Grid Interactive Vehicle Integration

Lessons & Opportunities from NY and MA

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Mission Driven Non-Profit
30 years experience reducing economic, environmental cost of energy use

Comprehensive Focus and Results
Energy Efficiency – Renewable Energy – Transportation

National and International consulting and implementation
Program design, planning & evaluation – policy and advocacy – research

Clients are government agencies, regulators, utilities, foundation, advocates

Operate three energy efficiency utilities
Efficiency Vermont – Efficiency Smart – DCSEU
Project Overviews:

NYSERDA Grid Interactive Vehicle Roadmap

Massachusetts Electric School Bus Pilot Project
NYSERDA Grid Interactive Vehicle Roadmap

Project Goal: Create a roadmap for decision-making about the introduction of grid-interactive vehicles in New York

- Engage key stakeholders
- Conduct preliminary research on technologies, electricity markets and regulations & standards
- Develop a gap analysis to identify areas that require further work and thought from State agencies and industry actors
EV Load Growth

New York ZEV Program Compliance Scenario

- Battery Electric Vehicles
- Plug-in Hybrids

Source: NESCAUM 2015
Project Tracks

Technology and Standards

Retail and Wholesale Energy Markets

Regulation and Policy
Technology & Standards

- Metering
- Control equipment for smart charging
- Bi-directional power transfer capability for distributed storage applications and V2G
Retail and Wholesale Energy Markets

Rate Design

Direct Control Charging
Regulation & Policy
Massachusetts Electric School Bus Pilot Partnership

- Project direction from Department of Energy Resources
  - Project sponsor and final direction

- Project management from VEIC
  - Conducted cost – benefit analysis on school bus technology
  - Manage procurement of vehicles and technology
  - Support outreach and education at schools and communities
  - Conduct evaluation

- School districts / pilot sites
  - Operate school buses
  - Test bidirectional charging systems
Massachusetts Electric School Bus Pilot Project Goals

1. **Use electric school buses in school bus service**
   - Purchase and deploy four school buses in Massachusetts
   - First electric school buses outside of California

2. **Use electric school bus (battery) as energy storage resource**
   - Demonstrate revenue potential of Vehicle to Grid (V2G) or Vehicle to Building (V2B)

3. **Advance electric vehicle technology with education and awareness**
Technology and Systems

- Electric School Buses
- Charging Equipment
  - Bi-directional capable
  - Communication software
Bi-directional Charging Equipment

• Charging equipment capable, but in limited commercial production

• Most experience is with pilot / demonstration projects
  – University of Delaware / PJM work
  – Los Angeles Airforce Base Pilot
  – MIT / Lincoln Labs Demonstration

• Start to bring technology to commercial application
Grid Interaction - Opportunities and Challenges

Lessons from MA and NY
Grid Interaction - Opportunities
Grid Interaction - an incremental approach

Retail / Distribution Level: 1-way power flows

Retail / Distribution Level: 2-way power flows

Wholesale / Transmission Level: 1-way power flows

Wholesale / Transmission Level: 2-way power flows
Retail / Distribution Level: 1-way power flows

- Utility Benefit – Demand Side Management
  - Indirect Controlled Charging, e.g. Time of Use rates
  - Controlled Charging / Smart Charging
Retail / Distribution Level: 2-way power flows

- Building or Resident Benefit – Vehicle to Building (V2B)
  - Peak Shaving
  - Emergency Shelter

- Utility Benefit – Storage Resource
  - Peak Shaving
  - Renewable Integration
Wholesale/Transmission Level: 1- and 2-way power flows

- Resource owner benefit – V2G Grid Services
  - Wholesale Demand Response Programs
  - Frequency Regulation

- Has received much attention as an opportunity to generate revenue

- Requires aggregation and costly software
New York State Grid Interactive Vehicle Roadmap: