Electric Vehicle Incentives: Data, Rebated Consumers, Outreach Strategies, and Impacts

Multi-State ZEV Task Force Meeting

12 December 2019

Image: https://www.zevstates.us/about-us//

Brett Williams, PhD – Principal Advisor, EV Programs

with thanks to Jennifer Boughton, Michelle Jones, Eric Fullenkamp, and others at CSE

Center for Sustainable Energy™

CSE Areas of Expertise

Clean Transportation

Adoption of electric vehicles and deployment of charging infrastructure

Built Environment

Advancing energy efficiency and renewable resources

Technology Convergence

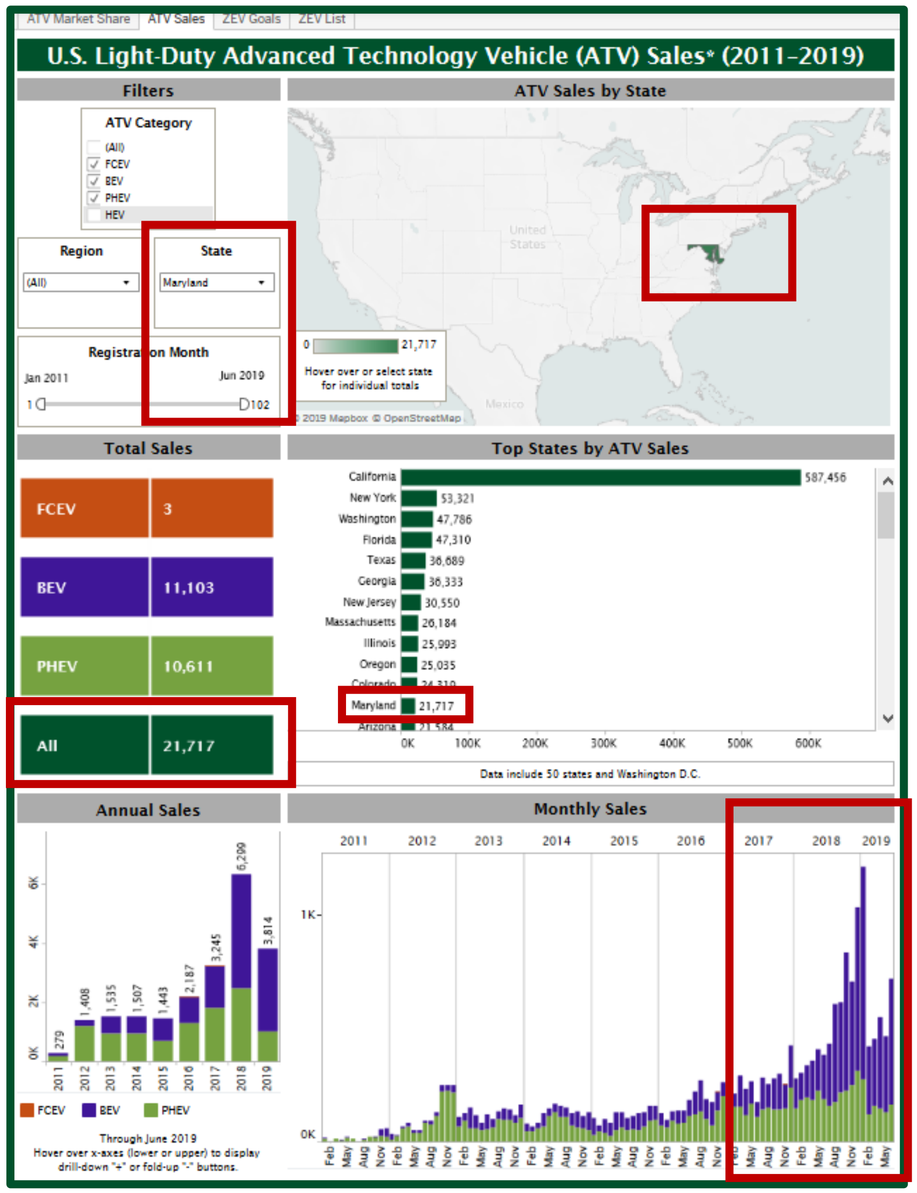
Interconnecting systems to achieve decarbonization

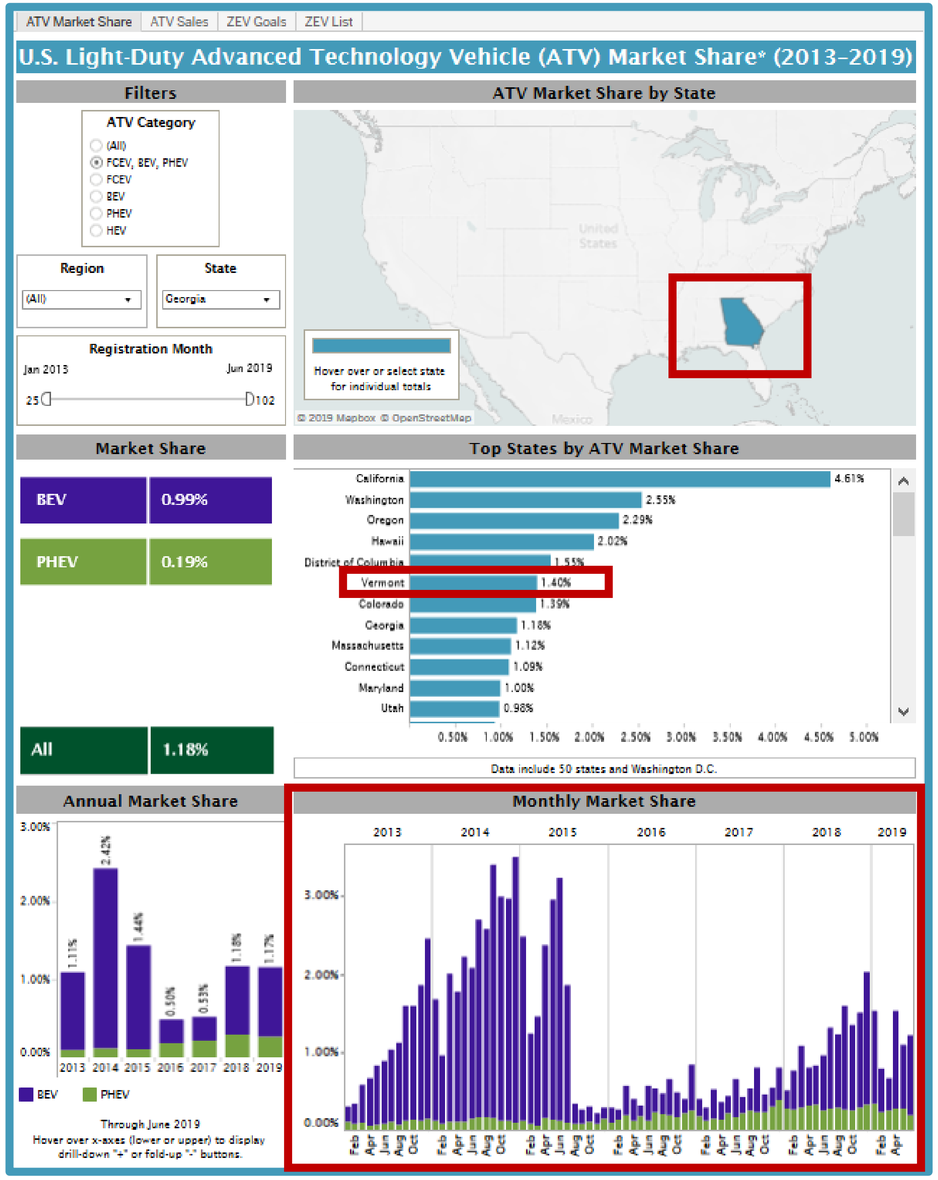
State EV Cash Rebate Programs Administered by CSE

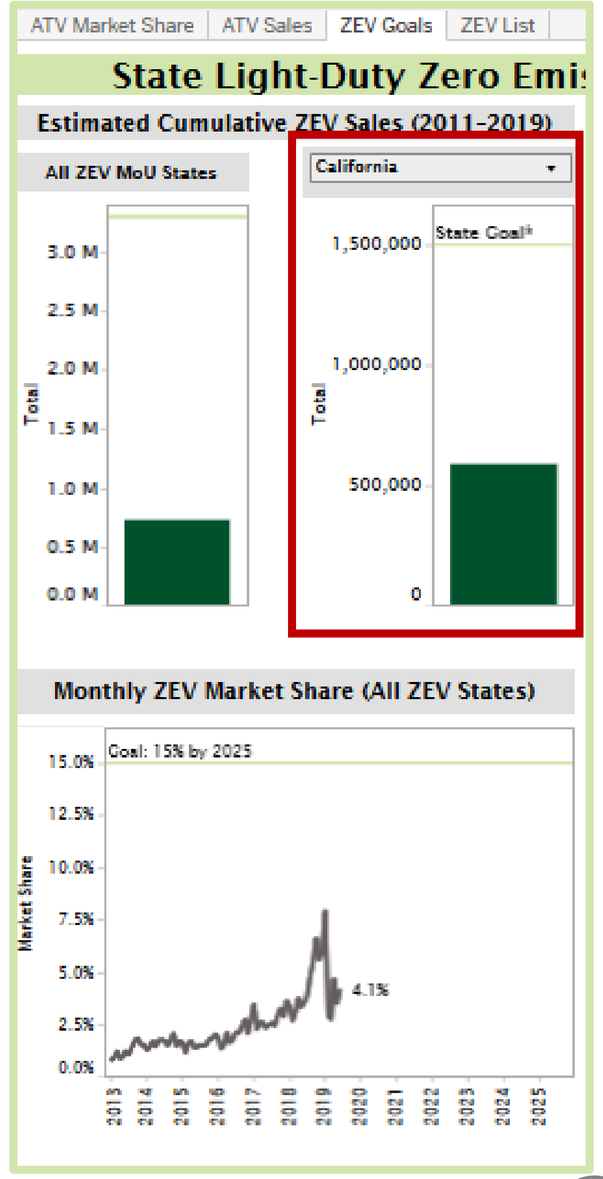
(as of 30 Sep. 2019)

	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 CVRP
Fuel-Cell EVs	$5,000	$1,500	$5,000	≥ 120 e-miles $2,000 ≥ 40 e-miles $1,700 ≥ 20 e-miles $1,100 < 20 e-miles $500	≥ 10 kWh $2,500 < 10 kWh $1,500
All-Battery EVs	$2,500	$1,500	≥ 200 e-miles $2,000 ≥ 120 e-miles $1,500 < 120 e-miles $500		
Plug-in Hybrid EVs	BEVx: $2,500 $1,500	BEVx only: $1,500	≥ 45 e-miles $1,000 < 45 e-miles $500		
Zero-Emission Motorcycles	$900	$450			$750 (and NEVs)
	• ≥20 e-miles • Income cap • Increased rebates for lower-income households (+$2,000)	• Purchase price ≤$50k • No fleet rebates Program ended 9/30/19	• BEVs & PHEVs ≤$50k base MSRP, FCEVs ≤$60k • Point-of-sale option • $150 dealer incentive	• Base MSRP >$60k = $500 • Point-of-sale	• Base MSRP <$50k • Point-of-sale option • Increased rebates for lower-income households (+$2,500), used EVs also

AA 50-State EV Sales, Market Share, and Goals Dashboard







Dashboard prepared by CSE for AA; linked at zevfacts.com

Outline

I. Statewide EV Rebate Program Update
- *Outputs*: Vehicles & Consumers Rebated (and paths forward)
- *Outcomes*: Behaviors Influenced
- *Impacts*: Emission & Market

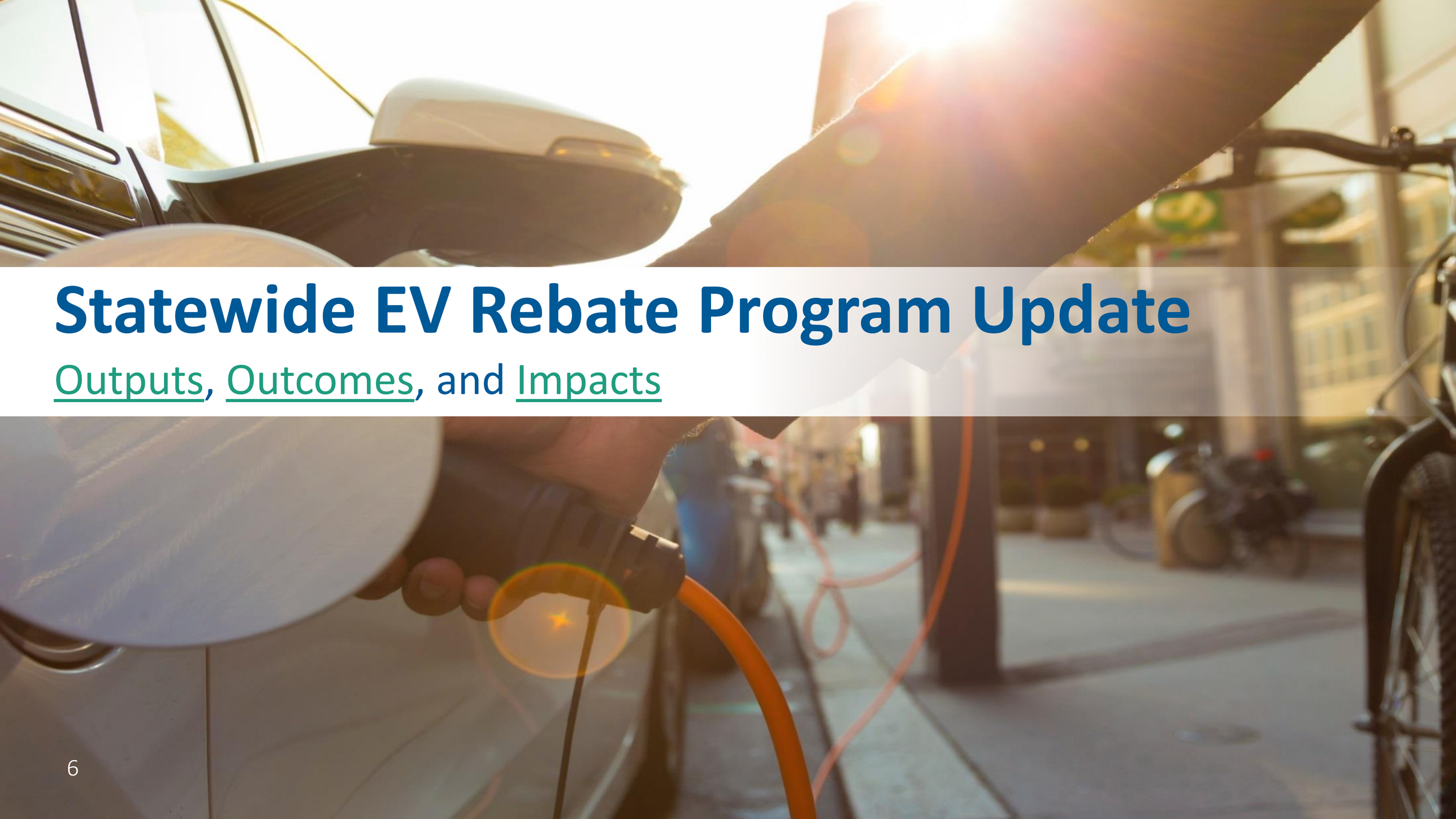
II. Additional Design Considerations
- Income Caps Compared to MSRP Caps
- Vehicle Eligibility Criteria (MSRP, e-range)
- Select Design Recommendations

III. Dealer Sales Incentives

IV. Broader Policy Options
- Tax vs. Cash Incentives, Complimentary Policies

V. Wrap Up, Additional Info

** EVs = light-duty plug-in hybrid, battery, and fuel-cell electric vehicles (PHEVs, BEVx vehicles, BEVs, and FCEVs)*



Statewide EV Rebate Program Update

Outputs, Outcomes, and Impacts

EV Rebate Designs

(As of Sept. 2018; Reflective of Most of the Data Gathered)

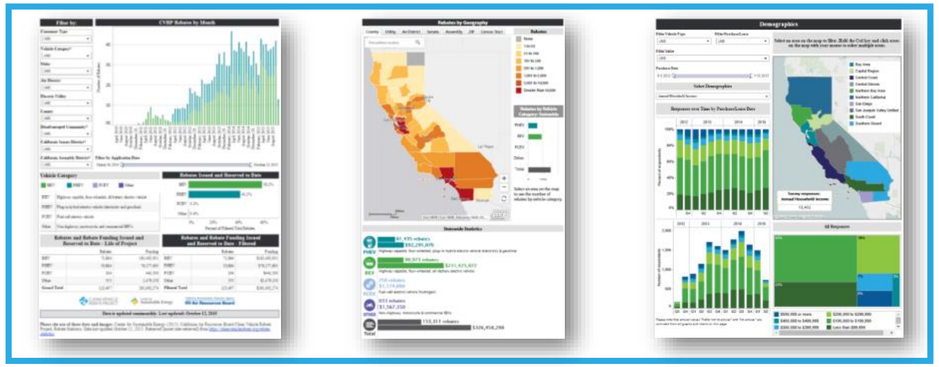
	CALIFORNIA CLEAN VEHICLE REBATE PROJECT™	MOR-EV Massachusetts Offers Rebates for Electric Vehicles	CHEAPR Connecticut Hydrogen and Electric Automobile Purchase Rebate	NEW YORK STATE
Fuel-Cell EVs 	$5,000	$2,500	$5,000	e-miles ≥ 120 $2,000 ≥ 40 $1,700 ≥ 20 $1,100 < 20 $500
All-Battery EVs 	$2,500	$2,500	e-miles ≥ 175 $3,000 ≥ 100 $2,000 < 100 $500	
Plug-in Hybrid EVs 	$2,500 (i3 REx) $1,500	≥10 kWh $2,500 <10 kWh $1,500	≥ 40 $2,000 < 40 $500	
Zero-Emission Motorcycles 	$900	$750		
	• e-miles ≥ 20 only • Consumer income cap • Increased Rebates for lower-income households	• Base MSRP ≥ $60k = $1,000 max. • no fleet rebates Program ended 9/30/19	• Base MSRP ≤ $60k only • dealer assignment • $150 dealer incentive ($300 previous)	• Base MSRP > $60k = $500 max. • point-of-sale via dealer

Center for Sustainable Energy®

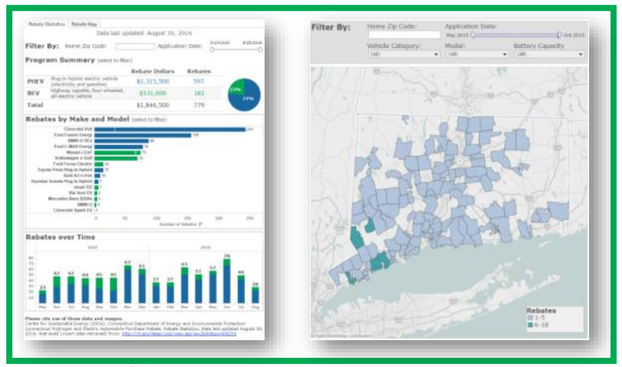
Outputs: Vehicles Rebated

Where Are EV Rebates Going?
Public Dashboards and Data Facilitate Informed Action

