PUSH EV DEMAND OR SUPPLY?
Evaluating zero-emissions vehicle policy in Canada

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How to get to 30% PEV sales by 2030?

Policies that can induce PEV sales

Demand-focused policy

- Purchase incentives
- Non-monetary incentives (HOV lane, etc.)
- Charger deployment

Supply-focused policy

- ZEV mandate (sale requirements)
- Fuel efficiency standards
- Low-carbon fuel standards

Some policy criteria: effective, cost, political acceptability, transformative signal

Adapted from: Melton et al. (2017), Energy Policy
Some research concepts
A reflexive, multi-method approach

- "Qualitative" interviews
  n = dozens

- "Quantitative" surveys
  n = 100s or 1000s

- Technology adoption models
  (0-15 year time horizon)

- Energy-economy system models
  (20-40yr + time horizon)

- "Reflexive Participant" surveys
- "Respondent-based" modeling
- Behaviourally realistic models
PEV consumer research: “Pioneers” and the “Early Mainstream”

New vehicle buyers

Potential “Early Mainstream” PEV buyers

PEV “Pioneers”

Source: Axsen et al. (2016), Transportation Research Part D
What is demand?

**Sales:** current market share.

**Latent demand:** demand for a product or service that a consumer cannot satisfy because it is not available, or they do not know that it is available.

**Induced demand:** an increase in sales due to increases in supply or awareness (or alleviation of other barriers).

Q1: what is the latent demand for PEVs?

Q2: how can policy push sales towards latent demand?

Source: Long et al. (Under Review), *Transportation Research Part D*
The data
Canadian “Mainstream” Survey (n = 2,123), representative of new vehicle buying households

Source: Kormos, et al. (Under Review), *Transportation Research Part D*
### Method 1: “Design Space” Exercise

Click [Here](#) to open the example response that we provide earlier in a new window.

<table>
<thead>
<tr>
<th>Vehicle type</th>
<th>Driving range</th>
<th>Gasoline fuel use</th>
<th>Refuel/ Home recharge time</th>
<th>Purchase price</th>
<th>I CHOOSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A conventional RAM 1500 4X4 FFV</td>
<td>750 km gasoline</td>
<td>15.2 L/100 km</td>
<td>5 mins</td>
<td>$50000</td>
<td>Conventional</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Please select ▼</td>
</tr>
<tr>
<td>A hybrid RAM 1500 4X4 FFV</td>
<td>750 km gasoline</td>
<td>10.2 L/100 km</td>
<td>5 mins</td>
<td>$51600</td>
<td>Hybrid</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1st Choice ▼</td>
</tr>
<tr>
<td>A plug-in hybrid RAM 1500 4X4 FFV</td>
<td>Electric for the first:</td>
<td>10.2 L/100 km</td>
<td>Time to fully charge empty battery at home</td>
<td>$0</td>
<td>Plug-in hybrid</td>
</tr>
<tr>
<td></td>
<td>Please select your answer ▼</td>
<td></td>
<td>Please select your answer ▼</td>
<td></td>
<td>Please select ▼</td>
</tr>
<tr>
<td>A electric only RAM 1500 4X4 FFV</td>
<td>Electric only for:</td>
<td>None</td>
<td>Time to fully charge empty battery at home</td>
<td>$0</td>
<td>Electric</td>
</tr>
<tr>
<td></td>
<td>Please select your answer ▼</td>
<td></td>
<td>Please select your answer ▼</td>
<td></td>
<td>Please select ▼</td>
</tr>
<tr>
<td>A hydrogen fuel cell RAM 1500 4X4 FFV</td>
<td>500 km hydrogen</td>
<td>None</td>
<td>5 mins</td>
<td>$61000</td>
<td>Hydrogen</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2nd Choice ▼</td>
</tr>
<tr>
<td>Vehicle type</td>
<td>Range</td>
<td>Recharge/refuel time</td>
<td>Destination recharging or refuelling access</td>
<td>Fuel cost</td>
<td>Purchase price &amp; incentive</td>
</tr>
<tr>
<td>----------------------</td>
<td>------------------</td>
<td>----------------------</td>
<td>--------------------------------------------</td>
<td>-----------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>Conventional Honda CIVIC</td>
<td>650 km gasoline</td>
<td>5 min.</td>
<td>Level 2</td>
<td>$32/week</td>
<td>$25,000 - $0</td>
</tr>
<tr>
<td>Hybrid Honda CIVIC</td>
<td>1070 km gasoline</td>
<td>5 min.</td>
<td>-</td>
<td>$20/week</td>
<td>$26,380 - $0</td>
</tr>
<tr>
<td>Plug-in hybrid Honda CIVIC</td>
<td>575 km electric</td>
<td>Home: 6 hrs. Work: 25% of destinations</td>
<td>-</td>
<td>$18/week</td>
<td>$30,180 - $5,000</td>
</tr>
<tr>
<td>Electric Only Honda CIVIC</td>
<td>200 km electric</td>
<td>Home: 6 hrs. Work: 25% of destinations</td>
<td>None</td>
<td>$10/week</td>
<td>$38,820 - $5,000</td>
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<tr>
<td>Hydrogen fuel cell Honda CIVIC</td>
<td>350 km hydrogen</td>
<td>5 min.</td>
<td>20% of gas stations</td>
<td>$10/week</td>
<td>$41,230 - $0</td>
</tr>
</tbody>
</table>
Design space results: 14-21% design some sort of ZEV, mostly PHEV

