Transportation Electrification: Policies and Incentives

- Moderator
  - **Matt Rogotzke**, Policy Analyst, NGA
- Speakers:
  - **Chris Rice**, Chief of Staff, Maryland Energy Administration
  - **Brett Williams,** Senior Principal Advisor, Center for Sustainable Energy
  - **Tim Echols,** Commissioner, Georgia Public Service Commission

Transportation Electrification: Incentives

National Governors Association Energy Policy Institute

19 July 2019, St. Paul MN

Brett Williams, PhD – Principal Advisor, EV Programs

with thanks to John Anderson, Michelle Jones, Jamie Orose, 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

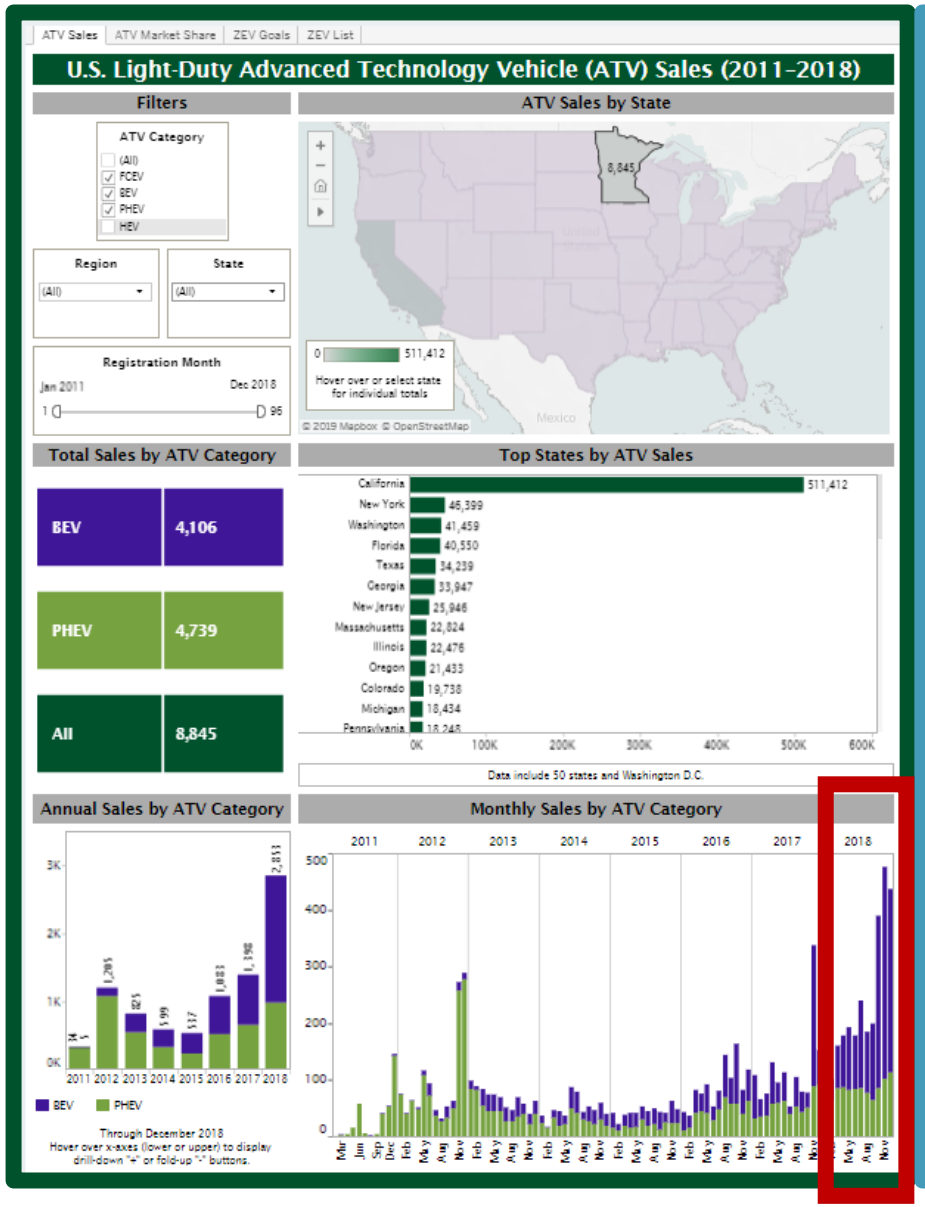
Interconnecting systems to achieve decarbonization

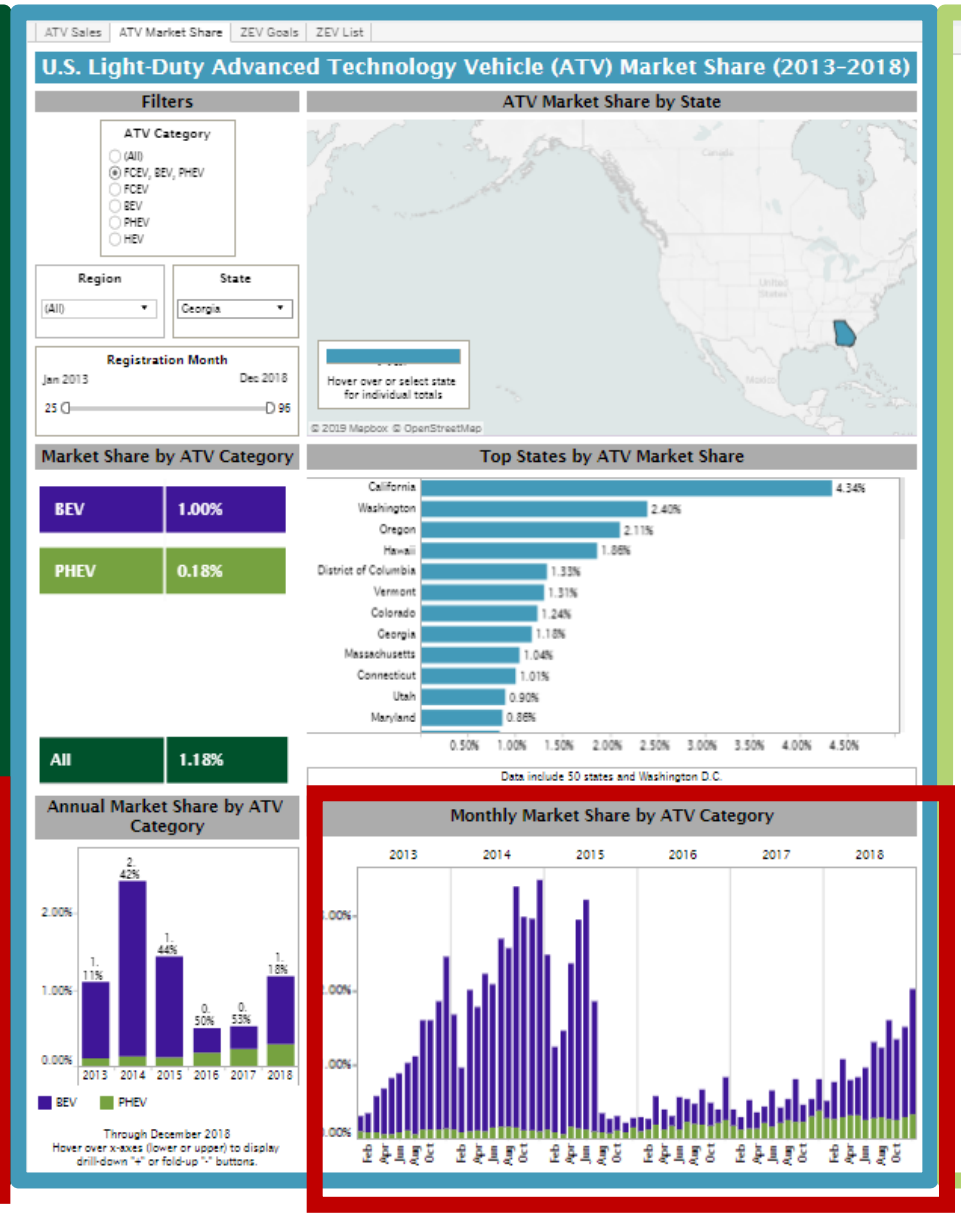
State EV Rebate Programs Administered by CSE

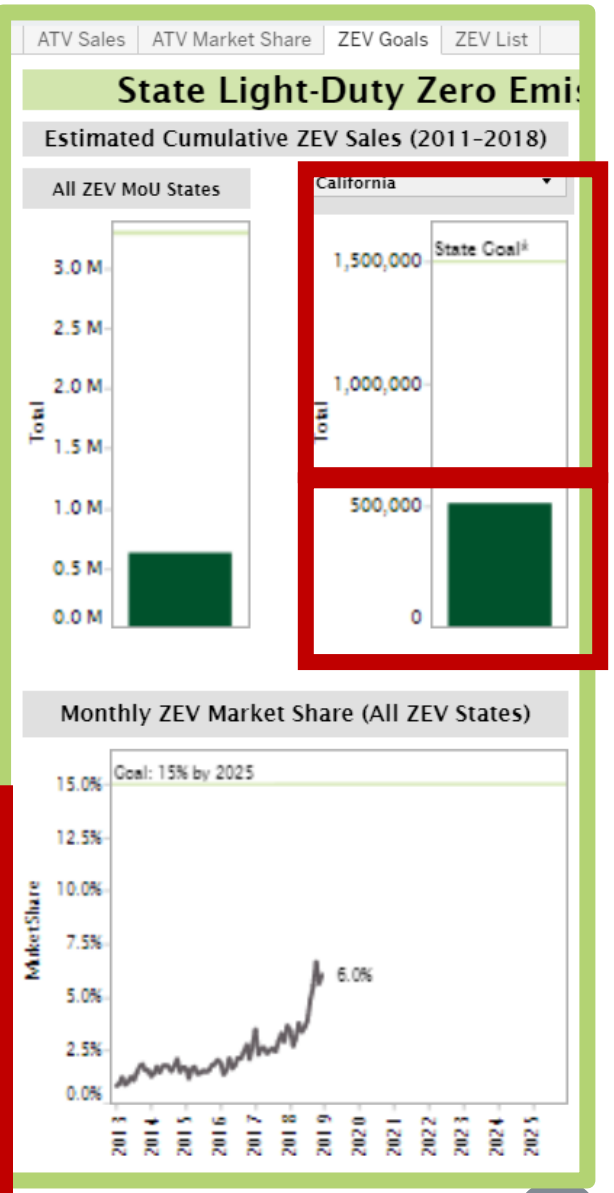
(as of Jan. 2019; Oregon pending)

	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	• 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





