Electric Vehicle Rebates: Lessons Learning
Connecticut EV Roadmap Technical Meeting, 8 February 2019

Brett Williams, MPhil (cantab), PhD – Principal Advisor, EV Programs, CSE

With thanks to: Nick Russell, Nick Pallonetti, Amy Lastuka, and others at:
# Statewide Electric Vehicle Rebates (as of Jan. 2019)

<table>
<thead>
<tr>
<th>Category</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><strong>Fuel-Cell EVs</strong></td>
<td>$5,000</td>
<td>$2,500</td>
<td>$2,500 (i3 REx)</td>
<td>$900</td>
</tr>
<tr>
<td><strong>All-Battery EVs</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>e-miles &lt; 20</td>
<td>$2,500</td>
<td>$1,500</td>
<td>BEVx only: $1,500</td>
<td></td>
</tr>
<tr>
<td>e-miles ≥ 20</td>
<td>$1,500</td>
<td>$1,500</td>
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<td></td>
</tr>
<tr>
<td>e-miles ≥ 45</td>
<td>$900</td>
<td>$450</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e-miles &lt; 45</td>
<td></td>
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<tr>
<td><strong>Plug-in Hybrid EVs</strong></td>
<td></td>
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</tr>
<tr>
<td>e-miles ≥ 20</td>
<td>$900</td>
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<tr>
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</tr>
<tr>
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<td>$900</td>
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</tr>
<tr>
<td>e-miles &lt; 20</td>
<td>$500</td>
<td></td>
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</tr>
</tbody>
</table>

**MSRP**
- ≤ $50k (PHEV & BEVs), MSRP ≤ $50k (FCEVs): dealer assignment; $150 dealer incentive
- > $60k: $500 max.; point-of-sale via dealer

**Consumer income cap:**
- Increased rebates for lower-income households

**e-miles**
- ≥ 120: $2,000
- ≥ 40: $1,700
- ≥ 20: $1,100
Outline

1. **EV Market Update**
   - Models, Market Share
   - Trajectory

2. **CHEAPR Update**
   - Outputs: Vehicles & Consumers Rebated
   - Outcomes: Behaviors Influenced
   - Impacts: Emission & Market

3. **Additional Considerations**
   - Designing for Equitable Access
   - Dealer Sales Incentive
   - Rebate Amounts

* 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: California

Monthly Count of Unique Models (#)

PHEV, BEVx, BEV, and FCEV (no ZEM or CZEVs)

Includes content supplied by R.L. Polk & Co, © 2018
## Electric Vehicle Choices: Major 2018 Models

### Plug-in hybrid EVs

<table>
<thead>
<tr>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Image 1]</td>
<td>![Image 2]</td>
<td>![Image 3]</td>
</tr>
<tr>
<td>![Image 7]</td>
<td>![Image 8]</td>
<td>![Image 9]</td>
</tr>
<tr>
<td>![Image 10]</td>
<td>![Image 11]</td>
<td>![Image 12]</td>
</tr>
</tbody>
</table>

### All-battery EVs

<table>
<thead>
<tr>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Image 13]</td>
<td>![Image 14]</td>
<td>![Image 15]</td>
</tr>
<tr>
<td>![Image 16]</td>
<td>![Image 17]</td>
<td>![Image 18]</td>
</tr>
<tr>
<td>![Image 19]</td>
<td>![Image 20]</td>
<td>![Image 21]</td>
</tr>
<tr>
<td>![Image 22]</td>
<td>![Image 23]</td>
<td>![Image 24]</td>
</tr>
</tbody>
</table>

### Fuel-cell EVs

<table>
<thead>
<tr>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Image 25]</td>
<td>![Image 26]</td>
</tr>
<tr>
<td>![Image 27]</td>
<td>![Image 28]</td>
</tr>
</tbody>
</table>
Connecticut EV Sales (Jan 2011–Aug 2018)

Monthly

Total

CT DMV: >>9,289 as of 1/1/2019

BEV 3,595
PHEV 5,537
All 9,133

Sources: https://autoalliance.org/energy-environment/zev-sales-dashboard/
CT DMV: https://www.ct.gov/dmv/cwp/view.asp?a=807&q=600850

Source: https://autoalliance.org/energy-environment/zev-sales-dashboard/
Market Share  (2018 thru August)

