Plug-in Electric Vehicles: 21st Century Energy Efficiency

Northwest Energy Coalition
Clean and Affordable Energy Conference
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Nancy E. Ryan, Ph.D.
Senior Director, Policy and Strategy
About E3

- E3 is an electricity consulting firm founded in 1989 in San Francisco
- Clients span local, state and federal government, small and large public and investor-owned electric utilities, and energy technology companies
- Research and practice area in long term CO2 pathways and utility impact of clean transportation (electric and gas)
- Approximately 30 staff in energy economics, distributed resources, policy implementation, and resource planning
Presentation Overview

- Key policy questions
- Highlights of studies for California utilities
- Learnings from Seattle City Light assessment of electrification options
- Policy implications
Threshold questions for regulators

- *Is promoting EV adoption in the public interest?*
- *Is public funding needed to promote EV adoption?*
- *What is best done by utilities vs. left to the competitive market?*
- *What is the appropriate level of utility ratepayer funding?*
- *How to maximize flexibility and minimize grid and customer costs?*
Do we need new power plants or transmission lines to support PEV charging?

What are the opportunities to exploit the latent flexibility in PEV charging load to balance out fluctuations in renewable energy generation?

Will EV charging overload local distribution circuits?
- New upgrades needed?
- Safety/Reliability affected?

Can PEV charging be timed to coincide with rooftop solar generation?
HIGHLIGHTS FROM CALIFORNIA
About the California Transportation Electrification Assessment

**Sponsors:**
- Pacific Gas & Electric
- Southern California Edison
- San Diego Gas & Electric
- Sacramento Municipal Utility District

**Study conducted in multiple phases:**
- Phase 1: Environmental benefits and barriers to adoption
- Phase 2: LDV grid impacts, costs and benefits
- Phase 3: Goods and people movement grid impacts, costs and benefits

Distribution grid impacts from PEV charging are modest in the near term

Feeder and substation utilization
“ZEV most likely” vehicle adoption and TOU rates

2010 2020 2030
Transportation electrification is fundamentally energy efficiency

Net Societal Benefits from PEV Charging Load
Illustrative results for California Utilities

- PEVs use primary energy more efficiently than conventional vehicles
- Costs and benefits span the power and transportation sectors, complicating policy
PEV load benefits ALL utility ratepayers

Net Revenues from PEV Charging Load
Illustrative results for California Utilities

- Utility rates are higher than the marginal cost of delivered energy in most hours
- PEVs are unique in providing environmental and customer benefits while putting downward pressure on rates
Smart charging lowers costs of PEV grid integration: Pilots needed!

+ **Rate design:**
  - Time of use rates
  - Dynamic rates (SDG&E’s proposed VGI pilot)
  - Demand charges

+ **Demand response:**
  - The utility or a third party directly controls when a vehicle charges: (PG&E/BMW pilot)
  - Designed to test extent of driver cooperation
  - Customer is paid for performance and can over-ride if necessary

Charging behavior responds to rates!

- Washington DC (No Time Varying Rates)
- San Diego (TOU Rates)
SEATTLE CITY LIGHT:
ASSESSMENT OF ELECTRIFICATION OPTIONS
Seattle City Light: Net ratepayer benefits of LDVs

Net Ratepayer Benefits of LDVs

- Net RIM Benefit
- Charger Cost
- Carbon Cost
- Energy Cost
- Capacity Cost
- Utility Bills

Million $2015

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<tr>
<th>Benefits</th>
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<tbody>
<tr>
<td>Base Case</td>
<td>$83</td>
<td>Higher Adoption</td>
<td>$141</td>
<td>Ratebased Chargers</td>
<td>Utility pays for 35% of charger installation</td>
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Societal Benefits of Electrifying Busses and Forklifts

Present Value Per Vehicle

**Buses**
- Benefits: $1,400,000
- Costs: $618,320

**Forklifts**
- Benefits: $80,000
- Costs: $5,019
Crowd-sourced PlugShare data on chargers identifies gaps

- Most complete data base of charger locations: all providers
- Drivers rate and review their experience
- Highlights maintenance problems
- Identifies sites with unmet charging demand
POLICY IMPLICATIONS FOR REGULATORS
Utility and Ratepayer Perspective: PEVs are the opposite of PV and EE

<table>
<thead>
<tr>
<th>GHG &amp; Emissions</th>
<th>Total Energy Consumption</th>
<th>Utility Infrastructure</th>
<th>Retail Rates</th>
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+ **PV and EE shift costs to other ratepayers**
+ **EVs increase utility asset utilization → lower rates**
Widespread EV adoption requires extensive charging infrastructure

+ CA’s ZEV Mandate requires 1.5 million zero-emissions vehicles on the road by 2025

+ Historically, most EV adopters
  - Own their homes
  - Charge their EVs primarily at home

+ Meeting the ZEV Mandate will require reliable, well-placed public charging infrastructure
  - Reduce range anxiety
  - Accommodate EV drivers who do not have access to home charging

Graphic is part of the February 2014 PEV Owner Survey by the Center for Sustainable Energy
OR and WA are national leaders in EV charging infrastructure

California utilities envision different roles to support electrification

**SDG&E**
- Utility does make-readies & provides rebate for chargers
- Smartphone app controls charging

**PG&E**
- Utility owns chargers
- Competes directly with EVSPs

**SCE**
- Duplicates functions built into the car
- Enables competitive EVSP market

Thank You

Nancy E. Ryan,
Senior Director for Policy & Strategy

415-391-5100
nancy@ethree.com