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# Plug-in Electric Vehicles

Emerging Technologies Stakeholder Meeting

Watson Collins
Northeast Utilities

October 17, 2011

http://www.plugmyride.org/

# Today's discussion

- Overview of Plug-in Electric Vehicle (PEV) rollouts in the state and CL&P's efforts
- Industry basics / background on PEVs
- Projected market penetration of PEVs (results of CL&P/UI study with Electric Power Research Institute)
- Recharging impacts on the utility grid

# Overview of CL&P's plug-in electric vehicle efforts

- Worked to ensure vehicles arrive in Connecticut
  - One of seven states for Volt launch
  - One of five markets for BMW Active E pilot
  - Signed MOUs with Nissan
  - Early launch market for Ford Focus Electric
  - Early launch market for Toyota Prius PHEV
- Member of Connecticut's Electric Vehicle Infrastructure Council, established in 2009 by an executive order from the Governor of CT.
- Founder and chair of the Regional Electric Vehicle Initiative (REVI) along with NSTAR, National Grid, UI, CMEEC, MMWEC. Group developing a paper on metering electric use of plug-in electric vehicles.
- Installed six Level II (240 V) charging stations at NU facilities.
- Pursuing a comprehensive & multi-phase utility research program.
  - Current research project focused on away-from-home charging
  - Future pilot testing to include residential charging



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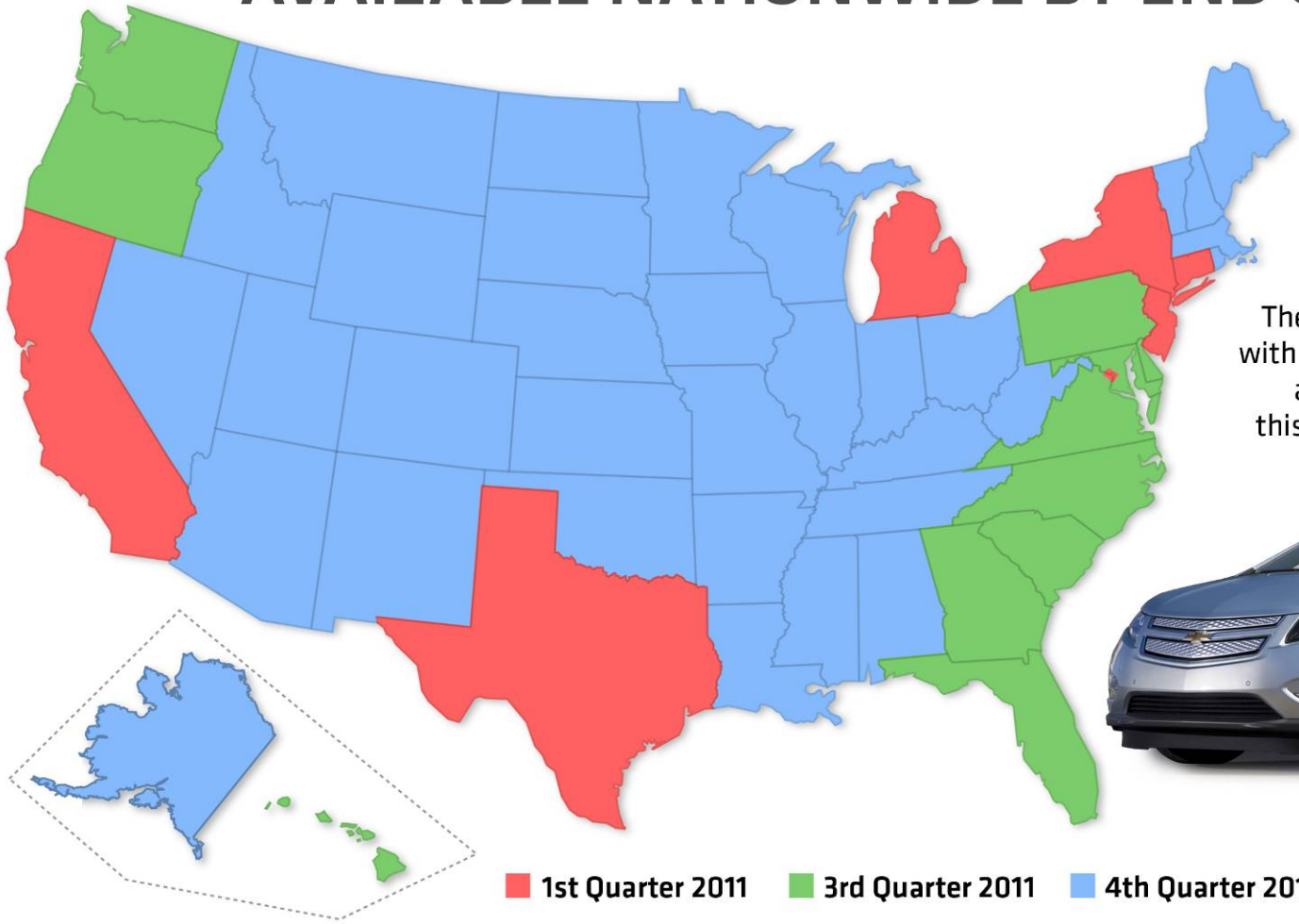
# AVAILABLE NATIONWIDE BY END OF 2011




The Chevrolet Volt electric vehicle with extended range will be available across the U.S. by the end of this year – six months sooner than originally planned.

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# Connecticut will also be an early launch market for both Ford and BMW

## BMW announces trial markets for ActiveE electric car effort

By Sebastian Blanco
Posted Sep 23rd 2010 10:59AM

Comments 12

The evolution of BMW's electric vehicle program, Project i, goes sort of like this: from Mini E concept to leasing that car to happy customers to the ActiveE concept to field tests of the larger sedan next year and then on to the Megacity EV, which is scheduled for 2013. Those last two steps have not yet happened, but today we learn a bit more about how and where the ActiveE, a modified 1 Series Coupe, will prowl the streets. BMW has announced that the following U.S. cities and areas will get the ActiveE:

- New York City
- Los Angeles
- San Diego
- San Francisco
- Sacramento
- Boston
- select markets in Connecticut

## Ford Announces 19 Launch Markets For 2012 Focus Electric

BY NELSON IRESON | 1,485 views | November 15, 2010

Ford Focus EV

SHARE THIS PAGE:

Ford's first all-electric passenger vehicle, the 2012 Focus Electric, has just received its list of initial launch markets. Totaling 19 cities in all, the vehicle will roll out across the country with Nissan LEAF-like targets for range and performance.

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# U.S. PEV Outlook from Edison Electric Institute

- 2011 Chevrolet Volt – 10,000 ($42k)
- 2012 Volt production to 45,000 ($40k)
- 2013 Volt production up to 100k (<$40k)
- 2011 LEAF Launch – 10,000 ($33k)
- 10,000 more LEAFs ($35k)
- 2013 LEAF production up to 100k
- Focus Electric Launch – 19 States
- C-Max ENERGI Launch
- Roadster since 2008 – over 1,800 sold ($109k)
- Model S Launch – 20,000/year ($57k)
- Model X Launch ($35k)
- Plug-in Prius Launch – 15 States ($32k)
- New RAV4 EV Launch
- i Launch ($27k)
- Active E, Mini E Launch - 2012
- Karma Launch ($100k)
- CODA Launch ($40k)

All prices are base model MSRPs before federal, state, local, or employer incentives. Leasing options are typically available and competitive (i.e. $350/mo for Volt or LEAF currently).

