Transportation Electrification: Incentives

REV2019 Conference

10–11 October 2019, South Burlington VT

Image: https://www.revermont.org/our-work/

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

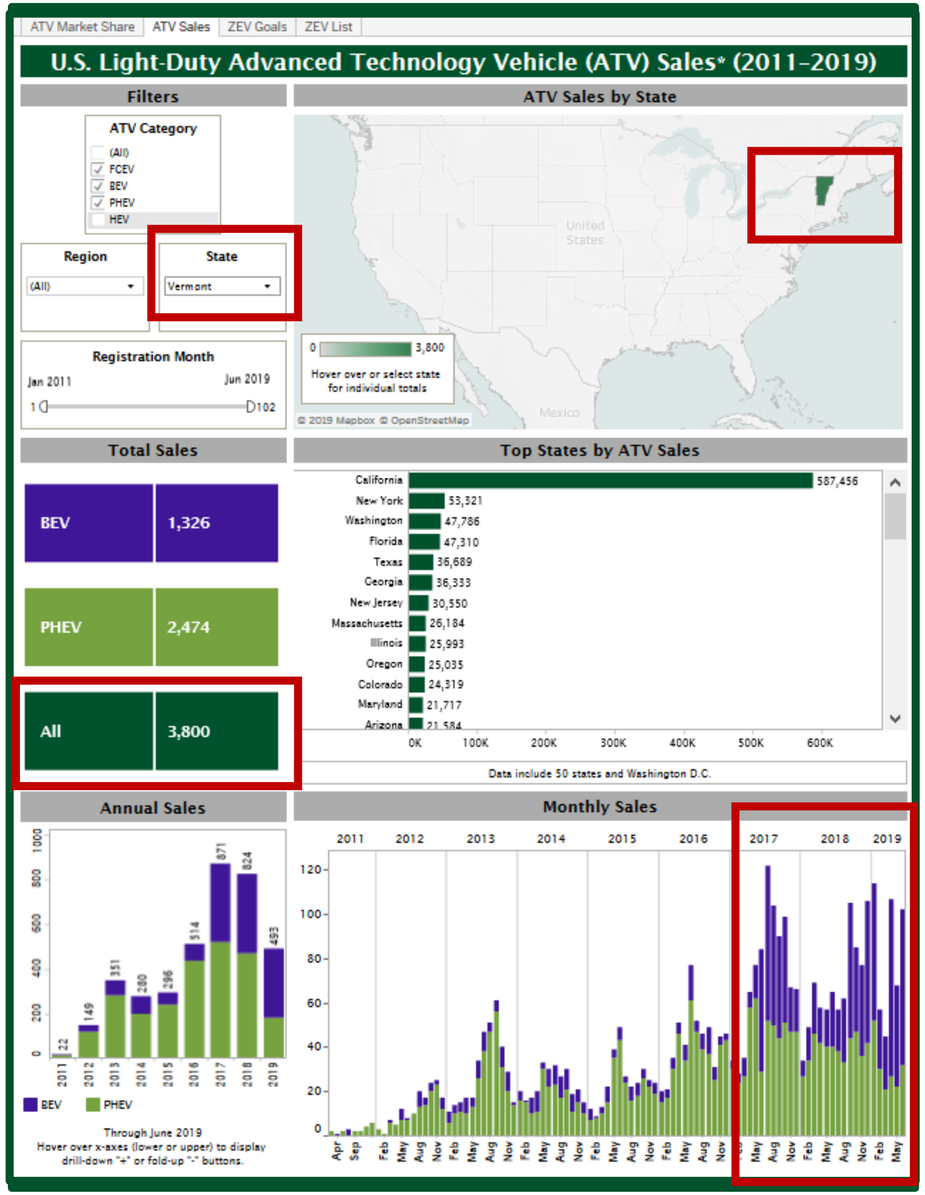
Interconnecting systems to achieve decarbonization

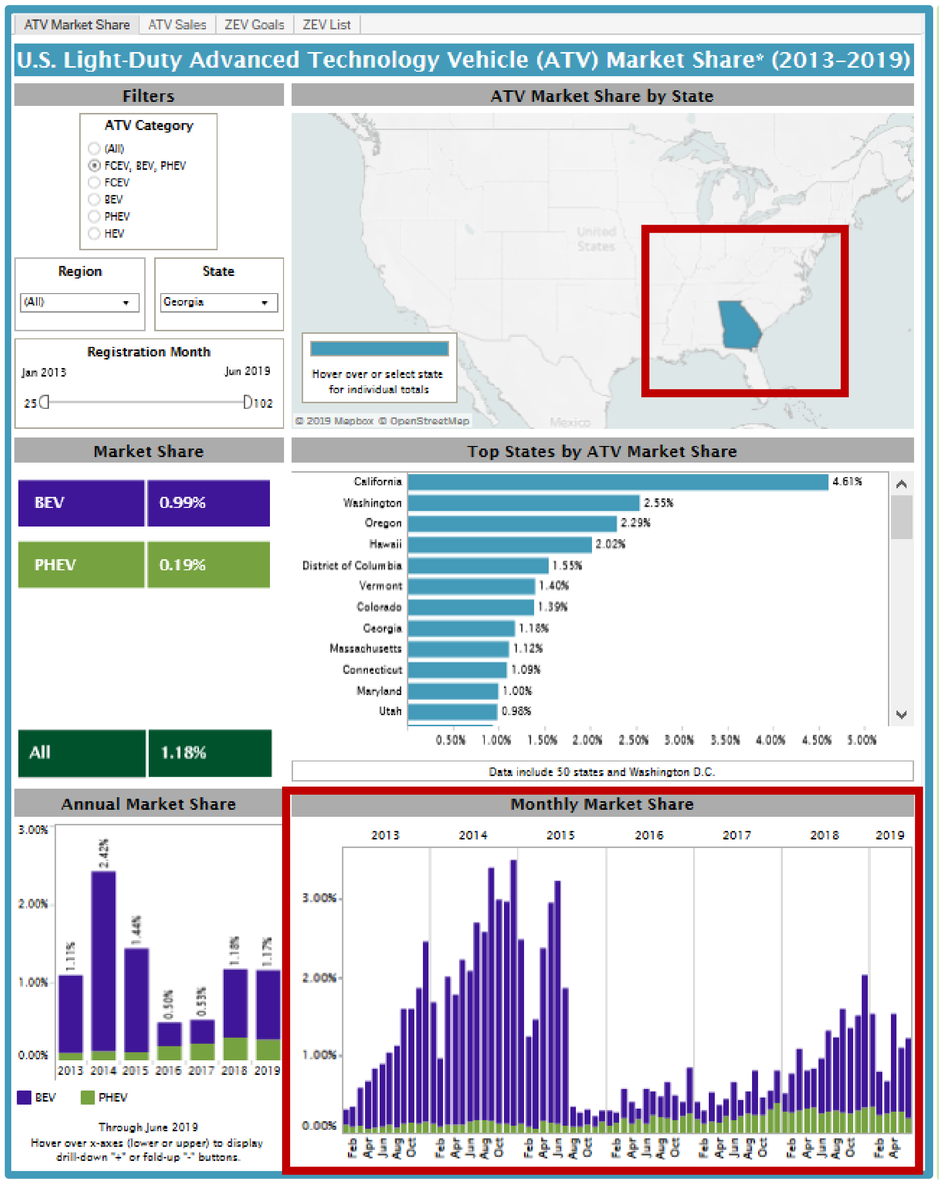
State EV Rebate Programs Administered by CSE

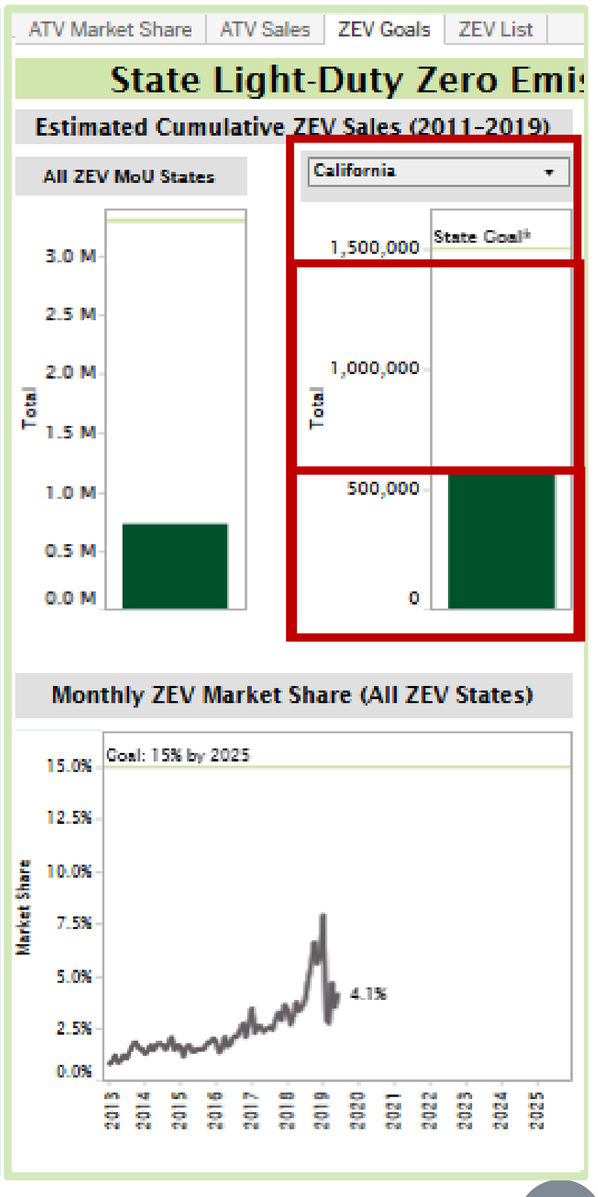
(as of Jan. 2019; Oregon pending)

	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

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





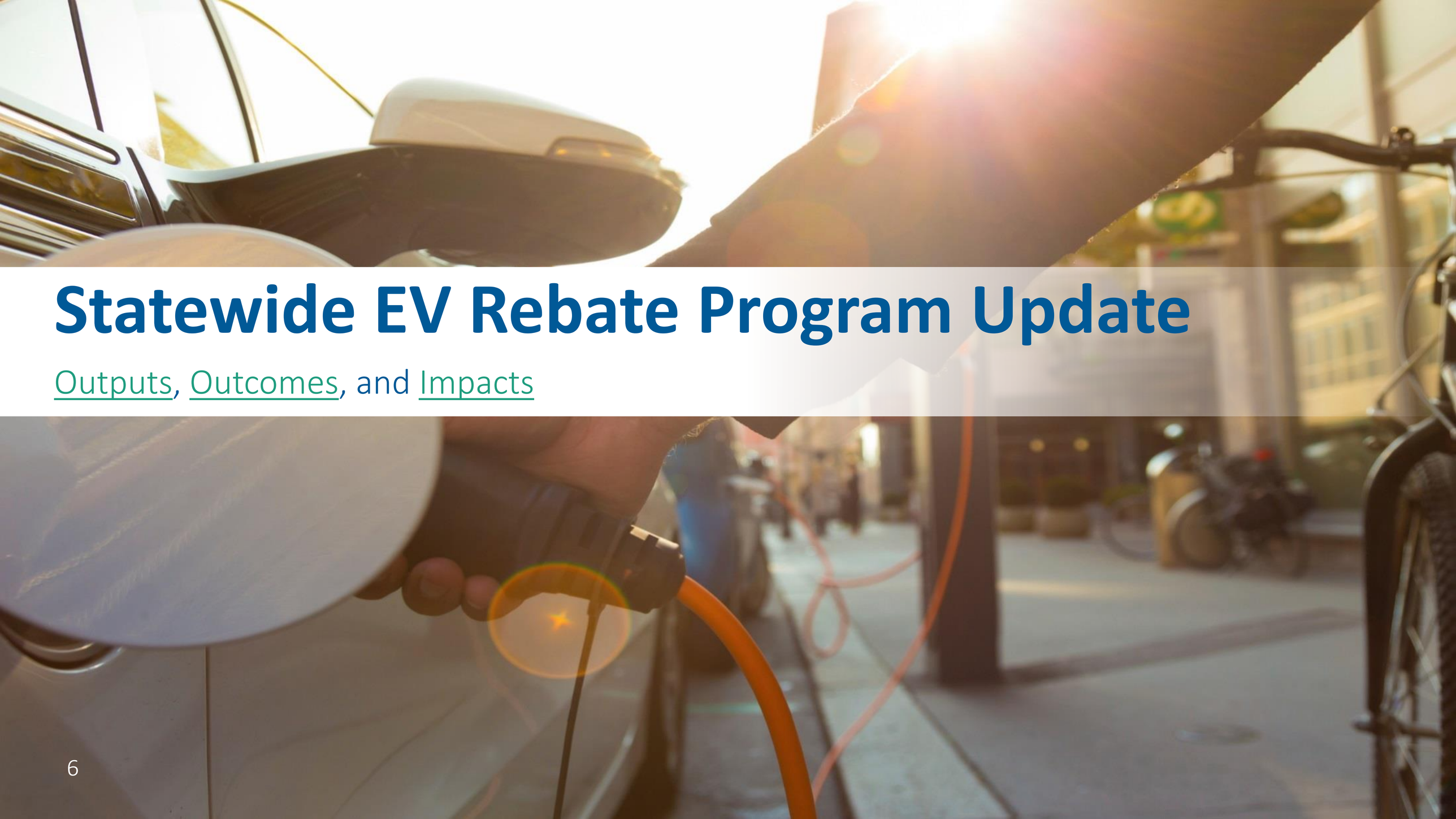


Dashboard prepared by CSE for AA; linked at zevfacts.com

Outline

- Statewide EV Rebate Program Update
  - Outputs: Vehicles & Consumers Rebated
  - Outcomes: Behaviors Influenced
  - Impacts: Emission & Market
- Additional Design Considerations
  - Rebate Effectiveness
  - Equity: Income caps compared to MSRP caps
- Dealer Incentives
- 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

