Workplace Charging Workshop: PEVs and PEV Charging

Watson Collins
Eversource Energy
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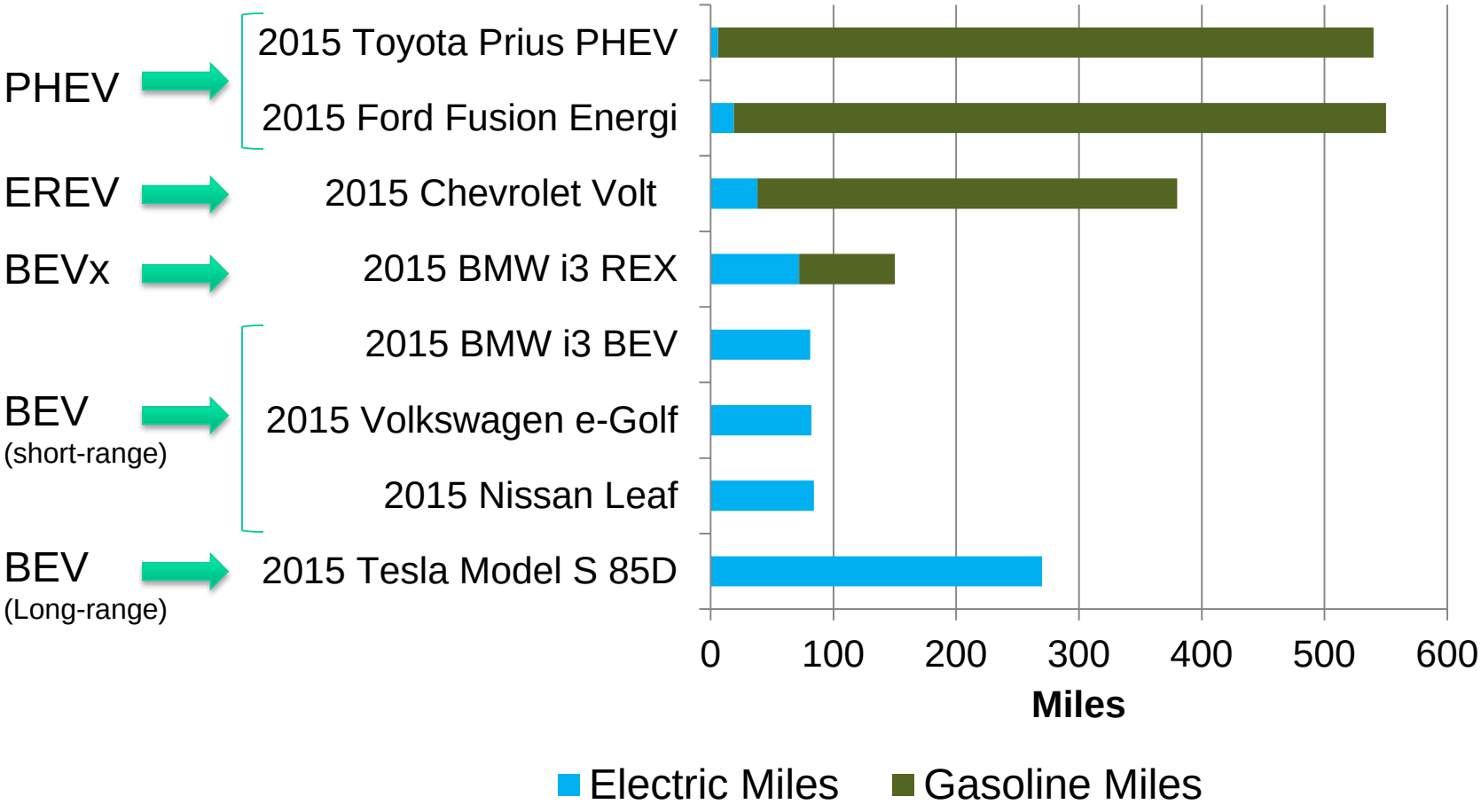
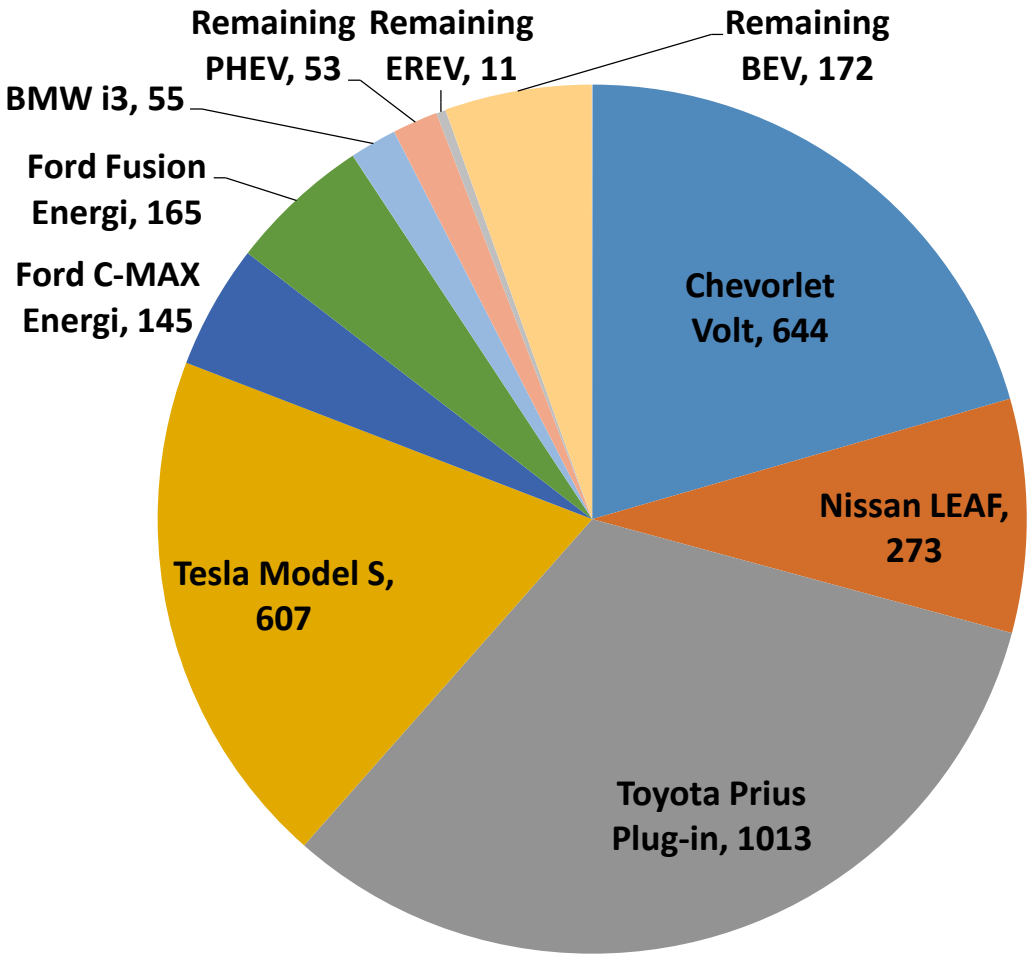
Agenda

