Lessons Learned About Electric Vehicle Consumers Who Rated the U.S. Federal Tax Credit "Extremely Important" in Enabling Their Purchase

35th International Electric Vehicle Symposium

15 June 2022

EVS35
OSL2022

Brett Williams, MPhil (cantab), PhD – Principal Advisor, EV Programs, CSE

with thanks to John Anderson, Eric Fullenkamp, and others at CSE, and to staff at the California Air Resources Board (CARB)

CALIFORNIA CLEAN VEHICLE REBATE PROJECT™

Center for Sustainable Energy™

State EV Rebate Programs Administered by CSE (as of 7/6/2021)

	CALIFORNIA CLEAN VEHICLE REBATE PROJECT	MOR-EV Massachusetts Offers Rebates for Electric Vehicles	CHEAPR Connecticut Hydrogen and Electric Automobile Purchase Rebate	NEW YORK STATE	OREGON CLEAN VEHICLE REBATE PROGRAM	chargeup New Jersey
Fuel-Cell EVs	$4,500 (+2,500*)	$2,500	$7,500 (+$2,000*)	≥ 200 e-miles†: $2,000 ≥ 40 e-miles: $1,000 < 40 e-miles: $500 Base MSRP > $42k: $500	≥ 10 kWh: $2,500 (+$2,500*) < 10 kWh: $1,500 (+$2,500*)	--
All-Battery EVs	$2,000 (+2,500*)	$2,500	$2,250 (+$2,000*)			$25/e-mile†: $2,000 max for MSRP < $55k; $5,000 max for MSRP < $45k
Plug-in Hybrid EVs	BEVx = $2,000 Others = $1,000 (+$2,500*)	BEVx = $2,500 Others = $1,500	$750 (+$1,500*)			
Zero-Emission Motorcycles	$750	--	--	--	$750 (and NEVs)	--
Program Design Elements	* Rebate adder: income-qualified	--	* Rebate adder: qualified by proxy	--	* Rebate adder: income-qualified	--
	--	--	Point-of-sale option	Point-of-sale	Point-of-sale option	Point-of-sale
	Base MSRP: - PEVs ≤ $60k	Purchase price ≤ $50k	Base MSRP: - FCEVs ≤ $60k - PEVs ≤ $42k	Base MSRP > $42k = $500	Base MSRP < $50k	Trim-specific MSRP < $55k
	≥ 30 e-miles†	≥ 25 e-miles†	--	--	--	--
	Income cap	--	• Used EV program ($7.5k/$3k/$1.125k) • $125/$75 dealer sales incentive	--	Used EVs also qualify	--

† Electric miles (e-miles) are U.S.-EPA-rated all-electric miles. BEVx = range-extended battery electric vehicle (BMW i3 REx). NEV = Neighborhood EV.

Outline: Characterizing Federal Tax Credit Influence

I. Introduction
II. Data and Representativeness
III. Methodology
IV. Results and Discussion
  - FTC Importance, Trends
  - Descriptive Differences Between Those Highly Influenced and Those Not
  - Ranked Ordered Distinguishing Factors
V. Conclusions & Recommendations for FTC design & outreach

Appendices & Additional Resources

B.D.H. Williams, J.B. Anderson (2022, Jun.), Lessons Learned About Electric Vehicle Consumers Who Found the U.S. Federal Tax Credit Extremely Important in Enabling Their Purchase, in procs. *35th International Electric Vehicle Symposium and Exhibition (EVS35)*, AVERE.

Introduction

Research Description

Background

- U.S. federal tax credit (FTC) of up to $7,500 for EV purchase or lease
- Phased down and out for Tesla and GM vehicles starting in 2019
- Renewal and expansion proposed as part of Build Back Better but blocked

Purpose

- Improve understanding of the influence of the FTC before phase down
- Calibrate future expectations
- Optimize strategic targeting of FTC and other supportive public resources

Objective

- Identify and rank-order characteristics of consumers most highly enabled by the electric-vehicle (EV) FTC to adopt

B.D.H. Williams, J.B. Anderson (2022, Jun.), Lessons Learned About Electric Vehicle Consumers Who Found the U.S. Federal Tax Credit Extremely Important in Enabling Their Purchase, in procs. *35th International Electric Vehicle Symposium and Exhibition (EVS35)*, AVERE.

Data and Representativeness

Program Summary During the Period Examined

Rebate Design

Fuel-Cell EVs	$5,000
All-Battery EVs	$2,500
Plug-in Hybrid EVs	$1,500 (i3 REx = $2,500)
Zero-Emission Motorcycles	$900
Key Features	• Increased Rebates for lower-income households: +$2,000 • Consumer income cap • e-miles ≥ 20 only

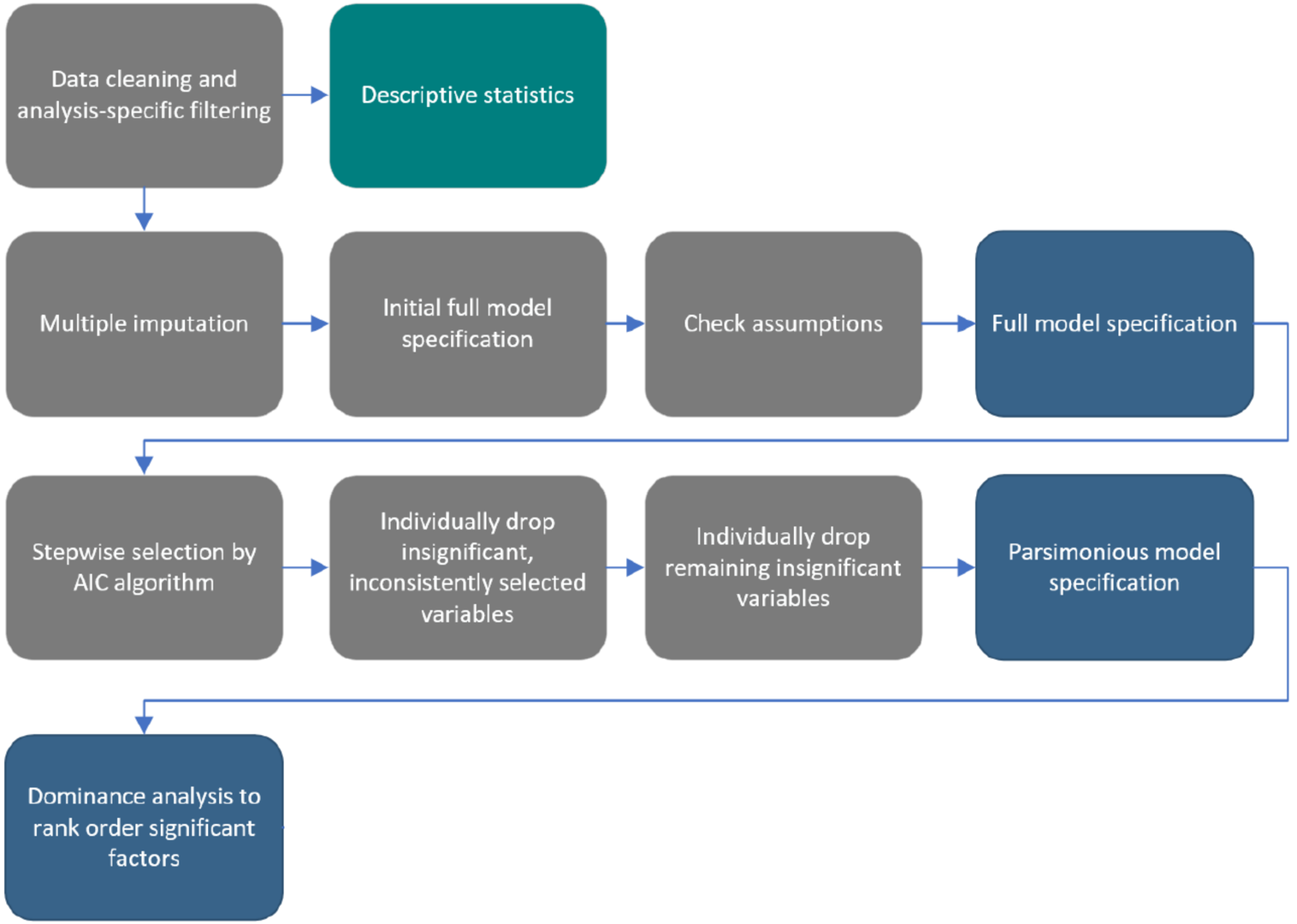
Overall Dataset

Purchase or Lease Dates	Nov. 2016 – Dec. 2018
Program Participants (no fleets)	N = 137,715* • PHEVs = 48,166 (35%) • BEVs = 85,245 (62%) • FCEVs = 4,304 (3%)
Survey Response Dates	15 November 2016 – 7 April 2019
Responses in Dataset	*n* = 27,508* • PHEVs = 9,432 (34%) • BEVs = 17,048 (62%) • FCEVs = 1,028 (4%)
Weighting Method	Iterative Proportional Fitting (raking)
Representative Dimensions	Vehicle technology type, model, purchase vs. lease, residence county
% of the EV Market	~49%, based upon (CSE and AAI 2021)

* Note: n was calculated as of 4/7/2019 and N as of 3/2/2020. These are technically not directly comparable because ~4,400 applicants who purchased/leased EVs in 2018 were added to the program in the interim due to an 18-month application window.