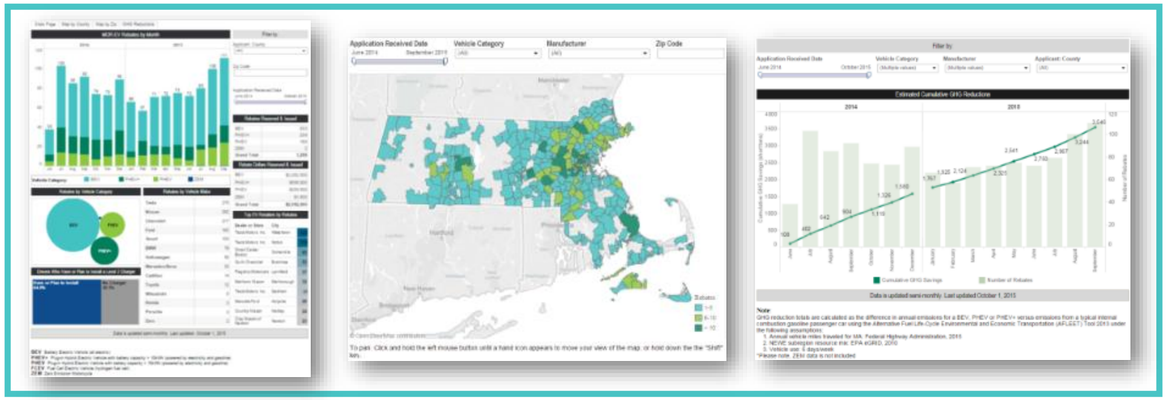
Statewide EV Rebate Programs: CA, MA, CT, NY



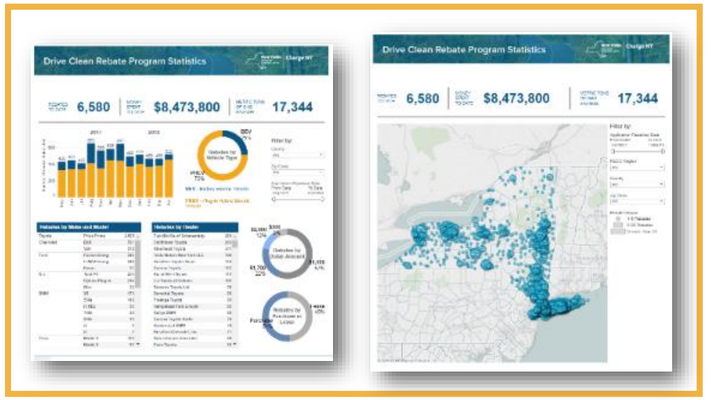
cleanvehiclerebate.org



ct.gov/deep



mor-ev.org



nyserda.ny.gov (dashboards done by NYSERDA)

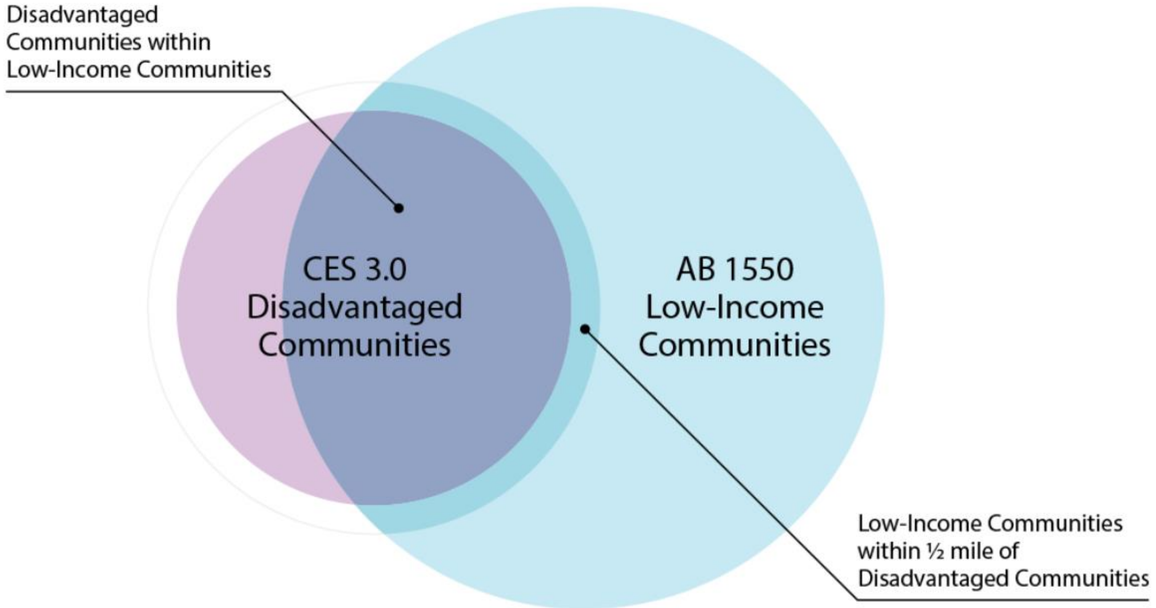
- > 350,000 EVs and consumers have received > $720 M in rebates
- > 70,000 survey responses being analyzed so far, statistically represent > 300,000 consumers
- Reports, presentations, and analysis growing

Equity Statistics Dashboard *(partial)*

Rebate Statistics | Equity Statistics | Notes | Mobile Version

CVRP Equity Rebate Statistics

Priority Communities (AB 1550) [2]



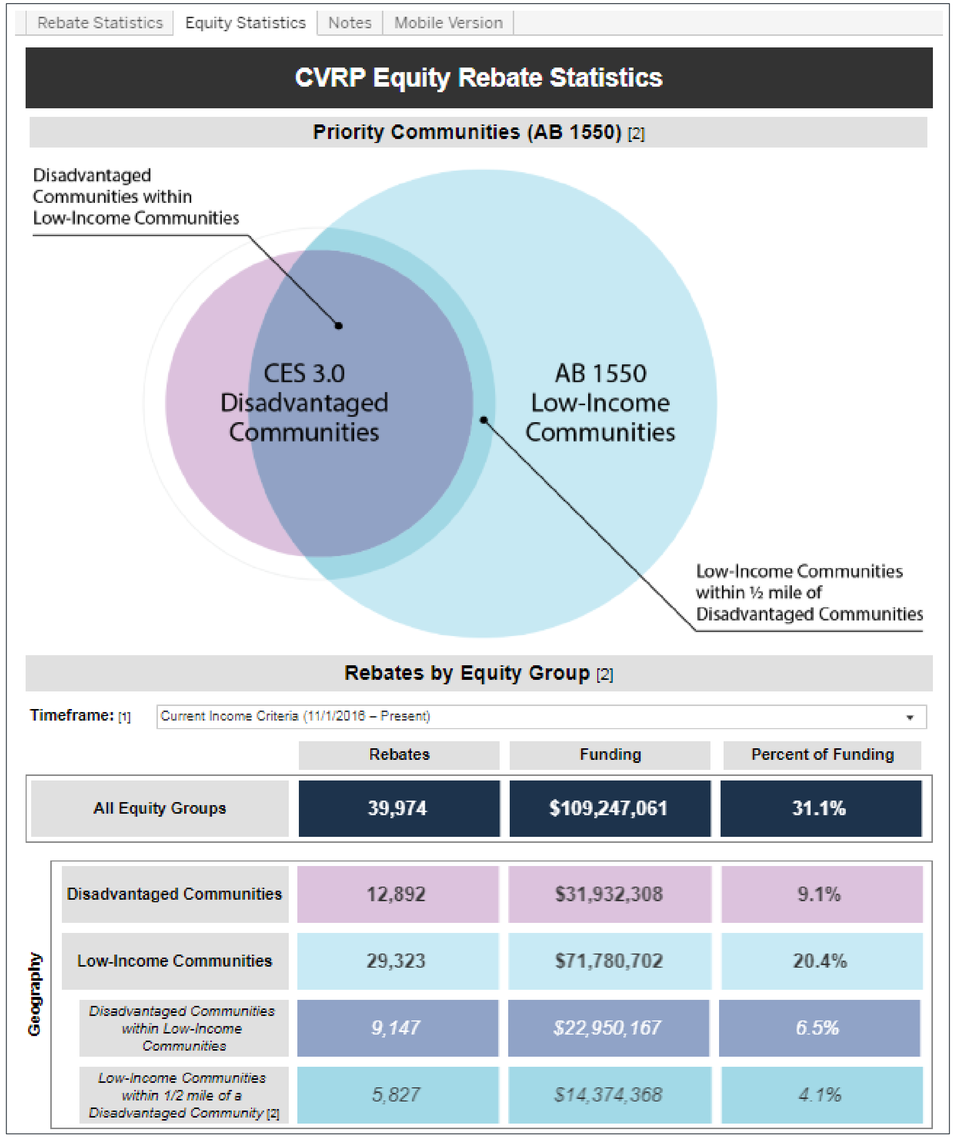
Rebates by Equity Group [2]

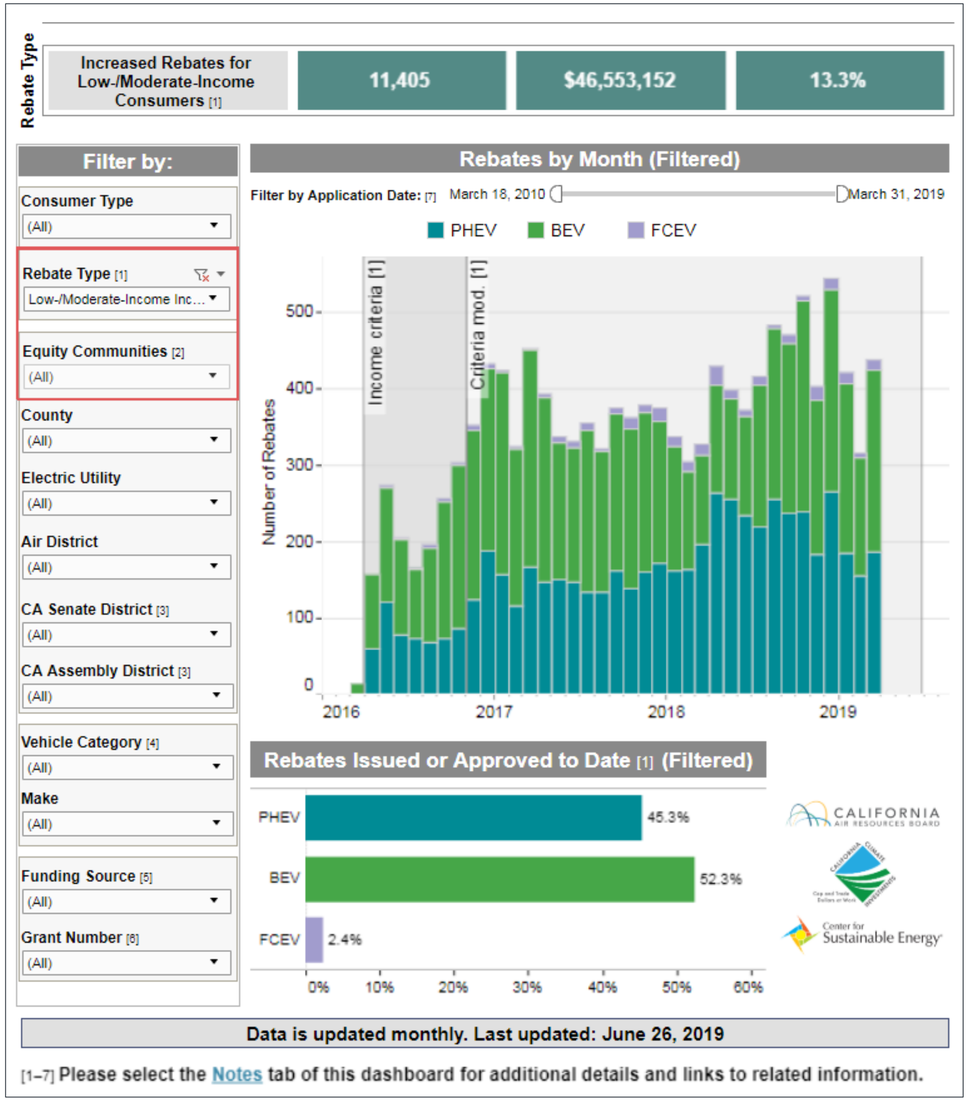
Timeframe: [1] Current Income Criteria (11/1/2016 – Present)

		Rebates	Funding	Percent of Funding
	All Equity Groups	**39,974**	**$109,247,061**	**31.1%**
Geography	**Disadvantaged Communities**	12,892	$31,932,308	9.1%
Geography	**Low-Income Communities**	29,323	$71,780,702	20.4%
Geography	*Disadvantaged Communities within Low-Income Communities*	*9,147*	*$22,950,167*	*6.5%*
Geography	*Low-Income Communities within 1/2 mile of a Disadvantaged Community* [2]	*5,827*	*$14,374,368*	*4.1%*
Rebate Type	**Increased Rebates for Low-/Moderate-Income Consumers** [1]	**11,405**	**$46,553,152**	**13.3%**

8/5/19 images from https://cleanvehiclerebate.org/eng/rebate-statistics

Equity Statistics Dashboard

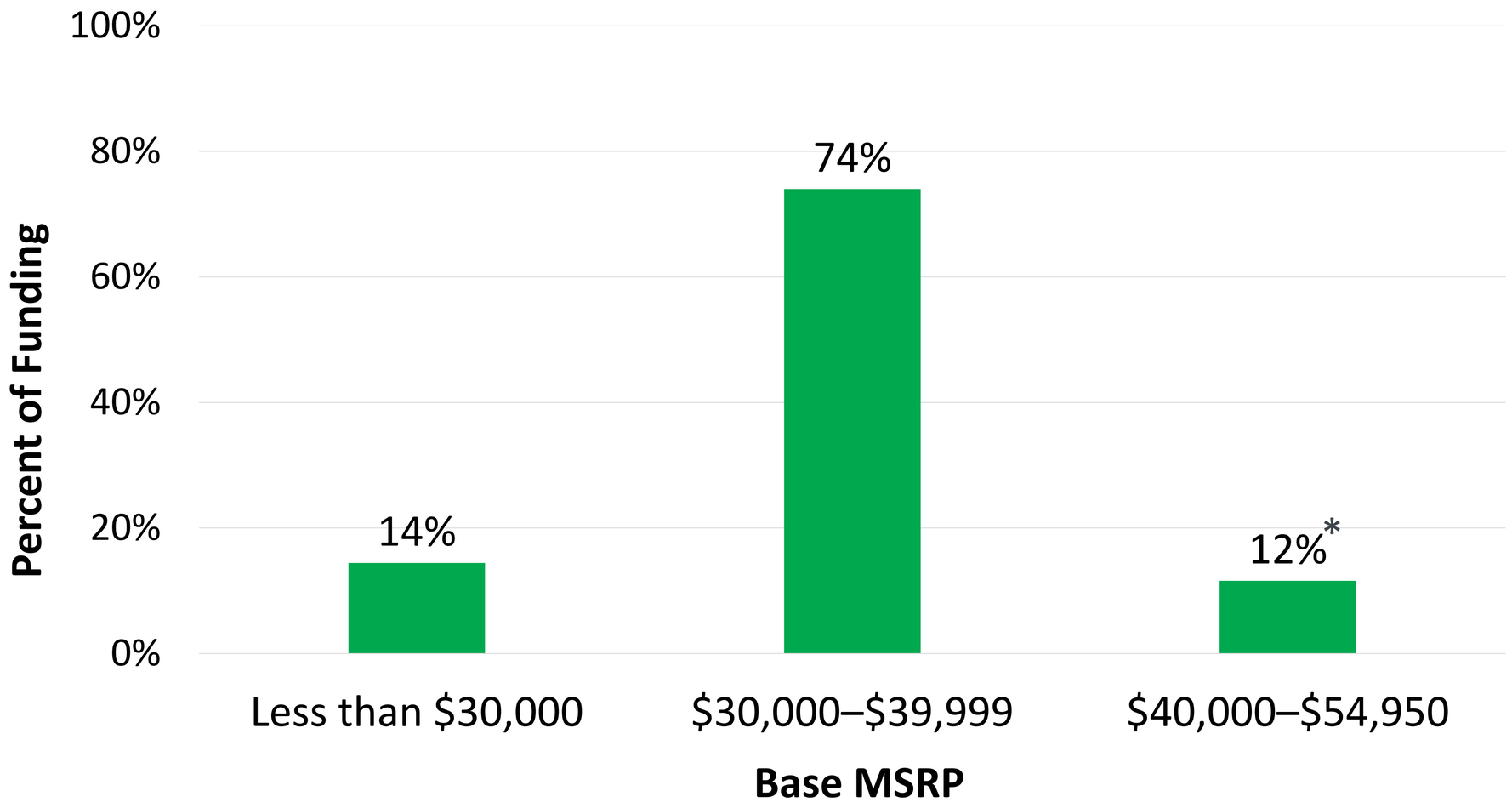




8/5/19 images from https://cleanvehiclerebate.org/eng/rebate-statistics

Moderately Priced Vehicles Received Most Funding

(thru April 2018, pre-“Model 3 effect”)



**$44,000 MSRP used for all rebated Model 3 vehicles.*

N=2,709 total CHEAPR rebates through April 2018; includes fleet rebates

Outputs: Consumers Rebated

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	Dec. 2010 – Dec. 2018	Jun. 2014 – Oct. 2018	May 2015 – Sep. 2018	Mar. 2017 – Jul. 2018	Dec. 2010 – Dec. 2018
Survey Responses (total n)*	62,092	4,555	1,565	1,808	70,020
Program Population (N)	278,538	10,920	3,510	8,651	301,619

** Weighted to represent the program population along the dimensions of vehicle category, vehicle model, buy vs. lease, and county (using raking method)*

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

	 **All** U.S. Population (Census 2017)		**New-Vehicle Buyers** U.S. MYs 2016–17 (2017 NHTS)
Selected solely White/Caucasian	61%	<<	74%
≥ 50 Years Old	34%	<<	51%
≥ Bachelor's Degree*	23%	<<<<	56%
Own Residence	63%	<<	75%
≥ $75k HH Income	38%	<<<	63%
Selected Male	49%	≈	51%

- New-car buyers are different on almost every dimension.
- More frequently:
  - White
  - Older
  - Degree holders
  - Residence owners
  - Higher income

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

Census 2017: 2013–2017 American Community Survey, http://factfinder2.census.gov.

2017 NHTS 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.

** Census & NHTS data characterize individual educational attainment.*

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

	 **All** U.S. Population (Census 2017)		**New-Vehicle Buyers** U.S. MYs 2016–17 (2017 NHTS)
Selected solely White/Caucasian	61%	<<	74%
≥ 50 Years Old	34%	<<	51%
≥ Bachelor's Degree*	23%	<<<<	56%
Own Residence	63%	<<	75%
≥ $150k HH Income	12%	<<	23%
Selected Male	49%	≈	51%

- New-car buyers are different on almost every dimension.
- More frequently:
  - White
  - Older
  - Degree holders
  - Residence owners
  - Higher income

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

Census 2017: 2013–2017 American Community Survey, http://factfinder2.census.gov.

2017 NHTS 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.

** Census & NHTS data characterize individual educational attainment.*

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

	 **All** U.S. Population (Census 2017)	**Driving Age** ***16+ Years Old*** U.S. Population (Census 2017)	**"Buying Age"** ***21+ Years Old*** U.S. Population (Census 2017)		**New-Vehicle Buyers** U.S. MYs 2016–17 (2017 NHTS)
Selected solely White/Caucasian	61%	64%	65%	<	74%
≥ 50 Years Old	34%	43%	47%	<	51%
≥ Bachelor's Degree*	23%	27%	30%	<<<	56%
Own Residence	63%	63%	64%	<<	75%
≥ $150k HH Income	12%	12%	12%	<<	23%
Selected Male	49%	49%	49%	≈	51%

- *Some* of the differences are explained by driving or buying age
- The rest may be due in part to ***social inequities***

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

Census 2017: 2013–2017 American Community Survey, http://factfinder2.census.gov.