***With many more coming by 2013:***

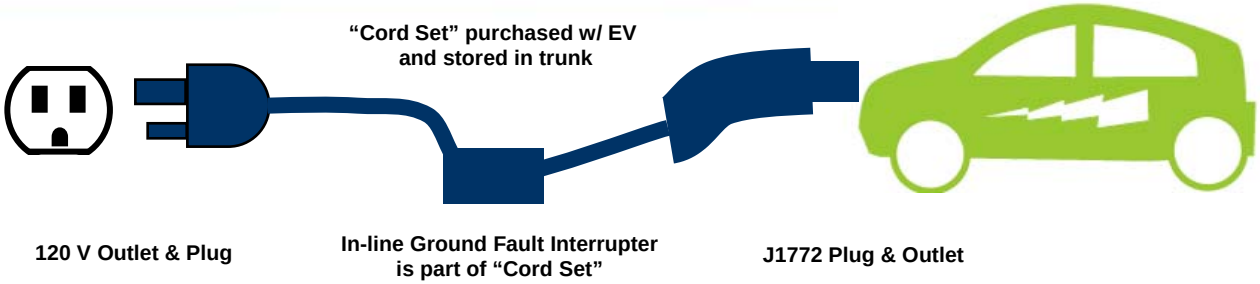
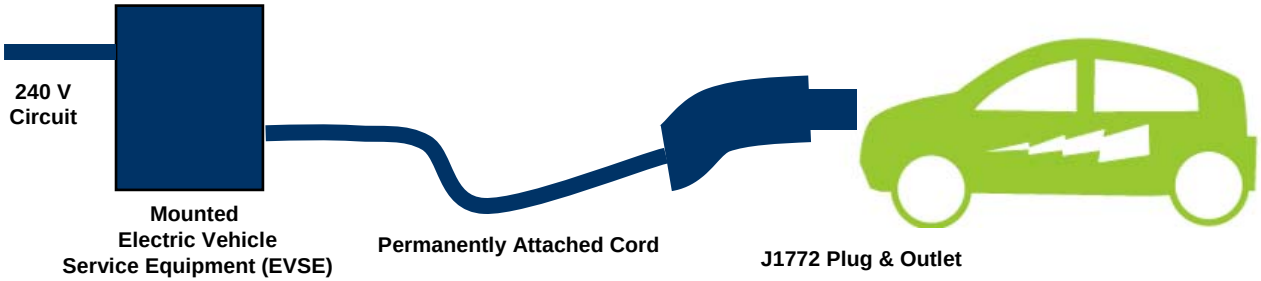
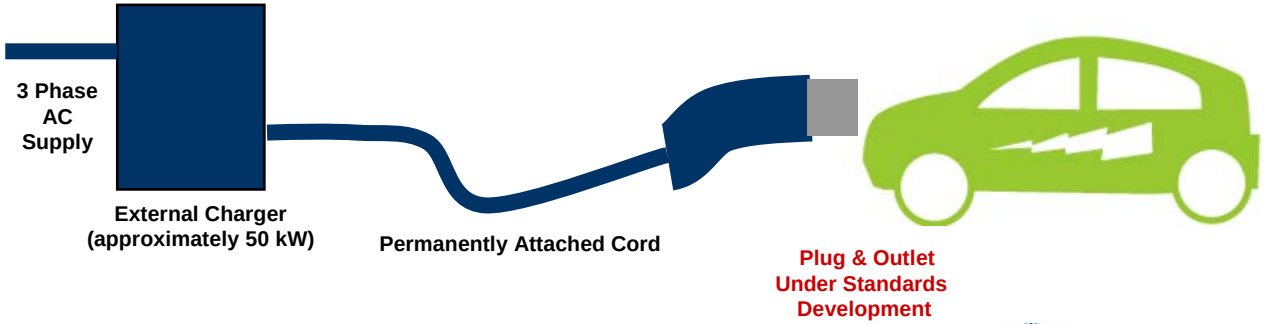
2010 | 2011 | 2012 | 2013

Edison Electric Institute
Power by Association

# Two plug-in technologies (choose what fits driving habits)

| Battery Electric Vehicle | | Plug-in Hybrid Electric Vehicle |
|---|---|---|
| | **Drivetrain** | |
| ~100 miles | **Electric Range** | 15 – 40 miles |
| Commuting, fixed routes, short routes, etc. | **Driving Patterns** | Irregular driving patterns, highway driving, long routes |
| Purists, principled, making statement, technology driven, 2nd vehicle, etc. | **Expected Profile of Vehicle Owners** | Primary vehicle, pragmatic consumers, expect same performance, no loss of convenience, etc. |
| Level 2 and DC Fast Charging | **Recharging Equipment Sizes** | 120 v outlets and Level 2 |
| **Home**, work & public | **Recharging Locations** | **Home** & work |

# EV connector standards

| | | |
|---|---|---|
| Level 1 Charging | • 120 V<br>• Used primarily for Plug-in Hybrid Electric Vehicles<br>• 8+ hour charging |  |
| Level 2 Charging | • 240 V<br>• Used for all types of Plug-In Electric Vehicles<br>• 3+ hour charging |  |
| DC Charging ("Fast Charging") | • 3 phase AC to external charger<br>• 15 to 30 minute charging |  |



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# Understanding the recharging infrastructure locations

Center of public dialogue (newsmakers)

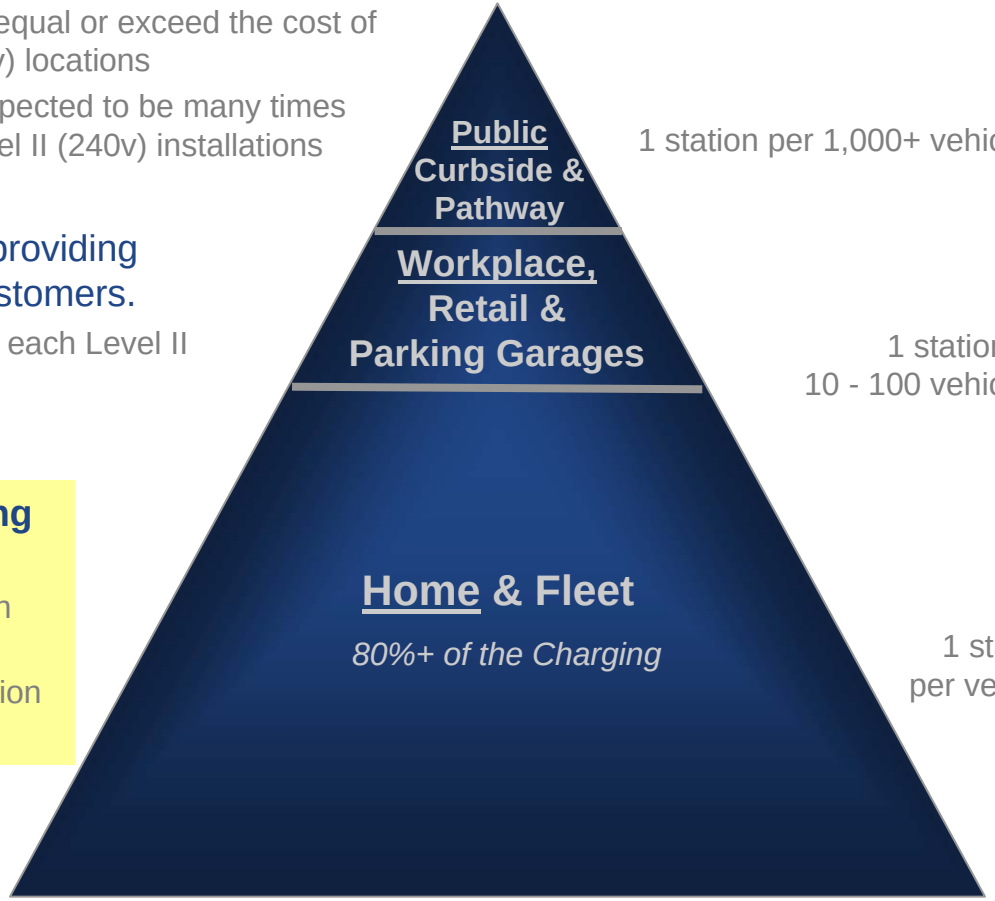
- Level II (240v) cost to equal or exceed the cost of business Level II (240v) locations
- Fast DC recharging expected to be many times greater the cost of Level II (240v) installations

Many businesses have an interest in providing charging station availability to their customers.

- Our experience indicates $10,000 + for each Level II (240v) station

**Home installations are required for recharging and are the least cost**

- Level 1 (120v) recharging outlets may already be in place
- Automaker programs plan around $2,000 per location for Level II (240v) installations




1 station per 1,000+ vehicles?

1 station per 10 - 100 vehicles?

1 station per vehicle



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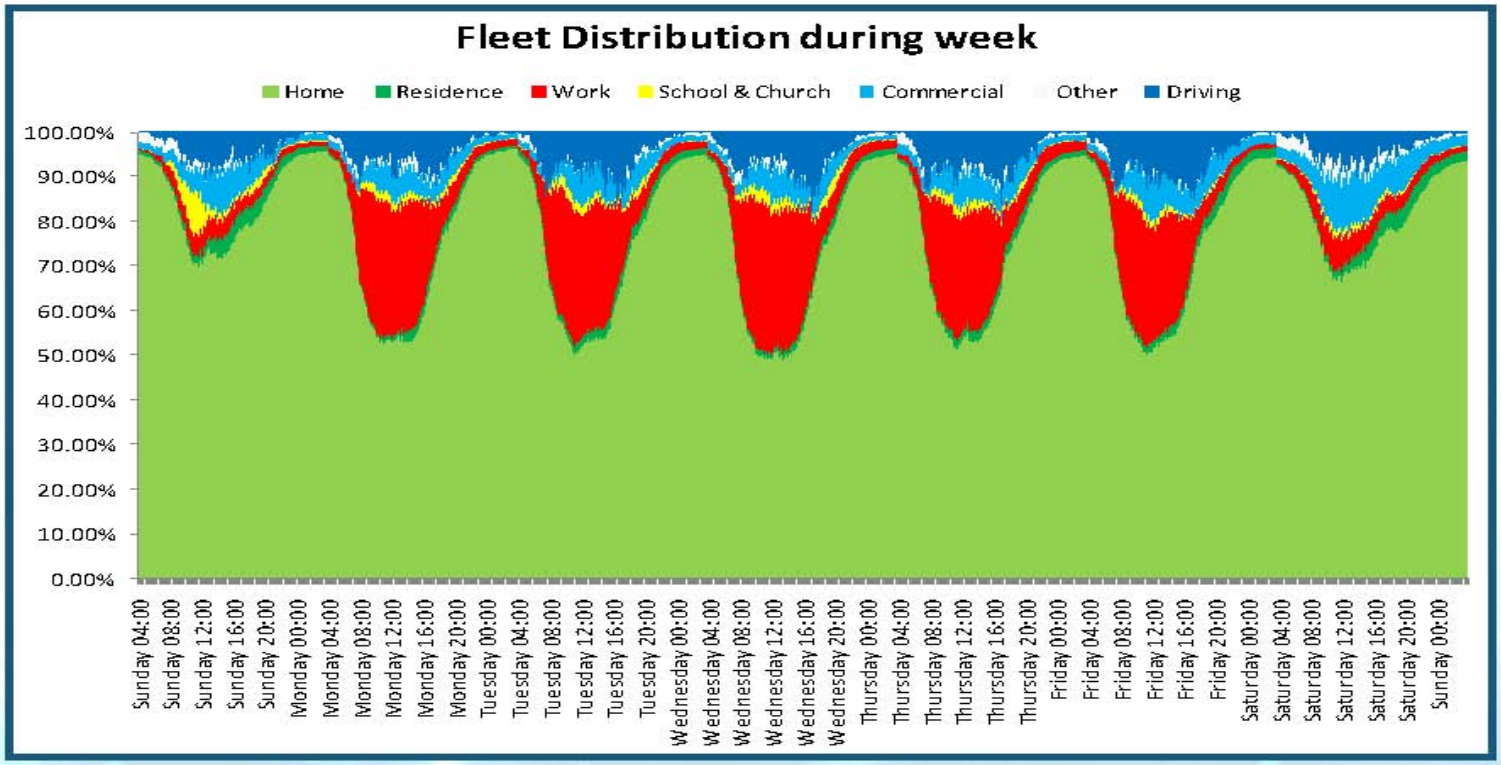
# Cars are parked at home most of the time




