Electrifying Transportation

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Principal Project Manager

Utility Technology Association 2015 Fall Conference
October 28, 2015
Let’s Talk about Electrified Transportation…

- EPRI’s Electric Transportation Program
- Light Duty Plug-in Vehicles – Market Status
- Utility Infrastructure Activity
- Things to Come
EPRI’s Electric Transportation Program
EPRI Electric Transportation Overview – What we lovingly call “Program 18”

18A: Plug-In Electric Vehicle Development
- PEV Evaluation and Test Data Analysis
- Advanced Battery and Powertrain Development for PEVs
- Advanced Vehicle Technologies for PEVs

18B: Commercial, Industrial and Fleet Applications
- C&I Electric Transportation Technology Assessment
- Fleet Applications for PEVs
- Plug-in Hybrid Marine Applications

18D: Electric Transportation Systems, Infrastructure, and Utility Readiness
- Infrastructure Working Council
- PEV Charging Infrastructure – Evaluation, Planning and Business Models
- Grid Integration of PEVs
- Utility PEV Readiness
- Environmental and Economic Assessment of Electric Transportation

18E: Advanced PEV Infrastructure and Smart Charging
- Smart Grid Technologies for PEV Grid Integration
- PEVs as Distributed Resources
- Advanced Infrastructure Development and Testing
Research Progress in Electric Transportation

A Few 2015 Highlights

- Deployed all Odyne plug-in hybrid bucket trucks and VIA trucks and vans in the DOE Medium-Duty PHEV program
  - Final report in last stages of publication
  - Data collection and analysis continues through 2016
- Released NRDC-EPRI Environmental Assessment Report
- Held successful Commercial and Industrial ET Meeting in Long Beach
- Held Truck and Bus Connector Meetings
- Three Example Supplemental Projects:
  - Open Vehicle-Grid-Integration Platform “Open Platform”
  - San Francisco 49er Stadium smart charging project
  - Deployment of Medium Voltage DC Fast Charger
Vehicle Grid Integration Phase 1: Proof Of Concept “The Big Demo”, Sacramento

- Development Phase: 08/2013-10/2014
- 12 utilities, 7 OEMs actively participated
- Status: Completed 10/16/2014 at SMUD
- Executed a simple DR Event Live through OVGIP to manage 7 OEM PEVs
- SEP2, OpenADR2b, ISO/IEC15118 protocols interoperability using telematics APIs
Transportation electrification can lead to large reductions in greenhouse gas emissions while also improving air quality.

This study validates the assertion that electrifying transportation is beneficial.

This study also provides ‘best practices’ for modeling grid emissions due to a large-scale shift towards electricity as a transportation fuel, which can be used to interpret future studies from outside parties.
Light Duty Plug-in Vehicles – Market Status
Light Duty Plug-in Electric Vehicles - Trends

- PEV Market – Positives
  - ZEV mandate requires 3.3M PEVs in CA and ZEV states by 2025
  - Accelerating global sales (> 1M since Q4 2010)
    - Roughly half of those vehicles were sold in the last 14 months
    - Top three countries are the U.S. (370k), Japan, and China
    - BMW i sales 9.3% of all BMW car sales in September 2015
  - Costs are decreasing
    - GM states $145/kWh battery today; $100/kWh by 2022
  - Potentially significant impact of Volkswagen’s “Dieselgate”
  - 25+ PEVs scheduled to launch by end 2019
    - Next-gen Volt and longer range LEAF coming Q4 2015
Light Duty Plug-in Electric Vehicles – Trends, continued

- **The Market - Challenges**
  - Flat sales increase 2015 versus 2014
  - No pickup truck (yet)
  - Varied mass market awareness and limited 50 state vehicle availability
  - Mixed dealer engagement

- **Charging**
  - Success of Tesla Supercharging Network
    - 521 globally installed stations with 2,941 charging ports
  - Higher power coming 7+ kW AC (home) and DC fast charging (125+ kW)
  - Challenges in approach to infrastructure planning and management
  - Open versus closed networks and standards processes
State of the PEV Industry

>373K PEVs Sold Though 9/30/2015
State of the PEV Industry
~25 New PEVs Are On The Way Though 2019

