Electricity Advisory Committee Meeting:
Grid Impacts of High Penetration of Plug-in Electric Vehicles

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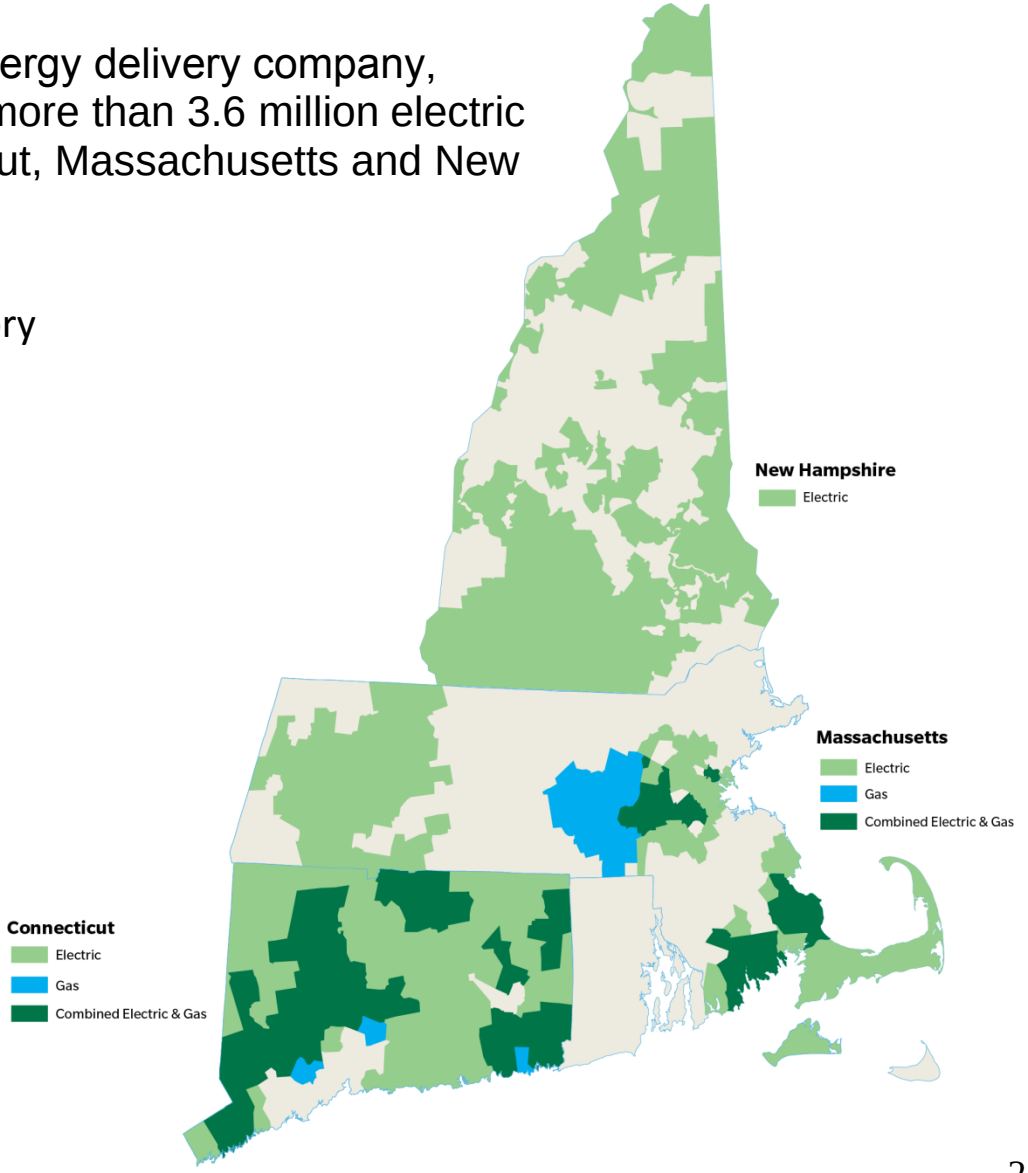
About Eversource

Eversource is New England's largest energy delivery company, safely and reliably delivering energy to more than 3.6 million electric and natural gas customers in Connecticut, Massachusetts and New Hampshire.