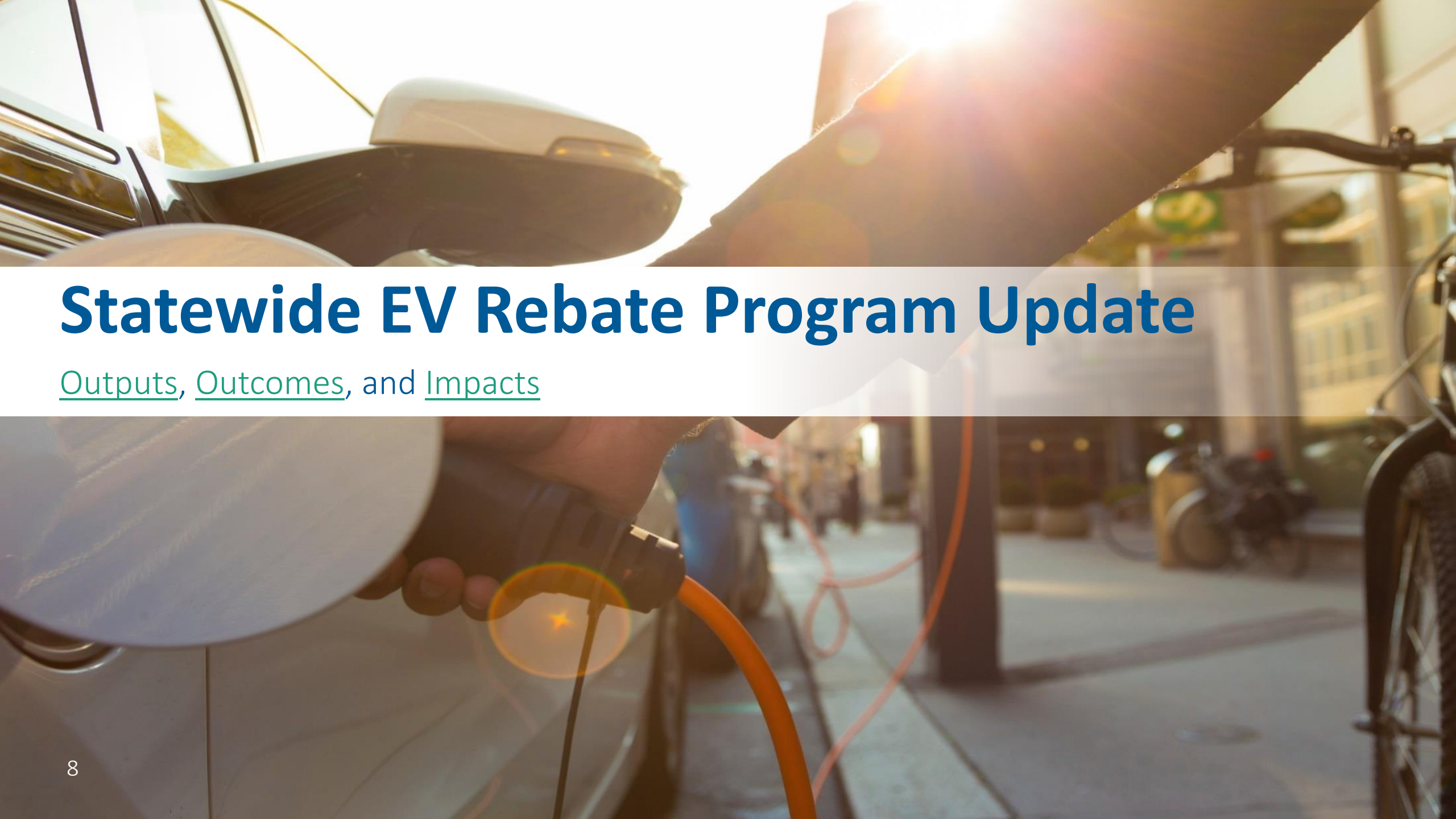


Linked at zevfacts.com

Outline

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

* 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	• 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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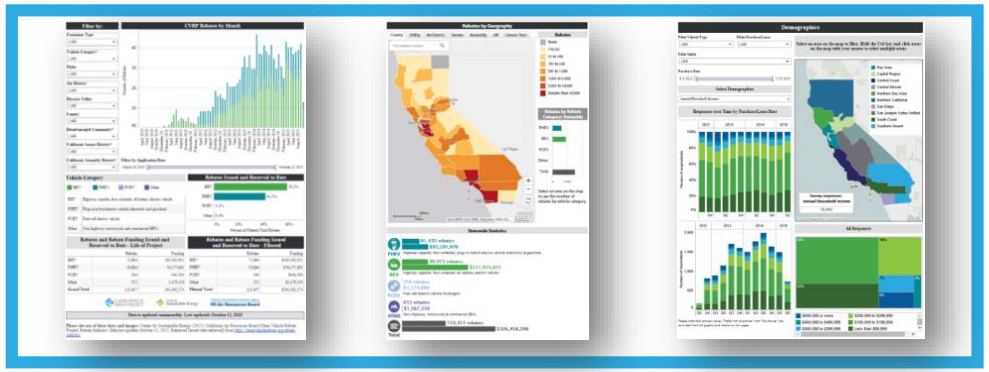
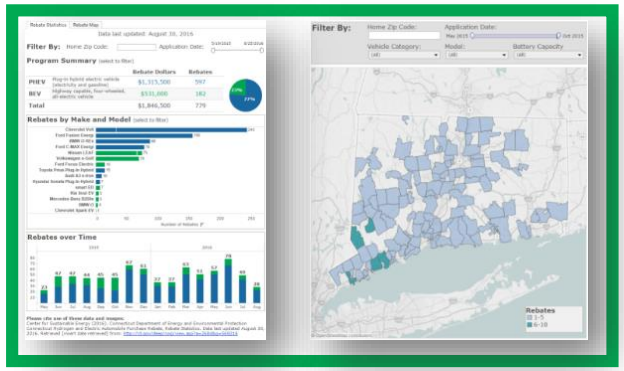
Outputs: Vehicles Rebated

Public dashboards and data facilitate informed action

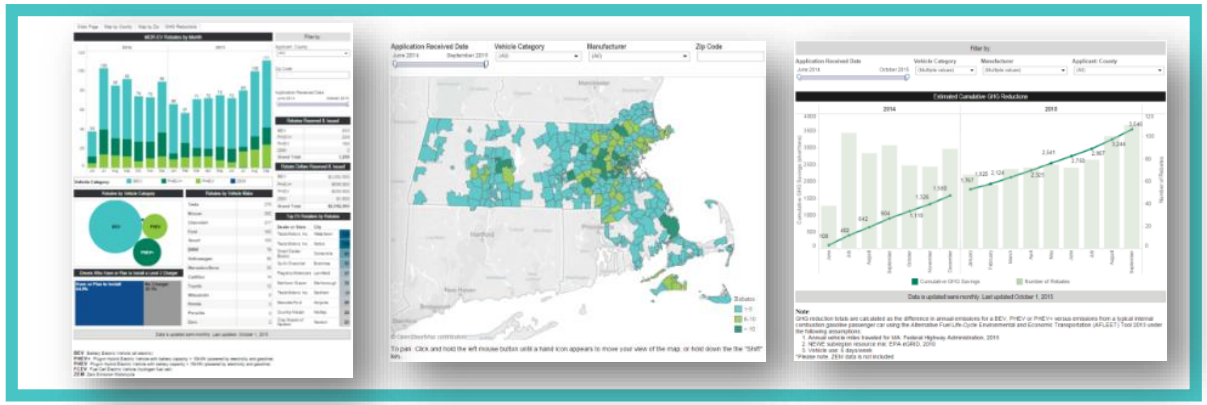
- > 320,000 EVs and consumers have received > $720 M in rebates
- > 45,000 survey responses being analyzed so far, statistically represent > 200,000 consumers
- Reports, presentations, and analysis growing



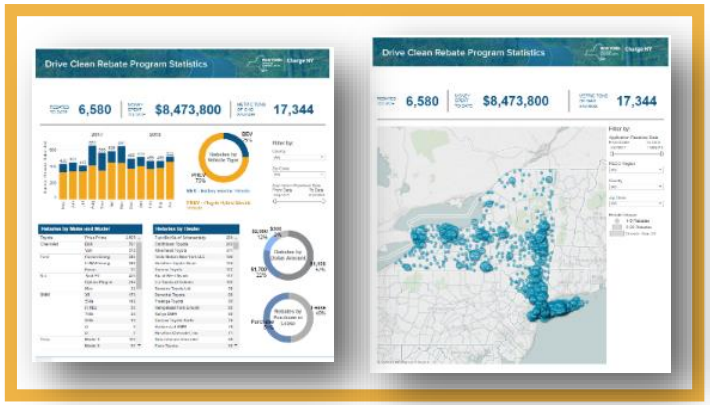
cleanvehiclerebate.org



ct.gov/deep



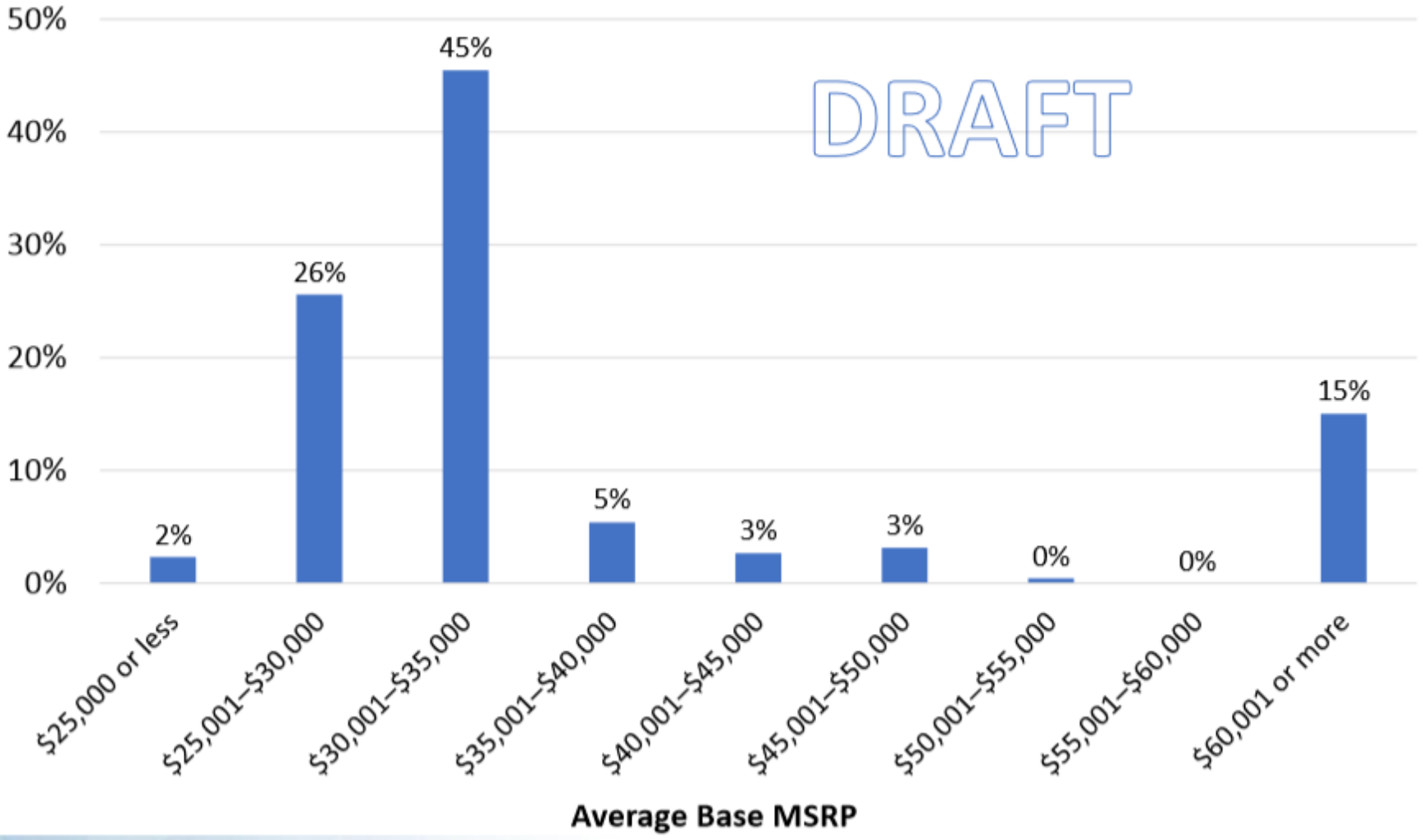
mor-ev.org



nyserda.ny.gov

Moderately-Priced Vehicles Receive Most Rebates

(Plug-in Vehicles through Aug. 2018)



Through August 2018. 'Average Base MSRP' does not reflect actual sale price and excludes typical costs (delivery charges, additional features, etc.). Includes content supplied by R.L. Polk & Co, © 2018. Note: 129 vehicles excluded due to insufficient data.

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 – May 2017	June 2014 – October 2017	May 2015 – June 2017	March 2017 – Nov. 2017	Dec. 2010 – Nov. 2017
Survey Responses (total n)*	40,438	2,549	819	817	44,623
Program Population (N)	185,367	5,754	1,583	3,937	196,641

* 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

	California Population (Census 2018)	Vehicle purchase "intenders" (CHTS 2012)
White/Caucasian	65%	76%
Male	50%	49%
≥ Bachelor's degree in HH	33%*	66%
Detached homes	58%	75%
≥ 50 years old	32%	31%
≥ $150k HH Income	18%	21%

* Census data characterize individual educational attainment for population 25 or older, whereas other data characterize highest household attainment

Census 2018: American Community Survey, 2013–2017 5-Year Estimates, Tables DP05, S1501, DP04, S0101, DP03

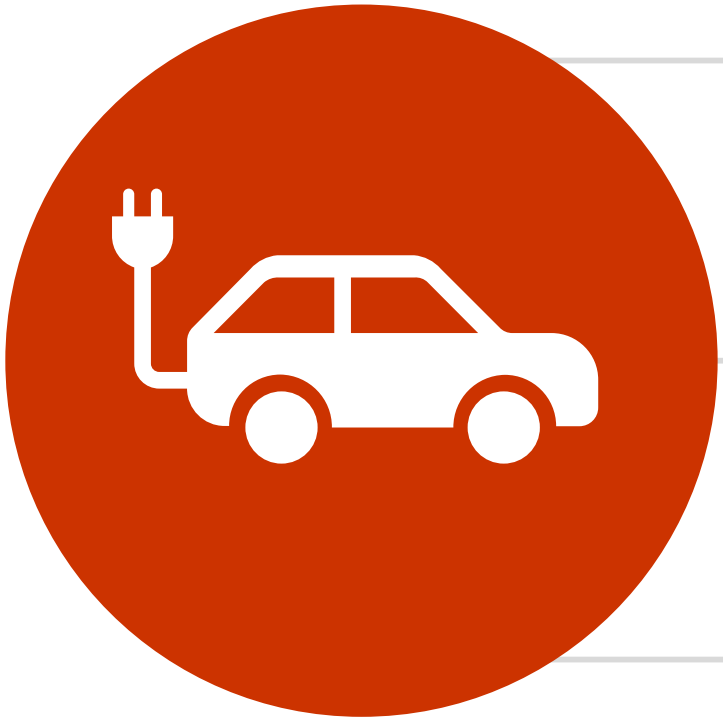
California Household Travel Survey, 2012: weighted, n = 42,431

EV Consumer Characteristics

	California Population (Census 2018)	Vehicle purchase "intenders" (CHTS 2012)	EV consumers, (rebated for Nov. 2016 – May 2017 adoption)
White/Caucasian	65%	76%	62% ↓
Male	50%	49%	72% ↑
≥ Bachelor's degree in HH	33%*	66%	81% ↑
Detached homes	58%	75%	77%
≥ 50 years old	32%	31%	50% ↑
≥ $150k HH Income	18%	21%	40% ↑

* Census data characterize individual educational attainment for population 25 or older, whereas other data characterize highest household attainment
Census 2018: American Community Survey, 2013–2017 5-Year Estimates, Tables DP05, S1501, DP04, S0101, DP03
California Household Travel Survey, 2012: weighted, n = 42,431
CVRP Consumer Survey, 2016–17 edition: filtered to purchase/lease dates Nov 2016–May 2017, weighted n = 5,327

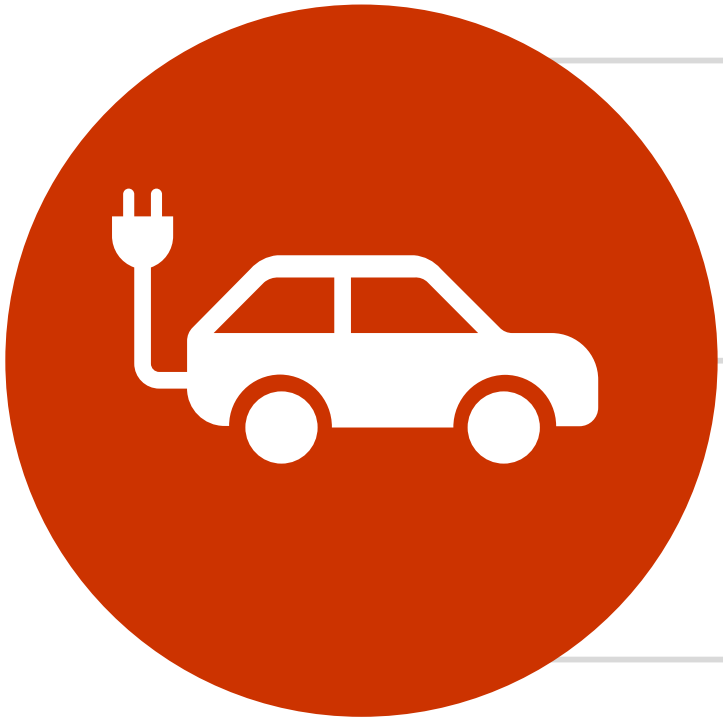
How can research help us grow markets for electric vehicles?