Methodology

Analysis Overview: Descriptive, Binary Logistic & Dominance



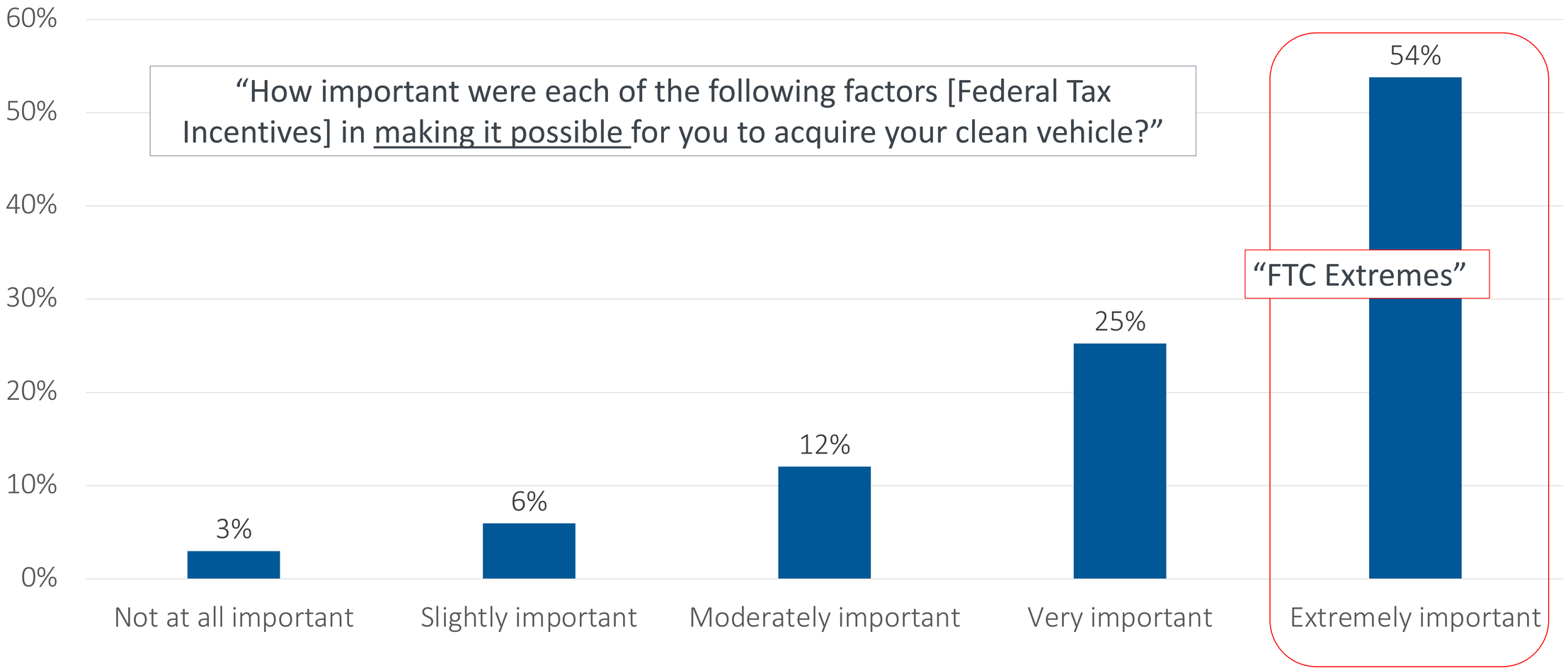
Results and Discussion

Descriptive, Binary Logistic Regression & Dominance Analysis

Descriptive Results

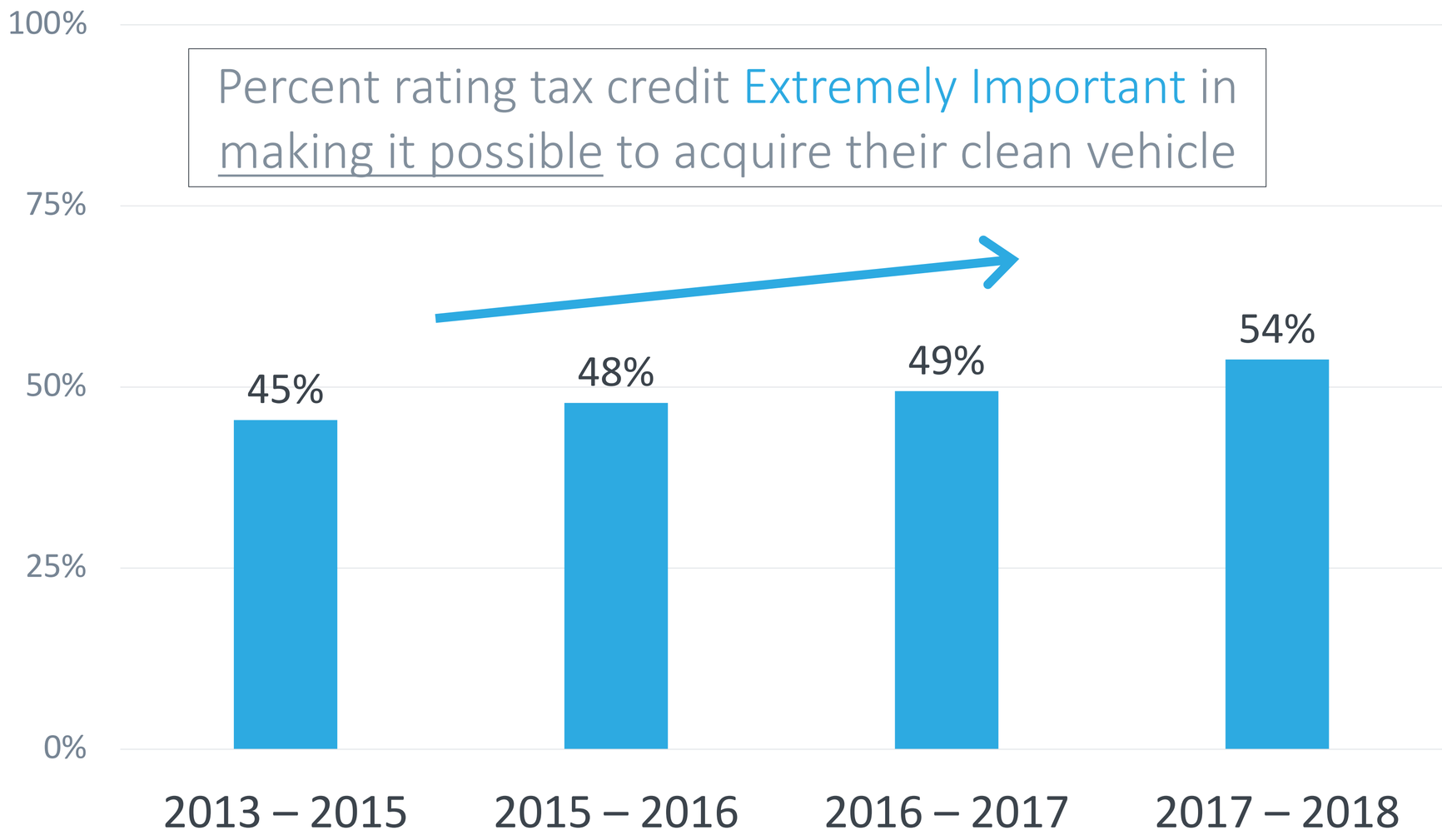
Extreme Importance of Federal Tax Credit for Plug-in EVs

Consumer Survey, 6/2017–12/2018



Weighted n = 17,101

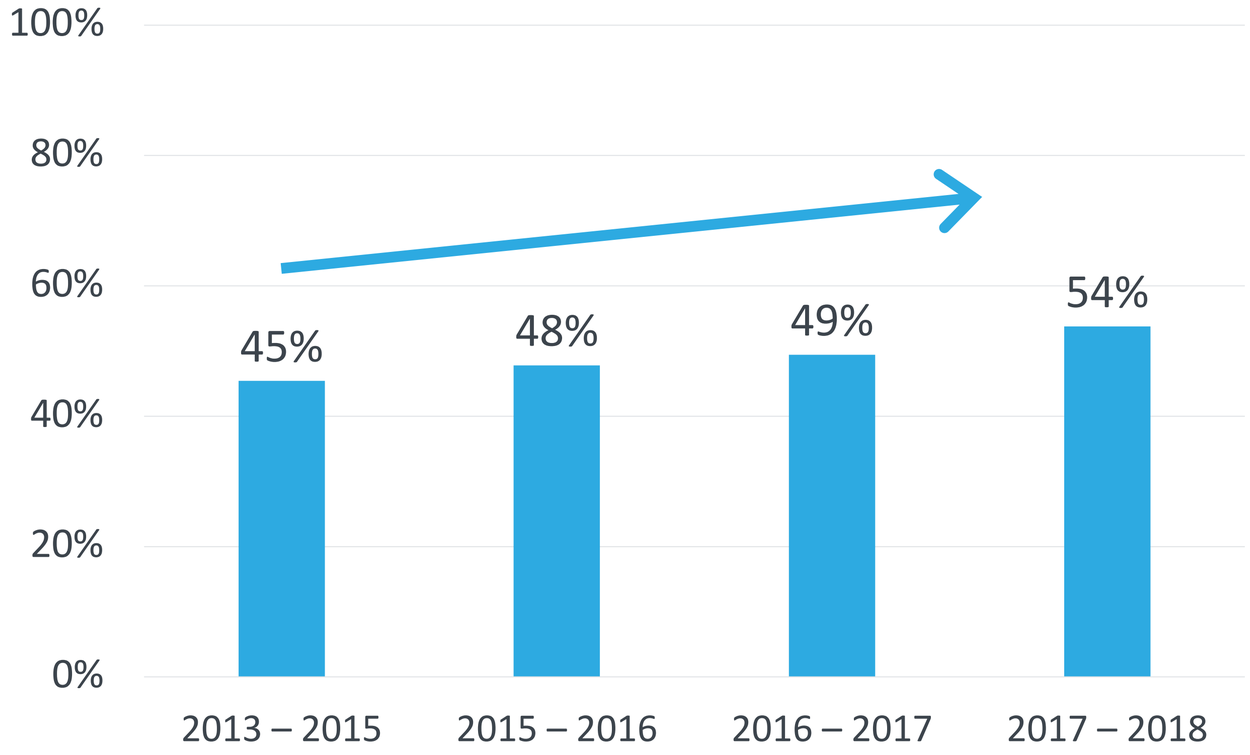
Extreme Importance of Federal Tax Credit Was Increasing

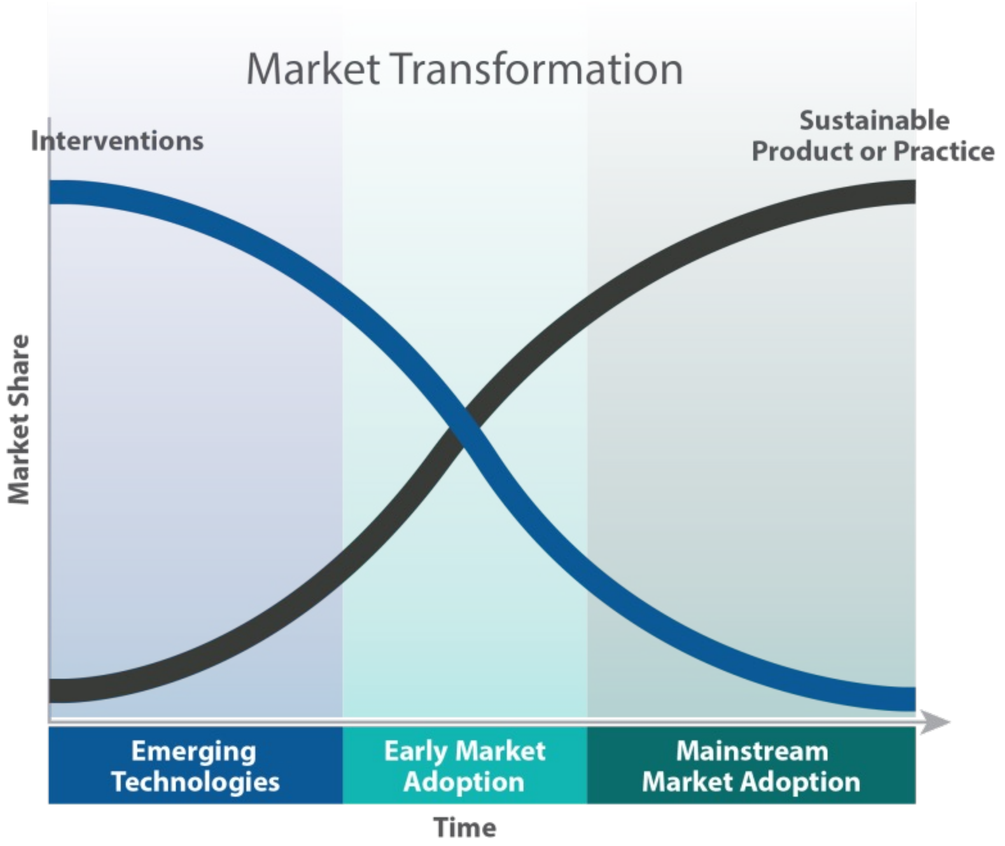


CVRP Consumer Survey: 2013–15 edition weighted n = 18,967, 2015–16 edition weighted n = 10,724, 2016–17 edition weighted n = 8,278; 2017–18 edition weighted n = 17,101

EV Federal Tax Credit Importance was *Increasing* Over Time, Contradicting a Common Paradigm About Phasing Out Incentives

