Demand and the Vehicle Revolution

The Case of Consumer Behavior and the Plug-In Electric Vehicle Purchase Process

Presentation at USAEE 2018
Dual Plenary Session: Demand and the Vehicle Revolution
September 24, 2018

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Acknowledgments: Thanks to DOE Vehicle Technologies Office for travel, funding of project reported on in this presentation
This Talk

• Introducing the problem space of this panel
• Introducing a consumer behavior research framework to synthesize PEV purchase decision research
• Applying this framework to the market for plug-in electric vehicles (PEVs)
• Concluding thoughts
Introducing the Problem Space of this Panel
Uncertain Energy Impacts: Case of Connectivity and Automation

Factors potentially contributing to an increase in energy consumption and associated emissions**:  
+ Reduced Travel Costs  
+ Increased Vehicle Miles Traveled (VMT)  
+ Zero-Occupancy Vehicles  
+ Access for New User Groups  
+ Faster Driving Speeds  
+ Shipment of Goods  
+ Increased Features

Factors potentially contributing to a decrease in energy consumption and associated emissions**:  
– Platooning or Drafting  
– Eco-Driving  
– Congestion Mitigation  
– De-emphasized Performance  
– Emerging Mobility Service Models  
– Improved Crash Avoidance  
– Power Train Efficiencies  
– Zero Emission Vehicles (ZEVs)**  
– Less Hunting for Parking  
– Vehicle Right Sizing

The Problem

• The scale of uncertainty related to changes in transportation technologies makes it difficult for policy-makers to plan
• A better understanding of consumer demand would help lot in reducing this uncertainty
Introducing a Consumer Behavior Research Framework to Synthesize PEV Purchase Decision Research
Consumer Purchase Decision Framework

**Decision Process Steps**

1. **Problem Recognition**
2. **Search**
3. **Alternative Evaluation**
4. **Purchase**
5. **Post-Purchase**

**Influences**

- **Internal factors**
  - Long-term
    - Demographic, psychological, and behavioral attributes
    - Consumer experience with product/brand
    - Switching costs
    - Brand attitude, loyalty
  - Short-term
    - Affect throughout the process
    - Impulse triggers

- **External factors**
  - Perception of risk
    - Negative consequences of a poor purchase decision
    - Probability of negative consequences
      - Prospect theory
      - Search, experience, credence goods
  - Risk management/consumer involvement in purchase
    - Constraints regarding purchase context
      - Too little time
      - Rapidly changing products
  - Role of third parties
Applying this framework to the market for plug-in electric vehicles (PEVs)
Problem Recognition Insight: Not all Consumer Segments will Approach Purchase in the Same Way

**Problem Recognition**
- Higher expected satisfaction (24%)
- Current dissatisfaction (43%)
- New need (14%)
- Product depletion (19%)

*Source: Punj & Srinivasan (1992)*

- **New need** segment (18% today?):
  - Shopped for the highest number of aggregate models across dealer visits
- **Product depletion** segment (30% today?):
  - Considered the smallest number of makes before visiting a dealership;
  - Made the smallest number of pre-decisions;
  - Shopped for the smallest number of aggregate models across dealership visits
Search Insight: Uneven PEV + Infrastructure Distribution Matters

- Internal search heuristics
- External search mechanisms (e.g., test drives, personal recommendations)
Alternative Evaluation Insight: Match/Mismatch between Reasons to Purchase vs. Reject Purchase

Top reasons for PEV purchase (CA)
1. Save money on fuel cost
2. Reduce environmental impact
3. HOV lane access
4. Increase energy independence
5. Want a vehicle with new/better technology

Top reasons to reject PEV purchase
1. Too expensive
2. Not available in desired vehicle class
3. Technology not dependable
4. Poor performance
5. Other

Top reasons for LDV Purchase:
1. Reliability
2. Durability
3. Quality of workmanship
4. Values for the money
5. Manufacturer’s reputation

Sources: Surveys by Strategic Vision (2013); Santulli (2015); Singer (2016)
**Purchase Insight: Dealerships Matter**

- Shrinking number of dealerships
- Distribution of product across dealerships
- Purchase complexity
  - Heterogeneous state incentives
  - Lease terms
  - Technical information

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Franchised New LDV Dealerships</th>
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<tbody>
<tr>
<td>1970</td>
<td>30,800</td>
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<tr>
<td>1975</td>
<td>29,600</td>
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<td>1980</td>
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<td>1995</td>
<td>22,800</td>
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<td>2000</td>
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<td>2005</td>
<td>21,640</td>
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<tr>
<td>2010</td>
<td>18,460</td>
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<td>2015</td>
<td>16,545</td>
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Post-Purchase Behavior-Relevant Insights

• **PEV buyers vs ICE buyers:**
  – More male, wealthy, married, professional, college-graduates...

• **Distance between consumer expectations and actual satisfaction** has a major effect on product evangelism – not much research on this

• **Role of charging behavior** is important and understudied
  – Physical issues (e.g., out-of-order chargers...)
  – Behavioral issues (e.g., occupied parking spaces, etiquette...)
  – Home charging most important

• **Availability and affordability** are issues (Axsen and Kurani 2012), especially as PEVs come off lease and enter secondary market (2/3 of vehicle sales)

• **Visible public charging** adds to sales, but how much is not clear enough to inform tradeoffs re: over-capacity issue for utilities

• **Question if people** (especially non-PEV owners) recognize a charger when they see one...
Concluding Thoughts
Many Behavioral Challenges in PEV Purchase Decision Process

• Multiple opportunities for negative consumer emotions to arise throughout the decision process
• Higher financial and psycho-social risks associated with PEV purchase vs. ICE purchase
• Purchase process highly time- and effort-intensive, with implications for product loyalty
• Heuristics/familiarity matters to the purchase process, especially given time constraints for many purchases
• Procrastination effects real re: policy incentives, technology advances
How Will Electrification Interact with Shared Mobility and CAVs?

**Shared Mobility Service Options**


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<td>Bikesharing</td>
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<td>Courier Network Services (CNS)</td>
<td>Public Transportation</td>
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<td>Carsharing</td>
<td>Carsharing</td>
<td>Car Rental</td>
<td>Liveries/Limousines/Pedicabs</td>
<td>Micro and Alternative Transit Services (including Microtransit, Paratransit, and Shuttles)</td>
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<td>Carpooling</td>
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<td>Casual Carpooling</td>
<td>Ridesourcing/TNCs</td>
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<td>On-Demand Ridesharing</td>
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<td>Taxis/E-Hail</td>
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<td>Vanpooling</td>
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**SAE Automation Levels** Image credit: NHTSA (2018)

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<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<tbody>
<tr>
<td>No Automation</td>
<td>Driver Assistance</td>
<td>Partial Automation</td>
<td>Conditional Automation</td>
<td>High Automation</td>
<td>Full Automation</td>
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<td>Zero autonomy; the driver performs all driving tasks.</td>
<td>Vehicle is controlled by the driver, but some driving assist features may be included in the vehicle design.</td>
<td>Vehicle has combined automated functions, like acceleration and steering, but the driver must remain engaged with the driving task and monitor the environment at all times.</td>
<td>Driver is a necessity, but is not required to monitor the environment. The driver must be ready to take control of the vehicle at all times with notice.</td>
<td>The vehicle is capable of performing all driving functions under certain conditions. The driver may have the option to control the vehicle.</td>
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Questions? Comments?

Shameless plugs:

• Behavior Energy Climate Change (BECC) conference in DC October 7-10, 2018
• More information:
  • Advancing Clean Energy Innovation Decision Science - CEIDS.lbl.gov
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