Source of Data - 2001 National Household Travel Survey ; GM Data Analysis (Tate/Savagian) - SAE paper 2009-01-1311



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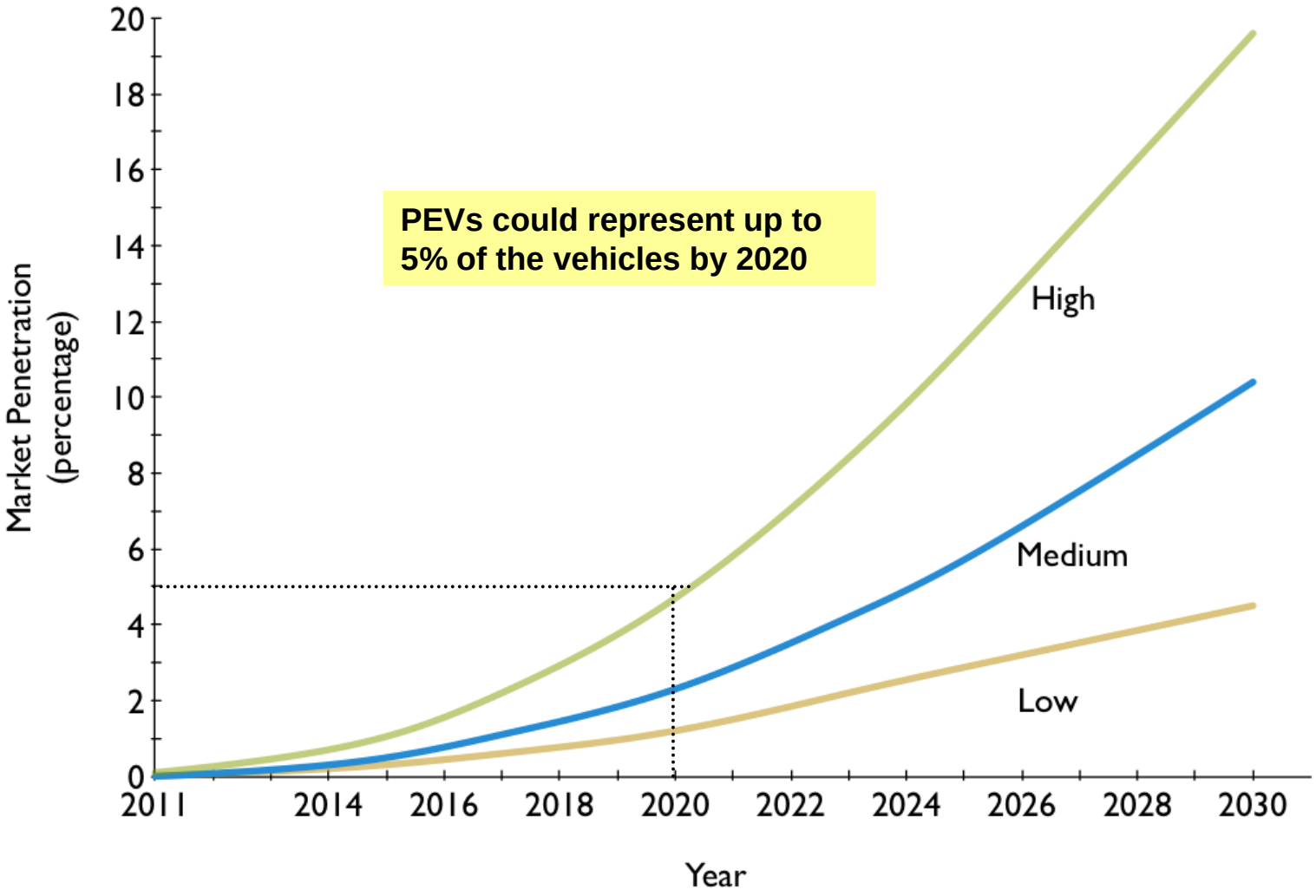
# The Electric Power Research Institute recently modeled PEV adoption for Connecticut

- EPRI developed three market adoption scenarios for Connecticut: low, medium, and high
- These scenarios cover the time span from 2010 through 2050
  - From 2010-2015, the estimate of the PEV share of new vehicle sales is based on “ground-up” sales estimates, which in turn are derived from PEV launch announcements and production estimates (“supply constrained” scenarios)
  - After 2015, the PEV market share begins with an extrapolation of the “ground-up” estimates and in later years trends toward an extrapolation of the past sales performance of HEVs (“consumer acceptance” scenarios)
- County-specific data is also available

# Projected market adoption of PEVs in Connecticut



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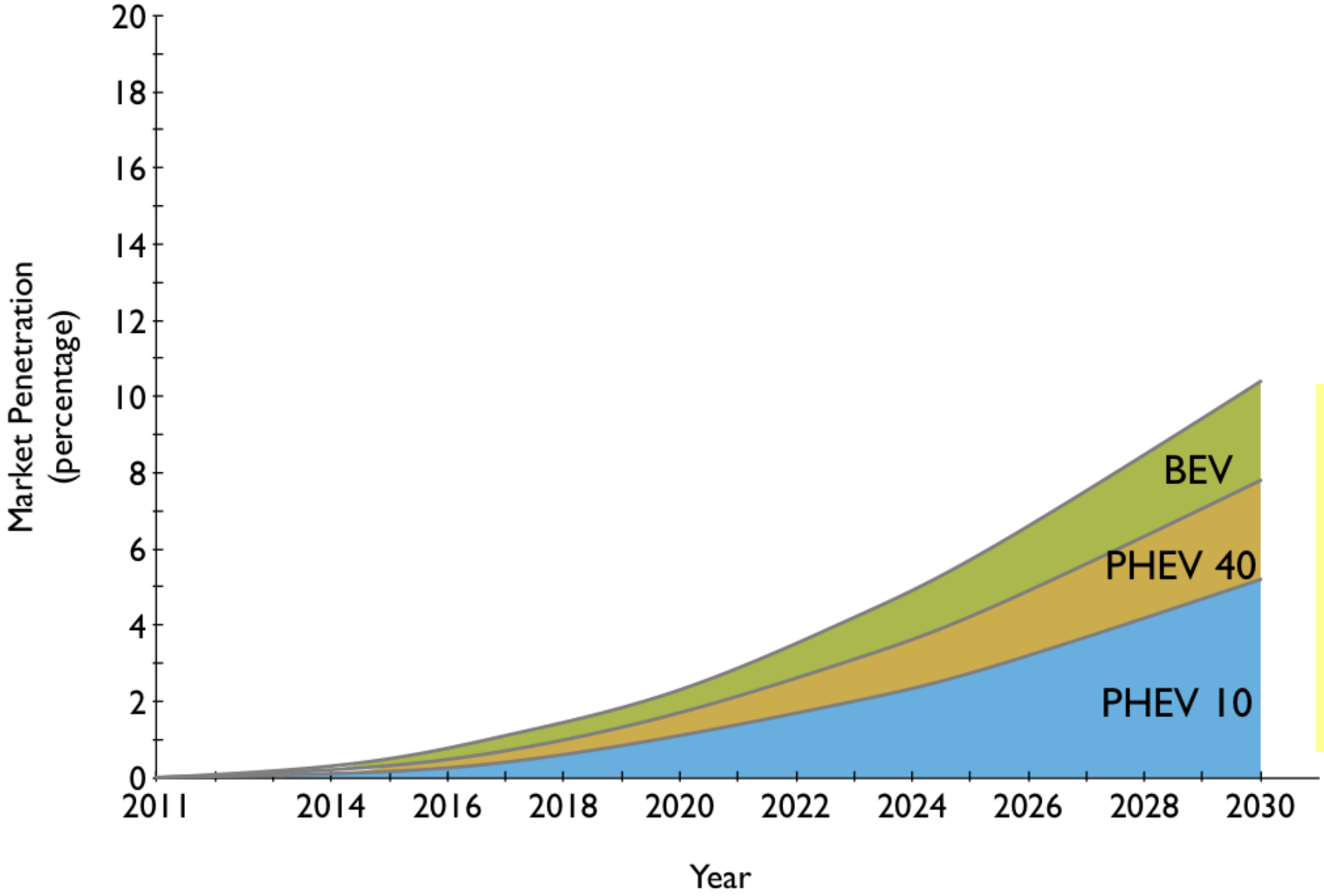
# Breakdown of PEV adoption by vehicle type (Medium Scenario)




