Buildings in the Age of Electric Vehicles

NESEA: BuildingEnergy Boston 2017

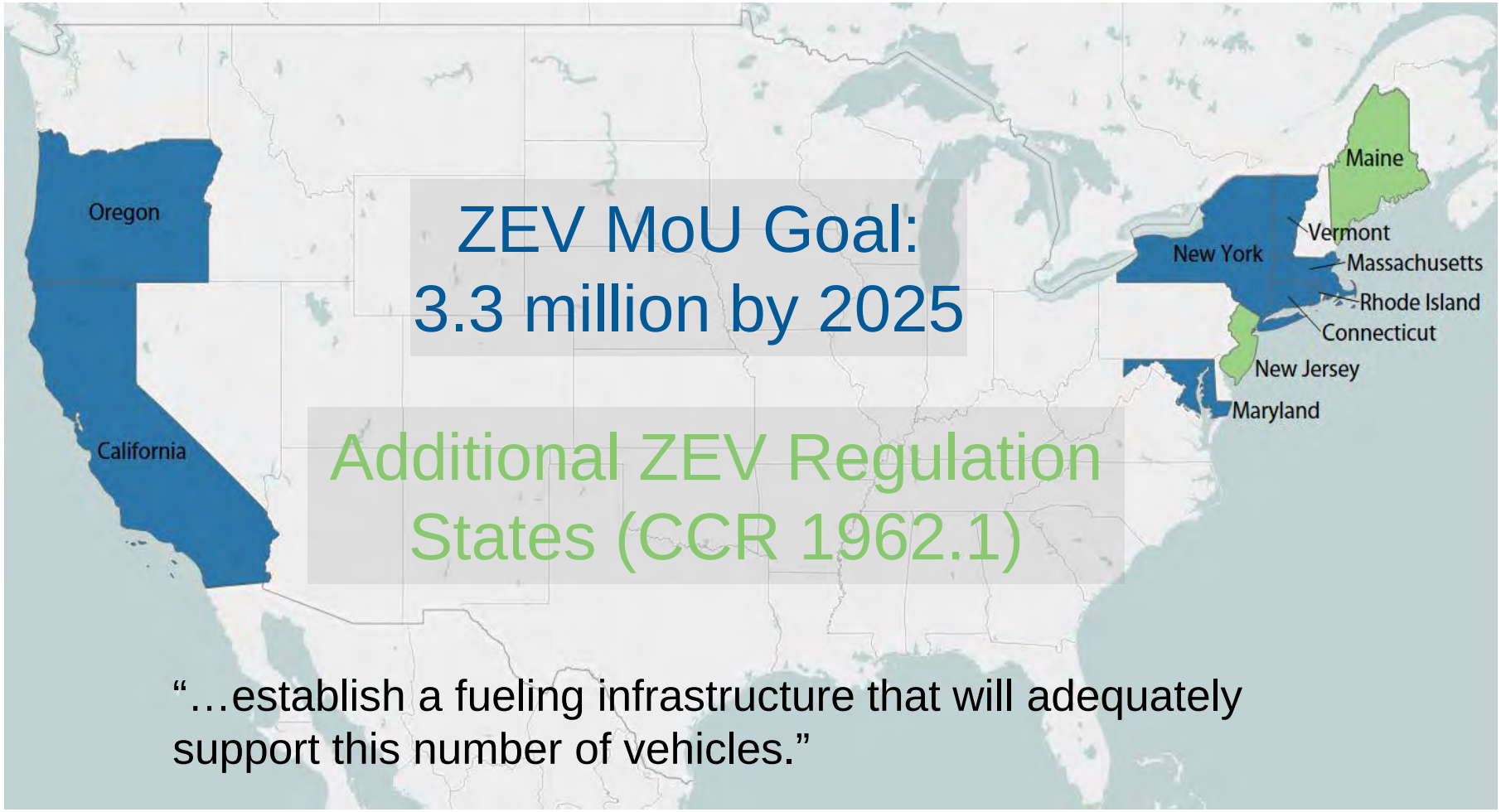
March 8, 2017

Andy Hoskinson, Senior Project Manager EV Initiatives

Center for Sustainable Energy®

Why Electric Vehicles…

ZEV MoU



ZEV MoU Goal:
3.3 million by 2025

Additional ZEV Regulation States (CCR 1962.1)

"…establish a fueling infrastructure that will adequately support this number of vehicles."

