Plug-in Electric Vehicle Integration with Local Energy Networks

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Storyline

• Business imperatives drive technology
• Local charging management important for PEVs
• EPRI focus on open standards-based connectivity
• Several viable technical approaches, and,
• Don’t forget the PEV owner!
Challenge for the facility owner is to balance access, utilization and capacity

<table>
<thead>
<tr>
<th>Access</th>
<th>Utilization</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Percentage of customers able to charge at a given time</td>
<td>• Percentage of capacity used on average</td>
<td>• Circuit rating - kW or Amps</td>
</tr>
<tr>
<td>• Driven by customer traffic</td>
<td>• Typically low - E.g., average utilization of</td>
<td>• Driven by the maximum simultaneous number of vehicles</td>
</tr>
<tr>
<td></td>
<td>public DC infrastructure is at 7%</td>
<td>charging</td>
</tr>
</tbody>
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Customer Satisfaction

Revenue

CapEx
Operational imperatives drive technology

Sources of Value to Operator

Energy Arbitrage
- Charging when bulk electricity costs are lower
- V2H → Peak shaving; ‘buying low, using high’

Deferred Distribution Upgrades
- Huge near-term opportunity
- Coordinate charging at distribution level to relieve stress

Ancillary Services
- Improved T&D reliability
- Aggregated services at premise or bulk level

Driver for Building Management System Integration
Emerging end load management landscape

- Utility Cloud
- Back Office Systems
- MDMS
- Concentrator
- AMI
- Meter Readings
- EVSPs
- Internet Comms
- Telematics
- Aggregators
  - EVSP Network Operators
  - Telematics Providers
  - Internet Service Providers
  - Home Security Companies
- Off-the-Shelf, DIY (IRIS, Staples…)
- SEP2 or other
- OpenADR
- Telematics
- Public Internet
## PEV load management approaches

<table>
<thead>
<tr>
<th>Approach</th>
<th>Description</th>
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<tbody>
<tr>
<td><strong>Minimal Intervention</strong></td>
<td>Lack of customer involvement</td>
</tr>
<tr>
<td>• On/Off control</td>
<td></td>
</tr>
<tr>
<td>• Similar to A/C programs</td>
<td></td>
</tr>
<tr>
<td><strong>Smart EVSE based DR</strong></td>
<td>Limited customer involvement</td>
</tr>
<tr>
<td>• Utilities like it</td>
<td>allows utility to control fixed endpoint</td>
</tr>
<tr>
<td>• Network vendors like it</td>
<td>enables them to be aggregators</td>
</tr>
<tr>
<td>• Not so popular with</td>
<td>consumers or OEMs</td>
</tr>
<tr>
<td><strong>Smart Charging on PEVs</strong></td>
<td>Enables Customer Preferences</td>
</tr>
<tr>
<td>• Direct, low-cost,</td>
<td>open standards-based, utility to PEV path</td>
</tr>
<tr>
<td>• Complemented by</td>
<td>automotive telematics</td>
</tr>
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</table>

Customer-focused load curtailment of PEV charging enables environmentally responsible and increased PEV mobility.
EPRI focused on enabling various business models for managing charging infrastructure

- Residential: Integrate with existing AMI and emerging HAN
  - Open Standards-Based – SEP2 over WiFi and HomePlug GreenPHY
  - Capable of bridging to legacy AMI networks via ZigBee 1.0 to SEP2 gateway
- Public/Workplace: Integrate with network services providers
  - Open Standards: Utility to Aggregator: OpenADR 2.0b
  - Aggregator to HAN/FAN: OpenADR 2.0b
  - Charging network management – OCPP 2.0

Open systems interface to charging networks critical for avoiding vendor lock-in, lowering costs and allowing customer choice
EPRI working directly with automotive OEMs on customer-centric, open standards platform

- Single, unified control interface to PEVs from ALL manufacturers
- Path to production for on-vehicle technology; Customer-centric
- Open and extensible standards based – OpenADR 2.0b and SEP2
- Through the cloud or HAN
- Joint effort by utility and automotive industries towards unifying the energy system

Participants:
BMW, Chrysler, Ford, GM, Honda, Mercedes-Benz, Mitsubishi, Nissan and Toyota

Source: BMW North America, Chrysler Group LLC, Ford Motor Company, General Motors Company, American Honda Motor Co., Mercedes-Benz, Mitsubishi Motors NA, Nissan USA, Toyota Motor Engineering & Manufacturing NA
Interoperability and open standards increase customer choice and lower costs

OCPP, OpenADR 2.0b

SEP2

Local Energy Management System

SEP2 over HPGP on Pilot

Open Back-End

Open Front End
Customer-centricity

• Customer participation key to success of charging infrastructure, standards and DR programs

• Barriers to customer engagement
  – Subscription fees / closed access / lack of choice
  – Limited say in how the charging to their vehicle is being managed
  – Little regard for PEV need for battery / vehicle management

• Critical to emphasize
  – DR communications directly with PEVs
  – Customer and vehicle preferences balancing local owner need for demand management
  – Open and interoperable access to charging infrastructure