- Plug-in Electric Vehicles (PEVs)
- Industry Trends
- Charging
- Eversouce's Involvement with PEVs

The automakers are developing a few types of Plug-in Electric Vehicles (PEVs)



Over 3,100 plug-in electric vehicles are registered in Connecticut



- PEVs Are Here – Market Pull (Zero Emission Vehicle Mandate)
- PEV Customers Love Them and Costs Are Decreasing… But Many Customers Aren't Even Aware of PEVs
- Automaker commitment to electrification continues, despite lower gasoline prices (Tesla, battery prices, ..)
- About 80% of vehicle charging occurs at home
- Each PEV consumes about 3,000 kWh per year

Top Selling PEV Models

Chevrolet Volt

Tesla Model S

Nissan Leaf

Toyota Prius Plug-in

Other PEV Models Currently Available

Ford C-MAX Energi

Ford Fusion Energi

BMW i3

Volkswagen E Golf

Mitsubishi i-MiEV

~25 New PEVs Are On The Way Though 2019

Make	Model	Type	Body Style	Battery Size (kWh)	All-Electric Range (miles)	Launch
Mercedes	S550e	PHEV	Luxury sedan	8.8	20	Q3 2015
Chevrolet	Volt	PHEV	Hatchback	18.4	50	Q3 2015
Mercedes	GLE550e	PHEV	SUV	8.8	18	Q3 2015
Audi	A3 etron	PHEV	Wagon	8.8	30	Q4 2015
BMW	X5 eDrive	PHEV	SUV	9	20	Q4 2015
Hyundai	Sonata	PHEV	Sedan	9.8	22	Q4 2015
Mercedes	C350e	PHEV	Luxury sedan	6.2	20	Q4 2015
Tesla	Model X	BEV	Crossover	80	250	Q4 2015
Mercedes	GLC350e	PHEV	Crossover	8.8	20	Q4 2015
Volvo	XC90 T8	PHEV	SUV	9.2	20	Q4 2015

~25 New PEVs Are On The Way Though 2019 (cont.)

