car	Mini Cooper, Kia Rio, Nissan Versa
Compact Car	Honda Civic, Mazda 3, Hyundai Elantra, Volkswagen Jetta
Midsize Car	Chevrolet Malibu, Honda Accord, Nissan Altima, Tesla Model 3, Toyota Camry
Large Car	Dodge Charger, Chrysler 300, Nissan Maxima, Audi A7, Tesla Model S
Sports Car	BMW i8, Nissan Z, Ford Mustang, Mazda MX-5 Miata, Porsche 911
Subcompact Crossover/SUV	Buick Encore, Kia Soul, Ford EcoSport, Honda HR-V, Fiat 500
Compact Crossover/SUV	Honda CR-V, Mazda CX-5, Hyundai Tucson, Tesla Model X, Toyota Rav4, Ford Bronco
Midsize Crossover/SUV	Chevrolet Traverse, Honda Pilot, Kia Sorento, Nissan Pathfinder, Jeep Grand, Porche Cayenne
SUV, Full-size/Large	Chevrolet Suburban, Ford Expedition, Chevrolet Tahoe, Lincoln Navigator

Small Pick-up Truck	Chevrolet Colorado, GMC Canyon, Honda Ridgeline, Hyundai Santa Cruz, Jeep Gladiator, Ford Ranger, Toyota Tacoma
Large/Full-size Pick-up Truck	Chevrolet Silverado, Ford F-Series, GMC Sierra, Nissan Titan, Toyota Tundra
Small Van (Minivan)	Chrysler Pacifica, Kia Carnival, Honda Odyssey, Nissan Quest, Toyota Sienna
Van, Full-size/Large	Chevrolet Express 1500, Ford Transit, Mercedes-Benz Sprinter, Nissan NV Cargo

Source: 2024 California Vehicle Survey, California Energy Commission

Fuel Type Descriptions

	Description of Fuel Types
Gasoline only vehicle	A vehicle that operates on gasoline only and has no hybrid components.
Gasoline Hybrid Electric vehicle (HEV)	A gasoline vehicle with hybrid components to increase fuel economy, but does not plug in for charging the battery.
Gasoline Plug-in Hybrid Electric vehicle (PHEV)	A gasoline vehicle with hybrid components and a larger battery which allows the vehicle to operate like a battery electric vehicle for a short distance (10-40 miles) and then operate on gasoline for a much longer distance (~300-400 miles).
Diesel only vehicle	A vehicle that operates on diesel or biodiesel only and has no hybrid components.
Battery Electric vehicle (BEV)	A vehicle that operates on a battery only and charges by plugging in at home or at a station.
Hydrogen Fuel Cell Electric vehicle (FCEV)	A hybrid electric vehicle that uses hydrogen to generate its own electricity in a fuel cell. The fuel cell powers the electric motor that drives the wheels and recharges the battery. Hydrogen is stored in a tank onboard the vehicle.

Source: 2024 California Vehicle Survey, California Energy Commission

Brand Type

Brand type consists of standard brands and premium brands. Standard brands have more affordable vehicles, whereas, premium brands offer high-end, luxury vehicles.

Standard Makes		Premium Makes	
Buick	Mercury	Acura	Lincoln
Chevrolet	Mini	Audi	Lucid
Chrysler	Mitsubishi	BMW	Mercedes-Benz
Dodge	Nissan	Cadillac	Polestar
Ford	Pontiac	Fisker	Porsche

GMC	Saturn	Genesis	Rivian
Honda	Smart	Hummer	Saab
Hyundai	Subaru	Infiniti	Tesla
Jeep	Suzuki	Jaguar	Volvo
Kia	Toyota	Land Rover	
Mazda	Volkswagen	Lexus	

Source: 2024 California Vehicle Survey, California Energy Commission

Model Year

This is the model year of the vehicle. A new vehicle would be a vehicle that has not been owned by anyone before. Vehicles in the choice sets range from 2019 to 2024 model years.

Vehicle Price

This is the price you would pay to purchase this vehicle without tax, title, or tags. It represents the final retail price of the car after any dealer incentives or discounts. It does not include the trade-in value of your current vehicle, if you had one.

Vehicle Range

This is the maximum distance the vehicle can travel on a full tank or full charge without refueling.

Fuel Stations

This is how you would fuel the specific vehicle. This may be refueling at a traditional fueling station (e.g., at a gas or diesel station); or other options that are available for some of the alternative fuels. This includes:

Type of Vehicle	Type of Station	Explanation
Gasoline or Diesel only	Refuel at station	Refuel at a traditional gasoline or diesel refueling station
Plug–in Hybrid Electric vehicle (PHEV)	Refuel at station	This is a traditional gasoline refueling station
Battery Electric vehicle only (BEV)	Plug in at work or charging station	This is the ability to charge your vehicle from various locations (e.g., work or charging station)
Hydrogen vehicle	Hydrogen fueling station	Refuel at a hydrogen station that provides high pressure, fast fill fueling.

Source: 2024 California Vehicle Survey, California Energy Commission

MPG/Fuel Economy

This is the fuel economy you would expect to get while driving the vehicle. The stated figure assumes 55% city driving and 45% highway driving. Fuel economy for hydrogen vehicles takes into account the number of miles the vehicle can go using the energy equivalent of a gallon of gasoline (MPGe).

Fuel Cost per 100 Miles

This is how much you would expect to pay for fuel in order to drive 100 miles. This number is based on the MPG or MPGe of the vehicle as explained in the above feature and the price of fuel.

Refueling Time

This is the amount of time it would take to refuel the vehicle at the location in "Refueling Station Availability." For some vehicles, this would be the amount of time it would take to fill the vehicle to a full tank of gasoline or diesel fuel. For other vehicles which use electric batteries (e.g., a battery electric only vehicle), this would be the amount of time it would take to fully charge the battery. For home refueling of battery electric vehicles (BEVs), this could take hours compared to minutes at a station.

Purchase Incentive

Incentive	Description
None	No incentive offered
HOV lane access	This allows you to travel in the HOV carpool lane as a single driver.
Tax Credits	This allows you to receive a tax credit, which would directly reduce the amount of your annual income tax owed. This includes a $1,000 tax credit for compressed natural gas vehicles or a $2,500, $5,000, or $7,500 tax credit for battery electric, plug-in hybrid electric, or hydrogen vehicles.
Rebates	This allows you to receive a certain amount of money off of the price of the vehicle through a purchase rebate. You would receive the rebate approximately 6 months after purchasing the vehicle. For compressed natural gas, battery electric, plug-in hybrid electric, or hydrogen vehicles, this rebate may be $500, $1,000, $1,500 or $2,500 off the purchase price.

Source: 2024 California Vehicle Survey, California Energy Commission

Annual Maintenance Cost

This is the total annual maintenance cost for the vehicle considering how many miles you drive each year. Maintenance costs include all costs associated with normal routine maintenance during a year including oil and filter changes. It does not include insurance, registration, fees, or unexpected repairs.

Acceleration Rate (0-60 mph)

The amount of time, in seconds, it takes for your vehicle to accelerate from 0-60 mph. Acceleration time varies from a low of 4 seconds for sports cars to a high of 14 seconds for some larger vehicles and engines that use non-traditional fuel types. Acceleration is related to horsepower, vehicle weight, and engine performance.

Appendix J:
Alternative Model Specifications

This appendix includes alternative model specifications, including regional models, for the following models based on data from the 2024 CVS:

- Residential Vehicle Type Choice Model
- Residential Autonomous Vehicle Choice Model
- Residential Vehicle Transaction and Replacement Model
- Residential New-Used Vehicle Choice Model
- Residential Vehicle Quantity Model
- Residential Vehicle Miles Traveled Model
- Commercial Vehicle Type Choice Model
- Commercial Autonomous Vehicle Choice Model

Residential Vehicle Type Choice (Regional Model)

Regional interactions were added to the base specification of the residential vehicle type choice model by running this model on subsets of the database that only include observations from each of California's six regions. Additionally, a pooled model was run that included interaction terms between the combination of regional dummy variables and parameters that differed from the pooled model in the respective region-specific model. The vehicle type choice regional model includes the following interaction terms for each vehicle ownership category:

- Sacramento*Full Size Van
- Sacramento*Small Pickup Truck
- Sacramento*Full Size Pickup Truck
- San Francisco*Small Pickup Truck
- San Francisco*Full Size Pickup Truck
- San Francisco*BEV
- Central Valley*Used (6 years old)

Pooled model estimates are presented in **Table 6**, and fit statistics are presented in **Table 7**.

Table 6: Residential Vehicle Type Choice Regional Model

Para-meter	Variable	Units	1 Veh Coeff.	1 Veh T-Stat	2 Veh Coeff	2 Veh T-Stat	3+ Veh Coeff	3+ Veh T-Stat
α_1	Reference vehicle (from consideration set)	-	0	NA	0	NA	0	NA
α_2	First non-reference vehicle	-	-0.91	-25.90	-1.01	-31.09	-1.13	-24.21
α_3	Second non-reference vehicle	-	-1.09	-27.81	-1.17	-32.50	-1.31	-25.37
α_4	Third non-reference vehicle	-	-1.51	-34.09	-1.54	-38.71	-1.65	-27.70
$\beta_{1,1}$	Subcompact Car	0,1	0	NA	0	NA	0	NA
$\beta_{1,2}$	Compact Car	0,1	0.27	3.26	0.09	1.08	0.13	0.98
$\beta_{1,3}$	Midsize Car	0,1	0.26	3.17	0.40	5.06	0.46	3.56
$\beta_{1,4}$	Large Car	0,1	-0.02	-0.16	0.07	0.70	0.22	1.48
$\beta_{1,5}$	Sports Car	0,1	0.25	2.45	0.08	0.80	0.18	1.14
$\beta_{1,6}$	Subcompact Crossover	0,1	0.23	2.71	0.18	2.04	0.27	2.02
$\beta_{1,7}$	Compact Crossover	0,1	0.24	3.08	0.37	4.48	0.55	4.13
$\beta_{1,8}$	Midsize Crossover/SUV	0,1	0.61	7.12	0.72	8.46	0.92	6.66
$\beta_{1,9}$	Large SUV	0,1	0.18	1.72	0.35	3.42	0.73	4.63
$\beta_{1,10}$	Small Van	0,1	-0.05	-0.46	0.14	1.40	0.21	1.41
$\beta_{1,11}$	Full-size/large Van	0,1	-0.26	-2.26	-0.01	-0.13	0.00	-0.01
$\beta_{1,12}$	Small Pickup Truck	0,1	0.16	1.47	0.08	0.81	0.36	2.22
$\beta_{1,13}$	Full-size/large Pickup Truck	0,1	0.33	2.74	0.41	3.62	0.72	4.34
$\beta_{2,1}$	Gasoline only	0,1	0	NA	0	NA	0	NA
$\beta_{2,2}$	Gas HEV	0,1	-0.10	-1.69	-0.02	-0.28	-0.26	-3.37
$\beta_{2,3}$	PHEV	0,1	-0.53	-2.64	-0.89	-4.72	-1.20	-4.28
$\beta_{2,4}$	Diesel	0,1	-0.65	-4.00	-0.85	-5.60	-0.58	-3.23
$\beta_{2,5}$	BEV	0,1	-0.23	-0.67	-0.48	-1.51	-0.57	-1.46
$\beta_{2,6}$	FCV	0,1	-0.45	-1.45	-0.73	-2.55	-0.84	-2.37
$\beta_{2,7}$	PFCV	0,1	-0.76	-2.10	-1.64	-4.86	-1.66	-3.73
$\beta_{3,1}$	Standard	0,1	0	NA	0	NA	0	NA
$\beta_{3,2}$	Premium	0,1	0.03	0.53	0.21	3.80	0.19	2.15