**PHEV 10 (Plug-in Hybrids with a 10 mile EV range) are expected to represent half of the PEV market**

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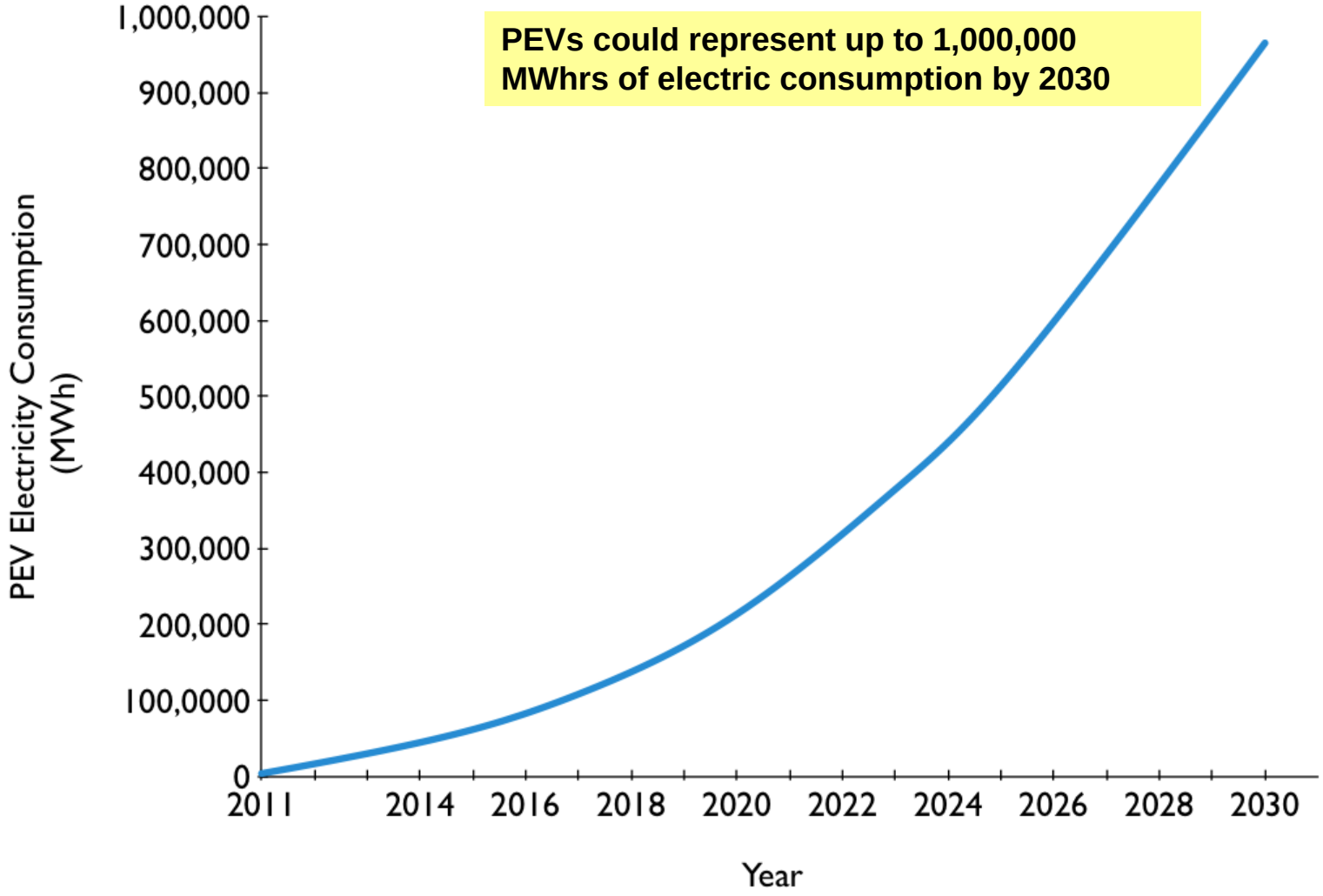
# PEV Electricity Consumption (Medium Scenario)

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# Impacts of PEV recharging on the utility grid

- Many national and regional studies have concluded that the increased electric demand from PEV recharging can be met by the region's bulk supply grid (generation, transmission, distribution)

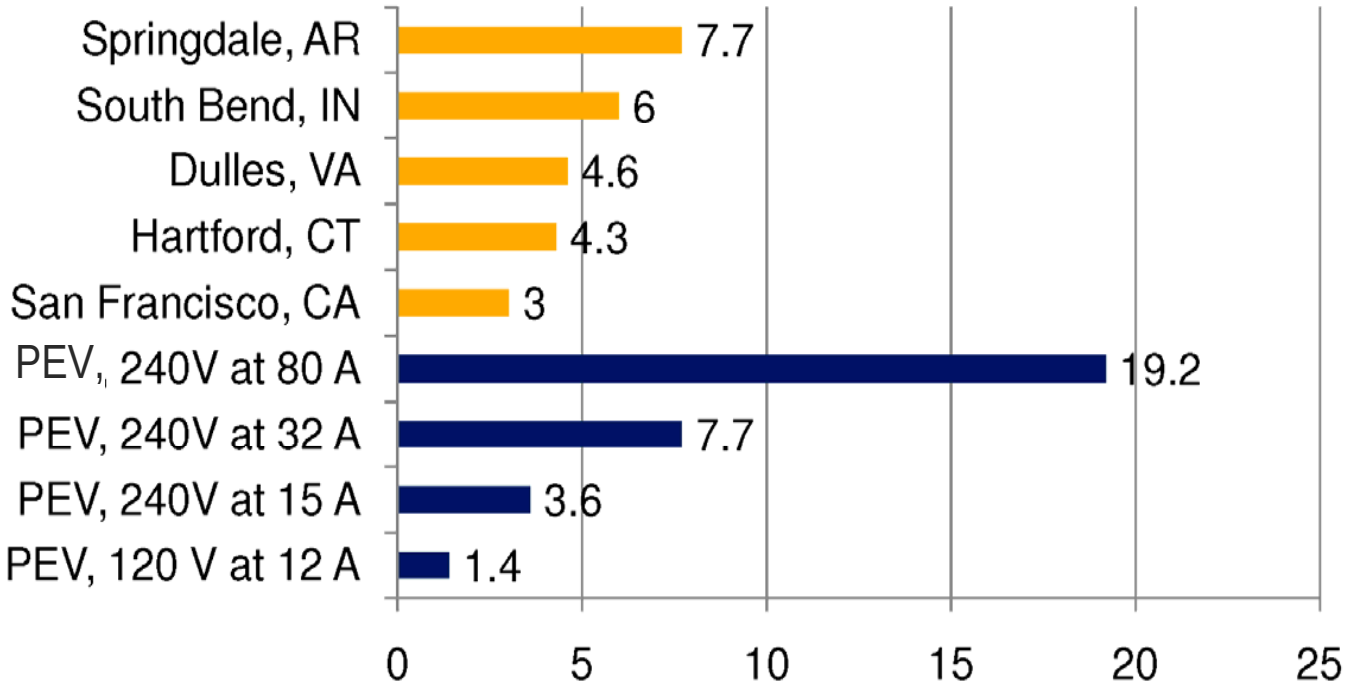
  According to the Integrated Resource Plan for Connecticut, January 1, 2010
  - "Even an optimistic view of PEV penetration in New England over the next two decades is unlikely to pose any unmanageable issues for maintaining reliable electric service."
  - "The potential increase in annual energy consumption is estimated to be about 3 percent in 2030."

