EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Plug-In Electric Vehicles and Infrastructure

Florida State Projections 2010 – 2030

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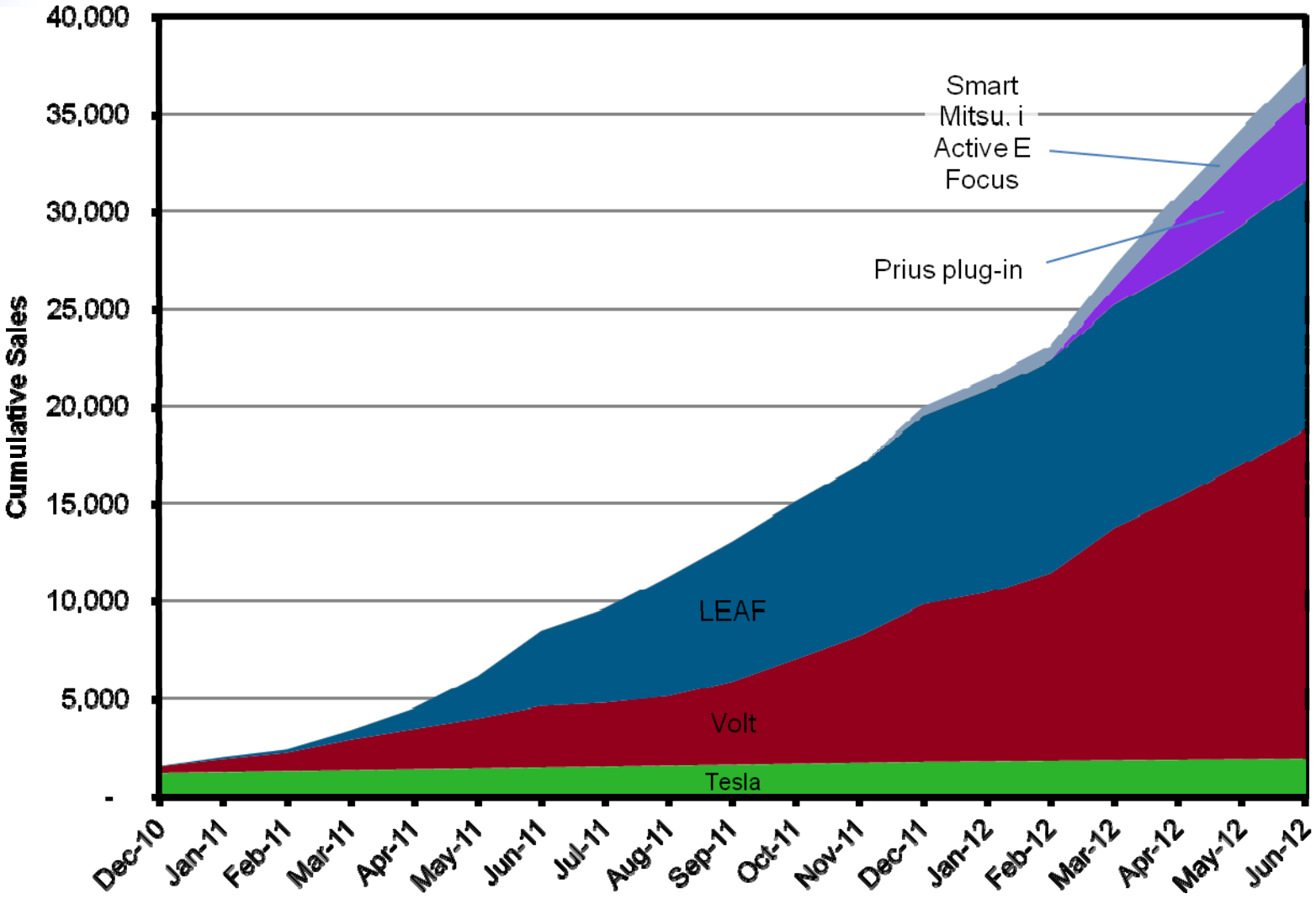
Director, Electric Transportation and Energy Storage

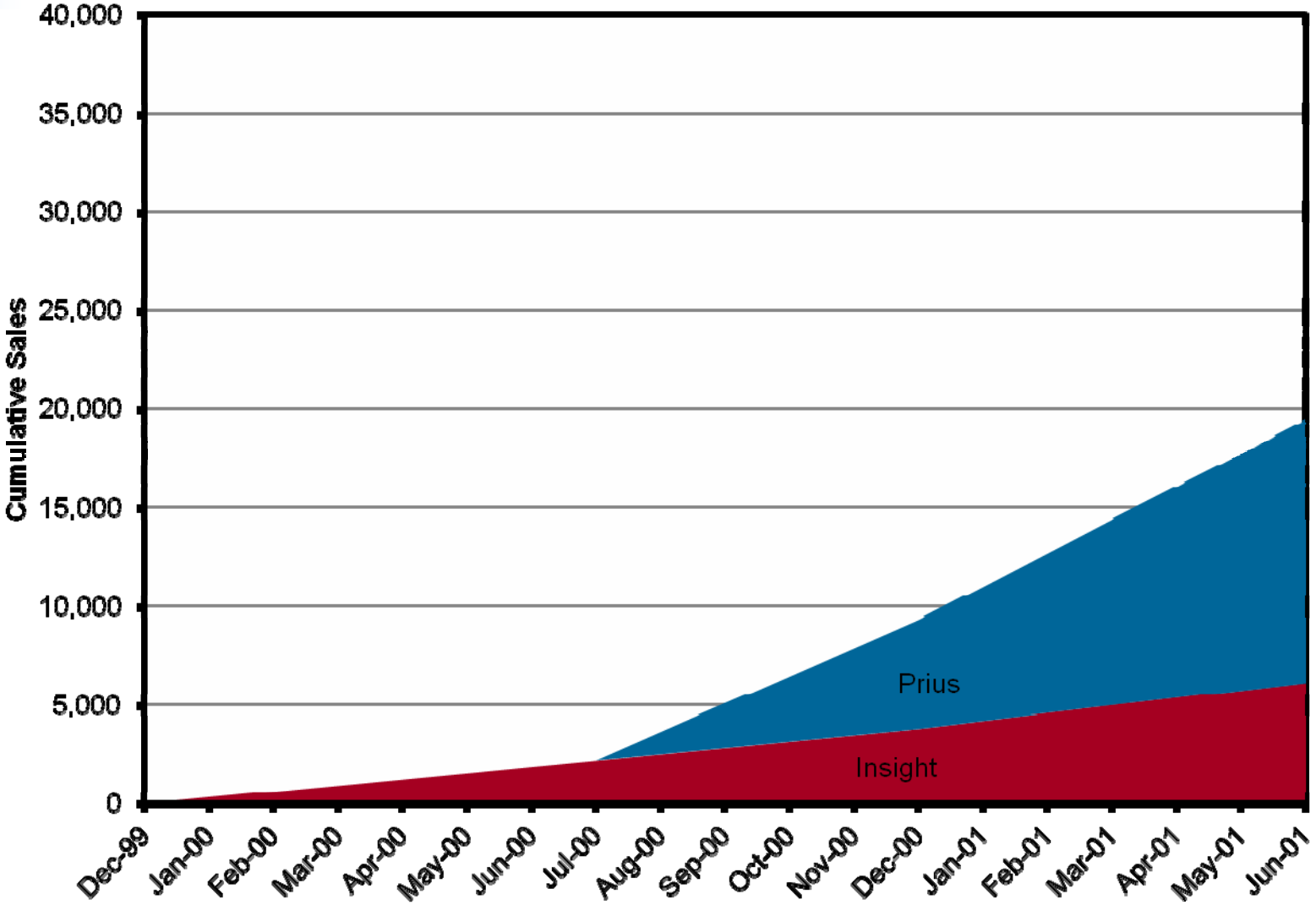
Florida PSC Workshop on EV Charging Stations
September 6, 2012

Nationwide Plug-In Electric Vehicle Sales
(As of June 30, 2012)