Our service territory

- Connecticut: Our electric service territory includes 149 towns and covers 4,400 square miles. Our natural gas service territory includes 71 towns and covers 2,341 square miles.
- Massachusetts: Our electric service territory includes 140 towns and covers 3,192 square miles. Our natural gas service territory includes 51 towns and covers 1,067 square miles.
- New Hampshire: Our service territory includes 211 towns and 5,628 square miles.



Eversource's approach to addressing the grid impacts of high penetration Plug-in Electric Vehicles

EVERSOURCE ENERGY

What we've done to grow our understanding

- Focused on understanding impacts
- Ran pilots and participated in studies
- Education and outreach

Key Topics for where we are going

- Vehicle Grid Integration for residential charging
- Open Vehicle-Grid Integration Platform
- Workplace charging / Fleets infrastructure (long-dwell time)
- Multi-unit dwelling infrastructure (long-dwell time)
- DC Fast Charging
- Seeking to enhance interoperability is all areas

Plug My Ride At Home

PLUG MY RIDE AT HOME

Plug My Ride at Home is a pilot program open to NSTAR Electric customers who own a plug-in electric vehicle. By participating, EV owners can be part of valuable research, while also having the opportunity to purchase a Level 2 EV Charger for the reduced price of $500.

Learn more about your charging routine by downloading and viewing data about your charging behaviors using Itron cloud software on your home computer, tablet or hand held device. You'll also have the opportunity to see charging routines of other pilot participants as another benefit.

Discounted pricing of $500 for Level 2 Charger for home (retail value of $2,500).

