



Integrated Energy Policy Report Update
Vehicle Grid Integration Workshop
California Energy Commission
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EV Grid, Inc.

EVGRID

EV Grid - Vehicle Grid Integration Services

ELECTRIC VEHICLE
DEPLOYMENTS



BATTERY DEVELOPMENT
& SERVICES



ENERGY STORAGE
MANAGEMENT



COMMUNICATIONS,
CONTROL & METERING



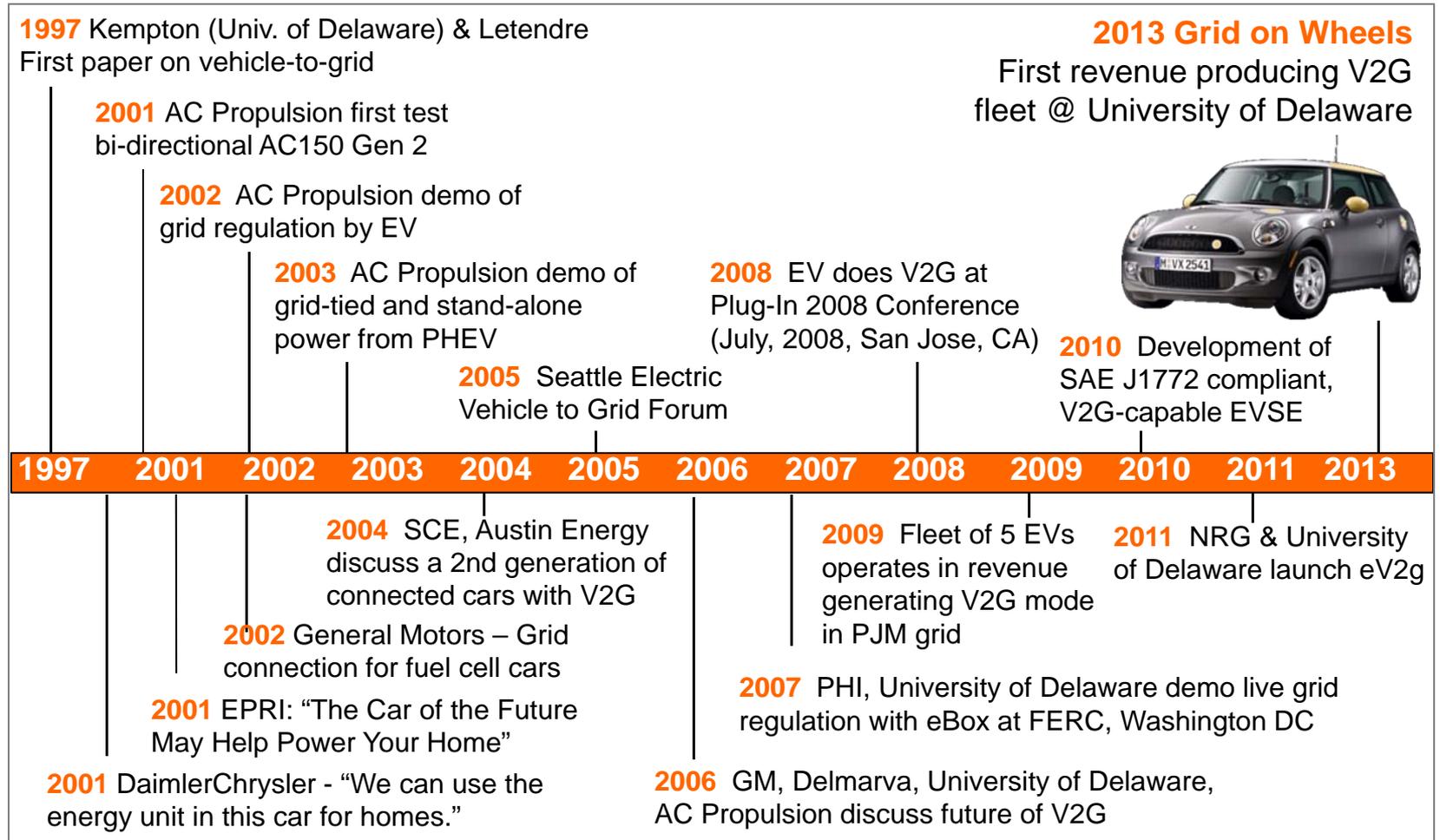
STANDARDS &
POLICY SUPPORT



EV Grid works with OEMs and site operators to develop and supply technology for grid-tied, mobile and stationary battery systems.