Para-meter	Variable	Units	1 Veh Coeff.	1 Veh T-Stat	2 Veh Coeff	2 Veh T-Stat	3+ Veh Coeff	3+ Veh T-Stat
$\beta_{4,1}$	New	0,1	0	NA	0	NA	0	NA
$\beta_{4,2}$	Used (3 Years Old)	0,1	-0.27	-4.84	-0.27	-5.89	-0.33	-4.62
$\beta_{4,3}$	Used (6 Years Old)	0,1	-0.47	-5.73	-0.60	-8.85	-0.61	-5.59
β_5	Ln (Vehicle price) *((income/mean income)^λ)	Price in ln ($1000)	-0.40	-5.43	-0.53	-9.61	-0.44	-4.88
	Vehicle price for income less than $20,000		-0.590		-0.896		-0.560	
	Vehicle price for income $20,000 to $39,999		-0.489		-0.719		-0.509	
	Vehicle price for income $40,000 to $59,999		-0.448		-0.649		-0.488	
	Vehicle price for income $60,000 to $79,999		-0.423		-0.607		-0.474	
	Vehicle price for income $80,000 to $99,999		-0.405		-0.577		-0.464	
	Vehicle price for income $100,000 to $119,999		-0.392		-0.554		-0.456	
	Vehicle price for income $120,000 or more		-0.386		-0.545		-0.452	
β_6	Total Range	ln (Miles)	0.06	1.30	0.27	5.63	0.24	3.39
β_7	Share of stations with diesel	%	0.13	0.44	-0.36	-1.35	-0.06	-0.18
β_8	Distance to hydrogen station	Miles	0.00	-1.37	-0.01	-2.48	0.00	-0.30
$\beta_{9,1}$	Distance to Level 2 charger	Minutes	0.00	-0.70	0.00	-0.95	0.01	0.85
$\beta_{9,2}$	Distance to Fast charger	Minutes	0.00	-0.04	0.00	-0.26	0.00	-0.20
$\beta_{9,3}$	Wait time for Fast charger	Minutes	0.00	-1.09	0.00	-0.90	0.00	0.49
$\beta_{10,1}$	No home charging	0,1	0	NA	0	NA	0	NA
$\beta_{10,2}$	Home charging	0,1	0.67	5.03	0.77	8.76	0.50	4.15
$\beta_{11,1}$	No work charging	0,1	0	NA	0	NA	0	NA
$\beta_{11,2}$	Work charging: Level 2	0,1	0.02	0.27	0.11	1.89	-0.04	-0.49
$\beta_{11,3}$	Work charging: Fast	0,1	0.05	0.85	0.08	1.26	-0.06	-0.69

Para-meter	Variable	Units	1 Veh Coeff.	1 Veh T-Stat	2 Veh Coeff	2 Veh T-Stat	3+ Veh Coeff	3+ Veh T-Stat
β_{12}	MPG or MPGe	Miles per gallon	0.01	4.82	0.00	2.69	0.00	2.54
β_{13}	Fuel cost per 100 miles	ln ($1000)	-0.06	-0.86	-0.03	-0.60	-0.22	-2.59
$\beta_{14,1}$	Level 2 charge time to go 10 miles	Minutes	0.00	0.25	0.00	-0.57	-0.01	-1.56
$\beta_{14,2}$	Level 2 charge time 10% to 80% charge	Hours	-0.01	-1.59	-0.01	-1.61	0.00	0.09
$\beta_{14,3}$	Fast charge time 10% to 80% charge	Minutes	0.00	-2.27	0.00	-0.81	0.00	-1.83
$\beta_{15,1}$	No purchase incentive	0,1	0	NA	0	NA	0	NA
$\beta_{15,2}$	HOV lane incentive	0,1	0.02	0.27	0.00	0.00	0.20	1.91
$\beta_{15,3}$	Tax incentive	$1000s	0.02	2.08	0.02	2.08	0.04	3.19
$\beta_{15,4}$	Rebate incentive	$1000s	0.03	2.92	0.02	1.40	0.04	2.28
β_{16}	Annual maintenance cost	ln ($1000)	-0.32	-5.01	-0.25	-4.15	-0.36	-4.13
β_{17}	0-60 MPH acceleration	Seconds	0.01	1.10	-0.01	-0.63	-0.01	-0.97
λ	Power transformation for income effect	-	-0.17	-2.47	-0.20	-3.66	-0.09	-0.98
$\beta_{18,1}$	Central Valley*used (6 years old)	0,1	0.11	0.67	0.03	0.18	0.32	1.51
$\beta_{18,2}$	Sacramento*full size van	0,1	-0.19	-0.63	-0.44	-1.60	-0.72	-1.29
$\beta_{18,3}$	Sacramento*small pickup	0,1	-0.40	-1.40	0.15	0.74	-0.46	-1.70
$\beta_{18,4}$	Sacramento*full size pickup	0,1	0.06	0.21	0.42	1.74	0.22	0.81
$\beta_{18,5}$	San Francisco*small pickup	0,1	-0.20	-1.21	0.01	0.04	0.04	0.17
$\beta_{18,6}$	San Francisco*full size pickup	0,1	-0.63	-2.68	-0.31	-1.70	0.08	0.38
$\beta_{18,7}$	San Francisco*BEV	0,1	0.16	1.46	0.41	4.23	0.12	0.82

Source: 2024 California Vehicle Survey, California Energy Commission

Table 7: Residential Vehicle Type Choice Regional Model Fit Statistics

Fit Statistics	1-Vehicle	2-Vehicle	3+-Vehicle
Number of Individuals	1,399	1,609	792
Number of Observations	11,192	12,872	6,336
Null Log-Likelihood	-15,515	-17,844	-8,784
Final Log-Likelihood	-11,939	-13,376	-6,395
Adjusted Rho-squared	0.2271	0.2475	0.2660

Source: 2024 California Vehicle Survey, California Energy Commission

In this regional specification, most parameters are not statistically significant at conventional levels. However, the following summarizes the additional findings from the regional model:

- Used vehicles seem to be associated with higher levels of utility in the Central Valley than in other areas of the state.
- Full size vans seem to be associated with less pronounced negative effects on utility in Sacramento.
- Small pickup trucks seem to be associated with negative effects on utility in Sacramento and San Francisco, especially in 1 and 3+ vehicle households.
- Full-size pickup trucks seem to be associated with negative effects (or less positive effects) on utility in Sacramento and San Francisco.
- BEVs seem to be associated with more positive effects on utility in San Francisco, especially in 2 vehicle households.

Residential Vehicle Type Cross-Nested Logit Choice Model

The final alternative specification of the residential vehicle type choice model is an alternative functional form. Rather than a multinomial logit model, this model is specified as a cross-nested logit (CNL) model following the example of (Hess et. al. 2012)[1]. In this model, all combinations of vehicle type and fuel type are specified as alternatives (with only up to four available for a respondent in a given experiment). Each of these alternatives is defined by membership in both one vehicle type nest and one fuel type nest. The remaining attributes are identical to the other residential vehicle type choice models.

However, the cross-nested model structure was not supported by the data collected in the 2024 CVS. In the estimated model, the majority of the structural nest parameters were estimated above 1. These structural parameters ought to fall within the unit interval to support a nested, or cross-nested modeling structure.

Because the CNL specification for the residential vehicle type choice model involved creating a distinct alternative for every combination of fuel type and vehicle type for each of the four alternatives shown in the DCE (364 alternatives) RSG checked to ensure that the structural parameters were not being influenced by mistake in the data cleaning process. When the structural parameters were constrained to 1 (essentially forcing the CNL model to match the MNL model), the parameter estimates and final log-likelihood values perfectly matched the MNL specification. This suggests that, indeed, the structural parameters were not being

1 Hess, Stephane, Mark Fowler, Thomas Adler, Aniss Bahreinian. 2012. A joint model for vehicle type and fuel type choice: evidence from a cross-nested logit study. *Transportation* 39: 593-625.

influenced by analytical mistakes, but that they indicated that the data from the 2024 CVS did not support a CNL specification.

Residential Autonomous Vehicle Choice Models

The first model using the residential autonomous vehicle choice model data is a MNL model that is based only on data gathered in the AV DCE. It is based on four alternative specific constants that account for variance in respondents' utility unrelated to price, and the price of the vehicle. As in the vehicle type choice models, the price parameter is specified as an interaction between the vehicle's price and the ratio of the respondent's income to the mean income for the ownership category raised to the power of λ. Model estimates are presented in **Table 8** on the following page, and fit statistics are presented in **Table 9**.

Table 8: Residential Autonomous Vehicle Choice Model

Para-meter	Variable	Units	1 Veh Coef.	1 Veh T-Stat	2 Veh Coef.	2 Veh T-Stat	3 Veh Coef.	3 Veh T-Stat
$\alpha_{1,1}$	Base Autonomy	0,1	0.00	NA	0.00	NA	0.00	NA
$\alpha_{1,2}$	Level 3 Autonomy	0,1	-0.11	-1.73	0.12	1.92	0.01	0.07
$\alpha_{1,3}$	Level 4 Autonomy	0,1	-0.43	-4.11	-0.21	-2.19	-0.42	-2.90
$\alpha_{1,4}$	Level 5 Autonomy	0,1	-0.45	-3.18	-0.03	-0.21	-0.08	-0.43
β_1	ln(Vehicle price) * ((income/mean income) ^ λ)	ln($1000)	-3.49	-9.95	-3.87	-11.89	-3.78	-7.29
	Vehicle price for income less than $20,000		-9.18		-10.75		-7.11	
	Vehicle price for income $20,000 to $39,999		-5.76		-7.02		-5.50	
	Vehicle price for income $40,000 to $59,999		-4.64		-5.76		-4.89	
	Vehicle price for income $60,000 to $79,999		-4.02		-5.05		-4.52	
	Vehicle price for income $80,000 to $99,999		-3.62		-4.58		-4.26	
	Vehicle price for income $100,000 to $119,999		-3.32		-4.24		-4.07	
	Vehicle price for income $120,000 or more		-3.20		-4.10		-3.99	
λ	Power Transformation for Income Effect	-	-0.42	-8.78	-0.39	-8.32	-0.23	-3.41

Source: 2024 California Vehicle Survey, California Energy Commission

Table 9: Residential Autonomous Vehicle Choice Model Fit Statistics

Fit Statistics	1-Vehicle	2-Vehicle	3+-Vehicle
Number of Individuals	1399	1609	792
Number of Observations	5596	6436	3168
Null Log-Likelihood	-54207.34	-64638.92	-31551.01
Final Log-Likelihood	-52074.5	-63062.07	-31013.21
Adjusted Rho-squared	0.1608	0.1164	0.1172

Source: 2024 California Vehicle Survey, California Energy Commission

As mentioned in the main report, this model suggests that respondents' utility is either not significantly influenced by autonomy levels of vehicles, or it is negatively influenced.