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

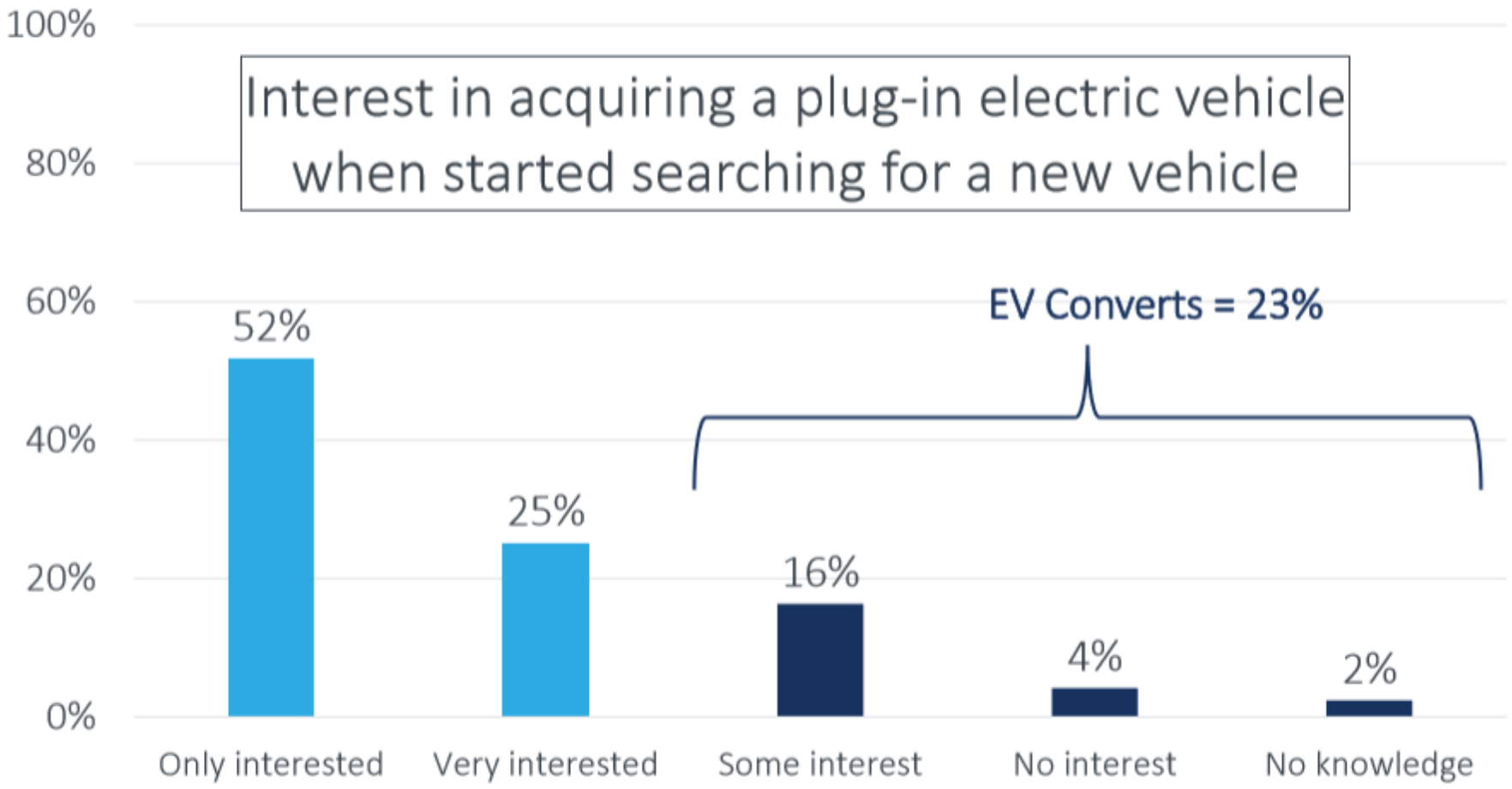
"Rebate Essential" Consumers: Minimizing Free Ridership

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

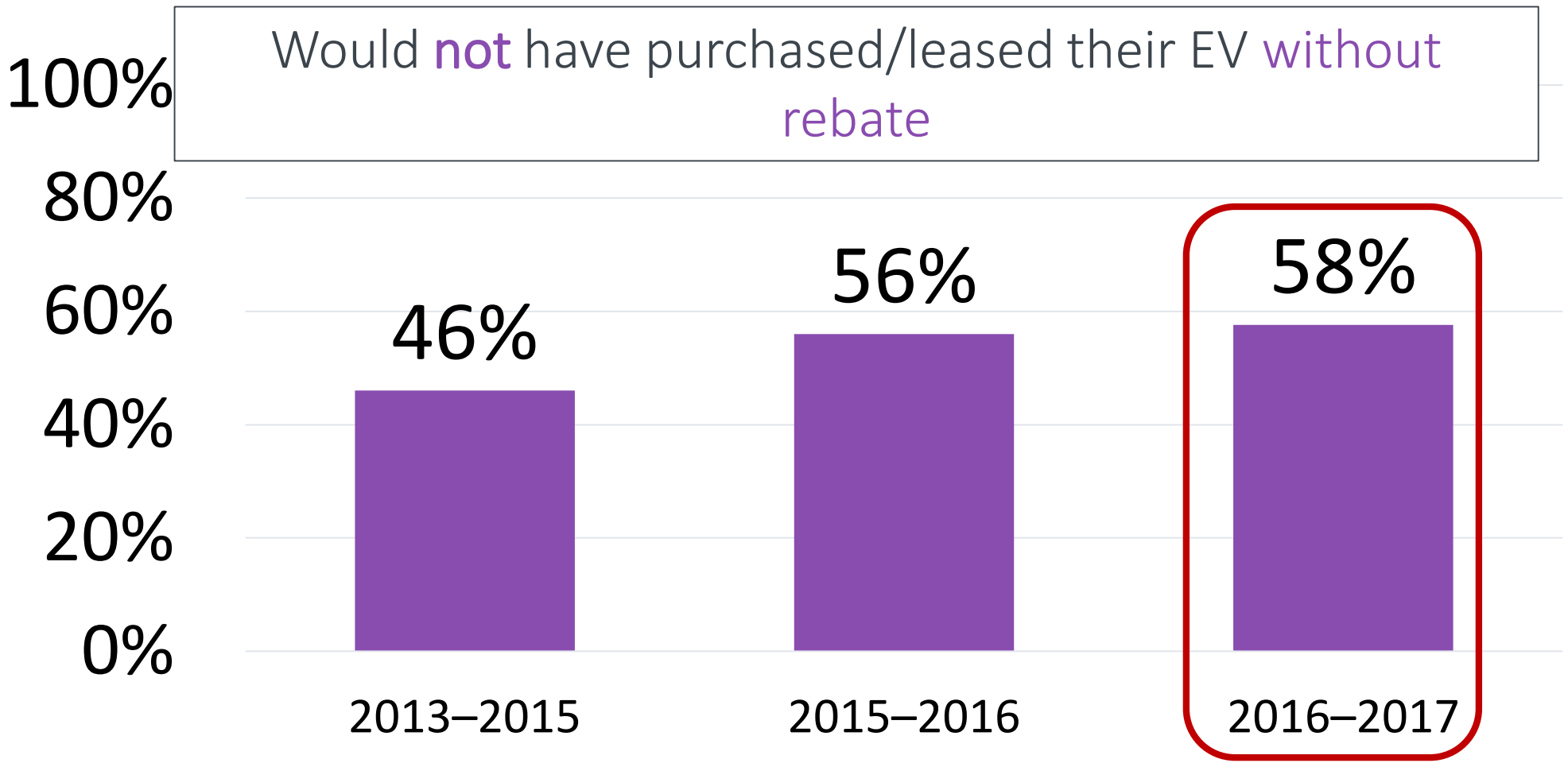
Characterize EV consumers with low initial interest in EVs, to look for additional opportunities to expand into the mainstream

“EV Converts”: Low Initial Interest



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

“Rebate Essentials”: Highly Influenced

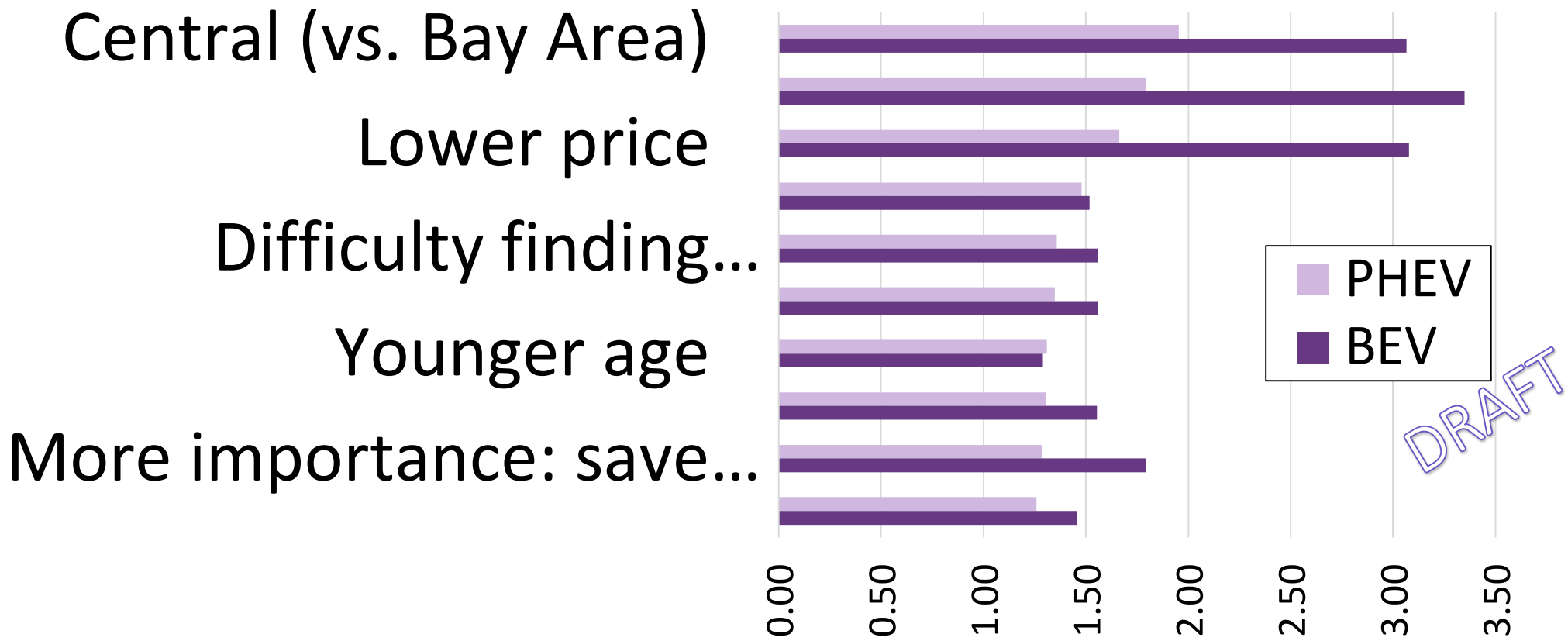


CVRP Consumer Survey: 2013–2015 edition: weighted, question n=19,208;
2015–2016 edition: weighted, question n=11,457;
2016–2017 edition: weighted, question n=9,261

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

Comparison to Other EV Adopters: Rebate Essential Explanatory Factors*

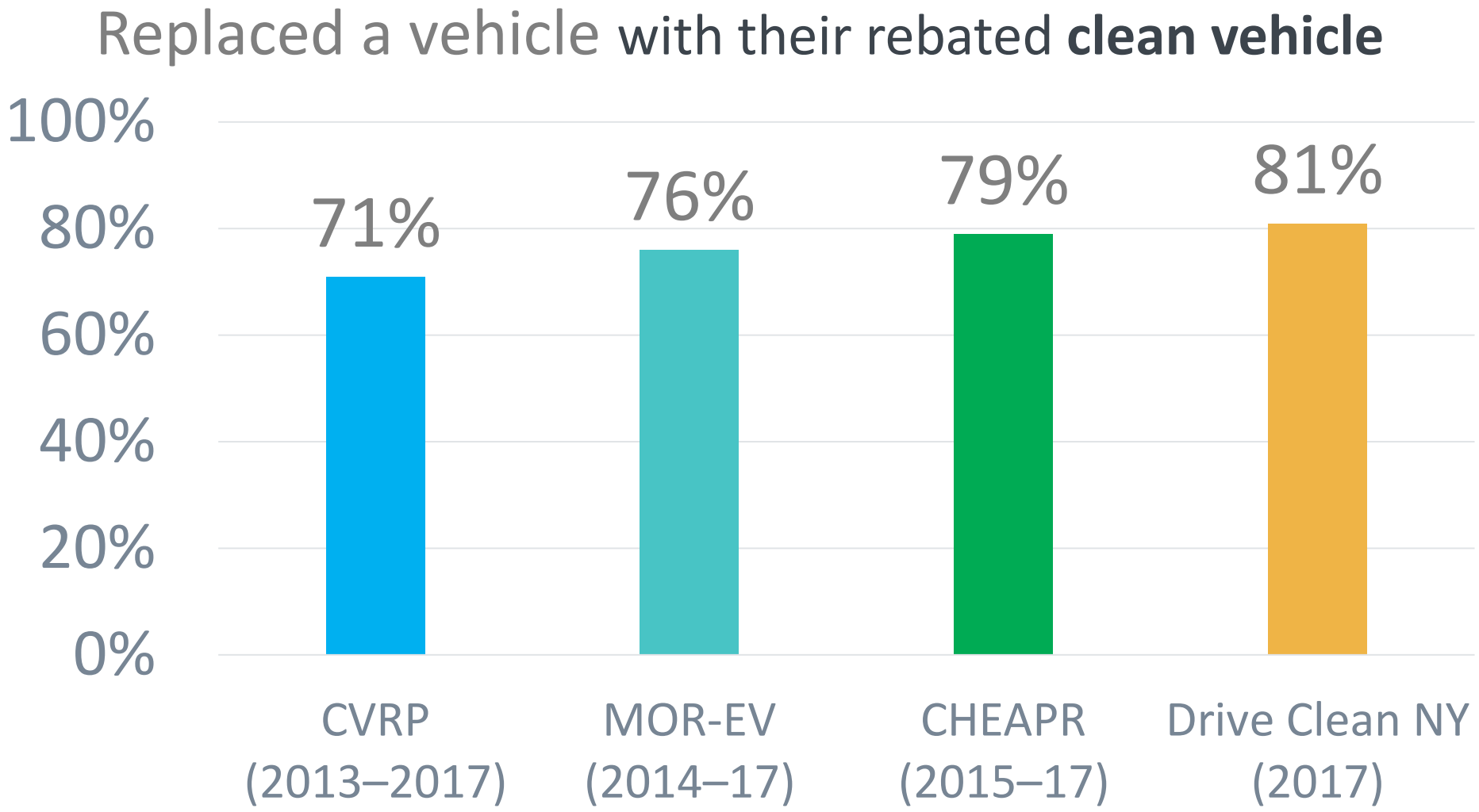
X-Standardized Rebate Essentiality **Odds Ratios**



* 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?