Source: https://autoalliance.org/energy-environment/zev-sales-dashboard/
Policy Support is Needed: Simplistic Trajectory Toward State Goal

Sales data and state goal from https://autoalliance.org/energy-environment/advanced-technology-vehicle-sales-dashboard/

150,000 EVs in 2043
CHEAPR Update

Outputs, Outcomes, and Impacts
CHEAPR Outputs

Vehicles Rebated
Rebates and Funding (as of Jan. 25, 2019)

<table>
<thead>
<tr>
<th></th>
<th>Rebate Dollars</th>
<th>Rebates</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHEV Plug-in hybrid electric vehicle (electric)</td>
<td>$4,195,000</td>
<td>2,653</td>
</tr>
<tr>
<td>BEV Highway capable, four-wheeled, all-electric</td>
<td>$4,221,500</td>
<td>1,523</td>
</tr>
<tr>
<td>Total</td>
<td>$8,416,500</td>
<td>4,176</td>
</tr>
</tbody>
</table>

Percent of Rebates
- BEV: 36%
- PHEV: 64%

Rebates over Time

Rebated Vehicles  (as of Jan. 25, 2019)

Moderately Priced Vehicles Received Most of the Funding (thru Dec. 2018)

- $44,000 MSRP used for all rebated Model 3 vehicles
- N=4,176 Total CHEAPR rebates through December 2018; Includes fleet rebates

<table>
<thead>
<tr>
<th>Base MSRP</th>
<th>Percent of Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than $30,000</td>
<td>12%</td>
</tr>
<tr>
<td>$30,000–$39,999</td>
<td>62%</td>
</tr>
<tr>
<td>$40,000–$55,700</td>
<td>26%</td>
</tr>
</tbody>
</table>

*CHEAPR = Connecticut Hydrogen and Electric Automobile Purchase Rebate*
Moderately Priced Vehicles Received Most Funding: thru April 2018 (pre-“Model 3 effect”)

- **Less than $30,000**: 14%
- **$30,000–$39,999**: 74%
- **$40,000–$54,950**: 12%

*Note: $44,000 MSRP used for all rebated Model 3 vehicles. N=2,709 Total CHEAPR rebates through April 2018; Includes fleet rebates.*
Moderately Priced Vehicles Received Most Funding (thru Dec. 2018)

- $25,000,000
- $20,000,000
- $15,000,000
- $10,000,000
- $5,000,000
- $0

Total Funding

- Base MSRP
  - Less than $30,000: 18%
  - $30,000–$39,999: 42%
  - $40,000–$147,500: 39% *

*N=13,272 completed and approved PEV applications through December 2018

*$44,000 MSRP used for all Model 3
Outputs
Consumers Rebated
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
Income-Based Eligibility: Implementation Considerations

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

MSRP may be a better proxy for equity in program eligibility
The majority of rebated consumers have annual household incomes less than $150,000.

CHEAPR Consumer Survey (2015–18): n=1,565 total respondents, weighted to represent N=3,510 participants.
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
### Data comparability: Program designs varied

<table>
<thead>
<tr>
<th>Type</th>
<th>MSRP ≤ $60k</th>
<th>$60k &lt; MSRP ≤ $100k</th>
<th>MSRP &gt; $100k</th>
</tr>
</thead>
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<tr>
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<tr>
<td></td>
<td>$1,500</td>
<td>$1,500</td>
<td>$1,500</td>
</tr>
<tr>
<td><strong>Zero-Emission Motorcycles</strong></td>
<td>$900</td>
<td>$750</td>
<td>$750</td>
</tr>
</tbody>
</table>

**e-miles**
- ≥ 120: $2,000
- ≥ 40: $1,700
- ≥ 20: $1,100
- < 20: $500

**e-miles**
- ≥ 175: $3,000
- ≥ 100: $2,000
- < 100: $500

**MSRP ≤ $60k**
- only; Dealer assignment; $150 dealer incentive ($300 previous)

**MSRP > $60k**
- $500 max.; point-of-sale via dealer

**e-miles**
- ≥ 20; Consumer income cap; Increased rebates for lower-income
- MSRP ≥ $60k only; $1,000 max., no fleet rebates

**MSRP ≤ $60k**
- only; Dealer assignment; $150 dealer incentive ($300 previous)
## Consumer Survey Data *(Rebates to Individuals Only)*

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

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

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

<table>
<thead>
<tr>
<th>Program Population (N)</th>
<th></th>
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<tbody>
<tr>
<td>185,367</td>
<td>5,754</td>
</tr>
<tr>
<td>1,583</td>
<td>3,937</td>
</tr>
<tr>
<td>196,641</td>
<td></td>
</tr>
</tbody>
</table>
Most Rebate Recipients Have Moderate Household Incomes

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

* Personal correspondence, Prof. Bunch (UCD)
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??