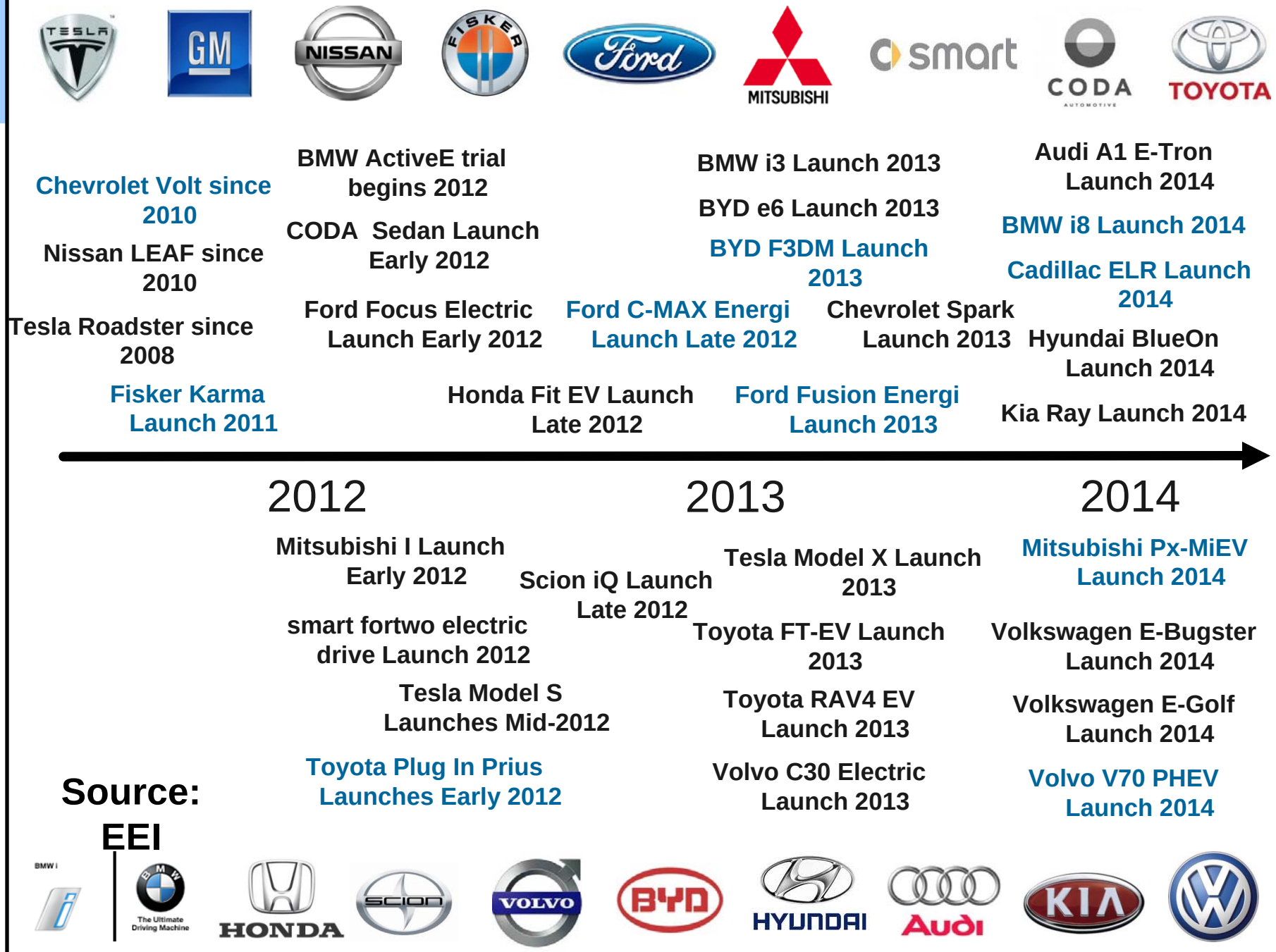


Sources: Automotive News, hybridcars.com

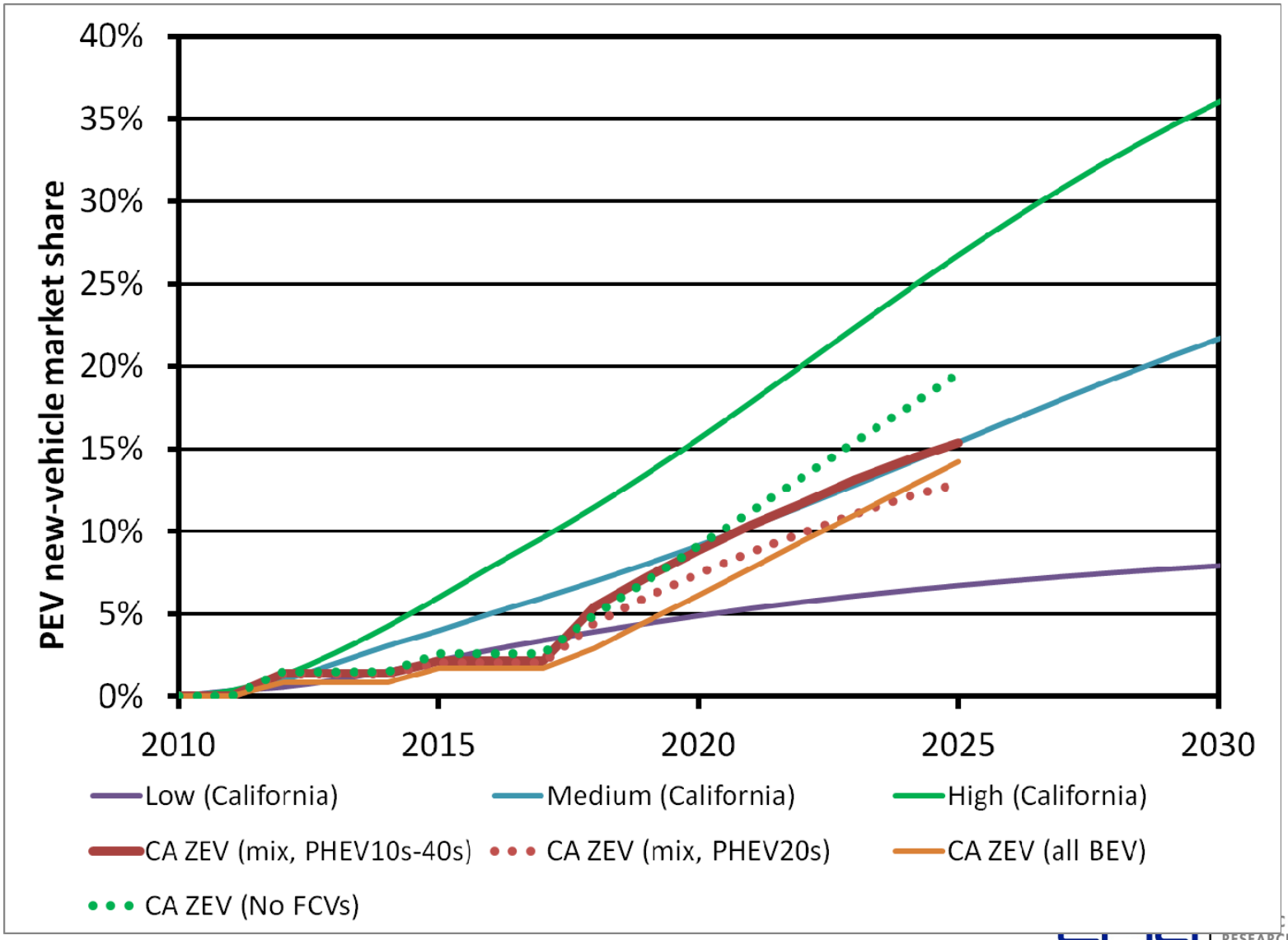
The Introduction of PEVs is Outpacing the Intro of HEVs (More models, greater sales numbers)



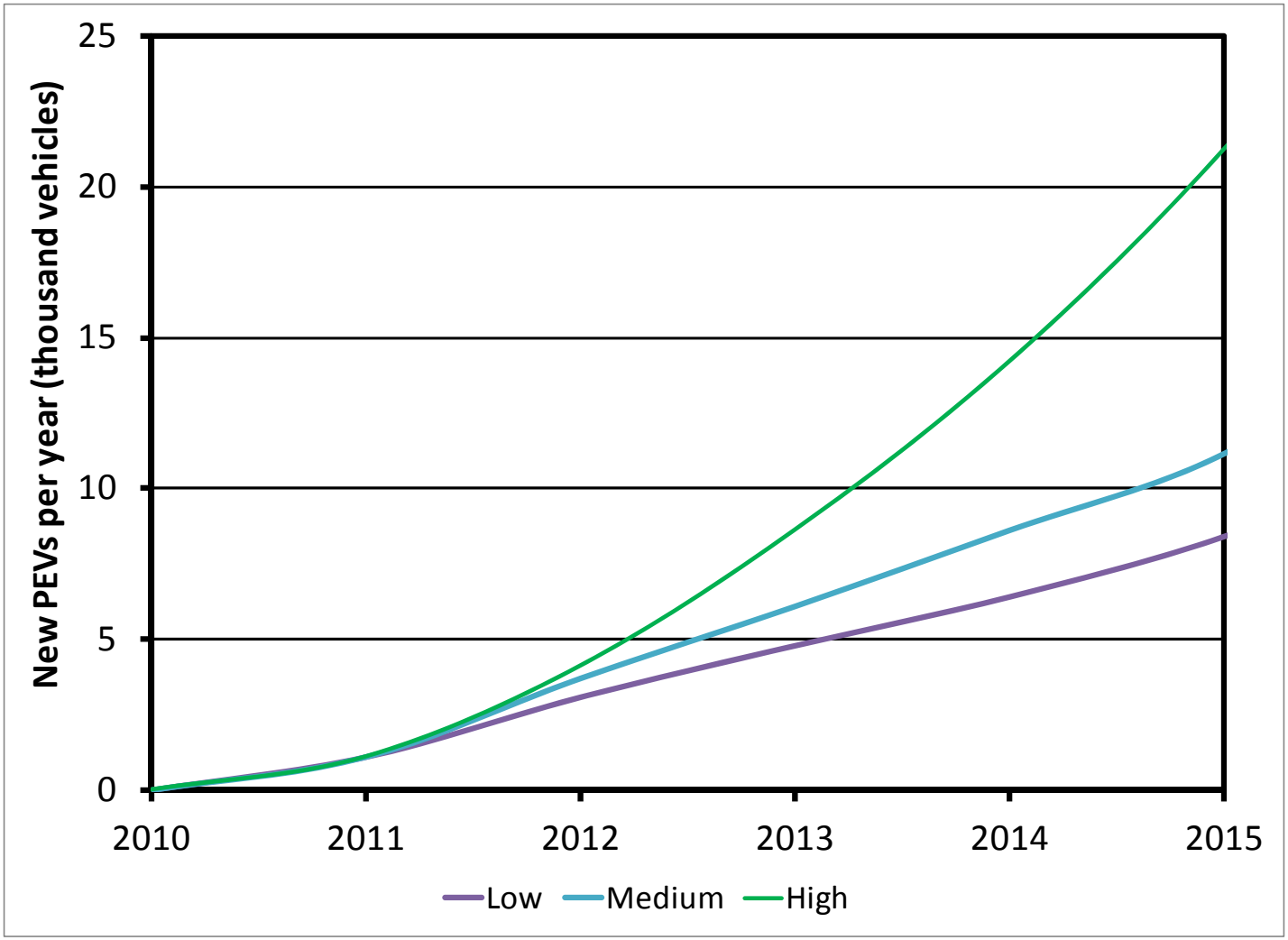
Source: US Department of Energy


Chevrolet Volt since 2010
Nissan LEAF since 2010
Tesla Roadster since 2008
Fisker Karma Launch 2011
BMW ActiveE trial begins 2012
CODA Sedan Launch Early 2012
Ford Focus Electric Launch Early 2012
Honda Fit EV Launch Late 2012
Ford C-MAX Energi Launch Late 2012
Ford Fusion Energi Launch 2013
BMW i3 Launch 2013
BYD e6 Launch 2013
BYD F3DM Launch 2013
Chevrolet Spark Launch 2013
Audi A1 E-Tron Launch 2014
BMW i8 Launch 2014
Cadillac ELR Launch 2014
Hyundai BlueOn Launch 2014
Kia Ray Launch 2014
2012
2013
2014
Mitsubishi I Launch Early 2012
smart fortwo electric drive Launch 2012
Tesla Model S Launches Mid-2012
Toyota Plug In Prius Launches Early 2012
Scion iQ Launch Late 2012
Tesla Model X Launch 2013
Toyota FT-EV Launch 2013
Toyota RAV4 EV Launch 2013
Volvo C30 Electric Launch 2013
Mitsubishi Px-MiEV Launch 2014
Volkswagen E-Bugster Launch 2014
Volkswagen E-Golf Launch 2014
Volvo V70 PHEV Launch 2014
Source: EEI

