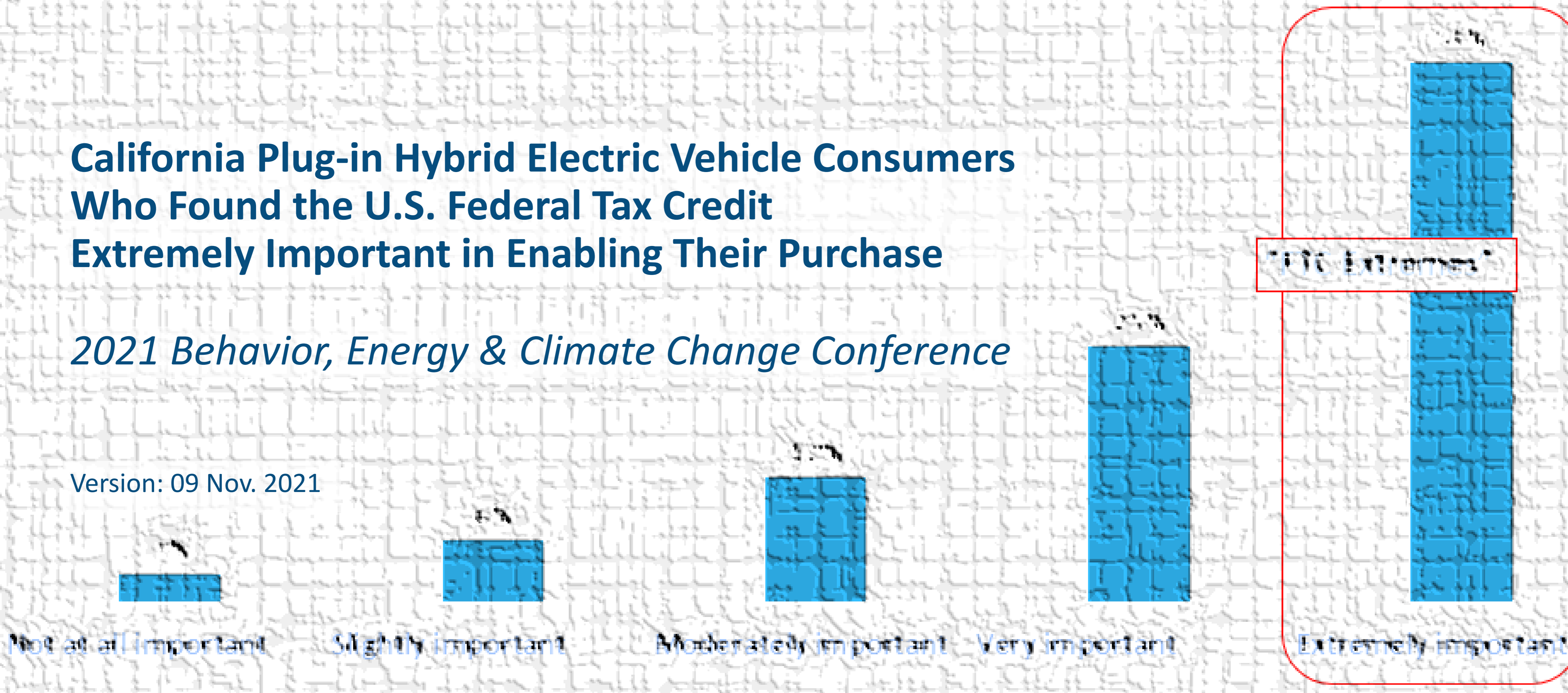# California Plug-in Hybrid Electric Vehicle Consumers Who Found the U.S. Federal Tax Credit Extremely Important in Enabling Their Purchase

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with thanks to John Anderson, Amy Lastuka, and Keir Havel at CSE

CALIFORNIA
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Research Description

Purpose

- Identify and rank-order characteristics of consumers most highly enabled by the electric-vehicle (EV) federal tax credit (FTC) to adopt
- Improve understanding of past impacts of FTC & calibrate future expectations
- Optimize strategic targeting of FTC and other supportive public resources