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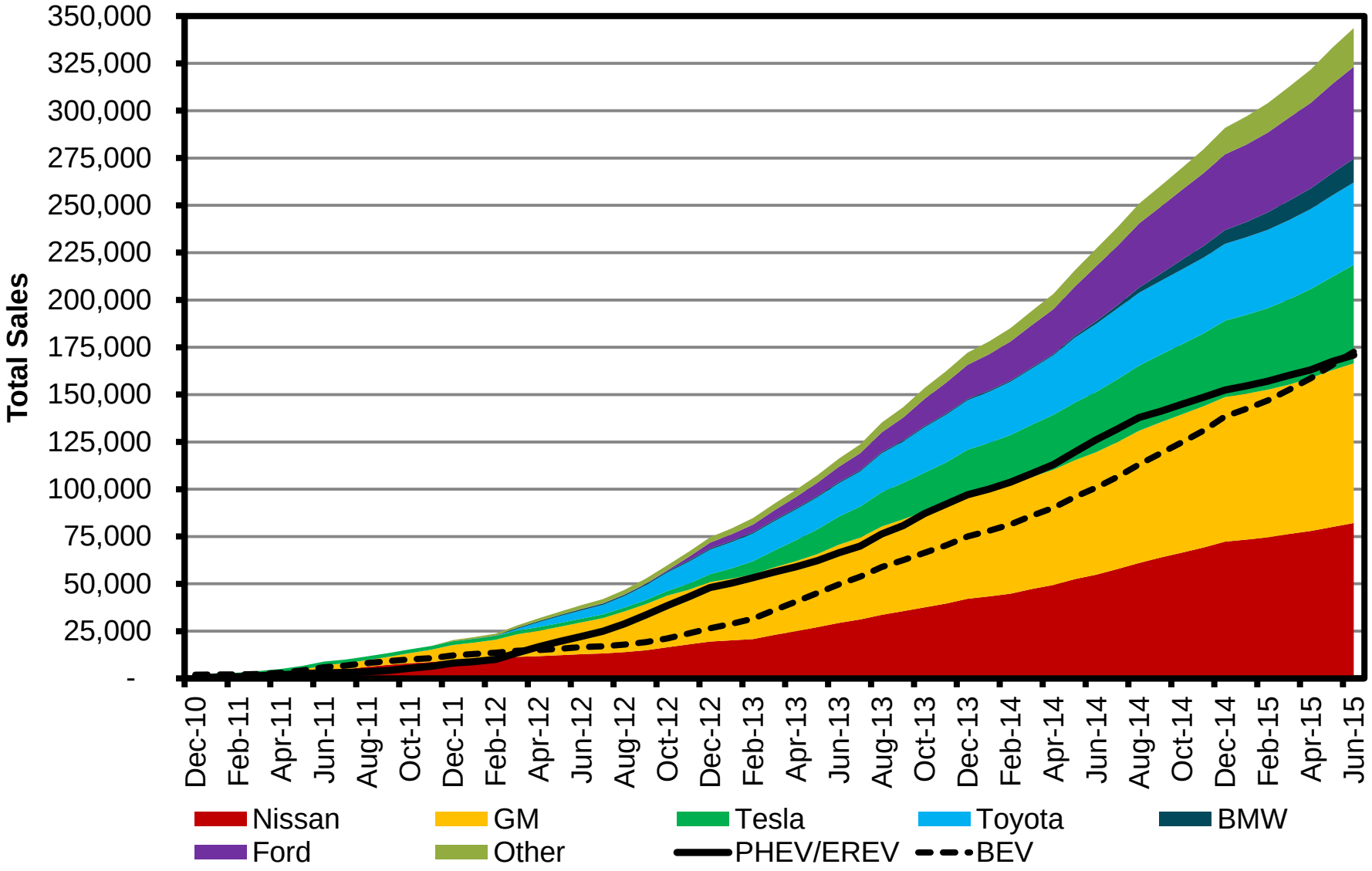
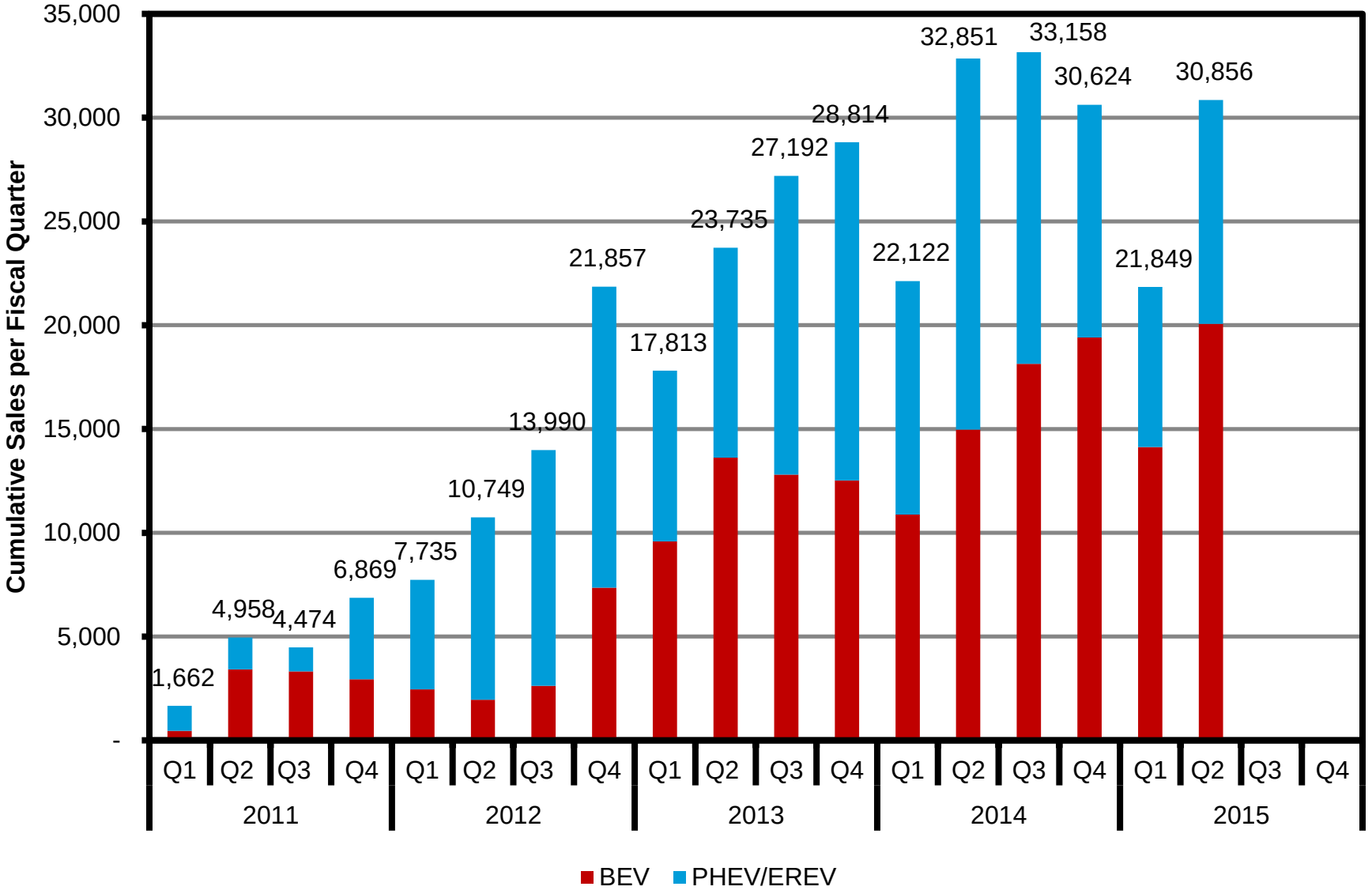
Make	Model	Type	Body Style	Battery Size (kWh)	All-Electric Range (miles)	Launch
Cadillac	CT6	PHEV	Luxury sedan	TBD	TBD	Q1 2016
BMW	330e	PHEV	Luxury sedan	TBD	22	Q1 2016
Mitsubishi	Outlander	PHEV	Crossover	TBD	TBD	Q2 2016
Audi	Q7 etron	PHEV	SUV	17.3	25	Q4 2016
Chrysler	Town & Country	PHEV	Minivan	TBD	TBD	Q4 2016
Volvo	V60	PHEV	Wagon	TBD	TBD	Q4 2016
BMW	740XeDrive	PHEV	Luxury sedan	TBD	20	Q4 2016
Nissan	Leaf	BEV	Hatchback	TBD	TBD	Q4 2016
BMW	X3 eDrive	PHEV	Crossover	TBD	20	Q3 2017
Chevrolet	Bolt	BEV	Hatchback	TBD	200	Q4 2017
VW	CrossCoupe	PHEV	SUV	14.1	20	Q4 2017
Subaru	Crosstek XV	PHEV	Crossover	TBD	TBD	Q2 2018
Porsche	Pajun	BEV	Luxury sedan	TBD	220	Q4 2018
BMW	i5	PHEV	Luxury sedan	TBD	TBD	Q4 2018
Jaguar	F-Pace	BEV	Crossover	TBD	300	Q2 2019

