

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

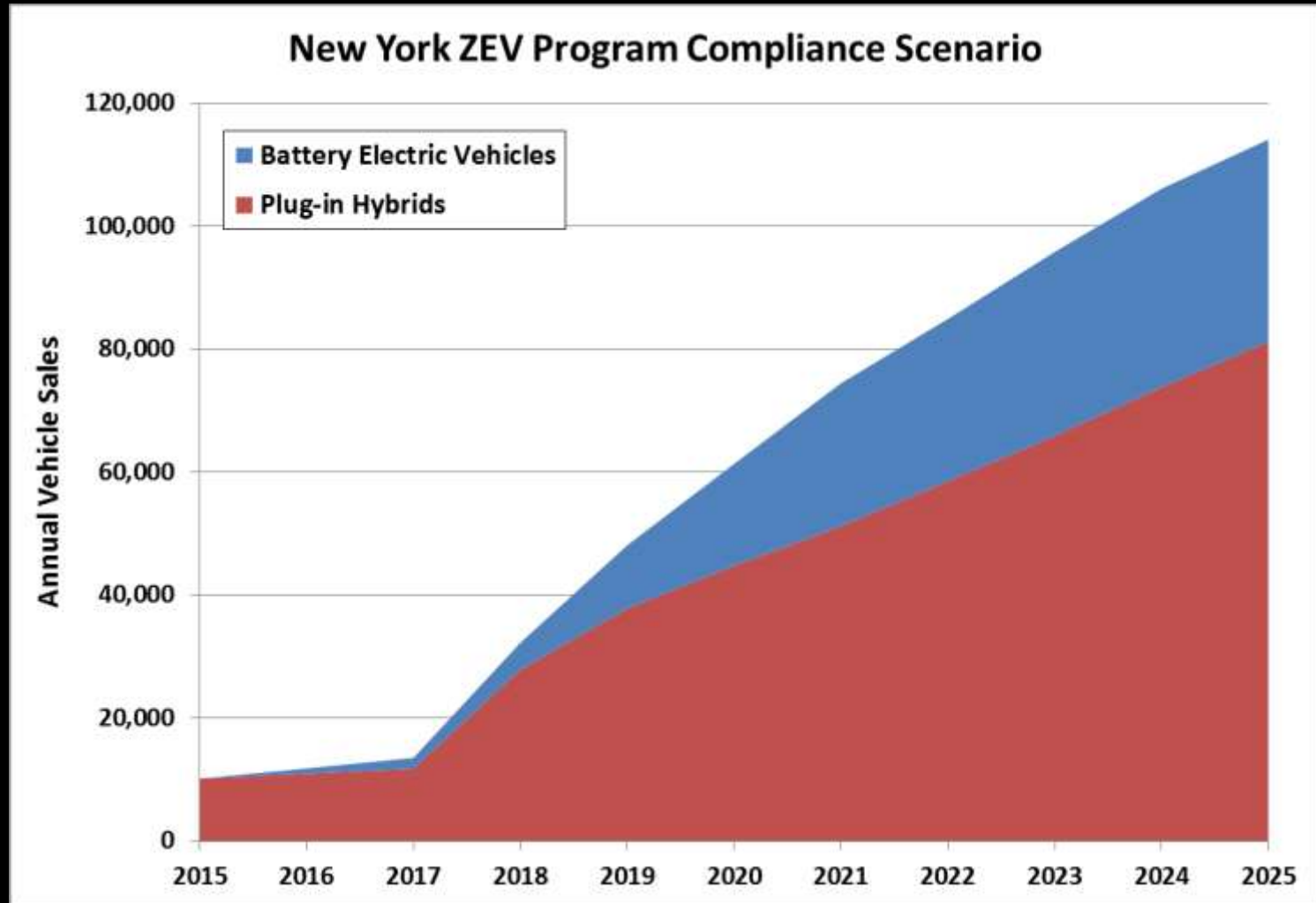
Massachusetts Electric School
Bus Pilot Project

