# Characterizing California Electric Vehicle Consumer Segments

Brett Williams, M.Phil. (cantab), Ph.D. Clair Johnson, Ph.D.

brett.williams@energycenter.org

www.cleanvehiclerebate.org





**Target Consumers:** 

rebate:

essential

dealer

Low-Interest "Converts"

**Demographics**: non-white,

**Motivations and interest**: less

impacts, more motivated by saving

money on fuel and perhaps vehicle

performance, less by carpool lane

**Information gathering**: found it

more difficult to find info on EVs,

learned about the rebate at the

**Vehicle characteristics**: perhaps

higher price; leasing (vs. buy), first

In contrast to Rebate Essentials, the

increased for consumers that are

access and energy independence, who spent less time researching

EVs, and who found out about the

rebate at the dealership (PHEV

**Common Across All** 

The odds of being in all four of the

target segments are increased for

white, more motivated by fuel cost

savings and less by environmental

impacts, and who found it more

difficult to find info on EVs.

consumers that are other than

consumers).

Segments

less motivated by carpool lane

odds of being a Convert are

EV, replacing a vehicle

Differences from

**Rebate Essentials** 

spent less time researching online,

motivated by environmental

access and less by energy

independence; more rebate

perhaps larger households

Consumers most influenced by the

Introduction

### **Overview**

In order to expand the frontiers of the electric vehicle (EV) market into the mainstream, this inquiry aims to identify and profile consumer market segments that are effective targets for supportive resources, such as information and incentives:

- **"Rebate Essentials"** those consumers highly influenced by rebates
- **"Converts"** EV adopters who had a low initial interest in EVs

Characteristics examined: transaction, household, demographics, motivations and experience with EVs.

Consumers of all-battery and plug-in hybrid EVs are examined separately to allow for important differences in those two products.

### How can consumer research help us grow markets for electric vehicles?



## "Adding fuel to the fire"

- (understand existing, generally enthusiastic adopters to target similar consumers) Characteristics and psychographics ▶ Who is "pre-adapted" to adopt?
- (e.g., Williams and Kurani 2006) Segment: all-battery vs. plug-in hybrid EVs

### "Tough market nuts to crack" (understand and break down barriers faced by consumers targeted based on policy

- Multi-unit dwellings
- Disadvantaged communities Low-to-moderate income consumers

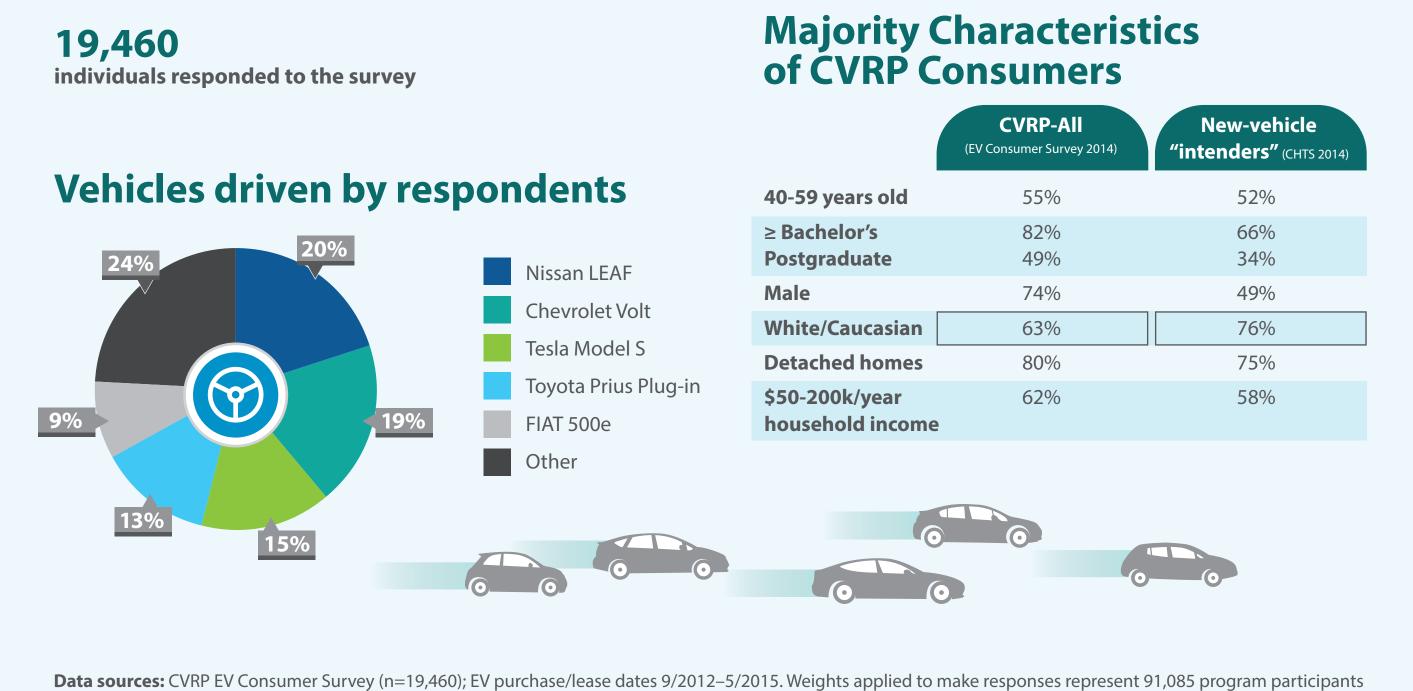
### "Expand market frontiers" (understand the margins of the market to target consumers who can be induced to

