Characterizing California Electric Vehicle Consumer Segments

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

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Center for Sustainable Energy (CSE)
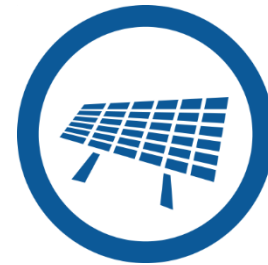
Building Performance

Clean Transportation

Distributed Generation

Energy Efficiency

Energy Storage

Renewable Energy

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Incentives Design & Administration

Consumer & Dealer Outreach

Stakeholder Engagement
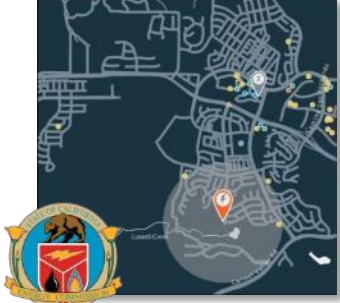
Fleet Assistance & Clean Cities

PEV, Alt.-Fuel, & ZEV Planning & Implementation

2nd Life Battery Research & Vehicle-Grid Integration

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CSE has processed >163k rebates totaling ~$350M

California (CVRP), 2010–present

- **Air Resources Board**
- 2007 Legislation (AB118, then AB8) allowing vehicle registration fees
- Greenhouse Gas Reduction Fund

Massachusetts (MOR-EV), 2014–present

- **Department of Energy Resources**
- Regional Greenhouse Gas Initiative

Connecticut (CHEAPR), 2015–present

- **Department of Energy & Environmental Protection**
- Utility Settlement
- Vehicle rebate *and* dealer incentive (consumer can also assign vehicle rebate to dealer)

Where can I get the data?: CSE Transparency Tools

- **Public, online, interactive dashboards facilitate informed action**
  - Data characterizing >163,000 EVs and consumers
  - ~$350M in rebates processed
  - >19,000 survey responses statistically represent >90,000 consumers

Also: zevfacts.com
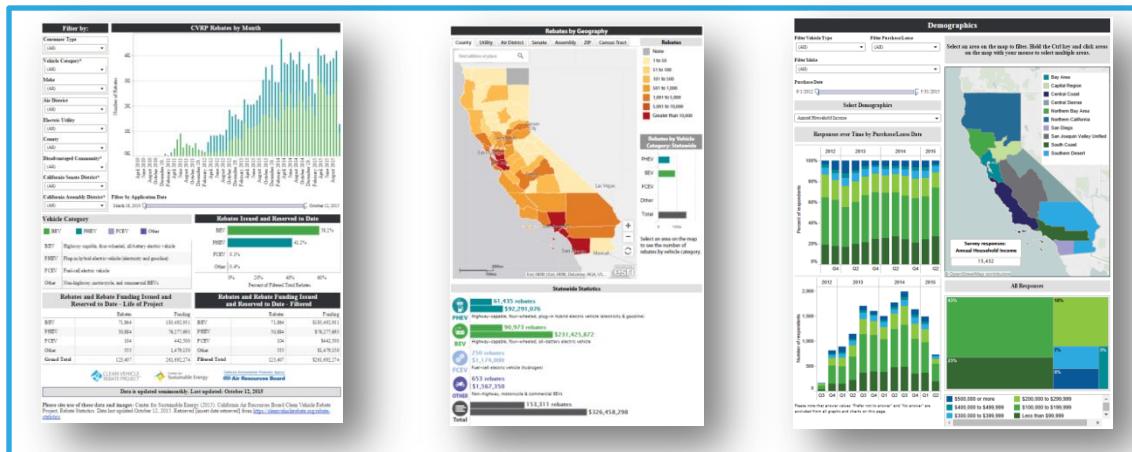
cleanvehiclerebate.org