Datasets: 44,623 total survey respondents weighted to represent 196,641 participants

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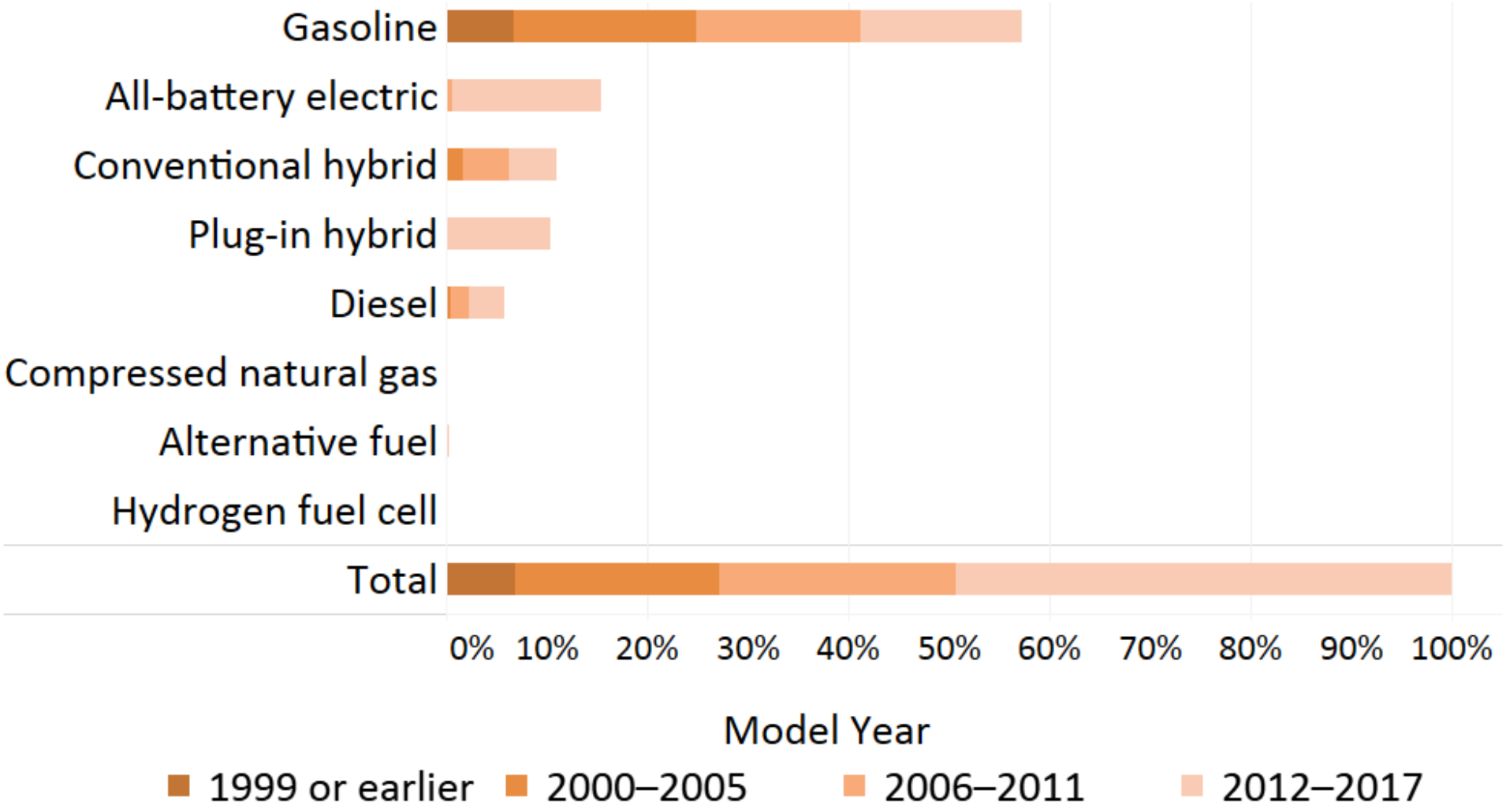
Impacts: Emission

What vehicles types have rebates helped replace?

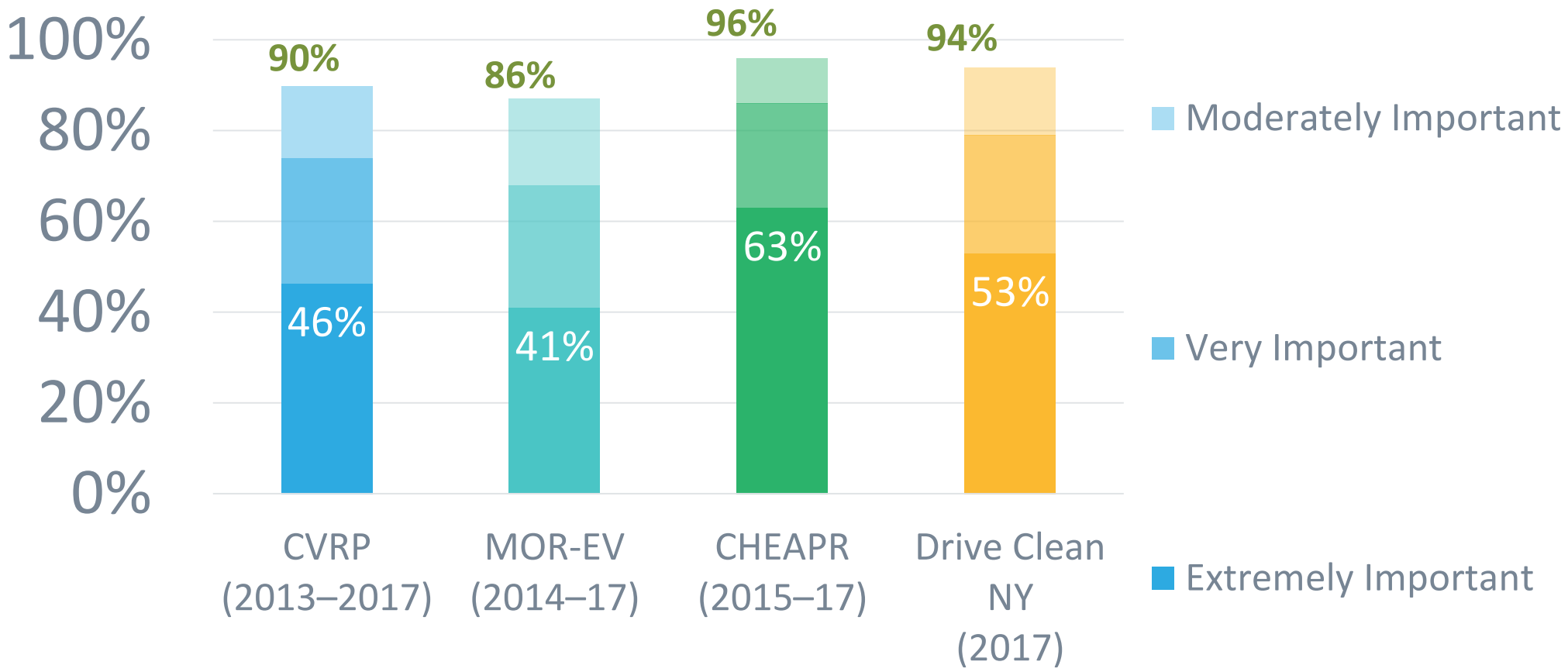


CVRP Consumer Survey. ***2016–2017*** edition, **trimmed to start *November 2016*,**
PEV respondents only, weighted, n=4,695

Impacts: Market

Rebate Influence: Importance

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



Datasets: 44,623 total survey respondents weighted to represent 196,641 participants

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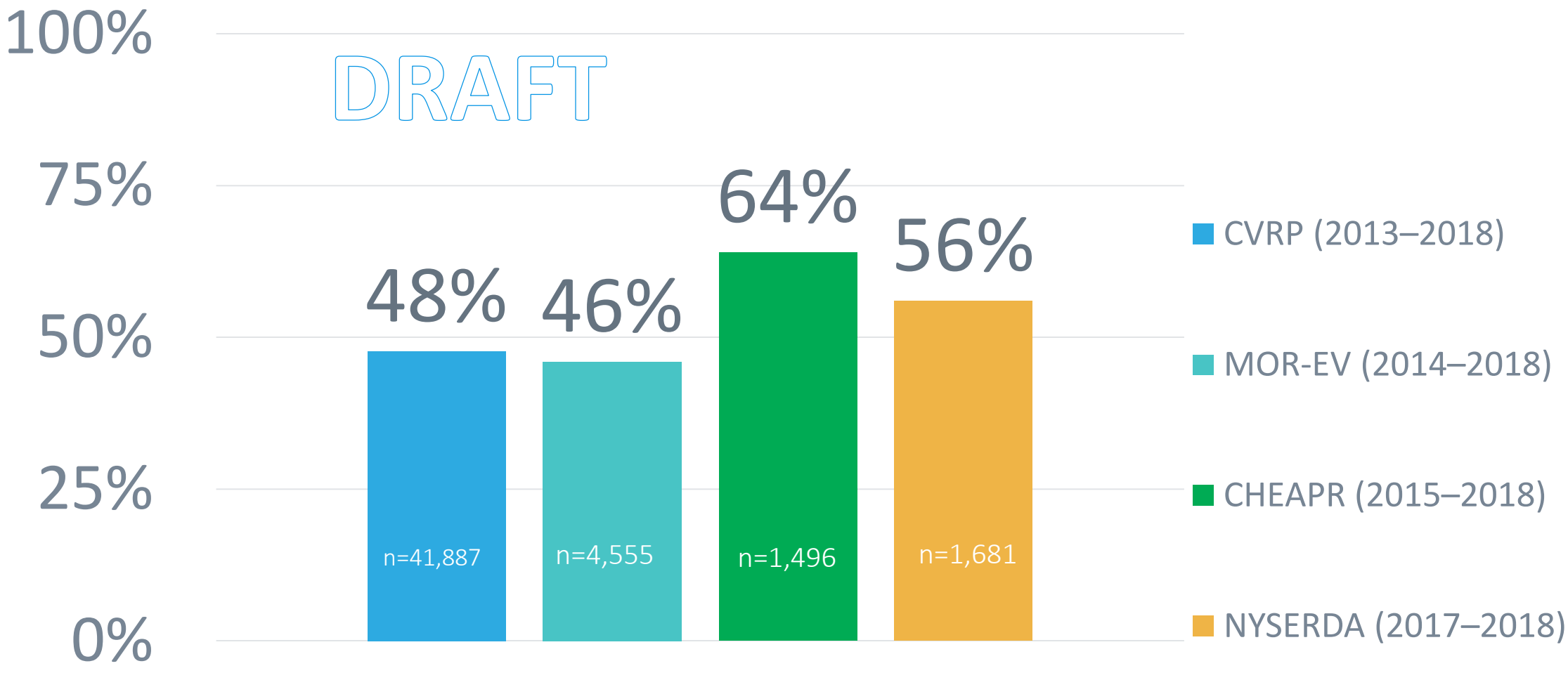
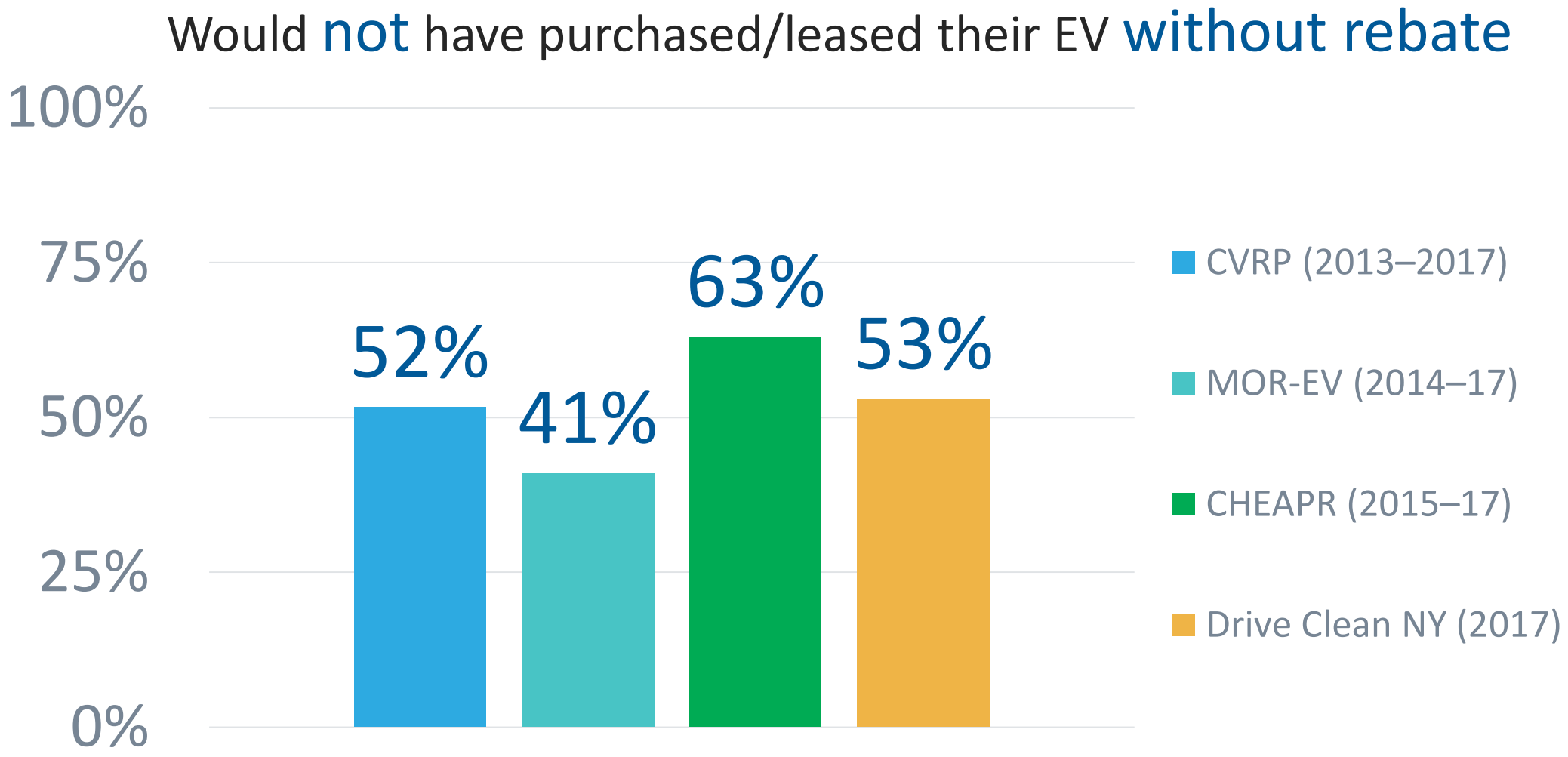
Percent Rating the Federal Tax Credit "Extremely Important"