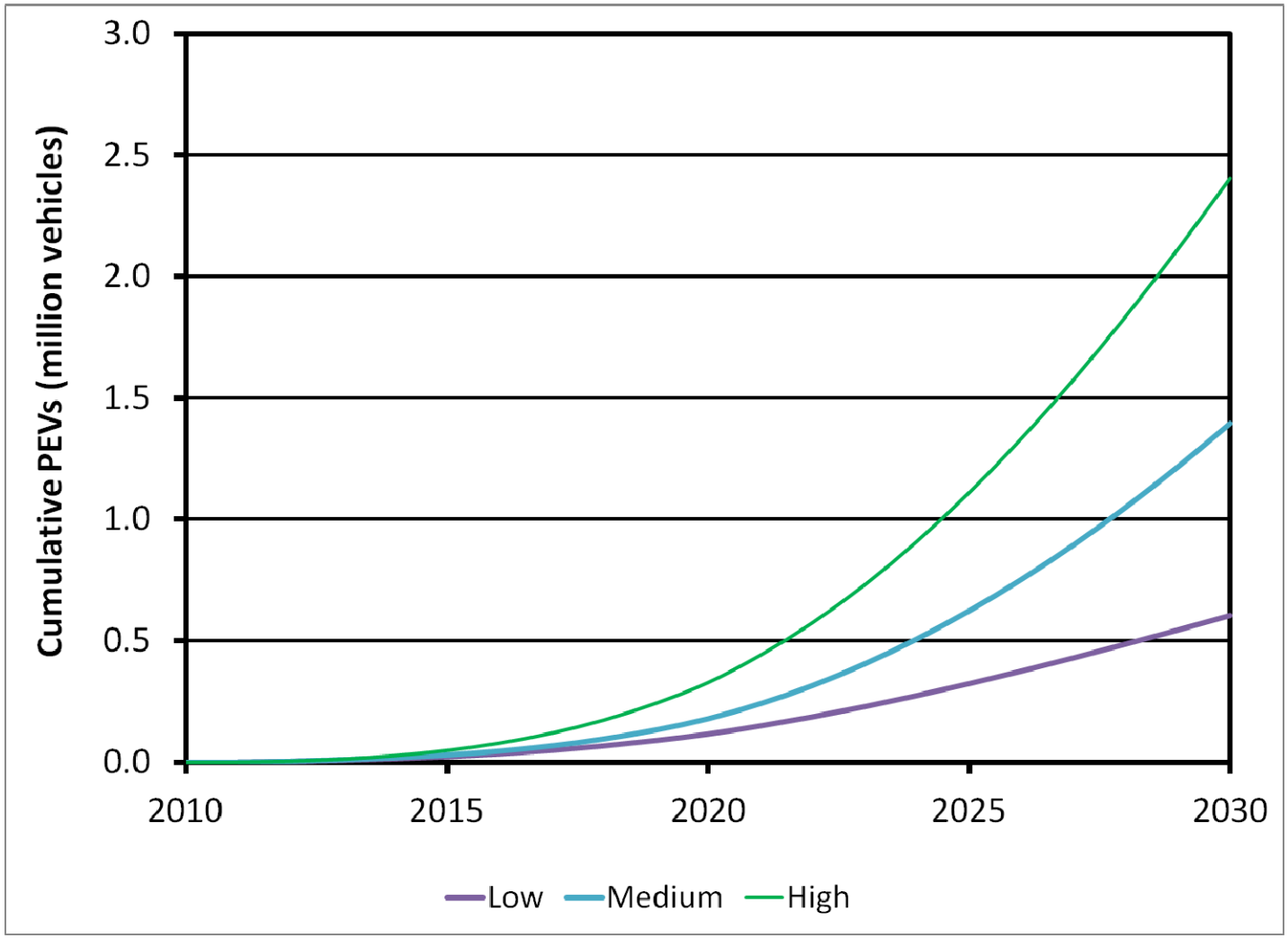
Zero Emission Vehicle Regulation in CA and 11 Other States Provides a 'Floor' under PEV Adoption Rates



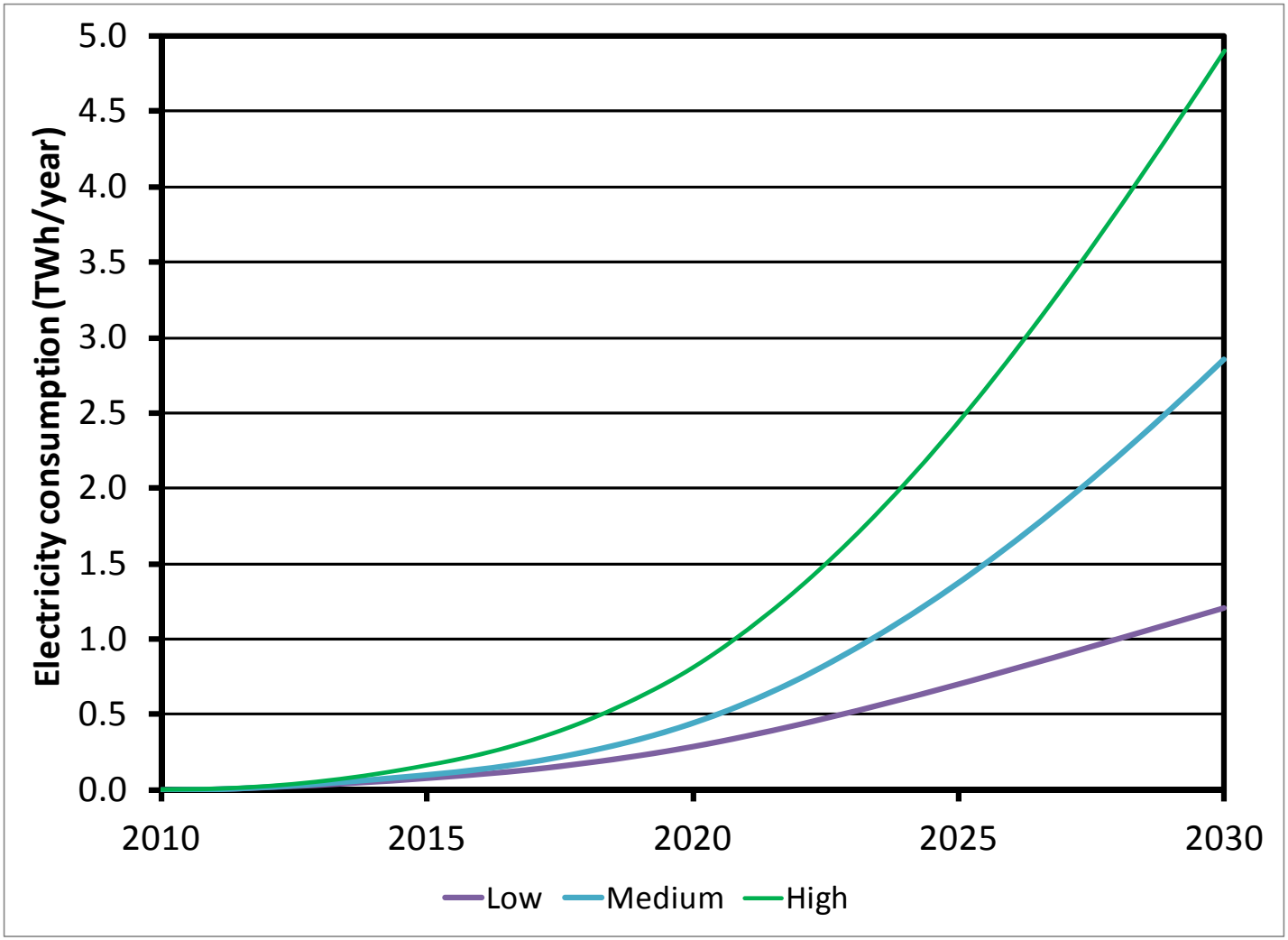
Florida New PEV Sales
Near-term 2010 – 2015