2017 NHTS 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.

** Census & NHTS data characterize individual educational attainment.*

Rebated EV Consumer Characteristics: 2017

	U.S. "Buying Age" Population 21+ Years Old (Census 2017)	U.S. New-Vehicle Buyers MYs 2016–17 (2017 NHTS)	CALIFORNIA CLEAN VEHICLE REBATE PROJECT™ CY 2017 weighted n = 9,539	MOR-EV Massachusetts Offers Rebates for Electric Vehicles CY 2017 weighted n = 1,285	CHEAPR Connecticut Hydrogen and Electric Automobile Purchase Rebate CY 2017 weighted n = 501	NEW YORK STATE Mar.–Dec. 2017 weighted n = 1,014
Selected solely White/Caucasian	65%	74%	58%	85%	88%	86%
≥ 50 Years Old	47%	51%	52%	61%	59%	60%
≥ Bachelor's Degree in HH	30%*	56%*	82%	90%	85%	73%
Own Residence	64%	75%	79%	92%	89%	90%
≥ $150k HH Income	12%	23%	40%	58%	41%	34%
Selected Male	49%	51%	72%**	74%	71%	68%

"Prefer not to answer," "I don't know," and similar responses are excluded throughout.
Census 2017: 2013–2017 American Community Survey, http://factfinder2.census.gov.
NHTS 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.
** Census & NHTS data characterize individual educational attainment, whereas other data characterize highest household attainment.*
*** 100% includes non-binary options.*

Differing Approaches, Similar Metrics…

	U.S. "Buying Age" Population 21+ Years Old (Census 2017)	U.S. New-Vehicle Buyers MYs 2016–17 (2017 NHTS)	CALIFORNIA CLEAN VEHICLE REBATE PROJECT™ CY 2017 weighted n = 9,539	MOR-EV Massachusetts Offers Rebates for Electric Vehicles CY 2017 weighted n = 1,285	CHEAPR Connecticut Hydrogen and Electric Automobile Purchase Rebate CY 2017 weighted n = 501	NEW YORK STATE Mar.–Dec. 2017 weighted n = 1,014
Selected solely White/Caucasian	65%	74%	58%	85%	88%	86%
≥ 50 Years Old	47%	51%	52%	61%	59%	60%
≥ Bachelor's Degree in HH	30%*	56%*	82%	90%	85%	73%
Own Residence	64%	75%	79%	92%	89%	90%
≥ $150k HH Income	12%	23%	40%	58%	41%	34%
Selected Male	49%	51%	72%**	74%	71%	68%

"Prefer not to answer," "I don't know," and similar responses are excluded throughout.
Census 2017: 2013–2017 American Community Survey, http://factfinder2.census.gov.
NHTS 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.
** Census & NHTS data characterize individual educational attainment, whereas other data characterize highest household attainment.*
*** 100% includes non-binary options.*

Rebated EV Consumer Characteristics—NY

	 NY Population *21+ Years Old* (Census 2017)	NY New-Vehicle Buyers (2017 NHTS)	 NY EV Consumers, (rebated for Mar. 2017 – Jul. 2018 adoption)
Selected solely White/Caucasian	58%	74%	86%
Male	48%	49%	70%
≥ Bachelor's degree in HH	35%*	64%*	76%
Own Residence	54%	73%	90%
≥ 50 years old	47%	43%	59%
≥ $150k HH Income	16%	23%	39%

Census 2017: 2013–2017 American Community Survey, http://factfinder2.census.gov.
National Household Travel Survey, 2017 calendar year: filtered for model year 2016/2017, state = NY, weighted n = 414,721.
NYSERDA Adoption Survey, 2017–18 edition: filtered to purchase/lease dates Mar 2017–Jul 2018, weighted n = 1,808.
**Census & NHTS data characterize individual educational attainment, whereas other data characterize highest household attainment.*

Rebated EV Consumer Characteristics—MA

MOR-EV
Massachusetts Offers Rebates for Electric Vehicles

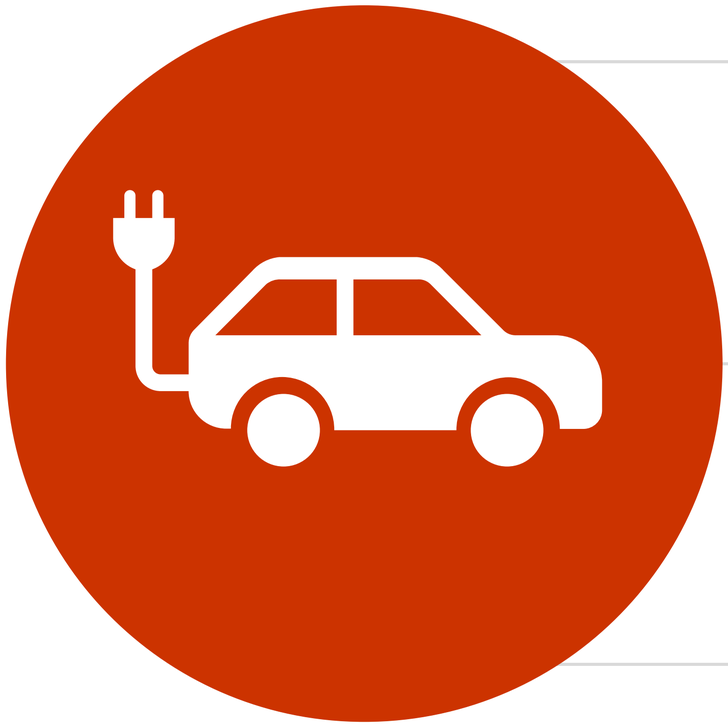
	 **MA Population** 21+ Years Old (Census 2017)	**New England New-Vehicle Buyers** MYs 2016–17 (2017 NHTS)		MOR-EV Massachusetts Offers Rebates for Electric Vehicles MA EV consumers (rebated for Jun. 2014 – Oct. 2018 adoption)
Selected solely White/Caucasian	76%	88%	>	85%
≥ 50 years old	48%	49%	<	58%
≥ Bachelor's degree in HH	41%*	61%*		90%
Own Residence	62%	82%	<	92%
≥ $150k HH Income	20%	37%	<<<	58%
Selected Male	48%	49%	<<<	78%

"Prefer not to answer," "I don't know," and similar responses are excluded throughout.
Census 2017: 2013–2017 American Community Survey, http://factfinder2.census.gov.
National Household Travel Survey, 2017 calendar year: filtered for model year 2016/2017, state = CT, MA, ME, RI, VT, NH, weighted n = 330,437.
MOR-EV Survey 2016 – 17 & 2017–18 edition: filtered to purchase/lease dates June 2014–Oct 2018, weighted n = 4,555.
**Census & NHTS data characterize individual educational attainment, whereas other data characterize highest household attainment.*

What is the path forward?

Strategies for Program Design and Outreach

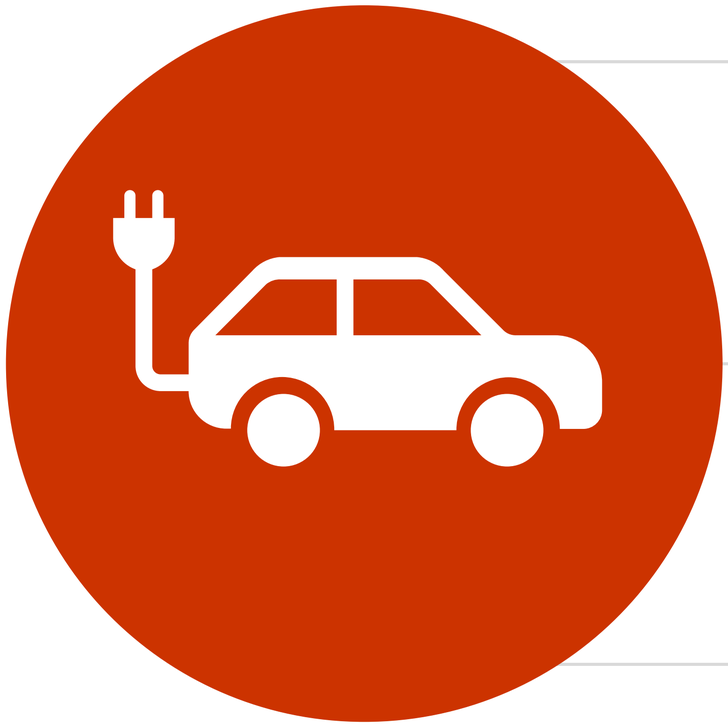
How Can Research Help Us Grow Markets for Electric Vehicles?



Low-Hanging Fruit

Understand existing adopters to reinforce and scale what is already working

How Can Research Help Us Grow Markets for Electric Vehicles?



Low-Hanging Fruit

Understand existing adopters to reinforce and scale what is already working

Tough Nuts to Crack

Understand and break down barriers faced by consumers targeted based on policy priorities

Expanding Market Frontiers

Go beyond the enthusiastic core of EV markets in order to expand further into the mainstream

Expanding Market Frontiers Through Strategic Segmentation

Existing Adopters: Market Acceleration

Characterize existing, generally enthusiastic and pre-adapted consumers, to target similar consumers who have the highest likelihood of adoption

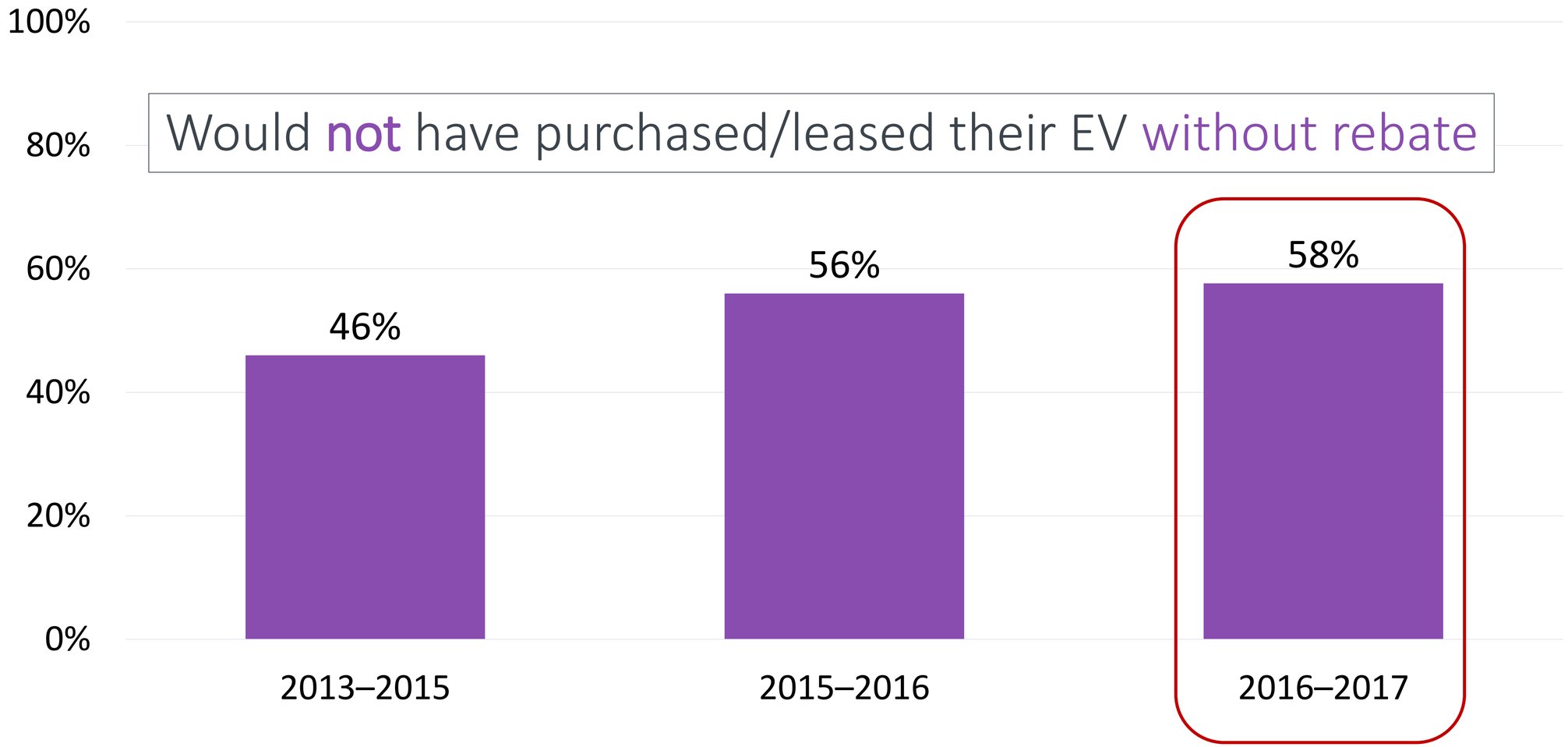
“Rebate Essential” Consumers: Minimizing Free Ridership

Characterize adopters most highly influenced by supportive resources to join the EV market, to improve the cost-effectiveness of outreach and program design

“EV Converts”: Moving Mainstream

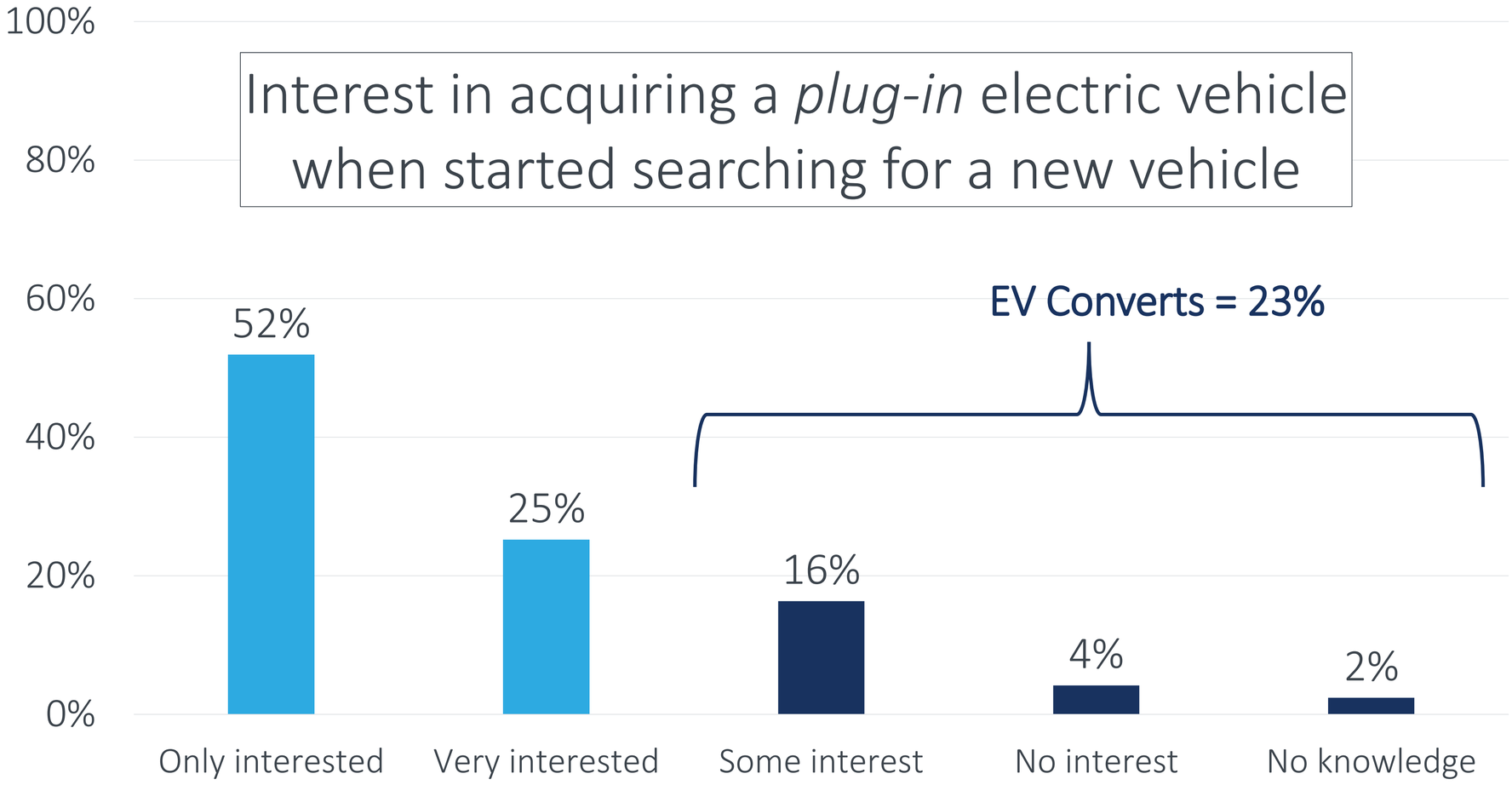
Characterize EV consumers with low initial interest in EVs, to look for additional opportunities to expand into the mainstream

“Rebate Essentials”: Highly Influenced



CVRP Consumer Survey: 2013–2015 edition: weighted, question n=19,208;
2015–2016 edition: weighted, question n=11,457;
2016–2017 edition: weighted, question n=9,261

“EV Converts”: Low Initial Interest



CVRP Consumer Survey, 2016–17 edition: filtered to purchase/lease dates Nov 2016–May 2017, weighted n = 5,327

Paths Forward: CA

	Low-Hanging Fruit ***Nov. 2016*** – Dec. 2018 weighted n = 23,478	Rebate Essentials	EV Converts	CA New-Vehicle Buyers, MYs '16–'17 (2017 NHTS)	Priority Populations
Selected solely White/Caucasian	54% ↑	↑	↑	51%	For example, CalEnviroScreen Disadvantaged Communities or AB 1550 Priority Communities
≥ 50 Years Old	52% ↑	↓	↓	46%	
≥ Bachelor's Degree in HH	83% ↑↑	↑↑	↑	58%*	
≥ $150k HH Income	42% ↑	↑	≈	32%	
Selected Male	73%* ↑↑↑	↑↑↑	↑↑	50%	

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

NHTS 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.

** 100% includes non-binary options.*

Strategic Segments: Explanation

Factors that Increase the Odds of Being an EV Convert*
(Relative to Other Plug-in EV Adopters)

Plug-in EV consumers (both PHEV and BEV) are **more likely converts if** they:

- are ***younger***, do ***not*** have ***solar***
- are ***not*** highly ***motivated by*** reducing ***environmental*** impacts or ***HOV lane*** access
- do ***not*** spend time ***researching EVs online***

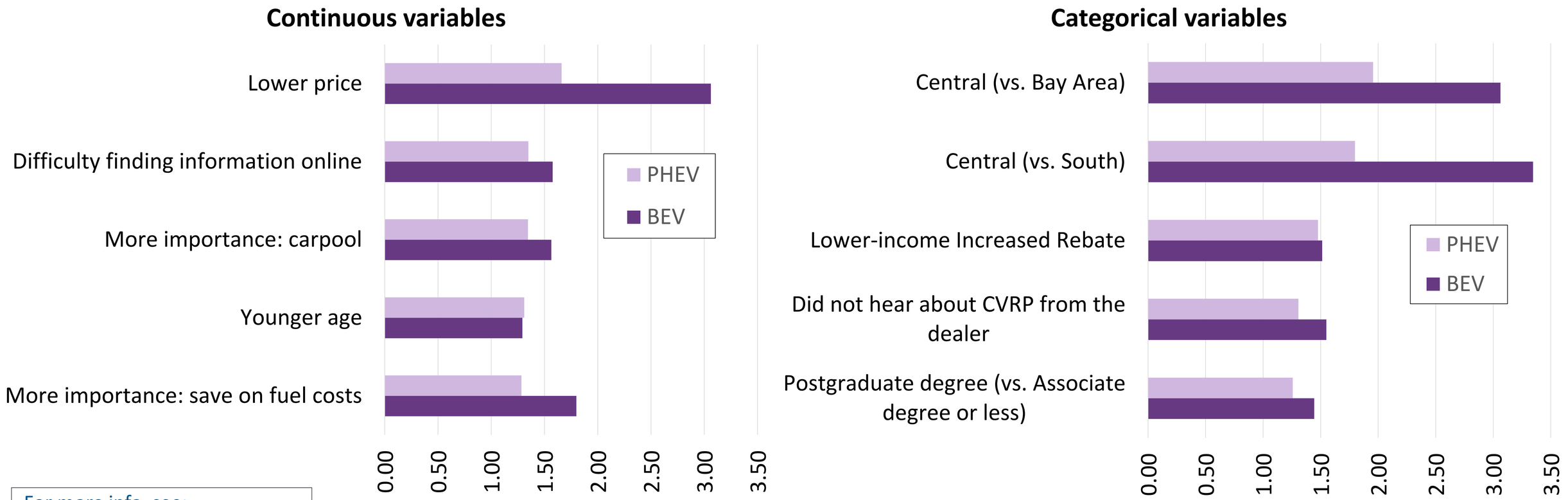
Additionally:

- **PHEV** consumers are more likely converts if they chose PHEVs other than the Volt
- **BEV** consumers are more likely converts if they:
  - are ***women***, do ***not*** identify as ***white***/Caucasian, ***live in*** the ***Central Valley or LA/SoCal*** area, or have ***lower income***
  - are ***moderately motivated by energy independence***
  - Have ***no workplace charging***
  - choose BEVs other than Bolt or Tesla (long-range BEVs?)
  - find the ***rebate essential*** to purchase/lease

** Significantly associated factors in binary logistic regression*

CALIFORNIA CLEAN VEHICLE REBATE PROJECT™

Comparison to Other Plug-in EV Adopters: Rebate Essential Explanatory Factors*



X-Standardized Rebate Essentiality Odds Ratios

For more info, see:
- 2016 BECC talk
- 2017 TRR paper and TRB poster
- 2018 EVS 31 talk…

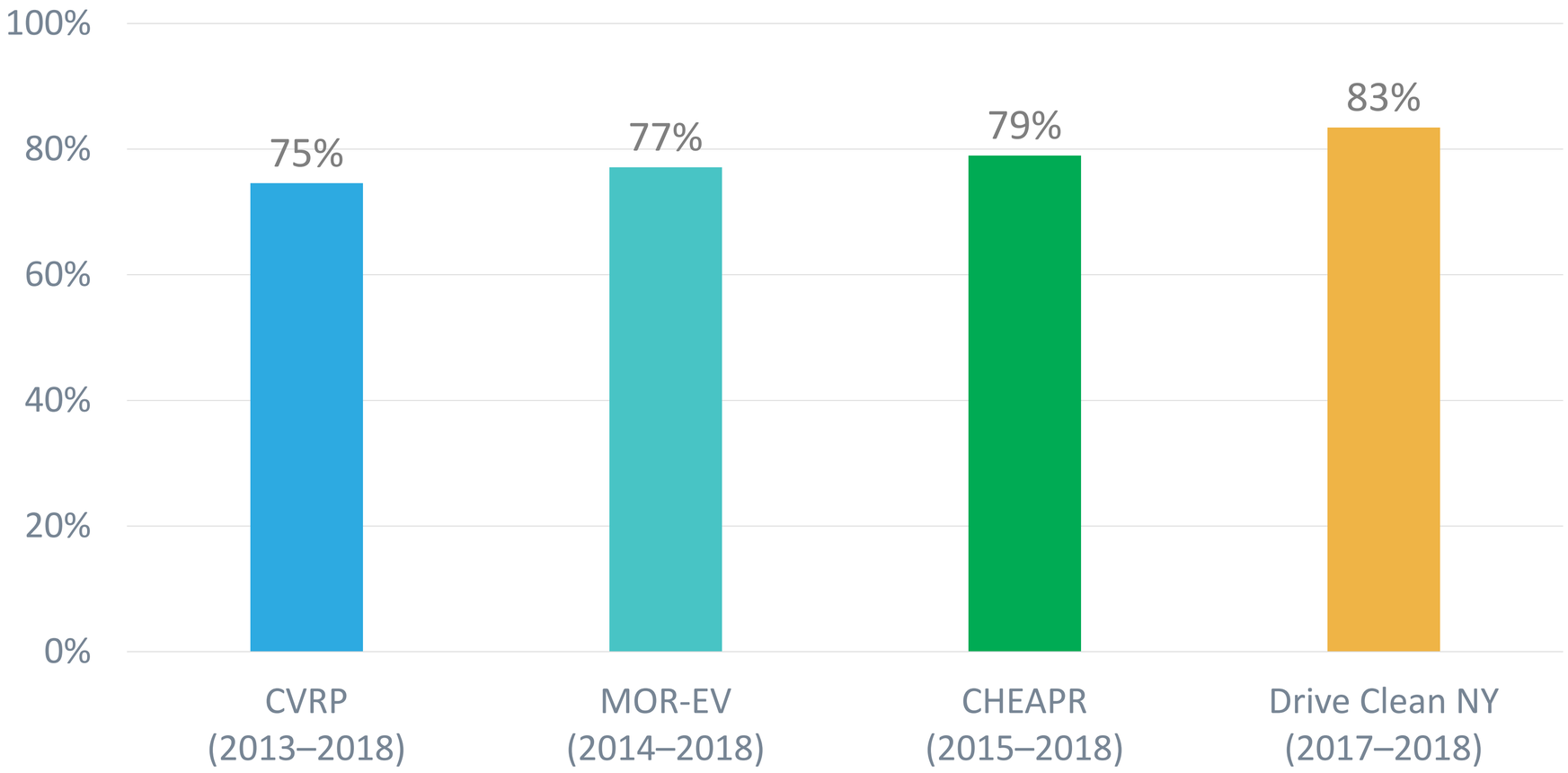
* Significantly associated factors in binary logistic regression.

Note: standardized odds ratios for categorical and continuous variables are not directly comparable.

Outcomes: Behaviors Influenced

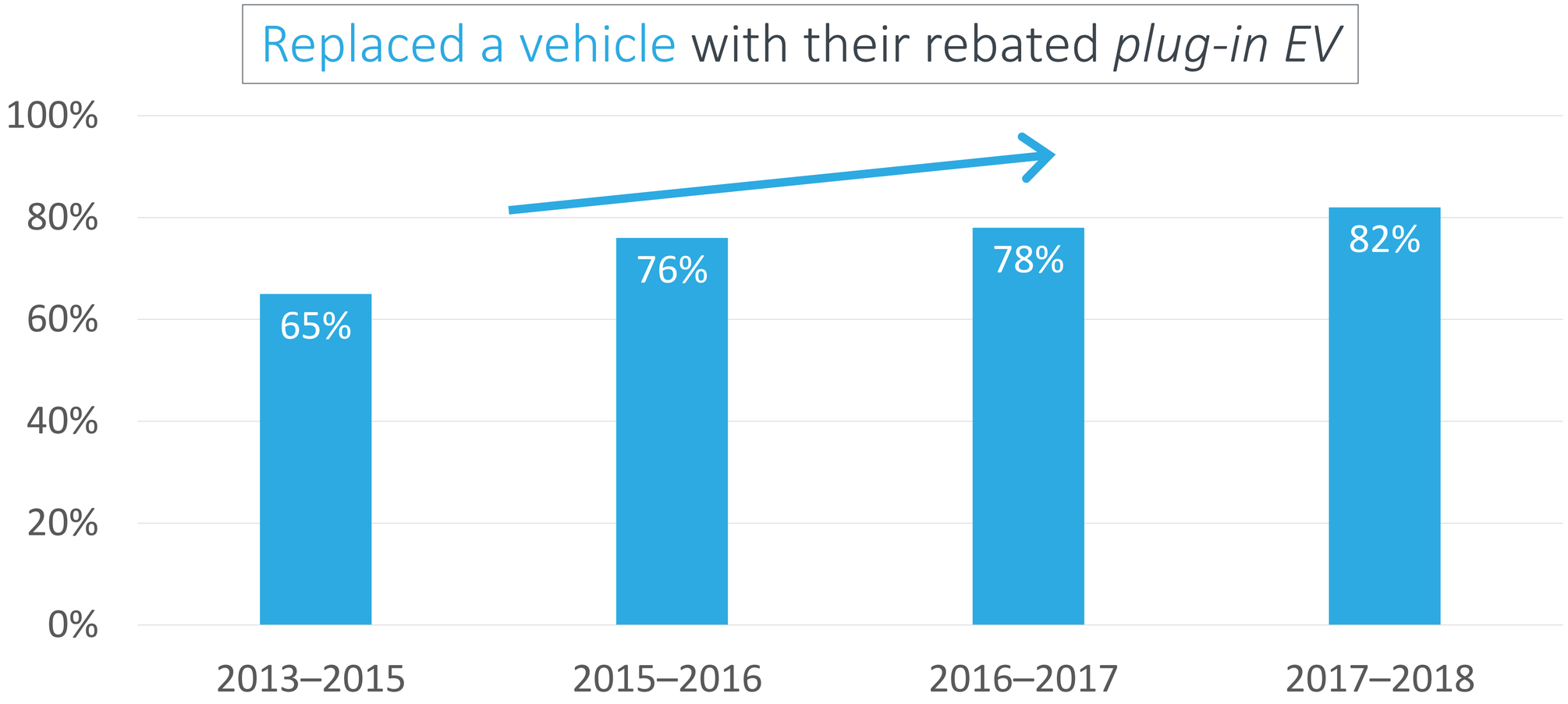
Do EVs Get Used?

Replaced a vehicle with their rebated **clean vehicle**



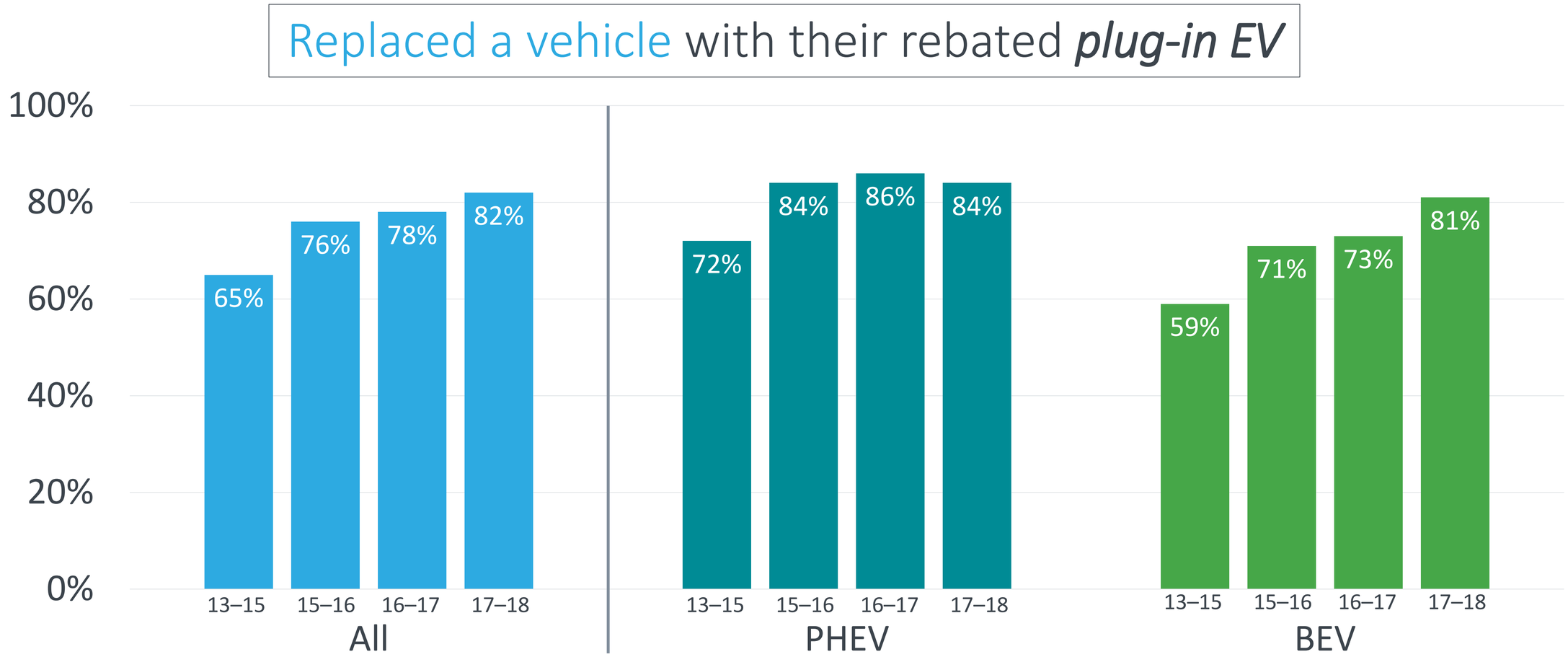
Overall datasets: 70,020 total survey respondents weighted to represent 301,619 rebate recipients

Vehicle Replacement is Increasing



CVRP Consumer Survey: 2013–2015 edition: weighted, question n=19,247;
2015–2016 edition: weighted, question n= 11,583;
2016–2017 edition: weighted, question n= 9,006;
2017–2018 edition: weighted, question n= 20,847

Vehicle Replacement Has Long Been High for PHEVs, Is Growing for BEVs

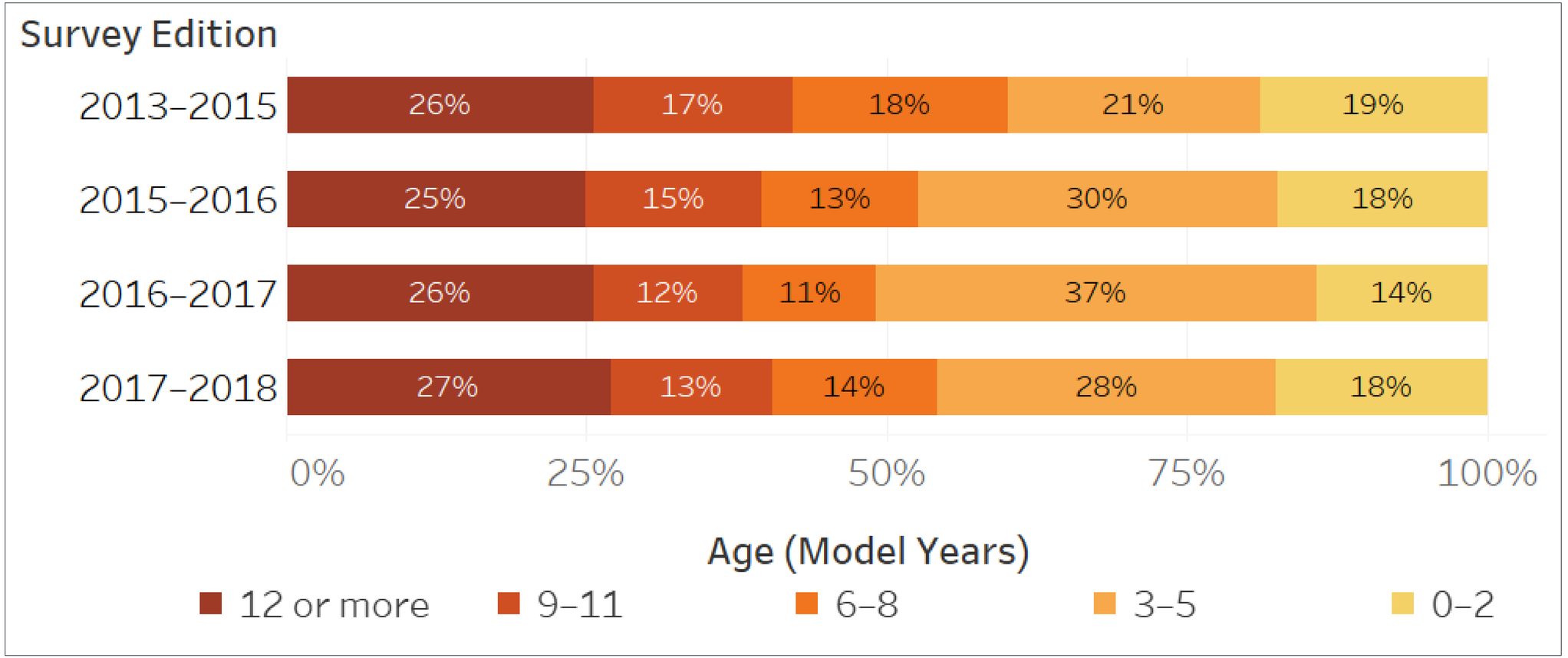


CVRP Consumer Survey: 2013–2015 edition: weighted, question n=19,247
2015–2016 edition: weighted, question n= 11,583
2016–2017 edition: weighted, question n= 9,006
2017–2018 edition: weighted, question n= 20,847

Impacts: Emission

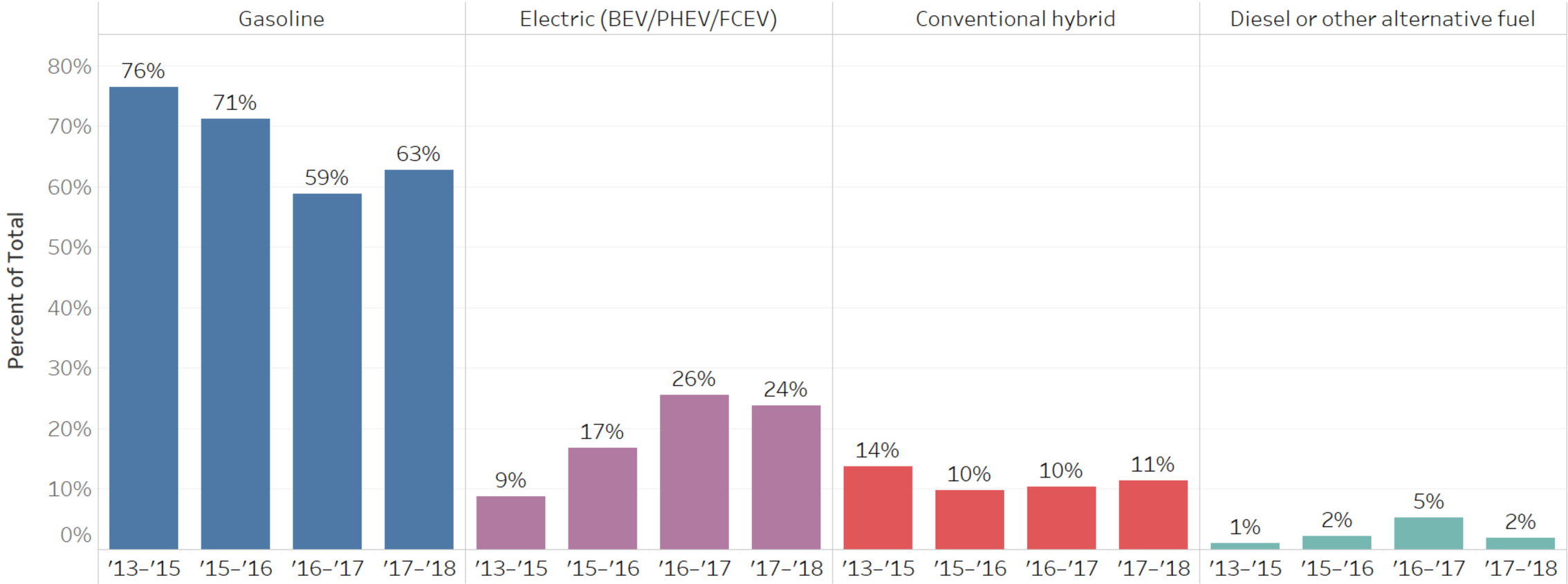
Replaced Vehicle Age

Age = Rebated EV model year − Replaced vehicle model year



CVRP Consumer Survey: 2013–2015 edition: weighted, question n= 12,252
2015–2016 edition: weighted, question n= 8,627
2016–2017 edition: weighted, question n= 6,933
2017–2018 edition: weighted, question n= 14,696