RSG then built a joint model to estimate the effect of vehicle autonomy and price for vehicle autonomy alongside estimates for the attributes in the vehicle type choice model. The model is "joint" because the estimated coefficient for vehicle price * (income/mean income) ^ λ is shared between both the vehicle choice and autonomous vehicle choice utility equations. The values of the AV utility function are scaled to match the errors of the vehicle type choice equation; a scale factor of 1 would suggest that the errors are distributed equally between both models. Scale factors greater than 1 will suggest that unobserved factors influencing choices in the AV experiments exhibited higher variance than those in the vehicle type choice experiments. **Table 10** on the following pages shows the parameter estimates for a base joint model. The parameter estimates for this joint model are similar to those reported above, except that level 3 turns positive and significant for 2 vehicle households. Increasing levels of autonomy are associated with decreasing levels of utility, independent of price. **Table 11** shows the fit statistics for this joint model.

Table 10: Residential Vehicle Type and AV Choice Joint Model Estimates

Para-meter	Variable	Units	1 Veh Coef.	1 Veh T-Stat	2 Veh Coef.	2 Veh T-Stat	3+ Veh Coef.	3+ Veh T-Stat
$\alpha_{1,1}$	Reference vehicle (from consideration set)	-	0.000	NA	0.000	NA	0.000	NA
$\alpha_{1,2}$	First non-reference vehicle	-	-0.907	-26.041	-1.017	-31.155	-1.128	-24.205
$\alpha_{1,3}$	Second non-reference vehicle	-	-1.090	-27.866	-1.176	-32.695	-1.306	-25.371
$\alpha_{1,4}$	Third non-reference vehicle	-	-1.511	-34.161	-1.543	-38.984	-1.651	-27.649
$\beta_{1,1}$	Subcompact Car	0,1	0.000	NA	0.000	NA	0.000	NA
$\beta_{1,2}$	Compact Car	0,1	0.285	3.529	0.102	1.275	0.138	1.022
$\beta_{1,3}$	Midsize Car	0,1	0.244	2.980	0.399	5.070	0.451	3.525
$\beta_{1,4}$	Large Car	0,1	-0.059	-0.592	0.053	0.563	0.208	1.409
$\beta_{1,5}$	Sports Car	0,1	0.183	1.824	0.055	0.548	0.163	1.030
$\beta_{1,6}$	Subcompact Crossover	0,1	0.238	2.785	0.186	2.154	0.273	2.042
$\beta_{1,7}$	Compact Crossover	0,1	0.224	2.818	0.370	4.484	0.546	4.117
$\beta_{1,8}$	Midsize Crossover/SUV	0,1	0.559	6.455	0.705	8.323	0.905	6.567
$\beta_{1,9}$	Large SUV	0,1	0.106	0.989	0.319	3.132	0.706	4.491
$\beta_{1,10}$	Small Van	0,1	-0.117	-1.115	0.112	1.123	0.145	0.937
$\beta_{1,11}$	Full-size/large Van	0,1	-0.311	-2.717	-0.025	-0.226	-0.013	-0.075
$\beta_{1,12}$	Small Pickup Truck	0,1	0.050	0.513	0.095	1.004	0.325	2.171
$\beta_{1,13}$	Full-size/large Pickup Truck	0,1	0.157	1.420	0.381	3.621	0.740	4.828
$\beta_{2,1}$	Gasoline only	0,1	0.000	NA	0.000	NA	0.000	NA
$\beta_{2,2}$	Gas HEV	0,1	-0.102	-1.782	-0.027	-0.498	-0.256	-3.386
$\beta_{2,3}$	PHEV	0,1	-0.535	-2.692	-0.889	-4.715	-1.190	-4.249
$\beta_{2,4}$	Diesel	0,1	-0.668	-4.122	-0.871	-5.737	-0.586	-3.300
$\beta_{2,5}$	BEV	0,1	-0.170	-0.505	-0.407	-1.302	-0.535	-1.370
$\beta_{2,6}$	FCV	0,1	-0.457	-1.471	-0.759	-2.650	-0.853	-2.426
$\beta_{2,7}$	PFCV	0,1	-0.753	-2.086	-1.657	-4.914	-1.653	-3.707
$\beta_{3,1}$	Standard	0,1	0.000	NA	0.000	NA	0.000	NA
$\beta_{3,2}$	Premium	0,1	-0.047	-0.742	0.178	3.233	0.174	1.909

Para-meter	Variable	Units	1 Veh Coef.	1 Veh T-Stat	2 Veh Coef.	2 Veh T-Stat	3+ Veh Coef.	3+ Veh T-Stat
$\beta_{4,1}$	New	0,1	0.000	NA	0.000	NA	0.000	NA
$\beta_{4,2}$	Used (3 Years Old)	0,1	-0.212	-4.071	-0.239	-5.092	-0.311	-4.396
$\beta_{4,3}$	Used (6 Years Old)	0,1	-0.366	-5.014	-0.543	-7.883	-0.564	-5.231
β_5	Ln (Vehicle price) * ((income/mean income) ^ λ)	Ln ($1000)	-0.277	-4.799	-0.445	-7.779	-0.407	-4.585
	Vehicle price for income less than $20,000		-0.623		-1.091		-0.689	
	Vehicle price for income $20,000 to $39,999		-0.422		-0.751		-0.556	
	Vehicle price for income $40,000 to $59,999		-0.352		-0.631		-0.504	
	Vehicle price for income $60,000 to $79,999		-0.312		-0.563		-0.472	
	Vehicle price for income $80,000 to $99,999		-0.285		-0.517		-0.449	
	Vehicle price for income $100,000 to $119,999		-0.266		-0.483		-0.432	
	Vehicle price for income $120,000 or more		-0.258		-0.469		-0.425	
β_6	Total Range	Ln (Miles)	0.066	1.376	0.273	5.602	0.239	3.374
β_7	Share of stations with diesel	%	0.134	0.461	-0.378	-1.429	-0.065	-0.210
β_8	Distance to hydrogen station	Miles	-0.004	-1.332	-0.008	-2.432	-0.001	-0.266
$\beta_{9,1}$	Distance to Level 2 charger	Minutes	-0.003	-0.757	-0.004	-0.916	0.005	0.835
$\beta_{9,2}$	Distance to Fast charger	Minutes	0.000	0.042	-0.002	-0.389	-0.001	-0.248
$\beta_{9,3}$	Wait time for Fast charger	Minutes	-0.002	-1.147	-0.002	-0.793	0.002	0.503
$\beta_{10,1}$	No home charging	0,1	0.000	NA	0.000	NA	0.000	NA
$\beta_{10,2}$	Home charging	0,1	0.649	4.894	0.766	8.805	0.492	4.120
$\beta_{11,1}$	No work charging	0,1	0.000	NA	0.000	NA	0.000	NA
$\beta_{11,2}$	Work charging: Level 2	0,1	0.015	0.251	0.113	1.899	-0.041	-0.491
$\beta_{11,3}$	Work charging: Fast	0,1	0.055	0.858	0.082	1.306	-0.069	-0.732

Para-meter	Variable	Units	1 Veh Coef.	1 Veh T-Stat	2 Veh Coef.	2 Veh T-Stat	3+ Veh Coef.	3+ Veh T-Stat
β_{12}	MPG or MPGe	Miles per gallon	0.006	4.719	0.003	2.437	0.005	2.532
β_{13}	Fuel cost per 100 miles	Ln ($1000)	-0.094	-1.463	-0.079	-1.368	-0.225	-2.731
$\beta_{14,1}$	Level 2 charge time to go 10 miles	Minutes	0.001	0.247	-0.002	-0.579	-0.007	-1.582
$\beta_{14,2}$	Level 2 charge time 10% to 80% charge	Hours	-0.014	-1.570	-0.012	-1.462	0.001	0.057
$\beta_{14,3}$	Fast charge time 10% to 80% charge	Minutes	-0.004	-2.165	-0.001	-0.815	-0.004	-1.850
$\beta_{15,1}$	No purchase incentive	0,1	0.000	NA	0.000	NA	0.000	NA
$\beta_{15,2}$	HOV lane incentive	0,1	0.018	0.247	0.004	0.051	0.199	1.921
$\beta_{15,3}$	Tax incentive	$1000s	0.019	2.158	0.018	2.118	0.039	3.155
$\beta_{15,4}$	Rebate incentive	$1000s	0.033	2.921	0.017	1.393	0.036	2.223
β_{16}	Annual maintenance cost	Ln ($1000)	-0.298	-4.478	-0.269	-4.386	-0.362	-4.144
β_{17}	0-60 MPH acceleration	Seconds	0.015	1.322	-0.004	-0.367	-0.013	-0.903
μ	Scale factor for AV model component	-	14.546	4.873	9.434	6.567	9.726	4.011
$\alpha_{2,1}$	Base Autonomy	-	0.000	NA	0.000	NA	0.000	NA
$\alpha_{2,2}$	Level 3 Autonomy	-	-0.004	-0.926	0.016	2.615	0.002	0.244
$\alpha_{2,3}$	Level 4 Autonomy	-	-0.022	-2.410	-0.016	-1.329	-0.040	-1.877
$\alpha_{2,4}$	Level 5 Autonomy	-	-0.021	-1.816	0.007	0.542	-0.003	-0.174
λ	Power Transformation for Income Effect	-	-0.355	-8.331	-0.340	-8.819	-0.195	-3.141

Source: 2024 California Vehicle Survey, California Energy Commission

Table 11: Residential Vehicle Type and AV Choice JointModel Fit Statistics

Fit Statistics	1-Vehicle	2-Vehicle	3+Vehicle
Number of Individuals	1399	1609	792
Number of Observations	11192	12872	6336
Null Log-Likelihood	-19719.05	-22724.36	-11020.76
Final Log-Likelihood	-18474.14	-21285.47	-10280.38
Adjusted Rho-squared	0.2041	0.2029	0.216

Source: 2024 California Vehicle Survey, California Energy Commission

Based on the model specification and coefficient values outlined above, the probability of a household selecting vehicle *i,* with vehicle type *v*, fuel type *f*, age *a,* and prestige level *p* is given by the following equation:

$$P(i) = \frac{e^{u_i^{v,f,a,p}}}{\sum_j e^{u_j^{v,f,a,p}}}$$

And the probability of a household selecting vehicle *i,* with autonomy level *av* is given by the following equation:

$$P(i) = \frac{e^{\mu u_i^{av}}}{\sum_j e^{\mu u_j^{av}}}$$

where $u_i^{v,f,a,p}$ is the modeled utility of vehicle i, given by the following equation:

$$u_i^{v,f,a,p} = \alpha_{1,i} + \sum_{v=1}^{13} \beta_{1,v} X_{1,v} + \sum_{f=1}^{7} \beta_{2,f} X_{2,f} + \sum_{p=1}^{2} \beta_{3,p} X_{3,p} + \sum_{a=1}^{3} \beta_{4,a} X_{4,a} +$$

$$+ \beta_5 X_5 (inc/mean_inc)^{\wedge}\lambda + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_{9,1} X_{9,1} + \beta_{9,2} X_{9,2} + \beta_{9,3} X_{9,3} + \beta_{10,1} X_{10,1} + \beta_{10,2} X_{10,2} + \beta_{11,1} X_{11,1} + \beta_{11,2} X_{11,2} + \beta_{11,3} X_{11,3} + \beta_{12} X_{12} + \beta_{13} X_{13} + \beta_{14,1} X_{14,1} + \beta_{14,2} X_{14,2} + \beta_{14,3} X_{14,3} + \beta_{15,1} X_{15,1} + \beta_{15,2} X_{15,2} + \beta_{15,3} X_{15,3} + \beta_{15,4} X_{15,4} + \beta_{16} X_{16} + \beta_{17} X_{17}$$

And where μu_i^{av} is the modeled utility of autonomous vehicle i, given by the following equation:

