Road-blocks to EV adoption in the Mass Market

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Fleet electrification is seen by many as an important step towards reducing carbon emissions.
Today, a focus on on policy and challenges associated with the economic tradeoff consumers face between EVs and ICEs

1. **Upfront Costs: EVs are still expensive relative to comparable ICEs**
   - What role might subsidies / mandates play?

2. **Operational Costs: Regulation and taxes affect the per-mile costs of EVs and ICEs**
   - Do pre-existing market distortions advantage EVs or ICEs?

Other challenges: Multi-unit dwellings, charging infrastructure, awareness, range anxiety, portfolio substitution
Upfront costs: EVs remain expensive relative to ICEs

- Invoice price of Nissan Leaf is $30,000 vs $14,000 for Nissan Versa
Can Incentives induce mass market adoption?

- Muehlegger and Rapson (2018) study a CA program called Enhanced Fleet Modernization Program.
  - Pilot program that paired retirements to generous replacement incentives.

- Important program features:
  1. Pilot program limited to South Coast and San Joaquin Air Districts (AQMDs)
  2. Consumers in “disadvantaged-communities” (DACs) receive a “plus-up” that roughly doubles the replacement incentive
  3. Means-tested. Limited to households below < 400% of FPL
Maps of Treatment Eligibility

Figure: California Zip Codes by DAC Status

- We compare prices and EV sales before / after the program, in and out of participating regions (grey), in and out of DACs (pink)
Main findings

1. Consumers capture the majority of the incentive, consistent with incidence results in Gulati et al. (2017).

2. The program did increase adoption of EVs substantially in these areas. (demand elasticity of -3.9).

3. Yet, conditional on the estimates above, BOE estimate of the cost of “1.5MM EVs by 2025,” substantially exceeds the $3B budgeted.
How much will 1.5 million EVs by 2025 cost?

<table>
<thead>
<tr>
<th>Baseline Growth Rate in EVs (2018-2025)</th>
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</thead>
<tbody>
<tr>
<td>10%</td>
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<tr>
<td>Elasticity = 1.9</td>
</tr>
<tr>
<td>Implied required change in Buy Price</td>
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<tr>
<td>Cumulative Subsidy Bill ($ Billions)</td>
</tr>
<tr>
<td>Elasticity = 3.9 (preferred)</td>
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<tr>
<td>Implied required change in Buy Price</td>
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<tr>
<td>Cumulative Subsidy Bill ($ Billions)</td>
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<tr>
<td>Elasticity = 7.8</td>
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<tr>
<td>Implied required change in Buy Price</td>
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<tr>
<td>Cumulative Subsidy Bill ($ Billions)</td>
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Notes: Estimates assume that 10% of the EV fleet is retired or exported each year starting in 2020 and a weighted-average (over new and used) EV price of approximately $26,000. There are 333,000 EVs assumed to be in the fleet at the beginning of 2018. By our estimates, the zero-subsidy growth rate of California EVs in 2015, 2016 and 2017 were 28.9, 21.7 percent and 18.6 percent respectively. "N/A" reflects subsidies that exceed 100 percent of the assumed value of the car.

Caveats
- Generalizability: EFMP program is a pilot program, trade-in necessary
- Total subsidy bills presented above. Federal incentives (or ZEV mandates) reduce fiscal burden to CA
- Assumed new vehicle program with $26k entry EV.
Economic Tradeoffs and Roadblocks to EV adoption

Today, a focus on policy and challenges associated with the economic tradeoff consumers face between EVs and ICEs

1. Upfront Costs: EVs are still expensive relative to comparable ICEs
   - What role might subsidies / mandates play?

2. Operational Costs: Policies distort the per-mile costs of EVs and ICEs in potentially disadvantageous ways
   - Regulated electricity prices

Other challenges: Multi-unit dwellings, charging infrastructure, awareness, range anxiety, portfolio substitution
Do buyers incorporate operational costs?

- Recent regulatory analyses (e.g., NPRM) assume myopic buyers
- Yet, empirical evidence suggest consumers internalize (vast) majority of future fuel costs when they buy a car

Do pre-existing price distortions advantage EVs or ICEs?

- Busse et al. (2013), Sallee et al. (2016)
- Allcott and Wozny (2014)
- Leard et al. (2017)
- 2016 Mid-term Review (3 years)
- 2018 NPRM (2.5 years)
Gasoline is underpriced relative to social marginal cost

- Parry and Small (2005) find U.S. gasoline taxes substantially underprice marginal cost
  - 2005 optimal gas tax estimate for U.S. = $1.01 per gallon
  - 2005 SCC $25 per tC / $7 per tCO₂ = 5 cpg

- Updating to reflect Obama SCC ($45 per tCO₂) →
  ≈ $1.30 - 1.35 per gallon

- U.S. federal gas tax = 18.4 cpg
- Average state gas tax (2017)= 32 cpg
Electricity prices often exceed social marginal cost

**Figure:** Price minus Social Marginal Cost

![Map showing price minus social marginal cost across the United States](image)

**Figure 9:** Marginal Price minus Average Social Marginal Cost per kWh

Source: Borenstein & Bushnell 2018
Where are the operational savings of an EV greatest?

Locations vary with respect to the operational savings of an EV.
- Lowest EV savings in MA = $106 per 12k miles
- Highest EV savings in WA = $625 per 12k miles
Other challenges to EV adoption, decarbonization

- Charging infrastructure
  - Particularly an issue in Multi-unit Dwellings (MUDs)

- Household portfolio substitution
  - EVs are driven less than other vehicles, households shift VMT away from EVs to ICEs (Davis 2018)
  - Households diversify portfolio - incentives for small cars push households to also adopt large LDV (Archsmith et al 2018)

- Awareness of EVs and charging stations remain low, despite increased penetration (Kurani and Hardman 2017)
Thank You

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