Center for Sustainable Energy™

ZEV MoU Action Plan

11 priority actions states could take

- #5 promote workplace charging
- #6 promote ZEV infrastructure planning and investment
- #7 Provide clear and accurate signage
- #8 Remove barriers to ZEV charging installations

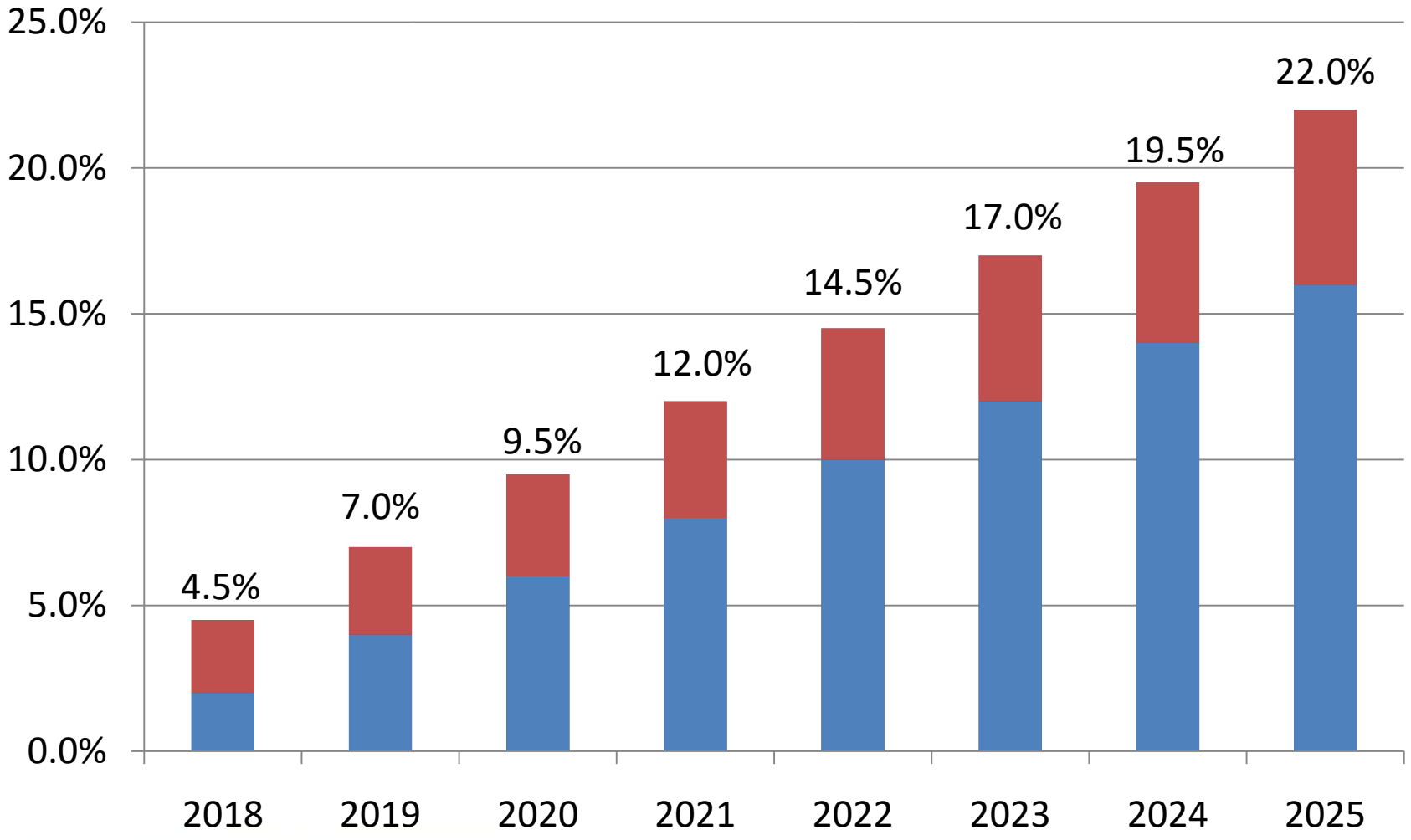
http://www.zevstates.us/

3.3 Million by 2025 - VERY basically…

- Manufacturers MUST produce ZEVs
- They get credits for producing a ZEV
- (Credits / total vehicle sales) ≥ minimum percentage
- If standards are not met:
  - financial penalties apply,
  - AND the manufacturer must make up the difference in future years

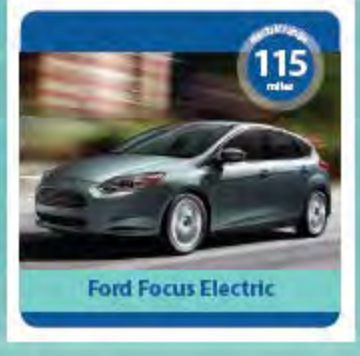
http://www.ucsusa.org/clean-vehicles/california-and-western-states/what-is-zev#.WL7erW8rKM9

ZEV Credits: 2018 MY Changes



Center for Sustainable Energy℠

Growing Number of BEVs



Center for Sustainable Energy™

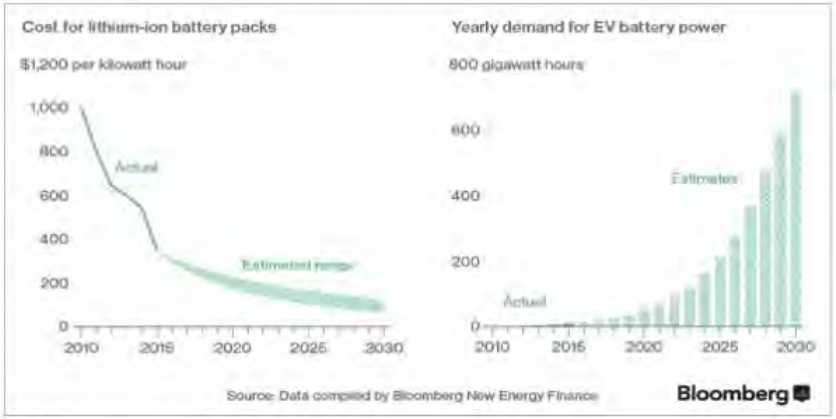
Growing Number of PHEVs

Center for Sustainable Energy℠

Growing Number of PEVs

- **Automaker Investments in New EV Models are Growing**
  - Investments in battery production and economies of scale are rapidly reducing EV battery prices, making EVs less expensive
  - Automakers from around the world are investing in new models that will expand consumer choice