$\mu u_i^{av} = \mu\ (\alpha_{2,i} + \beta_5 X_5 (inc/mean_inc)^{\wedge}\lambda)$

The terms in this equation are given by:

$\alpha_{1,i}$ = A constant for each alternative in the vehicle type DCE
$X_{1,v}$ = Array of dummy variables equal to 1 when vehicle type = *v*, otherwise 0
$X_{2,f}$ = Array of dummy variables equal to 1 when fuel type = *f*, otherwise 0
$X_{3,p}$ = Array of dummy variables equal to 1 when prestige = *p*, otherwise 0; available values for *p* are “standard” and “premium.”
$X_{4,a}$ = Array of dummy variables equal to 1 when vehicle age = a, otherwise 0; available values for *a* are “new,” “used (three years old),” and “used (six years old).”
X_5 = Purchase price of the vehicle (Ln ($1000))
inc = Annual household income of the household (dollars)
mean_inc = Mean of household income of all respondents (dollars) at each level of vehicle ownership.
X_6 = Average range of vehicle at 100% fueled (miles, natural log)

X_7 = Proportion of gas stations that have diesel fuel
X_8 = Distance to a hydrogen fuel station miles)
$X_{9,1}$ = Distance to a Level 2 charger (minutes)
$X_{9,2}$ = Distance to a Level 3 fast charger (minutes)
$X_{9,3}$ = Wait time for a Level 3 fast charger (minutes)
$X_{10,2}$ = A dummy variable that equals 1 if a home has access to a home charger, 0 otherwise
$X_{11,2}$ = A dummy variable that equals 1 if a respondent has access to a Level 2 charger at work, 0 otherwise
$X_{11,3}$ = A dummy variable that equals 1 if a respondent has access to a Level 3 fast charger at work, 0 otherwise
X_{12} = The average MPG or MPGe of vehicle (weighted 60% electric and 40% gas for PHEVs, and 60% electric and 40% hydrogen for PFCVs)
X_{13} = Average fuel cost per mile for the vehicle (weighted 60% electric and 40% gas for PHEVs, and 60% electric and 40% hydrogen for PFCVs) (Ln ($1000))
$X_{14,1}$ = Time to charge the vehicle enough to drive 10 miles with a Level 2 charger (minutes)
$X_{14,2}$ = Time to charge the vehicle from 10% to 80% with a Level 2 charger (hours)
$X_{14,3}$ = Time to charge the vehicle from 10% to 80% with a Level 3 fast charger (minutes)
$X_{15,2}$ = A dummy variable that equals 1 if the vehicle qualifies for access to the HOV lanes, 0 otherwise
$X_{15,3}$ = The value of a tax incentive for the vehicle ($1000)
$X_{15,4}$ = The value of a rebate incentive for the vehicle ($1000)
X_{16} = Average annual maintenance costs of vehicle (Ln ($1000))
X_{17} = Average time to accelerate from 0 to 60 MPH (seconds)
μ = A scale parameter for the AV components of the utility equation
$\alpha_{2,i}$ = A constant for each autonomy level alternative in the AV DCE

The denominator term is the sum of exponentiated utilities for all vehicles in the respondent's choice set, which includes all vehicle types and fuel types available for each model year.

In this model, most levels of autonomy were not associated with a significant effect on utility. Additionally, the scale factor estimate demonstrates a sizable amount of variance in the errors of the AV experiments. Practically, this is not surprising as respondents are unsure how to value levels of autonomy given its near absence in the personal vehicle market.

Table 12 on the following pages shows the estimates from a joint model that includes interactions between ZEV fuel types and ZEV ownership. Again, increasing autonomy levels are associated with decreasing utility. **Table 13** shows the fit statistics for this model. Because it is most likely that, when or if autonomous vehicles become widespread, they will primarily be ZEVs, this model also includes an interaction between the autonomous level constants and an indicator that is equal to 1 if the respondent chose a BEV. When the respondent chose a BEV in the vehicle choice DCE that is referenced in the AV DCE, increasing autonomy levels are associated with increasing utility.

Table 12: Residential vehicle Type and AV Choice Joint Model—ZEV Interactions

Para-meter	Variable	Units	1 Veh	1 Veh T-Stat	2 Veh	2 Veh T-Stat	3+ Veh Coef.	3+ Veh T-Stat
$\alpha_{1,1}$	Reference vehicle (from consideration set)	-	0.000	NA	0.000	NA	0.000	NA
$\alpha_{1,2}$	First non-reference vehicle	-	-0.887	-25.557	-0.984	-30.258	-1.095	-23.395
$\alpha_{1,3}$	Second non-reference vehicle	-	-1.069	-27.329	-1.140	-31.707	-1.271	-24.838
$\alpha_{1,4}$	Third non-reference vehicle	-	-1.487	-33.689	-1.506	-37.937	-1.618	-26.928
$\beta_{1,1}$	Subcompact Car	0,1	0.000	NA	0.000	NA	0.000	NA
$\beta_{1,2}$	Compact Car	0,1	0.280	3.470	0.106	1.322	0.139	1.028
$\beta_{1,3}$	Midsize Car	0,1	0.238	2.902	0.398	5.031	0.445	3.479
$\beta_{1,4}$	Large Car	0,1	-0.061	-0.604	0.056	0.593	0.217	1.463
$\beta_{1,5}$	Sports Car	0,1	0.178	1.777	0.069	0.695	0.175	1.103
$\beta_{1,6}$	Subcompact Crossover	0,1	0.235	2.747	0.183	2.096	0.271	2.017
$\beta_{1,7}$	Compact Crossover	0,1	0.225	2.838	0.372	4.471	0.552	4.154
$\beta_{1,8}$	Midsize Crossover/SUV	0,1	0.564	6.493	0.713	8.357	0.910	6.572
$\beta_{1,9}$	Large SUV	0,1	0.106	0.990	0.334	3.265	0.717	4.542
$\beta_{1,10}$	Small Van	0,1	-0.115	-1.092	0.122	1.216	0.148	0.951
$\beta_{1,11}$	Full-size/large Van	0,1	-0.305	-2.657	-0.013	-0.116	-0.003	-0.015
$\beta_{1,12}$	Small Pickup Truck	0,1	0.049	0.501	0.099	1.040	0.330	2.204
$\beta_{1,13}$	Full-size/large Pickup Truck	0,1	0.152	1.377	0.388	3.659	0.750	4.884
$\beta_{2,1}$	Gasoline only	0,1	0.000	NA	0.000	NA	0.000	NA
$\beta_{2,2}$	Gas HEV	0,1	-0.101	-1.753	-0.017	-0.322	-0.249	-3.277
$\beta_{2,3}$	PHEV	0,1	-0.610	-3.050	-0.944	-4.933	-1.371	-4.838
$\beta_{2,4}$	PHEV x (ZEV owner)	0,1	0.557	3.823	0.391	3.713	0.541	3.773
$\beta_{2,5}$	Diesel	0,1	-0.659	-4.063	-0.859	-5.655	-0.603	-3.371
$\beta_{2,6}$	BEV	0,1	-0.285	-0.838	-0.662	-2.093	-0.876	-2.178
$\beta_{2,7}$	BEV x (ZEV owner)	0,1	0.699	4.337	0.840	7.229	0.754	4.825
$\beta_{2,8}$	FCV	0,1	-0.515	-1.646	-0.865	-2.964	-1.007	-2.847
$\beta_{2,9}$	FCV x (ZEV owner)	0,1	0.441	2.666	0.340	2.654	0.331	1.871
$\beta_{2,10}$	PFCV	0,1	-0.804	-2.217	-1.766	-5.201	-1.672	-3.689
$\beta_{2,11}$	PFCV x (ZEV owner)	0,1	0.469	2.778	0.511	3.930	0.000	0.001
$\beta_{3,1}$	Standard	0,1	0.000	NA	0.000	NA	0.000	NA
$\beta_{3,2}$	Premium	0,1	-0.048	-0.754	0.182	3.284	0.175	1.925

Para-meter	Variable	Units	1 Veh	1 Veh T-Stat	2 Veh	2 Veh T-Stat	3+ Veh Coef.	3+ Veh T-Stat
$\beta_{4,1}$	New	0,1	0.000	NA	0.000	NA	0.000	NA
$\beta_{4,2}$	Used (3 Years Old)	0,1	-0.210	-4.003	-0.237	-5.023	-0.314	-4.419
$\beta_{4,3}$	Used (6 Years Old)	0,1	-0.364	-4.921	-0.548	-7.923	-0.571	-5.268
β_5	ln (Vehicle price) * ((income/mean income) ^ λ)	Price ln ($1000)	-0.280	-4.728	-0.449	-7.759	-0.420	-4.675
	Vehicle price for income less than $20,000		-0.618		-1.074		-0.692	
	Vehicle price for income $20,000 to $39,999		-0.422		-0.747		-0.565	
	Vehicle price for income $40,000 to $59,999		-0.353		-0.631		-0.514	
	Vehicle price for income $60,000 to $79,999		-0.314		-0.564		-0.483	
	Vehicle price for income $80,000 to $99,999		-0.288		-0.519		-0.461	
	Vehicle price for income $100,000 to $119,999		-0.268		-0.486		-0.445	
	Vehicle price for income $120,000 or more		-0.260		-0.472		-0.438	
β_6	Total Range (miles, log scale)	ln (Miles)	0.069	1.424	0.271	5.583	0.243	3.438
β_7	Share of stations with diesel	%	0.150	0.512	-0.376	-1.419	-0.108	-0.346
β_8	Distance to hydrogen station	Miles	-0.004	-1.333	-0.008	-2.407	-0.001	-0.258
$\beta_{9,1}$	Distance to Level 2 charger	Minutes	-0.003	-0.704	-0.004	-0.873	0.006	0.922
$\beta_{9,2}$	Distance to Fast charger	Minutes	0.001	0.245	-0.001	-0.350	.00009	0.015
$\beta_{9,3}$	Wait time for Fast charger	Minutes	-0.003	-1.234	-0.002	-0.718	0.001	0.318
$\beta_{10,1}$	No home charging	0,1	0.000	NA	0.000	NA	0.000	NA
$\beta_{10,2}$	Home charging	0,1	0.195	1.417	0.338	3.352	0.138	1.074
$\beta_{11,1}$	No work charging	0,1	0.000	NA	0.000	NA	0.000	NA
$\beta_{11,2}$	Work charging: Level 2	0,1	0.010	0.169	0.105	1.727	-0.053	-0.626
$\beta_{11,3}$	Work charging: Fast	0,1	0.061	0.940	0.080	1.247	-0.076	-0.792
β_{12}	MPG or MPGe	Miles per gallon	0.006	4.864	0.004	2.740	0.005	2.633
β_{13}	Fuel cost per 100 miles	ln($1000s)	-0.095	-1.477	-0.078	-1.334	-0.221	-2.656
$\beta_{14,1}$	Level 2 charge time to go 10 miles	Minutes	0.001	0.237	-0.002	-0.579	-0.006	-1.498
$\beta_{14,2}$	Level 2 charge time 10% to 80% charge	Hours	-0.014	-1.475	-0.013	-1.628	0.002	0.123
$\beta_{14,3}$	Fast charge time 10% to 80% charge	Minutes	-0.004	-2.222	-0.002	-1.039	-0.004	-1.836
$\beta_{15,1}$	No purchase incentive	0,1	0.000	NA	0.000	NA	0.000	NA
$\beta_{15,2}$	HOV lane incentive	0,1	0.021	0.283	0.006	0.083	0.185	1.745

