



Northeast
Utilities System®

Kickoff Meeting

Connecticut Electric Vehicles Infrastructure Council

December 9, 2009



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Northeast
Utilities System®

Hon. M. Jodi Rell's Executive Order No. 34

- > Signals the state's leadership and interest in preparing for upcoming electric vehicle (EV) introductions.
 - › Puts Connecticut in the forefront nationally.
 - › Key automakers quickly contacted NU with offers of support and interest in Connecticut being part of early roll-out plans.
 - › Massachusetts' EV readiness just getting under way.
 - › House Bill 698 public hearing Dec. 1; report back to Legislature June 30

- > Supports Connecticut's efforts to lower emissions and reduce dependency on foreign energy resources.

- > CL&P and NU commend the Governor's vision and fully support this initiative.
 - › NU, UI and CMEEC are working together as part of the Regional Electric Vehicle Initiative ("REVI") with three other New England-based utilities.



Agenda

> Electricity for transportation

- › Greenhouse gas emissions
- › Energy costs
- › Energy security / Oil dependency

> Passenger car rollouts

- › Makes, models & timeline

> Electric vehicle infrastructure

- › Charging station segments
- › Connector standards

> Building upon industry efforts

- › Collaboration
- › Industry initiatives
- › Market timeline
- › Additional references



NU was member of 3 groups receiving Transportation Electrification Funding

- › EPRI PHEV Trouble Truck (NU – 4 Trucks)
- › Ford & 15 leading utilities
- › National Alternative Fuels Training Consortium

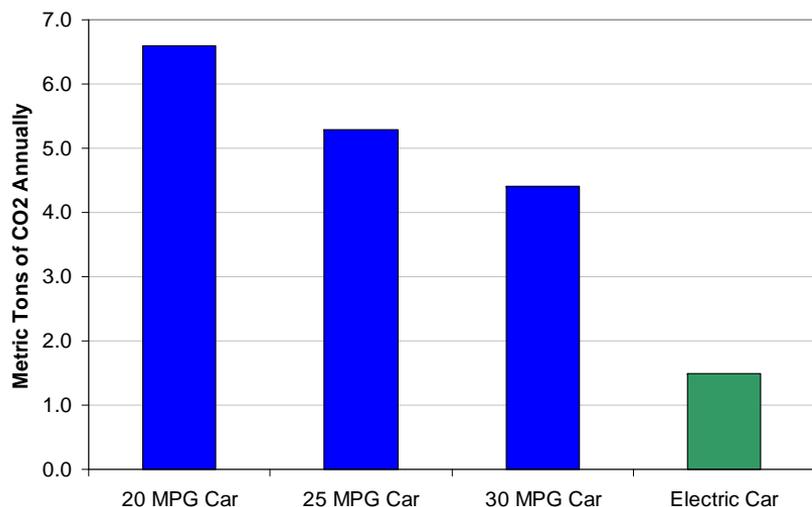
Electricity is an attractive transportation fuel

Conventional Vehicle	Tank / Plug to Wheels Efficiency (approx.)	Electric Vehicle
15 - 20%	Energy Supply Resource	70 - 80%
Oil, Biofuels, etc.	Carbon Profile	<ul style="list-style-type: none">› Diverse supply portfolio today› Primarily natural gas in New England› Can be almost any renewable resource› RGGI and RPS policies will continue to drive a cleaner generation fleet in New England
5.3 metric tons / year 15,000 miles, 25 MPG, 19.4 lbs CO2/gallon (EPA)	Fuel Cost	1.4 metric tons / year 15,000 miles, 5 mi/kWh, 1.0 lbs CO2/kWh (2007 ISO-NE Marginal Emissions Rate)
\$4.80 for 40 miles 25 MPG, \$3.00 per gallon	MPG Rating	\$1.60 for 40 miles 5 mi/kWh, 20¢ / kWh
27.5 MPG CAFE Standard		150 – 250 MPGe

See EPA website for additional information
<http://www.epa.gov/otaq/climate/420f05003.htm>