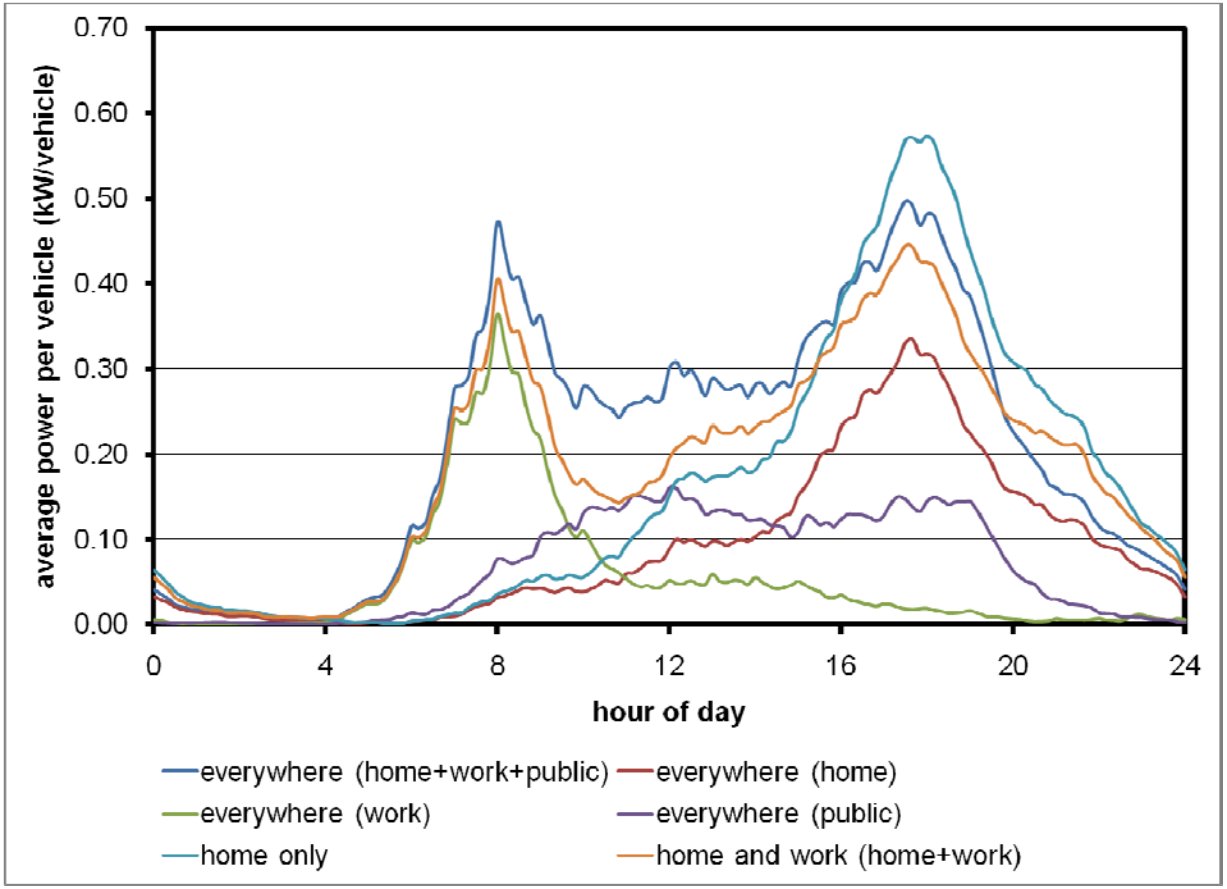
Florida Cumulate PEV Fleet
2010 – 2030



PEV Annual Electricity Consumption
2010 – 2030



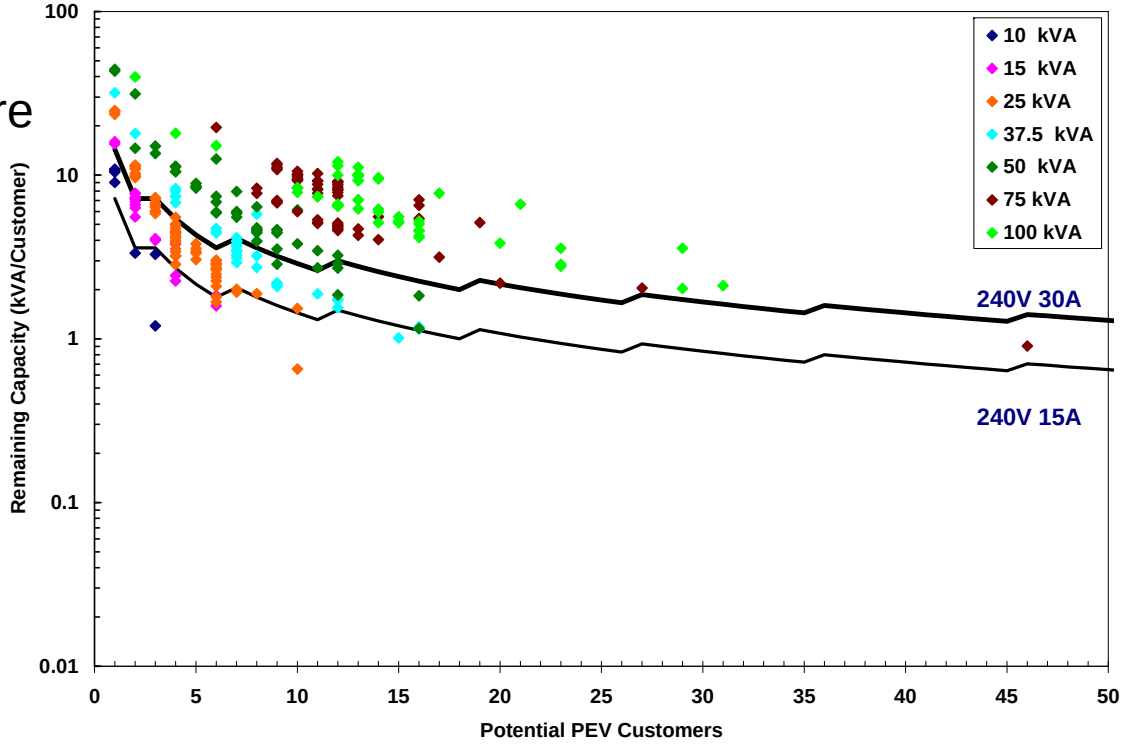
Aggregate System Impacts of PEVs are Low
Most scenarios are below 1 kW/vehicle peak demand

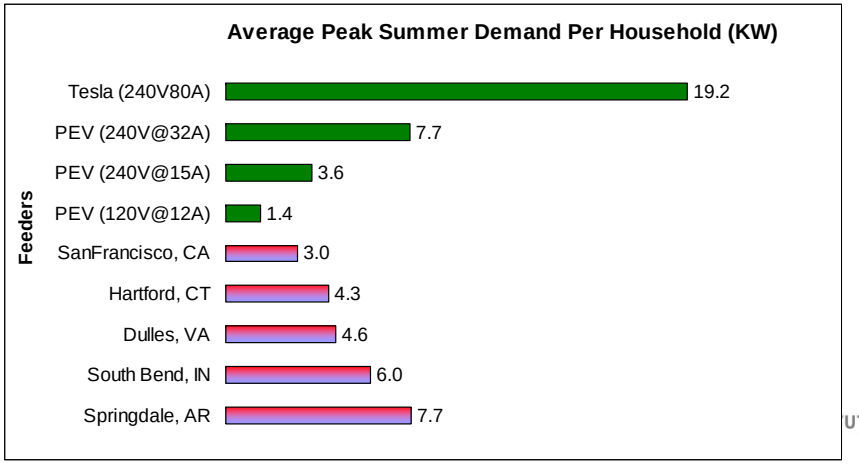


→6.6 kW charge power, PHEV40, weekdays

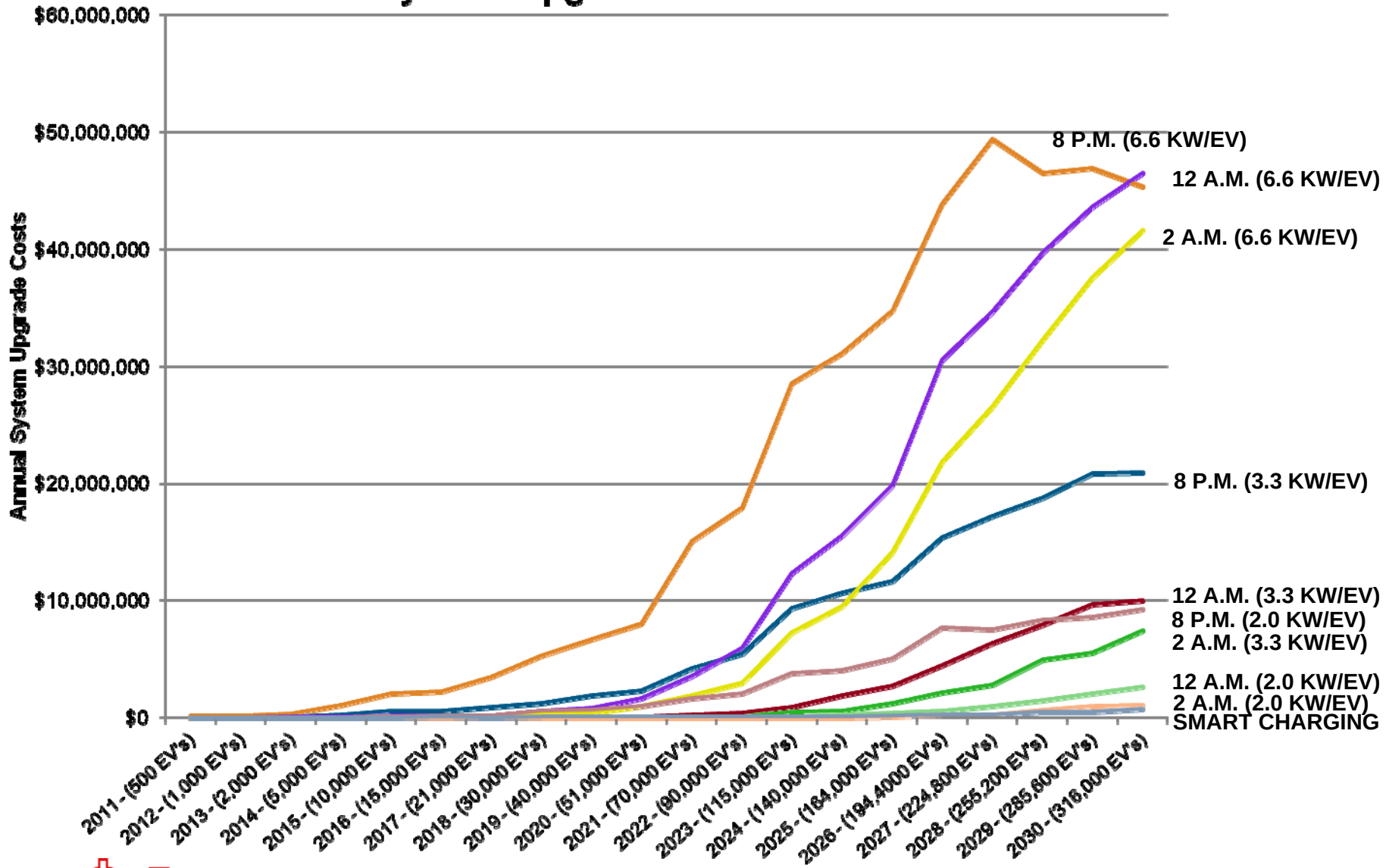
Distribution Impacts of PEV Charging

- Local distribution transformers are among the first equipment impacted
- Charge power is the likely dominant factor determining impact, not time-of-day
- Charge power is increasing—automotive OEMs trend to about a four-hour charge time
  - 19.2 kW is the maximum for residential AC charging
- TOU rates and other off-peak charging programs mitigate upstream impacts but offer limited help to local transformers
  - Especially true with clustering