Fed Tax Incentive Extreme Importance ≠ **Common paradigm**

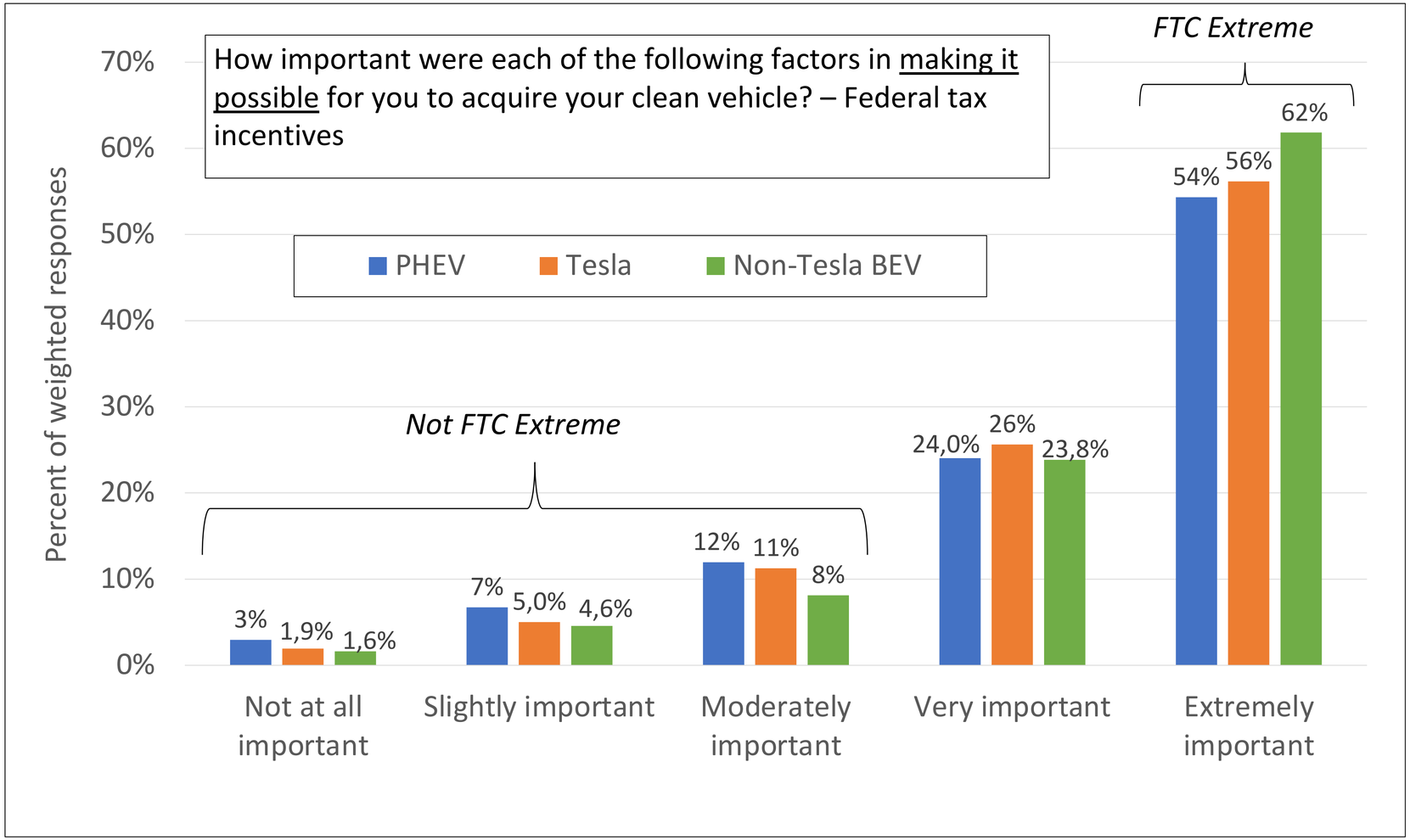




CVRP Consumer Survey: 2013–15 edition weighted n = 18,967, 2015–16 edition weighted n = 10,724, 2016–17 edition weighted n = 8,278; 2017–18 edition weighted n = 17,101

FTC Extreme Importance by Vehicle Category

Consumer Survey, November 2016 – April 2019, Leases Excluded



CVRP Consumer Survey, 2016-17 and 2017-18 Editions, weighted *n* = 13,669.

Summary of *FTC Extreme* Characteristics

(Weighted Descriptive Results)

	All PHEV Purchases	*FTC Extremely Important to PHEV Purchase*	All Tesla Purchases	*FTC Extremely Important to Tesla Purchase*	All Non-Tesla BEV Purchases	*FTC Extremely Important to Non-Tesla BEV Purchase*	CA New-Vehicle Buyers
	(weighted *n*=4,695)	(weighted *n*=2,551	(weighted *n*=7,398)	(weighted *n*=4,155)	(weighted *n*=1,577)	(weighted *n*=975)	Model Years 2016–17 (2017 NHTS, CA add-on[a])
Selected solely white/Caucasian	55%	50%**	51%	44%**	68%	64%**	51%
≥ 40 Years Old	77%	73%**	77%	73%**	82%	78%**	68%
≥ Bachelor's Degree in HH	80%	81%**	86%	86%	85%	84%	58% [b]
Own Residence	82%	81%	88%	87%**	89%	89%	63%
≥ $100k HH Income	66%	66%	80%	81%**	77%	77%	56%
Selected Male	69%	70%	78%	79%	73%	73%	50%

** Significant difference ($p < 0.05$) between FTC Extremes and Not FTC Extremes.

[a] NHTS is weighted to represent the population, not the new-vehicle subset. NHTS new-vehicle buyers identified based on a within-100-mile match between odometer and miles driven while owned. [b] NHTS data characterize individual education, whereas other data characterize highest household attainment.

FTC Extremes Are More Like Mainstream Car Buyers

Race/Ethnicity & Age

	All PHEV Purchases	*FTC Extremely Important to PHEV Purchase*	All Tesla Purchases	*FTC Extremely Important to Tesla Purchase*	All Non-Tesla BEV Purchases	*FTC Extremely Important to Non-Tesla BEV Purchase*	CA New-Vehicle Buyers
	(weighted *n*=4,695)	(weighted *n*=2,551	(weighted *n*=7,398)	(weighted *n*=4,155)	(weighted *n*=1,577)	(weighted *n*=975)	Model Years 2016–17 (2017 NHTS, CA add-on[a])
Selected solely white/Caucasian	55%	50%**	51%	44%**	68%	64%**	51%
≥ 40 Years Old	77%	73%**	77%	73%**	82%	78%**	68%
≥ Bachelor's Degree in HH	80%	81%**	86%	86%	85%	84%	58% [b]
Own Residence	82%	81%	88%	87%**	89%	89%	63%
≥ $100k HH Income	66%	66%	80%	81%**	77%	77%	56%
Selected Male	69%	70%	78%	79%	73%	73%	50%

** Significant difference ($p < 0.05$) between FTC Extremes and Not FTC Extremes.

Percentages are weighted. [a] NHTS is weighted to represent the population, not the new-vehicle subset. NHTS new-vehicle buyers identified based on a within-100-mile match between odometer and miles driven while owned. [b] NHTS data characterize individual education, whereas other data characterize highest household attainment.

Tesla *FTC Extremes* Are More Ethnicity Diverse than New-Vehicle Buyers

	All PHEV Purchases	*FTC Extremely Important to PHEV Purchase*	All Tesla Purchases	*FTC Extremely Important to Tesla Purchase*	All Non-Tesla BEV Purchases	*FTC Extremely Important to Non-Tesla BEV Purchase*	CA New-Vehicle Buyers
	(weighted *n*=4,695)	(weighted *n*=2,551	(weighted *n*=7,398)	(weighted *n*=4,155)	(weighted *n*=1,577)	(weighted *n*=975)	Model Years 2016–17 (2017 NHTS, CA add-on[a])
Selected solely white/Caucasian	55%	50%**	51%	44%**	68%	64%**	51%
≥ 40 Years Old	77%	73%**	77%	73%**	82%	78%**	68%
≥ Bachelor's Degree in HH	80%	81%**	86%	86%	85%	84%	58% [b]
Own Residence	82%	81%	88%	87%**	89%	89%	63%
≥ $100k HH Income	66%	66%	80%	81%**	77%	77%	56%
Selected Male	69%	70%	78%	79%	73%	73%	50%

** Significant difference ($p < 0.05$) between FTC Extremes and Not FTC Extremes.

Percentages are weighted. [a] NHTS is weighted to represent the population, not the new-vehicle subset. NHTS new-vehicle buyers identified based on a within-100-mile match between odometer and miles driven while owned. [b] NHTS data characterize individual education, whereas other data characterize highest household attainment.

Differences Between Incentivized EV Buyers and New-Vehicle Buyers Overall

Ranked from Smallest to Largest

New-Vehicle Buyer Majority Characteristic	PHEV *FTC Extremes* Purchases 11/16–12/18 (weighted *n*=2,213)	*Difference*	CA New-Vehicle Buyers Model Years 2016–17 (2017 NHTS, CA add-on[a])
Selected only White/Caucasian	51%**	← 0 pp →	51%
50+ years old	50%**	← 4 pp →	46%
≥ $100k HH income	67%**	← 11 pp →	56%
Own residence	81%	← 18 pp →	63%
Selected male	70%	← 20 pp →	50%

** Significant difference ($p < 0.05$) between FTC Extremes and Not FTC Extremes.

Percentages are weighted. [a] NHTS is weighted to represent the population, not the new-vehicle subset. NHTS new-vehicle buyers identified based on a within-100-mile match between odometer and miles driven while owned.

Interestingly, *FTC Extremes* Are Not Lower Income

Tax Liability Is Required

	All PHEV Purchases	*FTC Extremely Important to PHEV Purchase*	All Tesla Purchases	*FTC Extremely Important to Tesla Purchase*	All Non-Tesla BEV Purchases	*FTC Extremely Important to Non-Tesla BEV Purchase*	CA New-Vehicle Buyers
	(weighted *n*=4,695)	(weighted *n*=2,551	(weighted *n*=7,398)	(weighted *n*=4,155)	(weighted *n*=1,577)	(weighted *n*=975)	Model Years 2016–17 (2017 NHTS, CA add-on[a])
Selected solely white/Caucasian	55%	50%**	51%	44%**	68%	64%**	51%
≥ 40 Years Old	77%	73%**	77%	73%**	82%	78%**	68%
≥ Bachelor's Degree in HH	80%	81%**	86%	86%	85%	84%	58% [b]
Own Residence	82%	81%	88%	87%**	89%	89%	63%
≥ $100k HH Income	66%	66%	80%	81%**	77%	77%	56%
Selected Male	69%	70%	78%	79%	73%	73%	50%

** Significant difference ($p < 0.05$) between FTC Extremes and Not FTC Extremes.

Percentages are weighted. [a] NHTS is weighted to represent the population, not the new-vehicle subset. NHTS new-vehicle buyers identified based on a within-100-mile match between odometer and miles driven while owned. [b] NHTS data characterize individual education, whereas other data characterize highest household attainment.

Logistic Regression & Dominance Analysis

Logistic Regression Odds Ratios:
What Increases or Decreases the Odds of Being an *FTC Extreme?*

28 factors explored:

- Demographic
- Household
- Charging-access
- Motivation
- Purchase-enabling
- Dealer-experience
- Transactional

For illustration, for Tesla purchases:

Variable Description	Example Values	Missing	Full Model Odds Ratio	Pars. Model Odds Ratio	Dom. Rank
(Intercept)			0.08*	0.12*	
Demographic					
Age 30–39 (vs. 20–29)	1=true; 0=false	2.34%	1.31		
Age 40–49 (vs. 20–29)	1=true; 0=false	2.34%	1.18		
Age 50–59 (vs. 20–29)	1=true; 0=false	2.34%	0.92		
Age 60–69 (vs. 20–29)	1=true; 0=false	2.34%	0.84		
Age 70+ (vs. 20–29)	1=true; 0=false	2.34%	0.74		
Female (vs. male)	1=true; 0=false	3.17%	0.79*	0.79*	12
Selected only Asian (vs. selected only white)	1=true; 0=false	10.29%	1.81*	1.93*	6
Selected something other than only Asian or only white, including multiple selections (vs. selected only white)	1=true; 0=false	10.29%	1.05	1.14	
Associates degree (vs. some college or less)	1=true; 0=false	2.07%	1.11		
Bachelor's degree (vs. some college or less)	1=true; 0=false	2.07%	1.05		
Postgrad. degree (vs. some college or less)	1=true; 0=false	2.07%	1.11		
Married filing jointly (vs. single)	1=true; 0=false	3.67%	1.31*	1.28*	10
Widower, married filing separately or head of household (vs. single)	1=true; 0=false	3.67%	1.54	1.52	
Household					
$50k–$100k (vs. < $50k)	1=true; 0=false	13.73%	1.00		

Red indicates significant odds-decreasing factors (OR<1), green indicates significant odds-increasing factors (OR>1). $*p < 0.10$; $**p < 0.05$.