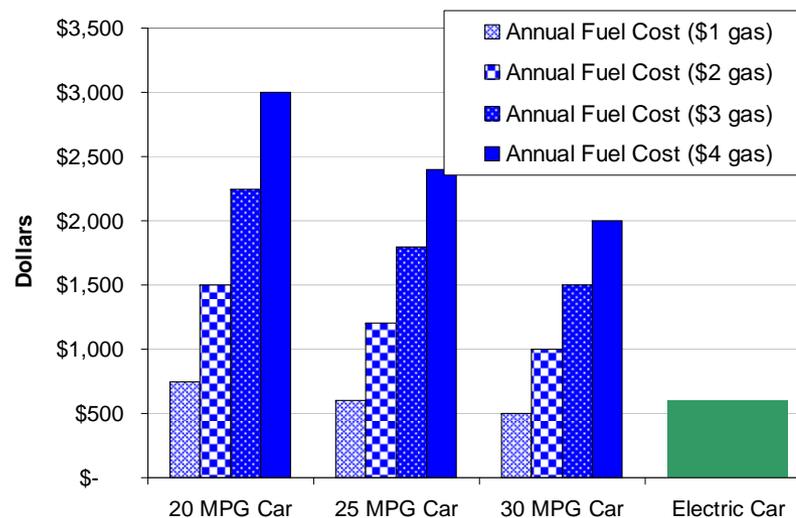
EVs have an attractive carbon footprint, fuel cost savings and MPG ratings

70–80% Reduction in CO₂ Emissions



40–60% Reduction in Annual Fuel Costs @ \$2 gas

(70–80% Reduction in Fuel Costs @ \$4 gas)



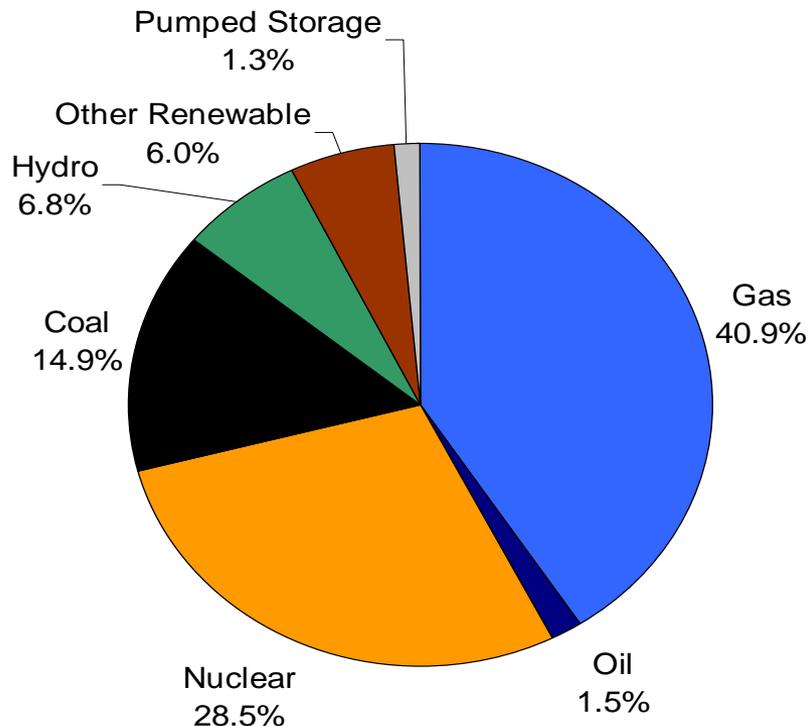
PHEVs are expected to get 80 to 150 MPGe ratings
 with full EVs getting 100 to 200+ MPGe ratings
 (EPA methodology based on BTU content of fuel delivered to vehicle)

Assumptions

- > 15,000 miles annually
- > 19.4 lbs CO₂/gallon (EPA)
- > 5 miles per kWh electric consumption (40 miles on 8 kWh)
- > 2007 New England marginal emissions rate is 1,004 lbs per MWh
- > 20 cent per kWh electric price



Energy Supplied by New England's Generation Fleet



Has much lower carbon emission rates than national averages:

- The percentage of total generation produced by gas-fired plants in New England was **41%** in 2008.
- Nationwide, about **21%** of electric energy is produced by power plants fueled by natural gas.

