CVRP: Data and Analysis Update

Public Workshop: Update to the 3-Year Plan for LDV Investments
(4 Dec. 2018, El Monte CA)

Brett Williams, PhD – Senior Principal Advisor, EV Programs, CSE

With thanks to:
- Nick Pallonetti, Ryan Bodanyi, John Anderson and others at CSE
Outline

• **Market Update**
  – Models,
  – Market Share
  – Sales Price: EVs* and Non-EVs

• **CVRP Update**
  – Outputs: Vehicles & Consumers Rebated
  – Outcomes: Behaviors Influenced
  – Impacts: Emission & Market

• **Additional Considerations**
  – Rebate Effectiveness
  – Select “Before”/“After” Indicators

* EVs = light-duty plug-in hybrid, battery, and fuel-cell electric vehicles (PHEVs, BEVx vehicles, BEVs, and FCEVs)
Market Update
Models, Market Share, & Sales Price: EVs and non-EVs
Unique Light-Duty Electric Vehicle Models Registered

PHEV, BEVx, BEV, and FCEV (no ZEM or CZEVs).
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Electric Vehicle Choices: Major 2018 Models

Plug-in hybrid EVs

All-battery EVs

Fuel-cell EVs
Note: LDV denominator includes light pickups and other categories with no EV offerings to date.
Includes content supplied by R.L. Polk & Co, © 2018
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‘Average Base MSRP’ does not reflect actual sale price and excludes typical costs (e.g., delivery charges, added features, etc.). Includes content supplied by R.L. Polk & Co, © 2018.
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Average Base MSRP and Number of Vehicles: BEVs & FCEVs

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CVRP Update

Outputs, Outcomes, and Impacts
CVRP Outputs

Vehicles Rebated
Cumulative CVRP Rebates (through August 2018)

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Through August 2018, issued and approved applications
CVRP Rebate Volumes Are Increasing

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<td>2014</td>
<td>43,702</td>
</tr>
<tr>
<td>2015</td>
<td>46,543</td>
</tr>
<tr>
<td>2016</td>
<td>44,455</td>
</tr>
<tr>
<td>2017</td>
<td>47,762</td>
</tr>
<tr>
<td>2018 (thru Aug.)</td>
<td>42,970</td>
</tr>
<tr>
<td>Total</td>
<td>270,459</td>
</tr>
</tbody>
</table>
Cumulative Rebates by Automaker (through June 2018)

- Chevrolet
- Tesla
- Other Brands
- Nissan
- Toyota
- Ford
- FIAT

Application Quarter

- Q1 2010
- Q1 2011
- Q1 2012
- Q1 2013
- Q1 2014
- Q1 2015
- Q1 2016
- Q1 2017
- Q1 2018

Cumulative Rebates

Issued rebates and approved applications
Moderately-Priced Vehicles Receive Most Rebates: Life of Program (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.
Rebates By County: Absolute and Share of Market

Rebates (thru June 2018)

36,933
3,097
68,871

Rebated LDV Market Share (2017*)

3%
7%
2%
2%

* Applications received in 2017, which may not align as closely to LDV registration dates as application purchase dates
Includes content supplied by R.L. Polk & Co, © 2018
Outputs
Consumers Rebated (incl. Equity Indicators)
## Majority Characteristics

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All</td>
<td>PHEV</td>
</tr>
<tr>
<td>White/Caucasian</td>
<td>76%</td>
<td>56%</td>
</tr>
<tr>
<td>Male</td>
<td>49%</td>
<td>72%</td>
</tr>
<tr>
<td>≥ Bachelor’s degree</td>
<td>66%</td>
<td>79%</td>
</tr>
<tr>
<td>Detached homes</td>
<td>75%</td>
<td>77%</td>
</tr>
<tr>
<td>40–59 years old</td>
<td>52%</td>
<td>50%</td>
</tr>
<tr>
<td>&lt; $150k HH Income</td>
<td>79%</td>
<td>80%</td>
</tr>
</tbody>
</table>

California Household Travel Survey, 2012: weighted, n = 42,431*
CVRP Rebates By Household Income Over Time (By Month)

Shaded bands denote waitlist periods.