* See: B.D.H. Williams (2022, Jun.), Targeting Incentives Cost Effectively: "Rebate Essential" Consumers in the New York State Electric Vehicle Rebate Program, for procs. *35th International Electric Vehicle Symposium and Exhibition (EVS35),* AVERE.

Factors that Increase the Odds of Being *FTC Extreme,* Rank-Ordered

High-Ranking Factors

PHEV	Tesla	Non-Tesla BEV
	"High" Contribution > 0.02	
P01. Saving money on fuel Very or Extremely important (vs. Not)	T01. Saving money on fuel more important	N01. Saving money on fuel Very or Extremely important (vs. Not/Slightly)
P02. Work charging availability Very or Extremely important (vs. Not)	T02. Work charging availability more important	N02. Carpool-lane access more important
P03. Carpool-lane access more important	T03. Carpool-lane access more important	N03. Age younger
P04. Charging availability other than home/work Very or Extremely important (vs. Not)	T04. Charging availability other than home/work more important	N04. Home charging availability Extremely important (vs. Not/Slightly)
P05. FTC incentive amount larger	T05. Home charging availability Extremely important (vs. Not) or Not important (vs. Slightly/Moderately)	
P06. Home charging availability Extremely important (vs. Not) or Not important (vs. Slightly)		

All factors significant ($p < 0.05$)

Factors that Increase the Odds of Being *FTC Extreme,* Rank-Ordered (cont.)

Medium- and Low-Ranking Factors

PHEV	Tesla	Non-Tesla BEV
"Medium" Contribution > 0.01		
P07. Make not Chevy nor Honda (vs. others)	T06. Racial/ethnic identification Asian (vs. white)	N05. Charging availability other than home/work more important
	T07. Vehicle performance more important	N06. Make not Chevrolet
	T08. Purchase price lower	N07. Vehicle performance Extremely important (vs. Not/Slightly)
"Low" Contribution < 0.01		
P08. Energy independence Extremely important	T09. Purchase quarter later in year	N08. No. of household vehicles more
P09. Purchase quarter later in year	T10. Tax filing status not single	N09. Purchase quarter later in year
P10. Educational attainment higher	T11 Number of previous EVs owned fewer	
P11. Purchase price lower	T12. Gender identification Male	
P12. Tax filing status Single (vs. Married Filing Separately)		
P13. Gender identification Male		

All factors significant ($p < 0.05$)

Conclusions & Recommendations

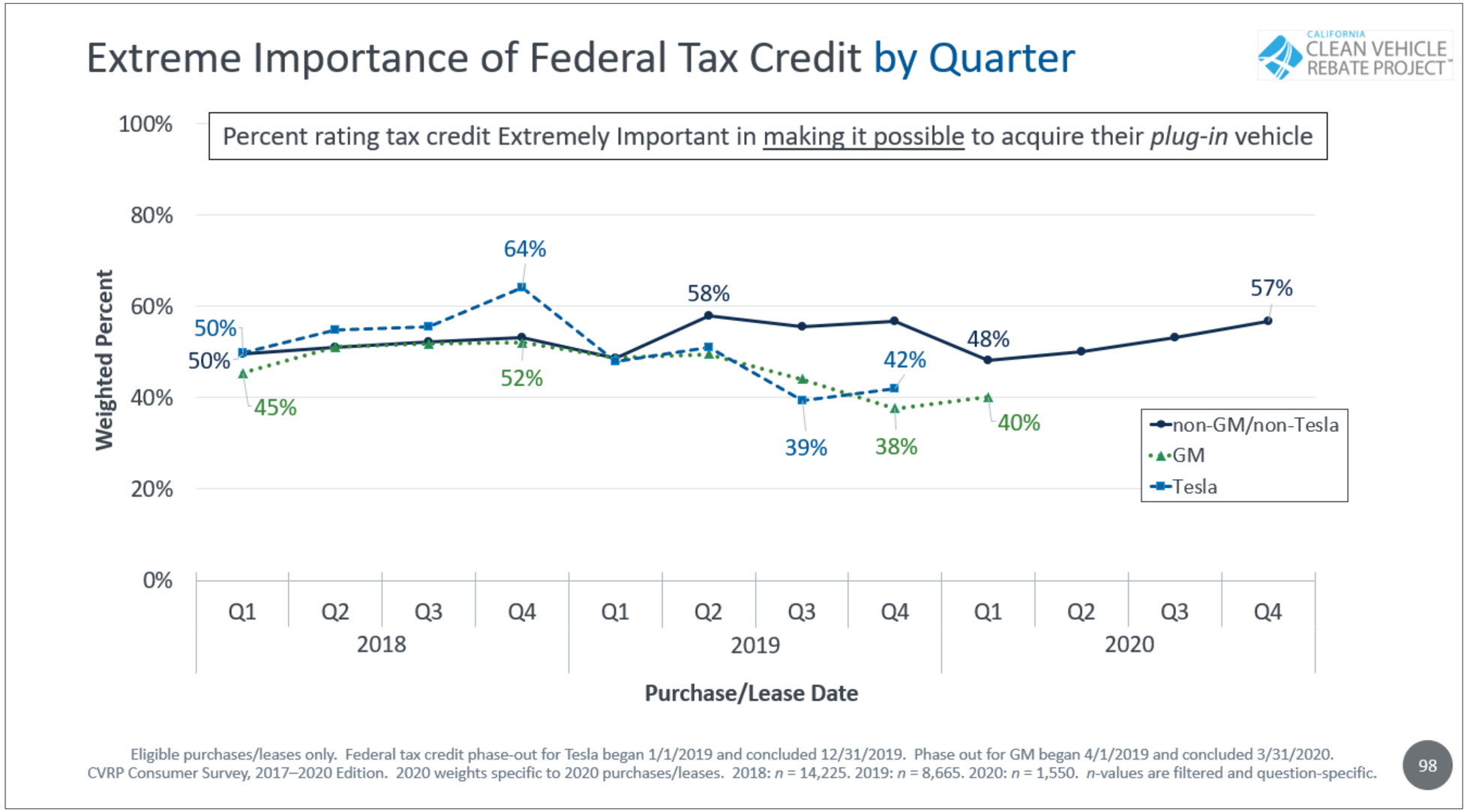
Conclusions & Recommendations for Outreach

- Level of initial interest in EVs not a significant factor → **FTC enabling consumers** with at least some interest, **not "converting" them to interest → outreach also needed**
- **Profile**
  - Fuel-/time-**savings oriented**; workplace/public/home **charging important** to realizing these benefits; also value **vehicle performance (BEV)**
  - Were distinguished by education (PHEV), Asian identity (Tesla), younger age and/or more vehicles (non-Tesla BEV) and/or male gender (PHEVs & Teslas, but very weakly)
    - Can use this profile to efficiently amplify FTC influence. Or do we want to try to change it?
- **Resonant messages** include financial savings, convenience benefits (e.g., carpool-lane access), energy independence (PHEVs), charging availability, and vehicle performance (BEV)
- **Messages lacking distinguishing resonance:** having solar, and the importance of environmental impacts, energy independence (BEVs), vehicle style, and the latest tech

Conclusions & Recommendations for FTC Design

- Solar and the importance of environmental impacts & new tech were *not* significant, but non-white race/ethnicity, younger age, and lower priced vehicles were → The FTC is **not simply** reinforcing stereotypical early EV adoption / **supporting free riders**
- The FTC was **highly influential to the majority** of consumers studied.
- FTC influence was *increasing* → **Too early to phase FTC out**
- Previous EV ownership not a major factor → **Don't limit benefit to a single purchase**
- FTC influence increases with credit amount → **FTC is not too big** (for consumers under CVRP's income cap)**, could be bigger** for some…
- Having low income either was not significant or *decreases* FTC influence → **FTC should not depend on tax liability**
- FTC influence increases as the time between purchase and tax refund shrinks → Discounting is important; **make FTC closer to the point of sale**
- FTC influence increases for lower-priced vehicles → **Limit benefit for luxury vehicles** and/or **increase benefit for lower-priced vehicles**

Next* Step: FTC Importance During Phase Down



* from: CVRP 2020 Data Brief: Incentive Influence

Next* Step: FTC Importance During Phase Down Findings

Summary & Select Findings: Rebate Influence

Context: program design and COVID-19 shaped impacts in 2020

- $60k MSRP cap and $500 decrease in standard rebate amounts as of Dec. 2019
- COVID-19 caused an anomalous year in several respects

2020 Incentive Influence:

CVRP Rebates

- 82% found the rebate an important enabler of their EV acquisition
- 38% would not have purchased/leased without it
  - 31% for Teslas, but 47% for PHEVs, 50% for non-Tesla BEVs, 66% for Increased Rebate recipients
- Rebate influence decreased from 2019 to 2020, primarily for Tesla consumers
- Tesla rebate influence decreases as MSRP increases
- Rebate influence decreases as income increases, particularly for Tesla
- Attractive offerings (including SUVs and Tesla products) have lower *Rebate Essentiality*

Federal-tax-credit (FTC)

- FTC influence more steady
- 50% of FTC-eligible CVRP consumers rated FTC an "Extremely Important" enabler
  - 54% for purchases, 42% for leases (often claimed by the leasing company)
- Data confirm influence decreased for Tesla and GM as FTC phased down and out
- 2019 FTC influence decreases above $50,000 MSRP
- Relative to 2019, 2020 influence increased for MSRP $30k–40k, but *decreased* for MSRP<$30k

99

* Excerpt from: CVRP 2020 Data Brief: Incentive Influence

Appendices & Additional Resources

Appendices

Introduction: Federal Tax Credit: Background

Up to $7,500 for the purchase or lease of a plug-in electric vehicle (PEV)*

- Credit amount decreases on the second calendar quarter after a manufacturer has sold 200,000…

Tesla Motors		1/1/10 to 12/31/18	1/1/19 to 6/30/19	7/1/19 to 12/31/19
 2012–19 Model S	EV	$7,500	$3,750	$1,875
 2016–19 Model X	EV	$7,500	$3,750	$1,875
 Model 3 Standard Range Plus	EV	$7,500	$3,750	$1,875
 2017–19 Model 3 Long Range	EV	$7,500	$3,750	$1,875
 2019 Model 3 Long Range AWD and AWD Performance	EV	$7,500	$3,750	$1,875
 2018–19 Model 3 Mid Range	EV	$7,500	$3,750	$1,875
 2008–11 Roadster	EV	$7,500	$3,750	$1,875
Chevrolet		1/1/10 to 3/31/19	4/1/19 to 9/30/19	10/1/19 to 3/31/20
 2017–19 Chevrolet Bolt EV	EV	$7,500	$3,750	$1,875
 2011–19 Chevrolet Volt	PHEV	$7,500	$3,750	$1,875
 2014–16 Chevrolet Spark EV	EV	$7,500	$3,750	$1,875

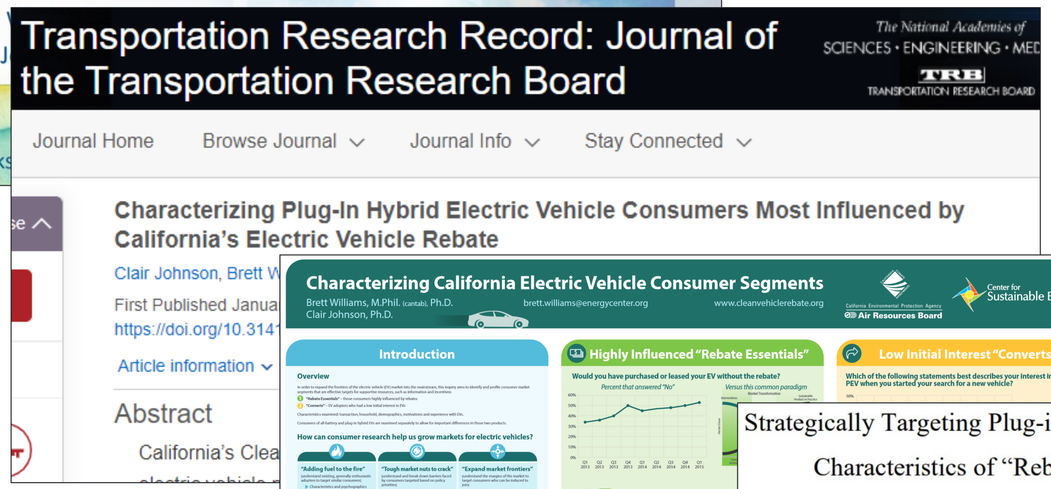
Images taken 8/16/19 from https://www.fueleconomy.gov/feg/taxevb.shtml