Nationally PEV Sales Exceeded 340k (June 30, 2015)



Continued Strong BEV Sale, Slowing PHEV Sales



"The Tesla Effect"

- **Part 1 – Impact on the Automotive Industry**
  - *"Audi, BMW, Mercedes-Benz, and Porsche are about to invest a combined **$7.5B** in new high-end electric vehicles and plug-in hybrids due out between 2018 and 2021. Their target: the American upstart (Tesla) from Silicon Valley*

  Kacher, Georg. "Germany's Plan to Shock Tesla." *Automobile*, Feb 2015: 52. Print.

- **Part 2 – Impact on the Individual Consumer**
  - *"Most Tesla Model S owners will be happy with 240V charging at home. Plug it in at night, sleep, and wake to a car ready for another 200-mile day. Beats pumping gas."*

  "Tesla Model S P85D." *Car and Driver*, Feb 2015: 52. Print.

- **Part 3 – Impact on the Overall Market**
  - Household name
  - Long-distance travel is easy

- **Part 4 – Impact on the Utility**
  - High power DC fast charging is a reality - Audi announced 150 kW (June 2016); other OEMs not far behind

PEVs can be change several ways, largely categorized by the speed of charging

Charging Level	Electrical Wiring	Charge Rate (kW)	Equipment Required
Level 1	120v, 15a	1.44 kW	NEMA 5-15 outlet, Cordset provided with vehicle
Level 2	240v, 20 - 100a	3.6 – 19.2 kW	EVSE* installed at site
DC Fast Charging	3 phase	50 kW	External battery charger installed at site

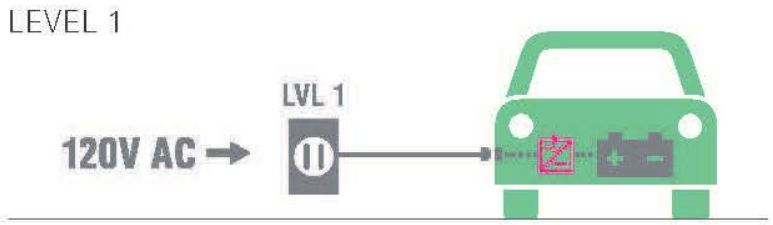
120V Portable Cordset

240V Home EVSE

DC Fast Charger

* Electric Vehicle Supply Equipment

Level 1 Charging



- A standard outlet provides 1.44kW at 12A
- 2 to 5 miles of range per hour of charging
- 8 to 12 hours for full charge of most vehicles
- Equipment cost ranges from $300 to $500

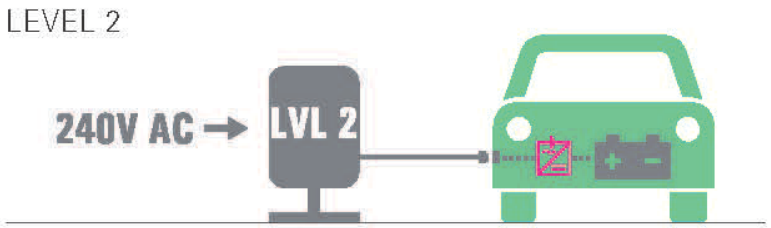
8–20+ HOURS CHARGE TIME

Level One (120 Volts)
Level 1 charging uses the same 120-volt current found in standard household outlets and can be performed using the power cord and equipment that most EVs come with. For businesses wanting to make this type of charging available on your property, it is as simple as installing dedicated 120 volt outlets in your company parking lot. Many residents can charge in their garage without any electrical upgrades.

Advantages
- Low installation costs
- Low impact on peak demand charges

Disdvantages
- Charge time is slow (EVs will get around 2 or 5 miles of range per hour of charge)

Level 2 Charging



- A low power Level 2 EVSE provides 2.88kW at 12A
- The standard Level 2 EVSE used for public charging provides 7.2kW at 30A
- 10 to 20 miles of range per hour of charging
- 4 to 6 hours for full charge of most vehicles
- Equipment cost ranges from $500 for basic home charging equipment to $6,000 for a public outdoor model with on-board billing system.

4 - 8 HOURS CHARGE TIME

Level Two (240 Volts)

Level 2 charging uses 208 or 240 volt power to enable faster regeneration of an EV's battery system. Providing this type of charging requires installation of an EVSE unit and electrical wiring capable of handling higher voltage power. Plug-in America's Accessory Tracker offers an updated list of Level 2 EVSE currently on the market.