Will continue to have a better carbon footprint:

- New England participates in the **Regional Greenhouse Gas Initiative (RGGI)**, a cap and trade market for power sector greenhouse gas emissions.
- Progressively increasing **Renewable Portfolio Standards (RPS)** will add low-impact resources to the market.
- NU and others are taking steps to further **de-carbonize** our electric supply fuel mix.

Source: page 62 of ISO- New England 2009 Regional System Plan

Automakers have committed to EV introductions

Expected Vehicle Introductions

- > Tesla Roadster *available today*
- > Chevy Volt *late 2010*
- > Nissan Leaf *late 2010*
- > Ford Transit Connect *late 2010*
- > Mitsubishi iMiEV *2010/11*
- > Think City EV *2010*
- > GM PHEV SUV *2010/11*
- > Fisker Karma *2010/2011*
- > Toyota Prius PHEV *2010 test / 2012*
- > Ford Focus EV *2011*
- > Chrysler platform *2011*
- > Tesla Model S *2011/12*
- > Audi *2011/12*
- > Volvo V70 *2012*
- > Hyundai *2012*
- > Daimler – Smart EV *2012*
- > VW E-up *2013*

Cadillac Converj 2012/13



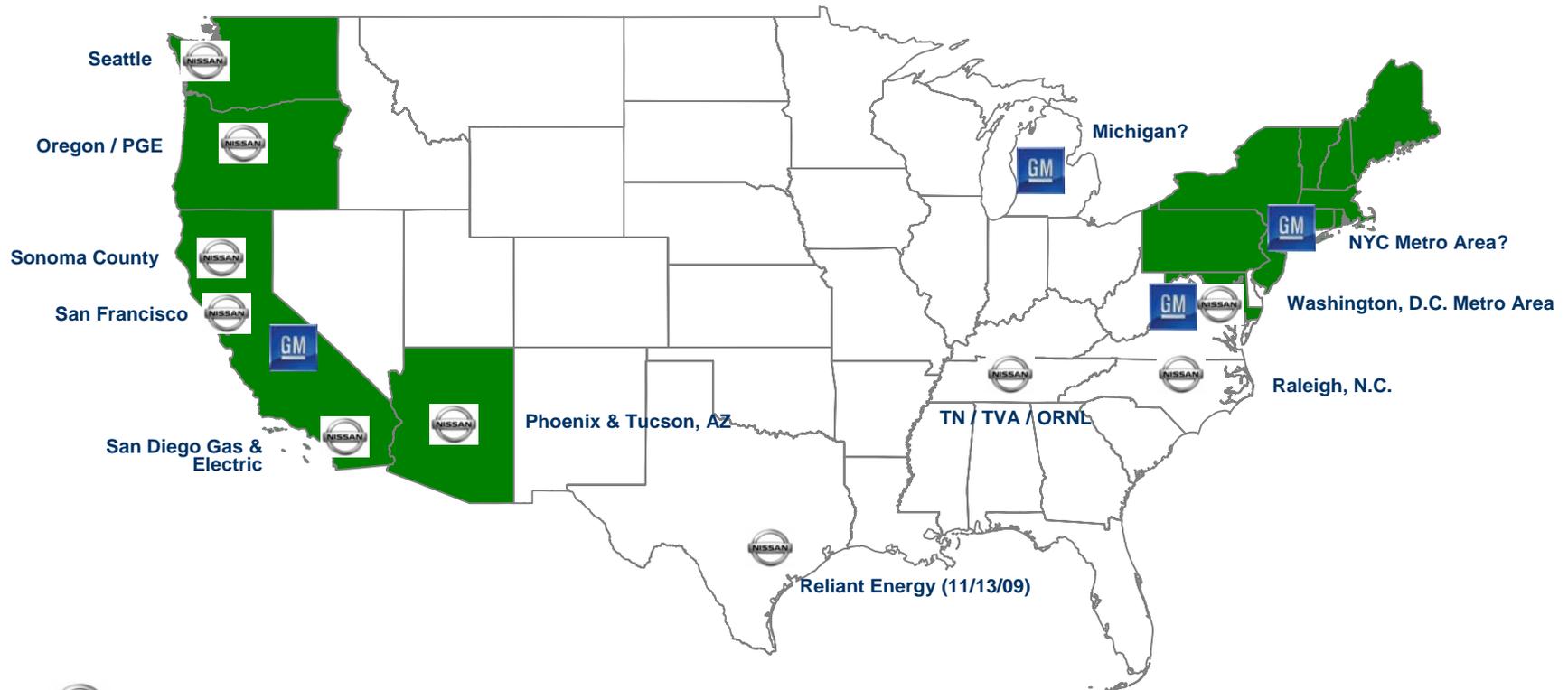
“The auto industry is moving much faster and in the race to win the electric car race the pace is even more accelerated. No wonder GM is revving up the Cadillac Converj.”