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From Vehicle to Grid in 16 Years



Grid-on-Wheels Project



- Develop and demonstrate vehicle-to-grid technology in PJM in order to:

Provide revenue to electric vehicle owners.

Support integration of variable renewable resources.

- Automaker participants include BMW and Honda, actively working to engage others.
- Technology developed by University of Delaware, licensed by NRG, automakers, EVSE makers.
- Measuring and optimizing losses, wear, and dispatch performance

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Grid-on-Wheels



- Two University locations with up to 18 cars came online in February, 2013.
- Plan to add 10 locations (including first residence) in Summer 2014, doubling capacity.
- Upcoming NYSERDA project to demonstrate vehicle to building use case.



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Grid-on-Wheels Customers



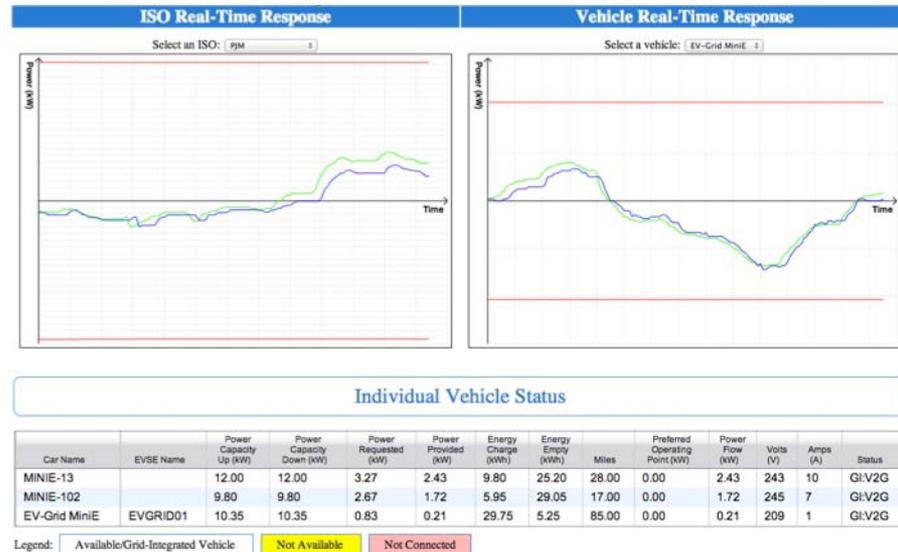
- Drivers schedule long trips to ensure grid services do not impact maximum range.
- For frequency regulation, state-of-charge fluctuates between 65% and 85%, so trips of typical length do not need to be scheduled.



Grid-on-Wheels Results



- Grossing \$5/car/day in behind-the-meter grid markets.
- Value of losses from frequency regulation measured at ~30% of gross revenue.
- Optimization estimated to cut losses by a factor of 2, boost revenue by 20%.
- Battery cycling measurements in progress, no wear cost results yet.