Approach

- Data prep and filtering (e.g., purchases only), descriptive analysis, logistic regression, and dominance analysis
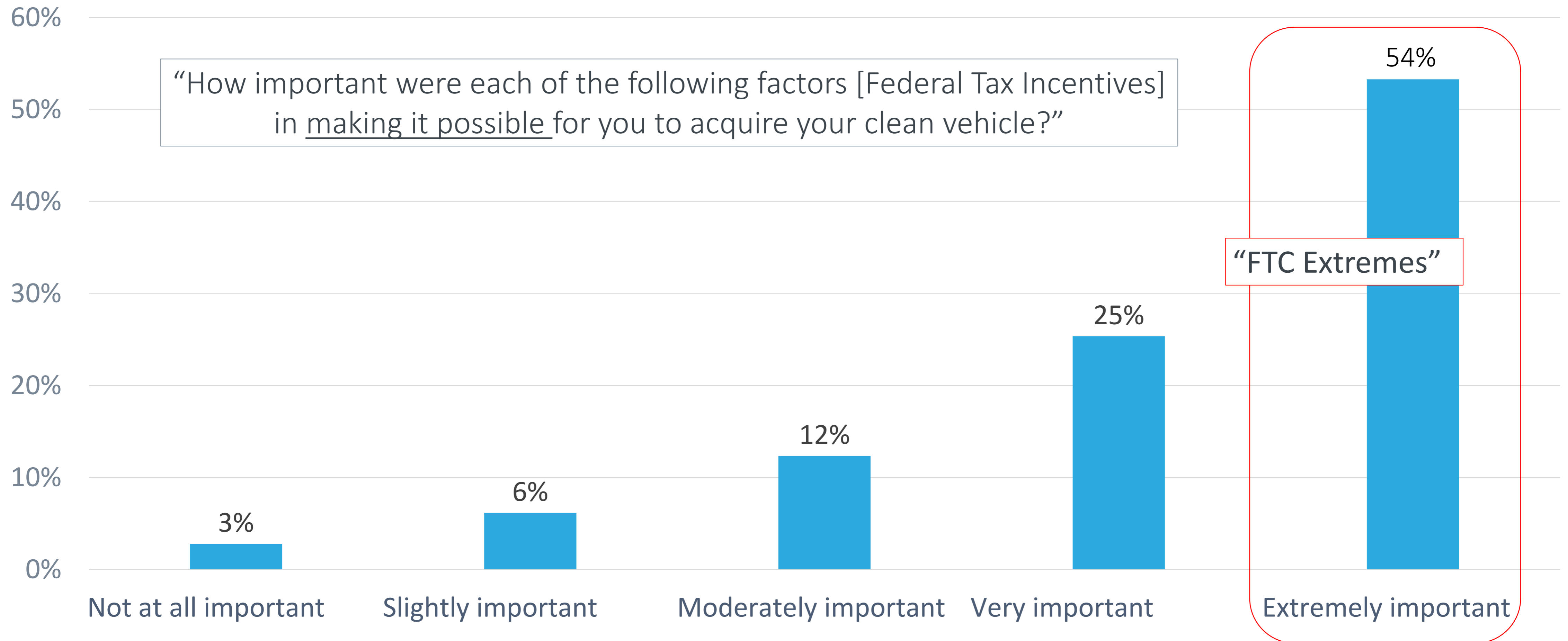
Contributions

- First characterization of *FTC Extremes*
- Develops the initial consumer-segmentation methodology considerably further
- More recent market data: 2017–2018 purchases/leases
  - previous consumer segmentations: 2013–2017

Data – Overall

Purchase or Lease Dates	1 Nov. 2016 –31 Dec. 2018
Program Participants	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%**

B.D.H. Williams, J.B. Anderson, A. Lastuka, 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., EDTA, EVS33, and Zenodo, Portland OR, 2020.

Extreme Importance of Federal Tax Credit for Plug-in EVs
Consumer Survey, 6/2017–12/2018

"How important were each of the following factors [Federal Tax Incentives] in <u>making it possible</u> for you to acquire your clean vehicle?"