Source: Long et al. (Under Review), Transportation Research Part D
Stated choice model: latent demand around 30%, up to 50% with policy

Source: Kormos et al. (Under Review), Transportation Research Part D
Latent class model: Segmenting respondents by PEV preference

Class 5: “PEV-enthusiast” 13%
(-) Hybrid
(-) PHEV and BEVs
(-) Hydrogen

Class 4: “ZEV-ambivalent” 21%
(+/-) Hybrid
(+/-) PHEV and BEVs
(+/-) Hydrogen

Class 3: “PHEV-oriented” 22%
(+ Hybrid
(+ PHEVs
(-) BEVs
(+/-) Hydrogen
- Fuel cost sensitive
- Charger availability
- Environmental concern

Class 2: “Hybrid-oriented” 21%
(- Hybrid
(-) PHEV and BEVs
(-) Hydrogen
- Fuel cost sensitive
- Environmental lifestyle

Class 1: “Conventional-oriented” 18%
(+) Hybrid
(++) PHEVs and BEVs
(+) Environmental lifestyle

Source: Kormos et al. (Under Review), Transportation Research Part D
The model
The respondent-based preference and constraint model (REPAC)

"Actual" Sales = Latent Demand x Home charging x PEV familiarity x PEV availability

Dealership availability

Class availability

Model variety

Source: Wolinetz & Axsen (2017), Technological Forecasting & Social Change
The respondent-based preference and constraint model (REPAC)

“Actual” Sales = Latent Demand x Home charging x PEV familiarity x PEV availability

Feedbacks: As sales increase...
...consumer awareness increases
...dealership availability increases

Source: Wolinetz & Axsen (2017), Technological Forecasting & Social Change
REPAC lines up well with actual PEV sales in 2015

Source: Wolinetz & Axsen (2017), Technological Forecasting & Social Change
Comparing policy packages in Canada

Target: 30% PEV market share by 2030

1) Current policies
   - Some purchase incentives, HOV lane access
   - Planned charger deployment
   - Clean Fuel Standard
   - National carbon pricing

2) + Incentive-based approach (demand-focused)
   - What is needed for 2030 target?
   - Incentives for how long? 2021, 2025, or 2030?

3) + ZEV-mandate approach (supply-focused)
   - Require 30% or 40% by 2030
   - Automakers comply via:
     • Increased PEV model variety and availability, and
     • internal cross-price subsidies,

Source: Axsen & Wolinetz (Under Review), Transportation Research Part D
Modeled ZEV purchase prices

2030 battery pack costs (CDN)

High: ~$125/kWh
Low: ~ $85/kWh

With increasing OEM markups

Source: Axsen & Wolinetz (Under review)
Current policies don’t get past 10% new market share...