CVRP Rebates By Household Income Over Time
(Smoothed with 1-Year Running Average)

Shaded bands denote waitlist periods.

Even Where Differences Remain, Rebate Recipients Look More And More Like Other Car Buyers

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

Male ≥ Bachelor’s degree

- 2013–2015
- 2015–2016
- 2016–2017
- Vehicle purchase “intenders” (CHTS 2012)
Even Where Differences Remain, Rebate Recipients Look More And More Like Other Car Buyers


California Household Travel Survey, 2012: weighted, n = 42,431
Rebates in Disadvantaged Communities (DACs)

Through June 2018, issued and approved.
Disadvantaged Communities (DACs) (2017)

- Population (2016): ~25%
- LDV Sales: 22.7%
- ZEV Sales: 8.2%
- Number of Rebates: 9.1%

Context Is Important: DAC vs. CA Rebates (2017)

Note: Some PHEV models could not be identified in the registration data, which may result in a minor overestimation of percent of market rebated.
Issued rebates and approved applications
Note: equity groups displayed are not mutually-exclusive
Low-income communities as defined for AB 1550

Funding Proportion Going to Equity Groups: Current Program  (Nov. 2016 thru June 2018)

- CES 3.0 Disadvantaged Communities: 9%
- Increased Rebates for Low-/Moderate-Income Consumers: 15%
- Low-Income Communities: 20%
Outcomes
Behaviors Influenced
Replaced a vehicle with their rebated EV

- 2013–2015: 65%
- 2015–2016: 76%
- 2016–2017: 78%

2015–2016 edition: weighted, n=11,583
2016–2017 edition: weighted, n=9,342
Impacts

Emission
What vehicles types have rebates helped replace?

- Gasoline
- All-battery electric
- Conventional hybrid
- Plug-in hybrid
- Diesel
- Compressed natural gas
- Alternative fuel
- Hydrogen fuel cell

**Model Year**
- 1999 or earlier
- 2000–2005
- 2006–2011
- 2012–2017

Replaced Vehicle Distribution

Model Year
- 1999 or earlier
- 2000–2005
- 2006–2011
- 2012–2017

Impacts

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

<table>
<thead>
<tr>
<th>Program</th>
<th>0%</th>
<th>20%</th>
<th>40%</th>
<th>60%</th>
<th>80%</th>
<th>100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVRP (2013–2017)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>90%</td>
</tr>
<tr>
<td>MOR-EV (2014–17)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>86%</td>
</tr>
<tr>
<td>CHEAPR (2015–17)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>96%</td>
</tr>
<tr>
<td>Drive Clean NY (2017)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>94%</td>
</tr>
</tbody>
</table>

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

Would **not** have purchased/leased their EV **without rebate**

Datasets: 44,623 total survey respondents weighted to represent 196,641 participants
Additional Considerations
Rebate Effectiveness, “Before/After” Comparisons
Rebate Effectiveness
Rebate Essentiality is *Increasing* Over Time

Would **not** have purchased/leased their EV **without** rebate

- **2013–2015**: 46%
- **2015–2016**: 56%
- **2016–2017**: 58%

2016–2017 edition: weighted, n=9,261*
Rebate Essentiality


- **2013–2015**: 46%
- **2015–2016**: 56%
- **2016–2017**: 58%

**Common paradigm**

- Market Transformation
  - Interventions
  - Sustainable Product or Practice

- Time:
  - Emerging Technologies
  - Early Market Adoption
  - Mainstream Market Adoption
Rebate Essentiality Reflects Interesting Trends

As MSRP increases, rebate influence decreases

Average Base MSRP:
- Less than $30,000: 64%
- $30,000–$39,999: 57%
- $40,000–$49,999: 56%
- $60,000–$69,999: 46%
- $80,000 or more: 43%