"FTC Extremes"

- Not at all important: 3%
- Slightly important: 6%
- Moderately important: 12%
- Very important: 25%
- Extremely important: 54%
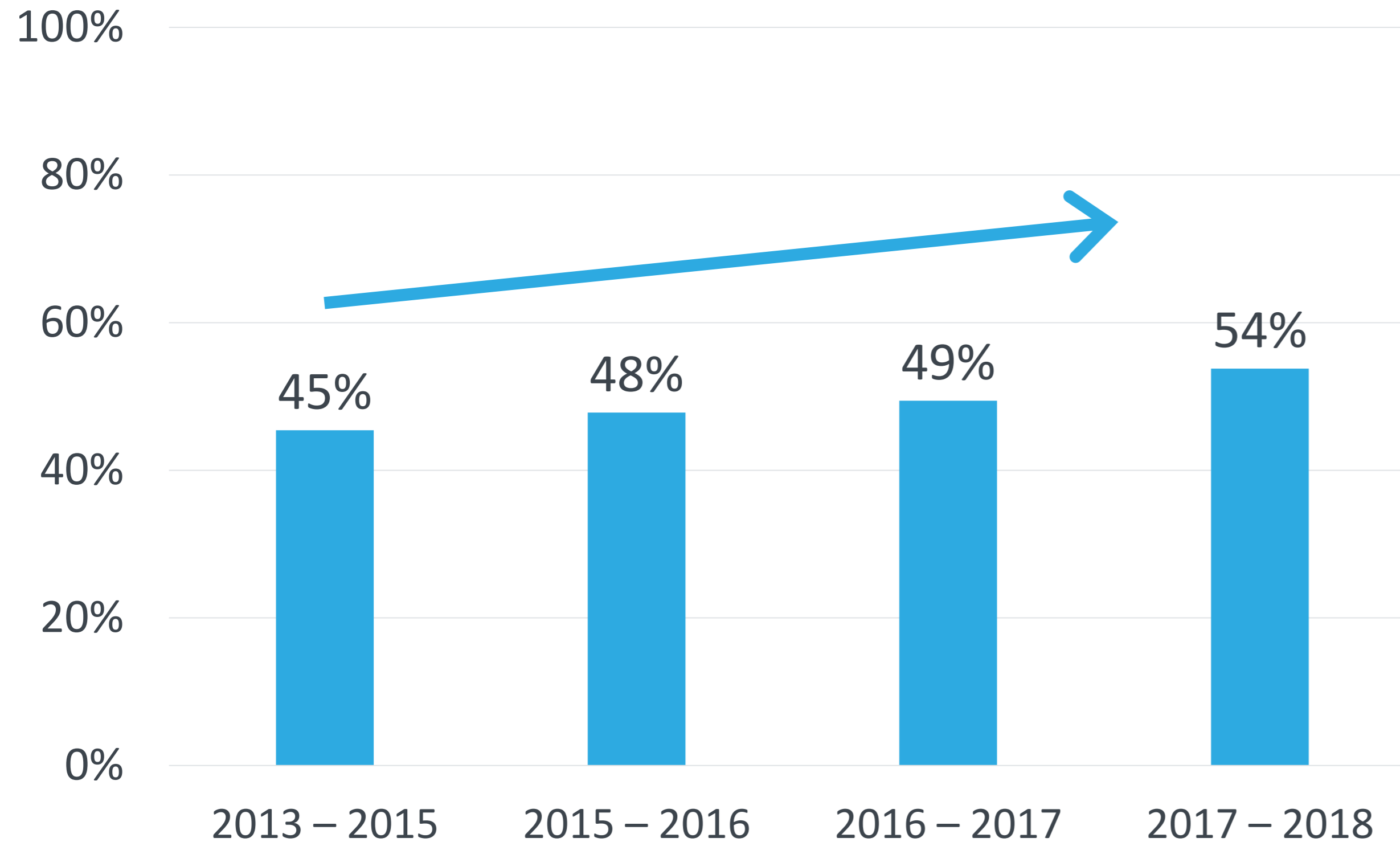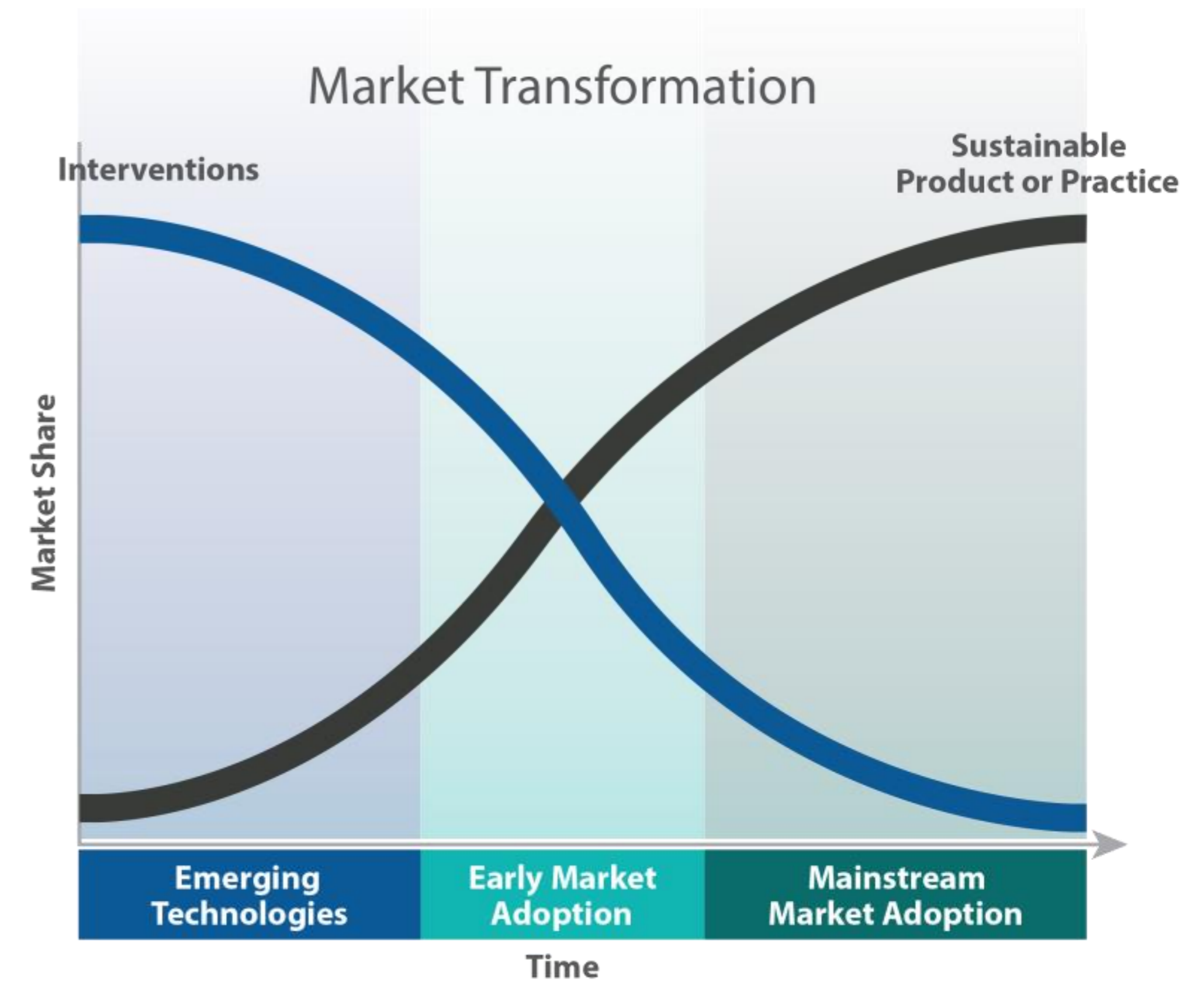
Weighted n = 17,101

