Electric Vehicles...  
Energy storage and energy security!

West Philly High PHEV

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President & CEO  
PJM Interconnection  
Alternative Fuel Vehicles Forum  
May 31, 2012
PJM as Part of the Eastern Interconnection

- 26% of generation in Eastern Interconnection
- 28% of load in Eastern Interconnection
- 19% of transmission assets in Eastern Interconnection

KEY STATISTICS

- PJM member companies: 750+
- Millions of people served: 60
- Peak load in megawatts: 163,848
- MWs of generating capacity: 185,600
- Miles of transmission lines: 65,441
- GWh of annual energy: 832,331
- Generation sources: 1,365
- Square miles of territory: 214,000
- Area served: 13 states + DC
- Internal/external tie lines: 142

21% of U.S. GDP produced in PJM

As of 1/4/2012
If you like wind …

… You have to love Storage

In planning queues 4/5/2012
Interruption Wind Generation

PJM Wind Output vs Installed Capability 2011

Capability Factor = 26.9%
July 21, 2011 – PJM New All-Time Peak

24 hour, RTO Wind Generation vs. RTO Load

300 MW on the system at peak.
MAGICC – PJM’s PHEV Demonstration Project
With funding support from: google.org

- Mid-Atlantic Grid Interactive Car Consortium (MAGICC)
- Over three years experience
- 5 aggregated vehicles
- Using Power Line Carrier (PLC) to send AGC signal to the vehicles via the SAE J1772 communication standard.

With funding support from:
- University of Delaware
- Pepco Holdings Inc
- AC Propulsion
- com verge
- ACUA
General Motors OnStar / PJM Pilot

Frequency Regulation
Percent Renewables
Locational Marginal Prices

PHASE 2
Addition of Residential Owned Volts

OnStar

Managed Charging
PHASE 1
1,000 Volt OnStar Laboratory Simulation

Frequency Response
Available for full-time Summer job.
35.5% of U.S. Energy use is oil

8.8 of 10 Americans commute using cars

Shale gas can power PHEVs and CNG
Pony Under the Christmas Tree?

60¢ (PJM Off-peak Price)

75¢ per “Gallon”

Natural Gas
THIS SALE
$ 0 1.90

Fuel
Premium 309¢
Regular 299¢
Electric 75¢
“Unleash us from the tether of fuel” — Lt. Gen. James Mattis, USMC
Fleet Electrification – DOD, non-tactical fleet

Price of fuel on the battlefield: ~$400/gal

Project Focused on Four Areas:
1. Volume Pricing
   - 10,000 units annually
2. Battery Right-sizing
   - 6,000-3,000 miles/year
3. Infrastructure Planning
4. Ancillary Services

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>% of Fleet</th>
<th>Ave. Annual Miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD Trucks*</td>
<td>22%</td>
<td>6251</td>
</tr>
<tr>
<td>LD 4x2 Trucks</td>
<td>15%</td>
<td>7690</td>
</tr>
<tr>
<td>LD Pass. Vans</td>
<td>11%</td>
<td>9043</td>
</tr>
<tr>
<td>Compact Sedans</td>
<td>9%</td>
<td>~16325</td>
</tr>
<tr>
<td>Midsize Sedans</td>
<td>9%</td>
<td>~16325</td>
</tr>
<tr>
<td>HD Trucks</td>
<td>9%</td>
<td>3516</td>
</tr>
</tbody>
</table>

*Largest fuel consumer in non-tactical fleet: 43M gallons of petroleum/year
• Prices to devices or time-of-use rates
• Utility load impact studies need to change with the vehicles (3kW, 6kW, 9kW…)
• Managed charging networks
  – Third party aggregators willing to control vehicle charging to the benefit of consumers and the bulk power system should be encouraged.
Elements of Innovation
Actions and characteristics of the word innovation

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