Annual System Upgrade Costs Vs. EV's Installed



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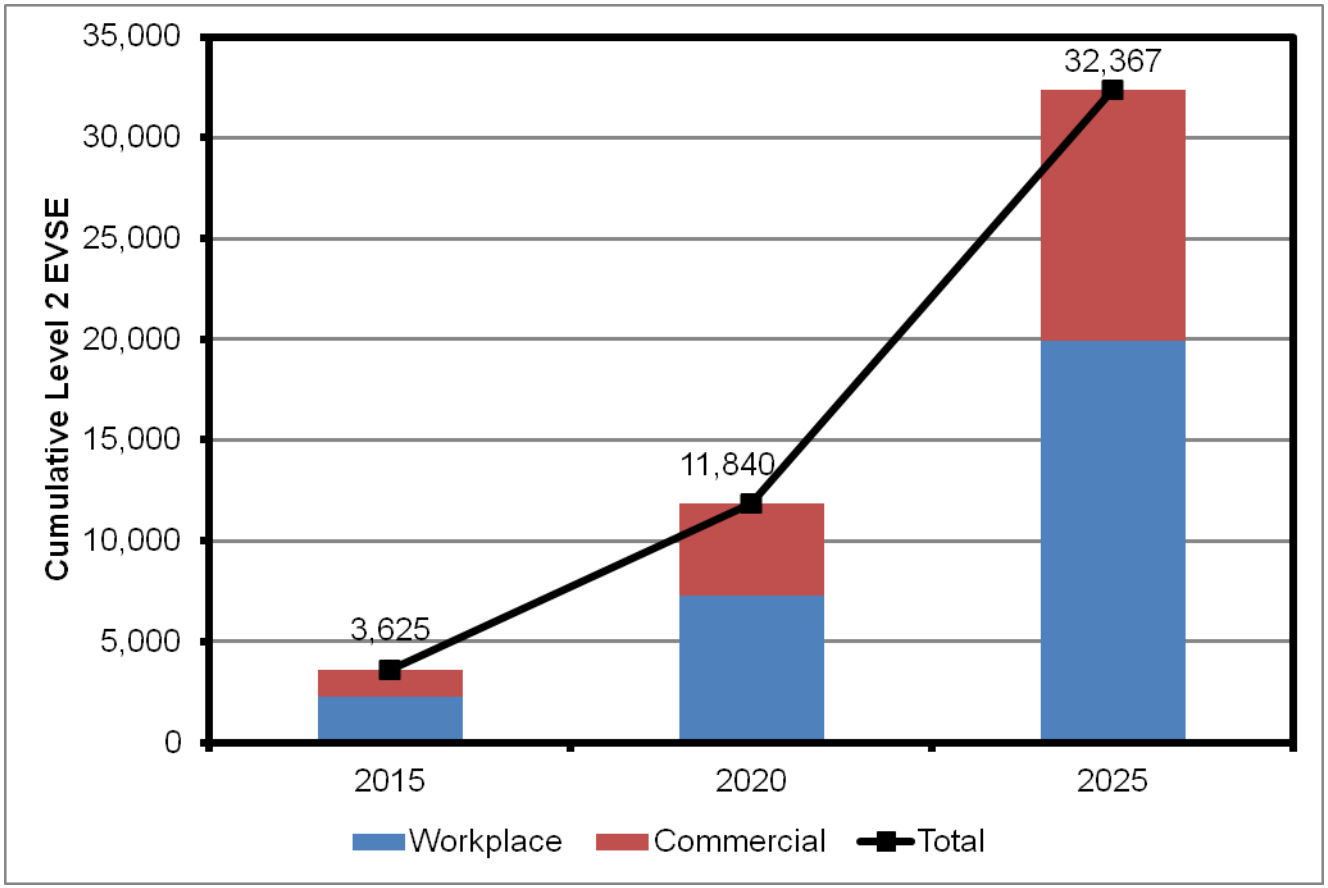
SACRAMENTO MUNICIPAL UTILITY DISTRICT
The Power To Do More.℠

PEV Fleet Projections Can Be Used to Estimate the Number of EV Charging Stations Needed in Florida



Extra Slides

Solar Assisted PEV Charging Stations

- **Combines vehicle charging with solar power and battery storage along with smart grid interface**
- **EPRI analysis showed capability to provide for entire station with normal commute patterns**

EPRI's Advanced Solar Charging Station combines PV (2kW per space) with energy storage and could effectively 'stand alone' at infrastructure

Location show is in Knoxville, additional locations in Chattanooga, Nashville, Memphis. Coming to NY.

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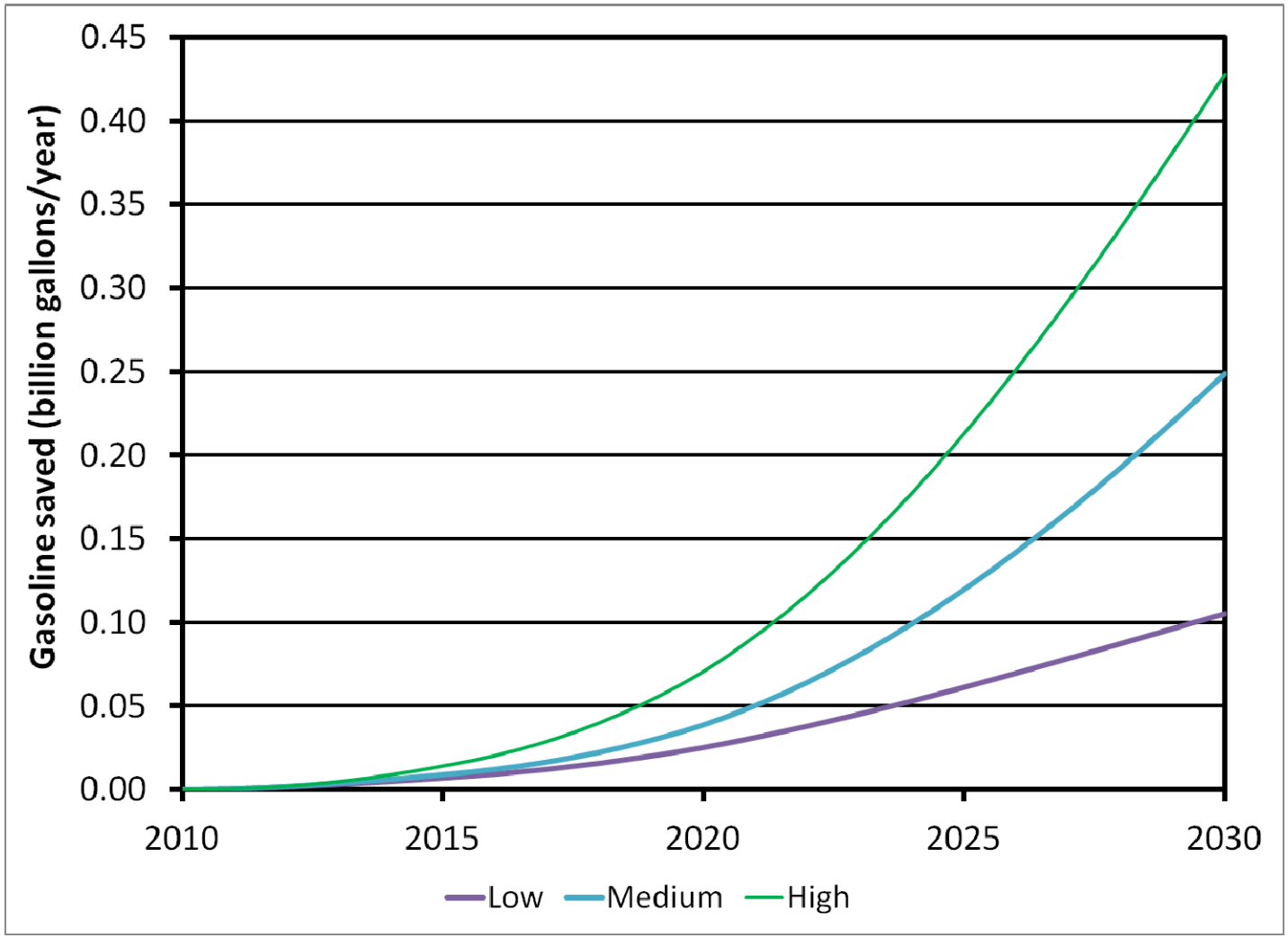
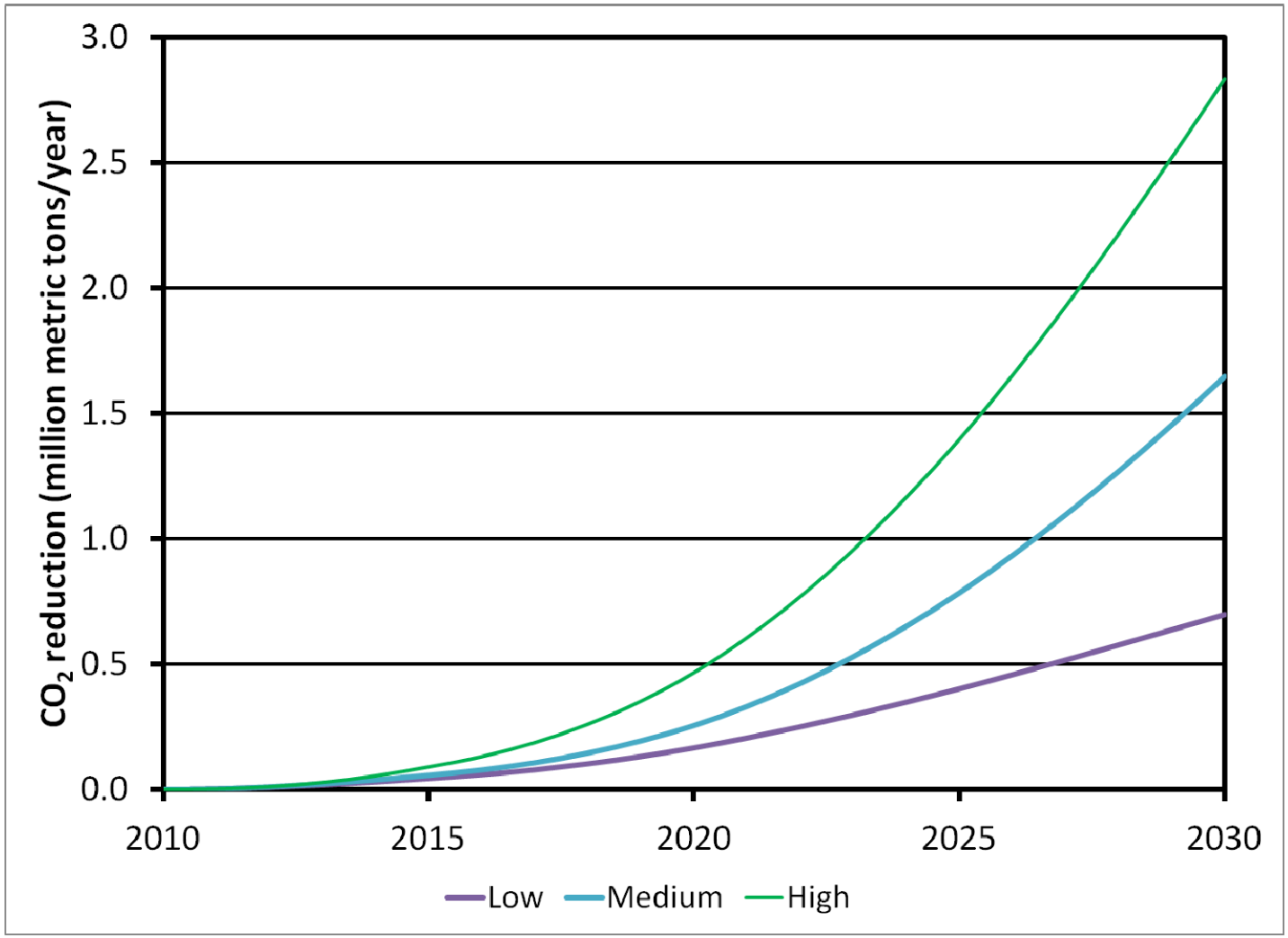
Gallons of Gasoline Saved