- Adopters most influenced by incentives – "rebate essentials"
- Adopters with low initial interest in EVs – "converts"

### Methodology

|                      | Rebate E  | ssentials             | Conv   | verts  |
|----------------------|---|-----------------------|--|--|
| Objective            | Identify characteristics associated with:   |                       |  |  |
|                      | Increased reb   | ate influence         | Initial interest in adopting   |  |
| Strategic Purpose    | Informs targeting resources at:   |                       |  |  |
|                      | Consumers who other   | wise would not adopt  | Non-enthusiasts  |  |
| Model                | Binary logistic   |                       | Ordered logistic   |  |
| Outcome variable:    | "Would you have purchased<br>or leased your PEV without<br>the CVRP rebate?"<br>[yes, no]   |                       | statements b<br>your interest i<br>you started yo<br>a new v<br>[scale rangin<br>interested in a | n a PEV when<br>our search for<br>ehicle?"<br>ng from only |
| Predictor variables: | Consumer, household, vehicle and transactional data reduced based on lack of theoretical relevance, "actionability," and to a lesser extent, correlations |                       |  |  |
| Data                 | 1a. PHEV<br>(n=7,711)   | 1b. BEV<br>(n=11,478) | 2a. PHEV<br>(n=7,711)  | 2b. BEV<br>(n=11,478)                                      |