Grid-on-Wheels Vehicles



BMW MINI-E



Honda Plug-In Accord



AC Propulsion eBox

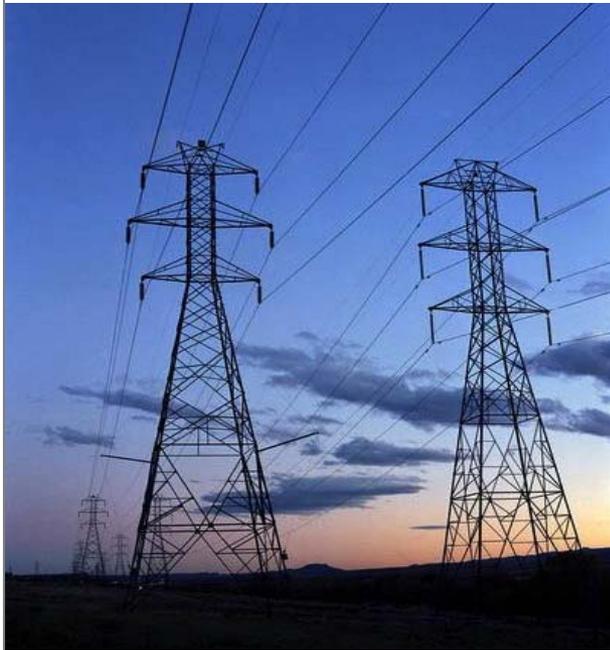


Ford F350 eVan Conversion

National V2G School Bus Demonstration



CGI AMERICA
CLINTON GLOBAL INITIATIVE



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V2G School Bus CGI Commitment

Under the auspices of the Clinton Global Initiative – America, the following have committed to prove the economic viability of zero emissions school buses in the US fleet



The power to change life.
The energy to make it happen.®





Project Overview

Working in five States to identify School Districts, funding and partnerships – California, Massachusetts, Illinois, Texas & New York

- Use a “C” or “D” size bus
- Install EV drive train, power electronics, batteries, V2G, V2B, and regenerative braking system
- Battery size estimated at 100 – 125 kwh
- Bi-directional charger at 60 kw
- Estimated range of school bus on a single charge – 80 miles





Safety First – then results

- The group that has made this commitment does not lose sight that the primary function of school buses is to deliver children to and from school safely. Safety will be the focus of these demonstrations.
- We will collect, analyze, and publicly distribute the results of this demonstration, as the secondary goal is provide the information needed to create a path based on sound economic and cost factors for an EV V2G School Bus Market.





Why School Buses & V2G?

- Very predictable daily operations
- National Average is 80 miles per day
- 4-8 average hours per day in operation
- Most buses run the same route every day
- Generally park in two locations – Depot and/or school building
- Alignment between facility and vehicle ownership
- Significant non-operational time – nights, weekends, holidays, summer
- School buses are generally owned, operated or contracted by the public sector



More Reasons....

- School buses are large – lots of room for batteries and it is energy storage that drives V2G revenue. **Under current design configuration 20-25 EV V2G school buses will represent 1 MWh of energy storage/delivery.**
- Current models indicate that V2G revenue can range from \$5000 to \$20,000 per bus per year.
- Direct transfer of technology to other short haul applications



Transportation Power, Inc.



Why Now?



- EV Technology has advanced significantly and EVs of various sizes are in use today
- Battery technology and costs are now becoming more mature
- V2G is a reality, no longer a theory
- Many school districts were forced by the recession to fall behind in their fleet renewal schedules which creates an opportunity for rapid transition to a cleaner, more advanced technology