Projected Costs and Demand for EV Batteries



Current U.S. Models	27
Current (100+ vehicles sold)	17
BEVs w/ 200+ mile range	2

Company	Commitment	Year
Chevy	Low-Cost Long-Range BEV	2016
Tesla	Low-Cost Long-Range BEV	2017
Nissan	Low-Cost Long-Range BEV	2018
Jaguar, Porsche, BMW	Luxury BEVs	2018, 2019, 2021
Ford	Low-Cost Long-Range BEV	2019
Volvo	BEV and several PHEVs	2019
Daimler	Four BEVs, first Mercedes in 2020	2020+
Hyundai	Low-Cost Long-Range BEV	2020
Ford	13 Electrified Vehicles	2020
VW	30 BEVs and PHEVs, first BEV in 2018	2025

EV Incentive Programs: History & Funding

Massachusetts Rebate Program - 2014

- Regional Greenhouse Gas Initiative
- Funded on demand, contingent on availability of funding

MOR-EV
Massachusetts Offers Rebates for Electric Vehicles

Connecticut Rebate Program - 2015

- Utility Settlement in $1M increments
- Seeking alternative, long-term funding

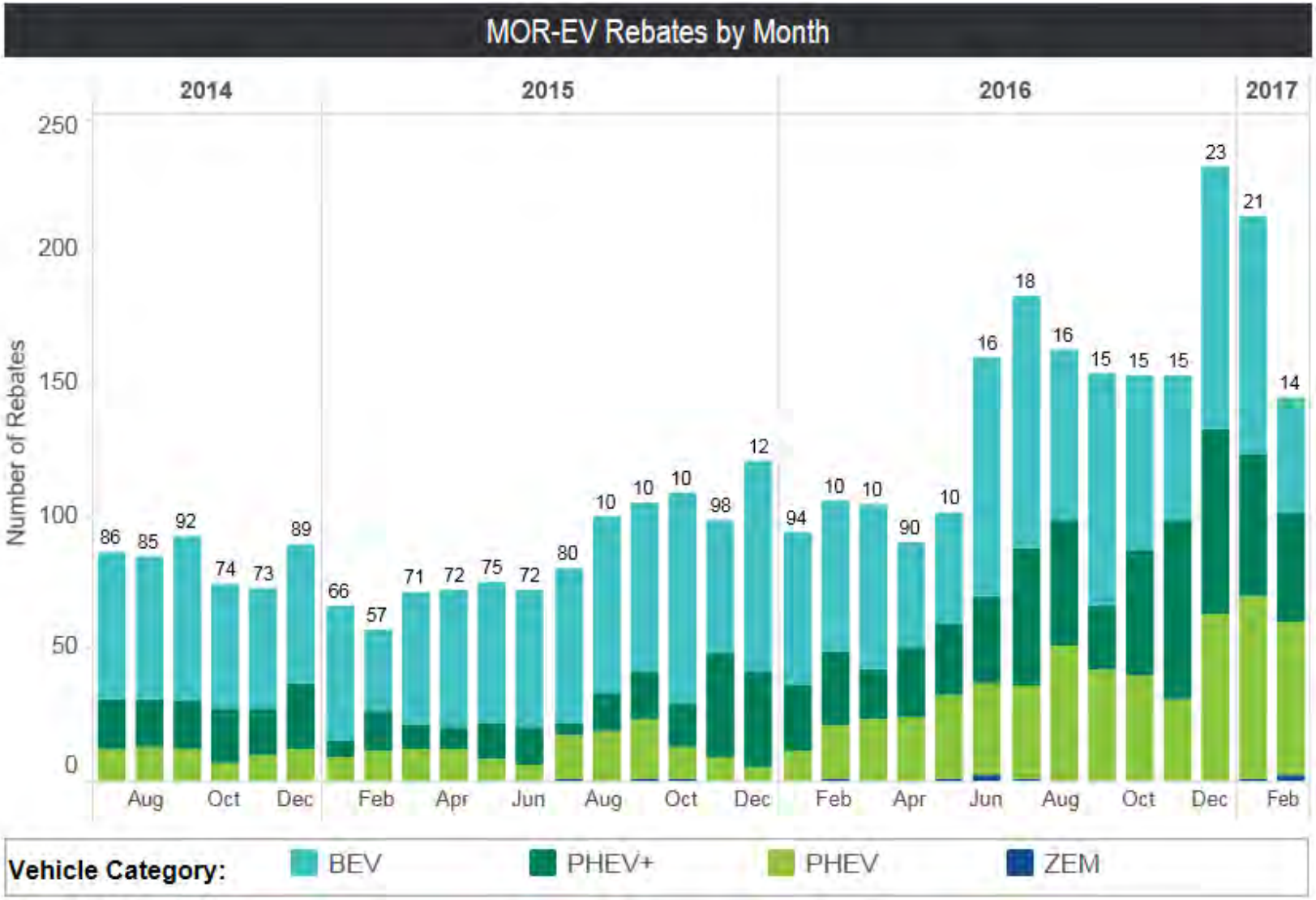
CHEAPR
Connecticut Hydrogen and Electric Automobile Purchase Rebate