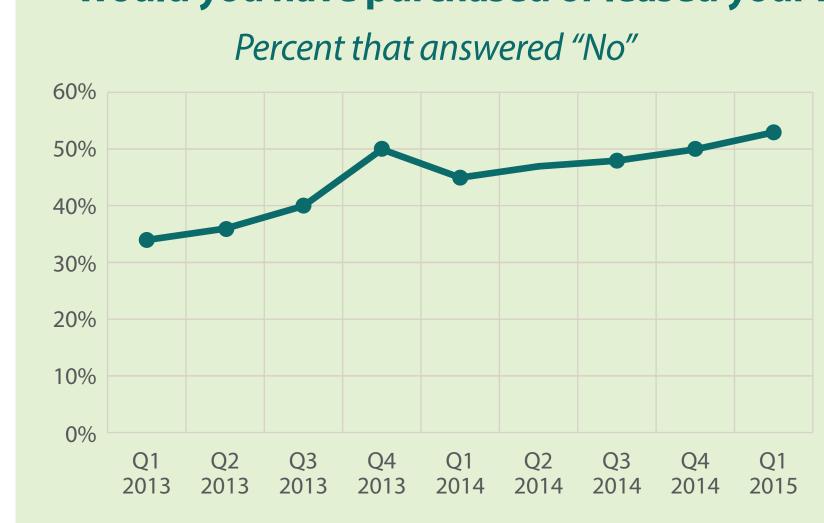
### Data

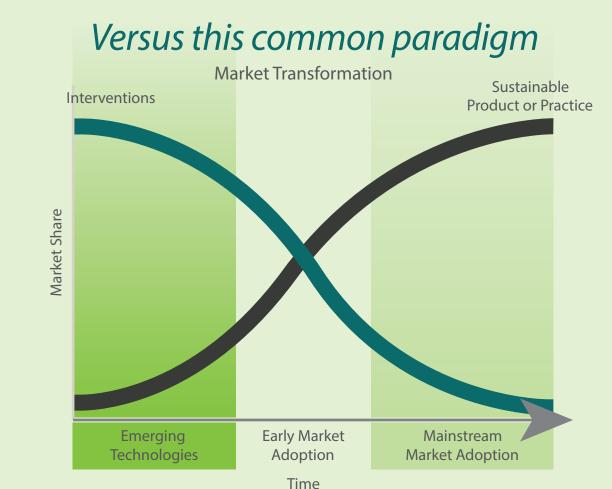


Data sources: CVRP EV Consumer Survey (n=19,460); EV purchase/lease dates 9/2012-5/2015. Weights applied to make responses represent 91,085 program participants along the dimensions of vehicle model, county, and buy vs. lease. Unweighted responses used in logistic regression to produce unbiased and consistent estimates and reduce standard errors.

## Highly Influenced "Rebate Essentials"

### Would you have purchased or leased your EV without the rebate?





## Low Initial Interest "Converts"

## Which of the following statements best describes your interest in a PEV when you started your search for a new vehicle?



### **Target Consumers:** "Rebate Essentials"

Consumers most influenced by the rebate: **Demographics**: male, non-white,

income, perhaps younger and larger households **Motivations and interest**: less motivated by environmental impacts, more motivated by saving money on fuel, carpool lane access,

and perhaps energy independence;

higher education, lower household

lower initial interest in EVs **Information gathering**: found it more difficult to find info on EVs, spent more time researching online, learned about the rebate before going to the dealer

Vehicle characteristics: lower price, bought (vs. lease)

Differen

**PHEV Co** 

The odds a

consumers

motivated

and buying

Differences -

|                          | rket Transformati        | on Sustainab<br>Product or Product |  |
|--------------------------|--------------------------|------------------------------------|--|
| Emerging<br>Technologies | Early Market<br>Adoption | Mainstream<br>Market Adoption      |  |
|                          | Time                     |                                    |  |

### **Results: Statistically Significant Odds-Increasing Factors**

| PHEV Odds Ratio | BEV Odds Ratio | <b>Explanatory Variable</b>                       | PHEV Odds Ratio | BEV Odds Ra |
|-----------------|----------------|---|-----------------|-------------|
|                 |                | Consumer demographics                             |                 |             |
| 1.38            | 1.18           | Male  | _               | _           |
| 1.25            | 1.23           | Non-white ethnicity                               | 1.35            | 1.43        |
| 1.08            | 1.11           | Graduate degree (vs. 2nd-highest: Bachelor's)     | _               | _           |
| _               | _              | Bachelor's degree (vs. 2nd: some college or less) | _               | 1.08        |
| 1.05            | 1.04           | Lower household income (\$50k)                    | _               | _           |
| 1.007           | _              | Younger (years)                                   | _               | _           |
| -               | 1.07           | More people in household (#)                      | _               | 1.09        |
|                 |                |   |                 |             |
|                 |                | Housing and region                                |                 |             |
| _               | 1.19           | Multi-unit dwelling (vs. non-MUD)                 | _               | _           |
| _               | 1.003          | No solar (vs. 2nd-highest: planning solar)        | 1.25            | 1.20        |
| _               | 1.18           | No workplace charging (vs. 2nd-highest: WPC)      | _               | _           |
| _               | 1.51           | Central CA (vs. 2nd-highest: Far South CA)        | _               | _           |
| -               | _              | No workplace charging (vs. access to WPC)         | _               | 1.16        |
| _               | _              | Central CA (vs. 2nd-highest: South CA)            | _               | 1.24        |
|                 |                |   |                 |             |
|                 |                | Reasons and interest                              |                 |             |