- The utility grid impacts will primarily be focused on the local distribution system
  - Both CL&P and UI have conducted studies of the potential distribution impacts
  - These studies have indicated that the service transformer and service wires will be the equipment most likely to be impacted by PEV recharging
  - These impacts are primarily driven by three factors
    - Adoption rates within neighborhoods
    - Power level of recharging, 6.6 kW and above has more impact than 1.4kW
    - Recharging time of day

# There is growing interest among automakers in producing PEVs with higher power level of recharging, which can equal or exceed the peak demand of a typical residence

**Orange: typical peak residential electricity use, kW**

**Blue: peak EV charging rate, kW**




(Research by Arindam Maitra, EPRI, 2010)



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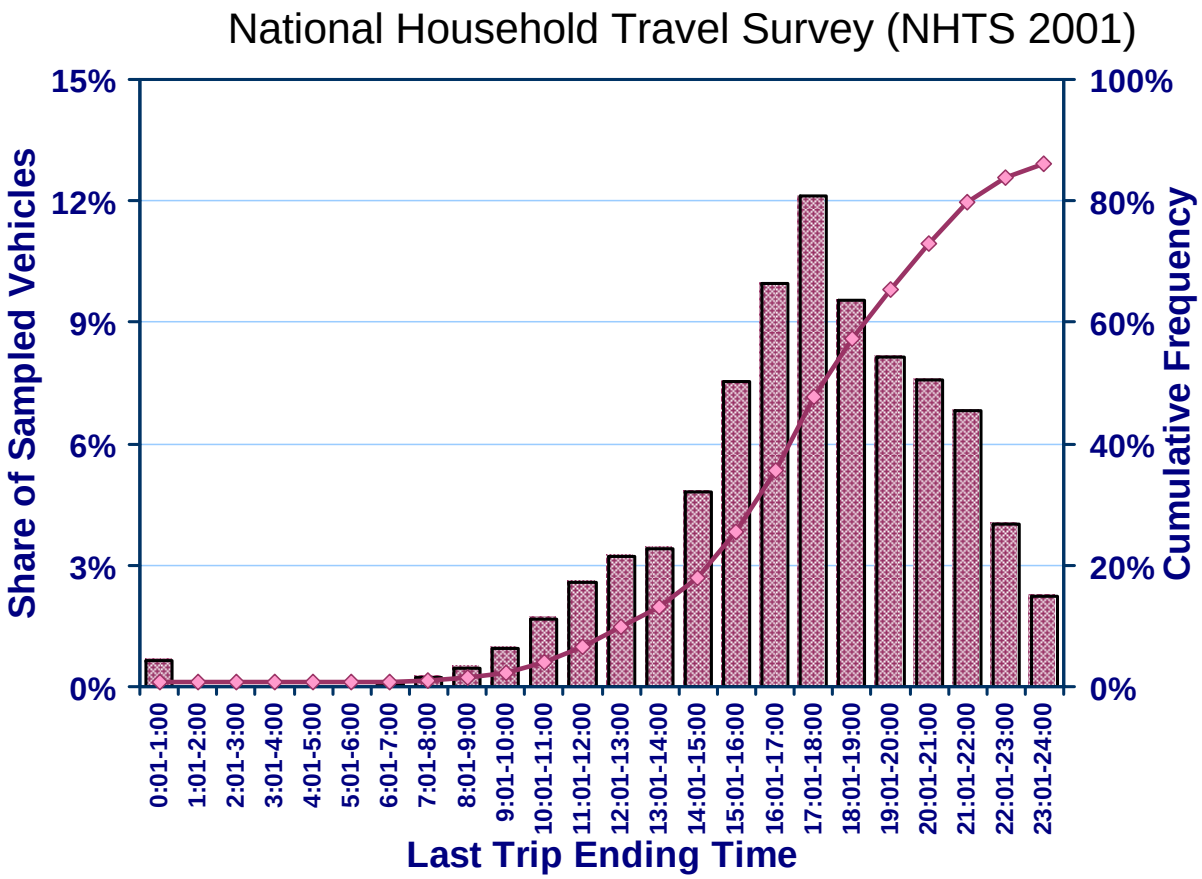
# For example: profile of home arrival time




| Hr | PDF |
|---|---|
| 0 | 0.65% |
| 1 | 0.01% |
| 2 | 0.01% |
| 3 | 0.01% |
| 4 | 0.00% |
| 5 | 0.02% |
| 6 | 0.07% |
| 7 | 0.23% |
| 8 | 0.45% |
| 9 | 0.95% |
| 10 | 1.66% |
| 11 | 2.56% |
| 12 | 3.21% |
| 13 | 3.41% |
| 14 | 4.80% |
| 15 | 7.54% |
| 16 | 9.95% |
| 17 | 12.12% |
| 18 | 9.56% |
| 19 | 8.16% |
| 20 | 7.58% |
| 21 | 6.82% |
| 22 | 4.02% |
| 23 | 2.22% |

•NHTS 2001 Unweighted Travel Day Data: Summary by Home Type, Purpose, End Time of the Last Trip, and Miles per Vehicle



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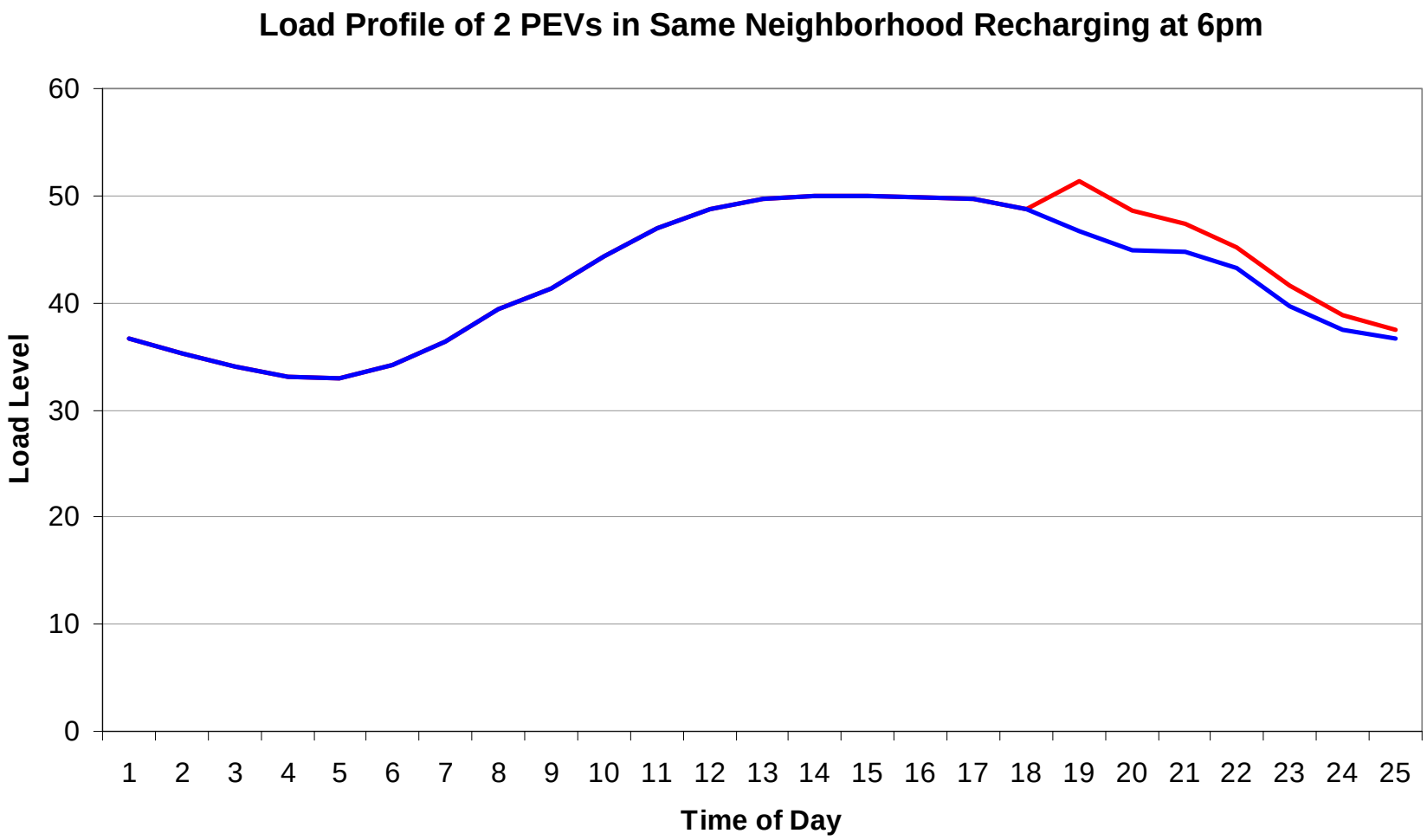
# PEV recharging at typical home arrival times can result in a higher local peak demand