California Rebate Program - 2010

- 2007 Legislation (AB118) allowing vehicle registration fees
- Greenhouse Gas Reduction Fund
- Annual funding cycle

CALIFORNIA CLEAN VEHICLE REBATE PROJECT℠

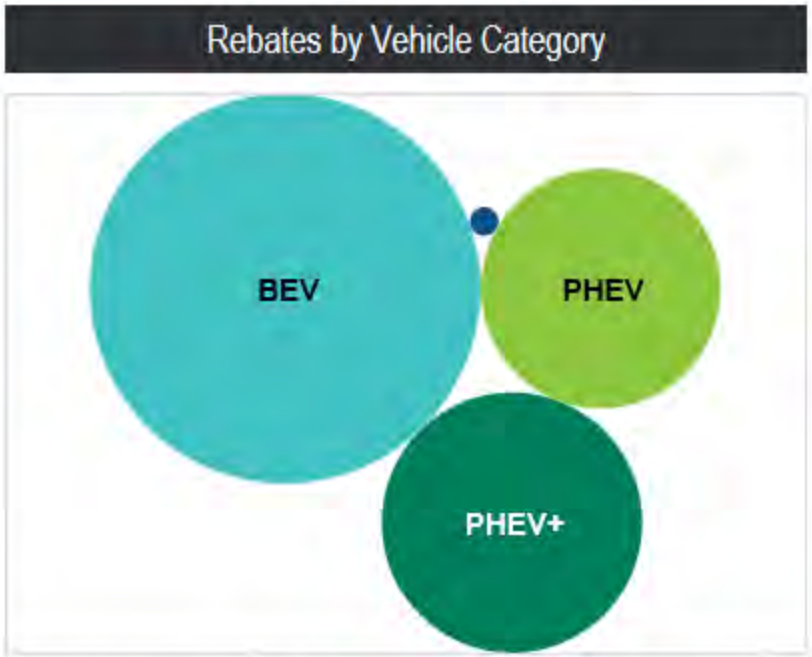
MOR-EV Program Statistics

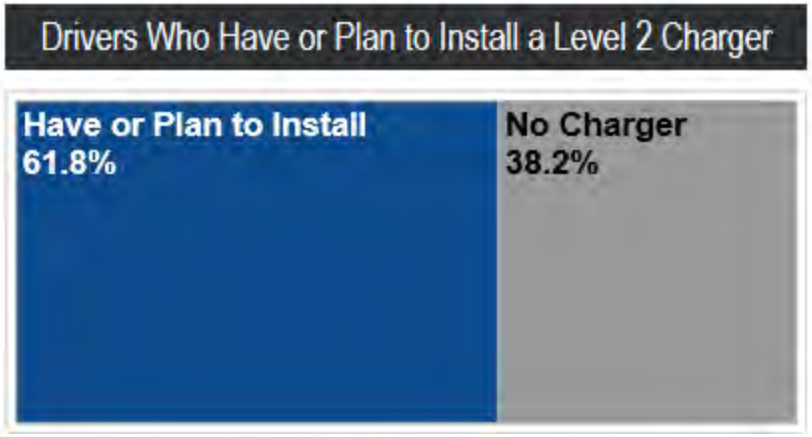


https://mor-ev.org/program-statistics

Center for Sustainable Energy℠

PEV Type & Charging Access

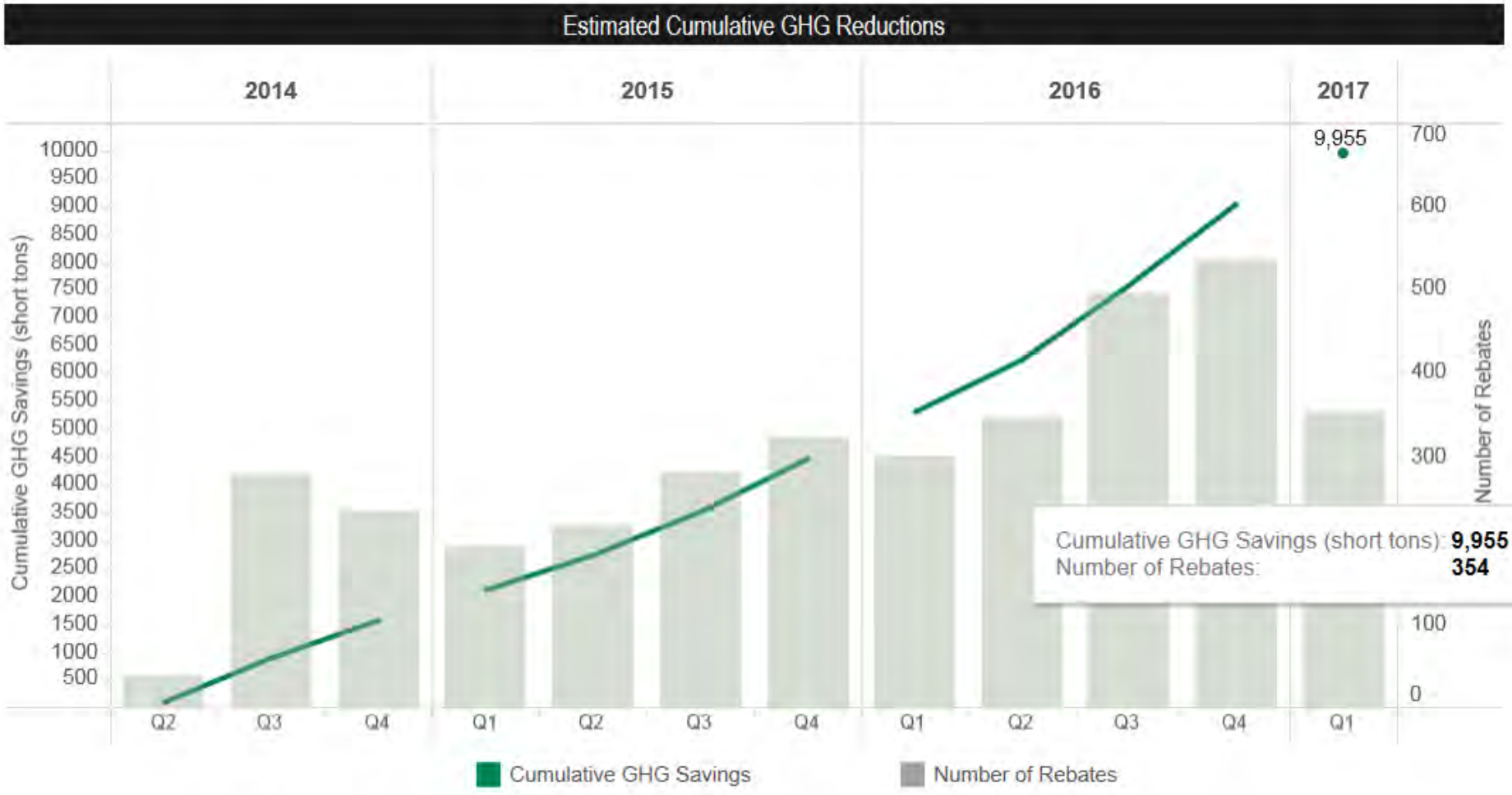




- 55% BEVs and 45% PHEVs
- Infrastructure 62% home/workplace charging
- 38% reliant on other charging