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

Replaced a vehicle with their rebated EV

<table>
<thead>
<tr>
<th>Year</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>May–Dec 2015</td>
<td>77%</td>
</tr>
<tr>
<td>2016</td>
<td>77%</td>
</tr>
<tr>
<td>2017</td>
<td>79%</td>
</tr>
<tr>
<td>2018 thru Sept</td>
<td>82%</td>
</tr>
</tbody>
</table>

CHEAPR Consumer Survey (2015–18): n=1,565 total respondents, weighted to represent N=3,510 participants
Impacts
Emission
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)

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?

- CVRP (2013–2017): 90%
- MOR-EV (2014–17): 86%
- CHEAPR (2015–17): 96%
- Drive Clean NY (2017): 94%

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

- MOR-EV (2014–17)
- CHEAPR (2015–17)
- Drive Clean NY (2017)
Rebate Essentiality for Most Rebated MY 2018 Models

CHEAPR Consumer Survey (2015–18): n=1,565 total respondents, weighted to represent N=3,510 participants.
Rebate Essentiality: Trend without Tesla or Prius Prime

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

Date Ranges based on vehicle purchase/lease date

- **May 2015–Dec 2015**: 71%
- **2016**: 65%
- **2017**: 70%
- **Jan 2018–Sept 2018**: 61%

CHEAPR Consumer Survey (2015–18): n=1,565 total respondents, weighted to represent N=3,510 participants
Additional Considerations
CVRP Income Cap Analysis: Informing Policy Discussions

Stakeholder Briefing, August 2016
Brett Williams, Ph.D. – Principal Advisor, Clean Transportation
Colin Santulli, M.A., PMP – Director, Clean Transportation

Thanks also to John Anderson, Clair Johnson, PhD, Roman Partida-Lopez, and others at CSE
Overview

CSE Priorities:

– Support state ZEV goals (2023 & 2025)
– Long-term incentive funding (3–5 year funding)
– Program design based on data and evaluation

Analysis:

– This analysis is best effort to evaluate potential impact of different income cap levels using available historical data
– Actual impact of the current cap on the ZEV market is unclear at this time; Effective date was March 2016
Distribution of CVRP Respondents by Household Income

- Less than $50,000: 5%
- $50,000 to $99,999: 17%
- $100,000 to $149,999: 23%
- $150,000 to $199,999: 18%
- $200,000 to $249,999: 13%
- $250,000 to $299,999: 7%
- $300,000 to $349,999: 5%
- $350,000 to $399,999: 3%
- $400,000 to $449,999: 2%
- $450,000 to $499,999: 1%
- $500,000 or more: 6%
Percent of CVRP Program Excluded

Income Cap - Filing Jointly/Single/Head-of-Household (in $100,000s)

- 500/250/350: 9%
- 450/250/300: 10%
- 400/200/300: 14%
- 350/175/250: 17%
- 300/150/200: 23%
- 250/125/175: 32%
Percent of Market Rebated (individuals only): Before and After the Income Cap (illustrative eras)

- **Before** era excludes anomalous run-up to income cap
- **After** era spans establishment of current income cap to the beginning of a waitlist

- 2015: 73% (33% of program)
- Nov. 2016–May 2017: 49%

CARB FY17–18 Funding Plan Appendix C. “Before” era excludes anomalous run-up to income cap. “After” era spans establishment of current income cap to the beginning of a waitlist.
Why are added vehicle volumes important?