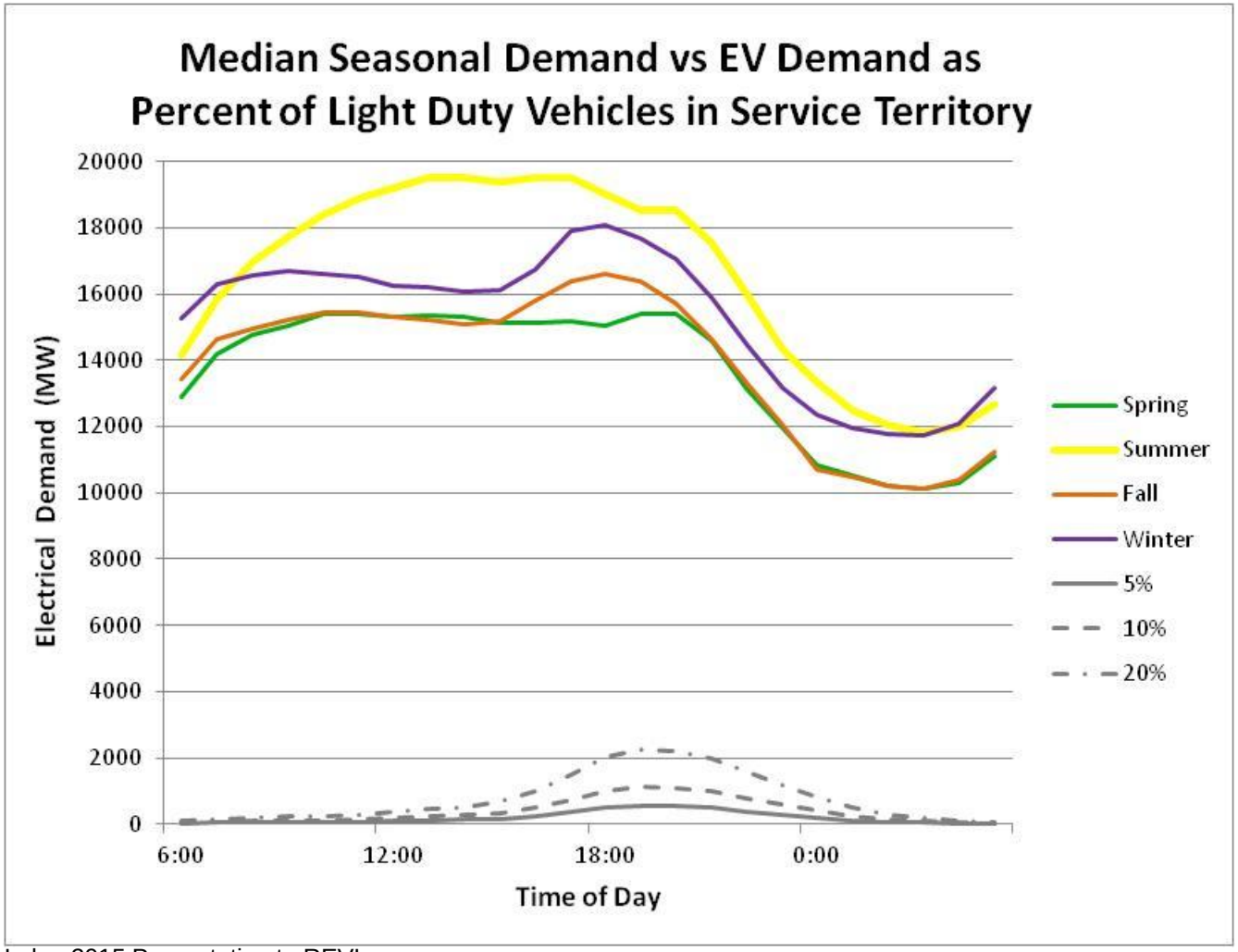
Getting Started

Plug My Ride at Home Pilot Program is open to all qualified NSTAR residential customers with a plug-in vehicle, or those customers in the process of purchasing one. Here's a checklist of pilot requirements to help get you started:

- ☐ Own a plug-in electric vehicle or hybrid, or be in the process of purchasing one.
- ☐ Be a residential NSTAR Electric customer
- ☐ Complete pilot documentation from our web site or from your dealer.
- ☐ Ensure your vehicle is registered in Massachusetts
- ☐ Install WIFI at home
- ☐ Contact NSTAR Electric Vehicle Information Center with:
  - NSTAR account number
  - Vehicle Identification number (VIN)
  - Copy of your vehicle registration
  - Copy of bill of sale for plug-in vehicle

From there, NSTAR will contact Clipper Creek, our pilot partner and EV charging manufacturer. A representative from Clipper Creek will contact you to review order status, installation process, and delivery date. You will need to contact your licensed electrician for installation of the charger at your home.

ISO New England Median Seasonal Demand in 2013 vs. Hypothetical EV Charging Demand