Center for Sustainable Energy℠

GHG Reductions

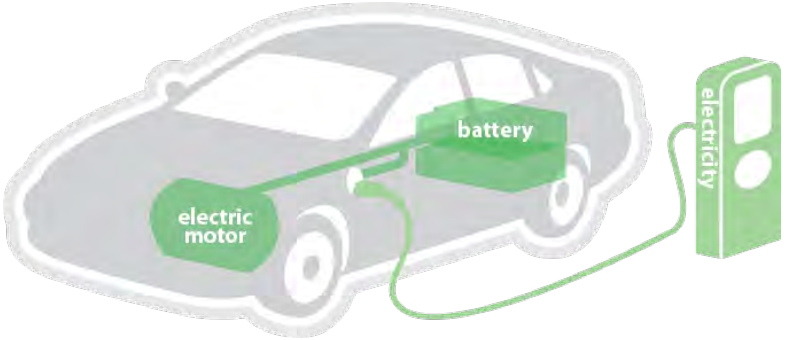


Center for Sustainable Energy™

Plug-in Electric Vehicles (PEVs)

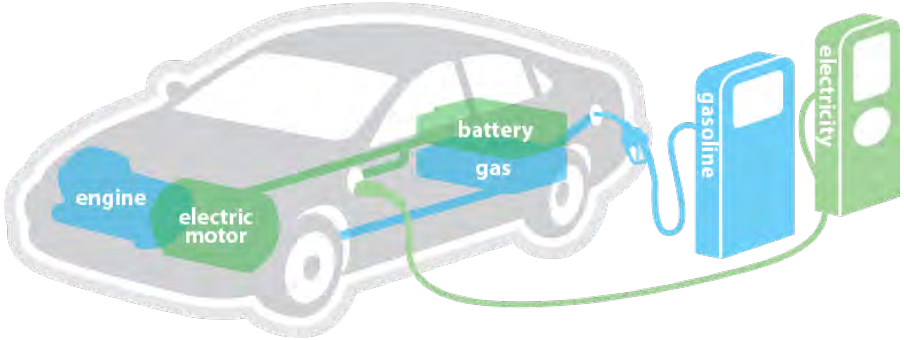
Battery Electric Vehicles

- All electric, zero-emissions
- 14 models available
- Examples: Nissan Leaf, Tesla Model S



Plug-in Hybrid Electric Vehicles

- Electric battery and gasoline
- 19 models available
- Examples: Chevrolet Volt, Ford C-Max Energi, BMW i8



PEVs in the Northeast

CLEAN VEHICLES > ELECTRIC VEHICLES

How Clean is *Your* Electric Vehicle?