Para-meter	Variable	Units	1 Veh	1 Veh T-Stat	2 Veh	2 Veh T-Stat	3+ Veh Coef.	3+ Veh T-Stat
$\beta_{15,3}$	Tax incentive	$1000s	0.020	2.189	0.020	2.307	0.040	3.147
$\beta_{15,4}$	Rebate incentive	$1000s	0.034	2.987	0.016	1.290	0.036	2.253
β_{16}	Annual maintenance cost	Ln($1000)	-0.299	-4.491	-0.274	-4.456	-0.359	-4.086
β_{17}	0-60 MPH acceleration	Seconds	0.016	1.391	-0.002	-0.210	-0.012	-0.819
μ	Scale factor for AV model component	-	14.291	4.824	9.287	6.548	9.353	4.026
$\alpha_{2,1}$	Base Autonomy	-	0.000	NA	0.000	NA	0.000	NA
$\alpha_{2,2}$	Level 3 Autonomy	-	-0.007	-1.324	0.012	1.755	-0.003	-0.276
$\alpha_{2,3}$	Level 3 Autonomy * (BEV)	-	0.011	1.407	0.020	1.827	0.024	1.426
$\alpha_{2,4}$	Level 4 Autonomy	-	-0.027	-2.611	-0.022	-1.694	-0.050	-2.027
$\alpha_{2,5}$	Level 4 Autonomy * (BEV)	-	0.018	1.769	0.025	1.770	0.035	1.640
$\alpha_{2,6}$	Level 5 Autonomy	-	-0.033	-2.479	-0.007	-0.473	-0.025	-1.012
$\alpha_{2,7}$	Level 5 Autonomy * (BEV)	-	0.049	3.396	0.057	3.247	0.081	2.767
λ	Power Transformation for Income Effect	-	-0.348	-7.957	-0.331	-8.496	-0.184	-2.970

Source: 2024 California Vehicle Survey, California Energy Commission

Table 13: Residential Vehicle Type and AV Choice JointModel Fit Statistics—ZEV Interactions

Fit Statistics	1-Vehicle	2-Vehicle	3+-Vehicle
Number of Individuals	1399	1609	792
Number of Observations	11192	12972	6336
Null Log-Likelihood	-19719.05	-22724.36	-11020.76
Final Log-Likelihood	-18431.63	-21215.41	-1023572
Adjusted Rho-squared	0.2056	0.2053	0.2189

Source: 2024 California Vehicle Survey, California Energy Commission

In this specification, higher levels of autonomy were associated with higher levels of utility for BEVs. This is expected because most vehicles with level 3 autonomy or higher are likely to be BEVs. Additionally, while the scale factor remains high in these models, we can identify a slight but positive willingness to pay for level 5 autonomy in BEVs. While it is not recommended that vehicle autonomy be included in forecasting, these results suggest that in future iteration of the CVS, vehicle autonomy could be included as an attribute of BEVs in the vehicle choice DCE.

Residential Transaction and Replacement (Regional Model)

The residential transaction and replacement model was estimated on subsets of the database for each region of California, but there was very little regional differentiation. Therefore, the transaction and replacement regional model includes regional fixed effects for each region in California. The region “rest of the state” is the baseline category and no region’s effects are statistically significant at conventional levels. Model estimates are presented in **Table 14** on the following page. **Table 15** shows the fit statistics for this model.

Table 14: Residential Transaction and Replacement (Regional Model)

	Variable	Description	Unit	Coef.	T-Stat
α_1	No Replacement Constant	No Replacement Alternative Specific Constant	-	3.152314	7.510874
	Vehicle Age Category 1	Vehicles up to 1 year old	0, 1	0	NA
β_1	Vehicle Age Category 2	Vehicles between 2 and 7 years old	0, 1	0.35	1.34
β_2	Vehicle Age Category 3	Vehicles between 8 and 15 years old	0, 1	0.43	1.58
β_3	Vehicle Age Category 4	Vehicles older than 15 years	0, 1	0.50	1.68
	Household Income Category 1	Annual household incomes less than $35,000	0, 1	0	NA
β_4	Household Income Category 2	Annual household incomes between $35,000 and $99,999	0, 1	-0.39	-2.03
β_5	Household Income Category 3	Annual household incomes at least $100,000	0, 1	-0.17	-0.83
β_6	Large Household (4+ members)	Households with four or more people	0, 1	0.34	2.81
β_7	Urban (dummy)	Respondent lives in a city center	0, 1	0.89	6.95
	Region (dummy)	Rest of the state	0, 1		
β_8	Region (dummy)	San Diego	0, 1	0.21	0.64
β_9	Region (dummy)	Los Angeles	0, 1	0.40	1.46
β_{10}	Region (dummy)	Central Valley	0, 1	0.02	0.05
β_{11}	Region (dummy)	Sacramento	0, 1	0.17	0.51
β_{12}	Region (dummy)	San Francisco	0, 1	0.26	0.89
θ_{rep}	Replacement Nest	Nest Coefficient	-	0.34	2.70

Source: 2024 California Vehicle Survey, California Energy Commission

Table 15: Residential Transaction and Replacement (Regional Model) Fit Statistics

Fit Statistics	Value
Number of Observations	3,757
Null Log-Likelihood	-3776.7
Final Log-Likelihood	-1343.77
Adjusted Rho-Square	0.6405

Source: 2024 California Vehicle Survey, California Energy Commission

Residential New-Used (Regional Model)

Two regional variations of the residential new-used model were estimated. The first regional model emphasizes the regional impact of the number of employed persons in a household by including an interaction term between the number of employed persons and a dummy variable that is equal to 1 if the respondent lives in the Los Angeles, San Francisco, or San Diego region. Model estimates for this model are presented in **Table 16**, and fit statistics are presented in **Table 17**. Based on this specification, increasing numbers of employed household members are associated with an effect on utility equal to $\beta_2 + \beta_3$ for households in the Los Angeles, San Francisco, and San Diego regions.

Table 16: Residential New-Used (Regional Model I)

	Variable	Units	Coef.	T-Stat
α_1	New vehicle constant	-	-8.54	-16.16
β_1	Household Income (Natural log)	$	0.78	16.40
β_2	Number of employed household members	Persons	-0.70	-6.15
β_3	Number of employed household members*LA, SF, SD	Persons*(0,1)	0.38	3.56
β_4	Number of vehicles in the household	Vehicles	-0.07	-2.11

Source: 2024 California Vehicle Survey, California Energy Commission

Table 17: Residential New-Used (Regional Model I) Fit Statistics

Fit Statistics	Value
Number of Observations	3,890
Null Log-Likelihood	-2,693
Final Log-Likelihood	-2,528
Adjusted Rho-Square	0.0604

Source: 2024 California Vehicle Survey, California Energy Commission

The second regional model emphasizes the regional impact of the number of vehicles in a household by including an interaction term between the number of household vehicles and two dummy variables, one that is equal to 1 if the respondent lives in the San Francisco region and one that is equal to 1 if the respondent lives in the Los Angeles region. Model estimates are presented in **Table 18** and fit statistics are presented in **Table 19**. In this model, increasing numbers of vehicles in the household are associated with an effect on utility equal to $\beta_3 + \beta_4$ for households in the San Francisco region and $\beta_3 + \beta_5$ for households in the Los Angeles region.

Table 18: Residential New-Used (Regional Model II)

	Variable	Units	Coef.	T-Stat
α_1	New vehicle constant	-	-8.51	-16.01
β_1	Household Income (Natural log)	$	0.76	15.66
β_2	Number of employed household members	Persons	-0.46	-5.46
β_3	Number of vehicles in the household	Vehicles	-0.07	3.56
β_4	Number of vehicles in the household*SF	Vehicles*(0,1)	0.03	3.51
β_5	Number of vehicles in the household*LA	Vehicle*(0,1)	0.03	5.31

Source: 2024 California Vehicle Survey, California Energy Commission

Table 19: Residential New-Used (Regional Modell II) Fit Statistics

Fit Statistics	Value
Number of Observations	3,890
Null Log-Likelihood	-2,696
Final Log-Likelihood	-2,522
Adjusted Rho-Square	0.0625

Source: 2024 California Vehicle Survey, California Energy Commission

Residential Vehicle Quantity (Regional Model)

The residential vehicle quantity regional model includes the following regional interactions:

- Proportion of household members who are employed*LA or SF
- The ratio of weekly household transit trips to number of household members*LA
- Population density*LA or SF
- Population density*Rest of the state

Based on this model (**Table 20** and **Table 21**), the effect of the number of employed members of a household is equal to $\beta_3 + \beta_4$ for households in the Los Angeles and San Francisco regions. The effect of the number of transit trips per household member is equal to $\beta_6 + \beta_7$ for households in the Los Angeles region. The effect of population density is equal to $\beta_8 + \beta_9$ for households in the Los Angeles and San Francisco regions and $\beta_8 + \beta_{10}$ for households in the rest of the state region.

Table 20: Residential Vehicle Quantity (Regional Model)

	Variable	Units	1 Veh Coef.	1 Veh T-Stat	2 Veh Coef.	2 Veh T-Stat.	3+ Veh Coef.	3+ Veh T-Stat
α_i	Vehicle ownership constant	-	-5.303	-4.44	-14.268	-10.56	-21.781	-13.20
β_1	Natural log of household income ($)	Ln ($)	0.626	5.48	1.246	9.99	1.604	11.05
β_2	Number of licensed drivers	Persons	1.451	3.93	2.809	7.20	3.954	9.73
β_3	Proportion of household members who are employed	Persons/Persons	1.762	3.20	1.519	2.71	1.668	2.86
β_4	Proportion of household members who are employed *LA, SF	Persons/Persons*(0,1)	-1.232	-2.05	-1.225	-2.01	-1.271	-2.01
β_5	Number of children under 16	Persons			0.311	4.85	0.361	4.72
β_6	Weekly transit trips per household member	Trips/Persons	-0.175	-4.61	-0.200	-5.47	-0.200	-5.47
β_7	Weekly transit trips per household member*LA	(Trips/Persons)*(0,1)	0.123	2.74	0.146	3.04	0.146	3.04
β_8	Population density	10,000 persons/square miles	-1.433	-2.80	-2.067	-3.84	-2.678	-4.41
β_9	Population density*LA, SF	10,000 persons/square miles*(0,1)	0.940	1.88	1.242	2.36	1.531	2.55
β_{10}	Population density*Rest of the state	10,000 persons/square miles*(0,1)	5.665	1.99	6.352	2.17	7.218	2.41
β_{11}	Rural dummy	0,1					0.832	4.16
β_{12}	Downtown dummy	0,1			-0.503*	-4.11	-0.503*	-4.11

* These parameter estimates are shared across utility equations.

Source: 2024 California Vehicle Survey, California Energy Commission

Table 21: Residential Vehicle Quantity Regional Model Fit Statistics

Fit Statistics	Value
Number of Observations	3,881
Null Log-Likelihood	-5,380
Final Log-Likelihood	-3,414
Adjusted Rho-Square	0.359

Source: 2024 California Vehicle Survey, California Energy Commission

Residential Vehicle Miles Traveled (Regional Model)

The residential vehicle miles traveled regional model includes the following regional interactions:

- Number of Licensed Drivers * Not Sacramento or Los Angeles
- Number of Licensed Drivers * Sacramento
- Number of Licensed Drivers * Los Angeles
- Vehicle Type = “Car” * Not San Francisco or Los Angeles
- Vehicle Type = “Car” * Los Angeles
- Fuel Type = HEV * Not San Francisco
- Fuel Type = HEV * San Francisco
- Population Density * Not San Diego or Los Angeles
- Population Density * San Diego
- Population Density * Los Angeles
- Downtown * Not Central Valley or Sacramento
- Downtown * Central Valley or Sacramento

Unlike other models, the interaction in this regional model are not additive, so regional effects are equal to only their respective parameter estimate (**Table 22** and **Table 23**).