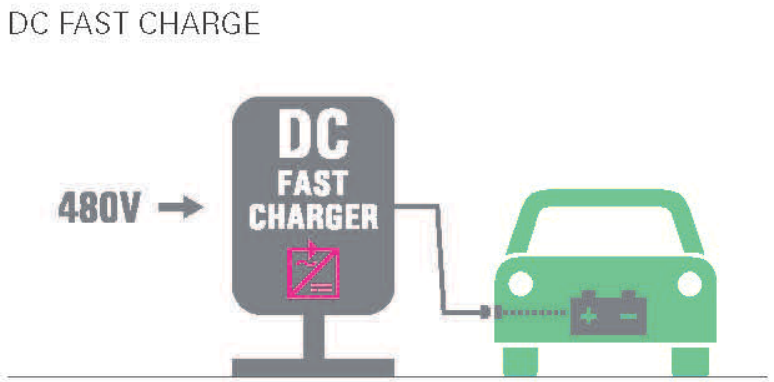
Advantages

- Charge time is significantly faster than Level 1 (EVs will get between 10 and 20 miles of range per hour of charge)

Disdvantages

- Installation costs are higher than Level 1 (as much as $5,000 for a commercial installation not including the cost of equipment)
- Potentially higher impact on peak demand charges

DC Fast Charging



30 MINUTES CHARGE TIME

- Reaches 40 to 65kW at 70 to 200A, requiring three-phase power
- 50 to 70 miles of range in 20 minutes of charging
- 80% battery charge in 20 to 30 minutes
- Equipment cost ranges from $15,000 to $50,000

DC Fast Charging (3 phase)

DC fast charging provides compatible vehicles with an 80 percent charge in 20-30 minutes by converting high voltage AC power to DC power for direct storage in EV batteries. However, automakers currently have two competing specifications for DC fast charging plugs, the CHAdeMO and SAE Combo standards. Nissan and Mitsubishi vehicles use CHAdeMO while vehicles from U.S. and European manufacturers have SAE Combo ports.

Advantages

- Charge time is reduced drastically. It's nearly as fast as refueling a gasoline vehicle

Disdvantages

- Equipment and installation costs are much higher than level 1 and level 2 charging ($15,000-$100,000 depending on equipment and power availability at site)
- Increased peak demand charges
- Competing standards are confusing to potential EV buyers and charging station operators

What's going on with workplace charging?

- After home charging, workplace charging is generally viewed as the next priority for EV charging infrastructure.
- Industry advocates and policymakers have identified workplace charging as a key component of the EV charging infrastructure.
- DOE has launched the Workplace Charging Challenge, with a goal of achieving a tenfold increase in the number of U.S. employers offering workplace charging in the next five years.
- An understandable usage pattern exists for workplace charging.
- Decision points:
  - Free or fee for drivers
  - Level of involvement
  - Locations and number of stations
  - Level of features in EVSE hardware (networking, metering, billing, ..)