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

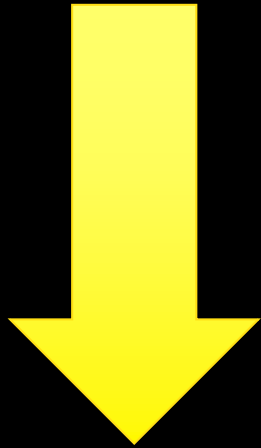
EV Load Growth



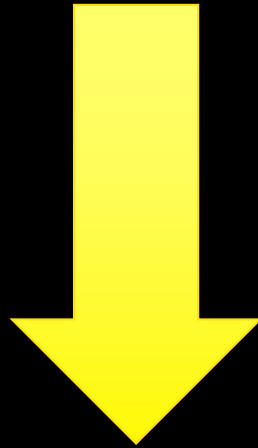
Source: NESCAUM 2015

Project Tracks

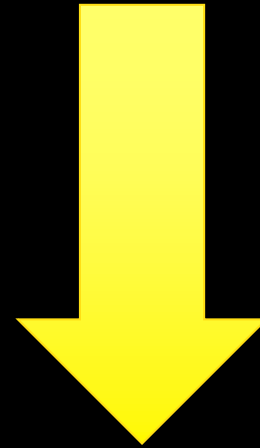
**Technology
and
Standards**



**Retail and
Wholesale Energy
Markets**

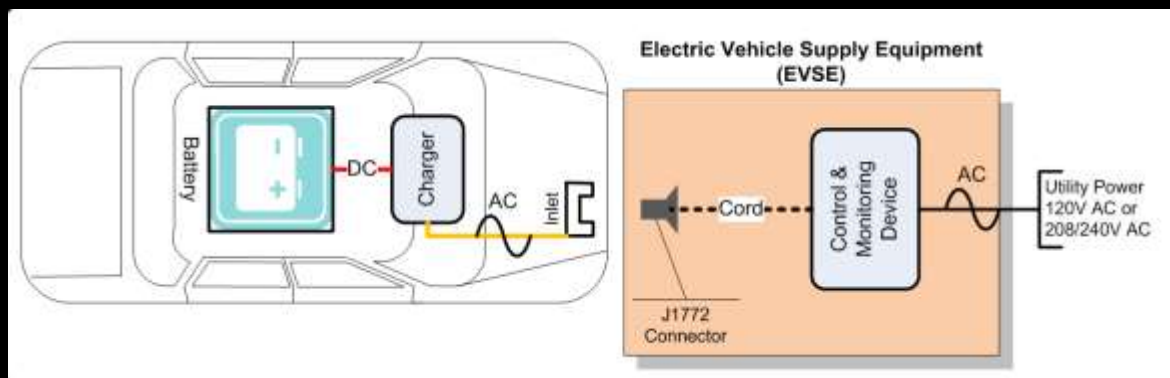
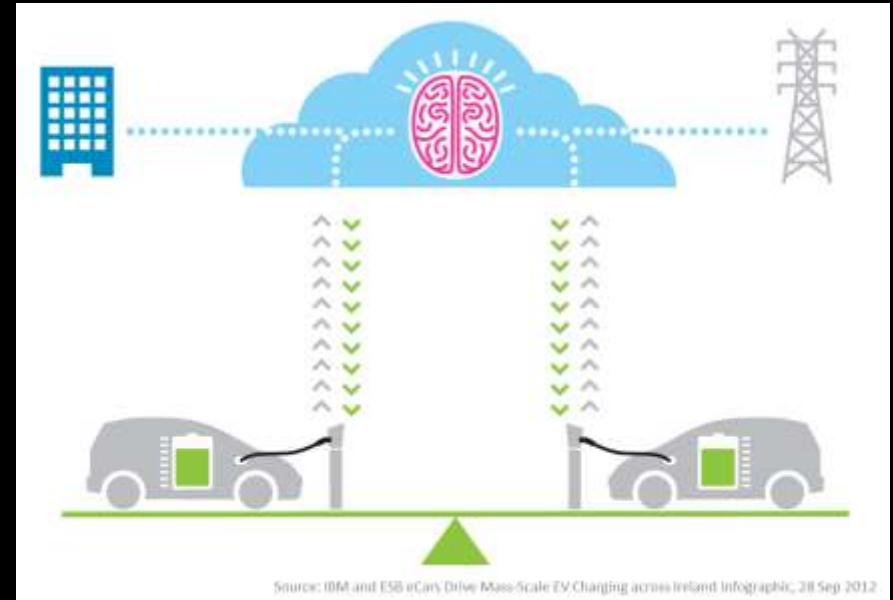