("in making it possible to acquire" EVs)



Overall datasets: 52,446 total survey respondents weighted to represent 234,562 rebate recipients

Rebate Influence: Essentiality



Datasets: 44,623 total survey respondents weighted to represent 196,641 participants

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Internal vs. External Perspectives

- Internal (program data):
  - Rebate Essentiality = 52% (59% for non-Tesla BEVs)

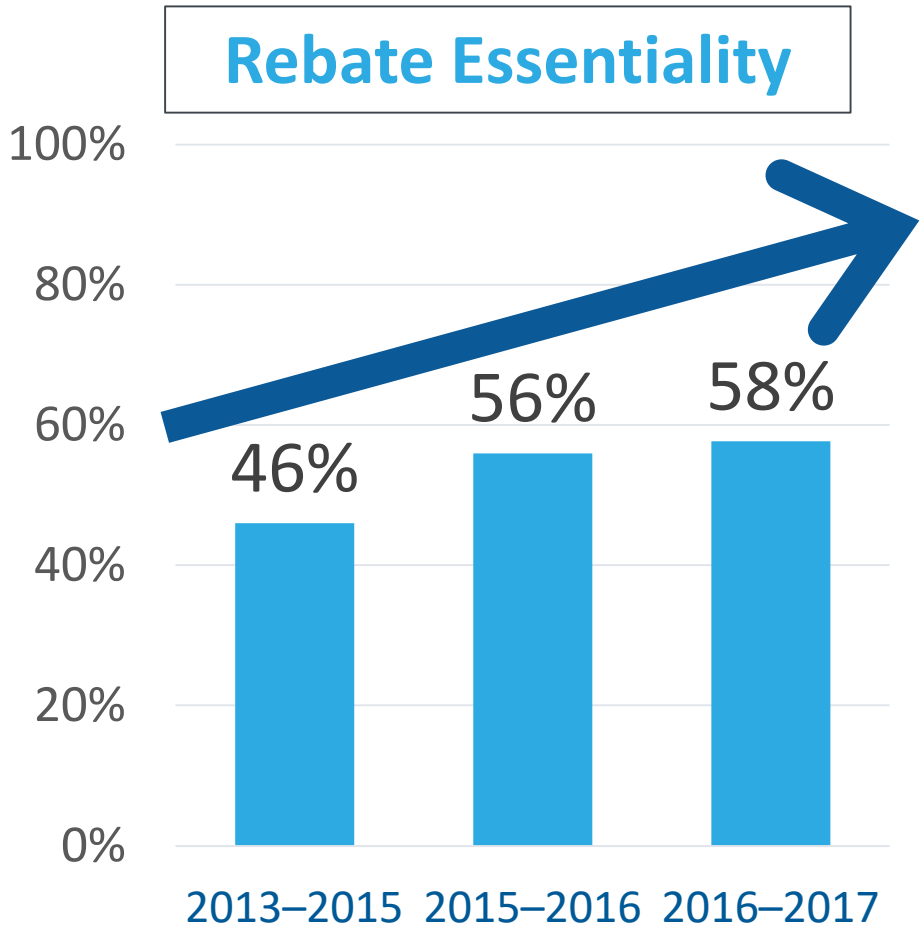
vs.

- External (select pertinent literature):

Source	Metric	Result
Jenn et al. (2018)	Increase in CA EV sales due to rebates	62%
Narassimhan and Johnson (2018)	Increase in BEV sales per ~$2,500 increase in incentives (adapted)	23.5%
Sheldon et al. (2016)	Increase in CA EV sales due to rebates	7%
Clinton et al. (2015)	Increase in BEV sales for every ~$2,500 of incentives (adapted)	18% (+/- ~22%)

DRAFT

Rebate Essentiality is *increasing* Over Time, Contradicting a Common Paradigm About Phasing Out Incentives



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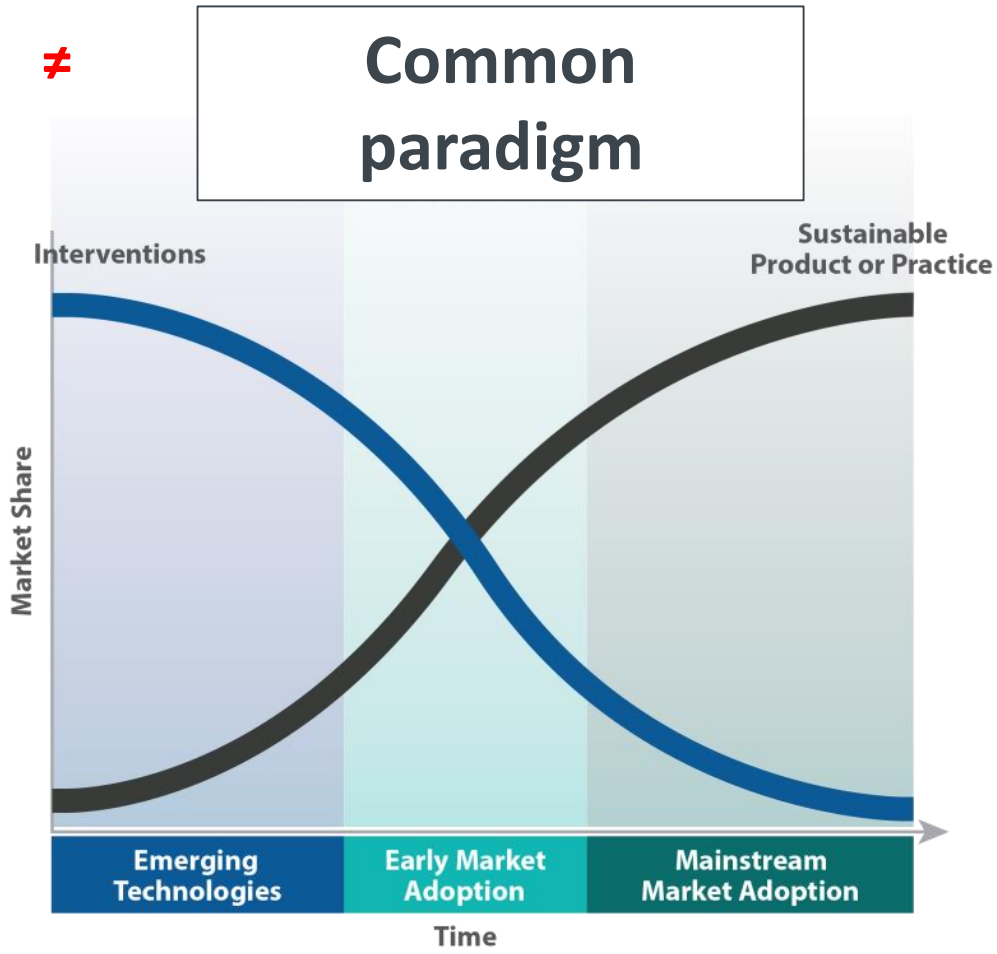

CVRP Consumer Survey. 2013–2015 edition: weighted, n=19,208
2015–2016 edition: weighted, n=11,457
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Additional Design Considerations

Rebate Effectiveness, Income and MSRP caps

Program-Change Scenarios: Individual Measures

#	Scenario	Savings, % of Middle	First-cycle cost	% of first-cycle vehicles lost	$ saved per vehicle lost
1	Middle (baseline)	0%	$505 M	-	-
2	Limit one per person	-2%	$494 M	1%	$3,820
3	Limit 3 months between purchase and application	-3%	$488 M	1%	$3,961
4	<$60k MSRP	-3%	$487 M	1%	$4,232
5	<$50k MSRP	-4%	$486 M	1%	$4,021
6	>30-mi EPA all-electric range (AER)	-4%	$484 M	2%	$3,092
7	>40-mi AER	-4%	$482 M	2%	$3,040
8	<$40k MSRP	-5%	$481 M	2%	$3,953
9	>50-mi AER	-5%	$479 M	2%	$2,947
10	Income cap—single filers: ≤$150k, other filers: ≤$250k	-5%	$479 M	2%	$3,832
11	>30-mi AER for PHEV/BEVx, >100-mi for others	-7%	$467 M	3%	$3,477
12	>50-mi AER for PHEV/BEVx, >100-mi for others	-8%	$463 M	3%	$3,326
13	>100-mi AER	-11%	$447 M	4%	$3,269
14	Standard rebates lowered $500	-12%	$444 M	NA	NA
15	Income cap—single filers: ≤$150k, other filers: ≤$204k	-12%	$445 M	4%	$3,737
16	Income cap—all filers: ≤$150k	-22%	$392 M	8%	$3,718

From https://ww2.arb.ca.gov/sites/default/files/2019-04/cvrp_workgroup_handout_042319.pdf

Income-Based Eligibility: Implementation Considerations

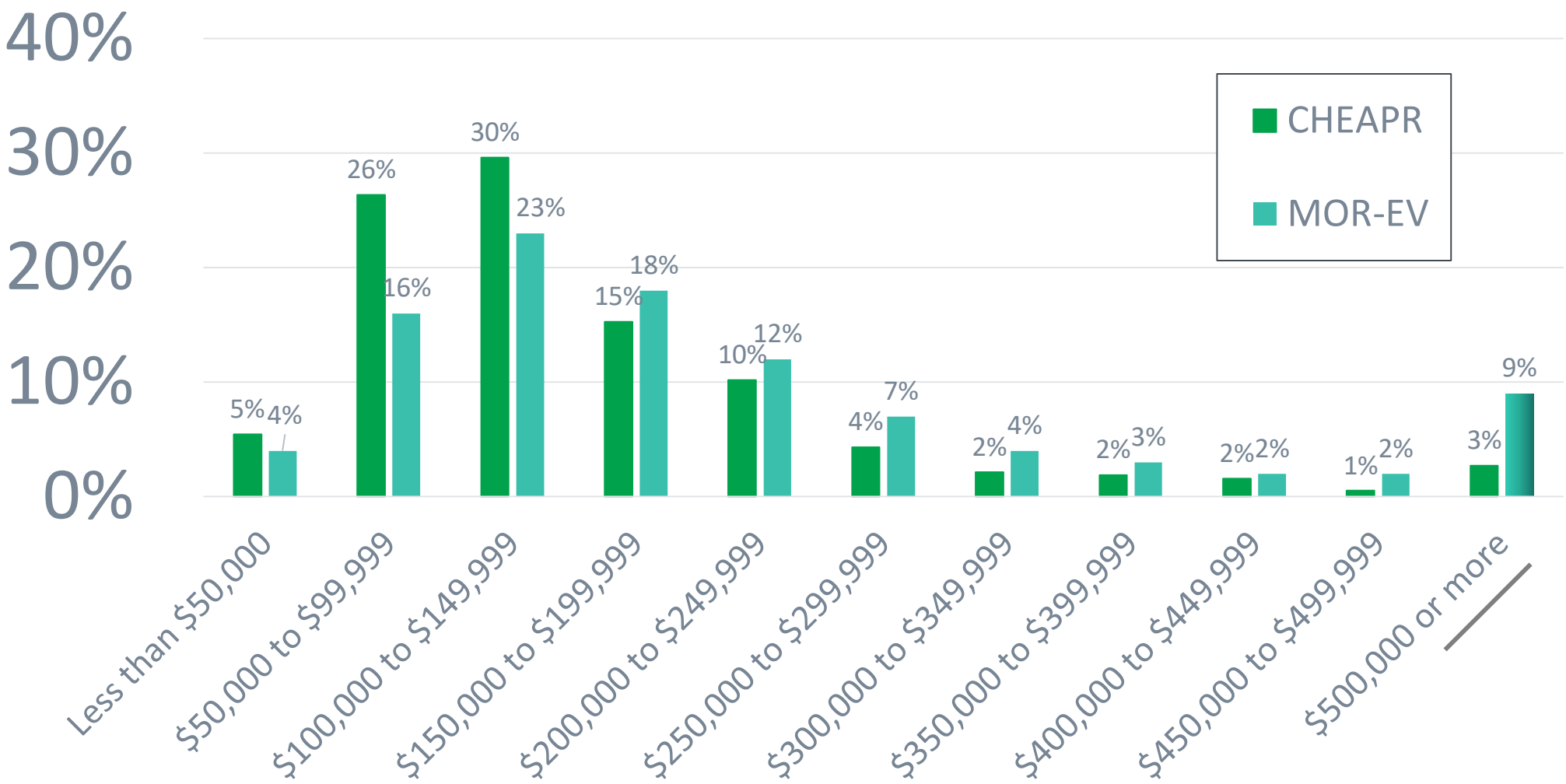
- **Dealer reluctance**, fears about liability
- **Outreach complexity**, consumer confusion
- **Application complexity**, affects all applicants
- **Intrusiveness**, tax forms
- **Wait times**, even for priority applicants
- **Investment** in processing systems, **labor**
- **Fraud**
- **Loopholes**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