Source: Axsen & Wolinetz (Under Review), Transportation Research Part D
$6000 / PEV subsidy until 2021...

Source: Axsen & Wolinetz (Under Review), Transportation Research Part D
$6000 / PEV subsidy until 2025...

Source: Axsen & Wolinetz (Under Review), Transportation Research Part D
$6000 / PEV subsidy until 2030… Can achieve 2030 target, but highly uncertain and expensive

Source: Axsen & Wolinetz (Under Review), Transportation Research Part D
Both ZEV mandate targets can be achieved (via increased supply and internal cross-price subsidies).

Source: Axsen & Wolinetz (Under Review), *Transportation Research Part D*
ZEV mandate: cross-price subsidies needed to comply

Source: Axsen & Wolinetz (Under Review), *Transportation Research Part D*
Policymaking is complex and needs multi-criteria evaluation

Source: Melton et al. (2017), Canada`s ZEV Policy Handbook
Policymaking is complex: Evaluating three policy packages that could achieve 2030 target

<table>
<thead>
<tr>
<th>Policy Package</th>
<th>Effectiveness</th>
<th>Cost Effectiveness</th>
<th>Public Support</th>
<th>Policy Simplicity</th>
<th>Transformational Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand-focused policy package</td>
<td>5</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Supply-focused package (ZEV mandate)</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Supply-focused package (vehicle emissions standard)</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

*Source: Melton et al. (2017), Canada's ZEV Policy Handbook*
Key implications

1. **Achievable**: 2030 goals of 30% PEV sales
2. Significant “latent” demand (20% to 40%)
3. But stronger policy needed to induce sales
   - Incentives needed for the long-term (costly)
   - ZEV mandate, puts more onus on automakers
   - Other policy packages possible
Extra
Consumer perceptions are complex: functional, symbolic and societal dimensions

Perspectives on the “mainstream” consumer

The “Rational Actor”….  The “Reflexive Participant”….

The “Reflexive Participant Approach”: Three elements

- Background: History, awareness, perceptions, patterns
- Reflexive experience: Tech trial, travel diary, Buyers’ guide
- Response exercise: Stated choice, design space, Follow up

Strong policy needed to overcome:
- Negative externalities (GHGs)
- Innovation externalities (R&D spillovers)
- Directionality and reflexivity failure

- Weber and Rohracher (2012)

Source: Melton, Axsen & Sperling (2016), Nature Energy
Long-term modeling suggests that PEVs can play an important role in GHG mitigation.

- **Current Policies**
- **“Ambitious” Policies** (no ZEV mandate)
- **+ZEV mandate**

### Graph Details
- **Passenger vehicle GHGs (well-to-wheel)**
- **2050 GHG Target**: 80% below 2005 GHGs
- **Source**: Sykes and Axsen (2017), *Energy Policy*

#### “Ambitious” Policies
- Carbon Tax: $30/t 2015 to $120/t 2050
- ZEV Subsidies: $5000 in 2015 and 2020
- LCFS: 20% less GHG intensive w/ biofuels
- CAFE: 60% less fuel intensive by 2050
6) From research to policy evaluation

- "Qualitative" interviews
  n = dozens

- "Quantitative" surveys
  n = 100s or 1000s

- Technology adoption models
  (0-15 year time horizon)

- Energy-economy system models
  (20-40yr + time horizon)

Policy evaluation
Canada’s Electric Vehicle Policy Report Card

Dr. Jonn Axsen
Suzanne Goldberg
Noel Melton

Sustainable Transportation Action Research Team
Simon Fraser University
November 2016

Energy Policy 107 (2017) 381-393

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Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Evaluating plug-in electric vehicle policies in the context of long-term greenhouse gas reduction goals: Comparing 10 Canadian provinces using the “PEV policy report card”

Noel Melton, Jonn Axsen, Suzanne Goldberg
Policy Goal:
To achieve long-term GHG mitigation targets, PEVs reach 40% of new vehicle market share by 2040 (IEA scenario) – that is an “A”

1. Identify electric vehicle supportive policies
2. Evaluate the effectiveness of each policy
3. Assign letter grades to each province (based on the effectiveness of their policies)