Baseline neighborhood load profile

Neighborhood load profile with PEVs



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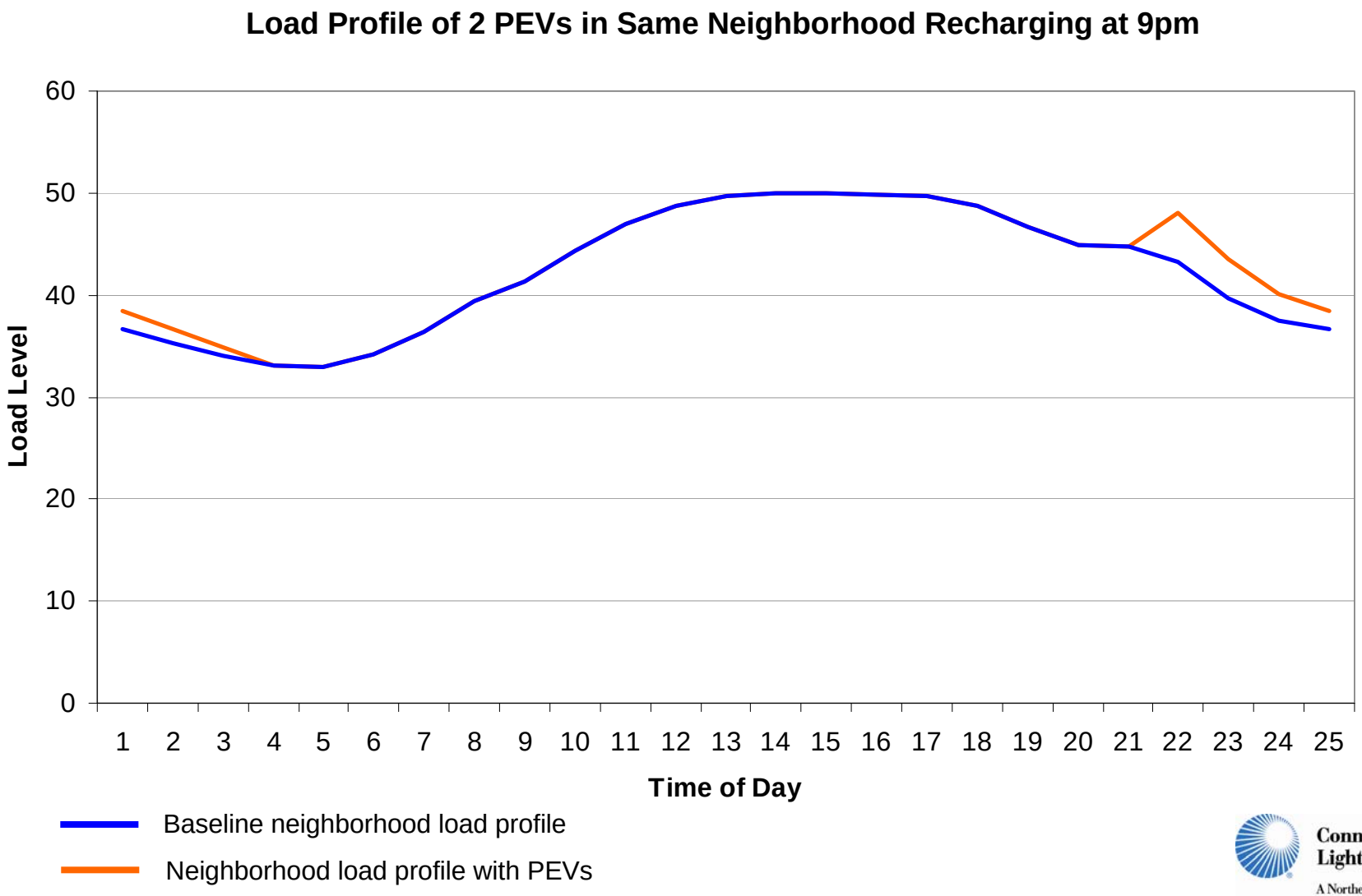
# Time shifting PEV recharging helps reduce potential local distribution impacts (no longer creates a new peak)



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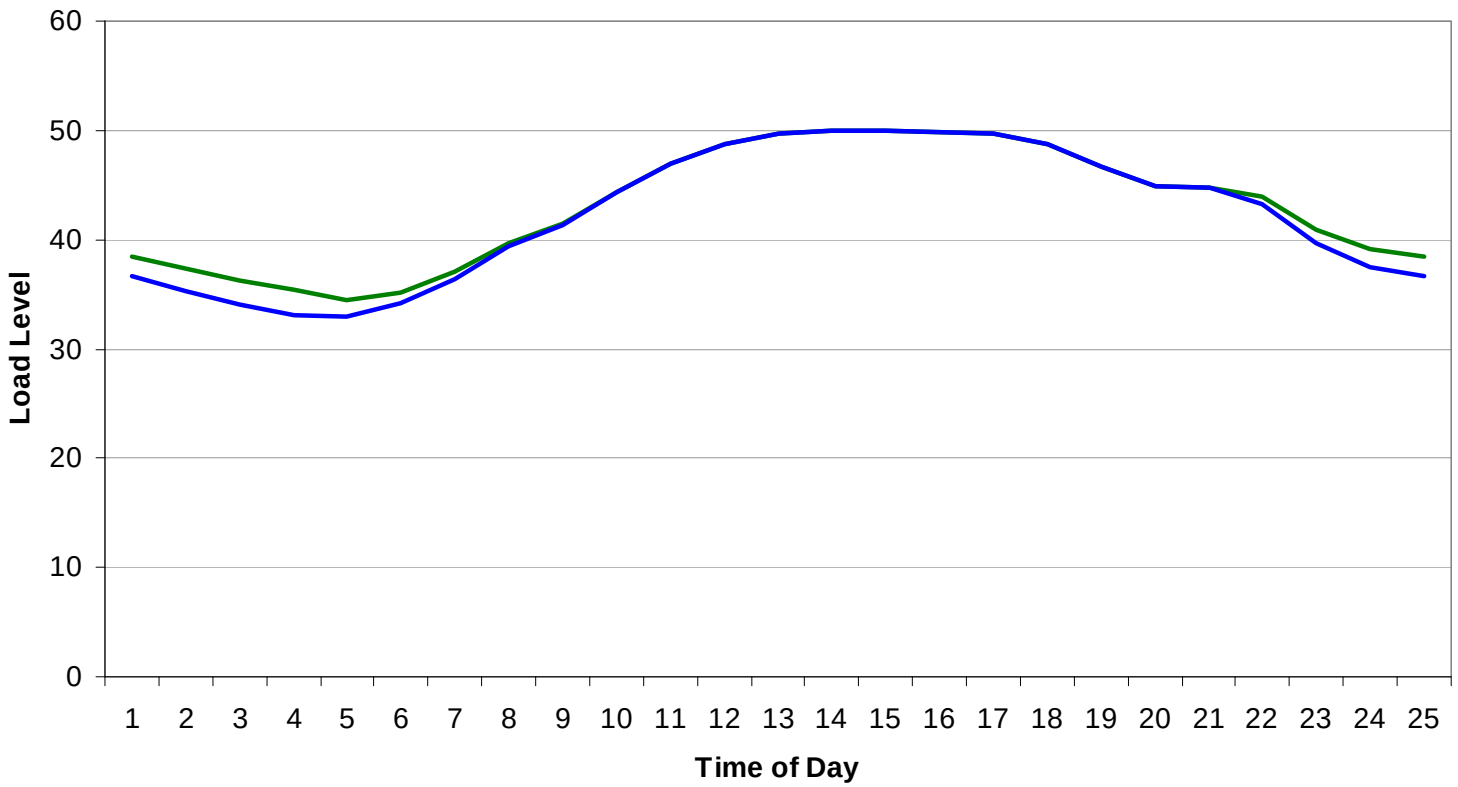
# “Managed” PEV recharging mitigates much of the potential local distribution impacts (least impact)

**Load Profile of 2 PEVs in Same Neighborhood With Managed Recharging***




* Managed Recharging combines time shifting and modulation of PEV recharging

Baseline neighborhood load profile

Neighborhood load profile with PEVs



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# Next Steps

- Share outcomes of EPRI's analysis of a statewide infrastructure plan (sent to CL&P / UI for initial review)

- Explore potential policies related to the PEV market
  - Vehicle incentives
  - Fuel programs like the Clean Fuel Standard

- Explore potential research projects and pilots to analyze and influence PEV charging patterns (build consumer preference for overnight recharging)