CNBC, 11/11/09



Passenger Car Rollouts -

Customer demographics, utility and policy support will drive the geography of initial vehicle rollouts



Nissan has announced partnerships with various communities



Chevrolet announced California, other early rollout markets are a “best guess”



Ford will focus on those states following California vehicle emissions standards



Other markets and other automaker rollouts expected closer to 2012



When will Connecticut get cars? That depends ...



120-day “exploratory” MOU now available (definitive agreement follows)

- › Signing based on State’s level of interest
- › LEAF vehicles / batteries made in Tenn. plant as of 2012



DOE project winner but no agreement reached

- › 15 utility participants nationally



Chevy Volt discussions in progress

- › GM / Electric Power Research Institute (EPRI) / Utility Collaborative



TOYOTA

Prius plug-in hybrid fleet demonstration vehicles

- › Application submitted



CHRYSLER

Chrysler is on EPRI Infrastructure Working Council

- › NU is active participant / presenter



MITSUBISHI
MOTORS

Potential for follow-up discussion

- › NU maintaining contact

Amphenol ~ Wallingford, Conn.

One of two companies worldwide producing the U.S. / Asia standard electric vehicle plug / connector.

Cabaire ~ Enfield, Conn.

Provider of truck stop electrification facilities, now developing electric vehicle charging stations.