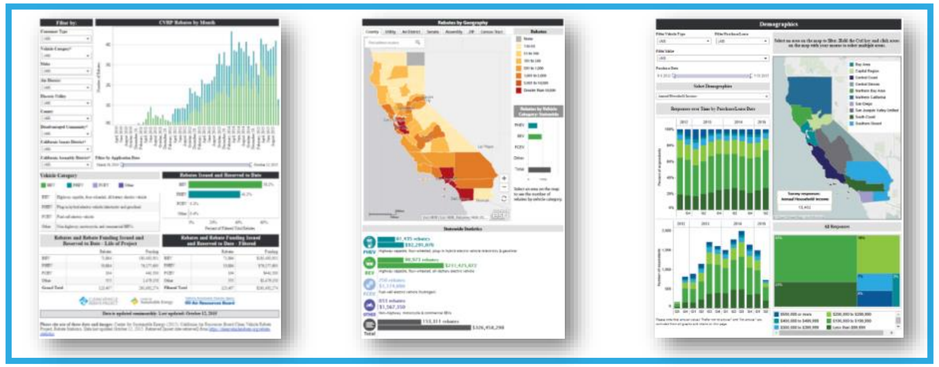
(As of Sept. 2018; Reflective of Most of the Data Gathered)

	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

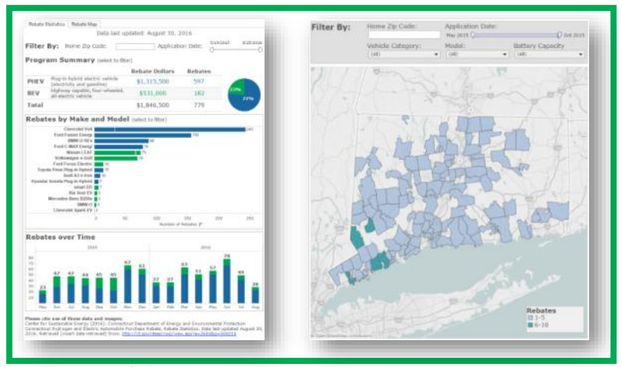
Center for Sustainable Energy®

Outputs: Vehicles Rebated

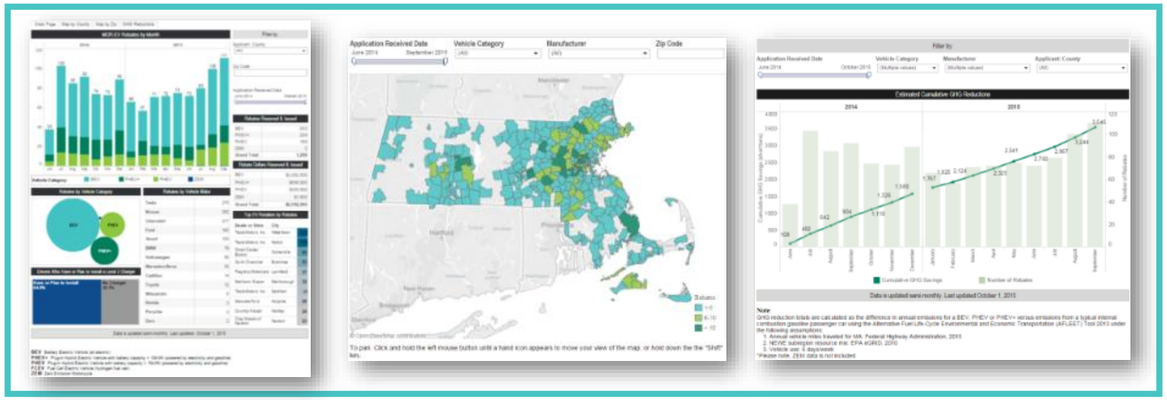
Where Are EV Rebates Going?
Public Dashboards and Data Facilitate Informed Action



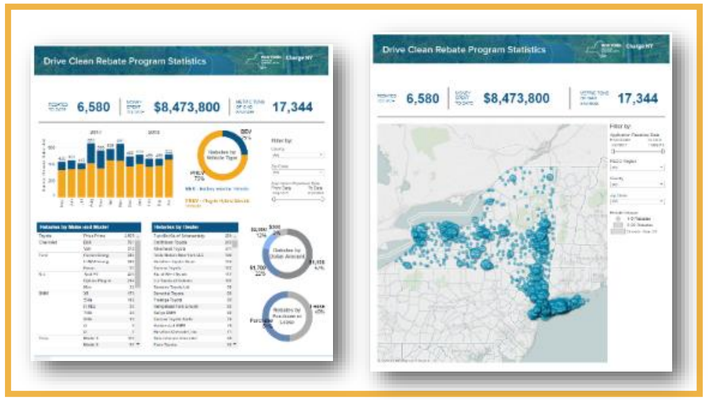
cleanvehiclerebate.org



ct.gov/deep



mor-ev.org



nyserda.ny.gov (dashboards done by NYSERDA)

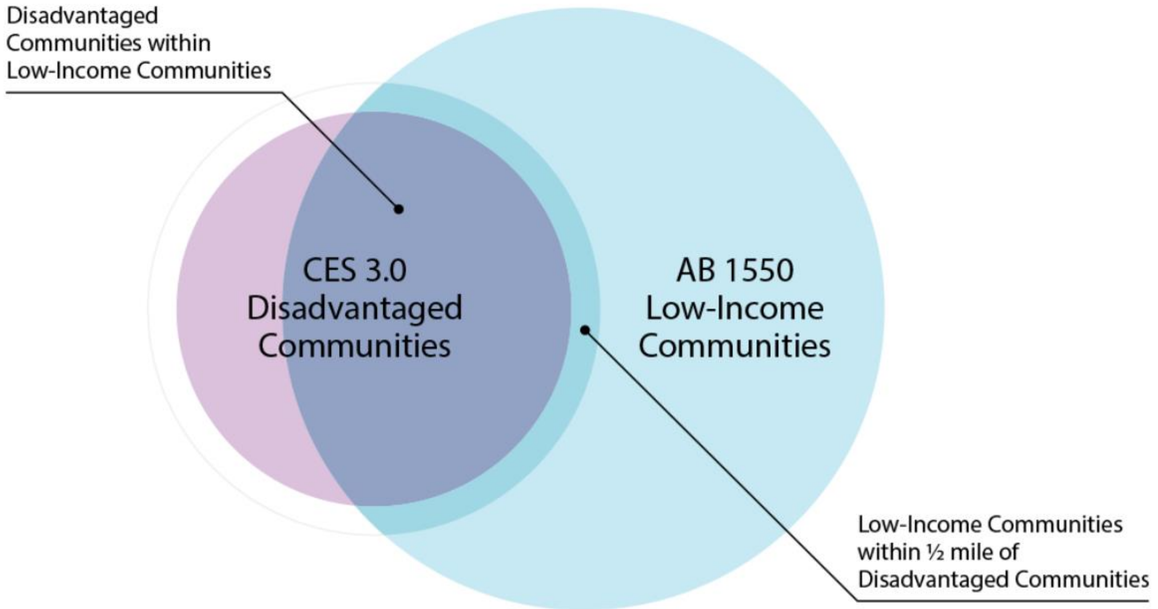
- > 350,000 EVs and consumers have received > $720 M in rebates
- > 70,000 survey responses being analyzed so far, statistically represent > 300,000 consumers
- Reports, presentations, and analysis growing

Equity Statistics Dashboard *(partial)*

Rebate Statistics | Equity Statistics | Notes | Mobile Version

CVRP Equity Rebate Statistics

Priority Communities (AB 1550) [2]



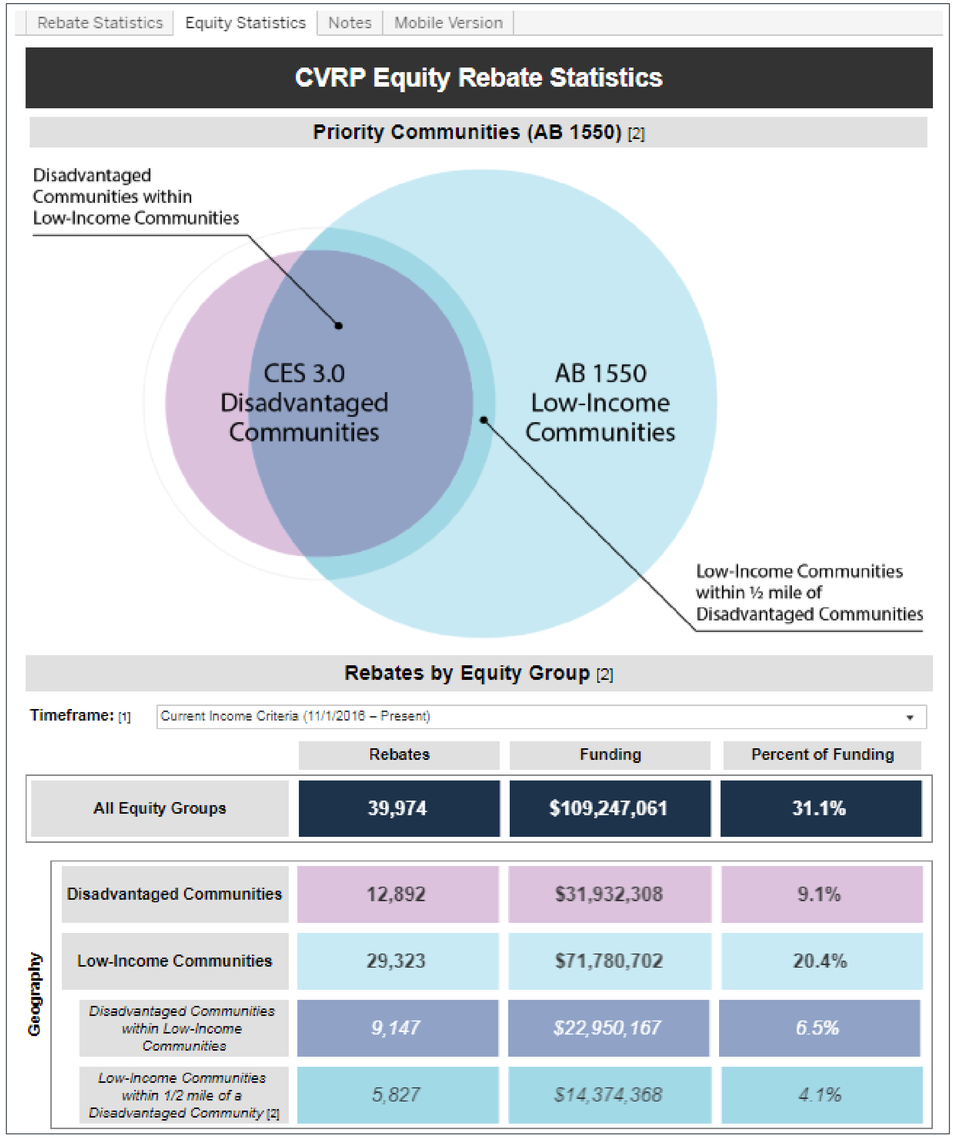
Rebates by Equity Group [2]

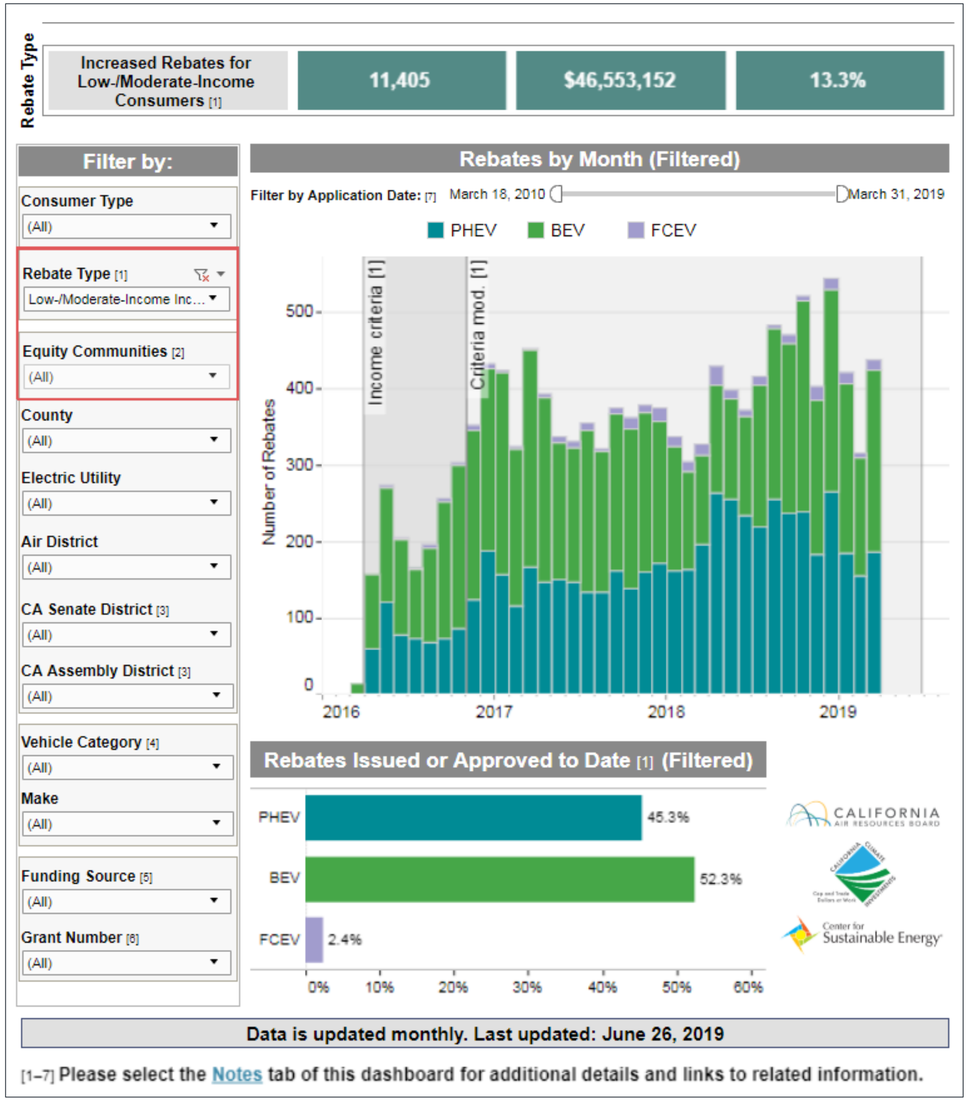
Timeframe: [1] Current Income Criteria (11/1/2016 – Present)