ct.gov/deep

mor-ev.org

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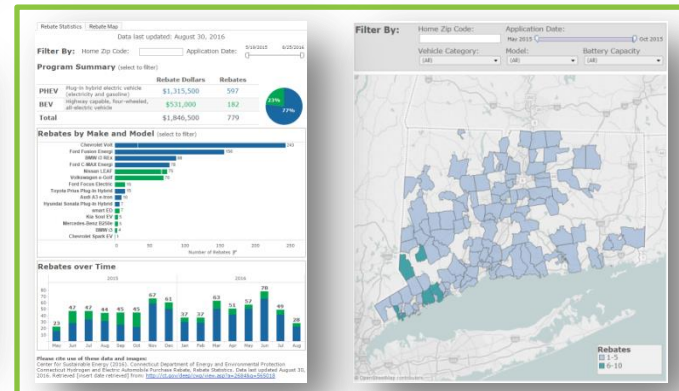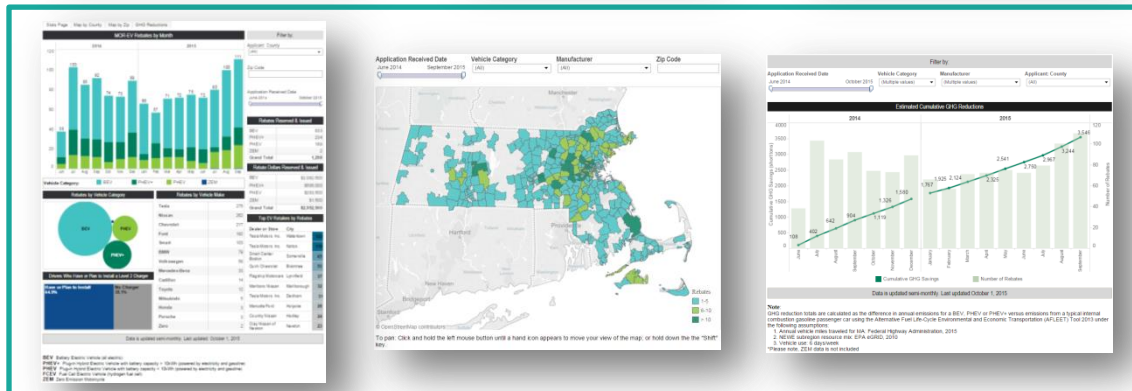
Statewide Monetary Incentives: CA's CVRP

		CVRP	Federal Tax Credit
	Hydrogen Fuel-Cell Electric Vehicles	*$5,000*	*$8,000*
	Battery Electric Vehicles (& i3 REx)	*$2,500*	*$7,500*
	Plug-in Hybrid Electric Vehicles	*$1,500*	*$2,500–$7,500*
	Neighborhood Electric Vehicles		
	Zero-Emission Motorcycles	*$900*	

Plug-in electric vehicles = all-battery + plug-in hybrid
i.e., PEVs = BEVs + PHEVs

California Environmental Protection Agency
Air Resources Board

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Outline: Characterizing Consumer Segments

- Background & Approach
- Results
  - Highly-influenced "Rebate Essentials"
  - Low-Initial-Interest "Converts"
  - Commonalities
- Summary "Profiles"

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Background & Approach

How can program evaluation help us grow markets for electric vehicles?

1. "**Adding fuel to the fire**": understand existing, generally enthusiastic adopters to target similar consumers
   - Segment: all-battery vs. plug-in hybrid EVs
   - Characteristics, motivations, and trends
   - Who is "pre-adapted" to adopt? (e.g., Williams and Kurani 2006)

2. "**Tough nuts to crack**": understand and break down barriers faced by consumers targeted based on policy priorities
   - Multi-unit dwellers
   - Disadvantaged Communities
   - Low-to-moderate income consumers

3. "**Expand market frontiers**": understand the margins of the market to target consumers who can be induced to join
   - Adopters with low initial interest in EVs -- "converts"
   - Adopters most influenced by incentives -- "rebate essentials"

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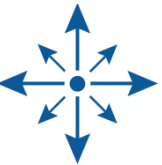
Methodology Overview

	1. Rebate Essentials	
Research Objective	Identify characteristics associated with:	
	increased rebate influence	
Strategic Purpose	Informs targeting resources at:	
	consumers who otherwise would not adopt	
Model	Binary logistic regression	
Outcome variable:	"Would you have purchased or leased your PEV without the CVRP rebate?" [yes, no]	
Predictor variables:	Consumer, household, vehicle, and transactional data Reduced based on lack of theoretical relevance, "actionability," and to a lesser extent, correlations	
Data	1a. plug-in hybrid (PHEV) (n=7,711)	1b. All-battery (BEV) (n=11,478)