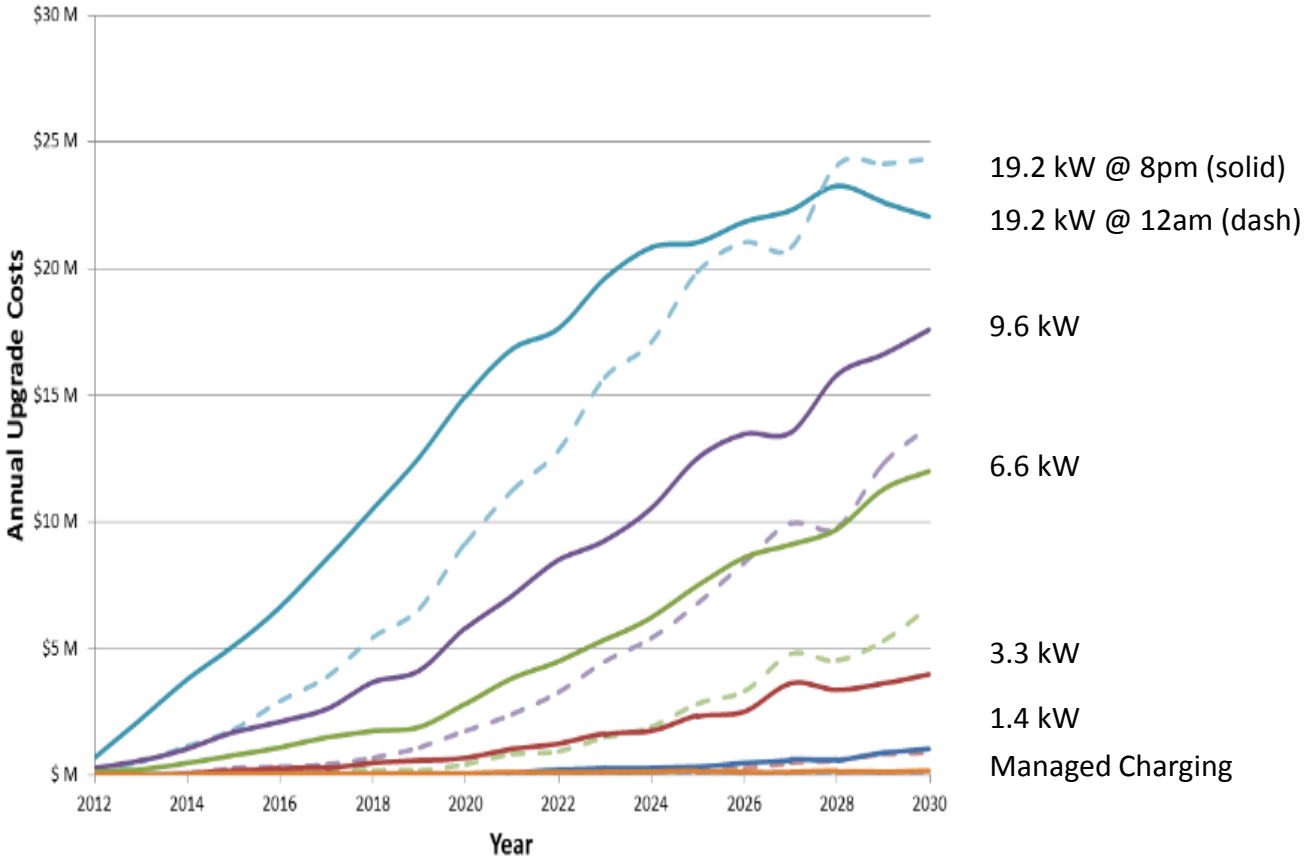


Source: Idaho National Labs, 2015 Presentation to REVI group

Grid Impacts of Plug-in Vehicle Charging

Annual System Upgrade Cost for Residential Charge Levels

Higher charge rates and unmanaged charging drive grid costs → smart charging and/or lower vehicle charge rates drive down grid costs.