		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

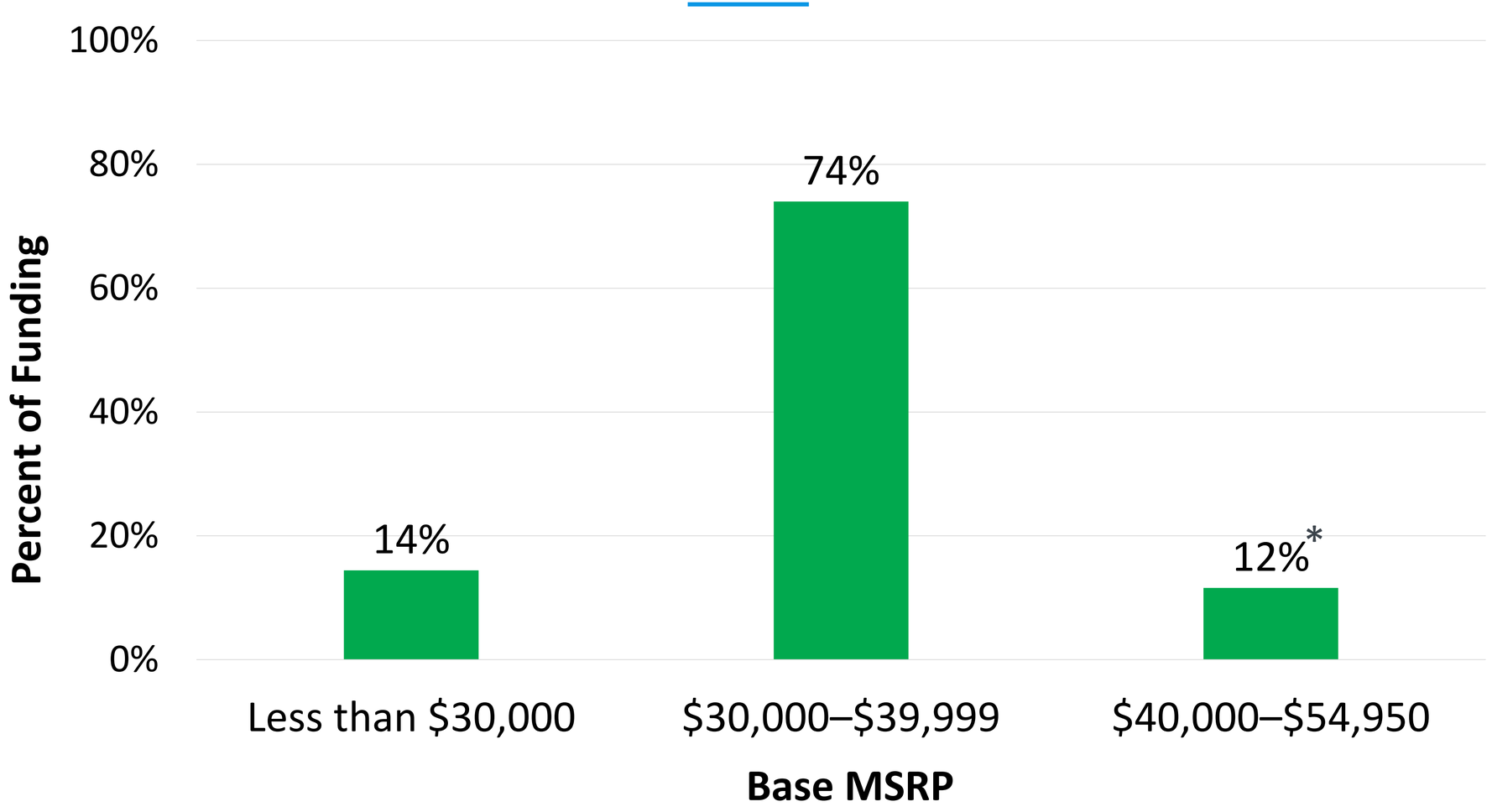




8/5/19 images from https://cleanvehiclerebate.org/eng/rebate-statistics

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

	 **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
- Some differences explained by driving age…

"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

	 **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 difference 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

	"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™ Dec. 2010 – Dec. 2018 weighted n = 62,092	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%	59%	85%	87%	86%
≥ 50 Years Old	47%	51%	50%	58%	54%	59%
≥ Bachelor's Degree in HH	30%*	56%*	83%	90%	83%	76%
Own Residence	64%	75%	83%	92%	89%	90%
≥ $150k HH Income	12%	23%	47%	58%	43%	39%
Selected Male	49%	51%	74%**	78%	74%	70%

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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 (CVRP "current program" only)

	 **All** 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
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≥ 50 Years Old	34%	51%	52%	58%	54%	59%
≥ Bachelor's Degree in HH	23%*	56%*	83%	90%	83%	76%
Own Residence	63%	75%	82%	92%	89%	90%
≥ $150k HH Income	12%	23%	42%	58%	43%	39%
Selected Male	49%	51%	73%**	78%	74%	70%

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≥ Bachelor's Degree in HH	30%*	56%*	83%	90%	83%	76%
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Rebated EV Consumer Characteristics: 2017

	 **All** 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	61%	74%	58%	85%	88%	86%
≥ 50 Years Old	34%	51%	52%	61%	59%	60%
≥ Bachelor's Degree in HH	23%*	56%*	82%	90%	85%	73%
Own Residence	63%	75%	79%	92%	89%	90%
≥ $150k HH Income	12%	23%	40%	58%	41%	34%
Selected Male	49%	51%	72%**	74%	71%	68%

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Rebated EV Consumer Characteristics: 2017

	"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
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≥ 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%
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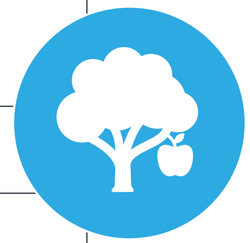
Differing Approaches, Similar Metrics…

	"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 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.*

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.*

EV Consumer Characteristics—MA

MOR-EV
Massachusetts Offers Rebates for Electric Vehicles

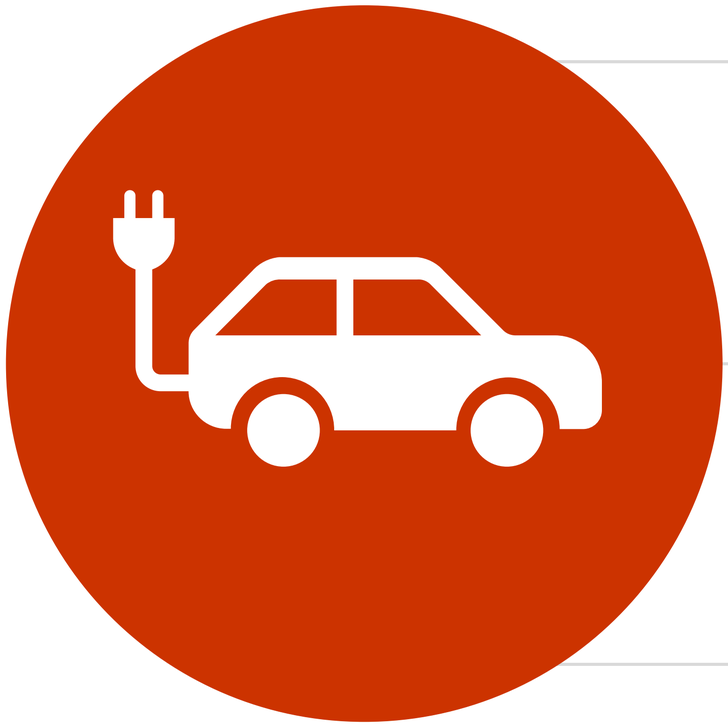
	 MA Population *21+ Years Old* (Census 2017)	New England New-Vehicle Buyers (2017 NHTS)		MOR-EV Massachusetts Offers Rebates for Electric Vehicles MA EV consumers, (rebated for Jun. 2014 – Oct. 2018 adoption)
Selected solely White/Caucasian	76%	88%	>	85%
Male	48%	49%	<<<	78%
≥ Bachelor's degree in HH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

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

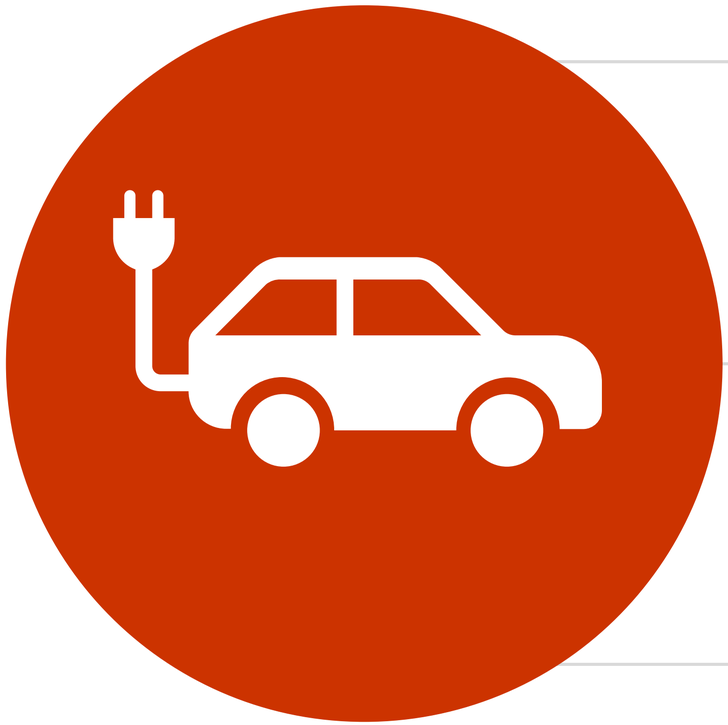
How Can Research Help Us Grow Markets for Electric Vehicles?



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

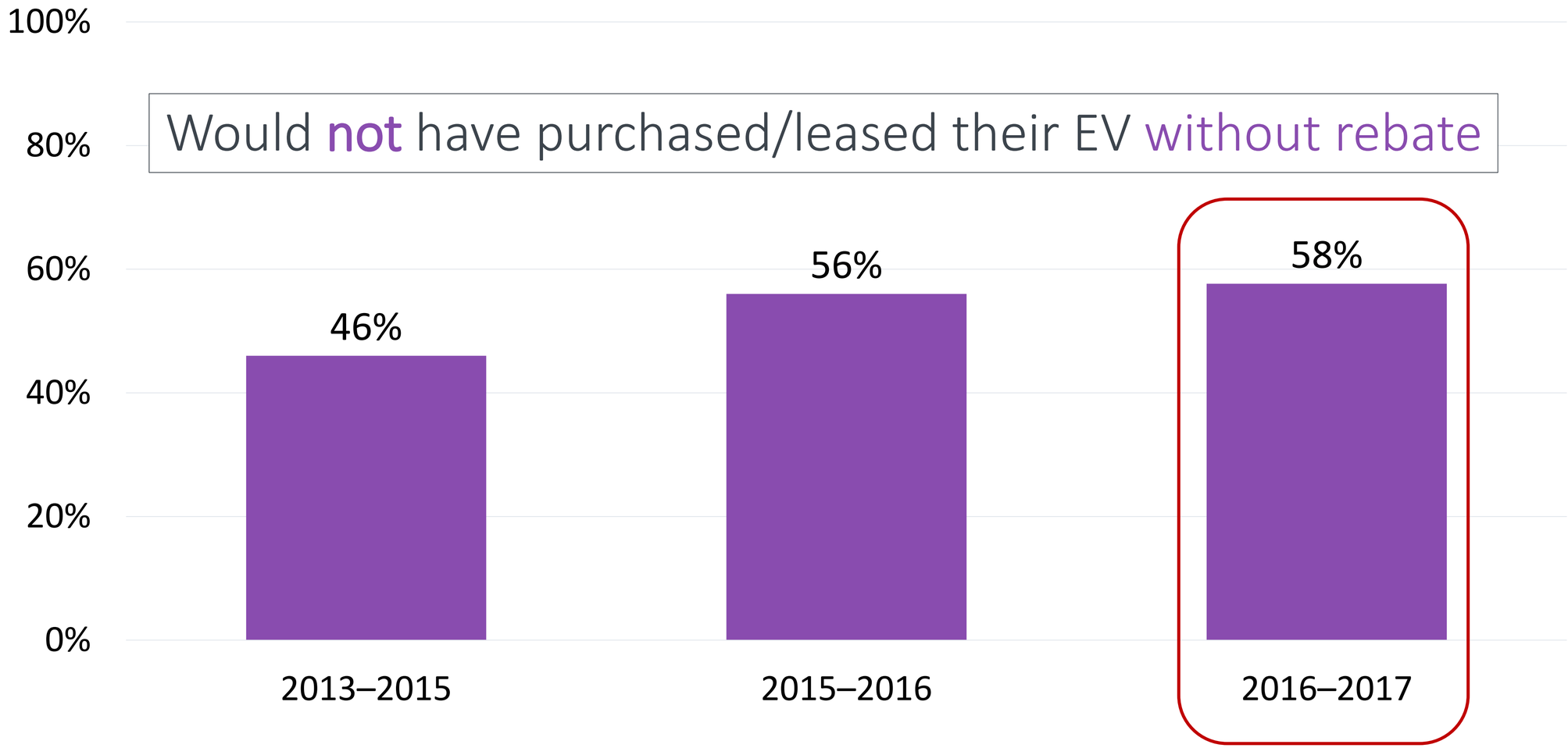
“Rebate Essential” Consumers: Minimizing Free Ridership