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Methodology Overview

	1. Rebate Essentials		2. Converts	
Research Objective	Identify characteristics associated with:			
	increased rebate influence		initial interest in adopting	
Strategic Purpose	Informs targeting resources at:			
	consumers who otherwise would not adopt		non-enthusiast, more mainstream consumers	
Model	Binary logistic		Ordered logistic	
Outcome variable:	"Would you have purchased or leased your PEV without the CVRP rebate?" [yes, no]		"Which of the following statements best describes your interest in a PEV when you started your search for a new vehicle?" [scale]	
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 (n=7,711)	1b. BEV (n=11,478)	2a. PHEV (n=7,711)	2b. BEV (n=11,478)

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Survey sample
19,460
individuals responded to the survey**

Vehicles driven by respondents

- 20%
- 24%
- 9%
- 13%
- 15%
- 19%

Legend:
- Nissan LEAF
- Chevrolet Volt
- Tesla Model S
- Toyota Prius Plug-in
- FIAT 500e
- Other
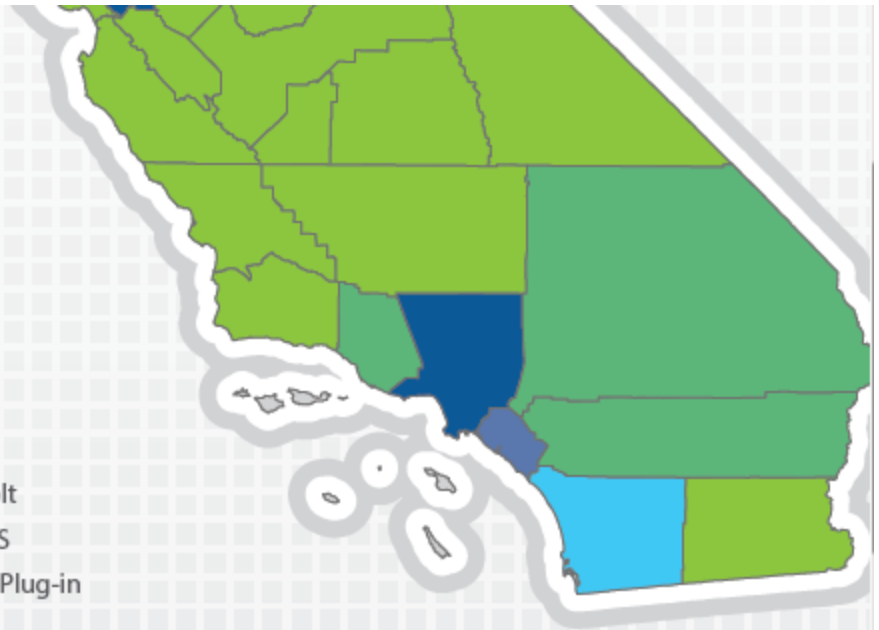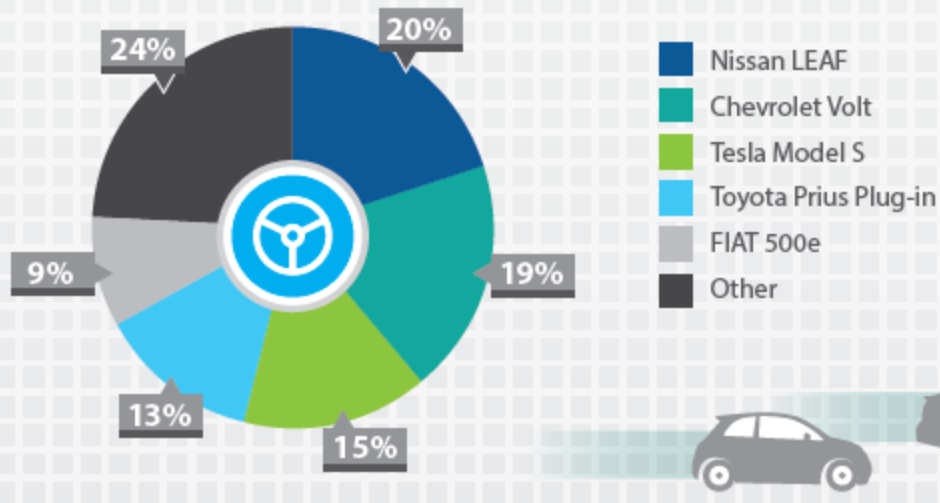
* Through May 2015, 150,287 new PEVs were adopted in California, 75,748 PHEVs and 74,539 BEVs.
** Results have been weighted to be representative of the entire program with respect to county, vehicle model and whether the vehicle was purchased or leased.