* Light-duty plug-in electric vehicles, including both plug-in hybrid EVs (PHEVs) and battery EVs (BEVs)

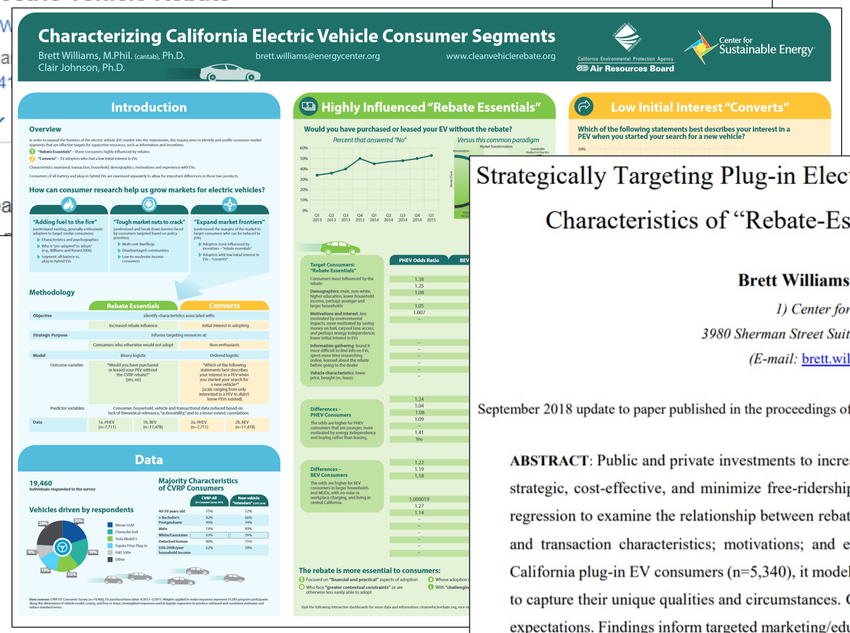
Previous Related CSE Work

Consumer Segmentation Work: Summary

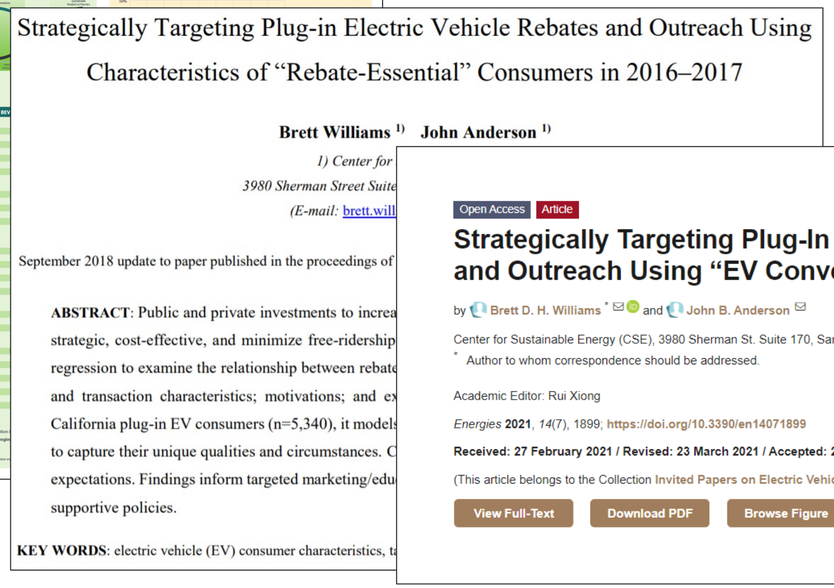
BECC Conference (Williams & Johnson 2016)



TRR journal article (Johnson and Williams 2017)



TRB poster (Williams and Johnson 2017)



EVS 31 paper (Williams & Anderson 2018)

Energies journal article (Williams & Anderson 2021)

Incentive Influence: Select Publications with Related Content

(reverse chronological, as of 5/2022)

- B.D.H. Williams, J.B. Anderson (2022, Jun.), Lessons Learned About Electric Vehicle Consumers Who Found the U.S. Federal Tax Credit Extremely Important in Enabling Their Purchase, for procs. 35th International Electric Vehicle Symposium and Exhibition (EVS35), AVERE.
- B.D.H. Williams (2022, Jun.), Targeting Incentives Cost Effectively: "Rebate Essential" Consumers in the New York State Electric Vehicle Rebate Program, for procs. 35th International Electric Vehicle Symposium and Exhibition (EVS35), AVERE.
- N. Pallonetti and B.D.H. Williams (2022, Jan.), Evaluating the Cost-Effectiveness of Greenhouse Gas Emission Reductions Associated with Statewide Electric Vehicle Rebate Programs in California and Massachusetts in 2019, for *International Energy Program Evaluation Conference 2022*.
- Williams, B. D. H. (2022, Jan.), Brief: PHEV Consumers Most Highly Influenced by the U.S. Federal Tax Credit. Clean Vehicle Rebate Project.
- B. D. H. Williams and J. B. Anderson (2021, Mar.), Strategically Targeting Plug-In Electric Vehicle Rebates and Outreach Using *"EV Convert"* Characteristics, *Energies*, vol. 14, no. 7, p. 1899.
- B.D.H. Williams, J.B. Anderson, A. Lastuka (2020, Sep.), Characterizing Plug-in Hybrid Electric Vehicle Consumers Who Found the U.S. Federal Tax Credit Extremely Important in Enabling Their Purchase, in: *33rd Electr. Veh. Symp.*, Electric Drive Transportation Association (EDTA), EVS33, and Zenodo, Portland OR.
- B.D. Williams, J. Orose, M. Jones, J.B. Anderson (2018, Oct.), Summary of Disadvantaged Community Responses to the Electric Vehicle Consumer Survey, 2013–2015 Edition. Clean Vehicle Rebate Project.
- B.D. Williams, J.B. Anderson (2018, Sep.), Strategically Targeting Plug-in Electric Vehicle Rebates and Outreach Using Characteristics of *"Rebate-Essential"* Consumers in 2016–2017, in: *31st Int. Electr. Veh. Symp.*, Society of Automotive Engineers of Japan, Inc., Kobe, Japan.
- C. Johnson, B.D. Williams, J.B. Anderson, N. Appenzeller (2017, Jun.), Evaluating the Connecticut Dealer Incentive for Electric Vehicle Sales, Center for Sustainable Energy (CSE).
- C. Johnson, B.D. Williams (2017, Jan.), Characterizing Plug-In Hybrid Electric Vehicle Consumers Most Influenced by California's Electric Vehicle Rebate, *Transp. Res. Rec*. 2628, 23–31.

Incentive Influence: Select Presentations with Related Content

(reverse chronological, as of 6/7/2022)

- CVRP 2020 Data Brief: Incentive Influence
- CARB Video: "Cost-Effectiveness of Greenhouse Gas Emission Reductions Associated with California's Clean Vehicle Rebate Project in 2019 (and 2020)," minutes 2:01-2:31. Slides.
- California Plug-in Hybrid EV Consumers Who Found the U.S. Federal Tax Credit Extremely Important in Enabling Their Purchase
- Data from Statewide Electric Vehicle Rebate Programs: Vehicles, Consumers, Impacts, and Effectiveness
- EV Purchase Incentives: Program Design, Outputs, and Outcomes of Four Statewide Programs with a Focus on Massachusetts
- What Vehicles Are Electric Vehicles Replacing and Why?
- Electric Vehicle Incentives and Policies
- Proposed FY 2019–20 Funding Plan: Final CVRP Supporting Analysis
- CVRP: Data and Analysis Update
- Cost-Effectively Targeting EV Outreach and Incentives to "*Rebate-Essential*" Consumers
- Electric Vehicle Rebates: Exploring Indicators of Impact in Four States
- Targeting EV Consumer Segments & Incentivizing Dealers
- Yale Webinar: "Supporting EV Commercialization with Rebates: Statewide Programs, Vehicle & Consumer Data, and Findings," 58 minutes. Slides.
- CVRP Income Cap Analysis: Informing Policy Discussions
- Characterizing California Electric Vehicle Consumer Segments

Data Context:
Program Design & Market Dynamics

U.S. Electric Vehicle Consumer Incentive Landscape

Federal Incentive

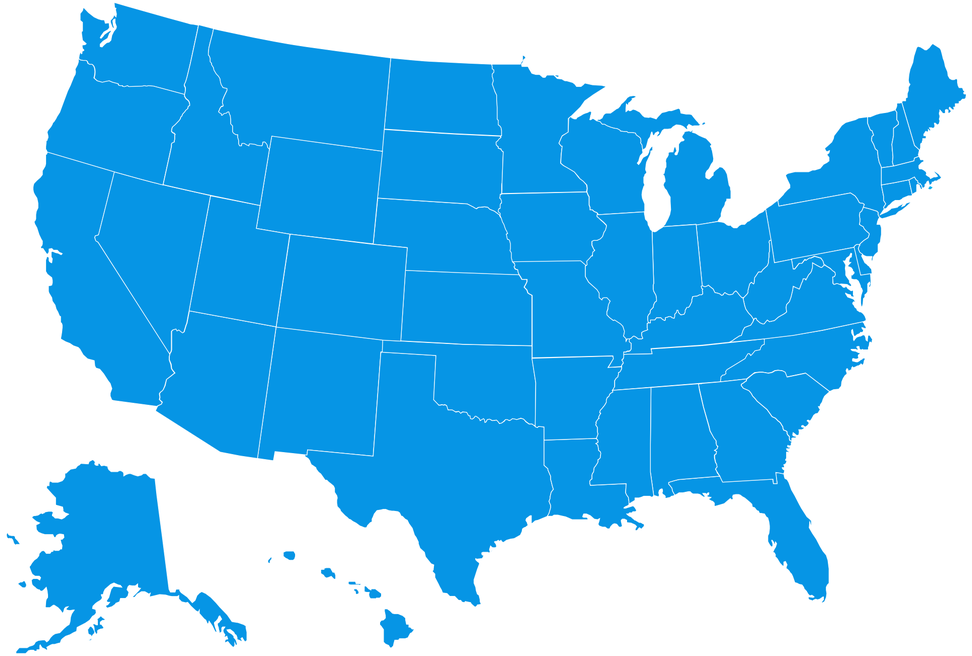
- Up to $7,500 as an income tax credit

State Incentives

- Post-purchase rebates
- Point-of-sale cash incentives
- Loan assistance

Local Incentives

- Additional cash incentives
- Scrap-and-replace programs



Rebate Amounts for Individuals In Effect During Study Period

CALIFORNIA CLEAN VEHICLE REBATE PROJECT™

	as of Mar. 2010	as of Jun. 2011	as of Jul. 2013	as of Jun. 2014	as of Mar. 2016	as of Nov. 2016	as of Dec. 2019
Fuel-Cell EVs 	$3,000–$5,000 ‡	$1,500–$2,500 ‡	$2,500	$5,000	$5,000 *	$5,000 **	$4,500 ***
Battery EVs † 	$3,000–$5,000 ‡	$1,500–$2,500 ‡	$2,500	$2,500	$2,500 *	$2,500 **	$2,000 ***
Plug-in Hybrid EVs 	$3,000	$1,500	$1,500	$1,500	$1,500 *	$1,500 **	$1,000 ***
Zero-Emission Motorcycles 	$1,500	$900	$900	$900	$900	$900	$750
Neighborhood EVs	$1,500	$900	$900	$900	$900	None eligible	None eligible
Commercial Zero-Emission Vehicle	$20,000						

† Includes range-extended battery electric vehicles.
‡ Amounts varied by ZEV type. For definitions, see CCR 1962.1.
* Lower-income consumers eligible for an additional $1,500.
** Lower-income consumers eligible for an additional $2,000.
*** Lower-income consumers eligible for an additional $2,500.