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

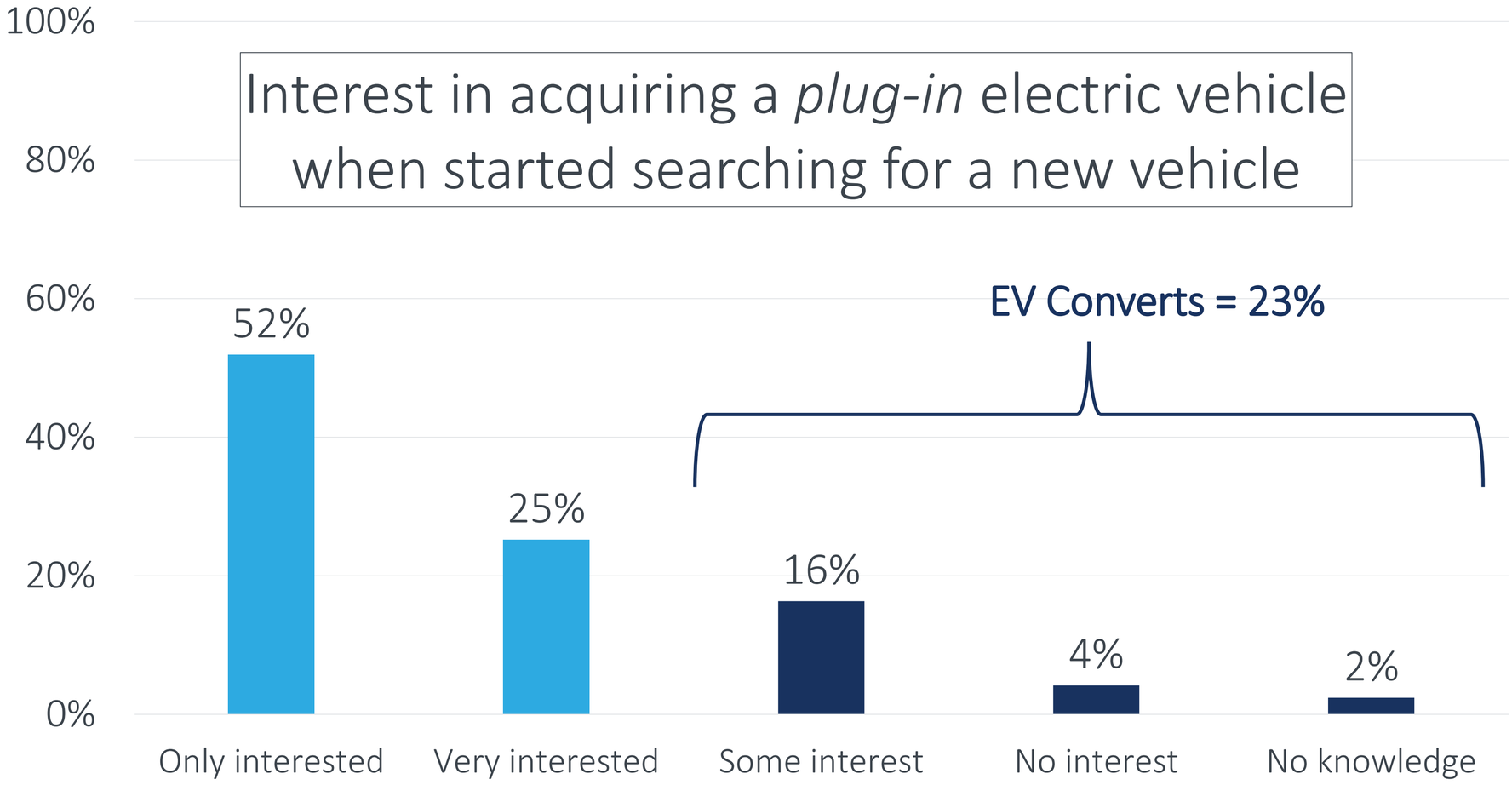
Characterize EV consumers with low initial interest in EVs, to look for additional opportunities to expand into the mainstream

“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.
** NHTS data characterize individual educational attainment, whereas other data characterize highest household attainment.*
*** 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*

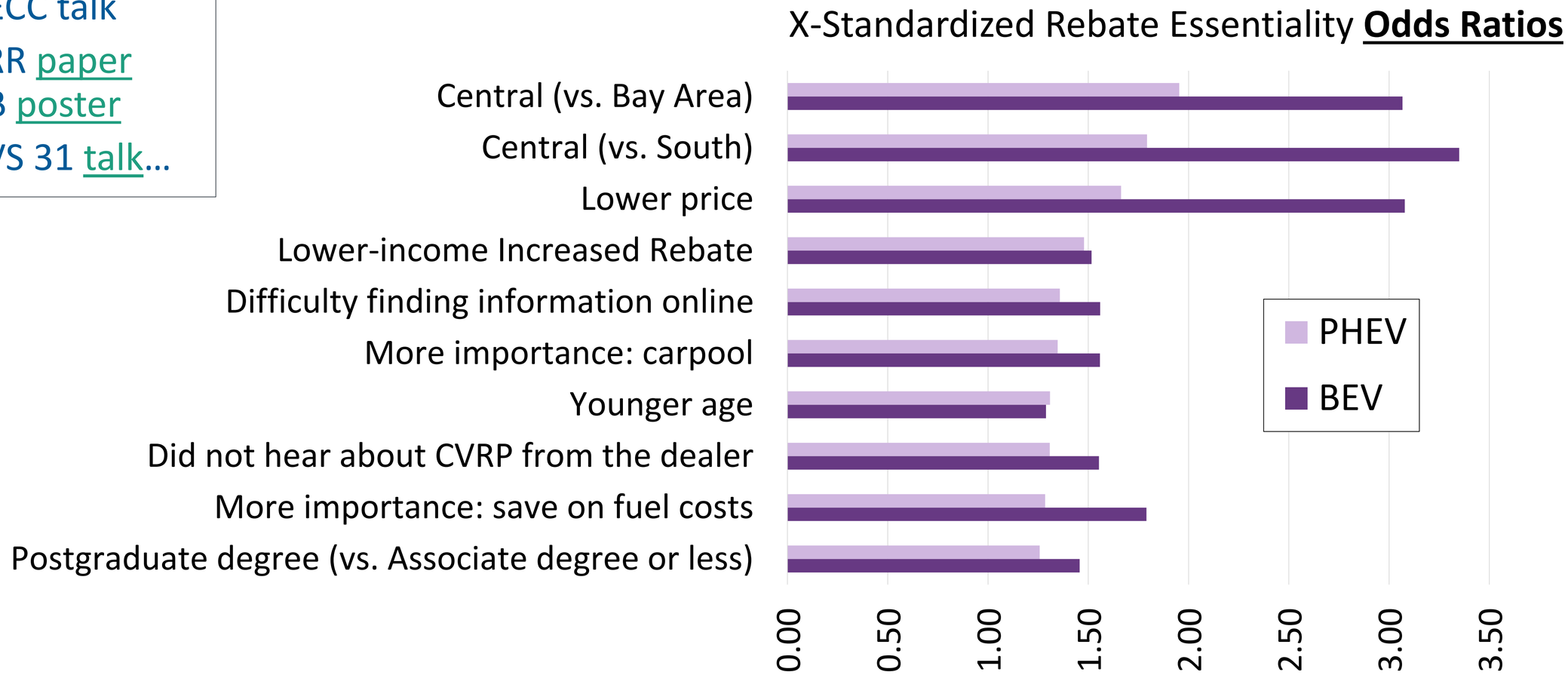
CALIFORNIA CLEAN VEHICLE REBATE PROJECT™

Strategic Segments: Prioritization

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

For more info, see:

- 2016 BECC talk
- 2017 TRR paper and TRB poster
- 2018 EVS 31 talk…

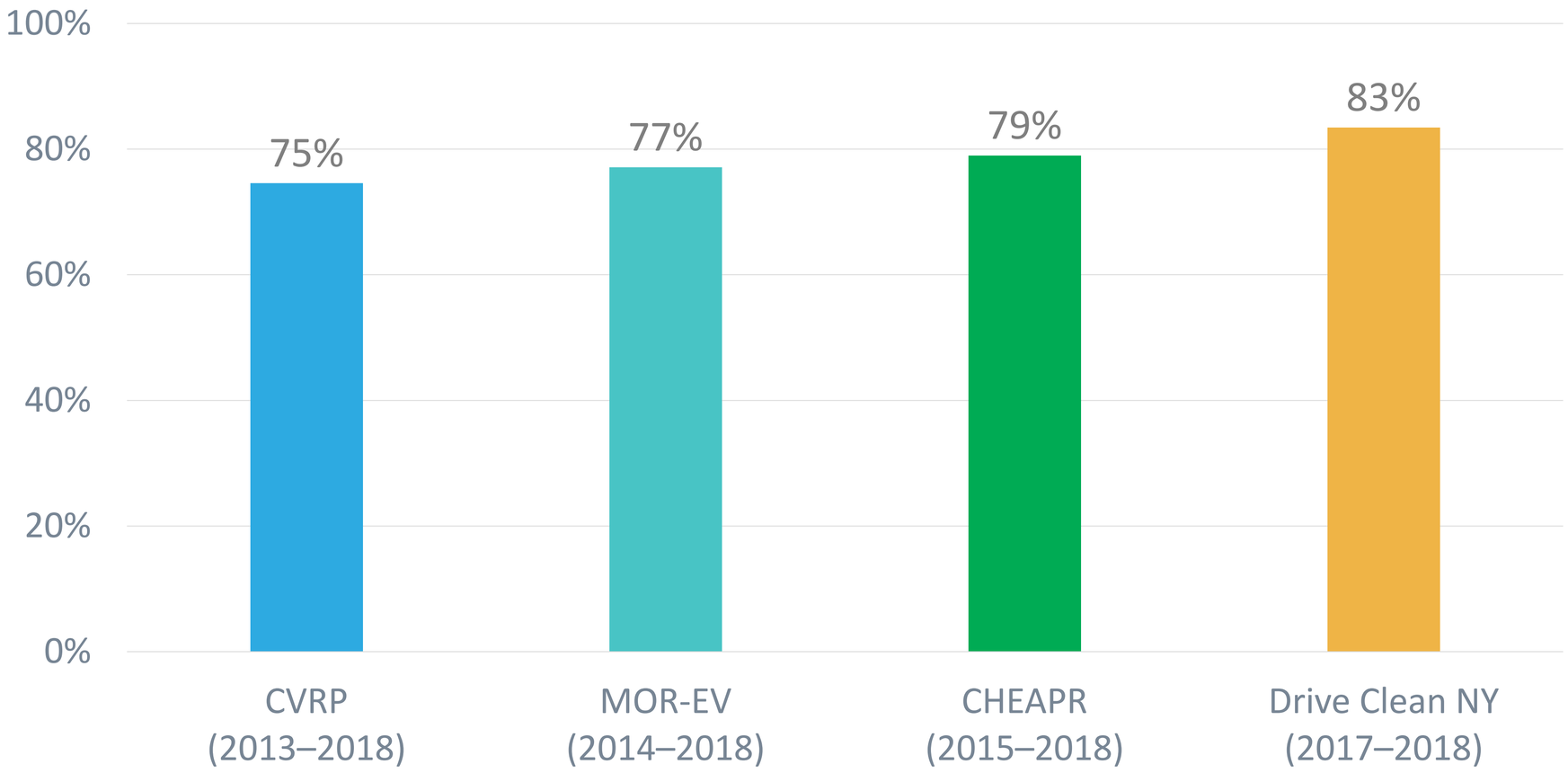


** Significantly associated factors in binary logistic regression of data characterizing CA rebate recipients who bought/leased EVs Nov. 2016 thru May 2017*

Outcomes: Behaviors Influenced

Do EVs Get Used?

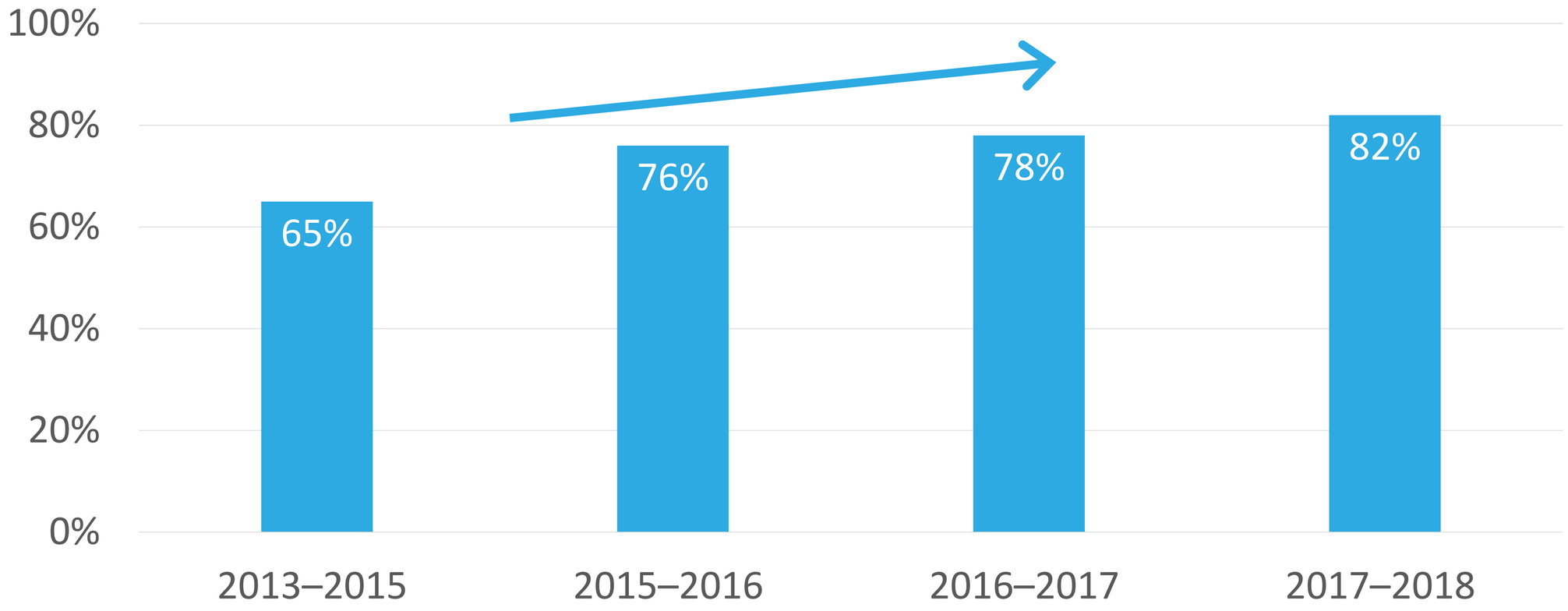
Replaced a vehicle with their rebated **clean vehicle**