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Characterizing Highly Influenced "Rebate Essential" Consumers

Percent that state they would not have purchased/leased without the rebate

California Clean Vehicle Rebate Project

Source: EV Consumer Survey
Respondents: 19,460
Purchase dates 9/1/12-5/31/15
Sampling weights applied

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Variable	PHEV Odds Ratio	BEV Odds Ratio
Consumer demographics		
Male	1.38	1.18
Non-white ethnicity	1.25	1.23
Graduate degree (vs. 2nd-highest: bachelor's)	1.08	1.11
Lower household income ($50k)	1.05	1.04
Reasons and interest		
More motivated by saving money on fuel	1.24	1.33
More motivated by carpool lane access	1.04	1.12
Less motivated by reducing environmental impacts	1.08	1.08
Lower initial interest in EVs	1.41	1.29
Information gathering		
Found it more difficult to find information on EVs	1.22	1.18
Spent more time researching EVs online	1.19	1.15
Did not hear about the rebate from the dealer	1.18	1.17
Transactional factors		
Vehicle price is lower ($)	1.000019	1.000016

PHEV n = 7,711; BEV n=11,478
All factors significant with $p < 0.05$

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Rebate Essential: Different Odds-Increasers

Variable	PHEV Odds Ratio	BEV Odds Ratio
Consumer demographics		
Younger (years)	1.007	
More people in household (#)		1.07
Housing & region		
Multi-unit dwelling (vs. non-MUD)		1.19
No solar (vs. 2nd-highest: planning solar)		1.003
No workplace charging (vs. 2nd-highest: WPC)		1.18
Central CA (vs 2nd-highest: Far South CA)		1.51
Reasons and interest		
More motivated by energy independence	1.09	
Transactional factors		
Buy (vs. lease)	1.27	
Chevy PHEV (vs. 2nd-highest: Toyota)	1.14	
Nissan BEV (vs. 2nd highest: FIAT)		1.04
Acquisition date (days)		1.001

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Characterizing Low-Initial-Interest "Converts"

California Clean Vehicle Rebate Project
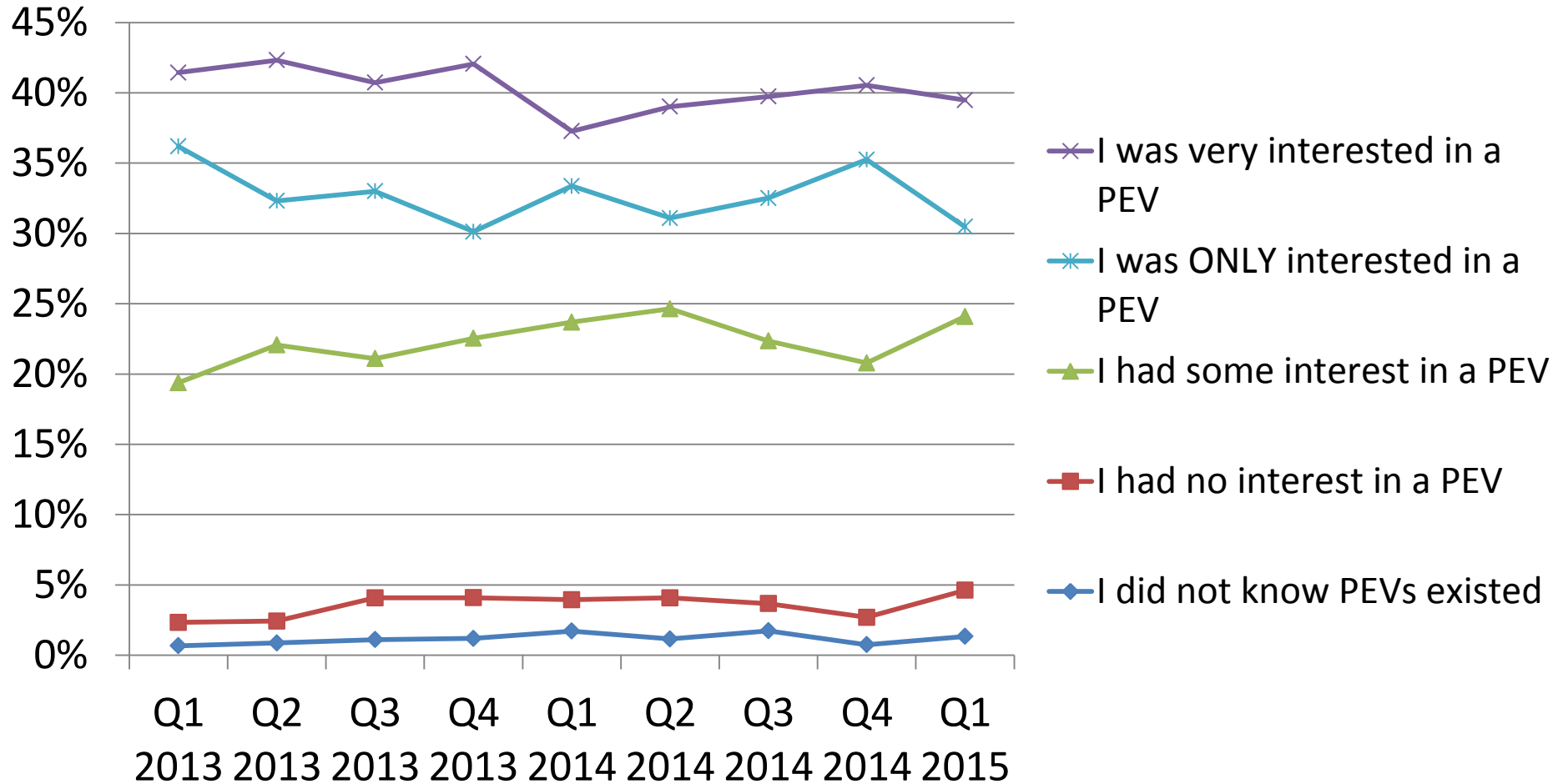
Source: EV Consumer Survey
Respondents: 19,460
Purchase dates 9/1/12-5/31/15
Sampling weights applied