Electric cars tend to produce less carbon pollution than gas-powered ones—but just how much less? Enter your ZIP code below to see how different types of vehicles stack up in your area. Entering a make, model, and year will narrow results to a specific EV model.

02210 | NISSAN | LEAF (24 KWH) | 2014 | CLEAR FILTERS

A **2014 Nissan LEAF (24 kWh)** charged in **02210** produces about as much global warming pollution as a gasoline vehicle getting **96 miles per gallon**.

SHARE

114 GRAMS OF CO_2e PER MILE

http://www.ucsusa.org/clean-vehicles/electric-vehicles/ev-emissions-tool#z/02210/2014/Nissan/LEAF (24 kWh)

PEVs in the Northeast

http://blog.ucsusa.org/dave-reichmuth/electric-cars-cold-weather-temperatures

Center for Sustainable Energy℠

PEVs in the Northeast

Northeast Drivers Want Electric Vehicles

Drivers in the Northeast are ready for EVs, and EVs are ready to meet the driving needs of Northeast residents.

- **55 percent of consumers in the Northeast are interested in EVs,** according to a survey from the Union of Concerned Scientists and Consumers Union. (UCS 2016)
- **Currently available electric cars could replace an estimated 87 percent of gasoline cars on a given day,** according to a recent study by the Massachusetts Institute of Technology. (Needell 2015).
- **EVs are ready for New England winters**. More all-wheel-drive EVs and longer ranges are reducing the challenges with cold-weather driving.

http://www.ucsusa.org/sites/default/files/attach/2016/11/northeast-and-mid-atlantic-zev.pdf

EVCS

AC Level 1 Charging

2 to 5 miles of range per 1 hour of charging

J1772 charge port

AC Level 1 EVSE (often referred to simply as Level 1) provides charging through a 120 volt (V) AC plug. Most, if not all, plug-in electric vehicles (PEVs) will come with an AC Level 1 EVSE cordset so no additional charging equipment is required. On one end of the cord is a standard NEMA connector, (for example, a NEMA 5-15, which is a common three-prong household plug) and on the other end is a SAE J1772 standard connector. The SAE J1772 connector plugs into the car's J1772 charge port and the NEMA connector plugs into a standard NEMA wall outlet.

AC Level 1 is typically used for charging when there is only a 120V outlet available, but can easily provide all of a driver's needs. For example, 8 hours of charging at 120V can replenish about 40 miles of electric range.

AC Level 2 Charging

10 to 20 miles of range per 1 hour of charging

J1772 charge port

AC Level 2 equipment (often referred to simply as Level 2) offers charging through 240V (typical in residential applications) or 208V (typical in commercial applications) electrical service. Most homes have 240V service available, and because AC Level 2 EVSE can charge a typical EV battery overnight, they will commonly be installed at EV owners' homes for home charging or are used for public charging equipment. This charging option can operate at up to 80 amperes and 19.2 kW. However, most residential AC Level 2 EVSE will operate at lower power. Many such units operate at up to 30 amperes, delivering 7.2 kW of power. These units require a dedicated 40 amp circuit.

AC Level 2 equipment uses the same SAE J1772 connector and charge port that Level 1 equipment uses. All commercially available PEVs have the ability to charge using AC Level 1 and AC Level 2 charging equipment. Although Tesla vehicles do not have a J1772 charge port, they do sell an adapter.