|  | 1.24 | 1.33 | More motivated by saving money on fuel           | 1.10 |
|--|------|------|--|------|
| are higher for PHEV rs that are younger, more d by energy independence ng rather than leasing. | 1.04 | 1.12 | More motivated by carpool lane access            | 0.92 |
|  | 1.08 | 1.08 | Less motivated by reducing environmental impacts | 1.21 |
|  | 1.09 | _    | More motivated by energy independence            | 0.92 |
|  | _    | _    | More motivated by vehicle performance            | _    |
|  | 1.41 | 1.29 | Lower initial interest in EVs                    | Yes  |
|  | Yes  | Yes  | Rebate essential                                 | 1.73 |
|  |      |      |  |      |
|  |      |      | Information gathering                            |      |

| 1.18  | Differences –   | 1.19     | 1.15     | Spent more time researching EVs online        | 0.74 | 0.74    |
|---|---|----------|----------|---|------|---------|
| Transactional factors           Transactional factors           Workplace charging, and living in central California.         1.000019         1.000016         Vehicle price is lower (\$)         –         0.89999           1.27         -         Buy (vs. lease)         0.80         0.83           1.14         -         Chevy PHEV (vs. 2nd-highest: Toyota)         -         -           -         1.04         Nissan BEV (vs. 2nd-highest: FIAT)         -         -           -         -         Ford (vs. 2nd-highest: other)         1.10         -           -         -         FIAT (vs. 2nd-highest: Nissan)         -         1.08           -         1.001         Acquisition date (days)         -         - | BEV Consumers   | 1.18     | 1.17     | Did not hear about the rebate from the dealer | 0.81 | _       |
| 1.27  | consumers in larger households and MUDs, with no solar or workplace charging, and living in |          |          | Transactional factors                         |      |         |
| 1.27       -       Buy (vs. lease)       0.80       0.83         1.14       -       Chevy PHEV (vs. 2nd-highest: Toyota)       -       -         -       1.04       Nissan BEV (vs. 2nd-highest: FIAT)       -       -         -       -       Ford (vs. 2nd-highest: other)       1.10       -         -       -       FIAT (vs. 2nd-highest: Nissan)       -       1.08         -       1.001       Acquisition date (days)       -       -   |   | 1.000019 | 1.000016 | Vehicle price is lower (\$)                   | _    | 0.99999 |
| -       1.04       Nissan BEV (vs. 2nd-highest: FIAT)       -       -         -       -       Ford (vs. 2nd-highest: other)       1.10       -         -       -       FIAT (vs. 2nd-highest: Nissan)       -       1.08         -       1.001       Acquisition date (days)       -       -  |   | 1.27     | _        | Buy (vs. lease)                               | 0.80 | 0.83    |
| -         -         Ford (vs. 2nd-highest: other)         1.10         -           -         -         FIAT (vs. 2nd-highest: Nissan)         -         1.08           -         1.001         Acquisition date (days)         -         -  |   | 1.14     | _        | Chevy PHEV (vs. 2nd-highest: Toyota)          | _    | _       |
| FIAT (vs. 2nd-highest: Nissan)  - 1.08  - 1.001  Acquisition date (days)  |   | _        | 1.04     | Nissan BEV (vs. 2nd-highest: FIAT)            | _    | _       |
| - 1.001 Acquisition date (days) -   |   | _        | _        | Ford (vs. 2nd-highest: other)                 | 1.10 | _       |
|   |   | _        | _        | FIAT (vs. 2nd-highest: Nissan)                | _    | 1.08    |
| First EV 3.96 4.34  |   | _        | 1.001    | Acquisition date (days)                       | _    | _       |
|   |   | _        | _        | First EV                                      | 3.96 | 4.34    |