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

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

Bar chart data (Fed Tax Incentive Extreme Importance):
- 2013 – 2015: 45%
- 2015 – 2016: 48%
- 2016 – 2017: 49%
- 2017 – 2018: 54%

Market Transformation diagram — Interventions, Sustainable Product or Practice; Market Share vs Time; Emerging Technologies, Early Market Adoption, Mainstream Market Adoption

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

Percent Rating the Federal Tax Credit "Extremely Important"

("...in <u>making it possible</u>" to acquire plug-in EVs): CA, MA, CT, NY
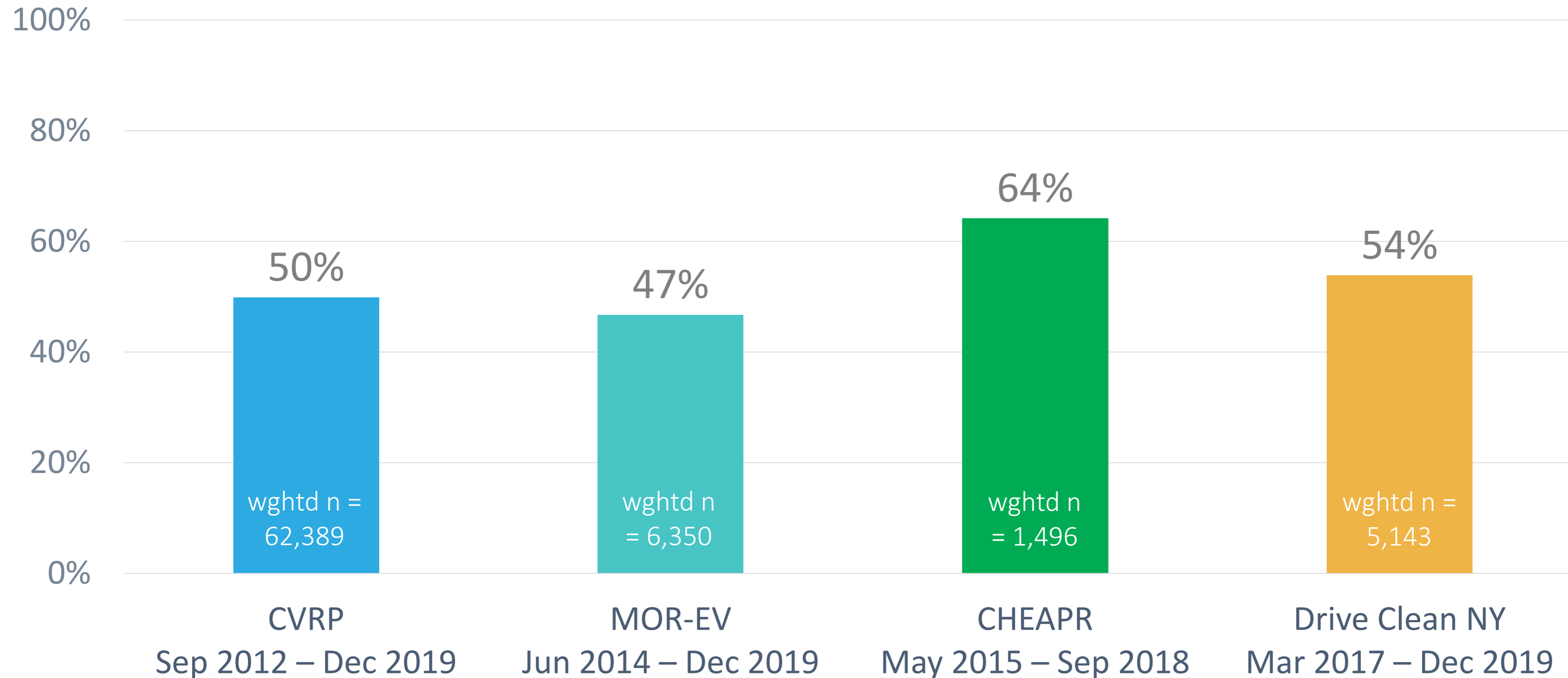
Weighted n values are question-specific.
Overall datasets: 80,557 total survey respondents weighted to represent 380,700 rebate recipients.