Photo of Cabaire Charging Post



Electric Vehicle Infrastructure – 3 charging station segments



- *Meter TBD*
- *Billing TBD*

- *Behind a meter*
- *Host facility pays electric bill*

- *Behind a meter*
- *EV owner pays electric bill*

Original Diagram Courtesy EPRI & GM



Electric Vehicle Infrastructure – Home charging installation



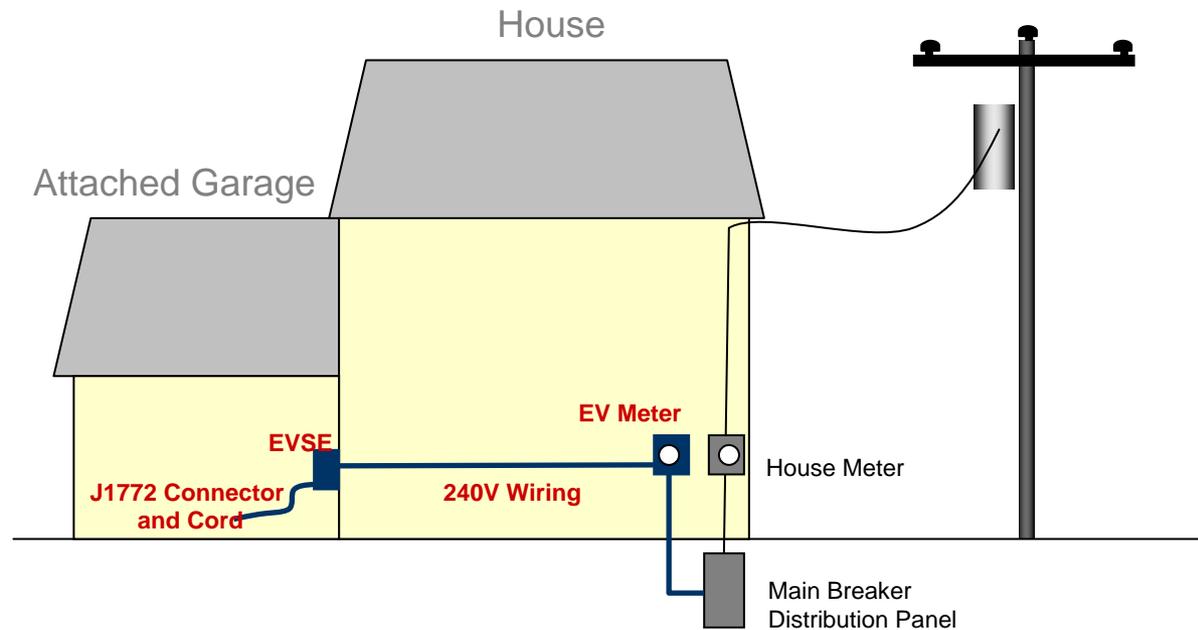
240V Home EVSE



120V Portable Cordset

Photos from GM.com

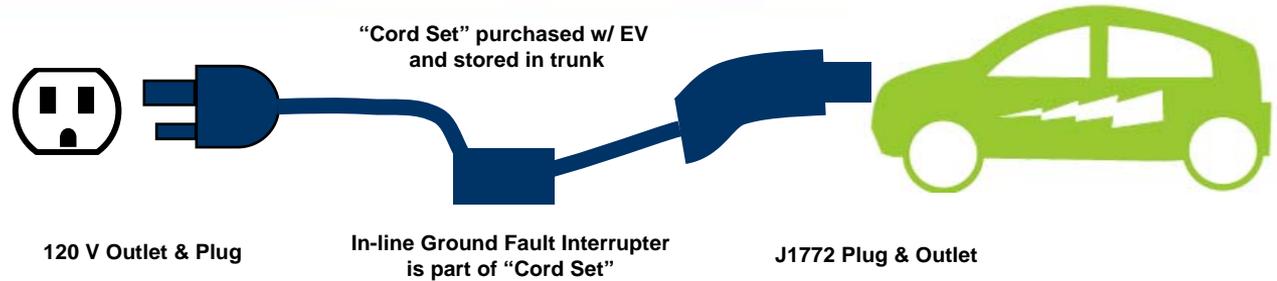
Components of Home Charging with Electric Vehicle Supply Equipment (EVSE)