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

Vehicle Replacement is Increasing

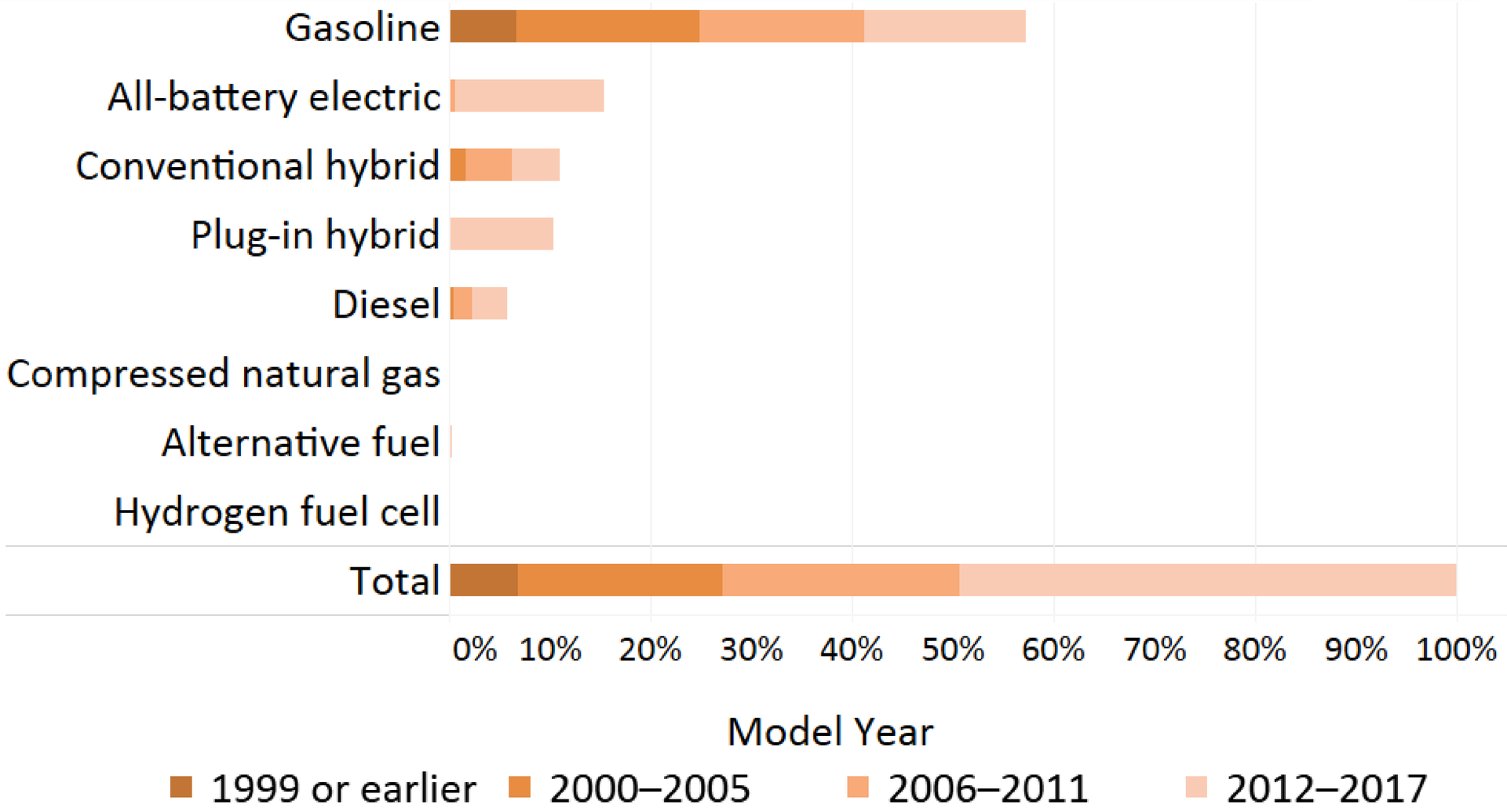
Replaced a vehicle with their rebated *plug-in EV*



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

What Vehicles Types Have Rebates Helped Replace?

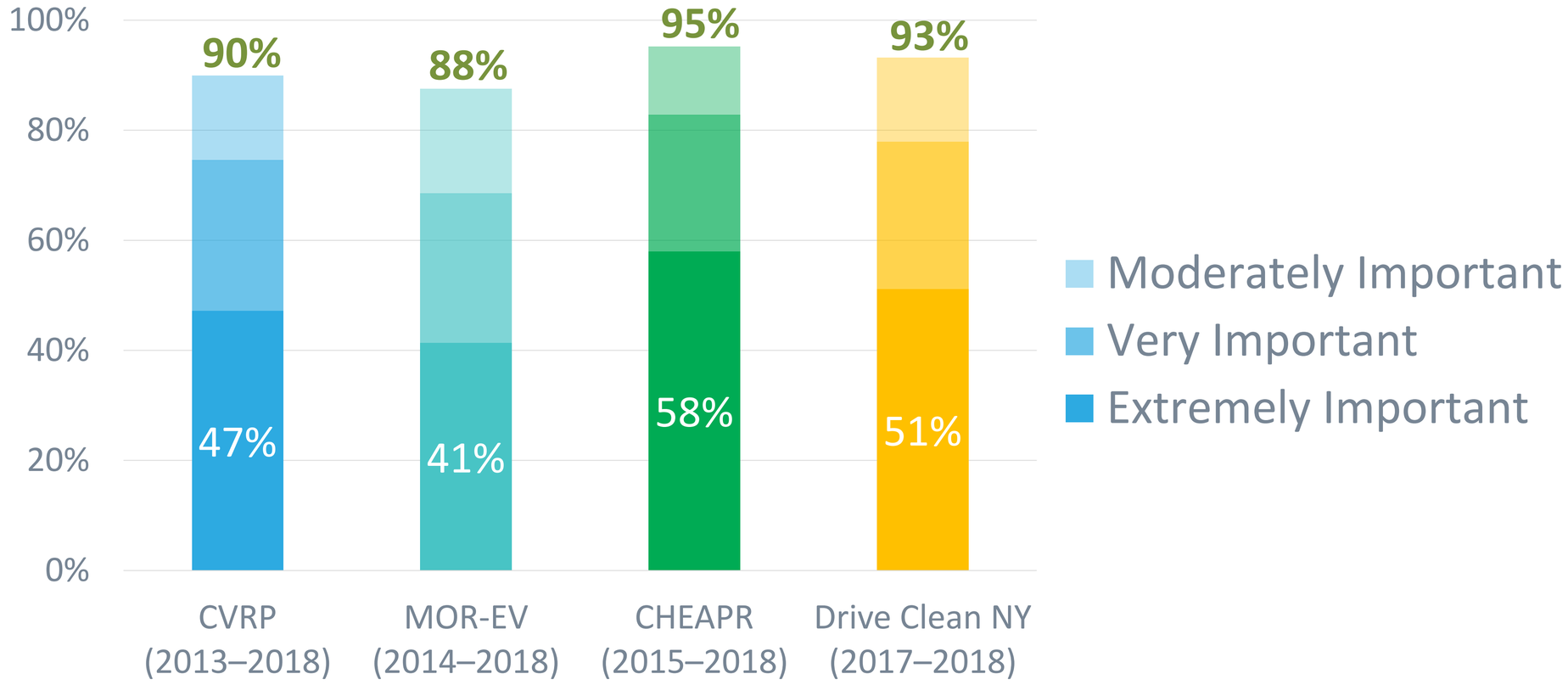


*CVRP Consumer Survey. **2016–2017** edition, **trimmed to start November 2016**, PEV respondents only, weighted, n=4,695*

Impacts: Market

Rebate Influence: Importance

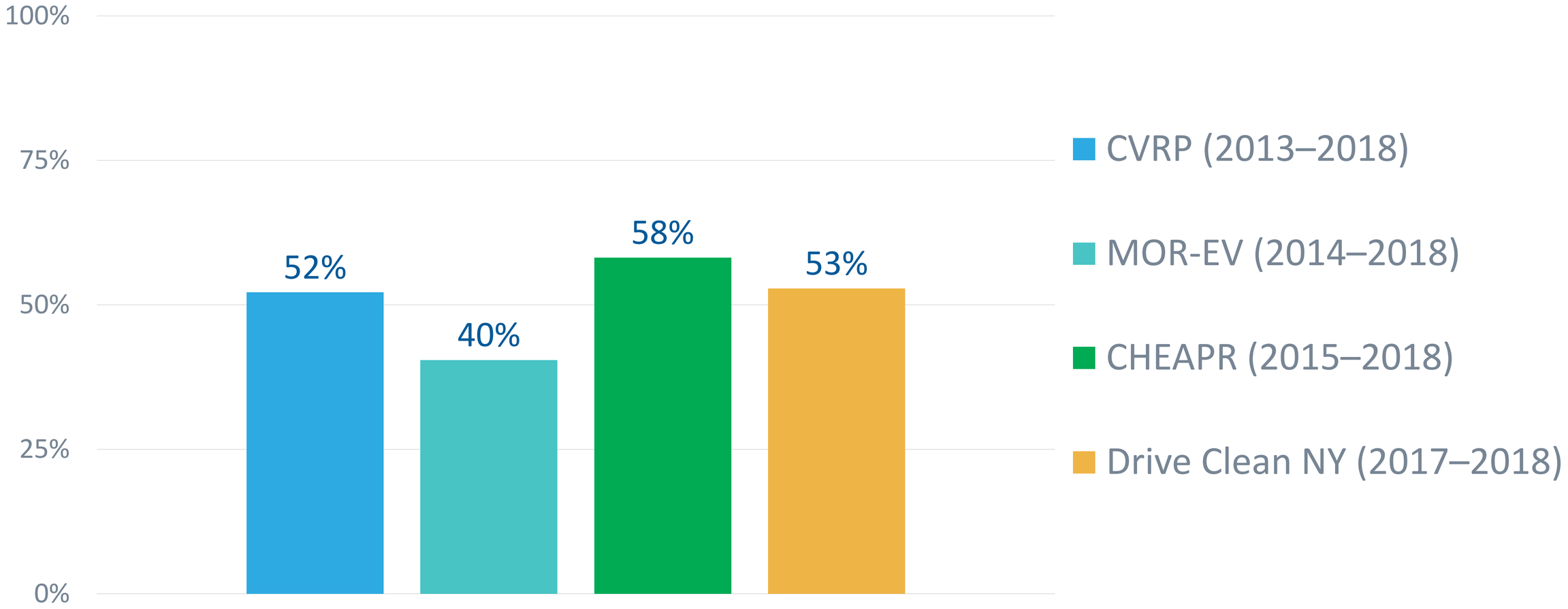
How important was the state rebate in making it possible for you to acquire your clean vehicle?