Program Design Shapes Outcomes

In effect during study period

CALIFORNIA CLEAN VEHICLE REBATE PROJECT™

as of Mar. 2010

- Incentive stacking permitted
- 36-month ownership requirement
- Rebates per year limit = 20

as of Dec. 2013

- Rebates per year limit = 2

as of May 2014

- 18-month application window

as of Dec. 2014 / Jan. 2015

- 30-month ownership requirement (retroactive)
- Total rebate limit = 2

as of Mar. 2016

- $250k–$500k income cap (PEVs)
- +$1,500 for income-qualified households (≤ 300% FPL*), excl. ZEMs

as of Nov. 2016

- $150k–$300k income cap (PEVs)
- +$2,000 for income-qualified households (≤ 300% FPL*), excl. ZEMs
- ≥ 20 UDDS electric miles

as of Jan. 2018

- $150k–$300k income cap on stacking HOV decal
  - (only binding on FCEVs)
- Rebate Now SD County preapproval pilot with point-of-sale option

as of Jan. 2019

- Stacking with CVAP grant not permitted (retroactive)

as of Dec. 2019

- Base MSRP ≤ $60k (PEVs)
- ≥ 35 UDDS electric miles
- +$2,500 † for income-qualified households (≤ 300% FPL*), excl. ZEMs
- 3-month application window ‡
- Total rebates limit = 1 §

as of Apr. 2020

- Stacking with CVAP grant permitted

as of Jan. 2021

- +$2,500 for income-qualified households (≤ 400% FPL*), excl. ZEMs

as of Apr. 2021

- ≥ 30 U.S. EPA electric miles (45 UDDS)
- Rebate Now preapproval option limited to income-qualified households, expanded to include SJ Valley

* FPL = Federal Poverty Level.

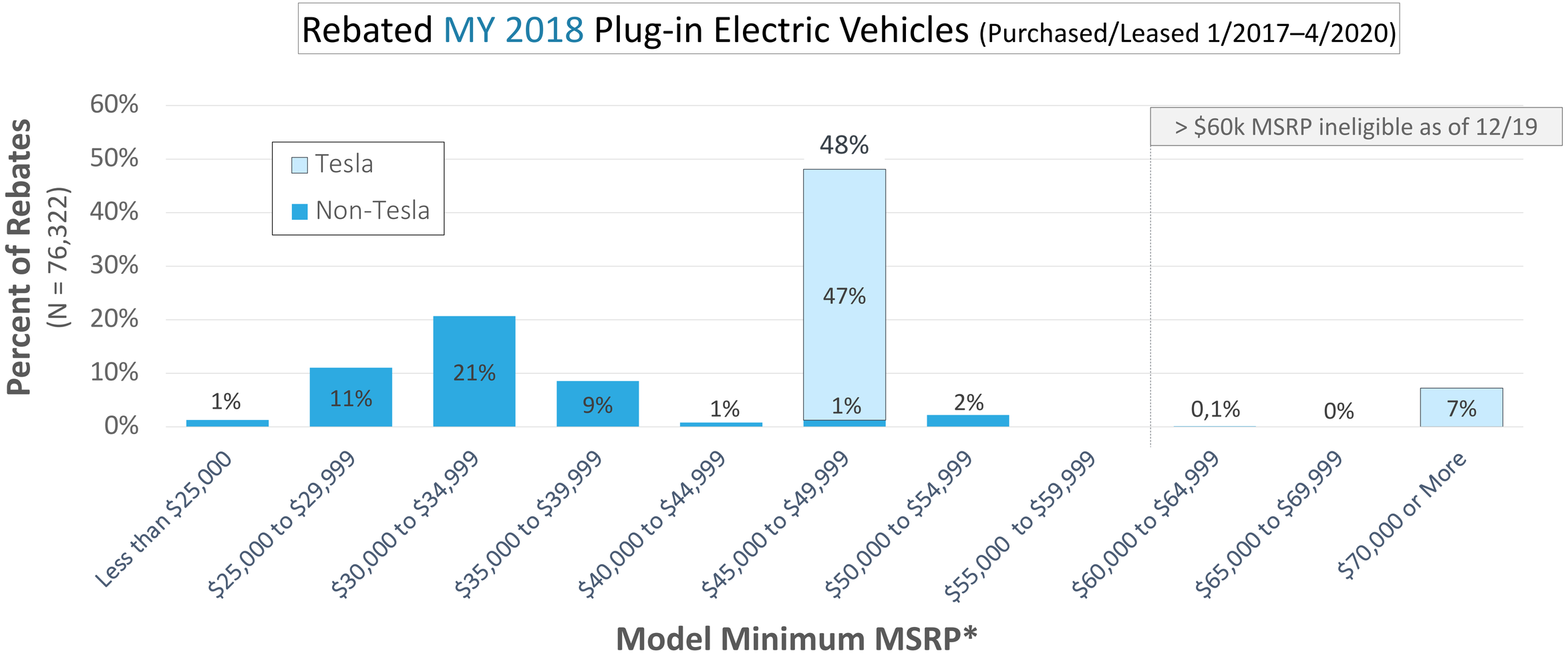
† Change due to $500 decrease in standard rebate amounts.

‡ COVID exemptions on application window effectively delayed implementation until 3/20/2021.

§ A second rebate can be approved for a FCEV if the first rebate was for a PEV.

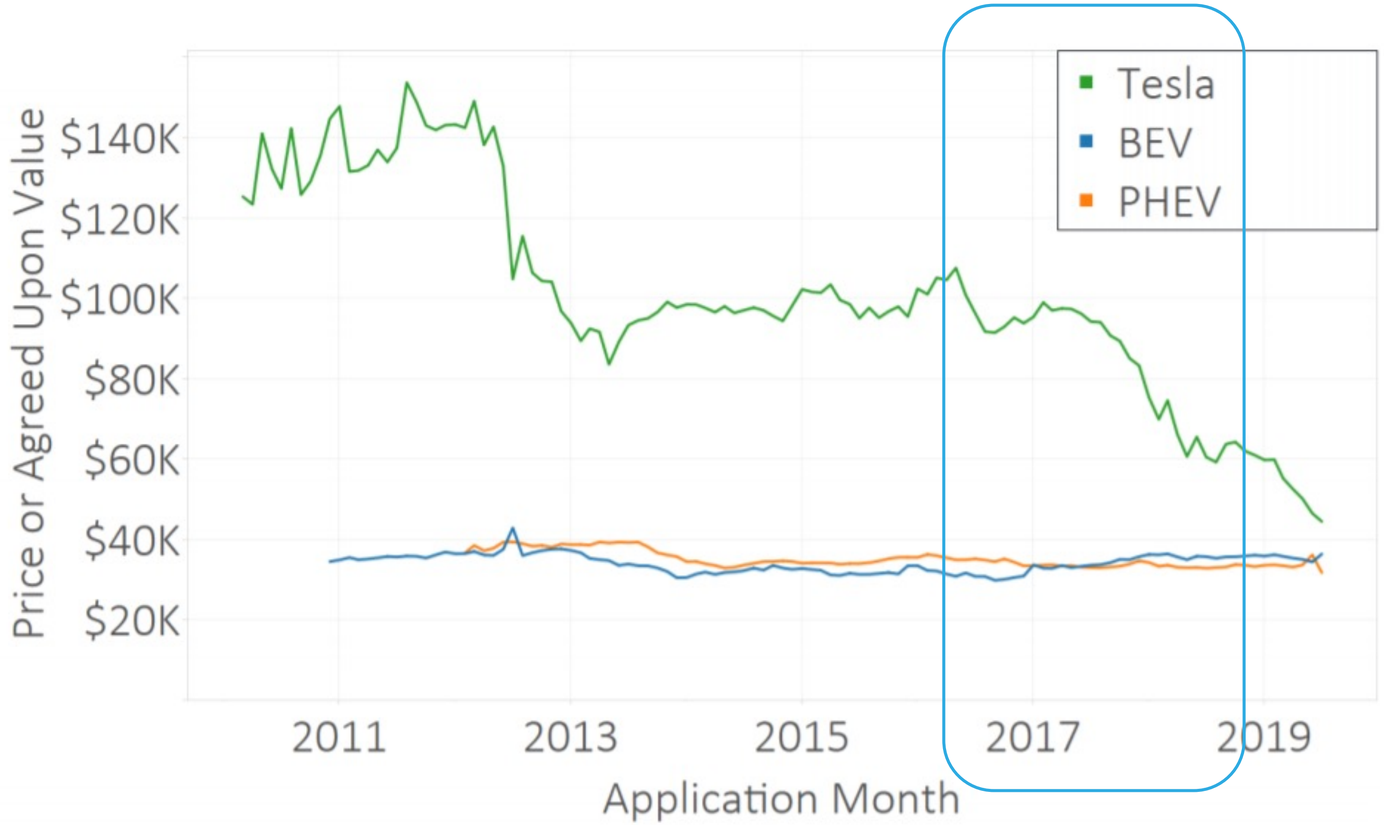
Moderately-Priced Vehicles Received Most Rebates

(especially non-Tesla)



*Each vehicle was assigned the minimum Manufacturer's Suggested Retail Price (MSRP) for that model on fueleconomy.gov and does not reflect sale price. Where MY 2018 MSRPs were unavailable, MY'17 MSRPs (Chevrolet Volt & Bolt EV) or MY'19 MSRP (Kia Soul EV) were used.
All Tesla Model 3's were assigned an MSRP of $49k (that of the predominantly available model variant at the time, the Long Range).

Average Rebated-Vehicle Purchase Price Remains Steady for non-Tesla Vehicles



As of 7/12/2019

37

Slide 37 from: https://cleanvehiclerebate.org/eng/content/proposed-fy-2019%E2%80%9320-funding-plan-final-cvrp-supporting-analysis

Data: CA Consumer Survey Data: Plug-in EVs*
(Shows Rebates to Individuals Only)