Electric Vehicle Infrastructure – EV connector standards

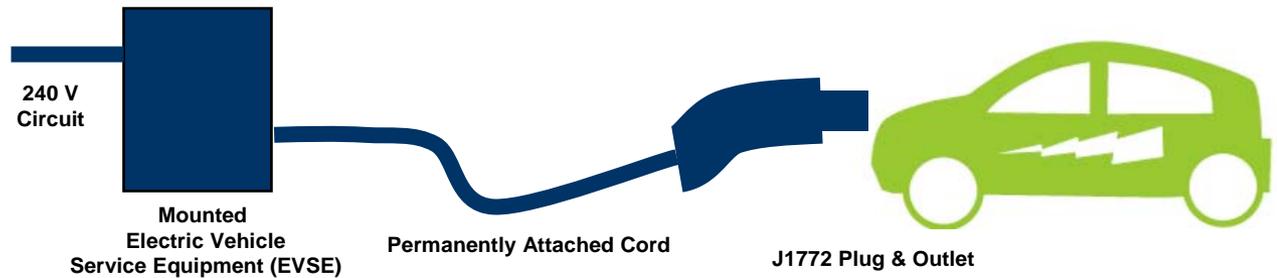
Level 1 Charging

- 120 V
- Used primarily for Plug-in Hybrid Electric Vehicles
- 8+ hour charging



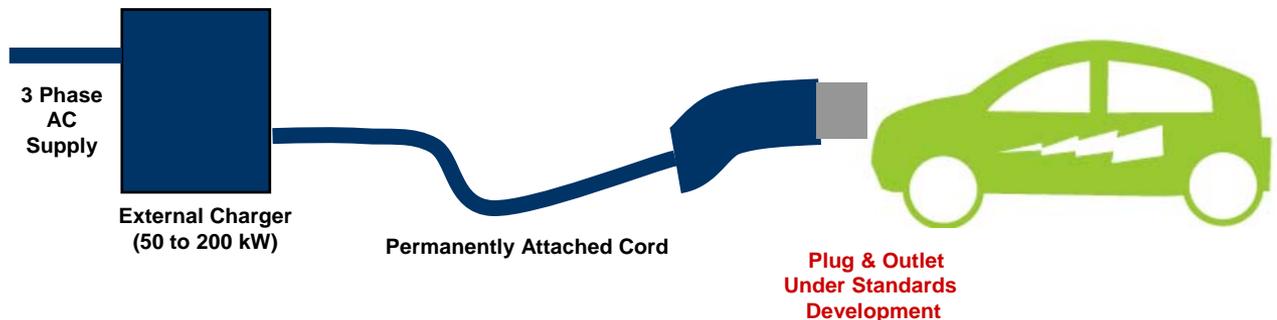
Level 2 Charging

- 240 V
- Used for all types of Plug-In Electric Vehicles
- 3+ hour charging



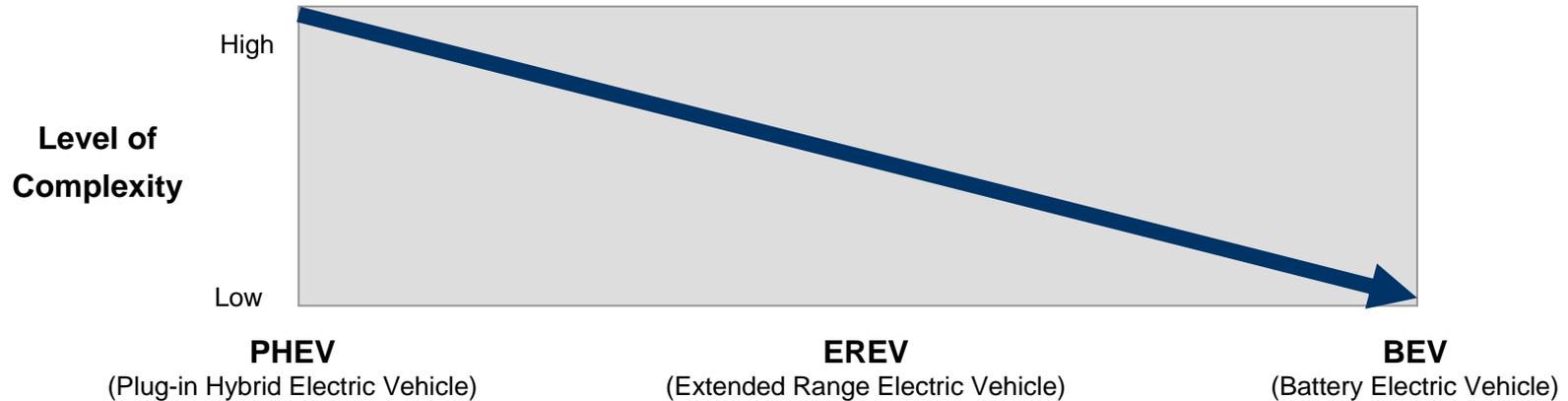
DC Charging (“Fast Charging”)

- 3 phase AC to external charger
- Only works for vehicles with compatible batteries
- 15 to 30 minute charging

