Electric Vehicle Market Overview – What’s Here, What’s Coming, and What are Utilities Doing about It

Dan Bowermaster
Program Manager, Electric Transportation
dbowermaster@epri.com
Office: (650) 855-8524
Cell: (650) 701-5099

EPRI Advisory Council
Houston, Texas
March 29, 2018
Contents

- What EVs are here
- What EVs are coming
- Can the grid handle it?
- Can we be smarter?
US EV sales exceed 787k through end of February 2018

US EV sales exceed 787k through end of February 2018
EV sales ~flat in 2013-2015, but increasing in 2016 and 2017
Customer choice increasing with ~90–93 EVs by 2022
Range of battery electric vehicles (BEVs) is also increasing
Major auto shows are featuring a variety of EVs

Source: Dan Bowermaster, Los Angeles, December 2017; www.insideevs.com, accessed 3/28/2018
And here come the big EVs

Sources: CleanTechnica.com, GreenCarReports.com, SchoolBusFleet.com; electrive.com, LG&E and KU, Dan Bowermaster
Higher charging power enables an EV to fuel similar to a gas car

![Graph showing power (kW) over years, with labels for different charging levels like Tesla Supercharger 120kW, Tesla Supercharger 90kW, CHAdeMO 50kW, and CHAdeMO/CCS 50kW, progressing from 2011 to 2019, with a peak at 350kW in 2019.}
Utilities are proposing ~$2.5B in EV charging

Key Challenges
- EV awareness
- Customer education
- Easy and reliable public charging infrastructure (to find, access, use, and pay)
Power impacts per EV are lower than one might expect

- An average PEV has a power impact of ~1 kW and an energy impact of ~ 2,800 kWh/year
How much generation exists today and how is it consumed?
Adding generation also support millions of EVs
So what about potential distribution impacts of EV charging?

- Power level and time of day impact annual distribution impacts

Source: **SMUD analysis of potential distribution impacts of EV charging, EPRI 2013**
What else does the data show?

**EPRI Grid Impact Phase 1 Study, 2012**

<table>
<thead>
<tr>
<th>AC Charge Rate</th>
<th>Circuit 1 Upgrades (of 286 Transformers)</th>
<th>Circuit 2 Upgrades (of 292 transformers)</th>
<th>Circuit 3 Upgrades (of 161 transformers)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3 kW</td>
<td>5 (2%)</td>
<td>7 (2%)</td>
<td>37 (23%)</td>
</tr>
<tr>
<td>6.6 kW</td>
<td>62 (22%)</td>
<td>88 (30%)</td>
<td>103 (64%)</td>
</tr>
<tr>
<td>9.6 kW</td>
<td>192 (67%)</td>
<td>132 (45%)</td>
<td>136 (84%)</td>
</tr>
<tr>
<td>19.2 kW</td>
<td>285 (100%)</td>
<td>229 (78%)</td>
<td>155 (96%)</td>
</tr>
</tbody>
</table>

**California IOU Upgrade Real World Results, October 2017**

<table>
<thead>
<tr>
<th></th>
<th>PG&amp;E</th>
<th>SCE</th>
<th>SDG&amp;E</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>EVs</td>
<td>142,732</td>
<td>108,135</td>
<td>26,498</td>
<td>277,365</td>
</tr>
<tr>
<td>Service Upgrades</td>
<td>228</td>
<td>197</td>
<td>35</td>
<td>460 (0.16%)</td>
</tr>
</tbody>
</table>

Options to improve

- Charge management
  - Dynamic pricing
    - SRP EV Pilot
  - Direct signaling
    - Automaker-utility “Open Vehicle-Grid Integration Platform”
  - Integrated demand response
    - Pepco Smart Charging Pilot
Options to improve

- **Vehicle-to-grid**
  - Smart Power Integration Node

- **Integrated planning**

- **High power DC fast charging**
  - Scoping
  - DC-as-a-service
Looking Ahead – Today and Tomorrow

- New transportation models
- 200+ mile mass-market battery EVs
- High power charging
- Smart charging programs
- Autonomous driving
Together…Shaping the Future of Electricity