Table 22: Residential Vehicle Miles Traveled (Regional Model)

	Attribute	Units	Pooled Coef.	Pooled T-Stat	2 Veh Coef.	2 Veh T-Stat.	3+ Veh Coef.	3+ Veh T-Stat
α_i	(Intercept)	-	9.037	37.01	8.030	20.78	8.531	14.39
β_1	Number of Licensed Drivers * Not Sacramento or Los Angeles	Persons*(0,1)	0.078	3.64	0.223	5.19	0.134	3.64
β_2	Number of Licensed Drivers * Sacramento	Persons*(0,1)	0.109	3.58	0.214	4.02	0.170	3.46
β_3	Number of Licensed Drivers * Los Angeles	Persons*(0,1)	0.093	4.24	0.185	4.38	0.1841	5.15
β_4	Proportion of Household Members who are Employed	Persons/Persons	0.336	8.18	0.291	4.72	0.421	4.35
β_5	Ln (Household Income)	Ln ($)	-0.027	-1.30	0.033	1.02	-0.001	-0.01
β_6	Number of Weekly Transit Trips per Household Member	Trips/Persons	-0.0183	-3.22	-0.033	-3.84	-0.0281	-2.44
β_7	Age	Years	-0.027	-8.74	-0.018	-3.41	-0.043	-9.21
β_8	Age Squared	Years squared	0.000	-6.25	-0.001	-4.27	0.000	-1.58
β_9	Vehicle Type = “Car” * Not San Francisco or Los Angeles	(0,1)*(0,1)	-0.007	-0.18	0.026	0.48	0.015	0.25
β_{10}	Vehicle Type = “Car” * San Francisco	(0,1)*(0,1)	-0.097	-2.32	-0.183	-3.05	-0.083	-1.15
β_{11}	Vehicle Type = “Car” * Los Angeles	(0,1)*(0,1)	-0.062	-1.91	-0.074	-1.64	-0.133	-2.41
β_{12}	Fuel Type = ZEV	(0,1)	0.139	4.08	0.184	3.94	0.161	2.71
β_{13}	Fuel Type = HEV * Not San Francisco	(0,1)*(0,1)	0.089	1.83	0.072	1.07	0.149	1.76
β_{14}	Fuel Type = HEV * San Francisco	(0,1)*(0,1)	0.205	2.62	0.232	2.12	0.239	1.78
β_{15}	Population Density * Not San Diego or Los Angeles	10,000 Persons/Square Miles*(0,1)	-0.04	-1.05	-0.07	-1.14	0.01	0.14

	Attribute	Units	Pooled Coef.	Pooled T-Stat	2 Veh Coef.	2 Veh T-Stat.	3+ Veh Coef.	3+ Veh T-Stat
β_{16}	Population Density * San Diego	10,000 Persons/Square Miles*(0,1)	0.10	0.98	0.25	1.57	0.09	0.35
β_{17}	Population Density * Los Angeles	10,000 Persons/Square Miles*(0,1)	-0.17	-5.09	-0.09	-1.90	-0.27	-3.57
β_{18}	Downtown * Not Central Valley or Sacramento	(0,1)*(0,1)	-0.34	-6.91	-0.37	-5.23	-0.51	-4.18
β_{19}	Downtown * Central Valley or Sacramento	(0,1)*(0,1)	0.25	1.94	0.42	2.21	0.36	1.16
β_{20}	3+ Vehicle Indicator	(0,1)	-0.16	-2.87	-	-	-0.08	-1.22

Source: 2024 California Vehicle Survey, California Energy Commission

Table 23: Residential Vehicle Miles Traveled (Regional Model) Fit Statistics

Fit Statistics	Pooled Sample	2 Vehicles	3+ Vehicles
Number of Observations (vehicles)	7,011	3,085	2,608
Number of fixed Parameters	21	20	21
Adjusted Pseudo R-Squared	0.18	0.159	0.287
Random Standard Deviation of the intercept	0.69	0.71	0.70

Source: 2024 California Vehicle Survey, California Energy Commission

Based on this model, the following regional effects are estimated:

- The number of licensed drivers has a stronger positive effect on household VMT in the Sacramento region and a weaker positive effect on household VMT in the Los Angeles region.
- The negative effect of car vehicle types on VMT is driven primarily by the San Francisco and Los Angeles regions.
- The positive effect of hybrid fuel types on VMT is primarily driven by 1 and two vehicle households in the San Francisco region.
- The negative effect of population density on VMT is primarily driven by the Los Angeles region, and the San Diego region is associated with a positive effect of population density on VMT.
- The Sacramento and Central Valley regions are associated with a positive effect of living in a downtown area on VMT.

Commercial Vehicle Type Choice (Regional Model)

The regional effects in commercial vehicle type choice are somewhat different from the ones used in residential vehicle type choice model (**Table 24** and **Table 25**).

Table 24: Commercial Vehicle Type Choice (Regional Model)

	Variable	Units	Coef.	T-Stat
α_1	Reference vehicle (from consideration set)	0,1	0	NA
α_2	First non-reference vehicle	0,1	-1.20	-42.02
α_3	Second non-reference vehicle	0,1	-1.54	-44.91
α_4	Third non-reference vehicle	0,1	-1.92	-48.86
$\beta_{1,1}$	Subcompact Car	0,1	0	NA
$\beta_{1,2}$	Compact Car	0,1	0.17	1.63
$\beta_{1,3}$	Midsize Car	0,1	0.60	6.00
$\beta_{1,4}$	Large Car	0,1	0.68	6.06
$\beta_{1,5}$	Sports Car	0,1	0.43	3.36
$\beta_{1,6}$	Subcompact Crossover	0,1	0.32	2.88
$\beta_{1,7}$	Compact Crossover	0,1	0.56	5.24
$\beta_{1,8}$	Midsize Crossover/SUV	0,1	1.10	10.83
$\beta_{1,9}$	Large SUV	0,1	1.15	10.33
$\beta_{1,10}$	Small Van	0,1	1.03	9.67
$\beta_{1,11}$	Full-size/large Van	0,1	1.46	13.99
$\beta_{1,12}$	Small Pickup Truck	0,1	1.22	12.08
$\beta_{1,13}$	Full-size/large Pickup Truck	0,1	1.97	18.38
$\beta_{2,1}$	Gasoline only	0,1	0	NA
$\beta_{2,2}$	Gas HEV	0,1	-0.28	-5.79
$\beta_{2,3}$	PHEV	0,1	-1.21	-6.52
$\beta_{2,4}$	Diesel	0,1	-0.34	-3.18
$\beta_{2,5}$	BEV	0,1	-0.51	-2.13
$\beta_{2,6}$	FCV	0,1	-0.58	-2.74
$\beta_{2,7}$	PFCV	0,1	-1.32	-4.74
$\beta_{3,1}$	Standard	0,1	0	NA

	Variable	Units	Coef.	T-Stat
$\beta_{3,2}$	Premium	0,1	0.44	7.31
$\beta_{4,1}$	New	0,1	0	NA
$\beta_{4,2}$	Used (3 Years Old)	0,1	-0.41	-8.88
$\beta_{4,3}$	Used (6 Years Old)	0,1	-0.66	-9.38
β_{5}	Ln(Vehicle price)	ln ($10 00)	-0.54	-9.31
β_{6}	Total Range	ln (Miles)	0.18	3.74
β_{7}	Share of stations with diesel	%	0.19	1.05
β_{8}	Distance to hydrogen station	Miles	-0.01	-2.19
$\beta_{9,1}$	Distance to Level 2 charger	Minutes	0.00	-0.68
$\beta_{9,2}$	Distance to Fast charger	Minutes	0.00	0.87
$\beta_{9,3}$	Wait time for Fast charger	Minutes	0.00	-1.76
$\beta_{10,1}$	No home charging	0,1	0.00	NA
$\beta_{10,2}$	Home charging	0,1	0.74	5.71
$\beta_{11,1}$	No work charging	0,1	0.00	NA
$\beta_{11,2}$	Work charging: Level 2	0,1	0.05	0.85
$\beta_{11,3}$	Work charging: Fast	0,1	0.14	2.39
β_{12}	MPG or MPGe	Miles per Gallon	0.00	2.98
β_{13}	Fuel cost per 100 miles	ln ($1000)	-0.31	-5.93
$\beta_{14,1}$	Level 2 charge time to go 10 miles	Minutes	0.00	0.91
$\beta_{14,2}$	Level 2 charge time 10% to 80% charge	Hours	-0.01	-0.70
$\beta_{14,3}$	Fast charge time 10% to 80% charge	Minutes	0.00	-1.85
$\beta_{15,1}$	No purchase incentive	0,1	0.00	NA
$\beta_{15,2}$	HOV lane incentive	0,1	0.07	0.99
$\beta_{15,3}$	Tax incentive	$1000s	0.03	3.93
$\beta_{15,4}$	Rebate incentive	$1000s	0.03	2.24
β_{16}	Annual maintenance cost	ln ($1000)	-0.33	-5.76
β_{17}	0-60 MPH acceleration	Seconds	-0.02	-1.79
$\beta_{18,1}$	Sacramento*full size van	0,1	-0.32	-1.28
$\beta_{18,2}$	Sacramento*Subcompact Crossover	0,1	-1.30	-2.97
$\beta_{18,3}$	Sacramento*Diesel	0,1	0.14	0.90
$\beta_{18,4}$	Rest State*Diesel	0,1	0.41	3.37
$\beta_{18,5}$	Sacramento*BEV	0,1	-0.28	-1.50
$\beta_{18,6}$	San Francisco*BEV	0,1	0.14	0.65
$\beta_{18,7}$	Los Angeles*Share of stations with diesel	%	-0.11	-1.62

Source: 2024 California Vehicle Survey, California Energy Commission

Table 25: Commercial Vehicle Type Choice (Regional Model) Fit Statistics

Fit Statistics	Value
Number of Individuals	2,120
Number of Observations	16,960
Null Log-Likelihood	-23,512
Final Log-Likelihood	-15,446
Adjusted Rho-Square	0.3409

Source: 2024 California Vehicle Survey, California Energy Commission

Based on this model, the following regional effects are estimated:

- Full size vans are associated with lower levels of commercial utility in the Sacramento region.
- Subcompact crossovers are associated with lower levels of commercial utility in the Sacramento region.
- Diesel fueled vehicles are associated with higher levels of commercial utility in the Sacramento and Rest of the State regions.
- BEVs are associated with lower levels of commercial utility in the Sacramento region and higher levels of commercial utility in the San Francisco region.
- Share of stations with Diesel is associated with lower levels of commercial utility in the Los Angeles region. This suggests that Diesel would be associated with lower levels of commercial utility in the Los Angeles region even if diesel fuel were more accessible there.

Commercial Autonomous Vehicle Choice Model

As with the residential survey, commercial respondents were shown four supplemental SP experiments in which they chose a level of autonomy for one of the vehicles they selected in a vehicle choice experiment. **Table 26** shows the coefficient estimates for a basic model that only includes alternative specific constants for each level of autonomy and price. Fit statistics for the model are listed in **Table 27**. As in the residential autonomous vehicle model, preferences seem to be highly inconsistent and strongly opposed to autonomous vehicle technology.

