
Vermont
Energy Investment
Corporation

Electric Vehicles as a Grid Resource

In ISO-NE and Vermont

Vermont Energy Investment Corporation

Vermont Energy Investment Corporation

- Nonprofit with 25 years experience reducing economic, environmental costs of energy
- Comprehensive focus and results
  - Energy efficiency – Renewable energy – Transportation
- National & international consulting & implementation
  - Program design, planning, & evaluation – policy & advocacy – research
- Clients are government agencies, regulators, utilities, foundations, advocates
- Operate 3 Energy Efficiency Utilities

Efficiency Vermont

EFFICIENCY$MART

DCSEU

EV - Opportunity

- New demand for electricity
- More efficient use of utility resources
- Contribute to grid reliability as a resource in various wholesale markets

Opportunities

- Storage allows demand or load to be decouple from generation
- Vehicles are in use for mobility less than 5% of the time
- EVs need to be charging for approximately 10-20% of the day
- EVs represent a flexible load amenable to shifting

Vermont Electric Market Structure

Generation	Transmission	Distribution	Demand-Side Management	System Optimization and Balance
Utility + Utility calls on Independent Power Producers	Vermont Electric Power Company, Inc. (VELCO)	Utility maintains distribution	Utilities and independent service providers	ISO New England

KEY: Regulated Monopoly | Market Driven | Hybrid

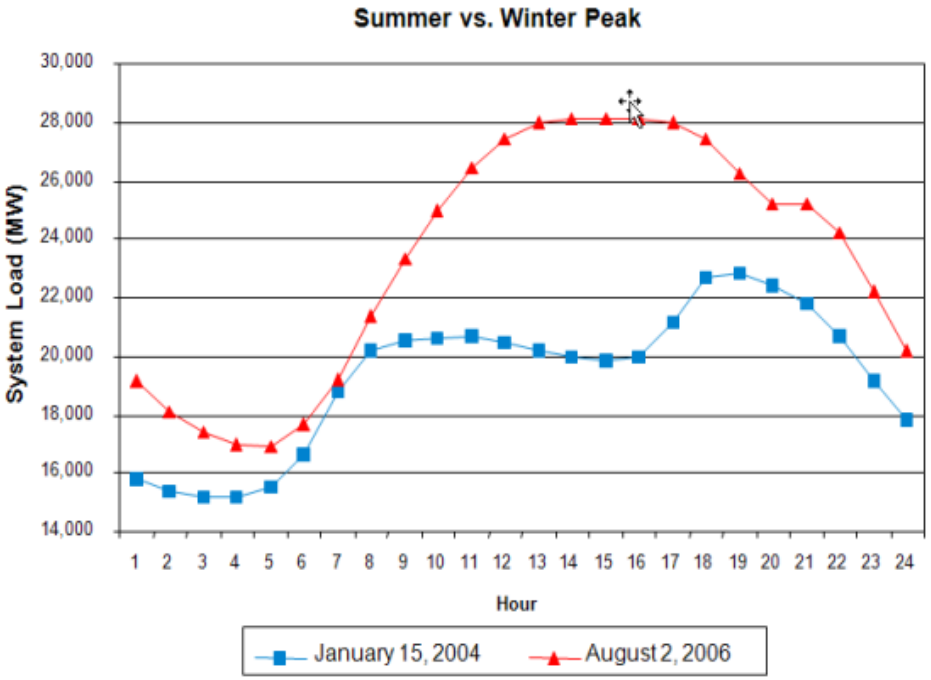
Adapted from Harvey, Hal and Sonia Aggarwal. “America’s Power Plan. Overview: Rethinking Policy to Deliver a Clean Energy Future.”

Incremental Approach

- Demand Side Management programs.
- Aggregated EVs serving as resources in the wholesale level ancillary service markets.
- Fully integrated system - aggregated EVs provide storage resources coupled with renewable energy sources providing distributed generation guarantees in capacity markets.

Demand Side Management

- ***Indirect: Time of Use Rates***
- ***Direct: Controlled Charging***



Source: ISO NEWSWIRE, http://isonewswire.com/updates/2011/12/5/iso-ne-forecasts-adequate-power-to-meet-demand-this-winter.html

Wholesale Markets: Vehicles Needed for Minimum Resource Size

Vehicles	Connection Level	Power Level (kW)	Number of EVs Needed
Average EVs currently on the road	**Level 1**	**1.4**	**715**
Average EVs currently on the road	**Level 2**	**3.6**	**278**
Higher power EVs becoming available	**Level 2**	**6.6**	**152**
EVs retrofitted with more powerful charger	**Level 2**	**15**	**67**
Electric school buses (or other large vehicles) retrofitted with high power charger	**DC Fast Charging**	**60**	**17**

Potential Regulation Resource Values

Scenario	Level of Participation and Configuration	Regulation Clearing Price ($/MWh)	Monthly Benefit per Vehicle
Illustrative Examples			
Individual vehicles, connected through Level 2 EVSE, aggregated through third party	**1 MW resource, 3.6 kW connection, 50% participation rate[i] (360 hrs/month), 417 vehicles[ii]**	**$6.74 - $46.66[iii]**	**$5 - $40 / month**
Electric school buses, connected through Fast charging EVSE, aggregated through fleet management	**1 MW resource, 60 kW chargers, 50% participation rate[i] (360 hrs/month), 25 vehicles[ii]**	**$6.74 - $46.66[iii]**	**$97 - $672 / month**
Demonstration Findings			
University of Delaware PJM Regulation pilot project	**100 kW resource, 18 kW chargers, 15 vehicles**	**$31.64[iv]**	**$150 / month**

Recommendations

- EV Rates
- Coordination of Participants and Stakeholders
- Standardization
- Cost-Benefit Analyses
- Demonstration
- EVs as part of the conversation

Thank You

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