DC Fast Charging

50 to 70 miles of range per 20 minutes of charging

J1772 combo

CHAdeMO

Tesla combo

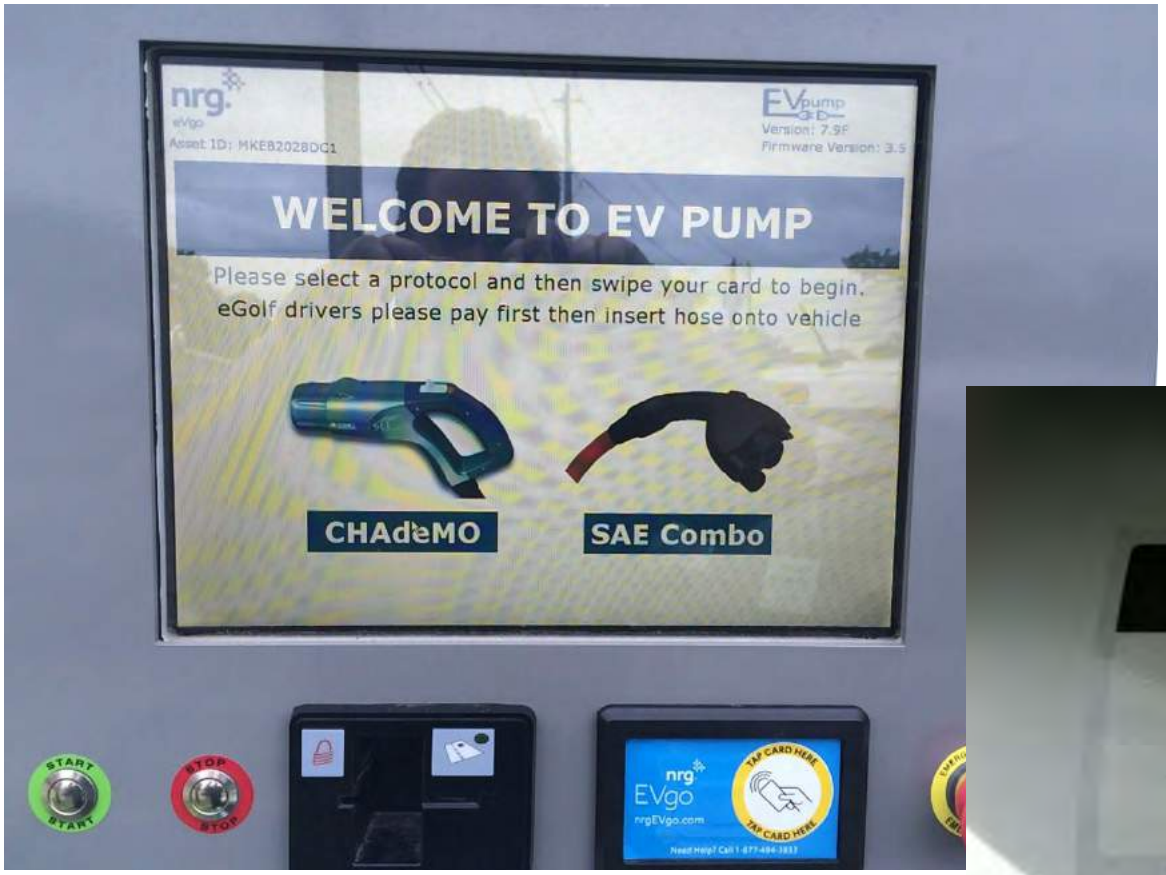
Direct-current (DC) fast charging equipment, sometimes called DC Level 2 (typically 208/480V AC three-phase input), enables rapid charging along heavy traffic corridors at installed stations. There are three types of DC fast charging systems, depending on the type of charge port on the vehicle: a J1772 combo, CHAdeMO, or Tesla.

The **J1772 combo** is used by Chevrolet and BMW and is unique because a driver can use the same charge port when charging with Level 1, 2, or DC Fast equipment. The only difference is that the DC Fast connector has two bottom pins.

The **CHAdeMO** is the most common of the three connector types and is used by Nissan, Mitsubishi, Toyota, and Fuji.

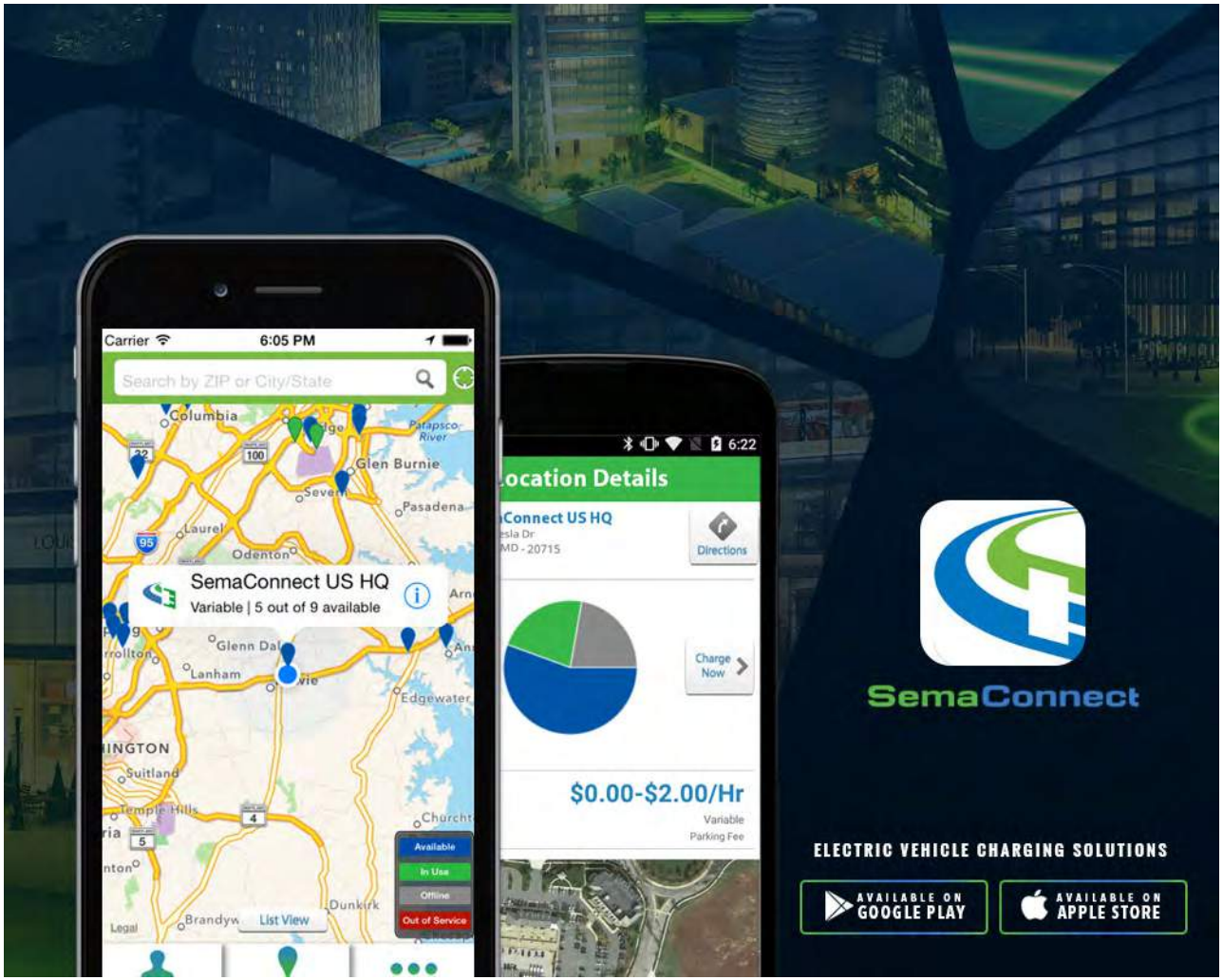
Tesla vehicles have a unique charge port and connector that works for all their charging options including their fast charging option, called a supercharger.