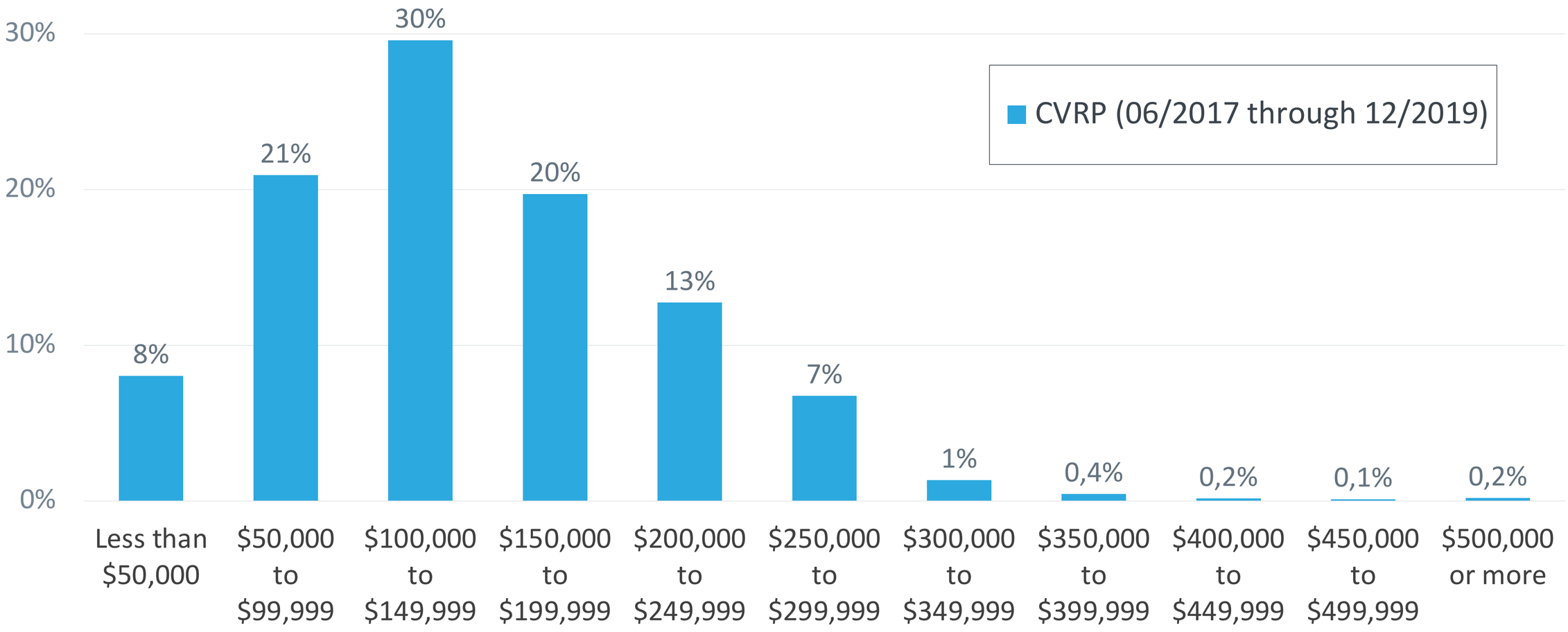
	2013–2015 Edition	2015–2016 Edition	2016–2017 Edition	2017–2019 Edition	Total
Vehicle Purchase/ Lease Dates	Sep. 2012 – May 2015	April 2015 – May 2016	May 2016 – May 2017	June 2017 – Dec. 2019	Sep. 2012 – Dec. 2019
Survey Responses (total n)**	19,460	11,611	8,957	25,615	65,643
Program Population (N)***	91,081	45,685	46,839	149,032	332,637

* PEVs include PHEVs and BEVs.

** Subsequently weighted to represent the program population along the dimensions of vehicle category, vehicle model, buy vs. lease, and county.

*** Some values may not be exact/comparable due to evolving weighting practices

Distribution of Plug-in EV *Rebates* by Household Income



CVRP Consumer Survey: 2017–2019 edition (June 2017 through December 2019 purchase/lease dates). Question weighted n = 22,529.

Setting an Appropriate Baseline: U.S. Car Buyers Are Different Than the Population

	 **All** U.S. Population (Census 2018)		**New-Vehicle Buyers** U.S. MYs 2016–17 (2017 NHTS)
Selected solely White/Caucasian	61%	<<	74%
≥ 50 Years Old	35%	<<	51%
≥ Bachelor's Degree	23%	<<<<	57%
Own Residence*	63%	<<	77%
≥ $75k HH Income*	40%	<<<	62%
Selected Male	49%	≈	51%

- New-car buyers are different on almost every dimension.
- More frequently:
  - White
  - Older
  - Degree holders
  - Residence owners
  - Higher income
- *Some* of the difference explained by driving or buying age
- The rest may be due in part to ***social inequities***

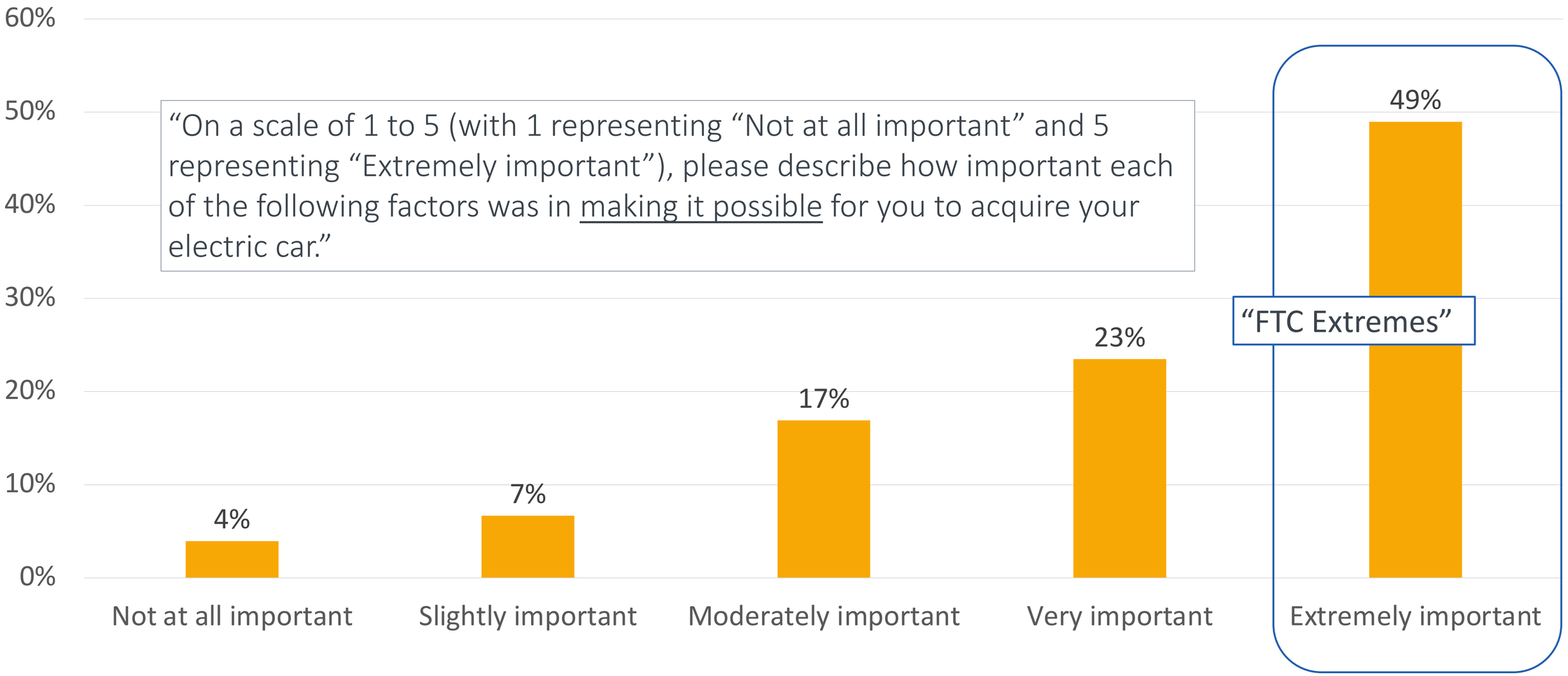
** Based upon household level data.*

Census 2018*: 2014–2018 American Community Survey, PUMS.* NHTS 2017 is *weighted to represent population, not new-vehicle subset. New-vehicle buyers identified based on within-100-mile match between odometer and miles driven while owned. "Prefer not to answer," "I don't know," and similar responses are excluded throughout.*

FTC Extremes: Additional Detail

Importance of Federal Tax Credit for Plug-in EVs

CY 2019*



* Note: federal tax credit began phasing out for Tesla and GM in 2019

Question weighted n = 2,033

Consumer Survey Data
(shows rebates to individuals only)

	CALIFORNIA CLEAN VEHICLE REBATE PROJECT™	MOR-EV Massachusetts Offers Rebates for Electric Vehicles	CHEAPR Connecticut Hydrogen and Electric Automobile Purchase Rebate	NEW YORK STATE	Total
Vehicle Purchase/ Lease Dates	Sep. 2012* – Dec. 2019	Jun. 2014 – Apr. 2020	May 2015 – Sep. 2018	Mar. 2017 – Jul. 2018	Sep. 2012* – Apr. 2020
Survey Responses (total n)**	66,902	6,616	1,565	1,808	76,891
Program Population (N)***	339,200	16,100	3,500	8,600	367,400

Includes fuel-cell EVs (CVRP only).

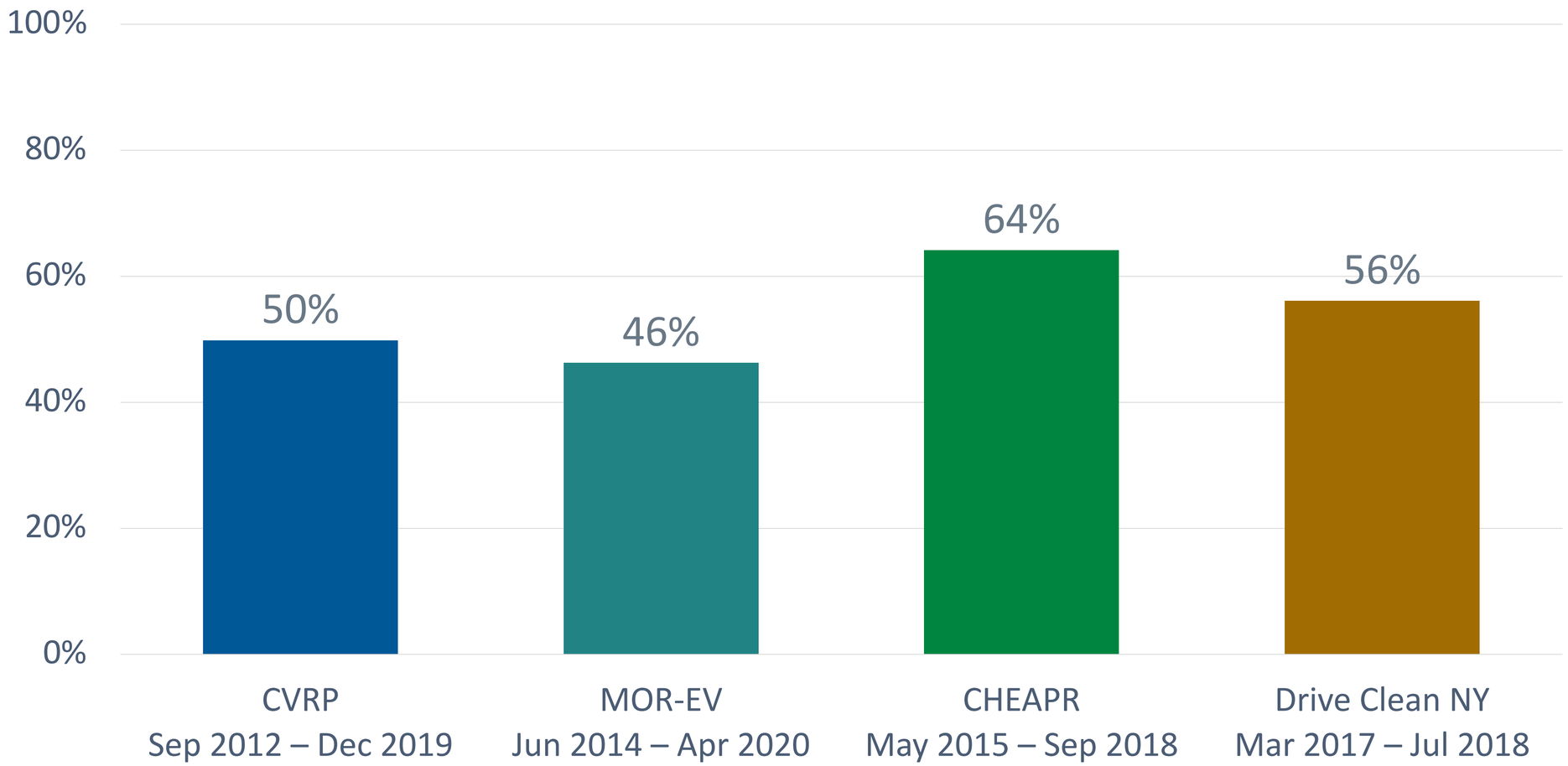
*Two fuel-cell EVs rebated by CVRP with purchase/lease dates from Dec. 2010 – Sep. 2012 are included.

** Subsequently weighted to represent the program population along the dimensions of vehicle category, model, buy vs. lease, and county.