Summary of *FTC Extreme* Characteristics
(Weighted Descriptive Results)

	PHEV *FTC Extremes*	CA New-Vehicle Buyers
	Purchases 11/16–12/18 (weighted *n*=2,213)	Model Years 2016–17 (2017 NHTS, CA add-on*)
Selected only White/Caucasian	51% ^	51%
50+ years old	50% ^	46%
≥ $100k HH income	67% ^	56%
Own residence	81%	63%
Selected male	70%	50%
Bachelor's degree or more in HH	82% ^	58%*

"Prefer not to answer," "I don't know," and similar responses are excluded.

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

^ Significant difference ($p < 0.05$) between *PHEV FTC Extremes* and PHEV consumers *without* extreme FTC importance.

Summary of *FTC Extreme* Characteristics
(Weighted Descriptive Results)

	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*)
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%
Bachelor's degree or more in HH	82% ^	n.a.	58%*

"Prefer not to answer," "I don't know," and similar responses are excluded.

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

^ Significant difference ($p < 0.05$) between *PHEV FTC Extremes* and PHEV consumers *without* extreme FTC importance.

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-R² 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*

Conclusions & Recommendations

for FTC Design:

- FTC influence was *increasing* → **Too early to phase FTC out**

- Previous EV ownership not a significant 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 particularly low income *decreases* FTC influence → **FTC should not depend on tax liability**

- FTC influence increases with purchase quarter → 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**

for FTC 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:** Thru 2018, **PHEV** *FTC Extremes* were practically minded, MPG-/fuel-/time-*savings oriented*; workplace and other **charging important** to realizing these benefits; **energy independence** may resonate; similar to other incentives, distinguished by education and male gender (but very weakly).
  - Can use this profile to efficiently amplify PHEV FTC influence. Or do we want to try to change it?

Characterizing Plug-in Hybrid Electric Vehicle Consumers Who Found the U.S. Federal Tax Credit Extremely Important in Enabling Their Purchase

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U.S. Population (by FPL status) Able to Receive Full Value of EV Tax Credit (based on average tax liability)
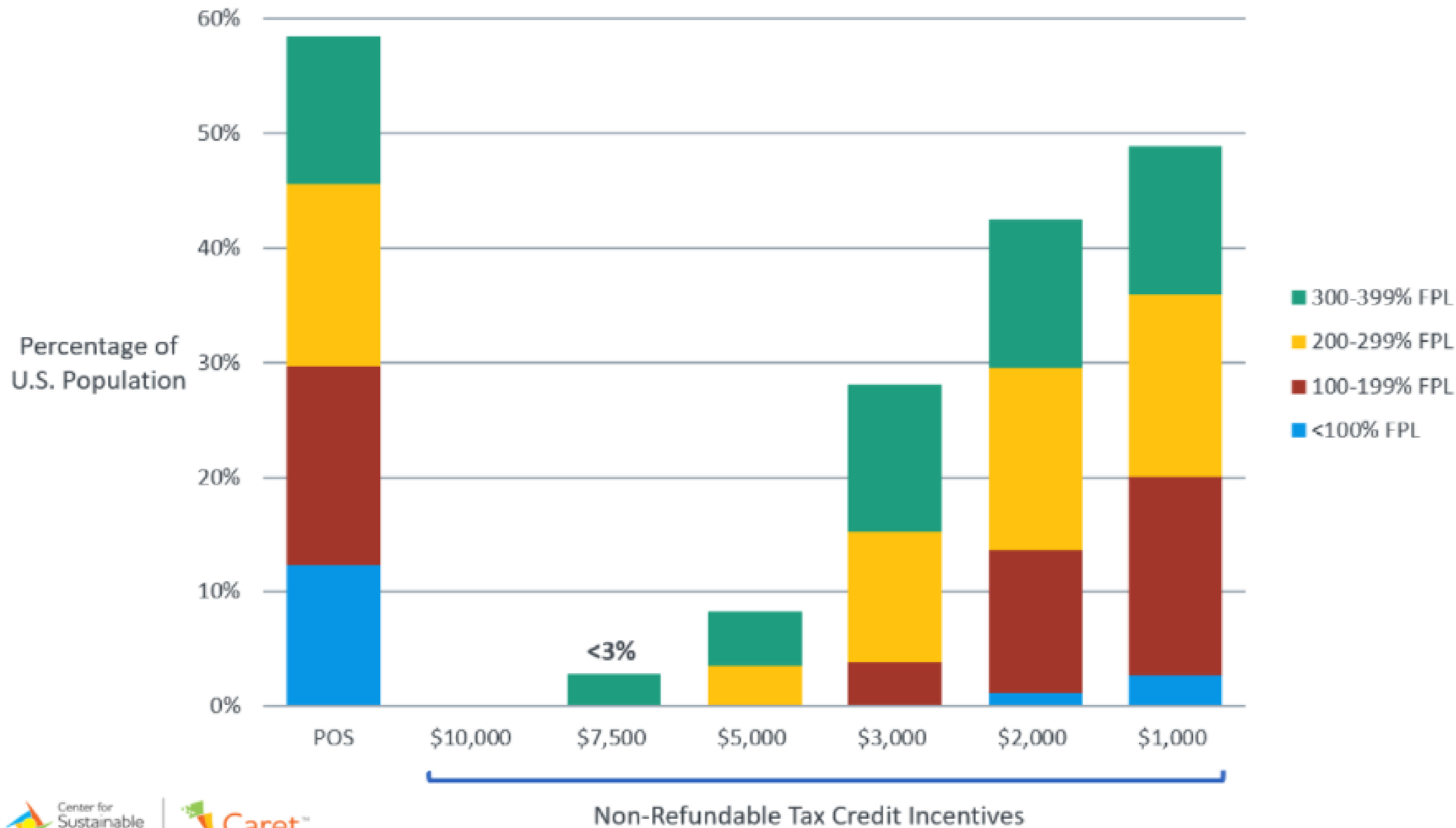
Select Publications   *(Reverse chronological, as of 7/30/21)*