EVCS



Center for Sustainable Energy™

EVCS



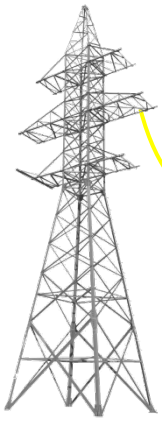
Center for Sustainable Energy℠

Importance of Signage

Center for Sustainable Energy℠

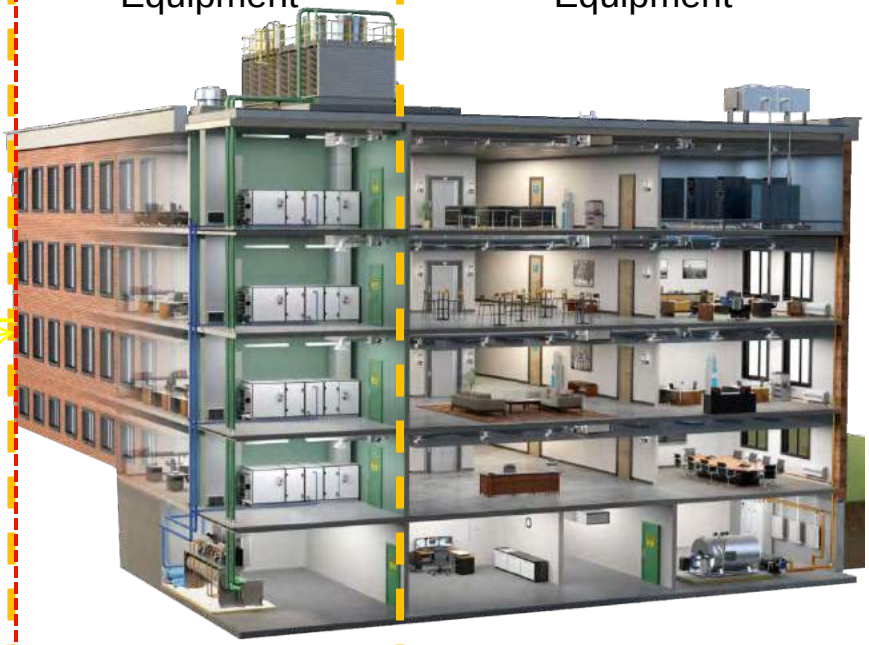
EVCS On-Site

Utility



Utility Meter

Infrastructure Equipment



Electrical Panels & Subpanels

Breakers

Power Management Equipment

Demarcation

Edge Equipment

<u>Load Management Environment</u>

Traditional Building Loads:

HVAC

Lighting

Plug Loads

Fleet Loads:

Charging Stations

Buses / Transit Vehicle Chargers

Boom Truck Chargers

Forklift Battery Chargers

Source: Cyber Switching, 2017

Takeaways

PEVs

- Models and associated demand are growing
- Work for majority of US drivers…even in colder climates

Plan EVCS in early

- Assess the need (e.g. regional studies/projections, employee/resident surveys, etc.) as a capital improvement
- Assessing the capacity to provide EVCS needs to anticipate the intended use/interaction and include power, space and connectivity
- Integrate with systems and site at a minimum, even aesthetics

Build / Deploy

- Consider scaling to realized demand
- ALWAYS put in extra conduit…everyone will thank you later