*** Small numbers of rebated vehicles are not represented in the time frames due to application lags. Rounded to nearest 100.

Percent Rating the Federal Tax Credit "Extremely Important"

("…in making it possible" to acquire *plug-in* EVs*)*



Overall datasets: 75,632 total survey respondents weighted to represent 360,800 rebate recipients.

Factors that Increase the Odds of Being a PHEV *FTC Extreme,* Rank-Ordered

(Logistic Regression and Dominance Analysis)

Variable Description	Odds-Increasing Examples	Average of Pseudo-R^2 Average Contributions	Rank
Importance of saving money on fuel	Very or extremely important (vs. Not)	0.045	1
Importance of charging availability at work	Very or extremely important (vs. Not)	0.039	2
Importance of carpool/HOV lane access	More important	0.027	3
Importance of charging availability at/near destinations other than home and work	Very or extremely important (vs. Not)	0.027	4
FTC incentive amount ($1,000s)	Larger amount	0.022	5
Importance of charging availability at home	Extremely important (vs. Not) Not important (vs. Slightly)	0.020	6
Vehicle make	Not Chevrolet nor Honda (vs. others)	0.011	7
Importance of increased energy independence	Extremely important	0.007	8
Purchase quarter	Later in year	0.006	9
Education	Higher educational attainment	0.005	10
Purchase price	Lower price	0.004	11
Tax filing status	Single (vs. Married filing separately)	0.003	12
Gender	Male	0.001	13

Summary of Statistically Significant Findings: PHEVs

The odds of being most highly influenced by the FTC to adopt increase with:

1. **Practical motivations:** Placing high importance on saving money on fuel; workplace, public, and home charging; carpool lane access (and energy independence)
2. **Larger benefit**: Receiving a larger tax credit
3. **Transaction characteristics:** Purchasing later in the year (closer to realizing benefit), lower-priced vehicles, non-Chevy/non-Honda PHEVs
4. **Demographics:** High educational attainment, single tax filing (vs. married filing separately), male

Controlling factors / Notably not significant:

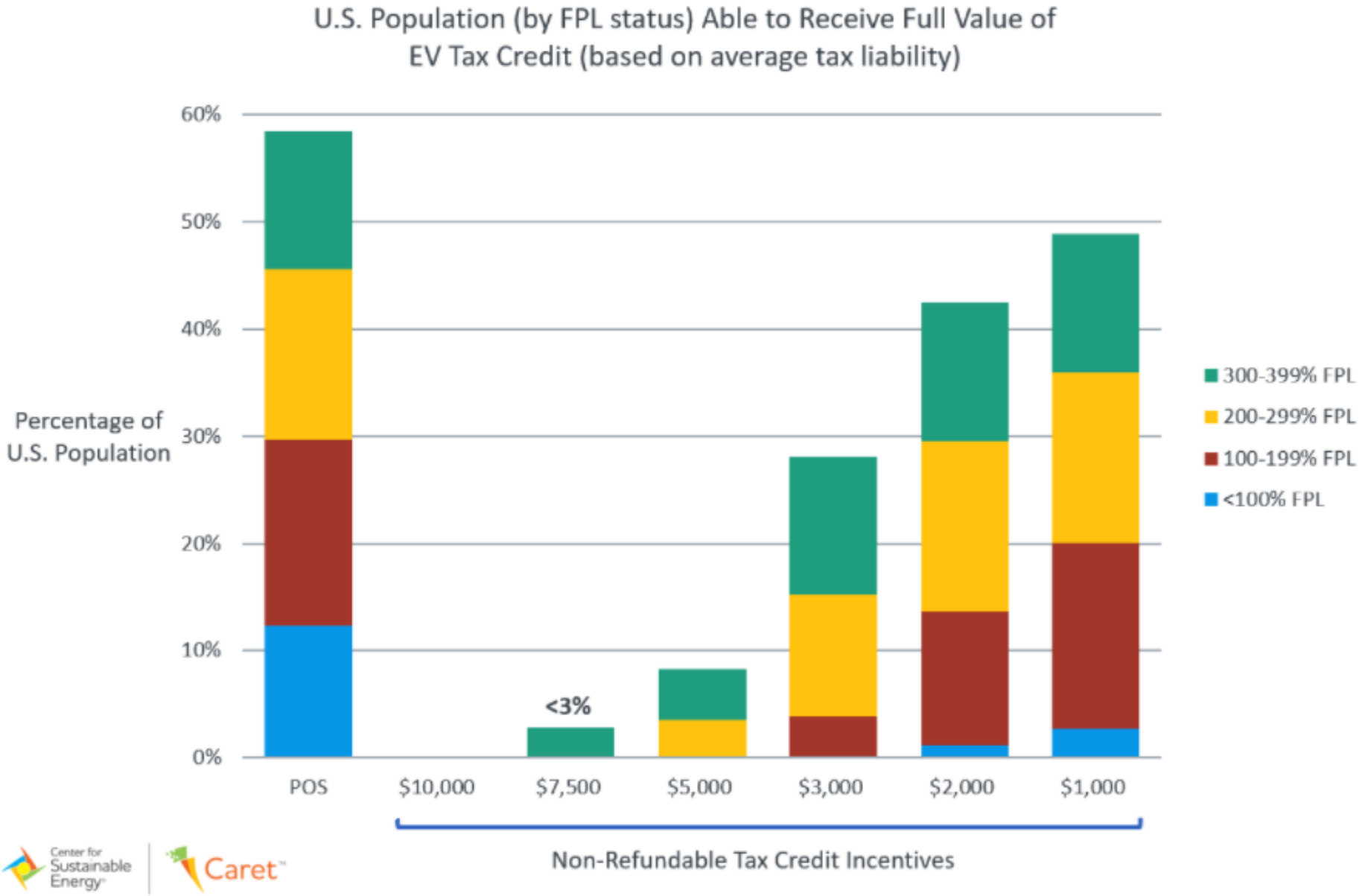
- Age, race/ethnicity, ***income***, household size, number of vehicles or drivers, ***previous EV ownership***, housing type or ownership, residential solar, region, ***importance of environmental impacts***, convenience of charging, vehicle performance, or desire for new technology, ***initial interest in an EV***

Caveats

- This work is centered on consumers who overcame their barriers to adoption, purchased/leased an EV, and participated in CVRP.
- Extrapolating these findings should be done with caution. Additional research is required to understand consumers who have not overcome their barriers to acquiring an EV.

Using the Findings

- Descriptive stats help us better understand rebated adopters and the *FTC Extreme* segment
- Logistic regressions and dominance analysis rank-order distinguishing predictors, telling us where to focus first



https://energycenter.org/thought-leadership/blog/how-make-evs-affordable-more-consumers

Additional Resources

Select Publications (Reverse Chronological, as of 5/2022)

- B.D.H. Williams, J.B. Anderson (2022, Jun.), Lessons Learned About Electric Vehicle Consumers Who Found the U.S. Federal Tax Credit Extremely Important in Enabling Their Purchase, for procs. *35th International Electric Vehicle Symposium and Exhibition (EVS35*), AVERE.
- B.D.H. Williams (2022, Jun.), Targeting Incentives Cost Effectively: "Rebate Essential" Consumers in the New York State Electric Vehicle Rebate Program, for procs. *35th International Electric Vehicle Symposium and Exhibition (EVS35),* AVERE.
- B.D.H. Williams (2021, Oct. [posted in 2022]), An Electric-Vehicle Consumer Segmentation Roadmap: Strategically Amplifying Participation in the New York Drive Clean Rebate Program, NYSERDA Report 21-30.
- Williams, B. D. H. (2022, Jan.), Brief: PHEV Consumers Most Highly Influenced by the U.S. Federal Tax Credit. Clean Vehicle Rebate Project
- N. Pallonetti and B. D. H. Williams (2021, Jul.), "Refining Estimates of Fuel-Cycle Greenhouse-Gas Emission Reductions Associated with California's Clean Vehicle Rebate Project with Program Data and Other Case-Specific Inputs," *Energies*, vol. 14, no. 15.
- B. D. H. Williams and J. B. Anderson (2021, Mar.), "Strategically Targeting Plug-In Electric Vehicle Rebates and Outreach Using '*EV Convert*' Characteristics," *Energies*, vol. 14, no. 7, p. 1899.
- S. Hardman, P. Plötz, G. Tal, J. Axsen, E. Figenbaum, P. Jochem, S. Karlsson, N. Refa, F. Sprei, B.D. Williams, J. Whitehead, B. Witkamp (2019), Exploring the Role of Plug-In Hybrid Electric Vehicles in Electrifying Passenger Transportation, International EV Policy Council, UC Davis Plug-in Hybrid and Electric Vehicle Research Center.
- B.D. Williams, J. Orose, M. Jones, J.B. Anderson (2018, Oct.), Summary of Disadvantaged Community Responses to the Electric Vehicle Consumer Survey, 2013–2015 Edition. Clean Vehicle Rebate Project.
- B.D. Williams, J.B. Anderson (2018, Sep.), Strategically Targeting Plug-in Electric Vehicle Rebates and Outreach Using Characteristics of "*Rebate-Essential*" Consumers in 2016–2017, in: *31st Int. Electr. Veh. Symp.*, Society of Automotive Engineers of Japan, Inc., Kobe, Japan.
- C. Johnson, B.D. Williams, J.B. Anderson, N. Appenzeller (2017, Jun.), Evaluating the Connecticut Dealer Incentive for Electric Vehicle Sales, Center for Sustainable Energy (CSE).
- C. Johnson, B.D. Williams (2017, Jan.), Characterizing Plug-In Hybrid Electric Vehicle Consumers Most Influenced by California's Electric Vehicle Rebate, *Transp. Res. Rec*. 2628, 23–31.

Select Presentations & Videos (Reverse Chronological, as of 6/2022)

- CVRP 2020 Data Brief: Incentive Influence
- CARB Video: "CVRP 2020 Data Brief: Consumer Characteristics," time 1:05:43–1:26:09. Slides.
- CARB Video: "Cost-Effectiveness of Greenhouse Gas Emission Reductions Associated with California's Clean Vehicle Rebate Project in 2019 (and 2020)," time 2:01-2:31. Slides.
- California Plug-in Hybrid EV Consumers Who Found the U.S. Federal Tax Credit Extremely Important in Enabling Their Purchase
- Data from Statewide Electric Vehicle Rebate Programs: Vehicles, Consumers, Impacts, and Effectiveness
- CVRP CY 2019 Data Brief: Vehicle Replacement & Incentive Influence
- CVRP Data Brief: MSRP Considerations
- EV Purchase Incentives: Program Design, Outputs, and Outcomes of Four Statewide Programs with a Focus on Massachusetts
- What Vehicles Are Electric Vehicles Replacing and Why?
- Electric Vehicle Incentives and Policies
- Proposed FY 2019–20 Funding Plan: Final CVRP Supporting Analysis
- CVRP: Data and Analysis Update
- Cost-Effectively Targeting EV Outreach and Incentives to "*Rebate-Essential*" Consumers
- Electric Vehicle Rebates: Exploring Indicators of Impact in Four States
- Targeting EV Consumer Segments & Incentivizing Dealers
- Yale Webinar: "Supporting EV Commercialization with Rebates: Statewide Programs, Vehicle & Consumer Data, and Findings," 58 minutes. Slides.
- CVRP Income Cap Analysis: Informing Policy Discussions

Recommended citation:

Williams, B.D.H., (2022, June). Presentation: “Lessons Learned About Electric Vehicle Consumers Who Rated the U.S. Federal Tax Credit “Extremely Important” in Enabling Their Purchase,” for the 35th International Electric Vehicle Symposium (EVS35), AVERE, Oslo.

brett.williams@energycenter.org

EVS35
OSL2022

CleanVehicleRebate.org

Center for Sustainable Energy™

CALIFORNIA CLIMATE INVESTMENTS
Cap and Trade Dollars at Work

CALIFORNIA AIR RESOURCES BOARD