MSRP may be a better proxy for income in program eligibility

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

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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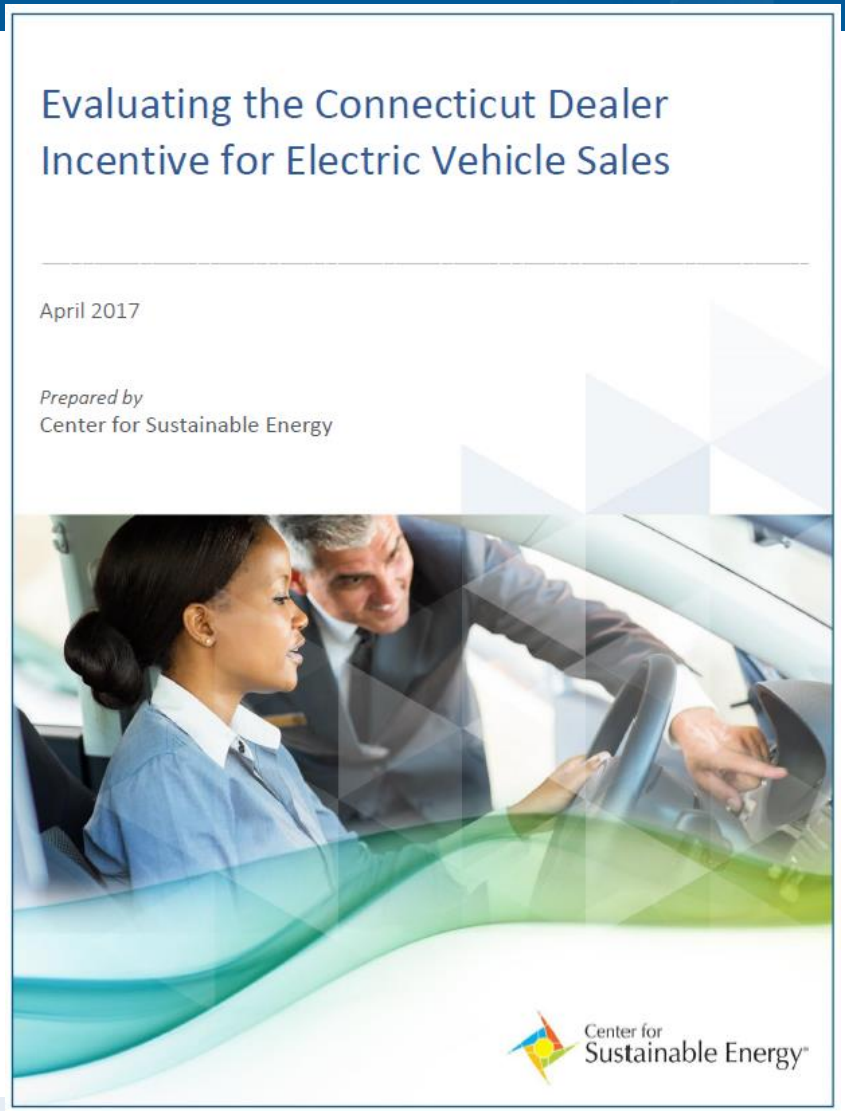
Dealer Incentives

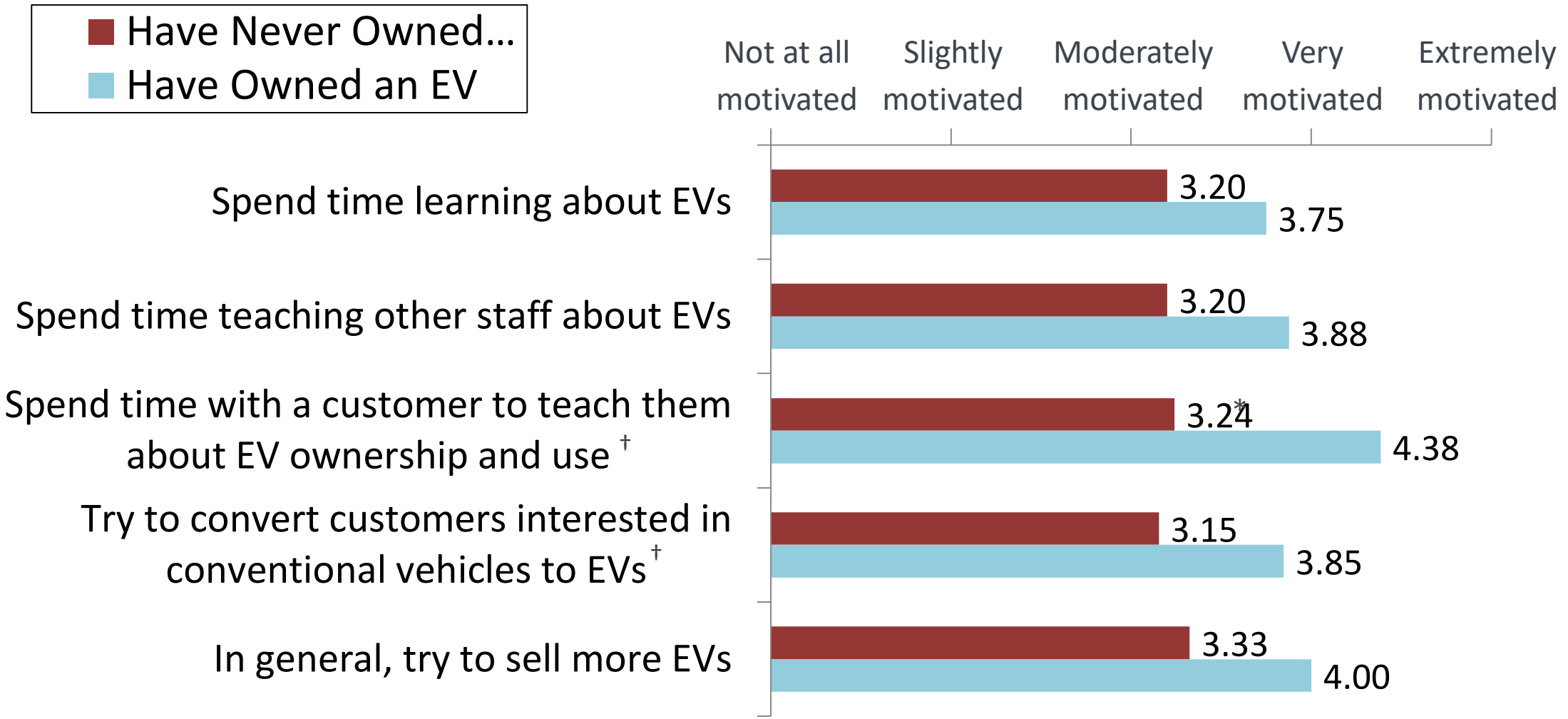
How is the dealer incentive working?



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

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 ($p < 0.05$)

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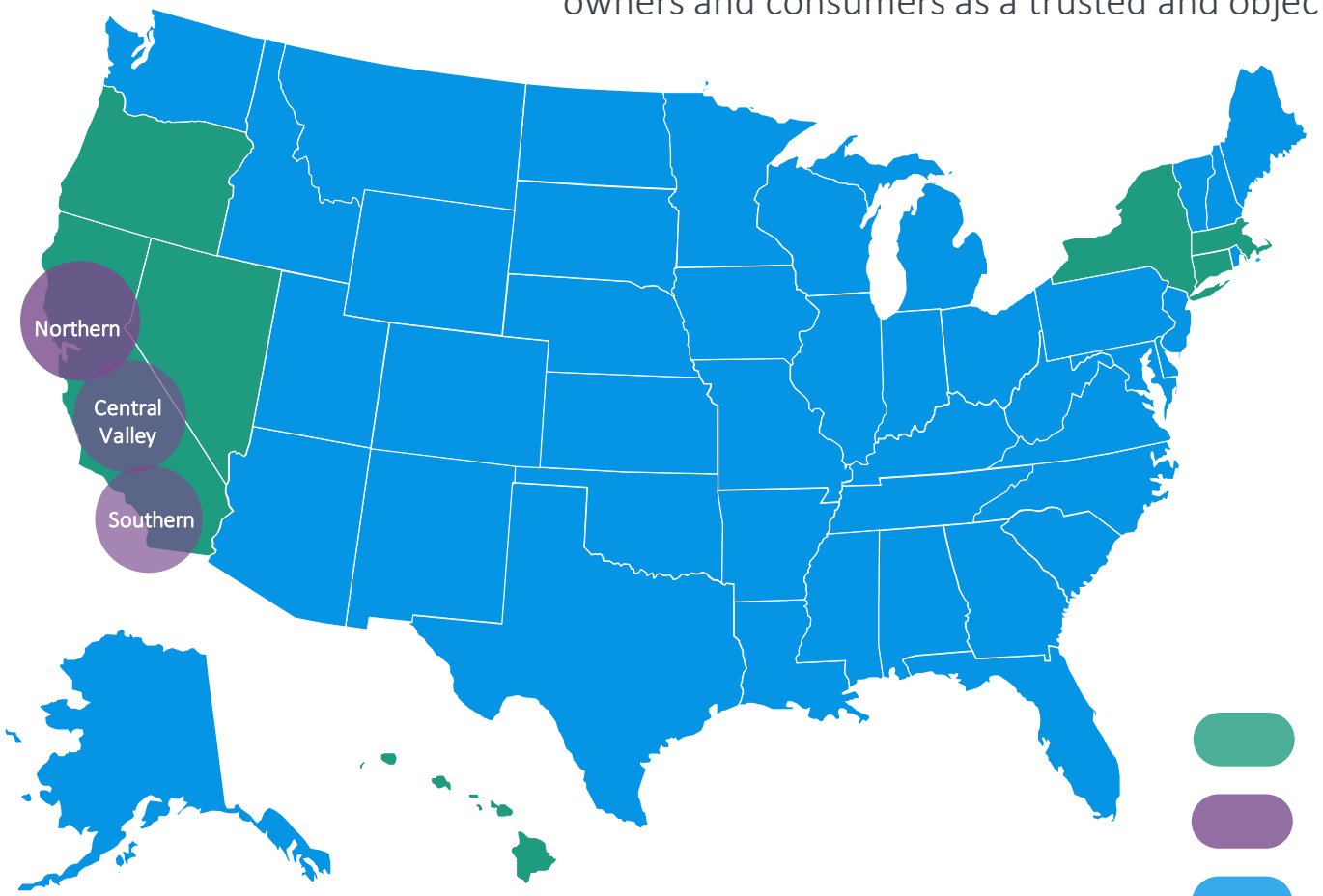
Summary: Select Findings

- Some consumer differences, particularly gender, remain
  - Trending in the right direction
  - Segmentation can support market-acceleration, equity, cost-effectiveness, or mainstreaming goals
- ~ 4/5^{ths} of rebated EVs replace older, more polluting vehicles
- Rebate influence on purchase/lease:
  - moderately to extremely important to 9/10^{ths}
  - essential to > half
- Avoiding > 30 tons of GHG emissions per vehicle over ~12-year vehicle life
- 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
- Dealer sales incentives motivate EV salespeople, particularly those with prior EV ownership experience

How can we help?

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



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

CSE: A Nonprofit With Billion-Dollar Program Management Experience

- **Five Statewide Electric Vehicle Rebate Programs**
  - > $700 million
  - > 300,000 rebated vehicles
  - > 200,000 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

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

Maryland Energy Administration

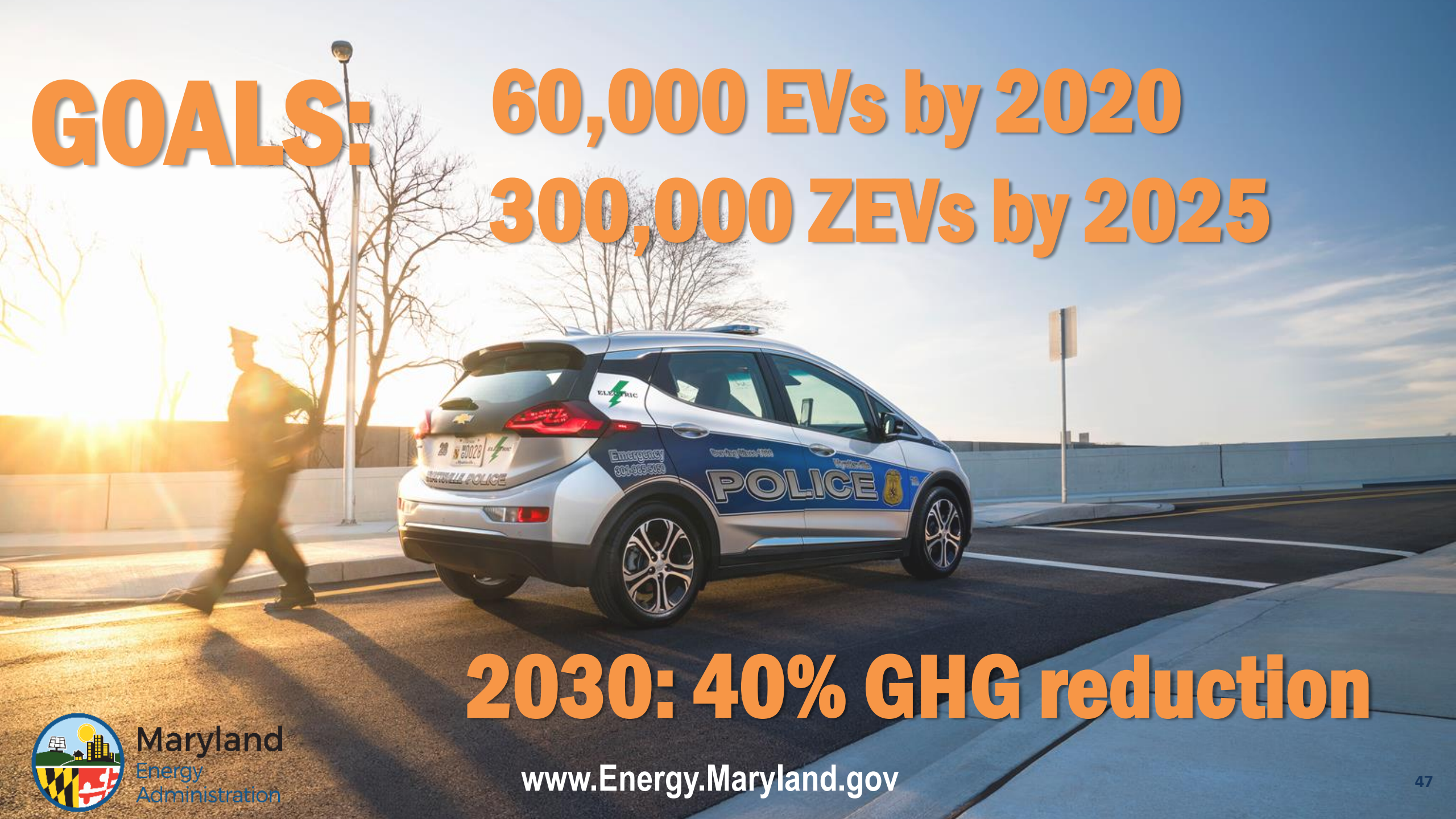
NGA Annual Energy Policy Institute

Mary Beth Tung, PhD, JD

Director

Maryland Energy Administration

www.Energy.Maryland.gov


GOALS:
60,000 EVs by 2020
300,000 ZEVs by 2025
POLICE
2030: 40% GHG reduction
Maryland
Energy
Administration
www.Energy.Maryland.gov