# Thank You

Watson Collins, P.E.
Manager, Business Development
collinw@nu.com
860.728.4843

http://www.youtube.com/watch?v=0NaI9SYhN34



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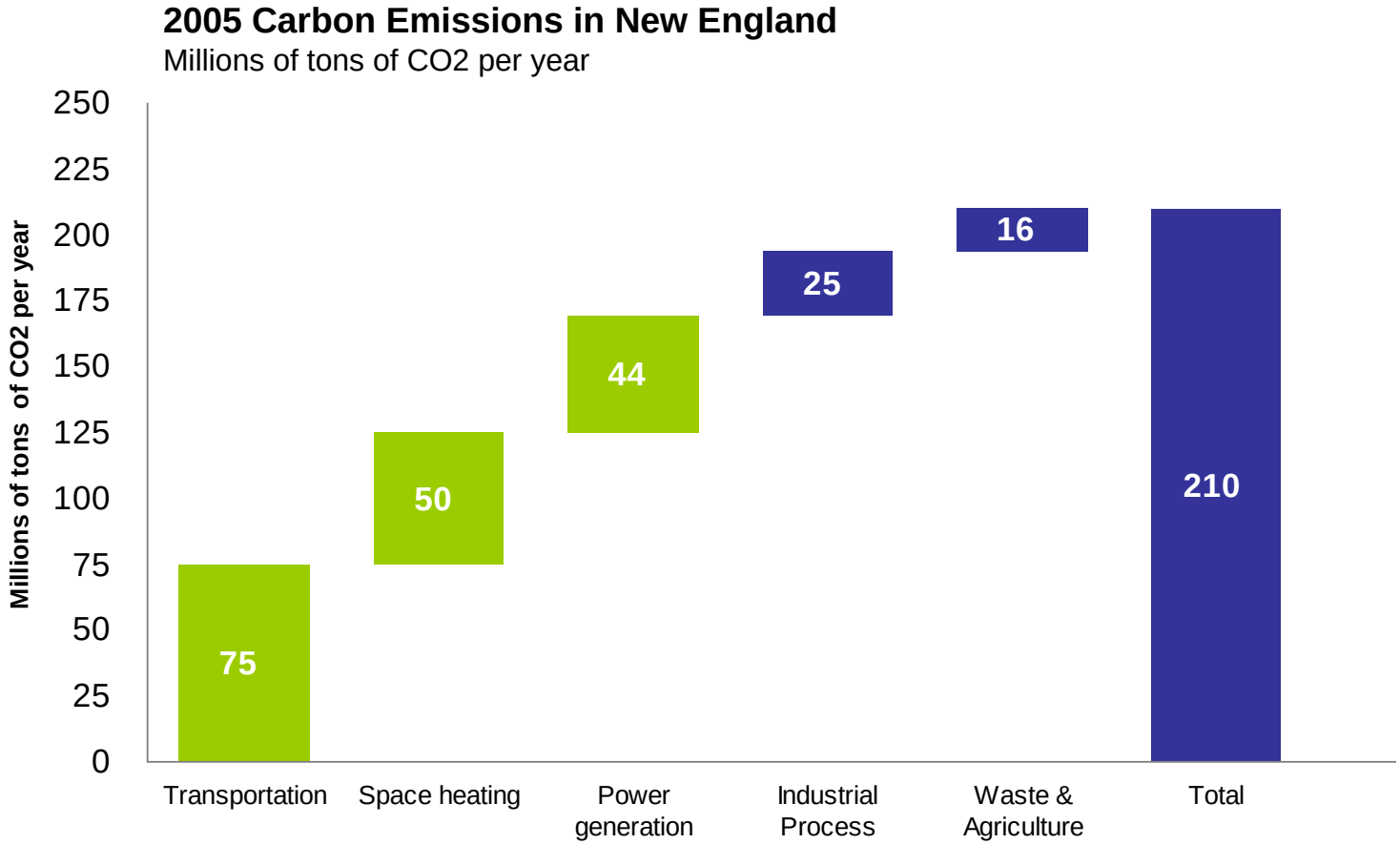
# Appendix slides

# Transportation contributes to over 1/3 of New England's GHG emissions




Source: Environment Northeast and NU analysis.



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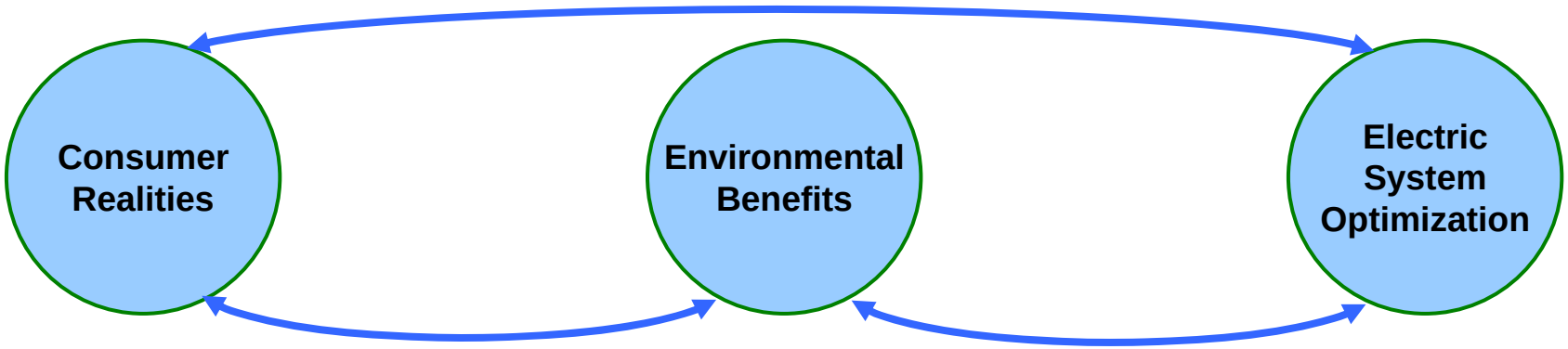
# PEVs hold lots of promise for consumers and policy makers

- Net reduction in greenhouse gas emissions
  - ~ 75% reduction in CO2 emissions (3.5 mile/kWh EV compared to 25MPG car)
- Reduced petroleum dependency
  - ~41% of New England's electricity comes from domestic natural gas
- Lower fuel cost for consumers
  - ~65% reduction in fuel costs (3.5 mile/kWh EV compared to 25MPG car)
- Economic development and industry leadership opportunities in an emerging industry
  - Early markets for Chevy Volt, Nissan Leaf and BMW ActiveE
- Electric driving experience = performance

# We believe there is an incredible synergy for overnight plug-in vehicle recharging




Consumer Realities

- Most economical recharging costs
- Daily driving is typically less than 40 miles total
- Parked for hours while you sleep
- Not going to gas station: unexpected consumer benefit

Environmental Benefits

- Plug-in vehicles have low emissions
- The emissions profile of electricity generation varies by region, time-of-day and season (New England is cleaner than average)

Electric System Optimization

- Given the existing infrastructure, only the last 50 feet need to be built
- Capacity exists on the utility system in overnight periods
- Plug-in vehicle recharging can reduce electric rates if done right (broader cost allocation)

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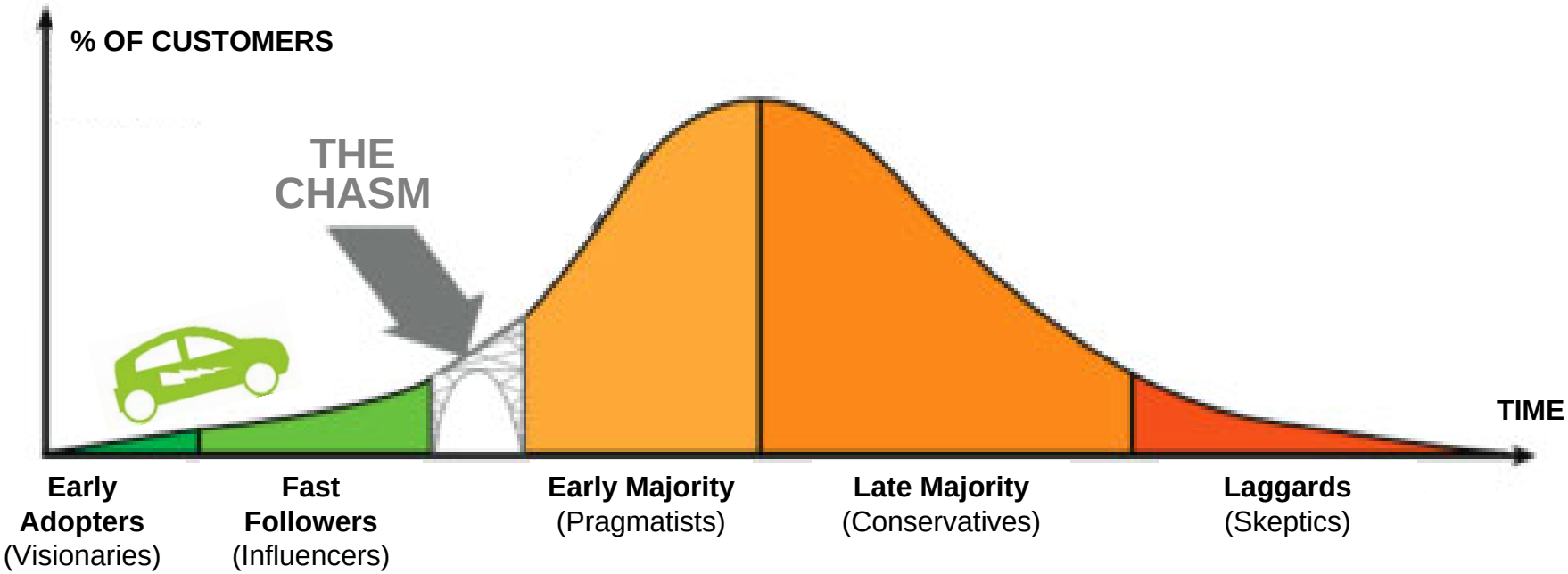
# The market will work through a natural progression of customer segments



Influencers from each stage help convert next stage



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# Testing vehicles and EVSEs on our own property

Vehicles

- Initially secured demonstration vehicles from automakers for temporary use
- Recently acquired Chevy Volts

Installed EVSEs at NU Property

- 6 stations currently installed

Purpose of this phase

- Gain experience with equipment - several vendors utilized
- Install equipment to learn about installation process and costs

What we learned

- Wiring costs varied dramatically
  - Civil works add significant cost if required
- Not all equipment is UL listed and is in varying stages of commercialization