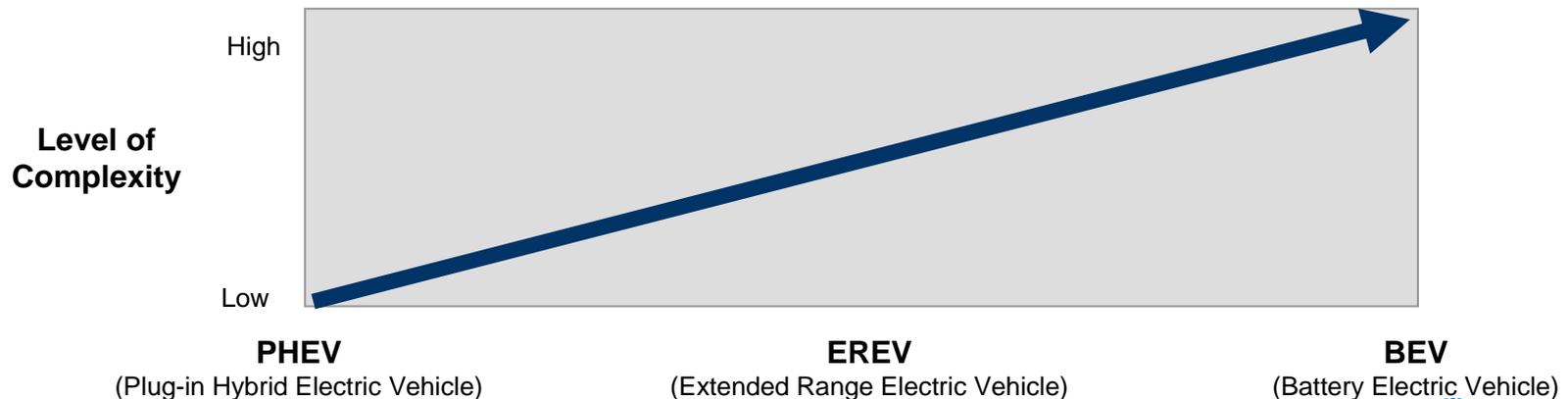


Demand on utility infrastructure will increase as “electric miles” increase

Vehicle drive trains become simpler as reliance on internal combustion engines decreases:



Utility infrastructure and charging infrastructure needs increase as “electric miles” increase:



Automaker design choices will impact utilities

	PHEV (Plug-in Hybrid Electric Vehicle)	EREV (Extended Range Electric Vehicle)	BEV (Battery Electric Vehicle)
Internal Combustion Engine	Yes (Powers wheels in parallel with Electric Motor)	Yes (Powers generator which charges batteries)	No
Average Electric Range	10 – 20 Miles (ICE still runs in electric mode)	40 Miles (ICE runs after battery is depleted)	100 + Miles
EPA MPG Rating	50 – 100 MPGe	80 – 120 MPGe	100 – 200+ MPGe
Charging Requirements	120v 15a circuit	120v 15a circuit (8 hours) 240v 20-30a circuit (3 hours)	240v 30-70a circuit (3-6 hours) DC charger* (15-30 min: 80% charge)
Useable Battery Sizing	3-5 kWh	8-10 kWh	20-35 kWh
Level of Charging Infrastructure Improvements Needed	Some	Moderate level of improvements for 240v charging	Moderate to high level of improvements; especially for 3Ø charging

* To charge a 35-kWh battery in 10 minutes requires up to 250 kilowatts of capacity.



Building upon industry efforts –

Collaboration is the key to avoid missing the opportunity

Group	Purpose of Group and NU Participation
EI Electric Transportation Task Force	<ul style="list-style-type: none">> Developed 5-point utility pledge to support EVs> Opportunities ongoing
Electric Power Research Institute	<ul style="list-style-type: none">> Technology deployment, technical studies, industry contacts and learning forum
 REVI REGIONAL ELECTRIC VEHICLE INITIATIVE	<ul style="list-style-type: none">> NU spearheading utilities working group to advance EVs in the region (NU, UI, CMEEEC, NGrid, NStar & MMWEC)
Infrastructure Working Council	<ul style="list-style-type: none">> Utility-led group to coordinate critical codes and standards for intercompatibility of national EV infrastructure> NU is the utility representative on committee working on public charging transactions / open standards
U.S. Green Parking Council	<ul style="list-style-type: none">> Developing “Green” certification for parking garages> Establishing standards for EV charging in parking garages, no resale of electricity> NU to be member of Advisory Board
National Plug-in Vehicle Initiative	<ul style="list-style-type: none">> Comprehensive clearinghouse of timely and accurate EV information for the media and the general public> NU to be member of Steering Committee
NESCAUM	<ul style="list-style-type: none">> NU is stakeholder in Low Carbon Fuel Standards proceedings to address CO2 allowance allocations for electric transportation
Clean Cities	<ul style="list-style-type: none">> Network of volunteer coalitions, which develop public/private partnerships to promote alternative fuels and advanced vehicles> NU working with Clean Cities to increase acceptance of electricity as an alternative fuel

California has conducted robust implementation discussions

Recommendations from Bay Area Mayors

Current State Of Electric Vehicle Products, Infrastructure And Policy In The San Francisco Bay Area (February 2009)