Table 26: Commercial Autonomous Vehicle Choice Basic Model

	Variable	Units	Coef.	T-Stat
$\alpha_{1,1}$	Base Autonomy	0,1	0.00	NA
$\alpha_{1,2}$	Level 3 Autonomy	0,1	-0.32	-5.62
$\alpha_{1,3}$	Level 4 Autonomy	0,1	-1.00	-10.26
$\alpha_{1,4}$	Level 5 Autonomy	0,1	-0.74	-5.85
β_1	Vehicle price	ln ($1000)	-3.46	-10.05

Source: 2024 California Vehicle Survey, California Energy Commission

Table 27: Commercial Autonomous Vehicle Choice Basic Model Fit Statistics

Fit Statistics	Value
Number of Individuals	2120
Number of Observations	8480
Null Log-Likelihood	-9899.07
Final Log-Likelihood	-9437.21
Adjusted Rho-Square	0.1969

Source: 2024 California Vehicle Survey, California Energy Commission

The data from both experiments were then merged and a joint model was estimated with utility equations for both decisions. **Table 28** shows the results of the base vehicle choice model merged with the autonomous vehicle choice data. **Table 29** shows the model fit statistics for this model.

Table 28: Commercial Vehicle Type & AV Vehicle Choice Joint Model Coefficients

	Variable	Units	Coef.	T-Stat
α1,1	Reference vehicle (from consideration set)	-	0.000	NA
α1,2	First non-reference vehicle	-	-1.200	-42.009
α1,3	Second non-reference vehicle	-	-1.541	-45.017
α1,4	Third non-reference vehicle	-	-1.920	-48.861
β1,1	Subcompact Car	0,1	0.000	NA
β1,2	Compact Car	0,1	0.164	1.576
β1,3	Midsize Car	0,1	0.595	5.948
β1,4	Large Car	0,1	0.670	5.991
β1,5	Sports Car	0,1	0.449	3.668
β1,6	Subcompact Crossover	0,1	0.258	2.376
β1,7	Compact Crossover	0,1	0.553	5.200
β1,8	Midsize Crossover/SUV	0,1	1.096	10.814
β1,9	Large SUV	0,1	1.141	10.326
β1,10	Small Van	0,1	1.029	9.656
β1,11	Full-size/large Van	0,1	1.442	13.836
β1,12	Small Pickup Truck	0,1	1.213	12.075
β1,13	Full-size/large Pickup Truck	0,1	1.962	18.419
β2,1	Gasoline only	0,1	0.000	NA
β2,2	Gas HEV	0,1	-0.279	-5.805
β2,3	PHEV	0,1	-1.217	-6.522
β2,4	Diesel	0,1	-0.279	-2.698
β2,5	BEV	0,1	-0.519	-2.180
β2,6	FCV	0,1	-0.579	-2.759
β2,7	PFCV	0,1	-1.323	-4.774
β3,1	Standard	0,1	0.000	NA
β3,2	Premium	0,1	0.441	7.288
β4,1	New	0,1	0.000	NA
β4,2	Used (3 Years Old)	0,1	-0.404	-8.833
β4,3	Used (6 Years Old)	0,1	-0.657	-9.329
β5	Vehicle price	ln ($1000)	-0.536	-9.267

	Variable	Units	Coef.	T-Stat
β6	Total Range	ln (Miles)	0.180	3.770
β7	Share of stations with diesel	%	0.151	0.830
β8	Distance to hydrogen station	Miles	-0.007	-2.219
β9,1	Distance to Level 2 charger	Minutes	-0.003	-0.681
β9,2	Distance to Fast charger	Minutes	0.003	0.828
β9,3	Wait time for Fast charger	Minutes	-0.003	-1.729
β10,1	No home charging	0,1	0.000	NA
β10,2	Home charging	0,1	0.737	5.632
β11,1	No work charging	0,1	0.000	NA
β11,2	Work charging: Level 2	0,1	0.047	0.851
β11,3	Work charging: Fast	0,1	0.138	2.352
β12	MPG or MPGe	Miles per gallon	0.004	3.054
β13	Fuel cost per 100 miles	ln ($1000)	-0.308	-5.864
β14,1	Level 2 charge time to go 10 miles	Minutes	0.003	0.906
β14,2	Level 2 charge time 10% to 80% charge	Hours	-0.006	-0.764
β14,3	Fast charge time 10% to 80% charge	Minutes	-0.003	-1.831
β15,1	No purchase incentive	0,1	0.000	NA
β15,2	HOV lane incentive	0,1	0.069	1.008
β15,3	Tax incentive	$1000s	0.033	3.874
β15,4	Rebate incentive	$1000s	0.025	2.179
β16	Annual maintenance cost	ln ($1000)	-0.334	-5.759
β17	0-60 MPH acceleration	Seconds	-0.016	-1.788
μ	Scale factor for AV model component	-	6.445	6.762
α2,1	Base Autonomy	0,1	0.000	NA
α2,2	Level 3 Autonomy	0,1	-0.050	-3.587
α2,3	Level 4 Autonomy	0,1	-0.155	-4.609
α2,4	Level 5 Autonomy	0,1	-0.115	-3.523

Source: 2024 California Vehicle Survey, California Energy Commission

Table 29: Commercial AV Vehicle Choice Joint Model Fit Statistics

Fit Statistics	Value
Number of Observations	2120
Number of Individuals	16960
Null Log-Likelihood	-27985.69
Final Log-Likelihood	-24901.97
Adjusted Rho-Square	0.2925

Source: 2024 California Vehicle Survey, California Energy Commission

Based on the model specification and coefficient values outlined above, the probability of a commercial vehicle fleet manager selecting vehicle *i,* with vehicle type *v*, fuel type *f*, age *a,* and prestige level *p* is given by the following equation:

$$P(i) = \frac{e^{u_i^{v,f,a,p}}}{\sum_j e^{u_j^{v,f,a,p}}}$$

And the probability of a commercial vehicle fleet manager selecting vehicle *i,* with autonomy level *av* is given by the following equation:

$$P(i) = \frac{e^{\mu u_i^{av}}}{\sum_j e^{\mu u_j^{av}}}$$

where $u_i^{v,f,a,p}$ is the modeled utility of vehicle i, given by the following equation:

$$u_i^{v,f,a,p} = \alpha_{1,i} + \sum_{v=1}^{13} \beta_{1,v} X_{1,v} + \sum_{f=1}^{7} \beta_{2,f} X_{2,f} + \sum_{p=1}^{2} \beta_{3,p} X_{3,p} + \sum_{a=1}^{3} \beta_{4,a} X_{4,a} +$$

$$+ \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_{9,1} X_{9,1} + \beta_{9,2} X_{9,2} + \beta_{9,3} X_{9,3} + \beta_{10,1} X_{10,1} + \beta_{10,2} X_{10,2} + \beta_{11,1} X_{11,1} + \beta_{11,2} X_{11,2} + \beta_{11,3} X_{11,3} + \beta_{12} X_{12} + \beta_{13} X_{13} + \beta_{14,1} X_{14,1} + \beta_{14,2} X_{14,2} + \beta_{14,3} X_{14,3} + \beta_{15,1} X_{15,1} + \beta_{15,2} X_{15,2} + \beta_{15,3} X_{15,3} + \beta_{15,4} X_{15,4} + \beta_{16} X_{16} + \beta_{17} X_{17}$$

And where μu_i^{av} is the modeled utility of autonomous vehicle i given by the following equation:

$\mu u_i^{av} = \alpha_{2,i} + \beta_5 X_5$

The terms in this equation are given by:

$\alpha_{1,i}$ = An constant for each alternative in the vehicle type DCE
$X_{1,v}$ = Array of dummy variables equal to 1 when vehicle type = *v*, otherwise 0
$X_{2,f}$ = Array of dummy variables equal to 1 when fuel type = *f*, otherwise 0
$X_{3,p}$ = Array of dummy variables equal to 1 when prestige = *p*, otherwise 0; available values for *p* are “standard” and “premium.”
$X_{4,a}$ = Array of dummy variables equal to 1 when vehicle age = a, otherwise 0; available values for *a* are “new,” “used (three years old),” and “used (six years old).”
X_5 = Purchase price of the vehicle (Ln ($1000))
X_6 = Average range of the vehicle at 100% fueled (Ln (Miles))
X_7 = Proportion of gas stations that have diesel fuel
X_8 = Distance to a hydrogen fuel station miles)
$X_{9,1}$ = Distance to a Level 2 charger (minutes)
$X_{9,2}$ = Distance to a Level 3 fast charger (minutes)
$X_{9,3}$ = Wait time for a Level 3 fast charger (minutes)
$X_{10,2}$ = A dummy variable that equals 1 if a home has access to a home charger, 0 otherwise
$X_{11,2}$ = A dummy variable that equals 1 if a respondent has access to a Level 2 charger at work, 0 otherwise
$X_{11,3}$ = A dummy variable that equals 1 if a respondent has access to a Level 3 fast charger at work, 0 otherwise
X_{12} = The average MPG or MPGe ofvehicle (weighted 60% electric and 40% gas for PHEVs, and 60% electric and 40% hydrogen for PFCVs)
X_{13} = Average fuel cost per mile for the vehicle (weighted 60% electric and 40% gas for PHEVs, and 60% electric and 40% hydrogen for PFCVs) (Ln ($1000))
$X_{14,1}$ = Time to charge the vehicle enough to drive 10 miles with a Level 2 charger (minutes)
$X_{14,2}$ = Time to charge the vehicle from 10% to 80% with a Level 2 charger (hours)
$X_{14,3}$ = Time to charge the vehicle from 10% to 80% with a Level 3 fast charger (minutes)
$X_{15,2}$ = A dummy variable that equals 1 if the vehicle qualifies for access to the HOV lanes, 0 otherwise
$X_{15,3}$ = The value of a tax incentive for the vehicle ($1000)
$X_{15,4}$ = The value of a rebate incentive for the vehicle ($1000)

X_{16} = Average annual maintenance costs ofvehicle (Ln ($1000))
X_{17} = Average time to accelerate from 0 to 60 MPH (seconds)
μ = A scale parameter for the AV components of the utility equation
$\alpha_{2,i}$ = A constant for each alternative in the AV DCE

The denominator term is the sum of exponentiated utilities for all vehicles in the respondent's choice set, which includes all vehicle types and fuel types available for each model year.

In this model, autonomy levels 3, 4, and 5 were associated with significantly lower levels of utility.

Table 30 shows the results of a joint model from the vehicle type choice and autonomous vehicle choice experiments that include an interaction between the ZEV fuel type variables and an indicator for fleets that include ZEVs. **Table 31** shows the fit statistics for this model.