Adapted from: Axsen et al. (2017), Energy Policy
Many PEV-supportive policies (62 active), mostly demand-focused
<table>
<thead>
<tr>
<th>Policy</th>
<th>Policy Benchmark (i.e. maximum stringency and duration)</th>
<th>Estimated 2040 electric vehicle market share impact</th>
<th>Grade</th>
<th>Estimated market share in 2040</th>
<th>Policy performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand-side policies</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Financial incentives</td>
<td>$12,000 per vehicle for 15 years.</td>
<td>10%</td>
<td>A</td>
<td>35%+</td>
<td>Excellent performance: Initiatives are likely to meet or exceed target</td>
</tr>
<tr>
<td>HOV lane access</td>
<td>100% of congested highways have HOV lane access for PEVs.</td>
<td>1%</td>
<td>B</td>
<td>20–35%</td>
<td>Moderate performance: Initiatives are likely to boost the adoption of electric vehicles but not achieve target</td>
</tr>
<tr>
<td>Public charging deployment</td>
<td>One public charger for every two gas stations (sufficient charger density to alleviate range anxiety).</td>
<td>3%</td>
<td>C</td>
<td>10–20%</td>
<td>Marginal performance: Initiatives are likely to achieve relatively limited adoption of electric vehicles</td>
</tr>
<tr>
<td>Building regulations</td>
<td>100% of population has level 2 home charging access.</td>
<td>8%</td>
<td>C</td>
<td>10–20%</td>
<td>Marginal performance: Initiatives are likely to achieve relatively limited adoption of electric vehicles</td>
</tr>
<tr>
<td>Carbon Price</td>
<td>Carbon price on track to meet $150/tonne CO2e by 2030.</td>
<td>15%</td>
<td>C</td>
<td>10–20%</td>
<td>Marginal performance: Initiatives are likely to achieve relatively limited adoption of electric vehicles</td>
</tr>
<tr>
<td>Supply-side policy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ZEV mandate</td>
<td>California’s ZEV mandate (requiring 9 to 21% electric vehicle sales by 2025).</td>
<td>15%</td>
<td>D</td>
<td>5–10%</td>
<td>Poor performance: Initiatives are likely to achieve relatively limited adoption of electric vehicles</td>
</tr>
<tr>
<td>Vehicle emissions standards</td>
<td>Vehicle emissions standards with electric vehicle credits reaching 98g CO2e/100 km by 2025.</td>
<td>2%</td>
<td>F</td>
<td>0–5%</td>
<td>Unsatisfactory performance: Initiatives, if any, are likely to induce only marginal adoption of electric vehicles</td>
</tr>
<tr>
<td>Low Carbon Fuel standards</td>
<td>Low carbon fuel standard requiring a 10% reduction in carbon intensity by 2020, with electric vehicle credits.</td>
<td>0.3%</td>
<td>F</td>
<td>0–5%</td>
<td>Unsatisfactory performance: Initiatives, if any, are likely to induce only marginal adoption of electric vehicles</td>
</tr>
</tbody>
</table>
Grades across Canada...
7 provinces in the “D” or “F” range

Adapted from: Axsen et al. (2017), Energy Policy
Grades across Canada... Ontario and BC in the “C” range

Adapted from: Axsen et al. (2017), Energy Policy
Grades across Canada….
Quebec is our inspiration at “B”

Adapted from: Axsen et al. (2017), Energy Policy
What are the most effective climate policies in Canada?

- ZEV mandate
- Incentive
- Carbon pricing

Adapted from: Axsen et al. (2017), Energy Policy
World-leading policy can raise all grades