Low-Interest Converts: Common Odds-Increasing Factors

Variable	PHEV Odds Ratio	BEV Odds Ratio
Consumer demographics		
Ethnicity is other than white	1.35	1.43
Housing and region		
No solar (vs. 2nd-highest: planning solar)	1.25	1.20
Reasons and enablers		
More motivated by saving money on fuel	1.10	1.06
Less motivated by reducing environmental impacts	1.21	1.31
Less motivated by carpool lane access	1.09	1.04
Less motivated by energy independence	1.09	1.08
Rebate essential	1.73	1.54
Information gathering		
Found it more difficult to find information on EVs	1.21	1.24
Spent *less* time researching EVs online	1.35	1.36
Transactional factors		
Lease (vs. buy)	1.25	1.21
First EV	3.96	4.34

PHEV n = 7,711; BEV n=11,478
All factors significant with $p < 0.05$

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Low-Interest Converts: Different Odds Increasers

Variable	PHEV Odds Ratio	BEV Odds Ratio
Consumer demographics		
Bachelor's degree (vs. 2nd: Some college or less)		1.08
More people in household (#)		1.09
Housing & region		
No workplace charging (vs. access to WPC)		1.16
Central CA (vs 2nd-highest: South CA)		1.24
Reasons and interest		
More motivated by vehicle performance		1.11
Information gathering		
Heard about the rebate at the dealership	1.23	
Transactional factors		
Vehicle price is higher ($)		1.0000059
Ford (vs. 2nd-highest: Other)	1.10	
FIAT (vs. 2nd highest: Nissan)		1.08
Replacing a vehicle		1.10

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All factors significant with $p < 0.05$

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Common Characteristics Across All Segments

Variable	PHEV-RE	PHEV-C	BEV-RE	BEV-C
Consumer demographics				
Ethnicity is other than white	1.25	1.35	1.23	1.43
Reasons, interest, and enablers				
More motivated by saving money on fuel	1.24	1.10	1.33	1.06
Less motivated by reducing enviro impacts	1.08	1.21	1.08	1.31
More rebate essential	Y	1.73	Y	1.54
Lower initial interest in EVs	1.41	Y	1.23	Y
Information gathering				
Found it more difficult to find info on EVs	1.22	1.21	1.18	1.24

PHEV n = 7,711; BEV n=11,478
All factors significant with $p < 0.05$

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Common Characteristics Across All Segments