Table 30: Commercial AV Vehicle Choice Joint Model Coefficients—ZEV Interactions

	Variable	Units	Coef.	T-Stat
α1,1	Reference vehicle (from consideration set)	-	0.00	NA
α1,2	First non-reference vehicle	-	-1.17	-40.89
α1,3	Second non-reference vehicle	-	-1.50	-43.99
α1,4	Third non-reference vehicle	-	-1.88	-47.80
β1,1	Subcompact Car	0,1	0.00	NA
β1,2	Compact Car	0,1	0.17	1.67
β1,3	Midsize Car	0,1	0.59	5.90
β1,4	Large Car	0,1	0.65	5.84
β1,5	Sports Car	0,1	0.46	3.74
β1,6	Subcompact Crossover	0,1	0.26	2.39
β1,7	Compact Crossover	0,1	0.55	5.17
β1,8	Midsize Crossover/SUV	0,1	1.10	10.86
β1,9	Large SUV	0,1	1.15	10.44
β1,10	Small Van	0,1	1.04	9.75
β1,11	Full-size/large Van	0,1	1.45	13.95
β1,12	Small Pickup Truck	0,1	1.22	12.13
β1,13	Full-size/large Pickup Truck	0,1	1.98	18.57
β2,1	Gasoline only	0,1	0.00	NA
β2,2	Gas HEV	0,1	-0.27	-5.54
β2,3	PHEV	0,1	-1.28	-6.77
β2,4	PHEV x (ZEV owner)	0,1	0.73	5.66
β2,5	Diesel	0,1	-0.26	-2.53
β2,6	BEV	0,1	-0.69	-2.84
β2,7	BEV x (ZEV owner)	0,1	1.19	9.96
β2,8	FCV	0,1	-0.64	-2.99
β2,9	FCV x (ZEV owner)	0,1	0.65	4.33
β2,10	PFCV	0,1	-1.40	-4.98
β2,11	PFCV x (ZEV owner)	0,1	0.91	6.07
β3,1	Standard	0,1	0.00	NA
β3,2	Premium	0,1	0.44	7.27

	Variable	Units	Coef.	T-Stat
β4,1	New	0,1	0.00	NA
β4,2	Used (3 Years Old)	0,1	-0.40	-8.83
β4,3	Used (6 Years Old)	0,1	-0.67	-9.43
β5	Vehicle price	ln ($1000)	-0.55	-9.41
β6	Total Range	ln (Miles)	0.18	3.76
β7	Share of stations with diesel	%	0.18	0.98
β8	Distance to hydrogen station	Miles	-0.01	-2.16
β9,1	Distance to Level 2 charger	Minutes	0.00	-0.86
β9,2	Distance to Fast charger	Minutes	0.00	0.94
β9,3	Wait time for Fast charger	Minutes	0.00	-1.97
β10,1	No home charging	0,1	0.00	NA
β10,2	Home charging	0,1	-0.02	-0.11
β11,1	No work charging	0,1	0.00	NA
β11,2	Work charging: Level 2	0,1	0.04	0.66
β11,3	Work charging: Fast	0,1	0.13	2.17
β12	MPG or MPGe	Miles per gallon	0.00	3.10
β13	Fuel cost per 100 miles	ln ($1000)	-0.31	-5.86
β14,1	Level 2 charge time to go 10 miles	Minutes	0.00	1.02
β14,2	Level 2 charge time 10% to 80% charge	Hours	-0.01	-0.81
β14,3	Fast charge time 10% to 80% charge	Minutes	0.00	-1.82
β15,1	No purchase incentive	0,1	0.00	NA
β15,2	HOV lane incentive	0,1	0.07	0.96
β15,3	Tax incentive	$1000s	0.03	3.99
β15,4	Rebate incentive	$1000s	0.02	2.14
β16	Annual maintenance cost	ln ($1000)	-0.34	-5.85
β17	0-60 MPH acceleration	Seconds	-0.01	-1.67
μ	Scale factor for AV model component	-	6.38	6.84
α2,1	Base Autonomy	0,1	0.00	NA
α2,2	Level 3 Autonomy	0,1	-0.06	-3.87
α2,3	Level 3 Autonomy * (BEV)	0,1	0.07	3.64
α2,4	Level 4 Autonomy	0,1	-0.17	-4.80
α2,5	Level 4 Autonomy * (BEV)	0,1	0.12	4.43
α2,6	Level 5 Autonomy	0,1	-0.15	-4.03
α2,7	Level 5 Autonomy * (BEV)	0,1	0.20	5.56

Source: 2024 California Vehicle Survey, California Energy Commission

Table 31: Commercial AV Vehicle Choice Joint Model Fit Statistics

Fit Statistics	Value
Number of Observations	2120
Number of Individuals	16960
Null Log-Likelihood	-27985.69
Final Log-Likelihood	-24701.42
Adjusted Rho-Square	0.298

Source: 2024 California Vehicle Survey, California Energy Commission

As in the residential model, autonomy levels 3, 4, and 5 were associated with increased levels of utility when they were applied to a BEV.

Finally, **Table 32** shows the parameter estimates for a joint model that includes interactions between industry type and vehicle class, industry type and fuel type (aggregated to ZEV), vehicle class and ownership patterns among firms, and industry type and autonomy level. This model included the following additional parameter estimates:

- an interaction between industry type 2 and industry type 3 (type 1 was the baseline) and a truncated array of vehicle body type dummy variables (car was the baseline)
- an interaction between industry type and a truncated array of fuel types (non-ZEV was the baseline)
- an interaction between a truncated array of vehicle body type and the proportion of vehicles of that body type in a given fleet.
- an interaction between industry type and the full array of autonomy levels.

Model fit statistics for this model are presented in **Table 33**.

Table 32: Commercial AV Vehicle Choice Joint Model—Industry Group Interactions

	Variable	Units	Coef.	T-Stat
α1,1	Reference vehicle (from consideration set)	-	0.00	NA
α1,2	First non-reference vehicle	-	-1.08	-37.58
α1,3	Second non-reference vehicle	-	-1.35	-38.67
α1,4	Third non-reference vehicle	-	-1.69	-42.31
β1,1	Subcompact Car	0,1	0.00	NA
β1,2	Compact Car	0,1	0.17	1.50
β1,3	Midsize Car	0,1	0.60	5.61
β1,4	Large Car	0,1	0.68	5.83
β1,5	Sports Car	0,1	0.50	3.96
β1,6	Subcompact Crossover	0,1	0.42	2.97
β1,7	Compact Crossover	0,1	0.72	5.32
β1,8	Midsize Crossover/SUV	0,1	1.22	9.18
β1,9	Large SUV	0,1	1.29	9.27
β1,10	Small Van	0,1	0.85	5.64
β1,11	Full-size/large Van	0,1	1.24	8.27
β1,12	Small Pickup Truck	0,1	0.99	6.80
β1,13	Full-size/large Pickup Truck	0,1	1.69	11.48
β1,14	Industry Group 2 X Car	0,1	0.00	NA
β1,15	Industry Group 2 X SUV	0,1	-0.04	-0.27
β1,16	Industry Group 2 X Van	0,1	-0.29	-1.54
β1,17	Industry Group 2 X Pickup	0,1	-0.34	-1.80
β1,18	Industry Group 3 X Car	0,1	0.00	NA
β1,19	Industry Group 3 X SUV	0,1	-0.22	-2.04
β1,20	Industry Group 3 X Van	0,1	-0.24	-1.76
β1,21	Industry Group 3 X Pickup	0,1	-0.42	-3.46
β2,1	Gasoline only	0,1	0.00	NA
β2,2	Gas HEV	0,1	-0.25	-5.25
β2,3	PHEV	0,1	-1.51	-7.75

	Variable	Units	Coef.	T-Stat
β2,4	Diesel	0,1	-0.29	-2.75
β2,5	BEV	0,1	-0.76	-3.09
β2,6	FCV	0,1	-0.80	-3.67
β2,7	PFCV	0,1	-1.56	-5.47
β2,8	Industry Group 1 X ZEV	0,1	0.00	NA
β2,9	Industry Group 2 X ZEV	0,1	0.48	3.82
β2,10	Industry Group 3 X ZEV	0,1	0.48	6.63
β3,1	Standard	0,1	0.00	NA
β3,2	Premium	0,1	0.37	6.11
β4,1	New	0,1	0.00	NA
β4,2	Used (3 Years Old)	0,1	-0.41	-8.89
β4,3	Used (6 Years Old)	0,1	-0.68	-9.47
β5	Vehicle price	Ln($1000)	-0.56	-9.50
β6	Total Range	Ln(Miles)	0.18	3.64
β7	Share of stations with diesel	%	0.20	1.06
β8	Distance to hydrogen station	Miles	-0.01	-2.25
β9,1	Distance to Level 2 charger	Minutes	0.00	-0.79
β9,2	Distance to Fast charger	Minutes	0.00	1.08
β9,3	Wait time for Fast charger	Minutes	0.00	-1.74
β10,1	No home charging	0,1	0.00	NA
β10,2	Home charging	0,1	0.71	5.21
β11,1	No work charging	0,1	0.00	NA
β11,2	Work charging: Level 2	0,1	0.04	0.72
β11,3	Work charging: Fast	0,1	0.15	2.44
β12	MPG or MPGe	Miles per gallon	0.00	2.04
β13	Fuel cost per 100 miles	Ln ($1000)	-0.35	-6.58
β14,1	Level 2 charge time to go 10 miles	Minutes	0.00	0.82
β14,2	Level 2 charge time 10% to 80% charge	Hours	-0.01	-0.70
β14,3	Fast charge time 10% to 80% charge	Minutes	0.00	-1.90
β15,1	No purchase incentive	0,1	0.00	NA
β15,2	HOV lane incentive	0,1	0.07	1.05
β15,3	Tax incentive	$1000s	0.04	4.04
β15,4	Rebate incentive	$1000s	0.03	2.24
β16	Annual maintenance cost	Ln ($1000)	-0.33	-5.64
β17	0-60 MPH acceleration	Seconds	-0.02	-1.81
β18,1	Vehicle Class = Car X Share of cars in fleet	0,1	0.54	5.05
β18,2	Vehicle Class = SUV X Share of SUVs in fleet	0,1	0.70	6.61
β18,3	Vehicle Class = Van X Share of vans in fleet	0,1	1.35	11.31
β18,4	Vehicle Class = Pickup X Share of pickups in fleet	0,1	1.38	12.63
μ	Scale factor for AV model component	0,1	6.23	6.89
α2,1	Industry Group 1 X Base Autonomy	0,1	0.00	NA
α2,2	Industry Group 1 X Level 3 Autonomy	0,1	-0.07	-3.64
α2,3	Industry Group 1 X Level 4 Autonomy	0,1	-0.18	-4.58
α2,4	Industry Group 1 X Level 5 Autonomy	0,1	-0.19	-4.01

	Variable	Units	Coef.	T-Stat
α2,5	Industry Group 2 X Base Autonomy	0,1	0.00	NA
α2,6	Industry Group 2 X Level 3 Autonomy	0,1	-0.04	-1.52
α2,7	Industry Group 2 X Level 4 Autonomy	0,1	-0.15	-3.41
α2,8	Industry Group 2 X Level 5 Autonomy	0,1	-0.17	-3.16
α2,9	Industry Group 3 X Base Autonomy	0,1	0.00	NA
α2,10	Industry Group 3 X Level 3 Autonomy	0,1	-0.04	-2.92
α2,11	Industry Group 3 X Level 4 Autonomy	0,1	-0.15	-4.34
α2,12	Industry Group 3 X Level 5 Autonomy	0,1	-0.08	-2.56

Source: 2024 California Vehicle Survey, California Energy Commission

Table 33: Commercial AV Vehicle Choice Model -ZEV & Industry Group Interaction, Fit Statistics

Fit Statistics	Value
Number of Observations	2120
Number of Individuals	16960
Null Log-Likelihood	-33410.63
Final Log-Likelihood	-24316.76
Adjusted Rho-Square	0.3086

Source: 2024 California Vehicle Survey, California Energy Commission

Based on this model, all industry groups were associated with lower levels of utility for autonomy levels 3, 4, and 5. However, the lower utility level for level 3 autonomy was not statistically significant at conventional levels for respondents in industry group 2.