### The rebate is more essential to consumers:

- S Focused on "financial and practical" aspects of adoption
- Who face "greater contextual constraints" or are otherwise less easily able to adopt
- Whose adoption is driven less by "green enthusiasm"

1.18

i With "challenging informational environments"

Visit the following interactive dashboards for more data and information: cleanvehiclerebate.org, mor-ev.org, ct.gov/deep and zevfacts.com

1.22

| PHEV Odds Ratio | BEV Odds Ratio | <b>Explanatory Variable</b>                       | PHEV Odds Ratio | BEV Odds Ratio |
|-----------------|----------------|---|-----------------|----------------|
|                 |                | Consumer demographics                             |                 |                |
| 1.38            | 1.18           | Male  | _               | _              |
| 1.25            | 1.23           | Non-white ethnicity                               | 1.35            | 1.43           |
| 1.08            | 1.11           | Graduate degree (vs. 2nd-highest: Bachelor's)     | _               | _              |
| _               | _              | Bachelor's degree (vs. 2nd: some college or less) | _               | 1.08           |
| 1.05            | 1.04           | Lower household income (\$50k)                    | _               | _              |
| 1.007           | _              | Younger (years)                                   | _               | _              |
| _               | 1.07           | More people in household (#)                      | _               | 1.09           |
|                 |                |   |                 |                |
|                 |                | Housing and region                                |                 |                |
| _               | 1.19           | Multi-unit dwelling (vs. non-MUD)                 | _               | _              |
| _               | 1.003          | No solar (vs. 2nd-highest: planning solar)        | 1.25            | 1.20           |
| _               | 1.18           | No workplace charging (vs. 2nd-highest: WPC)      | _               | _              |
| _               | 1.51           | Central CA (vs. 2nd-highest: Far South CA)        | _               | _              |
| _               | _              | No workplace charging (vs. access to WPC)         | _               | 1.16           |
| _               | _              | Central CA (vs. 2nd-highest: South CA)            | _               | 1.24           |
|                 |                |   |                 |                |
|                 |                | Reasons and interest                              |                 |                |
| 1.24            | 1.33           | More motivated by saving money on fuel            | 1.10            | 1.06           |
| 1.04            | 1.12           | More motivated by carpool lane access             | 0.92            | 0.96           |
| 1.08            | 1.08           | Less motivated by reducing environmental impacts  | 1.21            | 1.31           |
| 1.09            | _              | More motivated by energy independence             | 0.92            | 0.93           |
| -               | _              | More motivated by vehicle performance             | _               | 1.11           |
| 1.41            | 1.29           | Lower initial interest in EVs                     | Yes             | Yes            |
|                 |                |   |                 |                |

## 1.21 1.24 Found it more difficult to find information on EVs

| 1.10     | 1 • 1 7  | Did not near about the repate norm the dealer | 0.01 |         |
|----------|----------|---|------|---------|
|          |          |   |      |         |
|          |          | Transactional factors                         |      |         |
| 1.000019 | 1.000016 | Vehicle price is lower (\$)                   | _    | 0.99999 |
| 1.27     | _        | Buy (vs. lease)                               | 0.80 | 0.83    |
| 1.14     | _        | Chevy PHEV (vs. 2nd-highest: Toyota)          | _    | _       |
| _        | 1.04     | Nissan BEV (vs. 2nd-highest: FIAT)            | _    |         |
| _        | _        | Ford (vs. 2nd-highest: other)                 | 1.10 | _       |
| _        | _        | FIAT (vs. 2nd-highest: Nissan)                | _    | 1.08    |
| _        | 1.001    | Acquisition date (days)                       | -    | _       |
| _        | _        | First EV                                      | 3.96 | 4.34    |
| -        | -        | Replacing a vehicle                           | _    | 1.10    |

### The convert is more likely:

- 1 Less demographically specific/constrained
- Oriven less by "energy and the environment" than traditional vehicle-operation reasons
- With "challenging informational environments"

"Switching from old to new"

Thanks also to Tim Kleinheider, Georgina Arreola, Colin Santulli and others at CSE.