Utility Perspective on Plug-In Electric Vehicles

December 4, 2013
Transportation is dependent on oil

Figure 2.0 Primary Energy Consumption by Source and Sector, 2011

Source: EIA, Annual Energy Review
Oil dependence is costly

Costs of Oil Dependence to the U.S. Economy, 1970-2010

- Wealth Transfer
- Dislocation Losses
- Loss of Potential GDP

Source: Oak Ridge National Laboratory, *Vehicle Technologies Market Report*
Electricity is a cheaper “fuel”

Source: EIA, Short-Term Energy Outlook Real and Nominal Prices, September 2013

*Equivalent electricity price assumes average vehicle fuel economy of 28.2 mpg, PEV efficiency of 0.35 kWh/mi
PEVs are cleaner across the grid

EV MPG Ratings for Equivalent Global Warming Emissions, by Electricity Grid Region

Source: Union of Concerned Scientists, State of Charge
PEV sales are off to a good start

Source: Manufacturer Data
PEV market share outpacing HEVs

U.S. Light-Duty Market Share Since Launch

*2013 projected

Source: PEV sales: Manufacturer data; Annual sales totals: NADA; HEV sales: Alternative Fuels Data Center (DOE)
Benefits of PEVs to utilities

- System utilization means downward pressure on price
  
  In general: \( \text{rate (} $/\text{kWh}) = \frac{\text{cost of service} + \text{rate of return}}{\text{kWh sales}} \)

- Flexible/shapable load
  - Unlike many loads, charging characteristics (time, rate, location) are flexible and can be shaped with behavior

- Unlocks new opportunities
  - Near-term: demand-response, integration of renewable resources
  - Longer-term: distributed storage (V2G)

- Win-win situation
Utilities supporting the market

- **Education and outreach**
  - PEV information on websites draw heavy traffic
  - Employee programs, fleets, ride-and-drive events

- **Incentives and pilot projects**
  - Offset EVSE installation costs
  - Data-gathering projects

- **EV rates**
  - Time-of-use rates to shift off-peak
Need for education and awareness

- PEV awareness remains low:
  - November 18: “Consumers Have Favorable Views of Electric Vehicles, but Awareness Remains Low”¹
  - November 13: “Survey: Most Americans unaware of financial advantages of owning an electric car”²

- The Electric Generation (thethelectricgeneration.org)

Electric grid

Figure 4-1. Basic diagram of the electric power delivery system. Source: U.S.-Canada Power System Outage Task Force (2004).
Plenty of grid capacity

- 73% of the light-duty vehicle fleet could be supported by the existing grid.
- Such a market penetration would displace 6.5 million gallons of oil per day, or 52% of U.S. oil imports.
- Modeling shows essentially no generation or transmission impact through 2030.

Source: Pacific Northwest National Laboratory, *Impacts Assessment of Plug-In Hybrid Vehicles on Electric Utilities and Regional Power Grids*
Impact on distribution is manageable

- Transformer level distribution is where impact will be more evident
- To date, only tiny fraction of transformer upgrades due to PEVs
- Utilities closely monitoring PEV adoption
- Rising power levels could be a concern

Source: Silver Spring Networks, *How the Smart Grid Enables Utilities to Integrate Electric Vehicles*
Cars spend most of time at home

FIGURE 3-5 Distribution of vehicle locations throughout the week on the basis of data from the 2001 National Household Travel Survey. SOURCE: Tate and Savagian (2009). Copyright 2009 by SAE International. Reprinted by permission.
Low power charging works for most

<table>
<thead>
<tr>
<th>Miles Added</th>
<th>Hours Charging</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>15</td>
<td>3</td>
</tr>
<tr>
<td>20</td>
<td>4</td>
</tr>
<tr>
<td>25</td>
<td>5</td>
</tr>
<tr>
<td>30</td>
<td>6</td>
</tr>
<tr>
<td>35</td>
<td>7</td>
</tr>
<tr>
<td>40</td>
<td>8</td>
</tr>
<tr>
<td>45</td>
<td>9</td>
</tr>
<tr>
<td>50</td>
<td>10</td>
</tr>
<tr>
<td>55</td>
<td>11</td>
</tr>
<tr>
<td>60</td>
<td>12</td>
</tr>
<tr>
<td>65</td>
<td>13</td>
</tr>
<tr>
<td>70</td>
<td>14</td>
</tr>
<tr>
<td>75</td>
<td>15</td>
</tr>
<tr>
<td>80</td>
<td>16</td>
</tr>
<tr>
<td>85</td>
<td>17</td>
</tr>
<tr>
<td>90</td>
<td>18</td>
</tr>
</tbody>
</table>

- Level 1 (1.3 kW)
- Level 2 (3.3 kW)
- Level 2 (6.6 kW)
- DCFC (44 kW)

75% of daily trips
50% of daily trips
Charging infrastructure

- Charging priority:
  - 1) home charging
  - 2) workplace
  - 3) public

- Keeping costs down to drive market
- Public charging should be located intelligently
- Multi-Family Dwellings present a challenge
Open issues

Sale and Resale (i.e. third-party networks)

Interoperability (example: SAE Combo vs. CHAdeMO)

Flexibility is key

Source: NRG eVgo (www.evgonetwork.com/chevy-volt-charging-less-than-5-per-month/)

Source: Argonne National Lab (blogs.anl.gov/greenlab/2013/08/12/electric-vehicle-fast-chargers-slow-to-adapt/)
Thank you!
U.S. petroleum and other liquids consumption, production, and net imports (1950-2012)


Source: EIA (http://www.eia.gov/energy_in_brief/article/foreign_oil_dependence.cfm)
Top 10 States for PEV Sales (November 2012)

- California: 32%
- Florida: 6.6%
- Washington: 5.7%
- Texas: 4.3%
- New York: 3.5%
- Ohio: 3.1%
- North Carolina: 3.1%
- Illinois: 3.1%
- Tennessee: 2.9%
- Hawaii: 2.9%

Source: Edmunds (green.autoblog.com/2012/11/09/california-leads-in-green-car-sales-but-there-are-surprises-on/)
Extra slides

Charging Demand: Range of Aggregate Electricity Demand versus Time of Day

Phoenix, AZ

San Francisco, CA

Source: EV Project, Infrastructure Report Q2 2013
Extra slides

All markets

Charging Unit Utilization

Source: EV Project, Infrastructure Report Q2 2013