- N. Pallonetti and B. D. H. Williams, "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, Jul. 2021.

- B. D. H. Williams and J. B. Anderson, "Strategically Targeting Plug-In Electric Vehicle Rebates and Outreach Using 'EV Convert' Characteristics," *Energies*, vol. 14, no. 7, p. 1899, Mar. 2021.

- B.D.H. Williams, J.B. Anderson, A. Lastuka, 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, 2020. https://doi.org/10.5281/ZENODO.4021408

- 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, 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, 2019.

- B.D. Williams, J. Orose, M. Jones, J.B. Anderson, Summary of Disadvantaged Community Responses to the Electric Vehicle Consumer Survey, 2013–2015 Edition | Clean Vehicle Rebate Project, Center for Sustainable Energy (CSE), San Diego CA, 2018.

- B.D. Williams, J.B. Anderson, 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, 2018.

- C. Johnson, B.D. Williams, C. Hsu, J.B. Anderson, Summary Documentation of the Electric Vehicle Consumer Survey, 2013–2015 Edition | Clean Vehicle Rebate Project, Center for Sustainable Energy (CSE), San Diego CA, 2017.

- C. Johnson, B.D. Williams, J.B. Anderson, N. Appenzeller, Evaluating the Connecticut Dealer Incentive for Electric Vehicle Sales, Center for Sustainable Energy (CSE), 2017.

- C. Johnson, B.D. Williams, Characterizing Plug-In Hybrid Electric Vehicle Consumers Most Influenced by California's Electric Vehicle Rebate, *Transp. Res. Rec.* 2628 (2017) 23–31.

Select Presentations *(Reverse chronological, as of 7/30/21)*

- Data from Statewide Electric Vehicle Rebate Programs: Vehicles, Consumers, Impacts, and Effectiveness
- CVRP CY 2019 Data Brief: Vehicle Replacement & Incentive Influence
- CVRP CY 2019 Data Brief: Consumer Characteristics
- 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 Select Findings
- CVRP Income Cap Analysis: Informing Policy Discussions

Recommended citation:

B.D.H. Williams and J.B. Anderson, Presentation: "California Plug-in Hybrid Electric Vehicle Consumers Who Found the U.S. Federal Tax Credit Extremely Important in Enabling Their Purchase," Clean Vehicle Rebate Project, administered by the Center for Sustainable Energy on behalf of the California Air Resources Board, Sep. 2021.

Questions?: brett.williams@energycenter.org

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