MD Excise Tax Credit $3,000

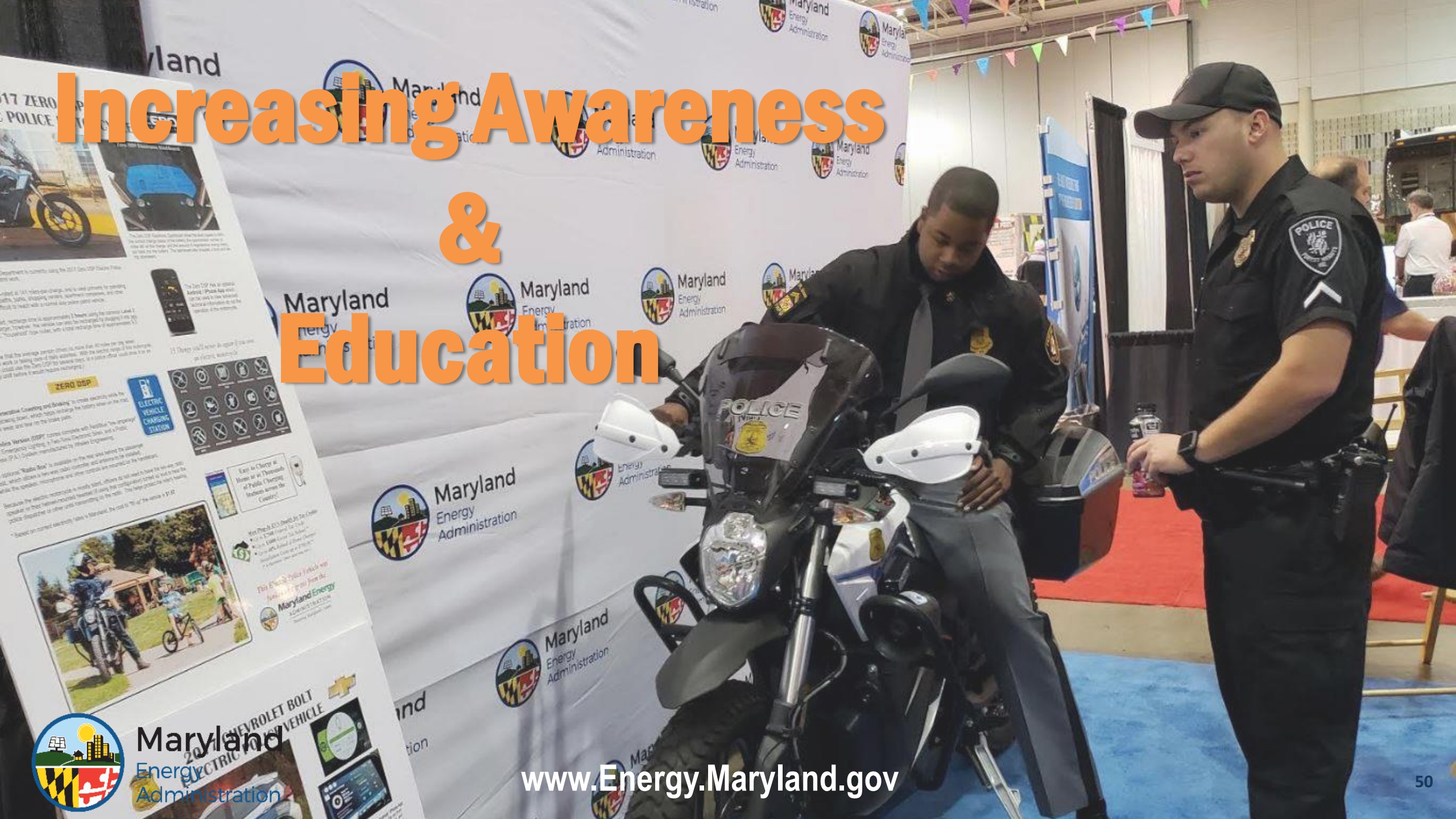
Maryland
Energy
Administration

www.Energy.Maryland.gov

Maryland Energy Administration

www.Energy.Maryland.gov

Increasing Awareness & Education



Maryland Energy Administration

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Maryland

Energy Administration

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Maryland
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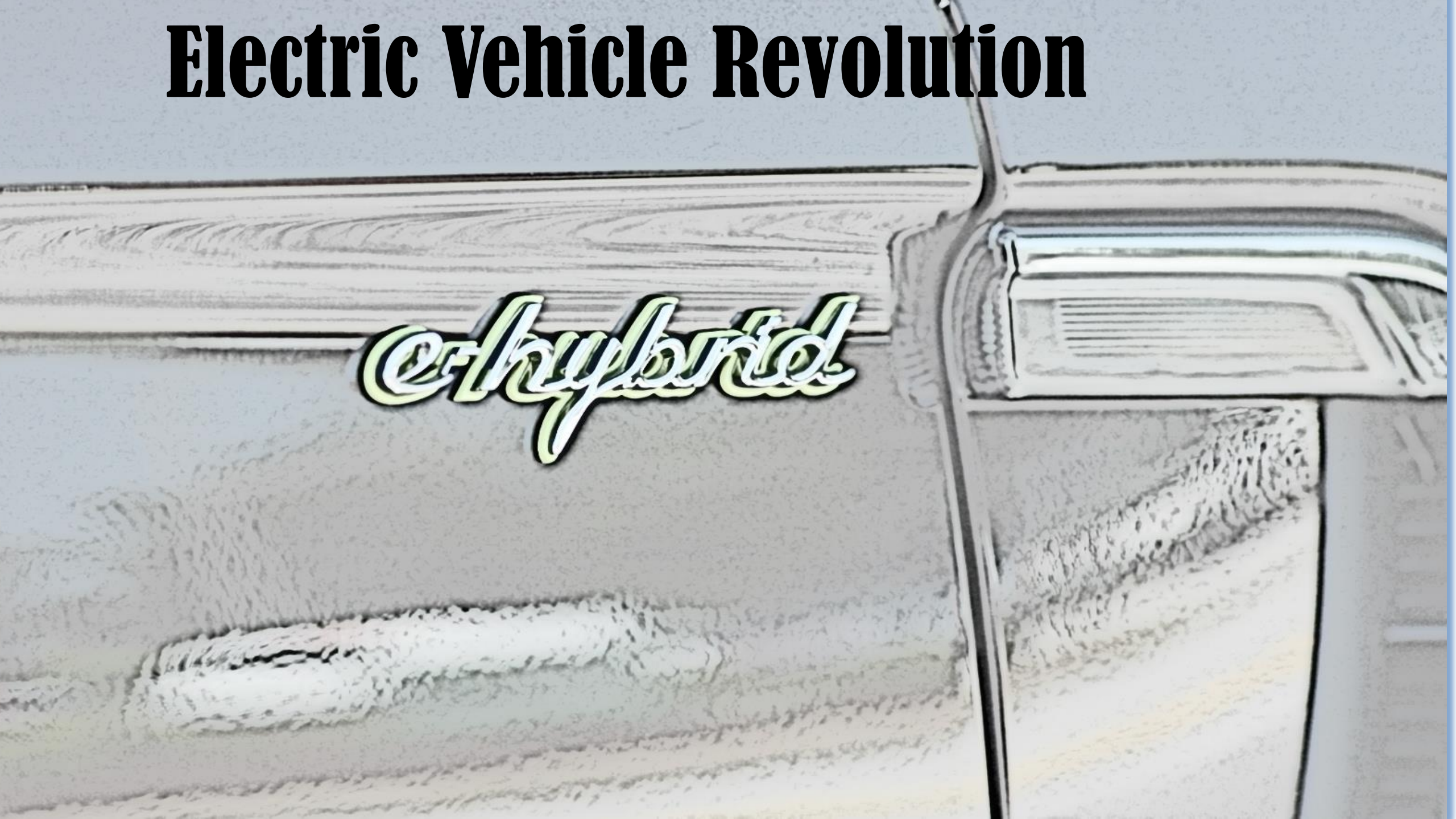
Live Tweet this session on Twitter

@timechols

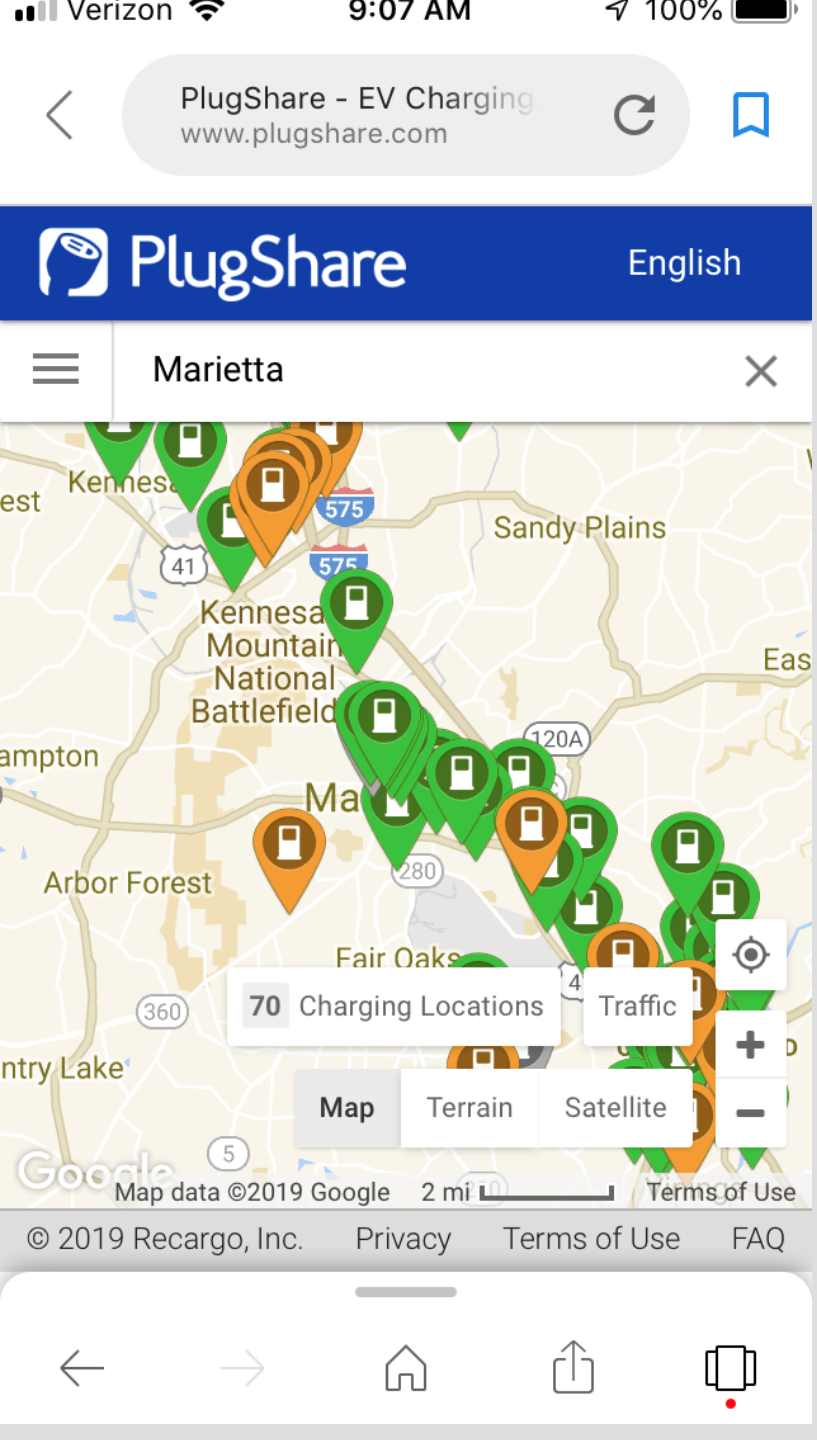
Electric Vehicle Revolution



Electric Vehicle sales are

rapidly rising

in the U.S.