<table>
<thead>
<tr>
<th>Province</th>
<th>Current policies*</th>
<th>Current + proposed*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>C−</td>
<td>C</td>
</tr>
<tr>
<td>British Columbia</td>
<td>C−</td>
<td>C−</td>
</tr>
<tr>
<td>Alberta</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>Saskatchewan</td>
<td>F</td>
<td>D</td>
</tr>
<tr>
<td>Manitoba</td>
<td>F</td>
<td>D</td>
</tr>
<tr>
<td>Ontario</td>
<td>C−</td>
<td>C</td>
</tr>
<tr>
<td>Quebec</td>
<td>B−</td>
<td>B</td>
</tr>
<tr>
<td>New Brunswick</td>
<td>F</td>
<td>D</td>
</tr>
<tr>
<td>Nova Scotia</td>
<td>F</td>
<td>D</td>
</tr>
<tr>
<td>Prince Edward Island</td>
<td>F</td>
<td>D</td>
</tr>
<tr>
<td>Newfoundland and Labrador</td>
<td>F</td>
<td>D</td>
</tr>
</tbody>
</table>
27% ZEV

- HFCV
- BEV
- PHEV

1: CV-oriented
2: HEV-oriented
3: PHEV-oriented
4: ZEV Curious
5: PEV-enthusiasts

Base

100%
80%
60%
40%
20%
0%
<table>
<thead>
<tr>
<th>Segment name</th>
<th>CV-oriented</th>
<th>HEV-oriented</th>
<th>PHEV-oriented</th>
<th>ZEV-curious</th>
<th>PEV-enthusiast</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of respondents in segment</td>
<td>23%</td>
<td>21%</td>
<td>22%</td>
<td>21%</td>
<td>13%</td>
</tr>
<tr>
<td>Latent Class Model</td>
<td>HEV</td>
<td>-2.87 ***</td>
<td>1.48 *</td>
<td>1.30 ***</td>
<td>0.653 *</td>
</tr>
<tr>
<td></td>
<td>PHEV</td>
<td>-4.92 ***</td>
<td>-1.47 ***</td>
<td>0.567 **</td>
<td>-0.603 **</td>
</tr>
<tr>
<td></td>
<td>BEV</td>
<td>-8.93 ***</td>
<td>-3.52 ***</td>
<td>-2.90 ***</td>
<td>0.0782</td>
</tr>
<tr>
<td></td>
<td>HFCV</td>
<td>-4.94 ***</td>
<td>-4.19 ***</td>
<td>-2.39 ***</td>
<td>0.0842</td>
</tr>
<tr>
<td>Measure of preferences (coefficients)</td>
<td>PHEV range (km)</td>
<td>0.001450</td>
<td>-0.000832</td>
<td>0.00263</td>
<td>0.00350 *</td>
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<tr>
<td></td>
<td>BEV range (km)</td>
<td>0.00598</td>
<td>0.00513</td>
<td>0.00265</td>
<td>-0.00277 ***</td>
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<tr>
<td></td>
<td>HFCV range (km)</td>
<td>0.000252</td>
<td>0.000227</td>
<td>0.00220 **</td>
<td>0.000335</td>
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<tr>
<td></td>
<td>Vehicle price (CAD$)</td>
<td>-0.000154 ***</td>
<td>-0.000292 ***</td>
<td>-0.000290 ***</td>
<td>-0.000302 ***</td>
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<tr>
<td></td>
<td>Fuel cost (CAD$/week)</td>
<td>-0.000225 **</td>
<td>-0.0133 ***</td>
<td>-0.0160 ***</td>
<td>0.000069</td>
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<tr>
<td></td>
<td>Incentive value (CAD$)</td>
<td>0.000129 ***</td>
<td>0.000133 ***</td>
<td>0.000296 ***</td>
<td>0.000079 *</td>
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<tr>
<td></td>
<td>Home charging (Level 1 or 2)</td>
<td>-0.127</td>
<td>-0.249</td>
<td>0.650 ***</td>
<td>-0.0172</td>
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<tr>
<td></td>
<td>Workplace charging (Level 1 or 2)</td>
<td>-0.281</td>
<td>0.165</td>
<td>0.0519</td>
<td>0.117</td>
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<tr>
<td></td>
<td>Public charging (% of destinations)</td>
<td>0.0120</td>
<td>0.00565</td>
<td>0.00260</td>
<td>0.00425</td>
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<tr>
<td></td>
<td>DC fast charging (access on major highways)</td>
<td>0.808</td>
<td>0.177</td>
<td>0.314 ***</td>
<td>0.162</td>
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<tr>
<td></td>
<td>Hydrogen station availability (% of gas stations)</td>
<td>0.0171</td>
<td>0.0205</td>
<td>0.0156 **</td>
<td>0.00121</td>
</tr>
<tr>
<td>Implied willingness-to-pay (ab)</td>
<td>Valuation of vehicle type ($ CAD)</td>
<td>HEV (all else held constant)</td>
<td>$ (18,675)</td>
<td>$ 5,052</td>
<td>$ 4,476</td>
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<tr>
<td></td>
<td>PHEV-60km (all else held constant)</td>
<td>$ (31,977)</td>
<td>$ (5,028)</td>
<td>$ 1,951</td>
<td>$ (12,396)</td>
</tr>
<tr>
<td></td>
<td>+ home charging</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>+ DC fast charging</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>BEV-220km (all else held constant)</td>
<td>$ (58,104)</td>
<td>$ (18,188)</td>
<td>$ 4,991</td>
<td>$ (7,755)</td>
</tr>
<tr>
<td></td>
<td>+ home charging</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>+ DC fast charging</td>
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<tr>
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<td>HFCV-500km (all else held constant)</td>
<td>$ (32,107)</td>
<td>$ (14,335)</td>
<td>$ 4,443</td>
<td>$ 3,904</td>
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<tr>
<td></td>
<td>10% gas stations</td>
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</tr>
<tr>
<td></td>
<td>50% gas stations</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>100% gas stations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Valuation of vehicle type ($ CAD)</td>
<td>PHEV range (per km)</td>
<td>$ 110</td>
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</tr>
<tr>
<td></td>
<td>BEV range (per km)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>HFCV range (per km)</td>
<td></td>
<td>$ 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fuel cost savings (per year)</td>
<td>$ 838</td>
<td>$ 2,373</td>
<td>$ 2,876</td>
<td>$ 2,494</td>
</tr>
<tr>
<td></td>
<td>Incentive value (per $1000 incentive)</td>
<td>$ 454</td>
<td>$ 1,019</td>
<td>$ 2,237</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Home charging (of Level 1 or 2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Workplace charging (of Level 1 or 2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Public charging (per % of destinations)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>DC fast charging (for access on major highways)</td>
<td></td>
<td>$ 1,082</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hydrogen stations (per % of gas stations)</td>
<td></td>
<td>$ 54</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Note the difficulty of modeling supply-focused policy (e.g. ZEV mandate)