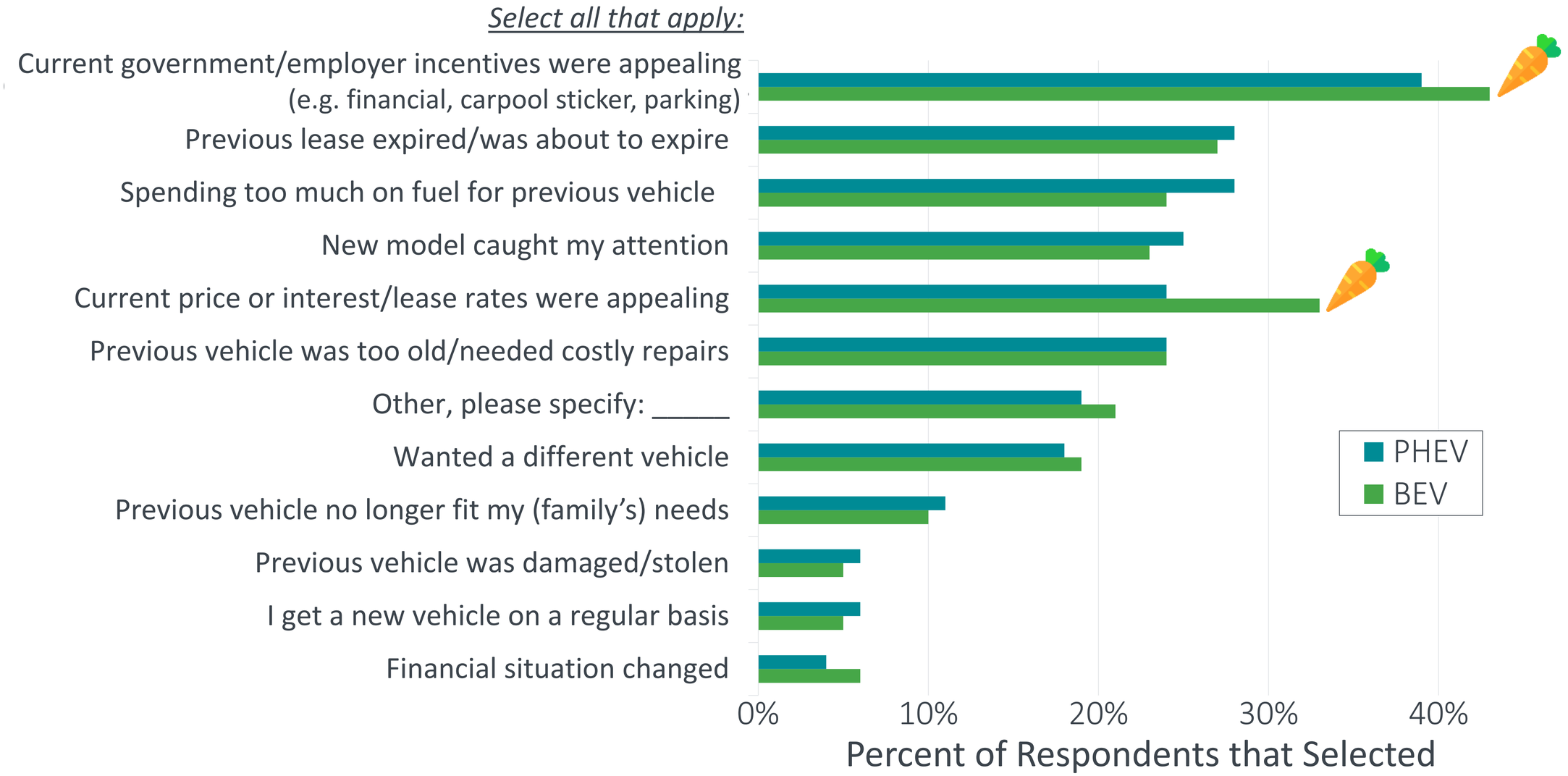
What Vehicle Types Have Rebates Helped Replace?



CVRP Consumer Survey: 2013–2015 edition: weighted, question n= 12,332
2015–2016 edition: weighted, question n= 8,594
2016–2017 edition: weighted, question n= 6,925
2017–2018 edition: weighted, question n= 17,021

Impacts: Market

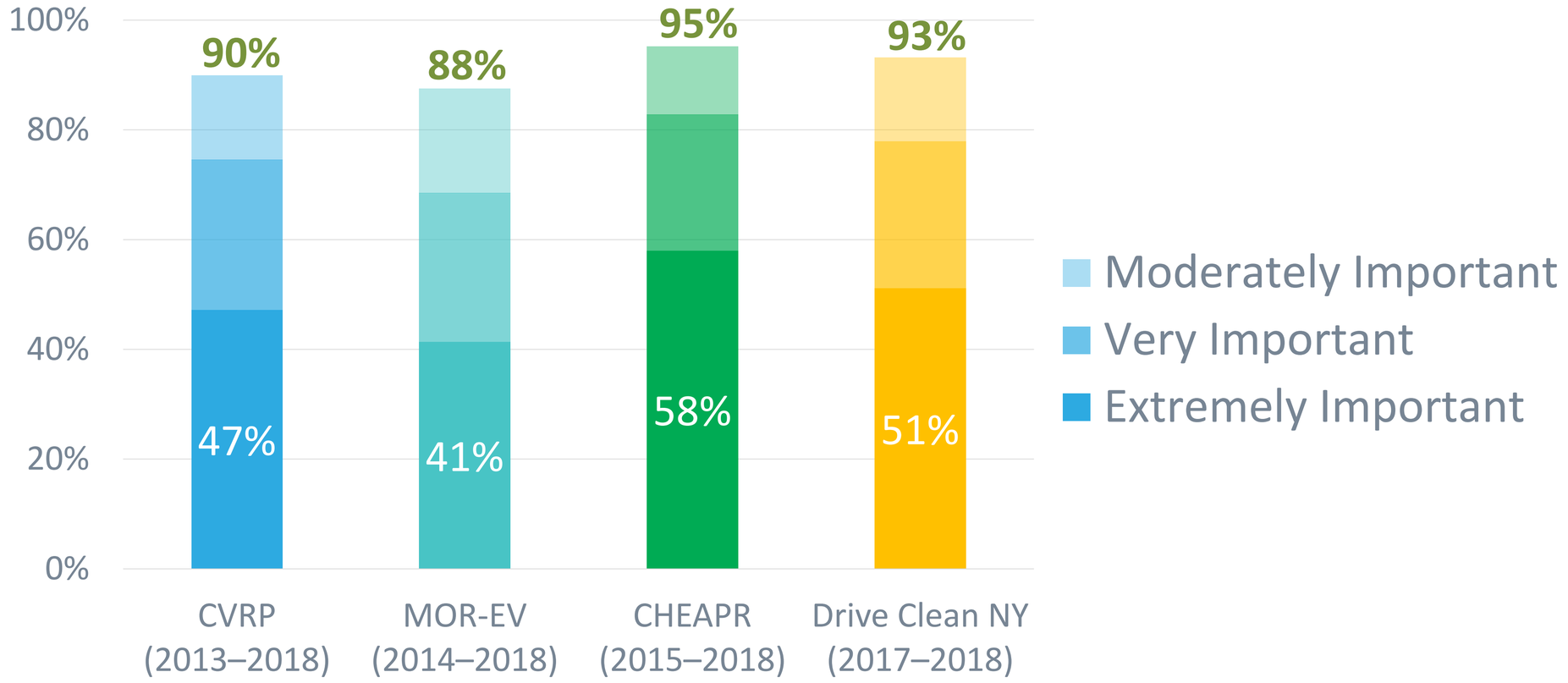
Financial lures are important to entice replacement with BEVs



CVRP Consumer Survey, **2016–2017** edition: weighted, question n= 7,000

Rebate Influence: Importance

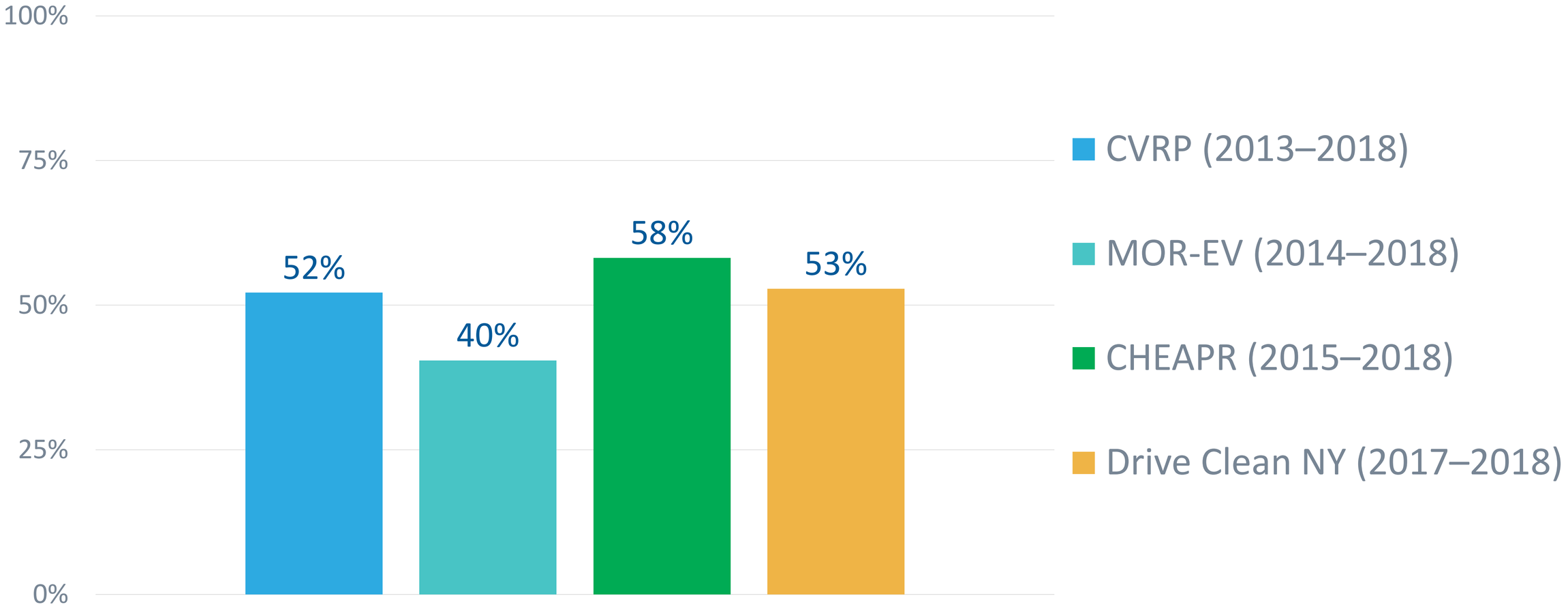
How important was the state rebate in making it possible for you to acquire your clean vehicle?



Overall datasets: 70,020 total survey respondents weighted to represent 301,619 rebate recipients

Rebate Influence: Essentiality

Would not have purchased/leased their clean vehicle without rebate



Overall datasets: 70,020 total survey respondents weighted to represent 301,619 rebate recipients

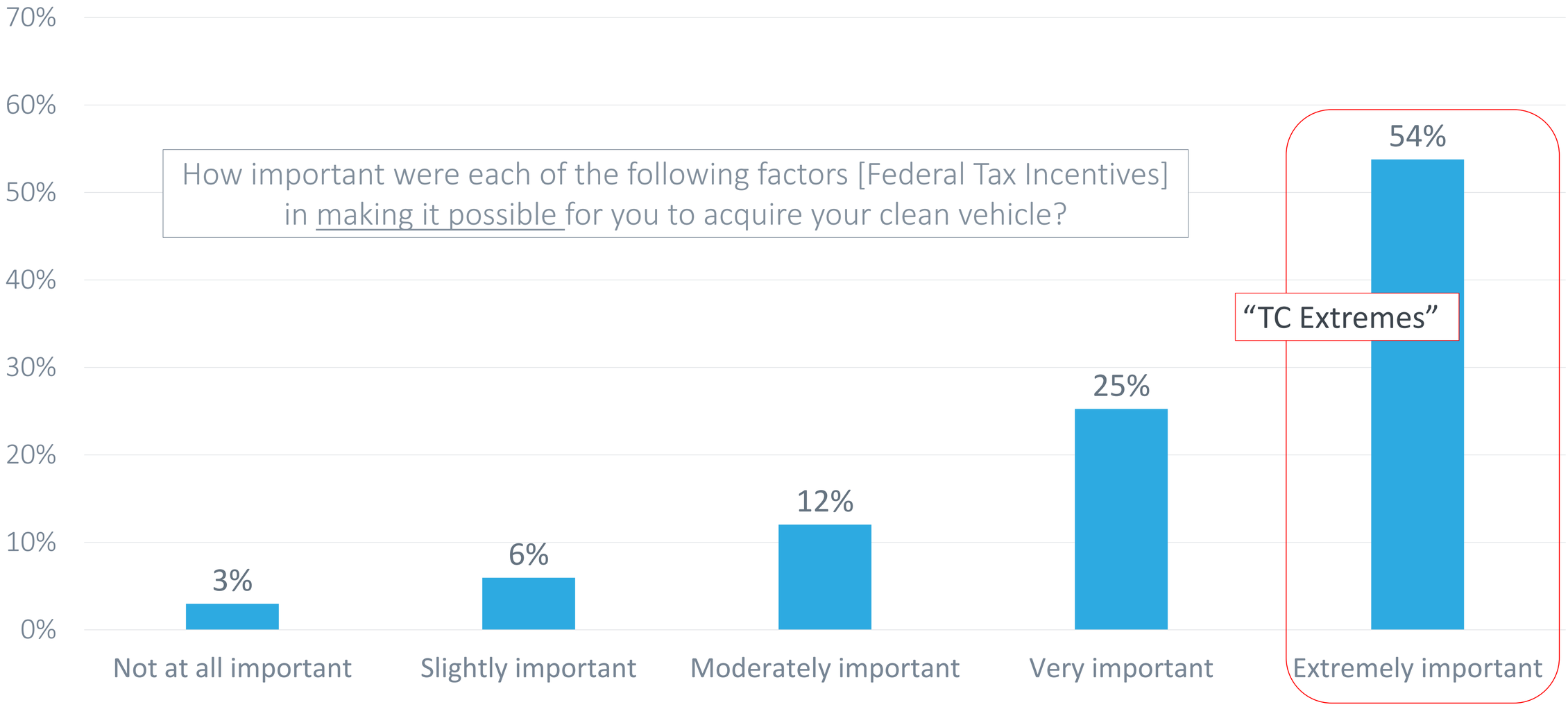
Federal Tax Credit: Background

- 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

* Light-duty plug-in electric vehicles, including both plug-in hybrid EVs (PHEVs) and battery EVs (BEVs)
Images taken 8/16/19 from https://www.fueleconomy.gov/feg/taxevb.shtml

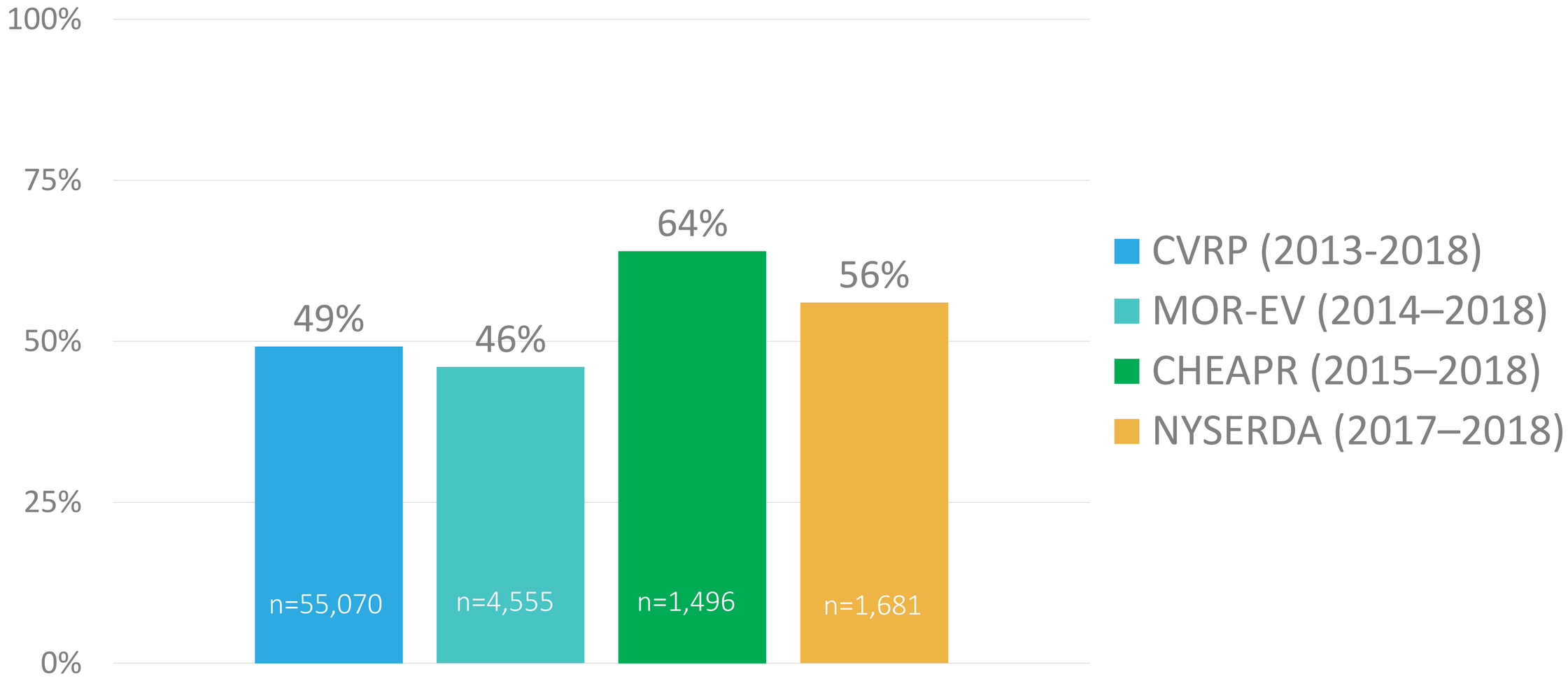
Importance of Federal Tax Credit (2017–18 survey edition)