CO2 Reduction



Charging Infrastructure
PEVs Generally Have Three Charging Options

120V – Level 1

Portable cordset
Use any 120V outlet

Up to 1.44 kW

DC Fast Charging

Up to ~ 50 – 60 kW

Fast, expensive

Standard not yet in place

240V – Level 2

Permanent charge station (EVSE)

Typ. 3.3 – 6.6 kW, but up to 19.2 kW

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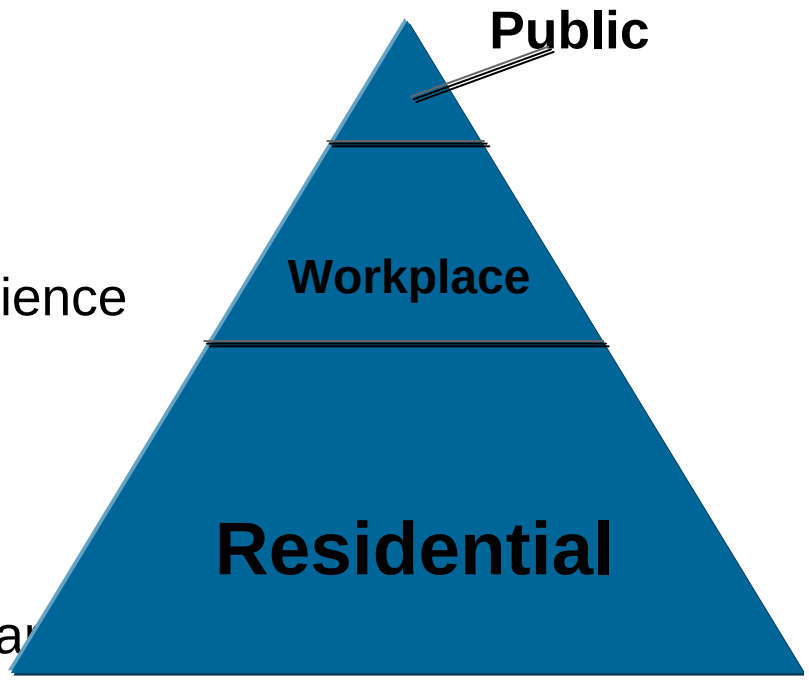
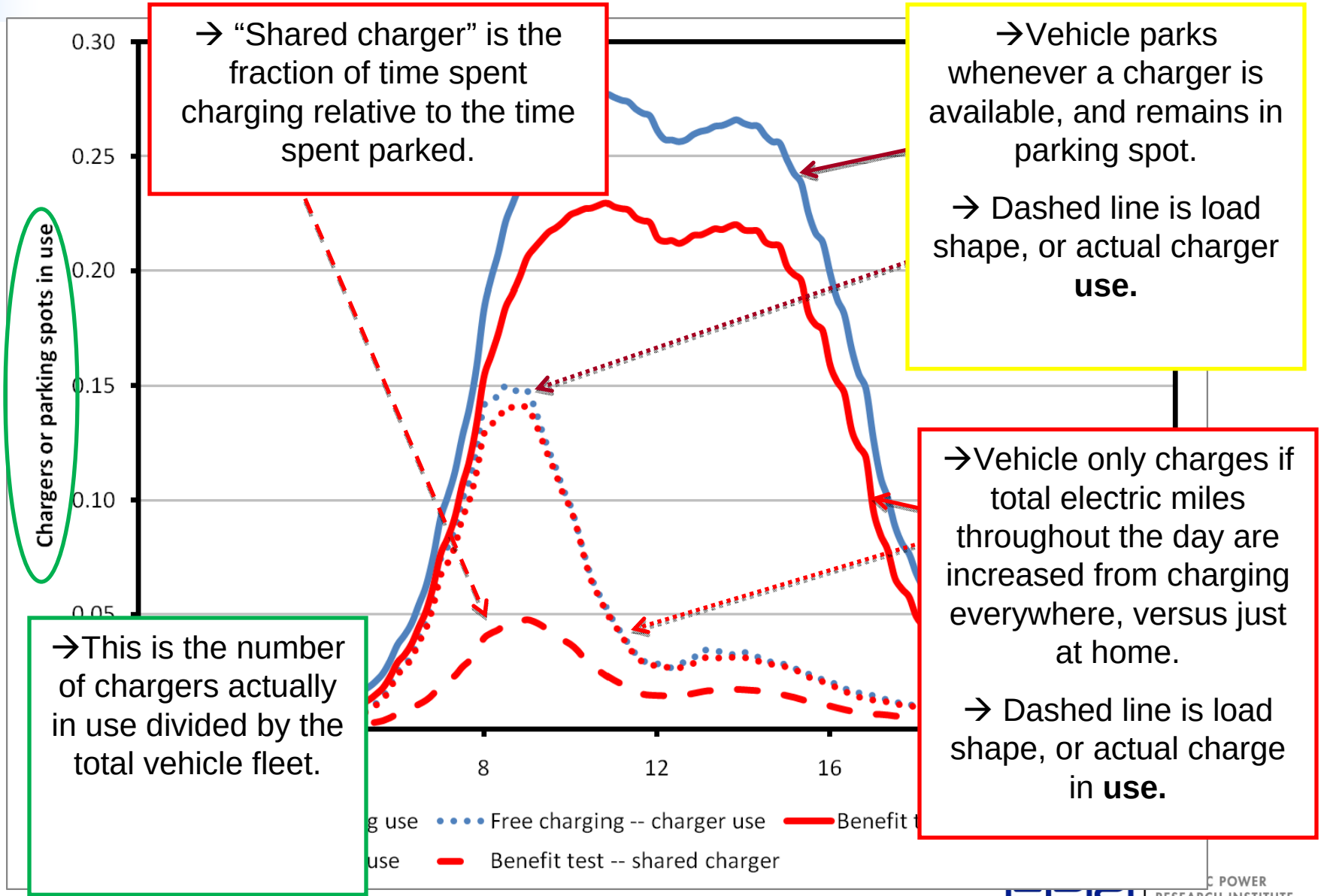
Planning and Implementing Infrastructure

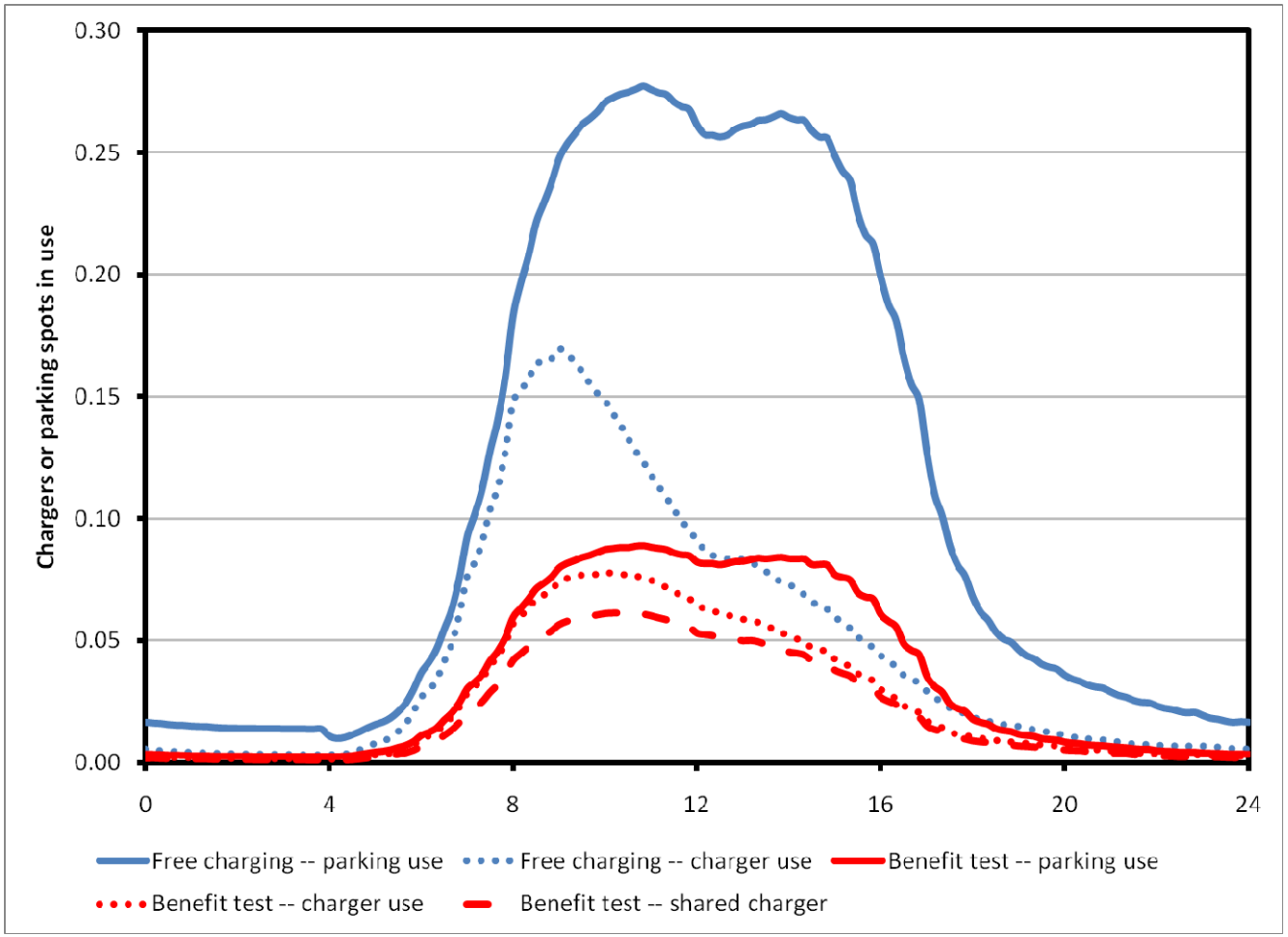
- Infrastructure can be expensive
  - ~ $1500 home, $2500+ public
- Focus on Residential
  - – 95% of vehicles end day at home
  - – Lower residential cost, improve convenience
- Workplace
  - – 2nd priority in terms of use
- Public Charging
  - – Critical vs. convenience – where there a
  - – **Public charging does only two things**
    - – **Enable BEVs to operate safely and confidently**
    - – **Increase electricity use in PHEVs**