Rebate Essentiality Reflects Interesting Trends

As MSRP increases, rebate influence diminishes

- $1,000 max rebate

* = small sample size (n < 30) in bin. MOR-EV Survey, 2014–17:

n = 2,549 total respondents, weighted to represent N=5,754 participants
Targeting EV Outreach and Incentives to Cost-Effective “Rebate-Essential” Consumers

EVS 31, 3 October 2018
Brett Williams, M.Phil. (cantab), Ph.D. – Senior Principal Advisor, EV Programs
John Anderson – Research Analyst
Targeting Rebate-Essential Consumers: Odds-Increasing Factors for PHEV and BEV Consumers

All are significant factors \( p < 0.05 \)

- Central (vs. Bay Area)
- Central (vs. South)
- Lower price
- Lower-income Increased Rebate
- Difficulty finding information online
- More importance: carpool
- Younger age
- Did not hear about CVRP from the dealer
- More importance: save on fuel costs
- Postgraduate degree (vs. Associate degree...)

X-Standardized Rebate Essentiality Odds Ratios

- PHEV
- BEV
Income Criteria: Before and After
Percent-of-EV-market-rebated decreased (only individual consumers shown)

- 2015: 73%
- Current program, pre-waitlist: 49%

CVRP Rebate Statistics and IHS Markit EV registration data
Median income decreased


$p < 0.01$
Vehicle replacement increased

2015

- Replaced: 61%
- Did Not Replace: 39%

Current program, pre-waitlist

- Replaced: 80%
- Did Not Replace: 20%


p = 0.01
Particularly for low-income communities

- 2015:
  - Replaced: 57%
  - Did Not Replace: 43%

- Current program, pre-waitlist:
  - Replaced: 81%
  - Did Not Replace: 19%
Next Steps

• Regression discontinuity?
• Propensity scoring?
Questions

Time to Discuss??
How can we help?

brett.williams@energycenter.org

Presentation available at: https://cleanvehiclerebate.org/
Online Resources & Extra Slides
Interactive data dashboards and downloads:

- Rebate statistics
- Rebate maps
- Survey results
Reports, analysis, infographics & presentations

  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

  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
Where can I get additional data?: CSE Transparency Tools

Public dashboards facilitate informed action across multiple U.S. states and regions

- cleanvehiclerebate.org
- ct.gov/deep
- sonomacleanpower.org
- zevfacts.com
- mor-ev.org
Additional Participant Evaluation Examples

• **Progress in Disadvantaged Communities** *(AEA pres 2016)*

• **Information Channels** *(EV Roadmap pres, 2016)*
  – Exposure & importance of various channels, consumer time spent researching various topics

• **Infographics**
  – Overall *(CVRP infographic, 2016)*
  – Disadvantaged Communities *(CVRP DAC infographic, 2017)*

• **Characterization of Participating Vehicles and Consumers** *(CVRP research workshop pres, 2015)*

• **Program Participation** by Vehicle Type and County *(CVRP brief 2015)*

• **Dealer services**: Importance and Prevalence *(EF pres 2015)*

[Link to image: Electric Vehicle Rebates in Disadvantaged Communities: Evaluating Progress with Appropriate Comparisons]

[Link to resource: http://energycenter.org/resources?combine=&resource=All&technology=248&target=All]
Rebate Share by Major Brand and Disadvantaged Community (DAC) Status

Through June 2018, issued and approved.
Electric Vehicle Rebates: Exploring Indicators of Impact in Four States

EV Roadmap 11, Portland OR, 20 June 2018
Brett Williams, Ph.D. – Principal Advisor, Clean Transportation
Michelle Jones and Georgina Arreola – Analysts

Thanks also to Jaclyn Vogel and others at CSE
### Consumer Survey Data  
*(Rebates to Individuals Only)*