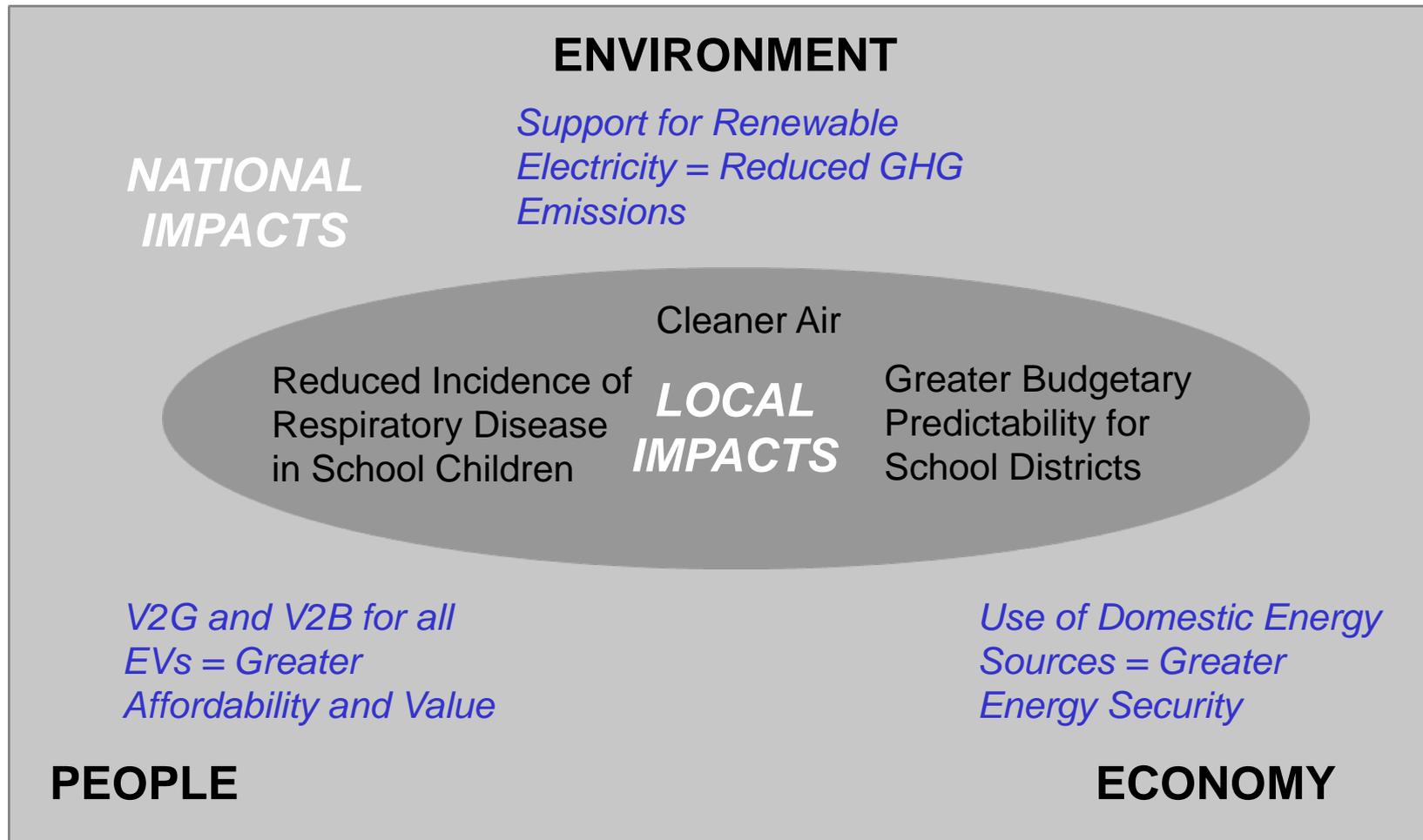
Economics of EV School Buses & V2G

The total cost of ownership/operation of EV V2G School Bus should be comparable to traditional diesel school buses when the following is considered:

- Cost of electricity as fuel (~\$1.10/gal equivalent) vs. diesel (~\$3.94/gal)
- Lower maintenance costs of EVs – no oil changes, fewer moving parts, fewer liquid/lubricant changes, less wear and tear on brakes, less downtime due to “routine maintenance”
- Revenue Generation from V2G technology in the Ancillary Services utility market
- Health costs avoided to children directly exposed to diesel fumes from diesel school buses, as well as improved air quality over all for a community with fewer diesel emissions
- Traditional diesel school bus prices predicted to remain constant or increase whereas EV V2G school bus prices are predicted to fall as battery technology and market advance and increase



The Big Picture





Challenge Accepted

- This will be hard – if it were easy, it would already have been done.
- There are numerous technology and operational issues to be brought together.
- From school bus driver education to grid integration – it will all have to be thought through.
- Working as a non-profit demonstration provides a path forward. Interested parties participate and contribute. All take home and build upon the lessons learned.



Thank You!



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