Volume is a proxy for a variety of market benefits, e.g.:

• For producers
  – Economies of scale
  – OEM learning-by-doing
  – Supply-chain creation

• For dealers
  – Salesperson familiarity
  – Supply on the lot

• For consumers
  – Consumer awareness and understanding
    • Parking lots as “second showrooms”
  – Information spillovers
  – Consumer learning-by-doing
    • Charging confidence
  – Adoption network effects

• For society
  – Use potential
    • Positive environmental externalities
<table>
<thead>
<tr>
<th>CVRP</th>
<th>Eligibility</th>
<th>Rebate Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Filing Status</strong></td>
<td>FCEV</td>
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<tr>
<td>Income Cap</td>
<td><strong>Gross Annual Income</strong></td>
<td></td>
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<tr>
<td></td>
<td>Individual</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt; $150,000</td>
<td></td>
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<tr>
<td></td>
<td>Head of Household</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt; $204,000</td>
<td>$5,000</td>
</tr>
<tr>
<td></td>
<td>Joint</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt; $300,000</td>
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<tr>
<td>Standard Rebate</td>
<td><strong>Income Cap</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Individual</td>
<td></td>
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<tr>
<td></td>
<td>300% FPL to &gt; $150,000</td>
<td>$5,000</td>
</tr>
<tr>
<td></td>
<td>Head of Household</td>
<td></td>
</tr>
<tr>
<td></td>
<td>300% FPL to &gt; $204,000</td>
<td>$5,000</td>
</tr>
<tr>
<td></td>
<td>Joint</td>
<td></td>
</tr>
<tr>
<td></td>
<td>300% FPL to &gt; $300,000</td>
<td></td>
</tr>
<tr>
<td>Increased Rebate</td>
<td><strong>Household Income ≤ 300 percent of the federal poverty level (FPL)</strong></td>
<td>$7,000</td>
</tr>
<tr>
<td>for Low-Income</td>
<td>Applicants*</td>
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<td></td>
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</tbody>
</table>

* Applications are also prioritized.
Program Effectiveness: MSRP criteria

- Are trivial to implement, already a program concept
- Avoid public investment in luxury products
- Direct private investments made by remaining rebate-motivated higher-income participants towards increasing the volume of mainstream products
- Reduce the cost of mainstream vehicles
- Reduce free ridership in a similar, if somewhat different manner
- “Optimal” thresholds are easier to identify

In brief, increases equity and reduces free ridership with minimal program costs (and market impacts are focused on luxury products with greater margins)
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
How is the dealer incentive working?

Evaluating the Connecticut Dealer Incentive for Electric Vehicle Sales

April 2017

Prepared by
Center for Sustainable Energy

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

- Spend time learning about EVs: 3.37 (Not at all motivated), 3.41 (Extremely motivated)
- Spend time teaching other staff about EVs: 3.40 (Not at all motivated), 3.43 (Extremely motivated)
- Spend time with a customer to teach them about EV ownership and use: 3.67 (Not at all motivated)
- Try to convert customers interested in conventional vehicles to EVs: 3.39 (Not at all motivated)
- In general, try to sell more EVs: 3.54 (Not at all motivated), 3.58 (Extremely motivated)

Question only asked of respondents who said they were aware of the dealer incentive; Respondents=57
Third and fourth statements only appeared to sales employees; Respondents=40
1 = Not at all motivated, 5 = Extremely motivated
To what extent are you motivated by the current dealer incentive to do each of the following?

<table>
<thead>
<tr>
<th>Activity</th>
<th>Not at all motivated</th>
<th>Slightly motivated</th>
<th>Moderately motivated</th>
<th>Very motivated</th>
<th>Extremely motivated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spend time learning about EVs</td>
<td>3.20</td>
<td></td>
<td></td>
<td>3.75</td>
<td></td>
</tr>
<tr>
<td>Spend time teaching other staff about EVs</td>
<td>3.20</td>
<td></td>
<td></td>
<td>3.88</td>
<td></td>
</tr>
<tr>
<td>Spend time with a customer to teach them about EV ownership and use†</td>
<td></td>
<td></td>
<td>3.24</td>
<td></td>
<td>* 4.38</td>
</tr>
<tr>
<td>Try to convert customers interested in conventional vehicles to EVs†</td>
<td></td>
<td></td>
<td>3.15</td>
<td>3.85</td>
<td></td>
</tr>
<tr>
<td>In general, try to sell more EVs</td>
<td></td>
<td></td>
<td>3.33</td>
<td>4.00</td>
<td></td>
</tr>
</tbody>
</table>

† Fourth and fifth statements only appeared to sales employees; respondents=40
*Statistically significant difference ($p < 0.05$)
brett.williams@energycenter.org
Related analysis available at energycenter.org/resources/transportation
Online Resources & Extra Slides
Where can I get additional data?: 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
Evaluation

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

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