<table>
<thead>
<tr>
<th>Vehicle Purchase/Lease Dates</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dec. 2010 – May 2017</td>
<td></td>
</tr>
<tr>
<td>July 2014 – October 2017</td>
<td></td>
</tr>
<tr>
<td>May 2015 – June 2017</td>
<td></td>
</tr>
<tr>
<td>March 2017 – Nov. 2017</td>
<td></td>
</tr>
<tr>
<td>Dec. 2010 – Nov. 2017</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Survey Responses (total n)*</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>40,438</td>
<td>44,623</td>
</tr>
<tr>
<td>2,549</td>
<td></td>
</tr>
<tr>
<td>819</td>
<td></td>
</tr>
<tr>
<td>817</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Program Population (N)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>185,367</td>
<td>196,641</td>
</tr>
<tr>
<td>5,754</td>
<td></td>
</tr>
<tr>
<td>1,583</td>
<td></td>
</tr>
<tr>
<td>3,937</td>
<td></td>
</tr>
</tbody>
</table>

*Weighted to represent the program population along the dimensions of vehicle category, vehicle model, buy vs. lease, and county (using raking method)*
### Data comparability: Program designs vary

<table>
<thead>
<tr>
<th>Type</th>
<th>Fuel-Cell EVs</th>
<th>All-Battery EVs</th>
<th>Plug-in Hybrid EVs</th>
<th>Zero-Emission Motorcycles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$5,000</td>
<td>$2,500</td>
<td>$2,500 (i3 REx)</td>
<td>$900</td>
</tr>
<tr>
<td></td>
<td>$2,500</td>
<td>$2,500</td>
<td>$1,500</td>
<td>$750</td>
</tr>
<tr>
<td>e-miles ≥ 20 only;</td>
<td></td>
<td></td>
<td>≥10 kWh $2,500</td>
<td>msrp ≥ $60k = $1,000 max., no fleet rebates</td>
</tr>
<tr>
<td>e-miles</td>
<td></td>
<td></td>
<td>&lt;10 kWh $1,500</td>
<td>MSRP &gt; $60k = $500 max.; point-of-sale via dealer</td>
</tr>
<tr>
<td>Consumer income cap</td>
<td></td>
<td></td>
<td></td>
<td>MSRP ≤ $60k only; dealer assignment; $150 dealer incentive ($300 previous)</td>
</tr>
<tr>
<td>and increased</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>rebates for lower-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>income households</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **e-miles**
  - ≥ 120 $2,000
  - ≥ 40 $1,700
  - ≥ 20 $1,100
  - < 20 $500
Most Rebate Recipients Have *Moderate* Household Incomes

- **< $100k**
  - MOR-EV (2014–17): 31%
  - CHEAPR (2015–17): 39%
  - Drive Clean NY (2017): 59%
  - U.S. new-car buyers (MY2015)*: 100%

- **$100–199k**
  - CVRP (2013–17): 43%
  - MOR-EV (2014–17): 41%
  - CHEAPR (2015–17): 45%
  - Drive Clean NY (2017): 43%
  - U.S. new-car buyers (MY2015)*: 100%

- **$200–299k**
  - CVRP (2013–17): 19%
  - MOR-EV (2014–17): 19%
  - CHEAPR (2015–17): 14%
  - Drive Clean NY (2017): 12%
  - U.S. new-car buyers (MY2015)*: 100%

- **> $300k**
  - CVRP (2013–17): 13%
  - MOR-EV (2014–17): 20%
  - CHEAPR (2015–17): 10%
  - Drive Clean NY (2017): 6%
  - U.S. new-car buyers (MY2015)*: 100%

---

*Personal correspondence, Prof. Bunch (UCD)*

44,623 total survey respondents weighted to represent 196,641 participants
The Best Comparison is to New Car Buyers, Not the U.S. Population

44,623 total survey respondents weighted to represent 196,641 participants
* Personal correspondence, Prof. Bunch (UCD)
** U.S. Census Data
Are White Males Over-Represented?

[Bar chart showing percentage comparisons between White/Caucasian and Male demographics across different programs.