<table>
<thead>
<tr>
<th>Make</th>
<th>Model</th>
<th>Type</th>
<th>Body Style</th>
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<th>All-Electric Range (miles)</th>
<th>Launch</th>
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## State of the PEV Industry

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Vehicles and Public Charge Stations in Tennessee

Tennessee has a little over 3000 vehicles with main concentrations in these ten counties:

- WILLIAMSON 757
- DAVIDSON 752
- RUTHERFORD 521
- SHELBY 322
- KNOX 203
- HAMILTON 163
- SUMNER 111
- WILSON 95
- MONTGOMERY 69
- SULLIVAN 51
Utility Infrastructure Activity
Utility Charging Infrastructure & Market Support Proposals

Background

- $1.145B proposed and in process

Why are utilities proposing to own and/or operate PEV charging infrastructure?

  - Market hindsight
    - 2010-2014 public investment (taxpayer) had mixed results in establishing a widespread, reliable PEV charging infrastructure network
    - Broader stakeholder willingness to consider utility role in PEV charging as providing a public good

  - Business goals
    - Support PEV drivers (customers)
    - Capture benefits to grid
    - Better understand, plan for, and minimize cost of grid impact
      - DC fast charging power increasing (150+ kW per charging station)
Utility Charging Infrastructure & Market Support Current Movement And Actions

**Washington State**: Bill allows utilities to ratebase charging infrastructure with an additional 2% return on equity allowance.

**PG&E**: $654M pilot filing. Rate base installation, ownership and operation of 25k stations at MuD, public, and workplaces. Provide market education.

**SCE**: $355M pilot filing. Rate base construction of up to 30k stubs in long dwell locations, provide rebates on stations and market education.

**SDG&E**: $103M pilot filing. Rate base 5.5k stations at MuDs and workplaces. Provide market education. Real time pricing for drivers plus delayed grid investment for all.

**Hydro Quebec**: Le Circuit de Electrique. L2 (625) and DC fast chargers (60) installation with site hosts partners.

**IPL**: $12M filing. Approved for $3M for distribution upgrades “in public interest.”

**KCP&L**: $20M shareholder funds. Own, operate, and maintain 1000 charging stations. No cost to host for installation or drivers for electricity for two years. Asking for cost recovery in parallel.

**Georgia Power**: $12M for 61 DC Fast Chargers and 2752 Level 2 for residential, business, multi-family, community, outreach & fleet. Provides $250 home / $500 commercial rebate & market education.

**Updated: 10/2/2015**
Things to Come
Integrating Vehicles with the Grid

OPEN VGI PLATFORM

Utility / Infrastructure Interface
- SEP 2/IEC/ISO 15118 / OpenADR 2.0b
- Data Analytics: Energy Use, Behavior, CustomerPrefs
- EVSE Network Interface
- Open API

Grid Services
- Aggregation
- Demand Response
- Renewable Balancing
- Measurement & Verification
- Demand Charge Mitigation
- Dynamic Pricing
- Phase 3 Extensions
- Frequency Regulation
- Energy / ISO Market Interface

Systems Coordination

Privacy & Security
Plug-in Vehicles for Resiliency

- Unique capabilities when compared to other back up power sources
  - Mobile
  - Well maintained
  - Some are “duel fuel”
  - Better emissions controls than typical generator
- Offer reasonable power and energy capacities
- They are available
Nissan 6.6KW Home Appliance System

Optimized Energy Usage
charge at night
Discharge during peak demand

Back-up Power

Source: EPRI IWC Meeting, March 2012, Leaf to Home, Joseph Thompson
What’s Next for Our Program?

- We will continue working with utilities in developing best practices for electrifying transportation
  - Charging Infrastructure
  - Opportunities in goods movement
  - Bus and truck electrification
  - Port, rail, intermodal electrification opportunities
  - Standards development

- Valuation studies
  - Helping utilities understand best roles to move technologies forward
  - Understanding customer needs
  - Building sustainable business cases

- Next generation technologies
  - Vehicle to grid
  - Wireless charging
Questions?

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Together…Shaping the Future of Electricity