Energy and Transportation Convergence: Challenges and Opportunities for Electric Grid Modernization

Grid Architecture and V2G

Ken Huber
Senior Technology & Education Principal
610-666-4215
huberk@pjm.com
Smarter Grid Network – Smart Home

- Smart Appliance Energy Management
- Smart Charger (PHEV) Storage

- Ancillary Services Signals
- Price Signals
- Generation Mix
- Reliability Control
- Load Curtailment

ISO/RTO

Reliability
System Planning

Grid Signal

Home

Smart Appliance Security
Load Management Self Generation

Network Adapter

Smart Grid Network

Aggregator
Wind Generation in PJM - Operational and Proposed

45,192 MW

* In planning queue - August 2009

www.pjm.com
Vehicle Charging Impact on PJM

Load (MW x 1000)

120 110 110 100 90 90 80 60

Capacity for 25+ million PEVs

Charging Energy

180,000 PEV Vehicles * 33 miles //
4 miles/ kWh = ~ 1500 MWh

~ 500 additional MW over 3 valley hours

Hour of Day

1 3 5 7 9 11 13 15 17 19 21 23

PJM©2009
Grid Benefits – Frequency Regulation

Load in GW

Hour of Day

Regulation

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A fossil power plant following a regulation command signal

Energy Storage (batteries / flywheels) accurately following a regulation command signal
Mid-Atlantic Grid Interactive Car Consortium
V2G Demonstration Project

- Mid-Atlantic Grid Interactive Car Consortium (MAGICC)
- Over 2 years experience (since October 2007) with the MAGICC battery electric vehicle responding to the PJM market signals
**Operational Details**

- Altairnano, Inc – Lithium Ion nano titanate battery
- Power: 1 MW for 15 minutes
- Usable Charge Range: 5% - 99%
- Energy: 300 kWh
- Efficiency: 90% round trip
“Cash Back” for Storage

1.018 MW

0.018 MW

1 MW

Aggregator

Smart Grid Network

- Frequency Regulation Signal