The benefits of workplace charging

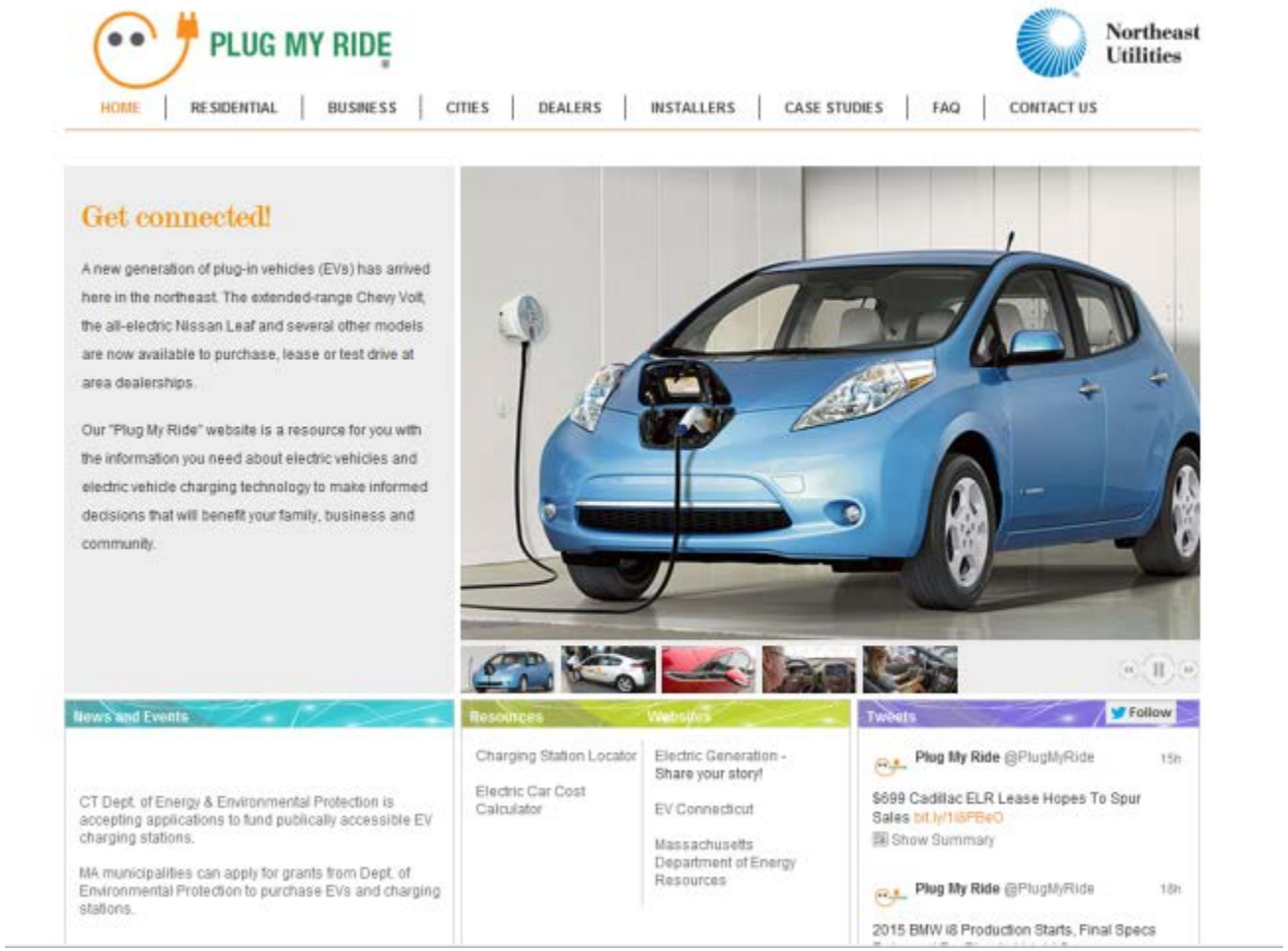
- Attract and retain employees
- Connects with corporate image
- Allows for more electric only miles for PHEVs
- Creates local ‘PEV showrooms’ for info sharing on vehicles

- Strategies (if charging for usage)
  - Charge by time to double utilization
  - Charge by session to get people to stay long
  - Charge by kwh to benefit short commuters

Eversource is working with the states on plug-in electric vehicle (PEV) programs

Education and Outreach	• EV Tech Center (Website, 800 number, trained reps, proactive outreach, ..) • Partner to Connecticut's CHEAPER Rebate Program
Planning Studies	• Planning Study for DC Fast Chargers • Planning Study of EV Customers with No Garage • Technical Evaluation of EV Storage Capabilities
Infrastructure Deployment	• Plug My Ride @ HOME SmartCharging Pilot • DC Fast Charger Deployment
Other	• DC Fast Charger Electric Rate

Eversource has a dedicated resources to serve customers interested in PEVs



www.PlugMyRide.org

or

855-463-6438

(Monday through Friday 8 a.m. - 5 p.m.)

Thank You

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(Twitter) @PlugMyRide

855-463-6438

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Watson Collins
Manager, Research & Business Development
watson.collins@eversource.com
(Twitter) @WatsonCollins3
860-728-4843

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