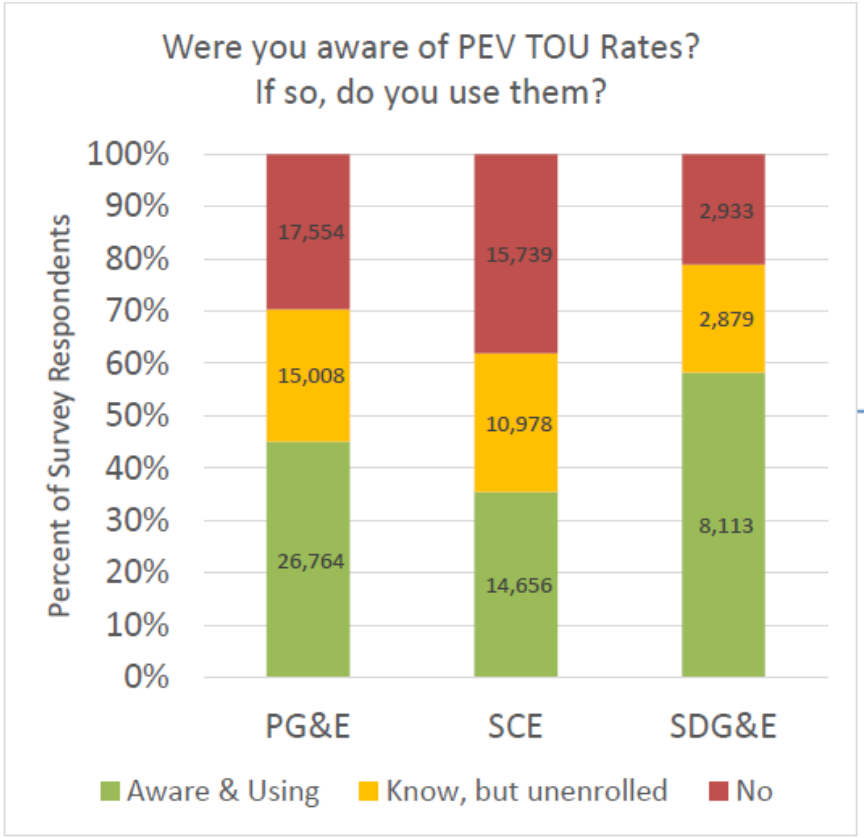


As the PEV market grows, it becomes increasingly important to apply smart charging

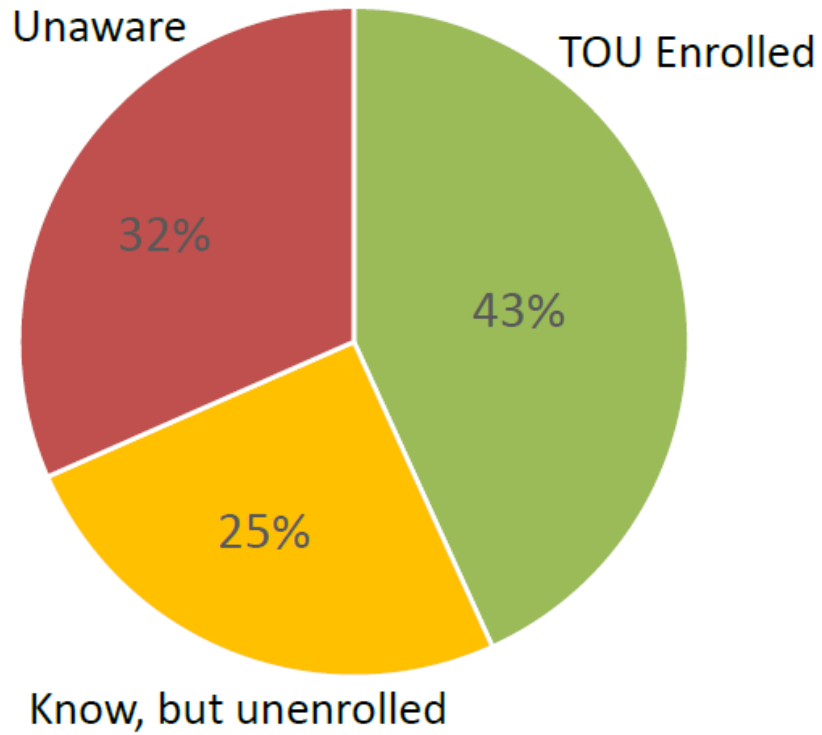
Source: Sacramento Municipal Utility District - Electric Grid Integration Costs for Plug-In Electric Vehicles (**April 2013)**

Uptake of Time-of-Use Rates

Awareness ≠ Action



Overall, ~60% of IOU PEV Customers remain on non-TOU Rates



CSE 2016

Source: Noel Crisostomo, presentation at 2016 EVs and the Grid Summit

Vehicle Grid Integration (VGI) questions for residential charging

- What is the driver for smart charging? Wholesale? Distribution? Vehicle? Other? Incentive for EV adoption?
- If wholesale, at what level of PEV adoption does this impact wholesale load shape?
  - When does that adoption level happen?
  - When do you make multi-million (tens or hundreds of million) dollar smart charging investments?
  - What do you need to put in place, learn or practice before then?
  - Will technology evolve between now and then?
- If distribution, what is the key driver of the distribution impacts? What are the strategies to mitigate this impact?
- If vehicle or other, what are the drivers for this?
- What is the benefit to cost ratio of an approach? What tradeoffs can be made to get the majority of the benefits for a lower cost? Is it just & reasonable?
- How do you make smart charging reliable? US electric grid SAIDI is about 1.5 hours per year (1.5 hours out of 8,760 hours)
- How do you make this easy, convenient and attractive to PEV drivers?