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

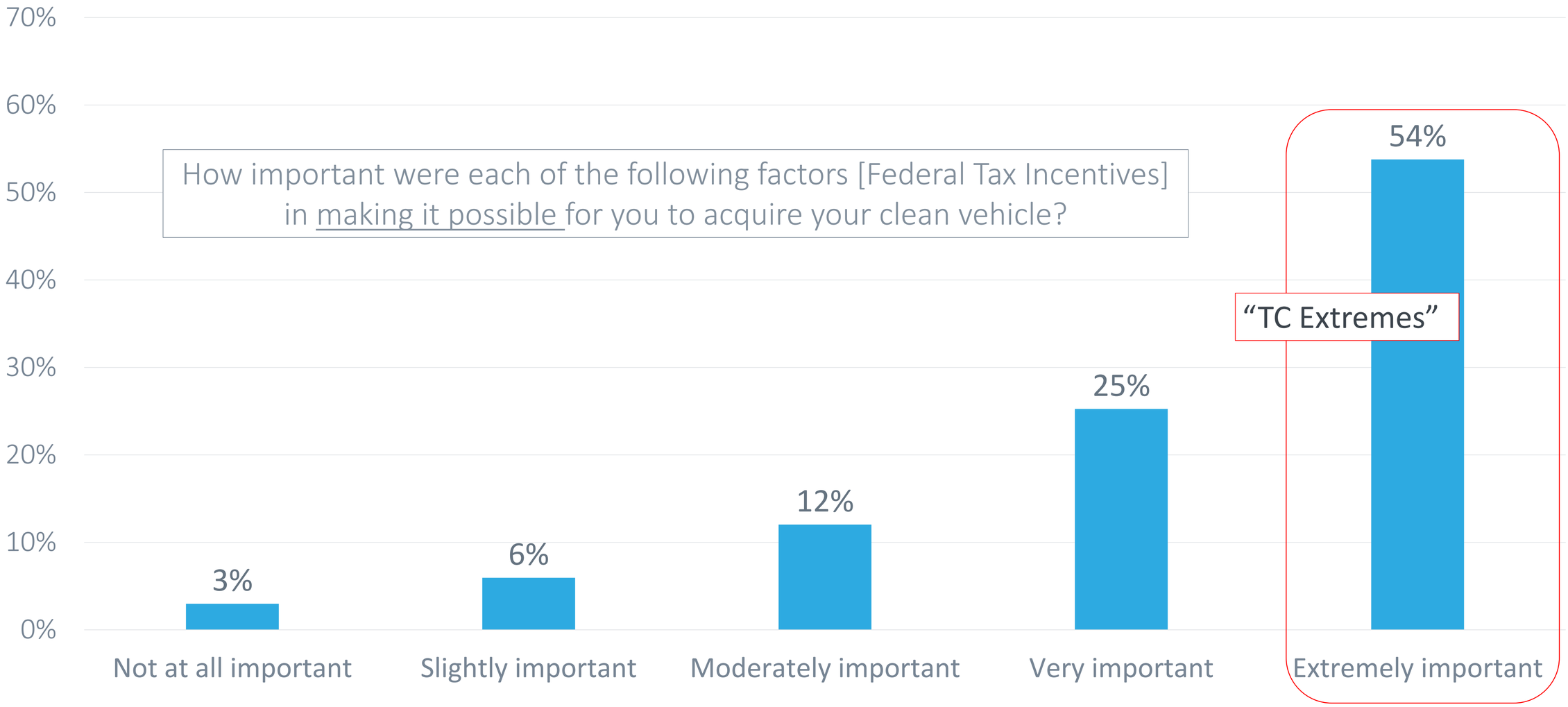
Federal Tax Credit: Background

- 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

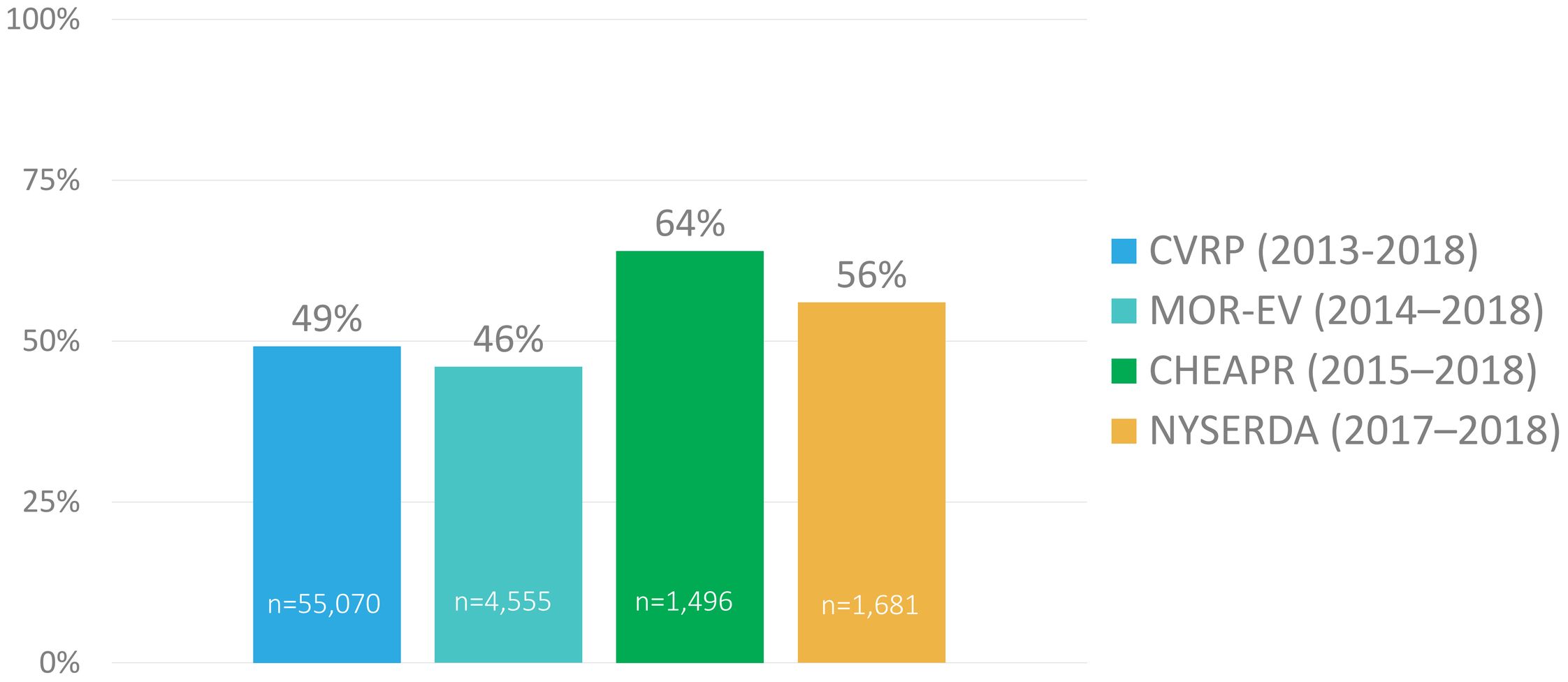
Importance of Federal Tax Credit (2017–18 survey edition)



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

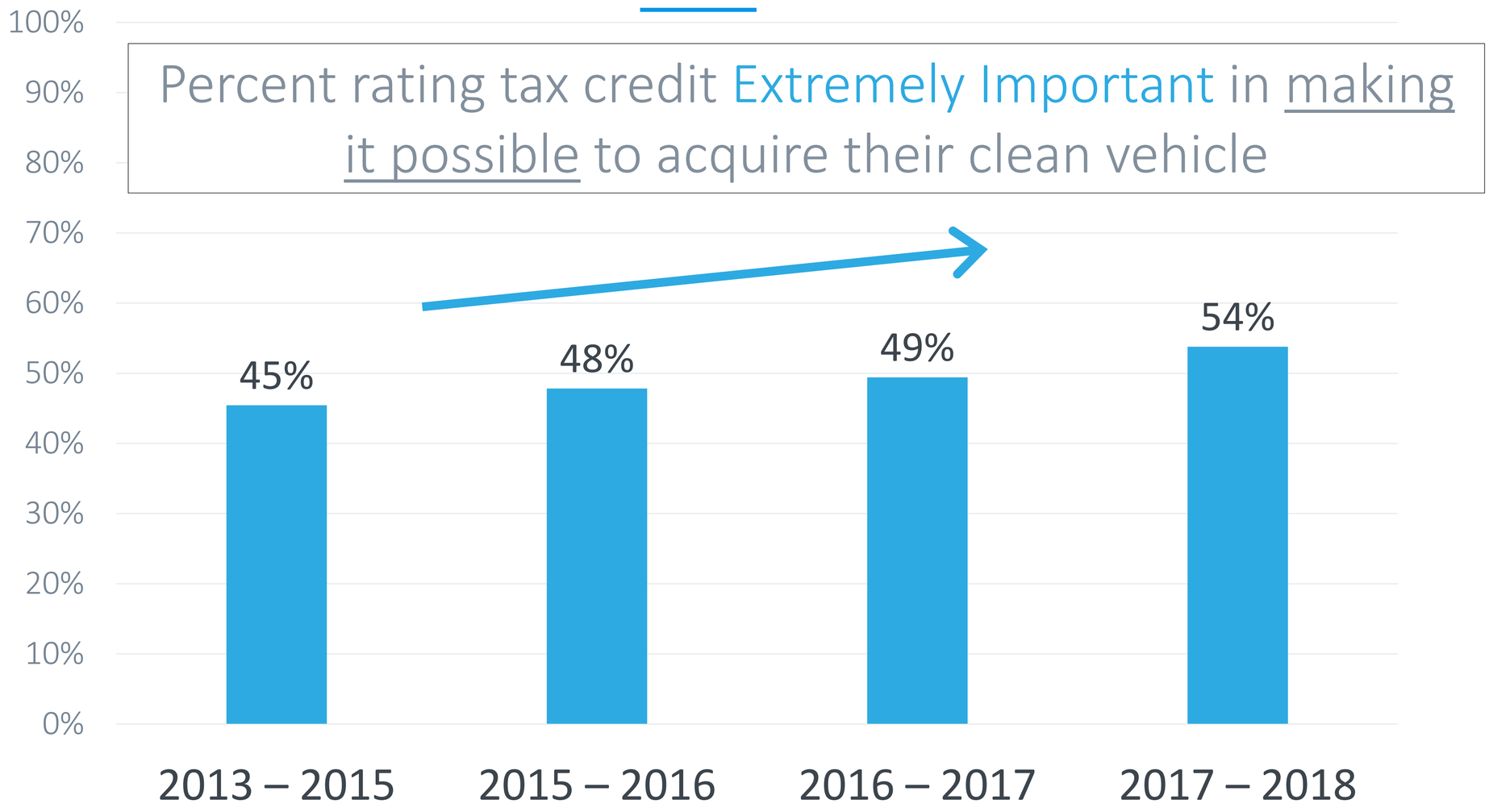
Percent Rating the Federal Tax Credit "Extremely Important"

("…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

Additional Design Considerations

Rebate Effectiveness, Income and MSRP caps

Assessment of Individual Measures

Ranked from most cost-effective to least cost-effective [$ saved/vehicles lost]

#	Scenario	Savings, % of Middle	First-cycle cost (excl. waitlist)	% of first-cycle vehicles lost	$ saved per vehicle lost ↑
1	Middle (baseline)	0% (baseline)	$264 M	0% (baseline)	(baseline)
2	< $60k MSRP	-6%	$246 M	2%	-$4,453
3	< $50k MSRP	-7%	$244 M	2%	-$4,219
4	Limit one per person (not retroactive)	0%	$263 M	0%	-$4,085
5	< $40k MSRP	-37%	$156 M	13%	-$3,973
6	Income cap—single filers: ≤ $150k, other filers: ≤ $250k	-6%	$248 M	2%	-$3,712
7	Income cap—single filers: ≤ $150k, other filers: ≤ $204k	-13%	$227 M	5%	-$3,616
8	Reduce standard rebate $500 ($150 for ZEM)	-13%	$226 M	5%	-$3,538
9	> 40-mi UDDS all-electric range	-6%	$246 M	3%	-$3,147
10	PHEV/BEVx: > 50-mi BEV/FCEV/ZEM: > 100 UDDS all-electric range	-7%	$242 M	3%	-$3,136
11	> 50-mi UDDS all-electric range	-7%	$243 M	3%	-$3,119
12	PHEV/BEVx: > 25-mi BEV/FCEV/ZEM: > 100 UDDS all-electric range	-1%	$260 M	1%	-$3,004
13	PHEV/BEVx: > 30-mi BEV/FCEV/ZEM: > 100 UDDS all-electric range	-2%	$260 M	1%	-$2,994
14	> 30-mi UDDS all-electric range	-1%	$260 M	1%	-$2,894
15	> 25-mi UDDS all-electric range	-1%	$261 M	1%	-$2,886
16	Limit 3 months between purchase and application*				

Assumes changes effective 1 December 2019. Note, first-cycle costs do not include an estimated $29 M waitlist.

* 3-month time limit assumed to produce no long-term savings or market losses (based on implementation of similar time limits in other states)

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

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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

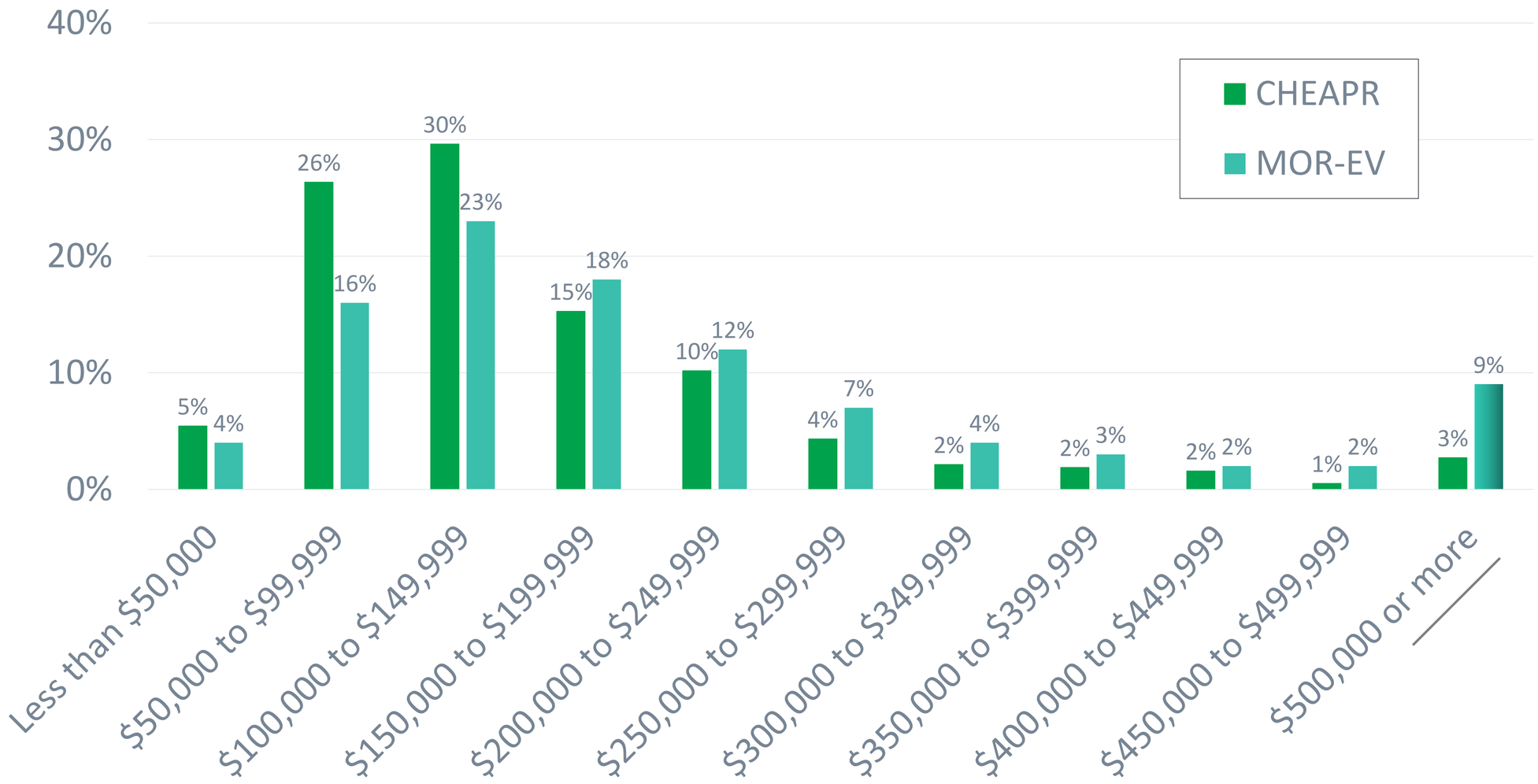
Point-of sale rebates with MSRP caps *may* better support equity goals…
Supplemented with *Increased Rebates* based upon income criteria