Variable	PHEV-RE[a]	PHEV-C[b]	BEV-RE[c]	BEV-C[d]
Consumer demographics				
Ethnicity is other than white	1.25	1.35	1.23	1.43
Reasons, interest, and enablers				
More motivated by saving money on fuel	1.24	1.10	1.33	1.06
Less motivated by reducing enviro impacts	1.08	1.21	1.08	1.31
More rebate essential	Y	1.73	Y	1.54
Lower initial interest in EVs	1.41	Y	1.23	Y
Information gathering				
Found it more difficult to find info on EVs	1.22	1.21	1.18	1.24

a. Other predictors included: vehicle price, buy vs. lease, vehicle make, age, gender, education, income, importance of HOV lane access, importance of energy independence, time spent researching PEVs, heard about CVRP at dealership

b. Other predictors included: buy vs. lease, vehicle make, first EV, solar at home, importance of HOV lane access, importance of energy independence, time spent researching PEVs, heard about CVRP at dealership

c. Other predictors included: purchase date, vehicle price, vehicle make, multi-unit dwelling residence, region of residence, solar at home, gender, education, income, importance of HOV lane access, time spent researching PEVs, heard about CVRP at dealership, access to workplace charging

d. Other predictors included: vehicle price, buy vs. lease, vehicle make, first EV, added vs. replaced, region of residence, solar at home, education, number in household, importance of HOV lane access, importance of energy independence, importance of vehicle performance, time spent researching PEVs, access to workplace charging

PHEV n = 7,711; BEV n=11,478
All factors significant with $p < 0.05$

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Summary "Profiles"

The rebate is more essential to consumers:

- focused on **"financial and practical"** aspects of adoption
  - saving money on vehicle price and fuel costs, being fully exposed to a purchase rather than a lease, being constrained by lower household income, carpool lane access
- who face **"greater contextual constraints"** or are otherwise less easily able to adopt
  - lower household income, perhaps younger and less established, perhaps more risk adverse and thus looking to an established hybrid brand, perhaps with less cultural exposure to EVs
- whose adoption is **driven less by "green enthusiasm"** than other values
  - less motivated by reducing environmental impact and more motivated by increased energy independence and saving money on fuel costs; and
- with **"challenging informational environments"**
  - low initial interest in EVs, greater difficulty finding information on EVs, who did more research online, but who perhaps benefitted from higher education to navigate these complex informational environments and have found out about the rebate before showing up at the dealership for their acquisition

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The convert is more likely:

- **less demographically specific/constrained**
  - May or may not be constrained by income, have postgraduate degrees, or be male
- **driven less by "energy and the environment"** than traditional vehicle-operation reasons
  - less motivated by reducing environmental impact and energy independence, and carpool lane access, and more by saving money and perhaps vehicle performance
  - No solar, perhaps no workplace charging
- with **"challenging informational environments"**
  - low initial interest in EVs, perhaps with less cultural exposure to EVs, greater difficulty finding information on EVs, who did *less* research online, and may learn about the rebate from the dealer
- **"switching from old to new"**
  - Leasing their first EV as a replacement vehicle

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Data Sources

Program:

- 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
- CVRP [Rebate Applications](#) (n=164,934)
  - EV purchase/lease dates 3/2010–9/2016

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Consumer research and analysis

- **Target Consumer Segments**: Converts, Rebate Essentials (forthcoming Oct 2016 pres and Jan 2017 paper)
- Progress in **Disadvantaged Communities** (forthcoming pres, Oct 2016)
- **Information Channels** ([EV Roadmap pres, 2016](#))
  - Exposure & importance of various channels, consumer time spent researching various topics
- **Infographics**
  - Overall ([CVRP infographic , 2016](#))
  - Disadvantaged Communities (forthcoming, Oct 2016)
- Characterization of **Participating Vehicles and Consumers** ([CVRP research workshop pres, 2015](#))
- **Program Participation** by Vehicle Type and County ([CVRP brief 2015](#))
- **Dealer services**: Importance and Prevalence (EF pres 2015)

Also:

- Evaluation of the CT Dealer Incentive (forthcoming pres, Oct 2016)

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Thank You for Your Attention

What would you like to know more about?
What decisions are you facing?
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We work nationally in the clean energy industry and are always open to exploring partnership opportunities.

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