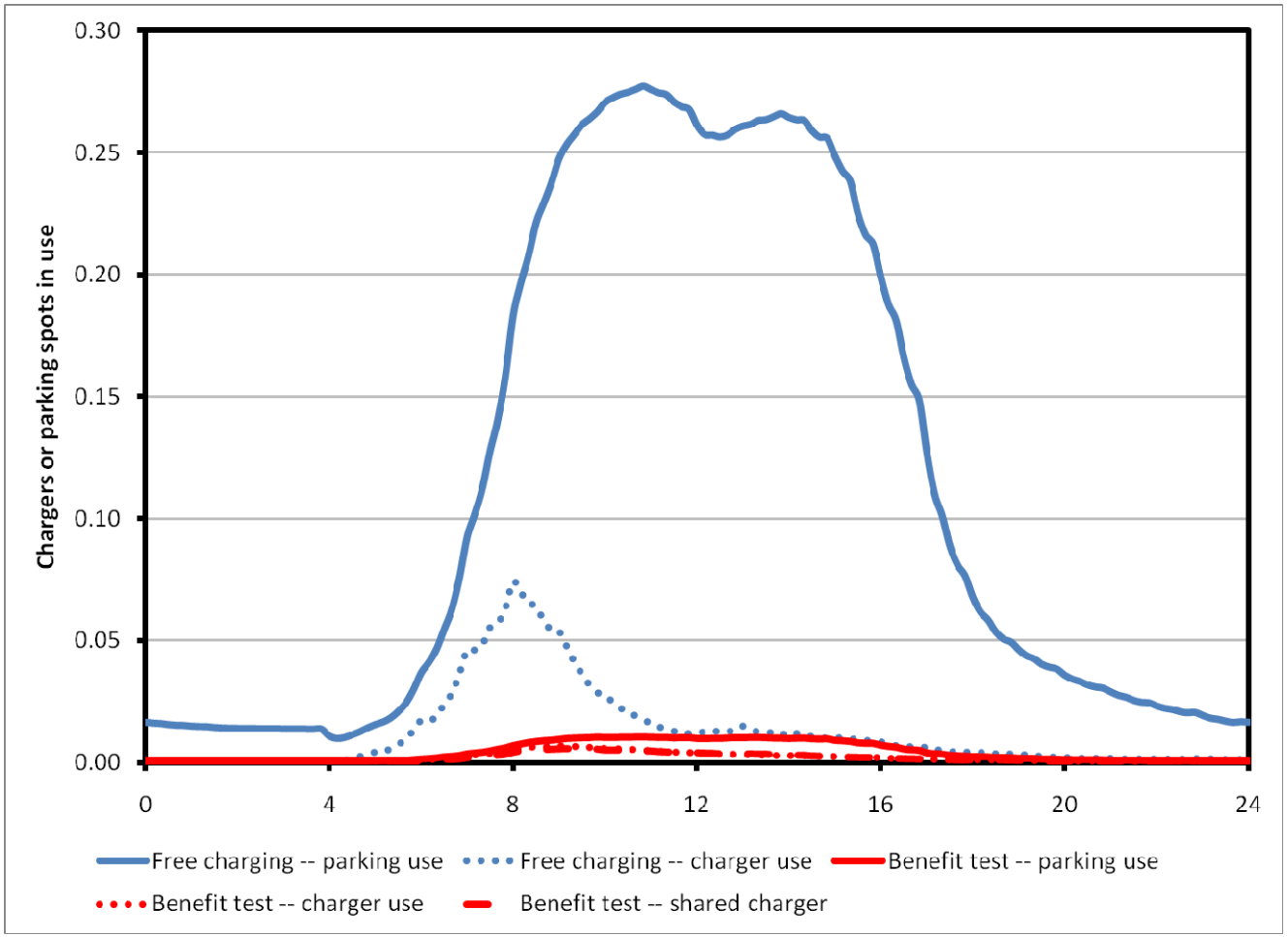
Results – How to Read the Following Charts