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

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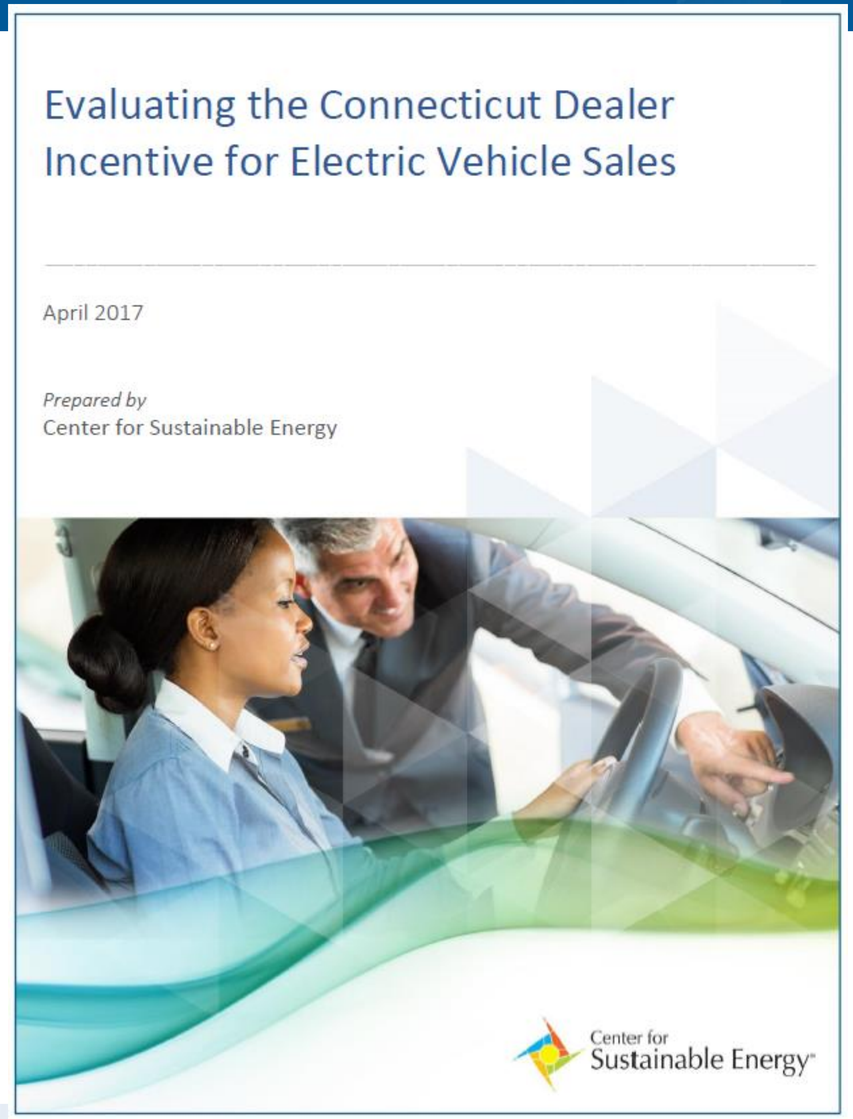
Dealer Incentives

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.

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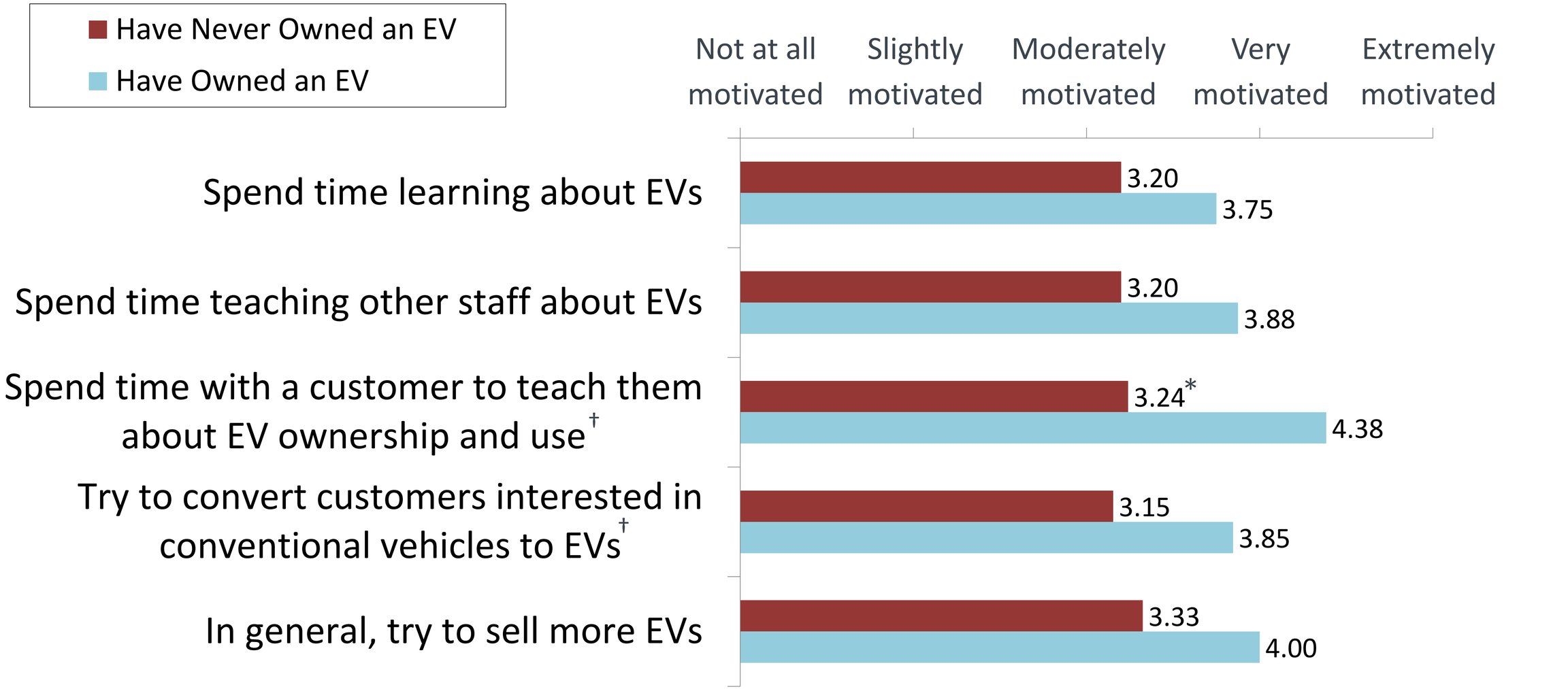
“To what extent are you motivated by the current dealer incentive to do each of the following?”



Respondents=57

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

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

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Wrap Up, Additional Resources & Details

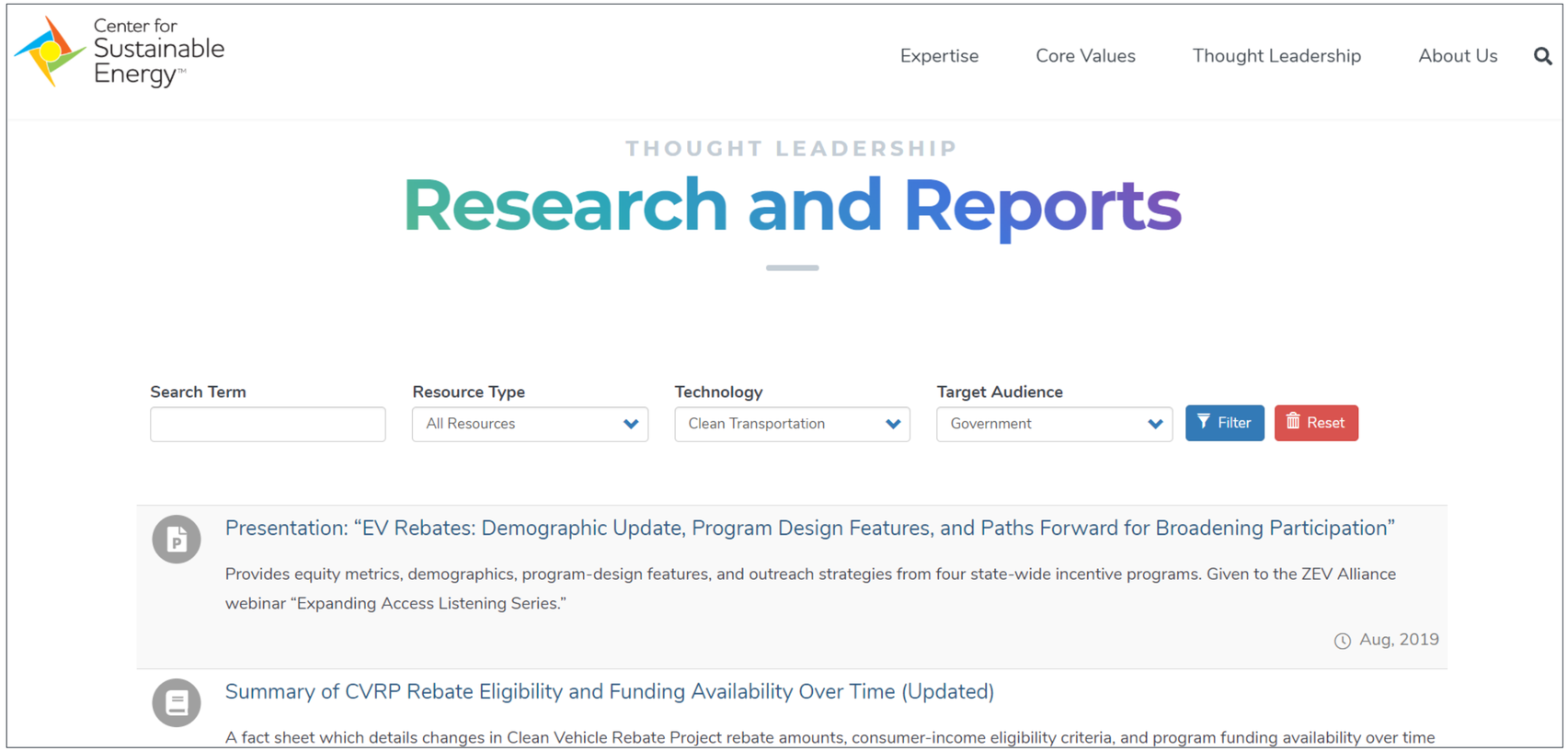
Select Findings: Program Impacts

- 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 replace 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 are increasing over time
- 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

Additional Resources & Details

CSE Clean Transportation Resources

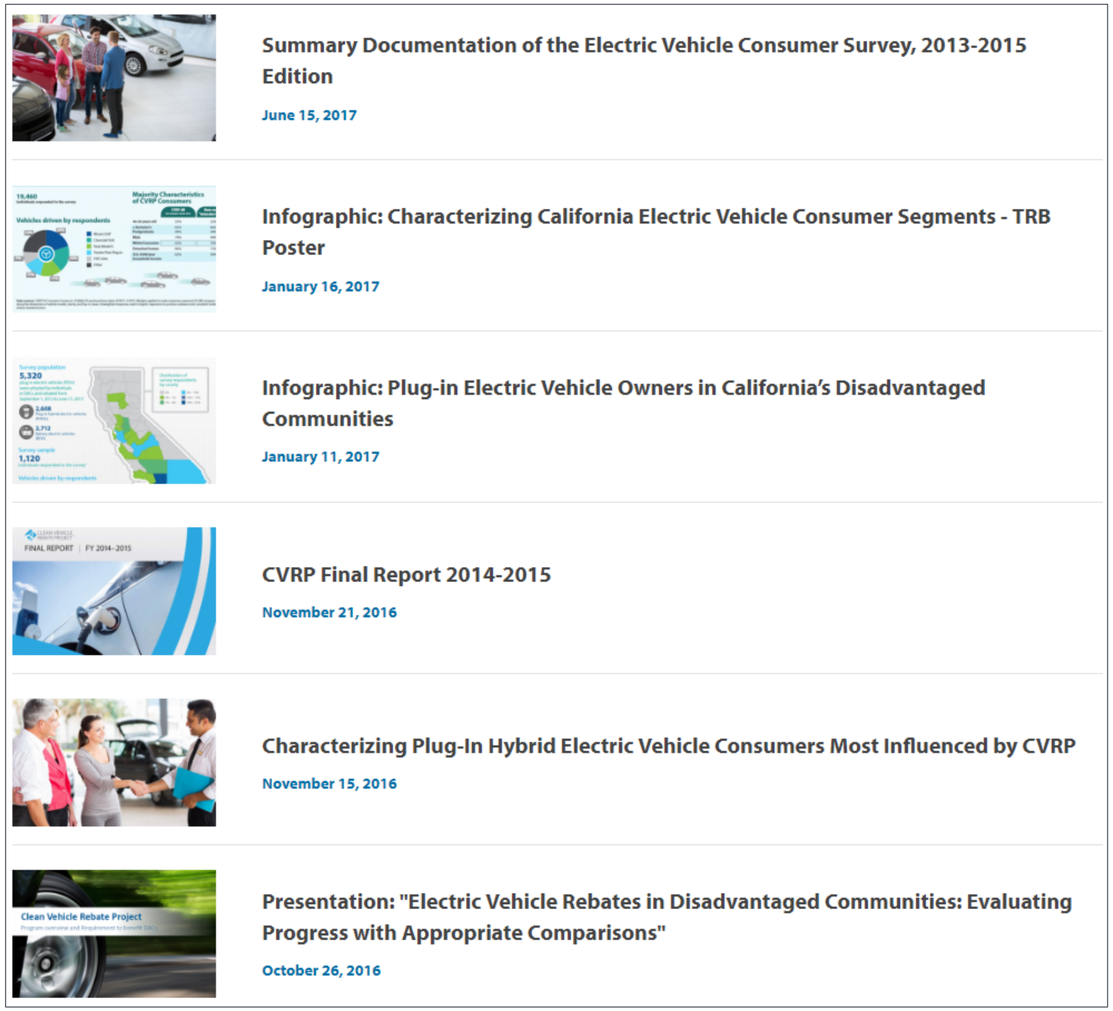
Reports, analysis, infographics, presentations, …