CVRP Consumer Survey, 2017–18 edition (6/17–12/18), weighted n = 17,101

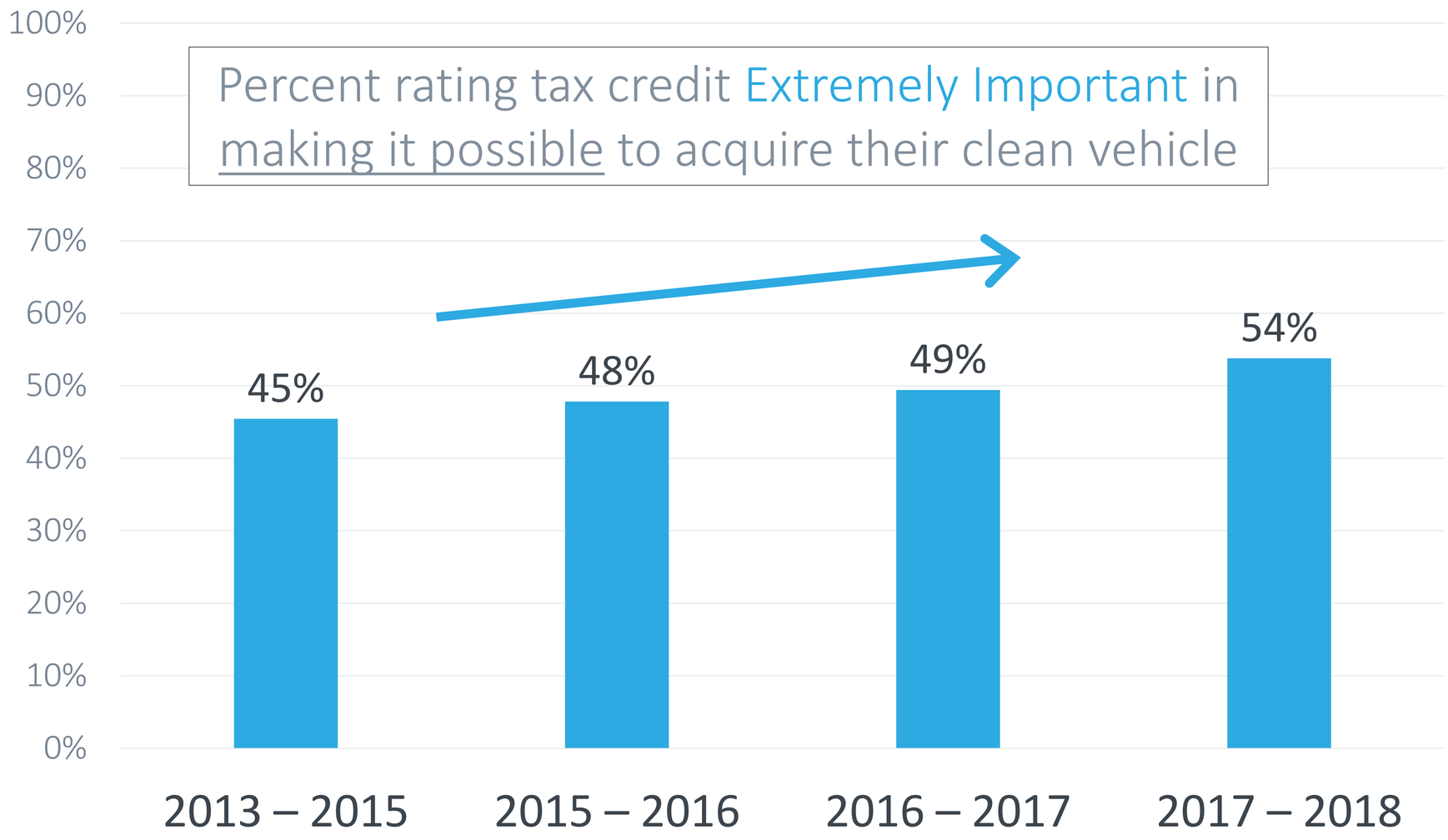
Percent Rating the Federal Tax Credit "Extremely Important"

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



Overall datasets: 70,020 total survey respondents weighted to represent 301,619 rebate recipients

Extreme Importance of Federal Tax Credit is Increasing

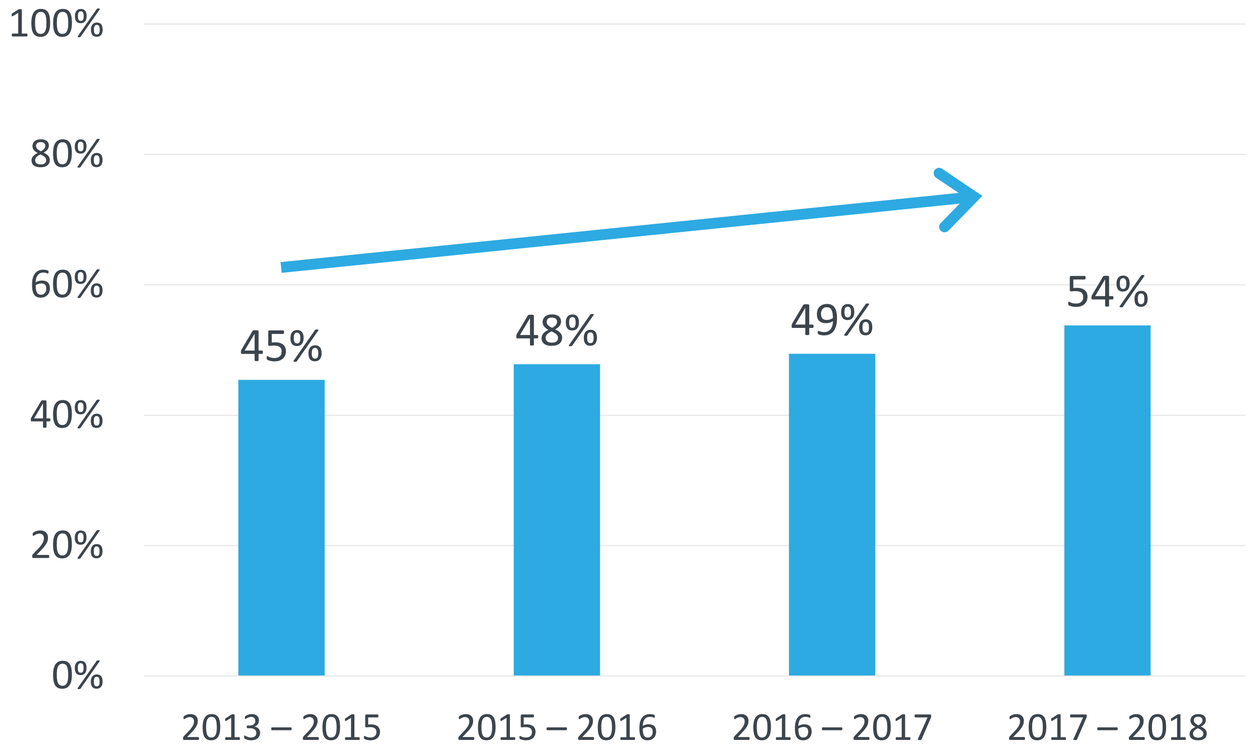


CVRP Consumer Survey: 2013–15 edition weighted n = 18,967, 2015–16 edition weighted n = 10,724, 2016–17 edition weighted n = 8,278; 2017–18 edition weighted n = 17,101

Fed Tax Incentive Importance is *Increasing* Over Time, Contradicting a Common Paradigm About Phasing Out Incentives

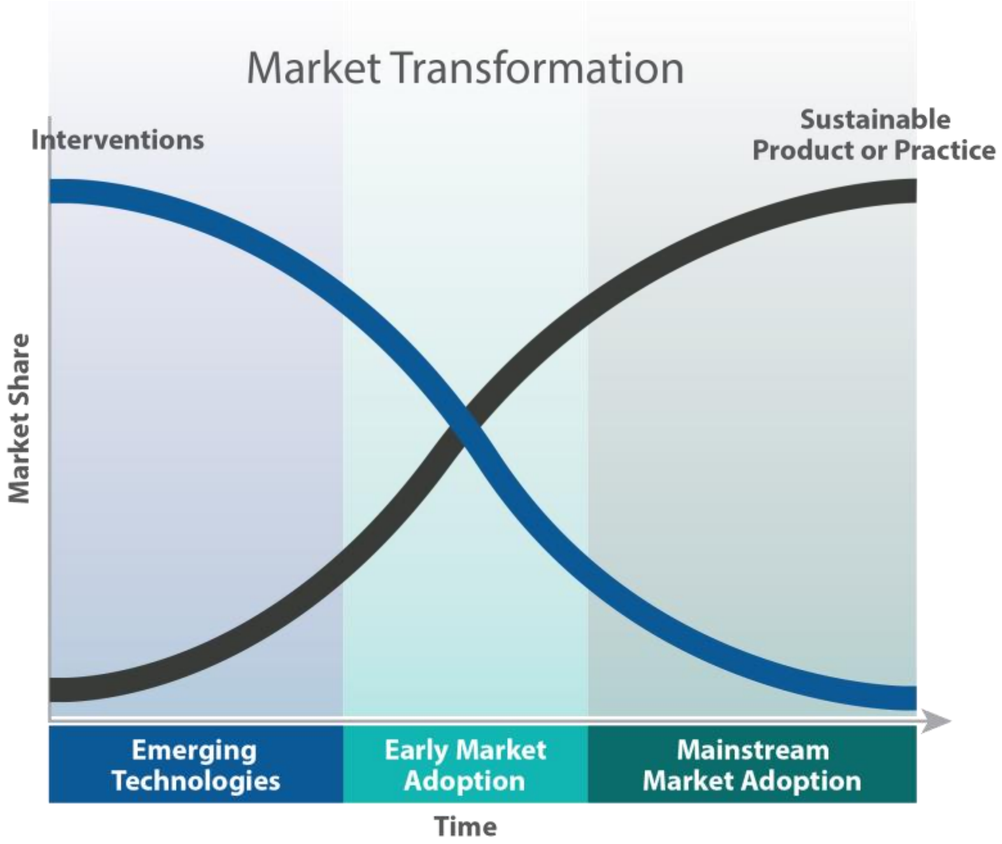
CALIFORNIA CLEAN VEHICLE REBATE PROJECT

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

Additional Design Considerations

Income and MSRP caps, Program-Change Analysis and Design Recommendations

EV Rebate Designs *(as of Sept. 2018), Reflective of most of the data gathered*

	CALIFORNIA CLEAN VEHICLE REBATE PROJECT™	MOR-EV Massachusetts Offers Rebates for Electric Vehicles	CHEAPR Connecticut Hydrogen and Electric Automobile Purchase Rebate	NEW YORK STATE
Fuel-Cell EVs 	$5,000	$2,500	$5,000	e-miles ≥ 120 $2,000 ≥ 40 $1,700 ≥ 20 $1,100 < 20 $500
All-Battery EVs 	$2,500	$2,500	e-miles ≥ 175 $3,000 ≥ 100 $2,000 < 100 $500	
Plug-in Hybrid EVs 	$2,500 (i3 REx) $1,500	≥10 kWh $2,500 <10 kWh $1,500	≥ 40 $2,000 < 40 $500	
Zero-Emission Motorcycles 	$900	$750		
	• e-miles ≥ 20 only • Consumer income cap • increased rebates for lower-income households	• Base MSRP ≥ $60k = $1,000 max. • no fleet rebates Program ended 9/30/19	• Base MSRP ≤ $60k only • dealer assignment • $150 dealer incentive ($300 previous)	• Base MSRP > $60k = $500 max. • point-of-sale via dealer

Center for Sustainable Energy®

CVRP	Eligibility		Rebate Amount			
	Filing Status	Gross Annual Income	FCEV	BEV	PHEV	ZEM
Income Cap	Individual	> $150,000	$5,000 (unless received an HOV sticker)	Not Eligible		
	Head of Household	> $204,000				
	Joint	> $300,000				
Standard Rebate	Individual	300% FPL to $150,000	$5,000	$2,500	$1,500	$900
	Head of Household	300% FPL to $204,000				
	Joint	300% FPL to $300,000				
Increased Rebate for Low-Income Applicants*	*Household* Income ≤ 300 percent of the federal poverty level (FPL)		$7,000	$4,500	$3,500	

** Applications are also prioritized.*

Income-Based Eligibility: Implementation Considerations

- **Dealer reluctance**, fears about liability
- **Outreach complexity**, consumer confusion
- **Application complexity**, affects all applicants
- **Intrusiveness**, tax forms
- **Wait times**, even for priority applicants
- **Investment** in processing systems, **labor**
- **Fraud**
- **Loopholes**
- **Precludes a point-of-sale rebate**, which would benefit those that need the rebate most

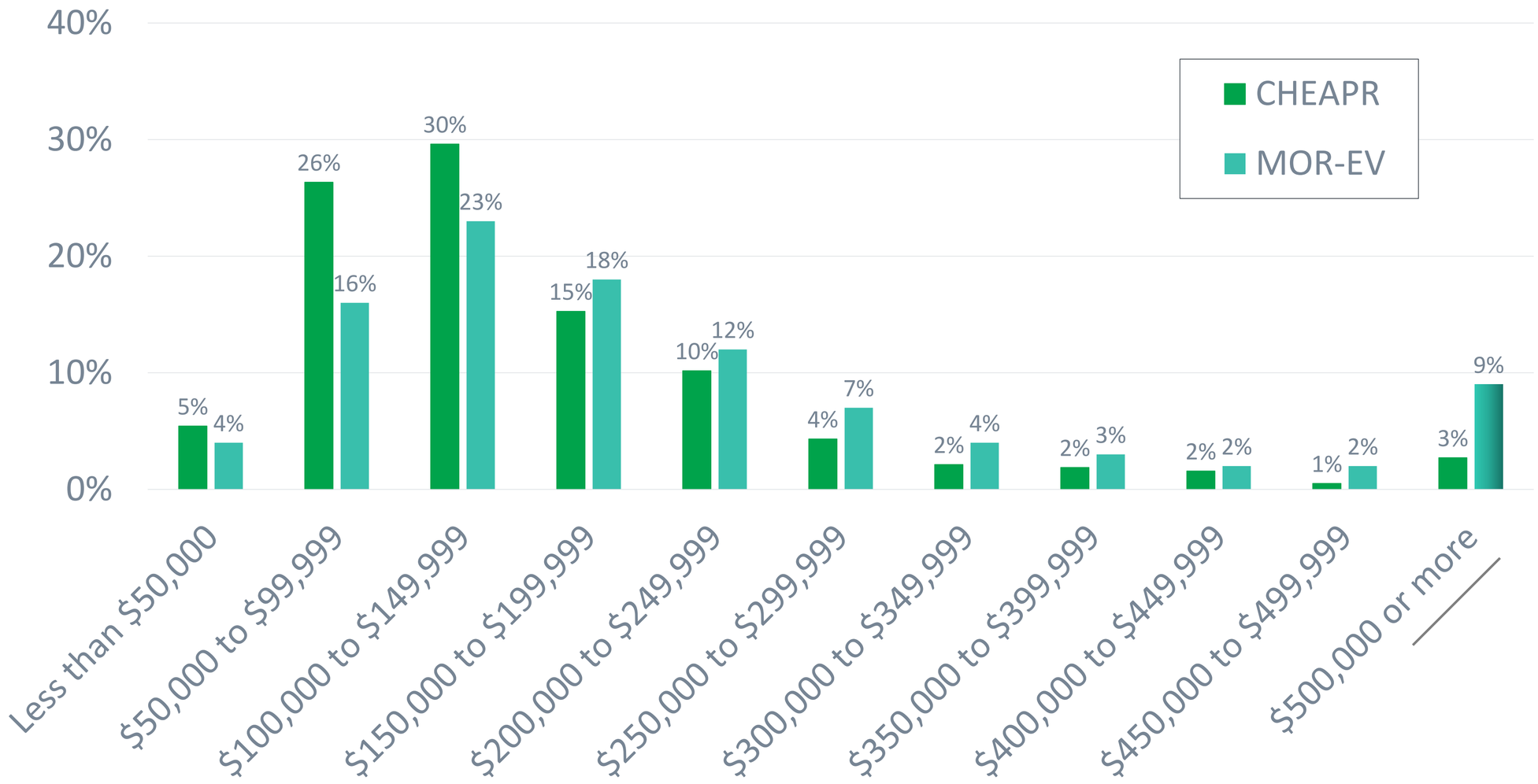
Point-of sale rebates with MSRP caps *may* better support equity goals…
Supplemented with *Increased Rebates* based upon income criteria

Differing Approaches, Similar Metrics…

	"Buying Age" *21+ Years Old* U.S. Population (Census 2017)	**New-Vehicle Buyers** U.S. MYs 2016–17 (2017 NHTS)	CALIFORNIA CLEAN VEHICLE REBATE PROJECT™ CY 2017 weighted n = 9,539	MOR-EV Massachusetts Offers Rebates for Electric Vehicles CY 2017 weighted n = 1,285	CHEAPR Connecticut Hydrogen and Electric Automobile Purchase Rebate CY 2017 weighted n = 501	NEW YORK STATE Mar. – Dec. 2017 weighted n = 1,014
Selected solely White/Caucasian	65%	74%	58%	85%	88%	86%
≥ 50 Years Old	47%	51%	52%	61%	59%	60%
≥ Bachelor's Degree	30%*	56%*	82%	90%	85%	73%
Own Residence	64%	75%	79%	92%	89%	90%
≥ $150k HH Income	12%	23%	40%	58%	41%	34%
Selected Male	49%	51%	72%**	74%	71%	68%

"Prefer not to answer," "I don't know," and similar responses are excluded throughout.
Census 2017: 2013–2017 American Community Survey, http://factfinder2.census.gov.
NHTS 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.
** Census & NHTS data characterize individual educational attainment, whereas other data characterize highest household attainment.*
*** 100% includes non-binary options.*

CHEAPR and MOR-EV Respondents by Household Income



CHEAPR Survey (2015–17): n=819 total respondents, weighted to represent N=1,583 participants
MOR-EV Survey (2014–17): n=2,549 total respondents, weighted to represent N=5,754

Center for Sustainable Energy®

Program-Change Estimates: Methodology and Data Inputs

Program-Change Levels Explored

- MSRP Cap (FCEV exempt)
  - $60k, $50k, $40k
- UDDS All-Electric Range (AER) Minimum
  - >25, >30, >40, >50, >100
- Income Cap (FCEV exempt)
  - Tax-filing status: $250k, $204k, $150k
- Application limitations
  - Limit one per person, limit three months to apply
- Rebate amounts
  - -$500 for standard rebates, no Standard Rebates, no PHEV rebates, no Standard PHEV rebates

Supporting Data

- MSRP Cap (FCEV exempt)
  - $60k, $50k, $40k
- UDDS All-Electric Range (AER) Minimum
  - >25, >30, >40, >50, >100
- Income Cap (FCEV exempt)
  - Tax-filing status: $250k, $204k, $150k
- Application limitations
  - Limit one per person, limit three months to apply
- Rebate amounts
  - -$500 for standard rebates, no Standard Rebates, no PHEV rebates, no Standard PHEV rebates

Electric Vehicles by Base MSRP

Key
> $60,000
$50,000–$59,999
$40,000–$49,999

* Indicates model year 2018, all others model year 2019

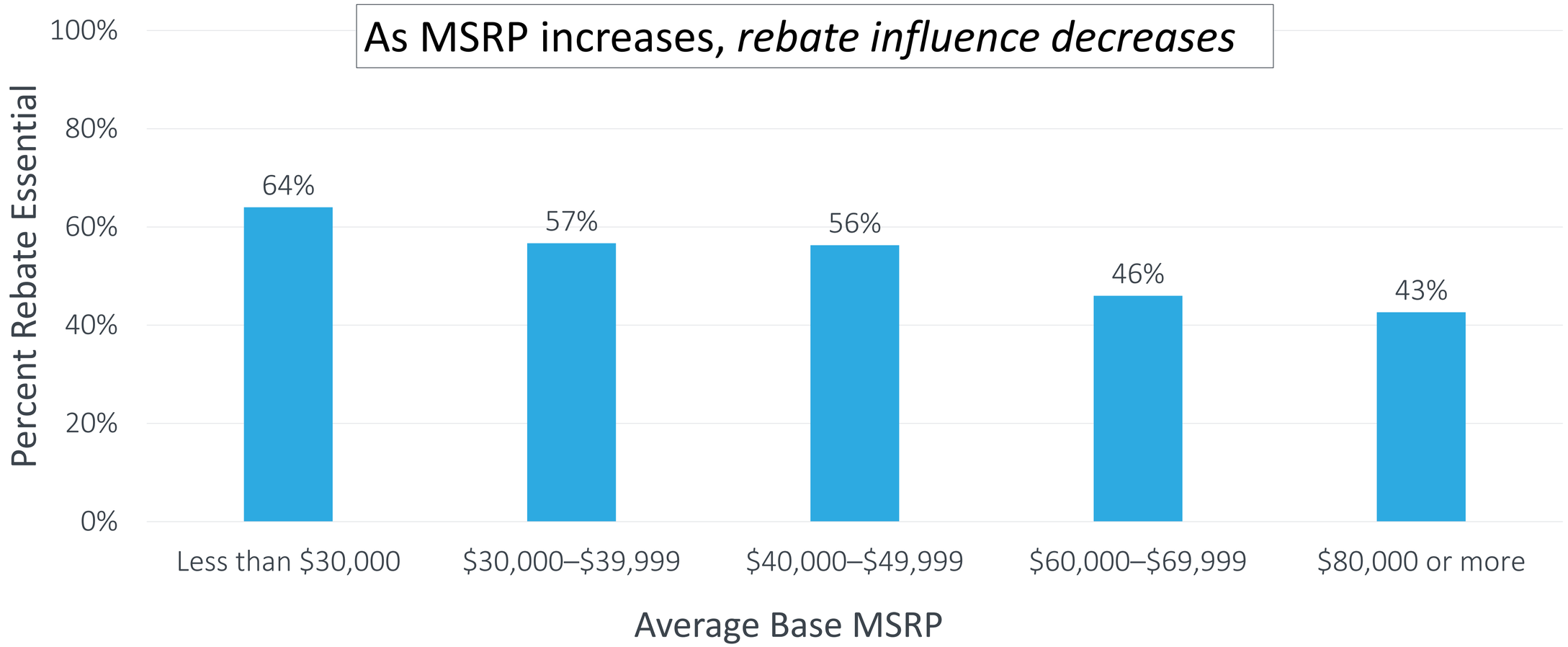
Base Manufacturer's Suggested Retail Price (MSRP) sources: Manufacturer websites, FuelEconomy.gov, Kelley Blue Book

Note: FCEVs, discontinued PEVs, and motorcycles not included.