A ZEV mandate can induce a variety of compliance strategies:

1. Increase ZEV availability in that region
2. More ZEV-ready dealerships
3. New ZEV makers emerge (e.g. Tesla)
4. Internal cross-subsides (cheaper ZEVs)
5. Long-term R&D (more variety, lower costs)
6. Strong signal for stakeholder coordination
7. More local ZEV marketing

“Sort of” modeled in REPAC as increasing awareness, but not preference change
California’s (and Quebec’s) ZEV Mandate

• Sales requirement: “the most direct policy change any state can take to ensure increased PEV deployment”
• California now: ZEVs ~15% of new market share by 2025
• Credits differ by vehicle (PHEV, EV, Fuel Cell)
• Credits can be traded among automakers (noncompliance = $5k per ZEV credit)

Note: Tesla earned $139 million in Q3 2016 by selling ZEV credits!
What might happen with a ZEV mandate?

A variety of potential actions….

For a small region (e.g. Quebec):

1. More EV models available (bigger inventory, less wait time)
2. More dealerships become EV-ready (training, etc.)
3. EVs become more affordable (pricing changes)
4. More local marketing

For the world:

5. Automakers channel more funds into R&D for EVs
6. New EV automakers can emerge (e.g. Tesla)
7. More, cheaper EV models in the long-term
8. Strong signal for various stakeholders to transition (direction)
Multiple ways to push electric vehicles, but subsidies cost* 20-30 times more than ZEV mandate

*Gov't Spending on PEV subsidies (millions, undiscounted)

Both can achieve 30% PEV new market share by 2030

Source: Axsen and Wolinetz (Under review), Transportation Research Part D