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

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

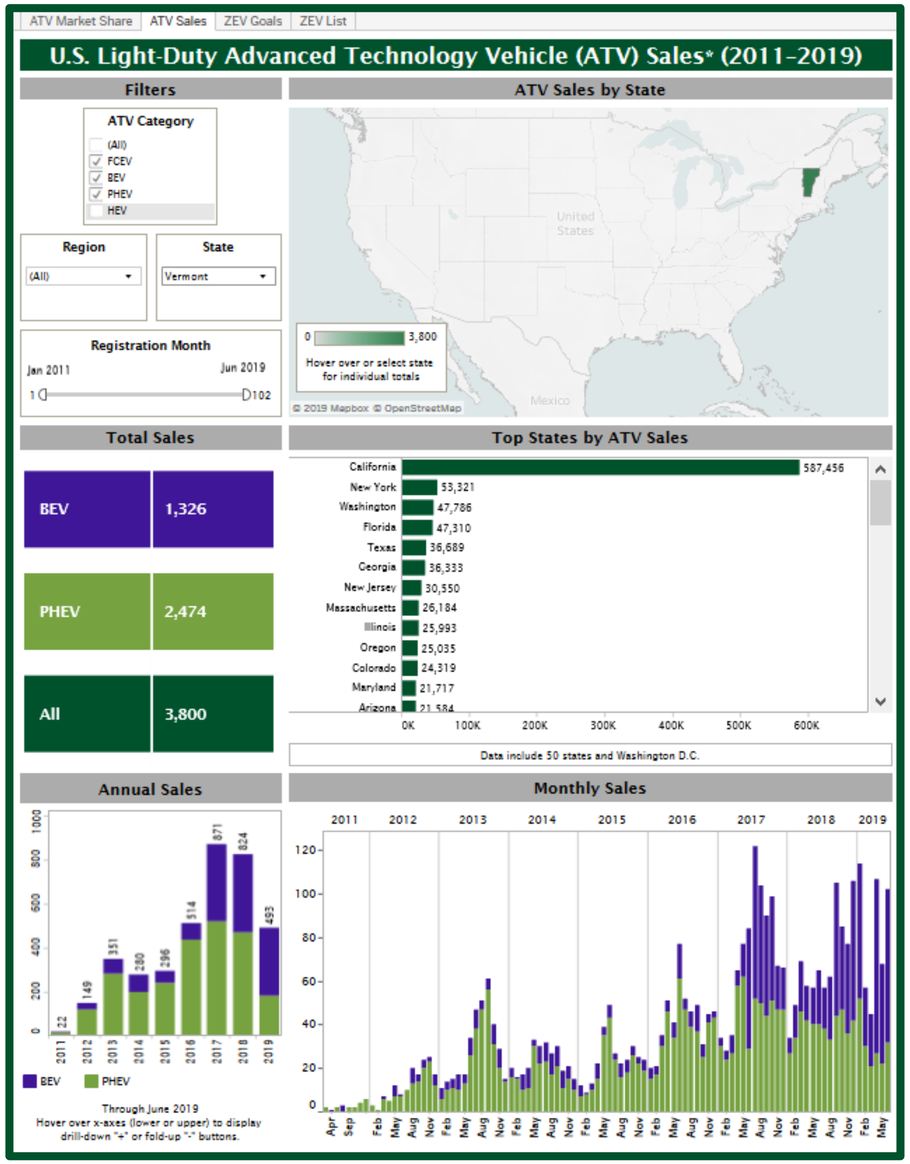
- Report: Evaluating the Connecticut Dealer Incentive for Electric Vehicle Sales
- Supporting EV Commercialization with Rebates: Statewide Programs, Vehicle & Consumer Data, and Select Findings
- Yale Webinar: Supporting EV Commercialization with Rebates: Statewide Programs, Vehicle & Consumer Data,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

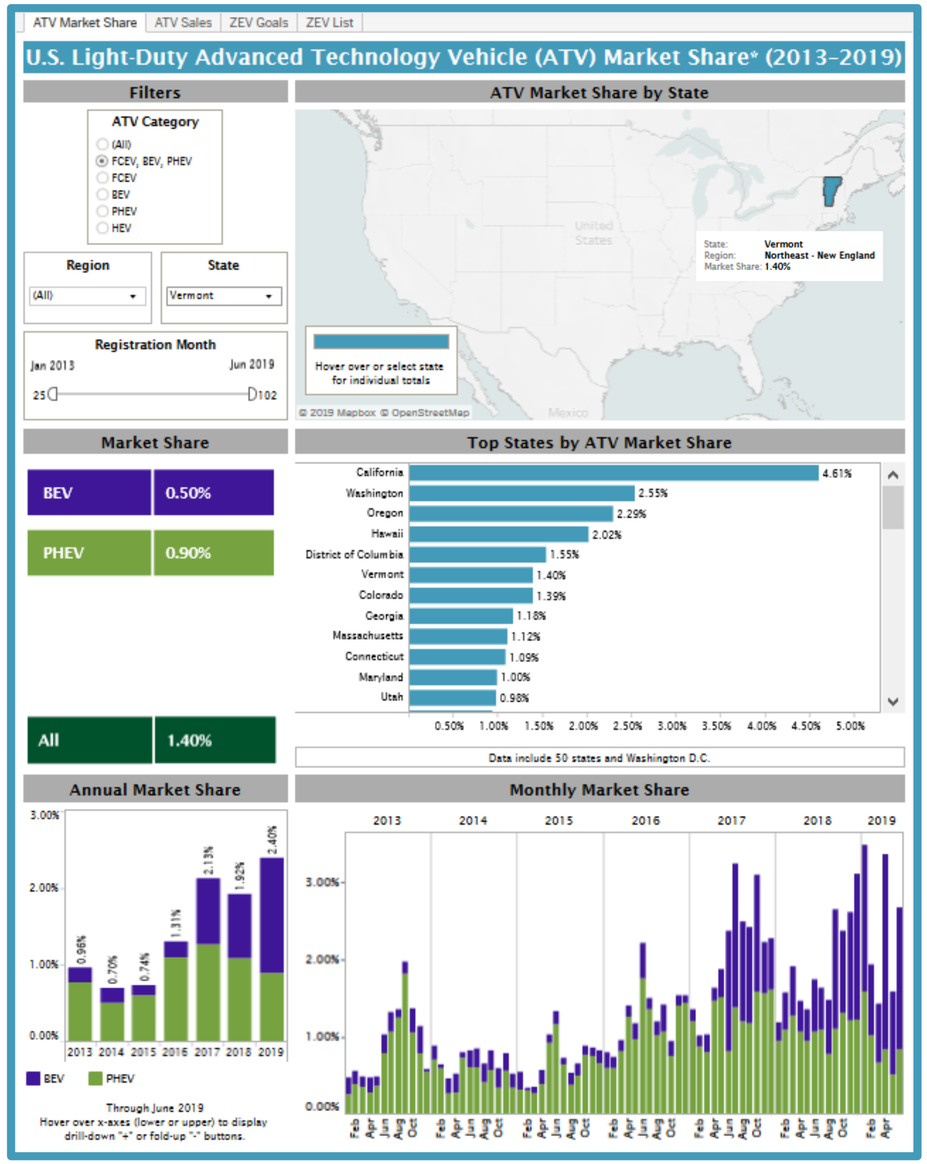
Consumer Survey Data *(Shows Rebates to Individuals Only, CVRP "Current Program" Only)*

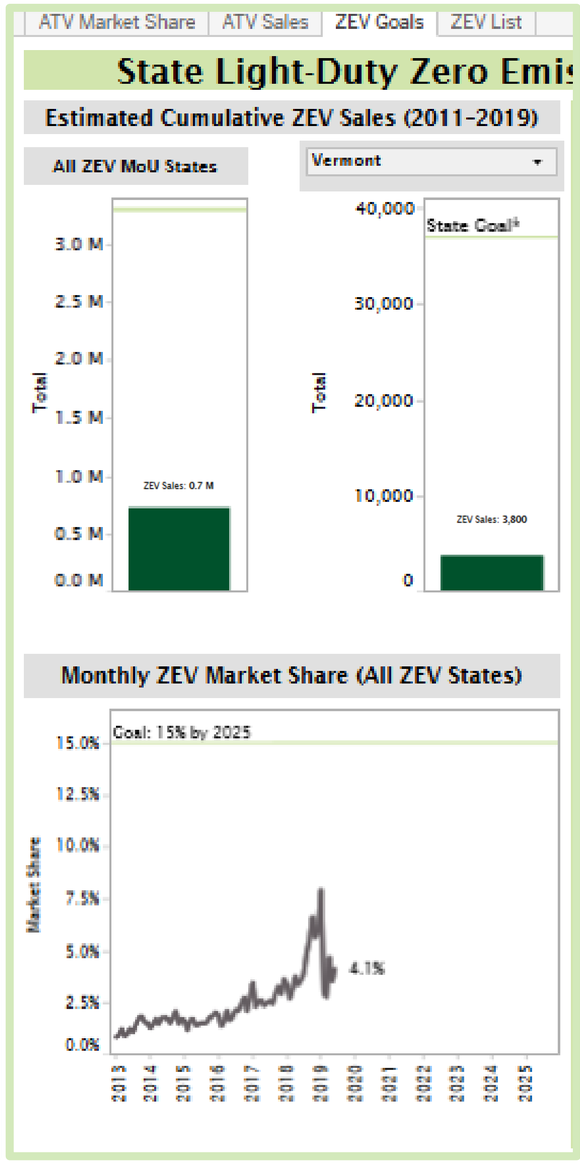
	CALIFORNIA CLEAN VEHICLE REBATE PROJECT™	MOR-EV Massachusetts Offers Rebates for Electric Vehicles	CHEAPR Connecticut Hydrogen and Electric Automobile Purchase Rebate	NEW YORK STATE	**Total**
Vehicle Purchase/ Lease Dates	***Nov. 2016**** – Dec. 2018	Jun. 2014 – Oct. 2018	May 2015 – Sep. 2018	Mar. 2017 – 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)*

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







Linked at zevfacts.com

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

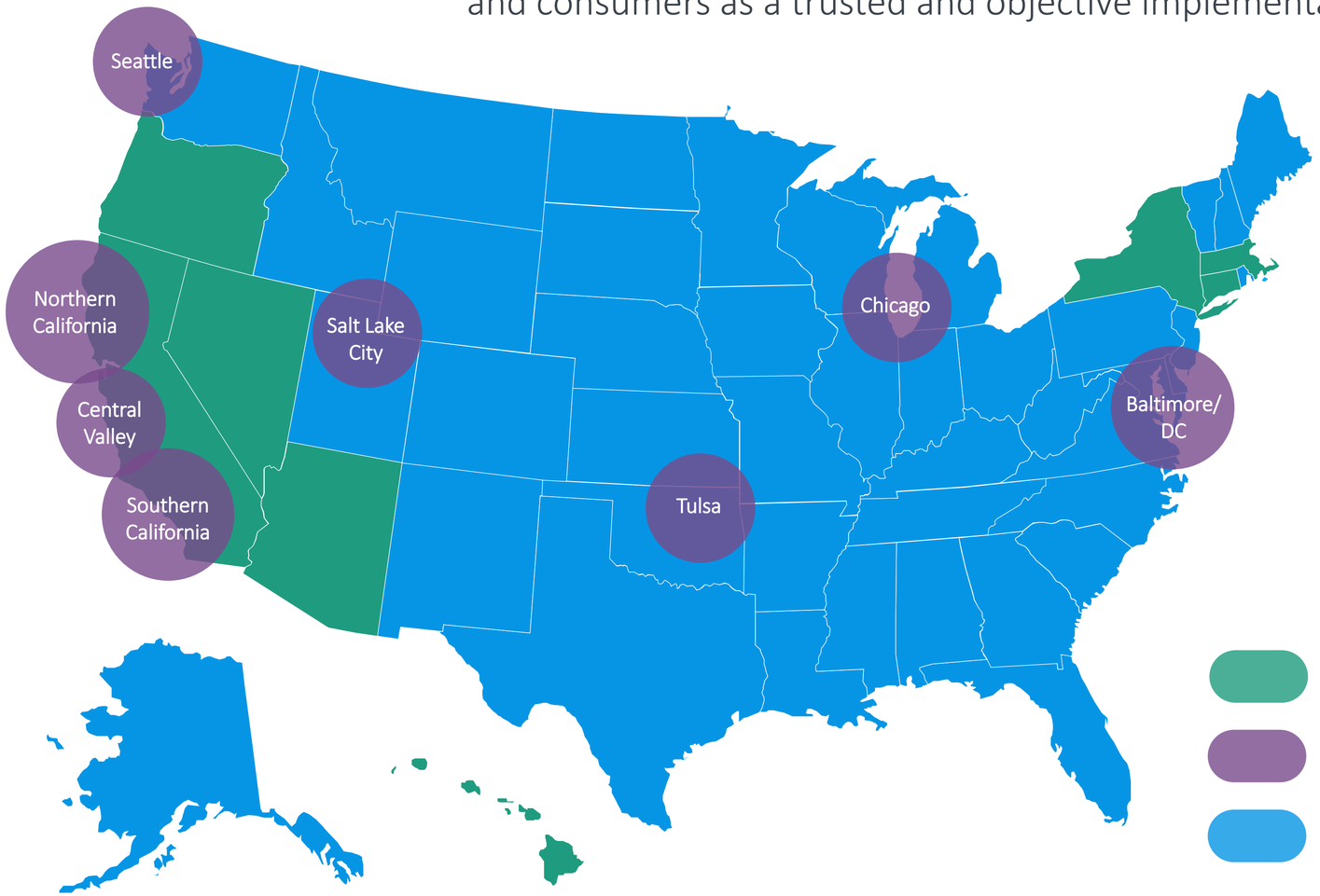
Interconnecting systems to achieve decarbonization

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

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

Contact Us

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Topics for Discussion

- EV market dynamics: models, product types, state statistics
- EV incentive design, for
  - Volume benefits
  - Cost effectiveness
  - Emissions reductions
  - Equity
- EV consumer demographics / incentive beneficiaries
- Implementation perspectives
- Pillars of program administration
- Mechanisms for increasing EV demand
  - Awareness, dealer sales incentives, consumer purchase incentives, infrastructure
- Comprehensive and effective EV policy frameworks
  - Vehicle supply, demand, fuel carbon intensity, vehicle use