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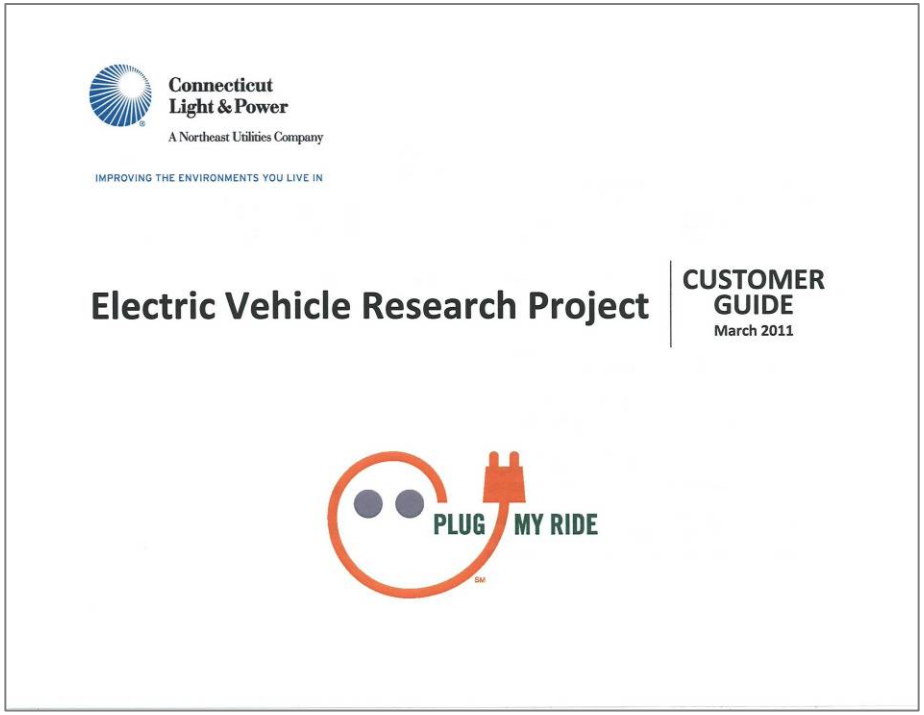
# We are working with customers to install EVSEs at customer locations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IMPROVING THE ENVIRONMENTS YOU LIVE IN

Electric Vehicle Research Project

CUSTOMER GUIDE
March 2011

PLUG MY RIDE

<u>Provide EVSEs to "early adopter" sites</u>

- 20-25 business and municipal sites
- Relying on "pull" from customers instead of utility "push"
- Customer responsible for wiring & installation

<u>Purpose of this phase</u>

- Install equipment at non-NU locations to learn about installation process and costs (permitting, metering options, different installation locations / configurations)
- Identify metering options

# CL&P is now developing a pilot for residential charging

- Collect data on EV charging patterns at home
- Test several rate options
  - Standard uniform rate
  - Super off-peak rate
  - Fixed fee plan
- Test metering technologies for recharging
  - Level 1 – even when new wiring is not required
  - Level 2
- Test integration of EV metering system with utility
  - Utilities will not be able to integrate with each vendors unique systems

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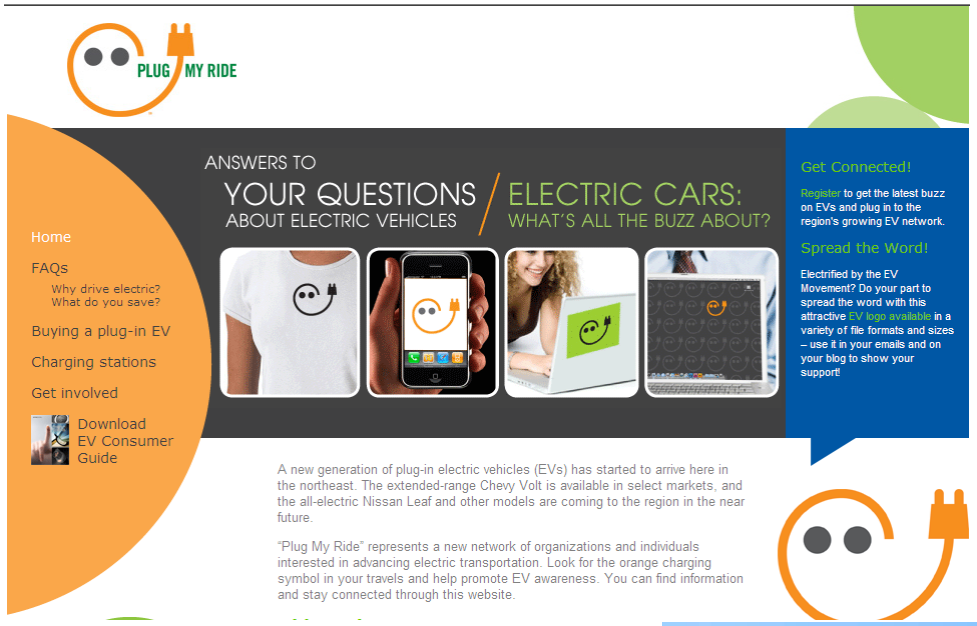
# Plug My Ride campaign has been launched

## Website

http://www.plugmyride.org/




## Charging Station Signage

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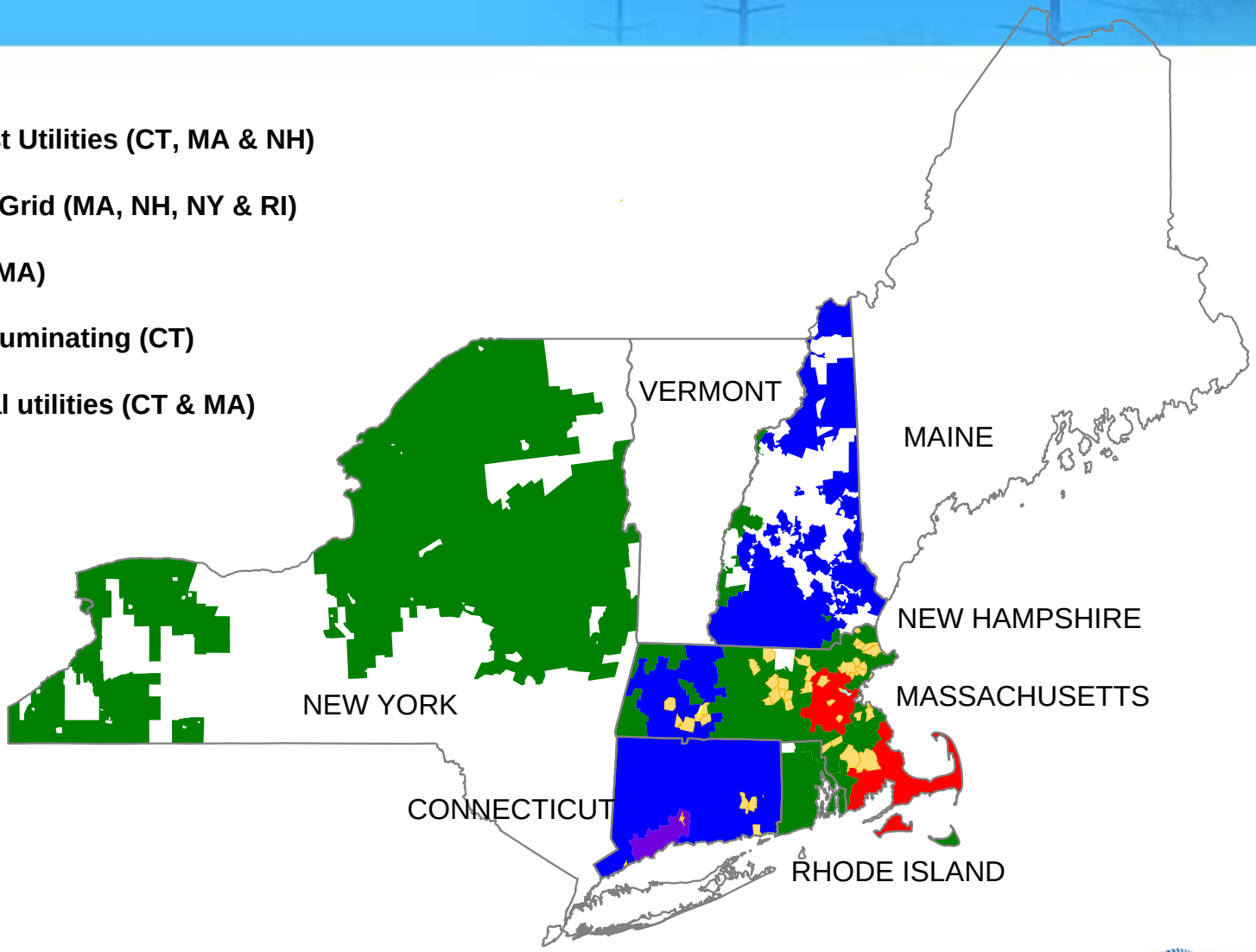
# The REVI utilities working group has operations in 5 states

- **Northeast Utilities (CT, MA & NH)**
- **National Grid (MA, NH, NY & RI)**
- **NSTAR (MA)**
- **United Illuminating (CT)**
- **Municipal utilities (CT & MA)**

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