Chargers are everywhere

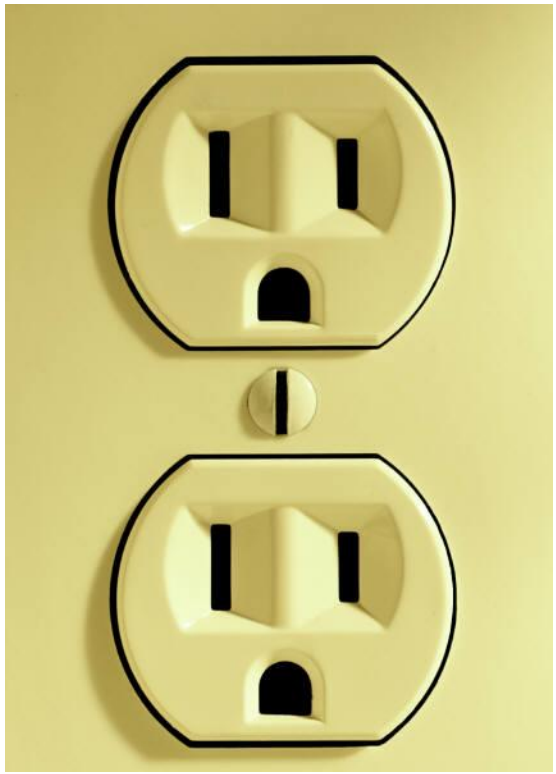
Lyft Ride-Share EV Experiment (ATL and SEATTLE)

- 50 Chevy Bolts
- $249 Rental (includes insurance and free charging)
- Must give 9 rides per week
- Can use car for personal use
- Facility in low-income blighted area
- Ride-Drive impact on Evs?
- Google “Tim Echols LYFT” to see my experience as driver

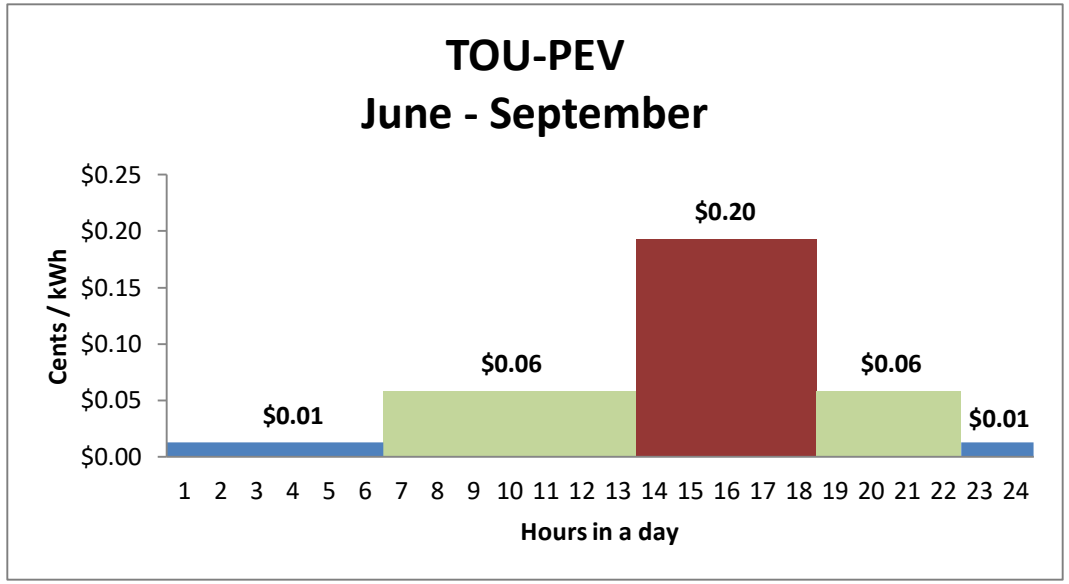
Windy Echols
and her LEAF

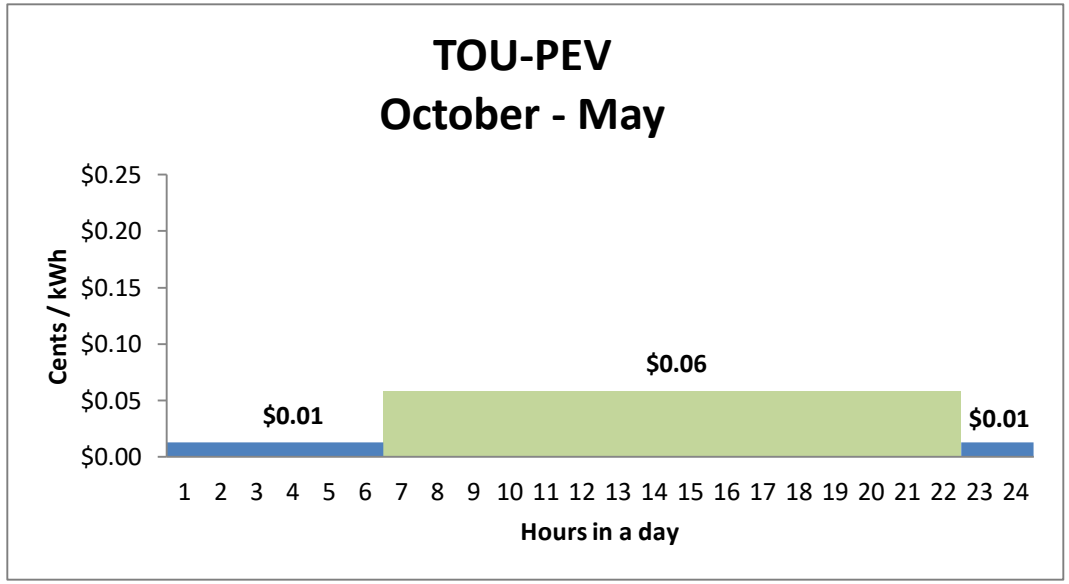
Tim’s Kia
Soul

Electric Vehicles will disrupt the market by 2031—UBS Lab Report



Time of Use – Plug-in Electric Vehicle

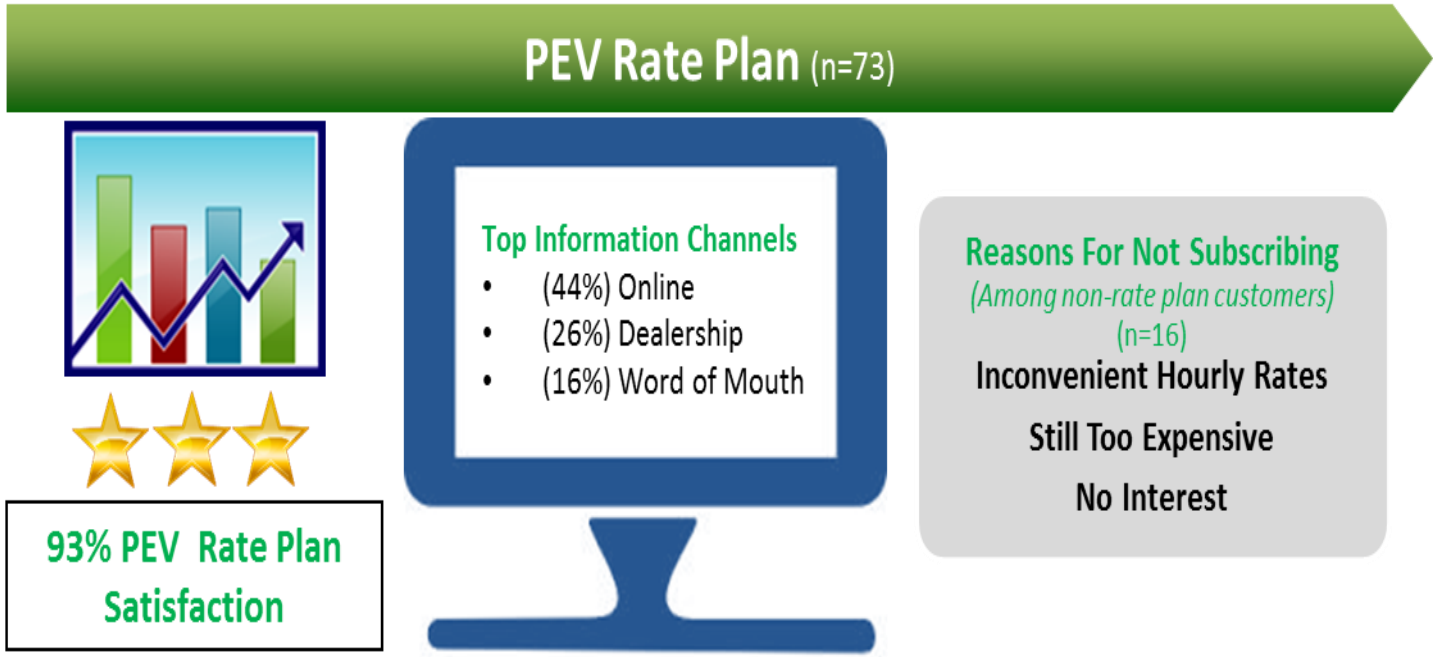




* Prices are rounded energy only and do not include fuel, ECCR,NCCR, DSM and taxes

- 1000 customers studied.
- Their annual electric bills decreased by $180 AFTER getting an electric car.
- Whole house rate
- Uses electricity at the cheapest time.

* Current Fuel Prices Rounded



GPC PEV Rate - Customer Load Study

- 94% customers are saving on this rate
- 15% increase in energy usage (3,023 kWh)
- PEV customers shifted an additional 10% usage to super off-peak

2011

- **V** Very limited availability
- **L** High lease rates
- **C** Almost no charging available

2010 - 2011	Chevrolet Volt	Nissan LEAF	Mitsubishi i-MiEV	Monthly Total
DEC 2010	326	19	0	345
JAN	321	87	0	408
FEB	281	67	0	348
MAR	608	298	0	906
APR	493	573	0	1,066
MAY	481	1,142	0	1,623
JUN	561	1,708	0	2,269
JUL	125	931	0	1,056
AUG	302	1,362	0	1,664
SEP	723	1,031	0	1,754
OCT	1,108	849	0	1,957
NOV	1,139	672	0	1,811
DEC	1,529	954	80	2,563
TOTAL	7,671	9,674	80	17,425

"Other" This Generation Plug-In Vehicles:

(since 2008, that were publically available, sold in the US, and that are not part of the monthly chart totals - minumum 100 units) *excludes NEVS

Tesla Roadster	1,900 (e)
Fisker Karma	1,700 (e)
Ford Transit Connect	550 (e)
McLaren P1	124
CODA	117

2019+

- **P** 48 models with a plug compared to 6 in 2011
- **C** Cox Enterprises launches PIVET
- **E** Electrify America infusion of cash due to cheating scandal

2017-US	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
Tesla Model S*	900	1,750	3,450	1,125	1,620	2,350	1,425	2,150					14,770
Chevrolet Volt	1,611	1,820	2,132	1,807	1,817	1,745	1,518	1,445					13,895
Toyota Prius Prime	1,366	1,362	1,618	1,819	1,908	1,619	1,645	1,820					13,157
Tesla Model X*	750	800	2,750	715	1,730	2,200	1,650	1,575					12,170
Chevrolet Bolt EV	1,162	952	978	1,292	1,566	1,642	1,971	2,107					11,670
Nissan LEAF	772	1,037	1,478	1,063	1,392	1,506	1,283	1,154					9,685
Ford Fusion Energi	606	837	1,002	905	1,000	707	703	762					6,522
Ford C-Max Energi	473	639	662	720	950	936	844	705					5,929
Fiat 500e**	752	590	785	541	515	645	475	415					4,718
BMW i3	382	318	703	516	506	567	601	504					4,097
BMW X5 xDrive40e	262	275	397	291	433	488	463	317					2,926
BMW 330e	129	144	365	260	475	496	387	409					2,665
VW e-Golf	332	293	342	307	381	232	308	317					2,512
Audi A3 Sprtbk e-tron	387	400	414	301	294	324	218	129					2,467
Chrysler Pacifica Hybrid**	12	0	0	335	705	355	125	425					1,957
Hyundai Sonata PHV**	190	175	295	280	220	255	205	185					1,805
Ford Focus Electric	56	228	407	125	132	110	148	131					1,337
Porsche Cayenne S-E	177	121	126	185	174	195	160	178					1,316
Kia Soul EV	117	152	171	167	129	100	145	300					1,281
Volvo XC90 T8 PHEV	96	83	103	145	146	202	174	265					1,214
BMW 530e				13	147	239	343	345					1,087
Kia Optima PHV	10	61	70	86	85	78	130	182					702
Mercedes C350e	210	51	17	3	7	0	112	212					612
Mercedes S550e	55	51	60	81	83	81	124	32					567
Mercedes B250e	53	56	50	66	46	46	81	58					456
BMW 740e	18	35	42	123	33	52	80	39					422
Mercedes GLE 550e	52	59	47	36	33	41	27	23					318
BMW i8	50	58	49	23	18	22	55	29					304
Hyundai IONIQ Electric			5	19	75	58	43	66					266
Mini Countryman S E PHV						10	75	86					171
smart ED	15	22	13	3	1	3	0	94					151
Tesla Model 3							30	75					105
Cadillac CT6 PHV				8	16	20	22	23					89
Volvo XC60 PHEV							13	65					78
Honda Clarity Electric							34	~15					34
Cadillac ELR	3	0	2	2	0	7	2	1					17
Chevrolet Spark EV	4	4	3	1	0	1	1	0					14
Porsche Panamera S-E	2	1	3	2	1	0	0	1					10
Mitsubishi i-MiEV	0	1	3	2	0	0	0	0					6
InsideEVs	11,004	12,375	18,542	13,367	16,638	17,332	15,620	16,624	0	0	0	0	121,502
2016 Results	6,221	7,763	13,857	10,531	11,467	14,863	13,067	14,592	17,224	11,007	13,237	24,785	158,614
Worldwide*	41,372	53,561	94,650	71,762	91,417	102,130	92,835						547,727

Georgia House Bill 170

Imposes New **UNFAIR** Road Use Tax

Smart Fortwo ED
2,100 lbs Curb Weight
$225/yr tax

Ford F-150
4,685 to 6,113 lbs Curb Weight
$164/yr tax

Shown to scale,
Both cars driven 12,000 miles per year.

Which one of these damages the roads more?

EVs are fighting for respect

Commercial (2 Broad categories)

Ride Share, Taxi, Autonomous

Fleet, Motor Pool, Delivery, Trucking

Municipal Fleet Charging

Los Angeles Sustainability Plan example

- 80% of new fleet vehicles by 2025.
- LAPD is the largest fleet in the city and the first department to “go electric” with the first 100 of 500 EVs in total.
- The LAPD charging hub will be a part of larger system
- Building on open standards

LIFE AFTER DEATH (DEMAND CHARGES)

In California:

The second-life battery system integrates two BMW i3 battery packs into a single housing.

In Alabama (without EV charging):

Being studied here by Southern Research using Nissan Leaf battery sets (10).

Echols amendment on 2nd Life Charging

- I move that the PSC authorize and direct Georgia Power to develop a pilot project utilizing used lithium ion batteries for a grid-connected charging system for electric vehicles.
- The goals of the pilot shall include keeping fast charging of clean electric vehicles affordable and insulating the grid from spikes in electricity demand.
- The cost of the pilot shall not exceed $250,000.
- Georgia Power shall work with the Staff in designing the project to ensure that the project has a public benefit.

ENERGY MATTERS

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