- White/Caucasian: 61%
- Male: 73%

- White/Caucasian: 82%
- Male: 89%

- White/Caucasian: 88%
- Male: 76%

Drive Clean NY (2017):
- White/Caucasian: 75%
- Male: 77%

CA vehicle-purchase “intenders” (CHTS 2012):
- White/Caucasian: 69%
- Male: 69%

25,163 total weighted survey responses
California Household Travel Survey, 2012: weighted, n = 42,431.
Do EVs get used?

Replaced a vehicle with their rebated clean vehicle

- CVRP (2013–2017): 71%
- MOR-EV (2014–17): 76%
- CHEAPR (2015–17): 79%
- Drive Clean NY (2017): 81%

Datasets: 44,623 total survey respondents weighted to represent 196,641 participants
Do EVs get used?: by Tech Type

Replaced a vehicle with their rebated EV

Datasets: 44,623 total survey respondents weighted to represent 196,641 participants
What vehicles have rebates helped replace?

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

- **Drive Clean NY (2017)**
- **CHEAPR (2015–17)**
- **MOR-EV (2014–17)**
- **CVRP (2013–2017)**

Model Year:
- 1999 or earlier
- 2000-2005
- 2006-2011
- 2012-2017
What vehicles have rebates helped replace?

- Gasoline
- Conventional hybrid
- All-battery electric
- Plug-in hybrid
- Diesel
- Flex-fuel/E85
- Compressed natural gas
- Hydrogen fuel cell
- Alternative fuel

Total

1994–1999
2000–2005
2006–2010
2011–2016

CVRP Consumer Survey. 2015–2016 edition: weighted, n=8,532
PEV-Replaced Vehicle Distribution: Top 10 Models

CVRP Consumer Survey. 2016–2017 edition, trimmed to start November 2016, PEV respondents only, weighted, n=1,601
Methodology: Characterizing Rebate-Essential Consumers

| **Rebate Essentials** |  
|-----------------------|---|
| **Research Objective** | Identify characteristics associated with increased rebate influence |
| **Strategic Purpose** | Informs targeting resources at consumers who otherwise would not adopt |
| **Model** | Binary logistic regression |
| **Outcome variable:** | “Would you have purchased or leased your PEV without the CVRP rebate?” [yes, no] |
| **Predictor variables:** | Consumer, household, vehicle, and transactional data |
| **Data** |  
| Nov 2016 – May 2017 | Plug-in hybrid (PHEV) (n=2,235) | All-battery (BEV) (n=3,105) |
Methodology: “Before and After”

• Data used:
  – Foundational dataset
    • CVRP rebate statistics, CalEnviroscreen Disadvantaged community (DAC) geodatabase, CVRP consumer survey data.
  – Polk EV registration data

• Data was split into 5 date ranges based on vehicle purchase date.
  – Pre-Income cap: Start of CVRP through 12/31/2015
  – Pre-cap market: 2015
  – Post-income cap, pre-waitlist: 11/1/2016 through 5/31/2017

• The focus of the analysis is on the pre-cap market and the post-income cap, pre-waitlist range.
“Before” and “After”: Data Summary

Foundational Dataset

<table>
<thead>
<tr>
<th></th>
<th>CVRP Rebates</th>
<th>Survey Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Before” = 2015*</td>
<td>44,823</td>
<td>11,269</td>
</tr>
<tr>
<td>“After” = Current program up until waitlist (Nov 2016 – May 2017)</td>
<td>26,819</td>
<td>5,616</td>
</tr>
</tbody>
</table>

Polk CA EV Registration Data

<table>
<thead>
<tr>
<th></th>
<th>EV Registrations</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Before” = 2015*</td>
<td>61,813</td>
</tr>
<tr>
<td>“After” = Current program up until waitlist (Nov 2016 – May 2017)</td>
<td>54,301</td>
</tr>
</tbody>
</table>

*Jan – Mar 2016 not included to avoid anomalous run-up to income cap
How can we help?

brett.williams@energycenter.org

CleanVehicleRebate.org