- › Expedite permitting and installation of EV charging outlets
- › Harmonize local regulations and standards across the region to achieve regulatory consistency for EV infrastructure
- › Provide incentives for employees, parking facility operators and others to install EV charging systems
- › Establish aggressive pooled-purchase orders for EVs in public and private fleets
- › Identify and secure all low voltage electrical outlets available for charging at government buildings
- › Identify and implement a roll-out plan for 220v chargers
- › Establish common government programs to promote EV purchase and charging system installation
- › Link EV programs to regional transit and air quality programs to make them integral with Bay Area's transportation and air pollution policies
- › Expedite permitting and approval for facilities providing extended-range driving capability in the region



California has conducted robust implementation discussions (cont.)

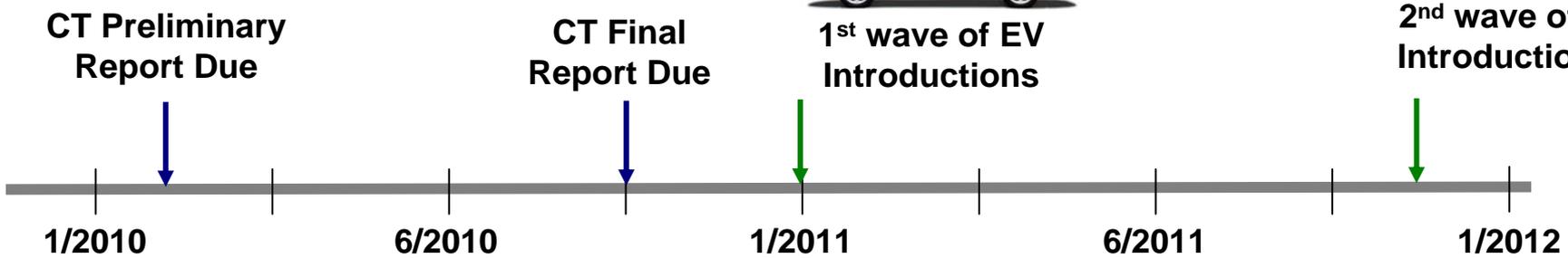
Proposed topics by California Public Utility Commission

Light-duty Vehicle Electrification In California: Potential Barriers And Opportunities (May 2009)

- › Rate design options, including the potential of a statewide electricity rate for PEVs,
- › Vehicle incentives to encourage Californians to buy and operate PEVs, including ratepayer funded incentive programs,
- › Options for development of metering and charging infrastructure for PEVs, and
- › Options to streamline permitting requirements and contractor installation of residential PEV charging equipment;
- › Options to incorporate PEV charging with renewable energy supply, including, but not limited to, photovoltaic (PV) arrays over charging stations or off-peak charging that takes advantage of overnight wind resources expected in the utility resource portfolio.



Building upon industry efforts – Timeline of vehicles and infrastructure



NU Research Project

- 2 NU locations (Hartford & Berlin)
- 3 Parking garages
- 2 curbside locations

CL&P Pilot Program (under consideration)

- Colleges
- State & Municipal facilities
- Commercial locations & Parking garages
- Others?

CL&P Rollout of Comprehensive Infrastructure Program (to be developed)

Building upon industry efforts – Suggested Resources

General Resources

- > University of California at Davis (many reports) <http://phev.its.ucdavis.edu/>
- > Plug In America <http://www.pluginamerica.org/>
- > EPA Emissions Facts <http://www.epa.gov/otaq/climate/420f05003.htm>
- > NESCAUM <http://www.nescaum.org/>
- > EDTA Conference (Jan. 26-28, 2010) <http://www.electricdrive.org/>

News Sources for Electric Cars

- > EV World <http://www.evworld.com>
- > Green Car Congress <http://www.greencarcongress.com>

Recommended Reports

- > U.S. DOE PHEV Infrastructure Review <http://avt.inel.gov/pdf/phev/phevInfrastructureReport08.pdf>
- > Impacts of PHEVs on Regional Power Generation http://www.ornl.gov/info/ornlreview/v41_1_08/regional_phev_analysis.pdf
- > Electrification Coalition - Electrification Roadmap <http://www.electrificationcoalition.org/>