Workplace Charging – PHEV40 1.44kW

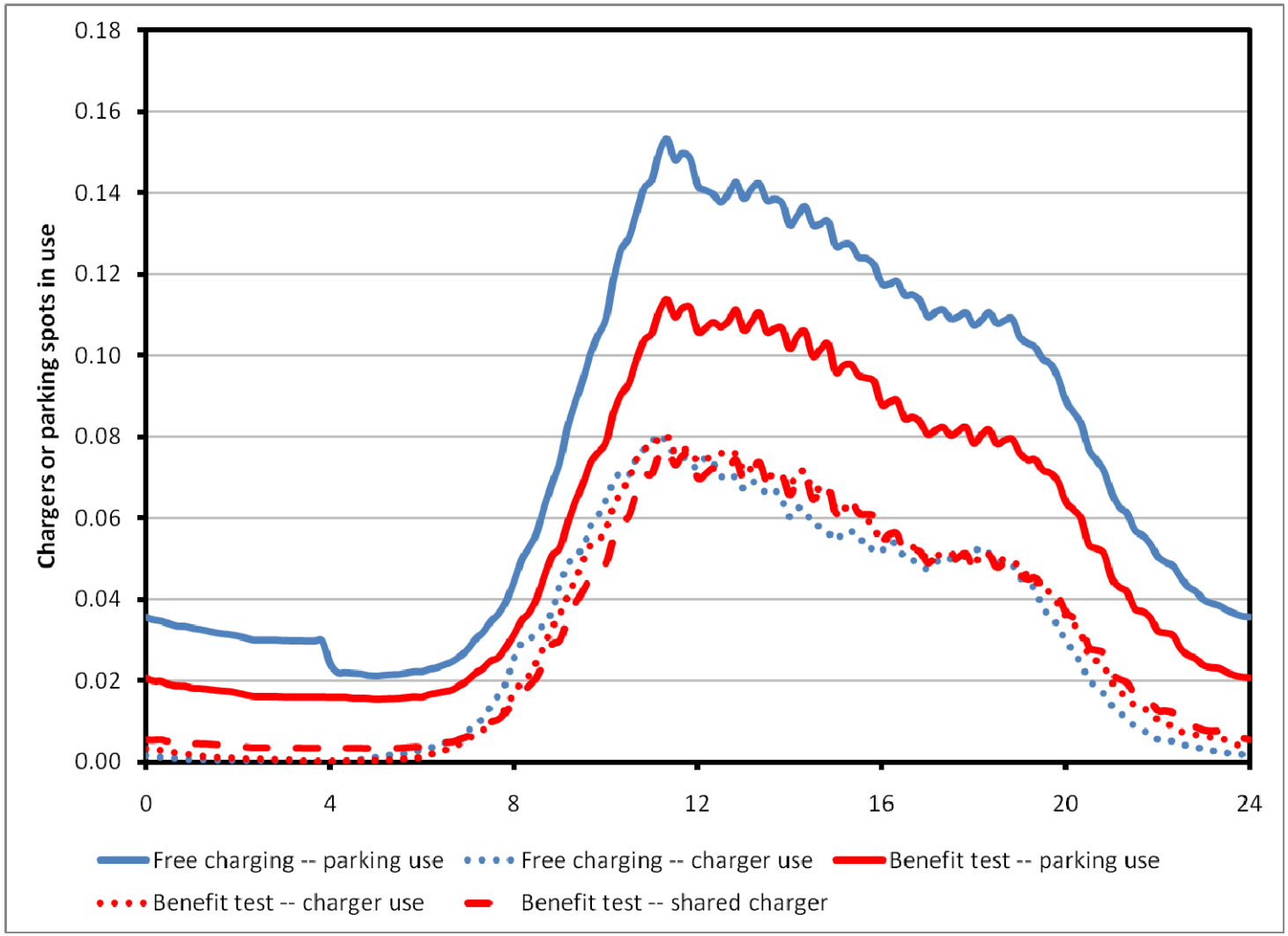


Workplace Charging – BEV100 6.6kW

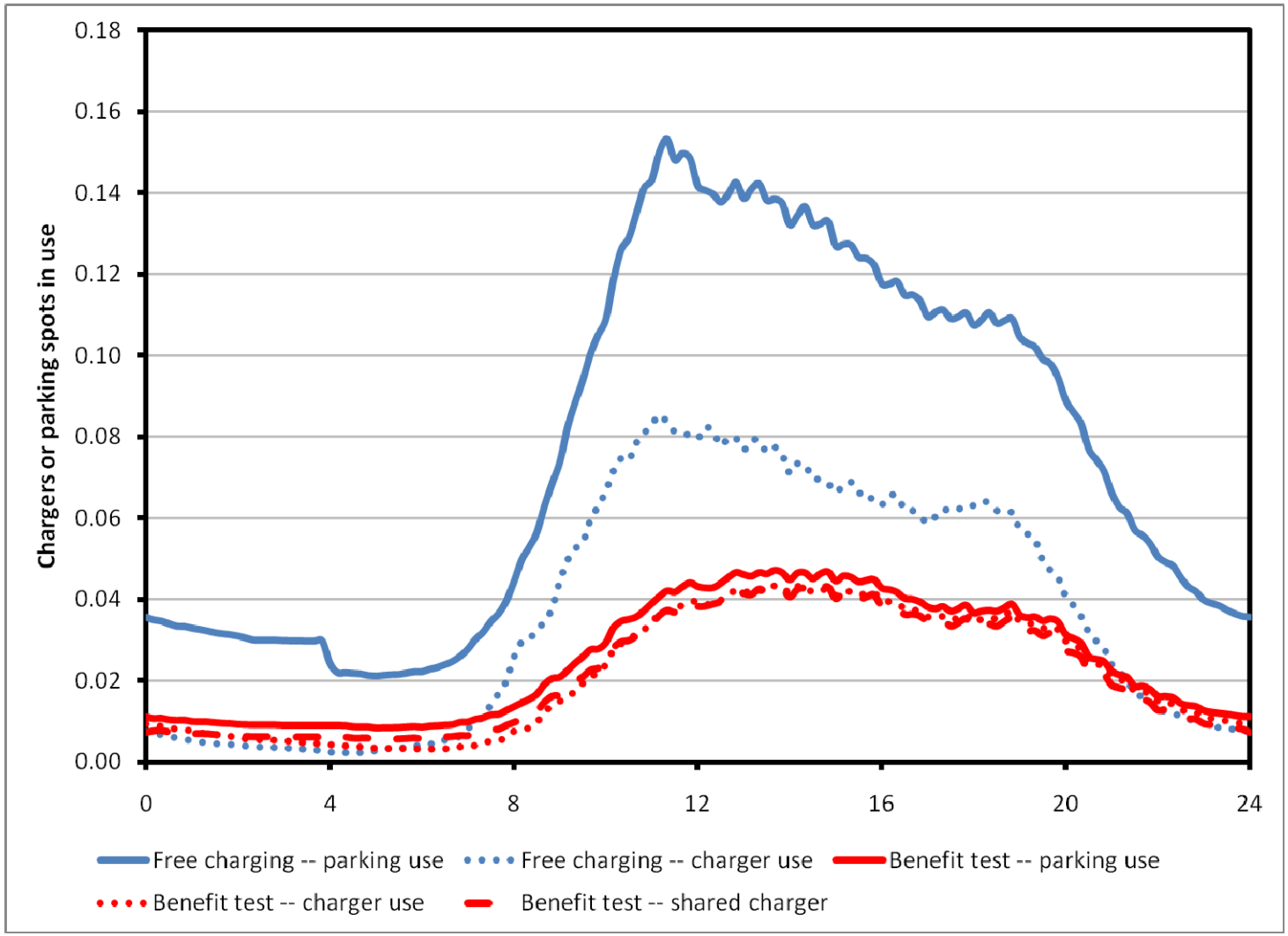


When BEV100s are only allowed to charge when needed, they charge nearly the entire time. Again, very little benefit is seen for shared-charger model.

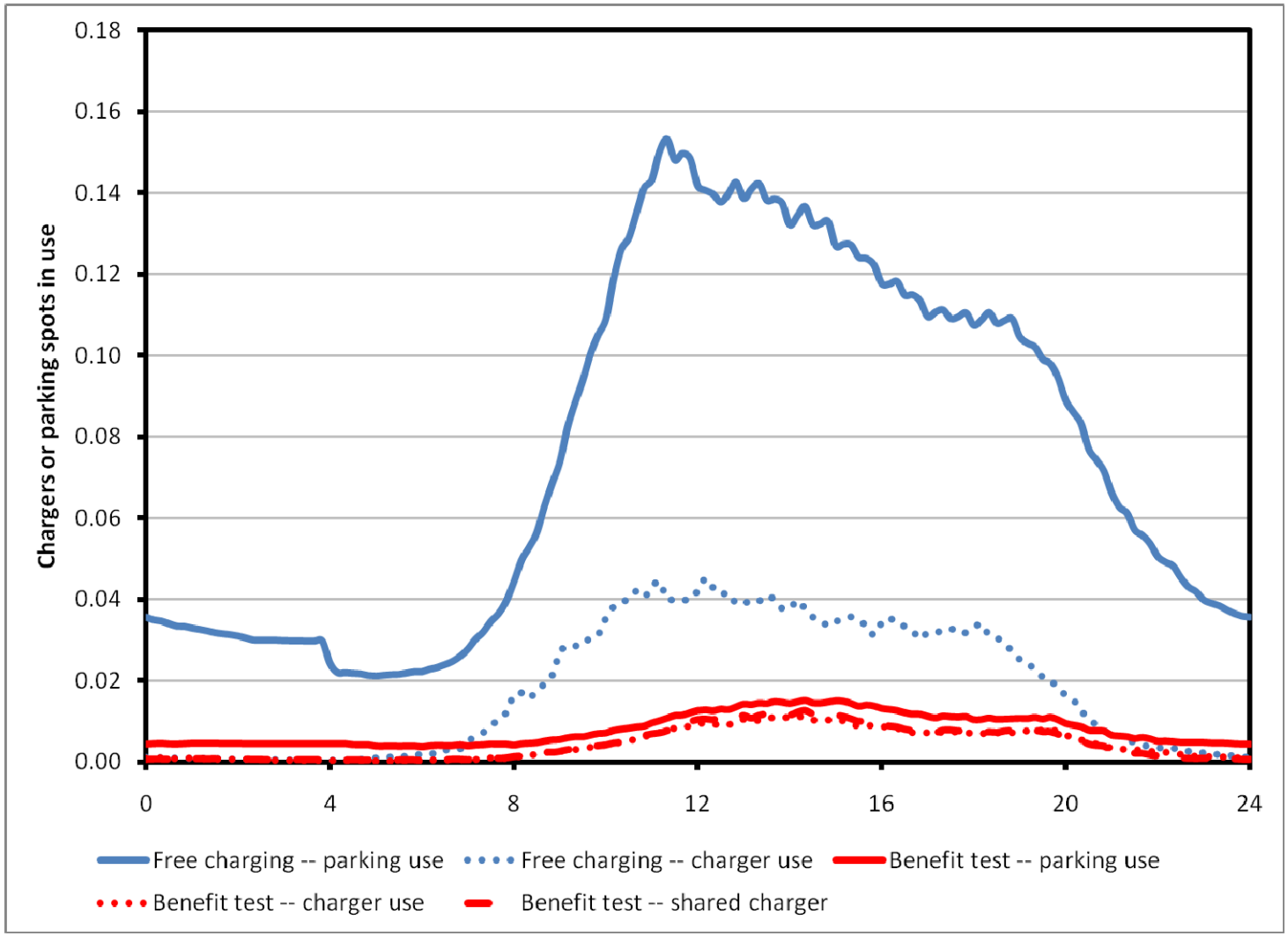
Public Charging – PHEV10, 1.44 kW



Public Charging – PHEV40, 1.44 kW

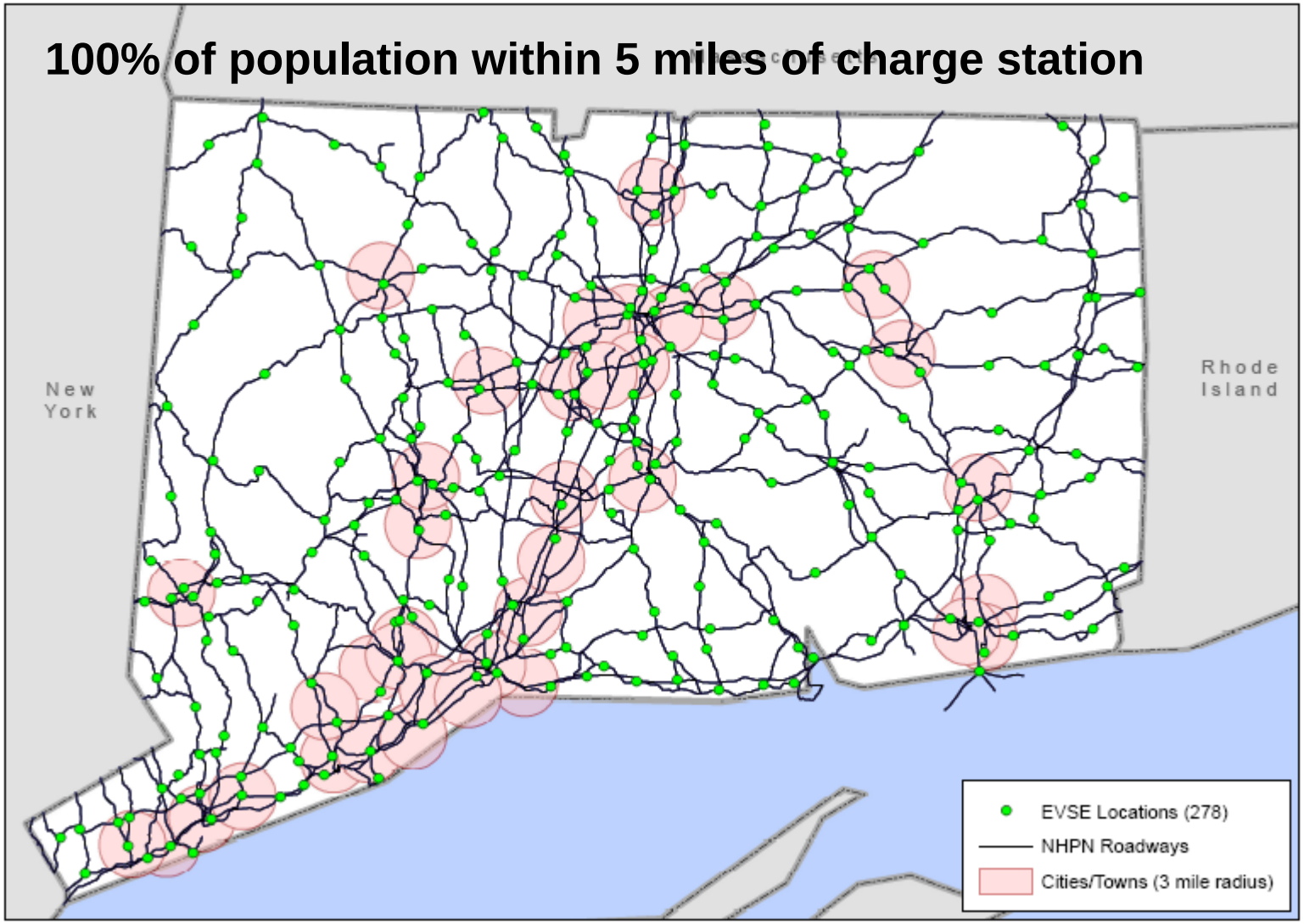


Public Charging – BEV100, 6.6 kW



Statewide or Regional Infrastructure

State of Connecticut Example – 275 Level 2 EVSEs



DC Fast Charging

- Likely to significantly increase customer acceptance of BEVs
  - Expect DC charging in PHEVs also
- Equipment falling in price, installation and service costs will be dominant expenses
  - Demand charges
- Uncertain how to financially sustain a significant network
- Careful planning can minimize the number of charge spots