**Regulation
and
Policy**



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

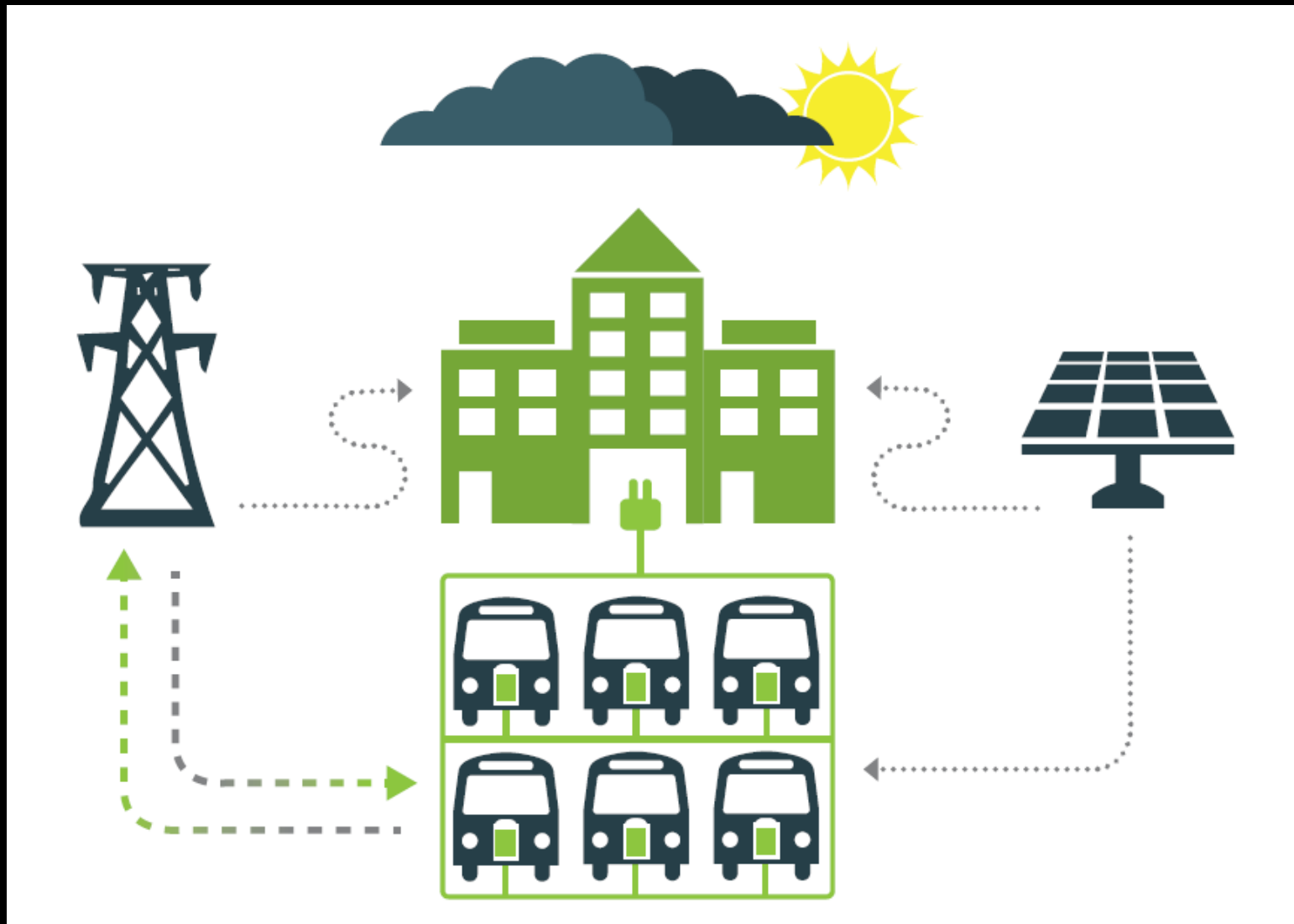


Grid Interaction - Opportunities and Challenges



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



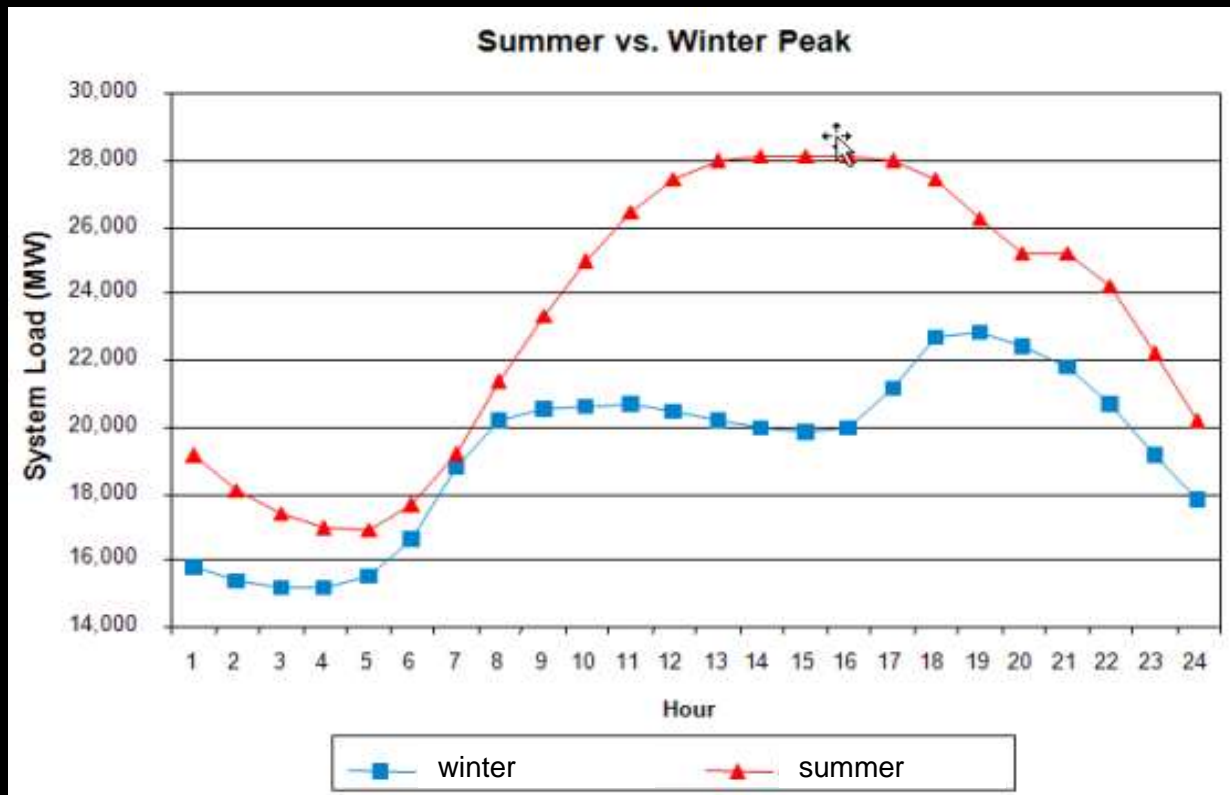
Wholesale / Transmission Level: 1-way power flows



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

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New York State Grid Interactive Vehicle Roadmap:

<http://www.veic.org/resource-library/new-york-state-grid-interactive-vehicle-study-roadmap>



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