CALIFORNIA CLEAN VEHICLE REBATE PROJECT™

Vehicle Make and Model	Base MSRP
BMW 530e xDrive iPerformance	$55,700
Audi A3 e-tron*	$39,500
BMW 530e iPerformance	$53,400
Volvo XC60 T8	$55,300
Volvo XC90 T8	$67,000
Volvo S90 T8	$63,900
Mitsubishi Outlander PHEV	$34,595
Toyota Prius Prime	$27,350
Ford Fusion Energi	$34,595
Kia Niro Plug-in Hybrid	$28,500
Hyundai Sonata Plug-in Hybrid	$32,400
Hyundai Ioniq PHEV	$25,350
Kia Optima Plug-in Hybrid	$35,390
Chrysler Pacifica	$39,995
Honda Clarity Plug-In Hybrid	$33,400
smart Electric Fortwo Cabriolet	$28,100
smart Electric Fortwo Coupe	$23,900
FIAT 500e	$32,995
Honda Clarity Electric	$37,540
BMW i3 REx*	$48,300
Kia Soul EV	$33,950
Ford Focus Electric*	$29,120
Hyundai Ioniq Electric	$30,315
Volkswagen e-Golf	$30,495
BMW i3s REx	$51,500
Nissan LEAF	$29,990
BMW i3	$44,450
BMW i3s	$47,650
Nissan LEAF Plus	$36,550
Jaguar I-PACE	$69,500
Chevrolet Bolt	$36,620
Tesla Model X	$88,000
Hyundai Kona Electric	$36,450
Tesla Model 3 (Medium-range)	$47,990
Tesla Model S	$85,000

Rebate Essentiality Reflects Interesting Trends

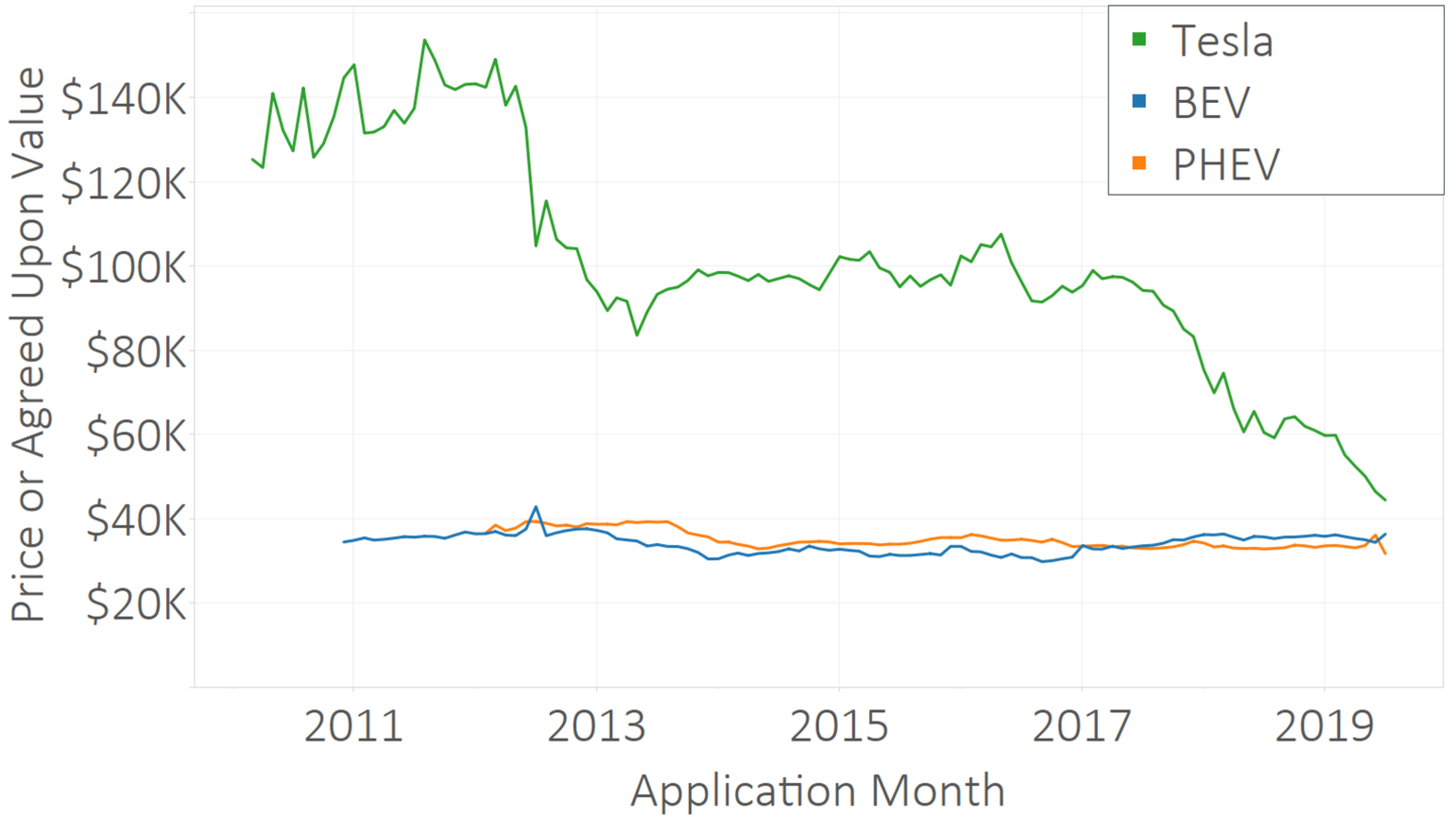


CVRP Consumer Survey: 2016–17 edition, weighted, n = 8,927

Rebate Importance by Vehicle Price

MOR-EV Survey, 2014–17: n = 2,549 total respondents
weighted to represent N = 5,754 participants
Excludes one response missing price data.

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



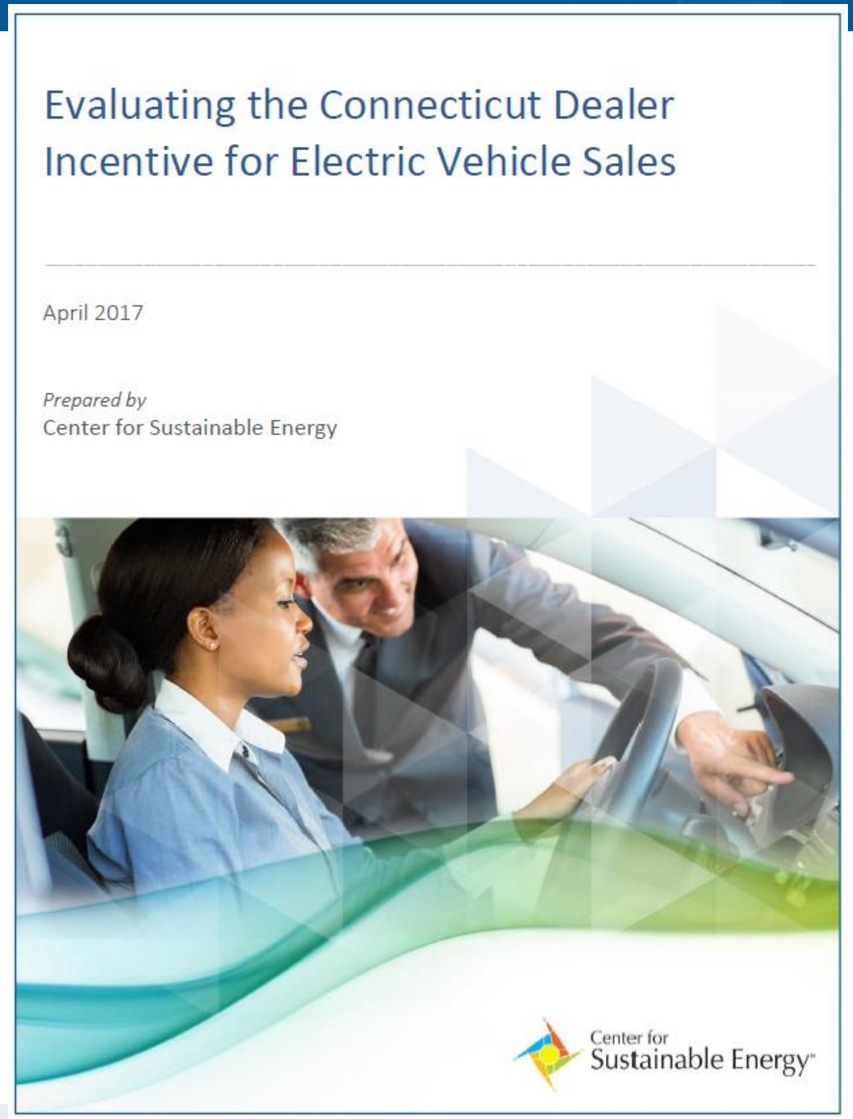
As of 7/12/2019

Program Design Recommendations: Consider…

- **Vehicle eligibility: base MSRP** (vehicle simply on or off posted list), not upon case-by-case purchase price
- **Rebate amounts: EPA all-electric range thresholds** (fueleconomy.gov), not complex kWh calculations
- **Strategic outreach** based upon program data to **cost-effectively target highly-influenced and mainstream consumers**: “Rebate Essentials” and “EV Converts”
- **Incentive types:**
  1. **Point-of-sale cash rebate** to improve **effectiveness** and **equity, engage dealers**
  2. **Dealer sales incentive** (like a “SPIFF” for the dealership and salesperson) to **leverage dealer outreach** and **motivate sales**
- **Application and Support: Simple** online **application** and rapid **reimbursement** of dealers
- **Program Transparency**:
  - **Dashboards** to show **availability of funds**, rebate **stats**, **consumer-survey** responses and **program impacts** (vehicles added, GHGs avoided)
  - **Internal evaluation** to **guide outreach**, **refine implementation**, and **support planning** (including **projections**)

Dealer Incentives

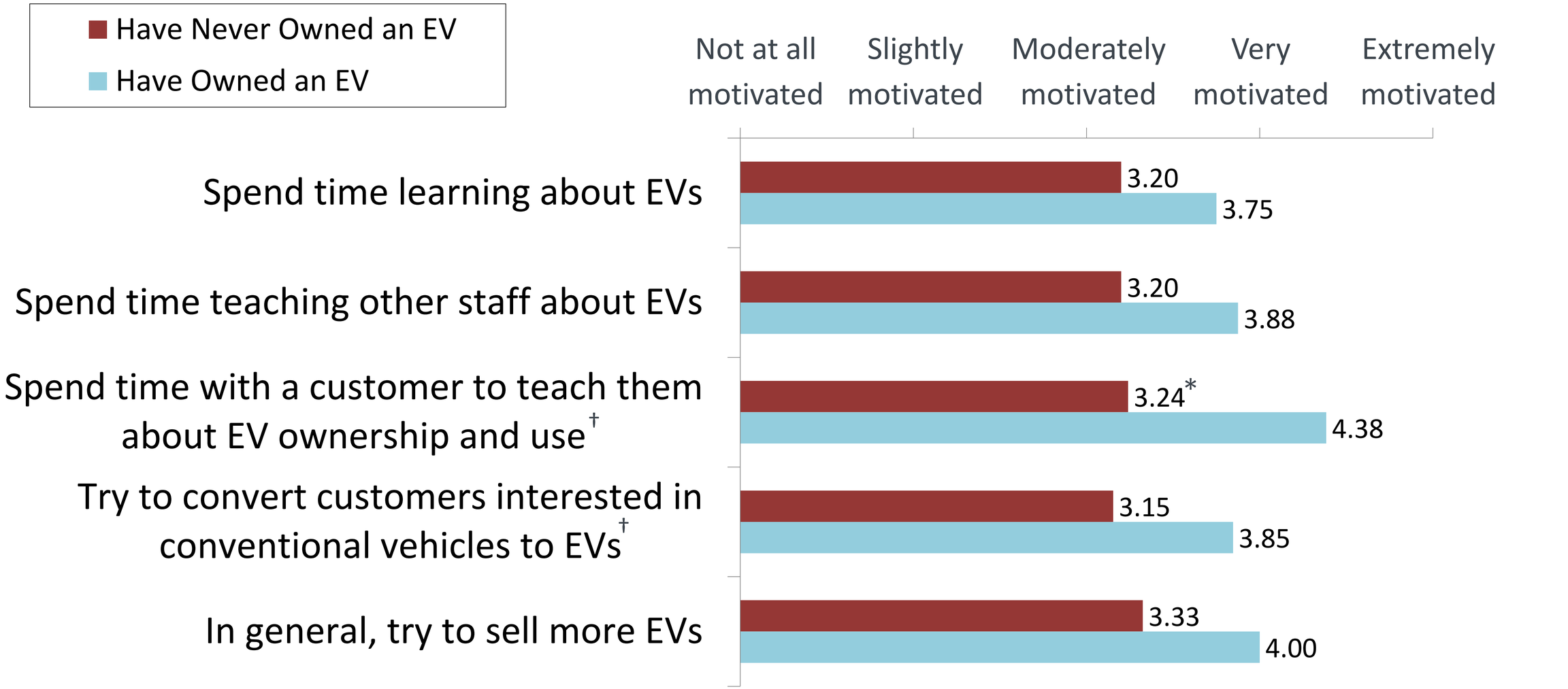
How is the Dealer Incentive Working?



Johnson, Clair, Williams, Brett, Anderson, John & Appenzeller, Nicole (2017), Evaluating the Connecticut Dealer Incentive for Electric Vehicle Sales, Center for Sustainable Energy.

Center for Sustainable Energy®

“To what extent are you motivated by the current dealer incentive to do each of the following?”



Respondents=57

† Fourth and fifth statements only appeared to sales employees; respondents=40

**Statistically significant difference ($p < 0.05$)*

Center for Sustainable Energy®

Broader Policy Options

Tax vs. Cash Incentives, Complementary Policies and Programs

Potential Disadvantages of Tax Incentives

- Equity challenges
  - Consumers who need incentives most often:
    - Lack tax liability*, upfront capital, and financing
    - Are overburdened by tax-planning uncertainty and complexity
    - Can’t float the incentive until tax time
  - Risks: Benefits biased toward free riders with resources, not mainstream
- Dealer’s disengage due to uncertainties, complexities, fear of liability
- General-fund tax expenditures can
  - Compete directly with core services (“fire-fighters and teachers”)
  - Be less transparent than state appropriation processes
  - Be less directly tied to revenue source (e.g., taxpayer desires to spend transportation funds on transportation services, etc.)

* Or, in the case of excise taxes, the typical vehicles purchased may not be subject to an excise tax large enough to max out the credit (e.g., in the case of a 6% excise tax, it would take a $50k purchase price to receive a $3,000 maximum credit, regardless of battery size)

Potential Advantages of Cash Incentives

- Equity, dealer, and general-fund challenges (previous slide) solved, particularly by point-of-sale rebates
- 3 Pillars of Successful Program Administration:
  - Outreach increases widespread awareness of EVs
  - Simple application and (multilingual) customer support facilitates participation by priority populations
  - Program tracking and evaluation provide: transparency, ongoing and adaptive program improvement, and market intelligence that empowers stakeholders throughout the EV ecosystem
- Indications in the research literature suggest rebates might be significantly more effective than tax credits, and point-of-sale rebates even more so

Complimentary Programs & Policies

- Three primary nutrients of for EV demand:
  - 1) upfront purchase/lease subsidies, 2) awareness campaigns, and 3) charging infrastructure
  - Need at least a little of each, else market “starves” and other nutrients become ineffective
- Other polices:
  - Cap-and-invest (e.g., TCI)
  - EV Supply (ZEV regs)
  - Low-carbon fuel standards (LCFS)
  - Fee-bates (potentially revenue-neutral)
  - HOV-lane access and other perks

Wrap Up, Additional Resources & Details

Select Findings: Program Impacts

- Some consumer differences, particularly gender, remain
  - Trending in the right direction
  - Segmentation can support market-acceleration, cost-effectiveness, or mainstreaming, or equity goals
- **~ 4/5^{ths}** of rebated EVs ***replaced*** older, more polluting vehicles
- Avoiding > 30 tons of GHG emissions per vehicle (12-year life) at costs < $100/ton
- Rebate influence on purchase/lease:
  - moderately to extremely important to 9/10^{ths}
  - essential to > 1/2
- Indicators of **impact** tend to be ***increasing***
- Programs with MSRP caps and cash on the hood may support equity as well as, or better than, programs with income caps. *Supplement* with Increased Rebates based on income, as needed.
- Dealer sales incentives motivate EV salespeople, particularly those with prior EV ownership experience

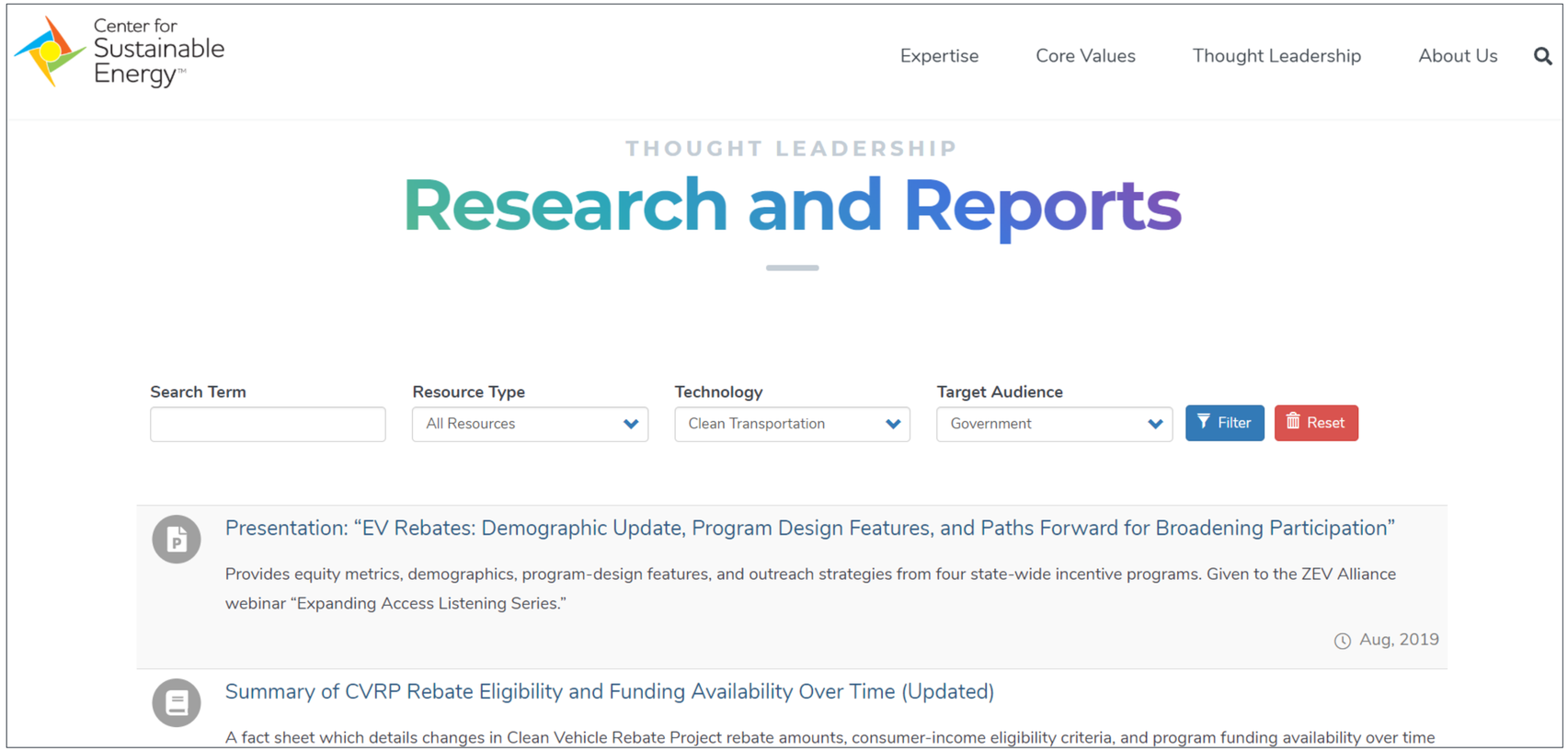
Select Findings: Vehicle Replacement

- **~4/5^{ths}** of rebated EVs ***replaced*** older, more polluting vehicles
- PHEVs produced strong replacement rates early, BEVs catching up
- These and other **impacts tend to be *increasing*** over time
- Replaced vehicles:
  - **1/4th** are **>12 years old**, **1/2** are **>5 years old**
  - **2/3^{rds}** are **gasoline**, down from 3/4^{ths}, but *stabilized/rebounding*
- In absence of the rebate, **2/3^{rds}** of consumers may have **used a different vehicle than rebated**, 40% a non-EV, and **20–25% their old vehicle**
- Related research: when compared to buying a *new* non-EV, rebated EVs may be saving >30 tons of GHG emissions per vehicle (12-year life) at costs <$100/ton

Additional Resources & Details

CSE Clean Transportation Resources

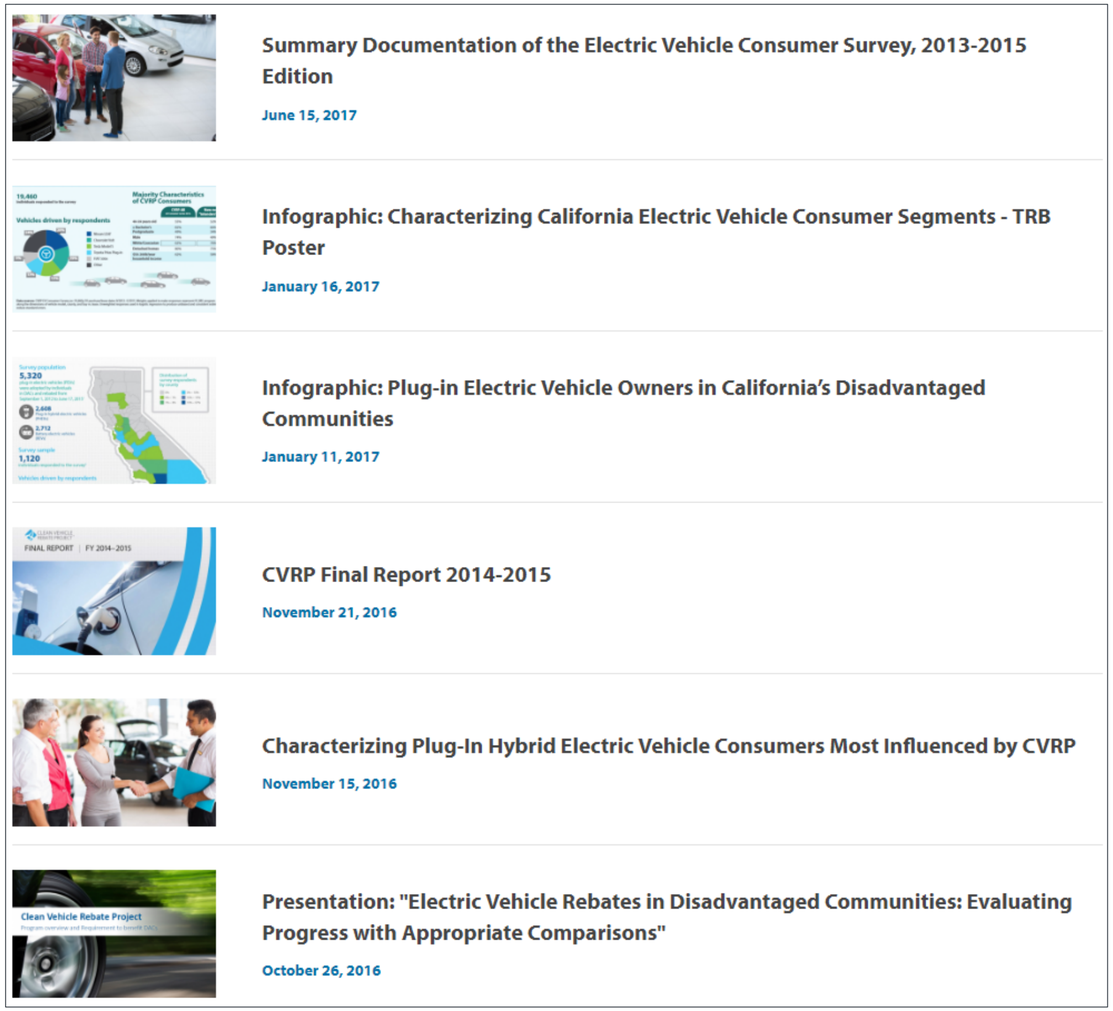
Reports, analysis, infographics, presentations, …



Evaluation: CVRP Analysis

CALIFORNIA CLEAN VEHICLE REBATE PROJECT℠

[Program reports, fact sheets, infographics & presentations]



Summary Documentation of the Electric Vehicle Consumer Survey, 2013-2015 Edition

June 15, 2017

Infographic: Characterizing California Electric Vehicle Consumer Segments - TRB Poster

January 16, 2017

Infographic: Plug-in Electric Vehicle Owners in California's Disadvantaged Communities

January 11, 2017

CVRP Final Report 2014-2015

November 21, 2016

Characterizing Plug-In Hybrid Electric Vehicle Consumers Most Influenced by CVRP

November 15, 2016

Presentation: "Electric Vehicle Rebates in Disadvantaged Communities: Evaluating Progress with Appropriate Comparisons"

October 26, 2016

Select Pertinent Highlights *(Reverse Chronological)*

- Additional Analysis of CVRP Funding Need and Program-Change Scenarios (and predecessors linked on last slide)
- "CVRP: Data and Analysis Update"
- Cost-Effectively Targeting EV Outreach and Incentives to "Rebate-Essential" Consumers
- Peer-Reviewed Conference Paper: "Strategically Targeting Plug-in Electric Vehicle Rebates and Outreach Using Characteristics of 'Rebate-Essential' Consumers in 2016–2017" (update)
- "Electric Vehicle Rebates: Exploring Indicators of Impact in Four States"
- Targeting EV Consumer Segments & Incentivizing Dealers

Select Pertinent Highlights, Cont. *(Reverse Chronological)*

- Report: Evaluating the Connecticut Dealer Incentive for Electric Vehicle Sales
- Supporting EV Commercialization with Rebates: Statewide Programs, Vehicle & Consumer Data, and Select Findings
- Yale Webinar: Supporting EV Commercialization with Rebates: Statewide Programs, Vehicle & Consumer Data, and Select Findings
- "CVRP Income Cap Analysis: Informing Policy Discussions"

EV Rebate Designs

(As of Sept. 2018; Reflective of Most of the Data Gathered)

	CALIFORNIA CLEAN VEHICLE REBATE PROJECT™	MOR-EV Massachusetts Offers Rebates for Electric Vehicles	CHEAPR Connecticut Hydrogen and Electric Automobile Purchase Rebate	NEW YORK STATE
Fuel-Cell EVs 	$5,000	$2,500	$5,000	e-miles ≥ 120 $2,000 ≥ 40 $1,700 ≥ 20 $1,100 < 20 $500
All-Battery EVs 	$2,500	$2,500	e-miles ≥ 175 $3,000 ≥ 100 $2,000 < 100 $500	
Plug-in Hybrid EVs 	$2,500 (i3 REx) $1,500	≥10 kWh $2,500 <10 kWh $1,500	≥ 40 $2,000 < 40 $500	
Zero-Emission Motorcycles 	$900	$750		
	• e-miles ≥ 20 only • Consumer income cap • Increased Rebates for lower-income households	• Base MSRP ≥ $60k = $1,000 max. • no fleet rebates Program ended 9/30/19	• Base MSRP ≤ $60k only • dealer assignment • $150 dealer incentive ($300 previous)	• Base MSRP > $60k = $500 max. • point-of-sale via dealer

Center for Sustainable Energy®

State EV Rebate Programs Administered by CSE

(as of Jan. 2019; Oregon pending)

	CALIFORNIA CLEAN VEHICLE REBATE PROJECT™	MOR-EV Massachusetts Offers Rebates for Electric Vehicles	CHEAPR Connecticut Hydrogen and Electric Automobile Purchase Rebate	NEW YORK STATE
Fuel-Cell EVs 	$5,000	$1,500	$5,000	e-miles ≥ 120 $2,000 ≥ 40 $1,700 ≥ 20 $1,100 < 20 $500
All-Battery EVs 	$2,500	$1,500	e-miles ≥ 200 $2,000 ≥ 120 $1,500 < 120 $500	
Plug-in Hybrid EVs 	$2,500 (i3 REx) $1,500	BEVx only: $1,500	≥ 45 $1,000 < 45 $500	
Zero-Emission Motorcycles 	$900	$450		
	• ≥ 20 e-miles only • Income cap • Increased rebates for lower-income households	• Base MSRP ≤ $50k • No fleet rebates Program ended 9/30/19	• BEVs & PHEVs ≤ $50k base MSRP, FCEVs ≤ $60k • Point-of-sale option • $150 dealer incentive	• Base MSRP > $60k = $500 max.; • Point-of-sale

Consumer Survey Data *(Shows Rebates to Individuals Only, CVRP "Current Program" 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	***Nov. 2016**** – Dec. 2018	Jun. 2014 – Oct. 2018	May 2015 – Sep. 2018	Mar. 2017 – Jul. 2018	Jun. 2014 – Dec. 2018
Survey Responses (total n)**	23,478	4,555	1,565	1,808	31,406
Program Population (N)	135,897	10,920	3,510	8,651	158,978

** After the most recent change in the program's income criteria, to reflect the "current program era"*
*** Weighted to represent the program population along the dimensions of vehicle category, vehicle model, buy vs. lease, and county (using raking method)*

Rebated EV Consumer Characteristics (CVRP "current program" only)

	"Buying Age" *21+ Years Old* U.S. Population (Census 2017)	**New-Vehicle Buyers** U.S. MYs 2016–17 (2017 NHTS)	CALIFORNIA CLEAN VEHICLE REBATE PROJECT™ ***Nov. 2016*** – Dec. 2018 weighted n = 23,478	MOR-EV Massachusetts Offers Rebates for Electric Vehicles Jun. 2014 – Oct. 2018 weighted n = 4,555	CHEAPR Connecticut Hydrogen and Electric Automobile Purchase Rebate May 2015 – Sep. 2018 weighted n =1,565	NEW YORK STATE Mar. 2017 – Jul. 2018 weighted n = 1,808
Selected solely White/Caucasian	65%	74%	54%	85%	87%	86%
≥ 50 Years Old	47%	51%	52%	58%	54%	59%
≥ Bachelor's Degree in HH	30%*	56%*	83%	90%	83%	76%
Own Residence	64%	75%	82%	92%	89%	90%
≥ $150k HH Income	12%	23%	42%	58%	43%	39%
Selected Male	49%	51%	73%**	78%	74%	70%

"Prefer not to answer," "I don't know," and similar responses are excluded throughout.
Census 2017: 2013–2017 American Community Survey, http://factfinder2.census.gov.
NHTS 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.
** Census & NHTS data characterize individual educational attainment, whereas other data characterize highest household attainment.*
*** 100% includes non-binary options.*

CSE Areas of Expertise

Clean Transportation

Adoption of electric vehicles and deployment of charging infrastructure

Built Environment

Advancing energy efficiency and renewable resources

Technology Convergence

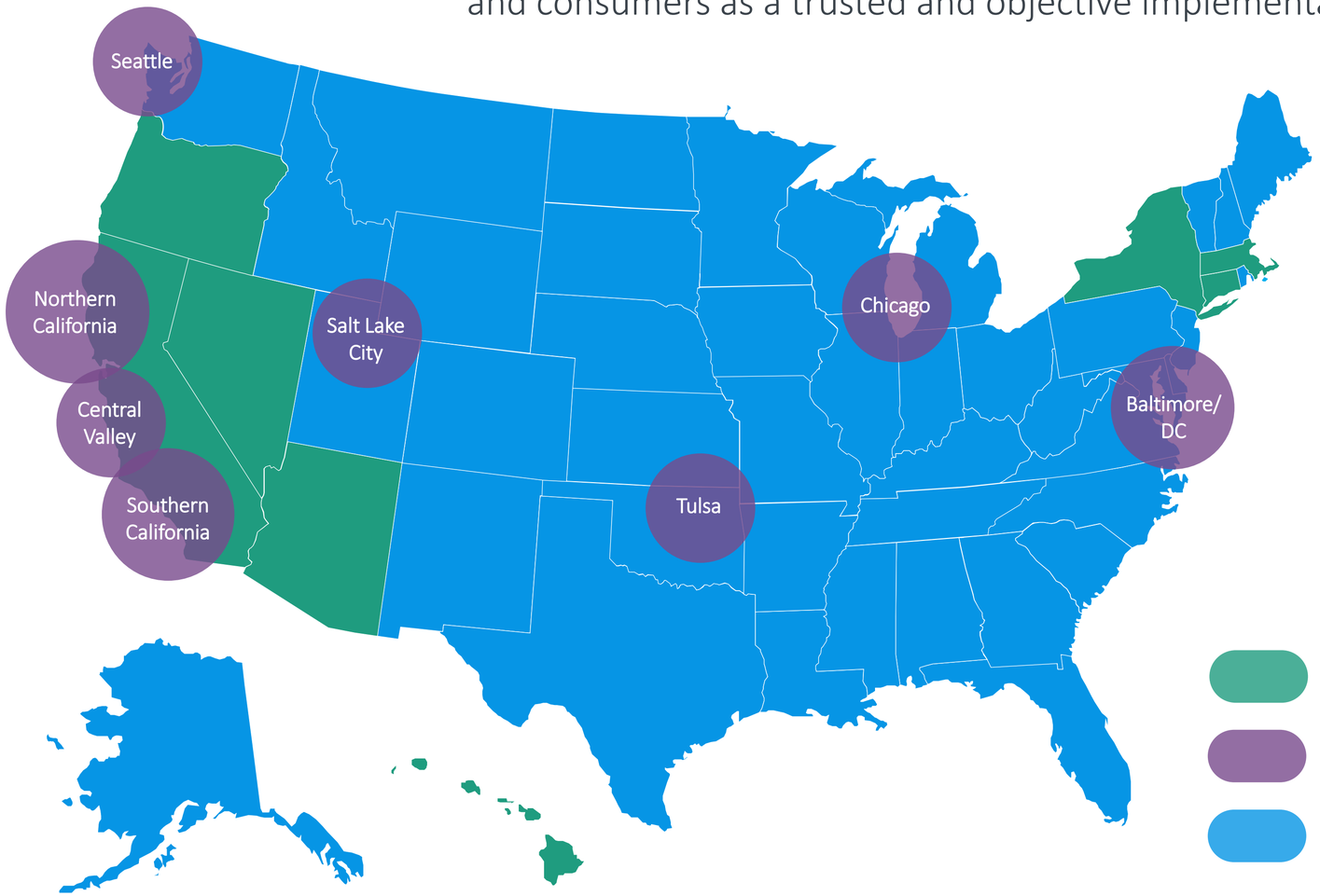
Interconnecting systems to achieve decarbonization

CSE: A Nonprofit With Billion-Dollar Program Management Experience

- **Five Statewide Electric Vehicle Rebate Programs**
  - > $720 million
  - > 350,000 rebated vehicles
  - > 300,000 consumers characterized
- **Statewide EV Charging Incentives**
  - > $100 million
  - 367 DC fast chargers, 211 Level 2 chargers and growing
  - Diverse: urban, rural, mountains, deserts, plains
- **Solar On Multifamily Affordable Housing Program**
  - $1 billion
  - 300 MW + virtual net energy metering

How Can We Help?

We work with governments, regulators, utilities, CCAs, businesses, property owners, and consumers as a trusted and objective implementation partner and technical advisor.



For more information:

https://cleanvehiclerebate.org/eng/program-reports

https://energycenter.org/thought-leadership/research-and-reports

brett.williams@energycenter.org

- Statewide incentive programs
- Region-specific solutions
- Tackling issues of national importance

Contact Us

EnergyCenter.org

HEADQUARTERS

3980 Sherman Street, Suite 170
San Diego, CA 92110

REGIONAL OFFICES

Boston MA • Brooklyn NY
Los Angeles CA • Oakland CA
Sacramento CA • Stony Brook NY

TELEPHONE

858-244-1177

Topics for Discussion

- Tales in EV Sales, in Maryland and elsewhere
- Who is buying EVs and receiving rebates?
  - EV consumer demographics / incentive beneficiaries (a.k.a. “Are they just rich white guys?”)
- What are the paths forward?
  - EV incentive design and outreach strategy for: Volume benefits vs. Cost effectiveness vs. Equity
- Outcomes: what behaviors are rebates influencing?
  - A.k.a. “Are EVs just toys that don’t get used and don’t do any good?”
- Impacts: for the market and emissions
  - A.k.a. “Do they do any good?”
- What about the federal tax credit?
- Implementation perspectives and program design considerations
  - Income caps vs. MSRP caps
  - Pillars of program administration
- Dealer sales incentives
- Comprehensive and effective EV policy frameworks
  - Vehicle supply, awareness, purchase/lease incentives, dealer sales incentivefuel carbon intensity, vehicle use
- Musings for Maryland: program-design recommendations