



# **The Near Future of Electric Transportation**

**Pennsylvania Public Utility Commission**

**Alternative Fuel Vehicles Forum**

**May 31, 2012**

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**Senior Vice President**

# Mainstream PEV Commercialization Began December 2010



## Chevrolet Volt

- Extended Range Electric Vehicle (EREV - A plug-in hybrid with a guaranteed electric range).
- 40-mile range
- Charging: 8-9 hours at 120V, 12A  
3 hours at 240V, 15A



## Nissan Leaf

- Battery Electric Vehicle
- 100-mile range
- Charging: 20 hours at 120V, 12A  
8 hours at 240V, 15A  
30 min at 400V, 150A



**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**

**BMW i3 Launch 2013**

**BYD e6 Launch 2013**

**BYD F3DM Launch 2013**

**Ford Fusion Energi 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**

**Scion iQ Launch Late 2012**

**Tesla Model X Launch 2013**

**Mitsubishi Px-MiEV Launch 2014**

**smart fortwo electric drive Launch 2012**

**Toyota FT-EV Launch 2013**

**Volkswagen E-Bugster Launch 2014**

**Tesla Model S Launches Mid-2012**

**Toyota RAV4 EV Launch 2013**

**Volkswagen E-Golf Launch 2014**

**Toyota Plug In Prius Launches Early 2012**

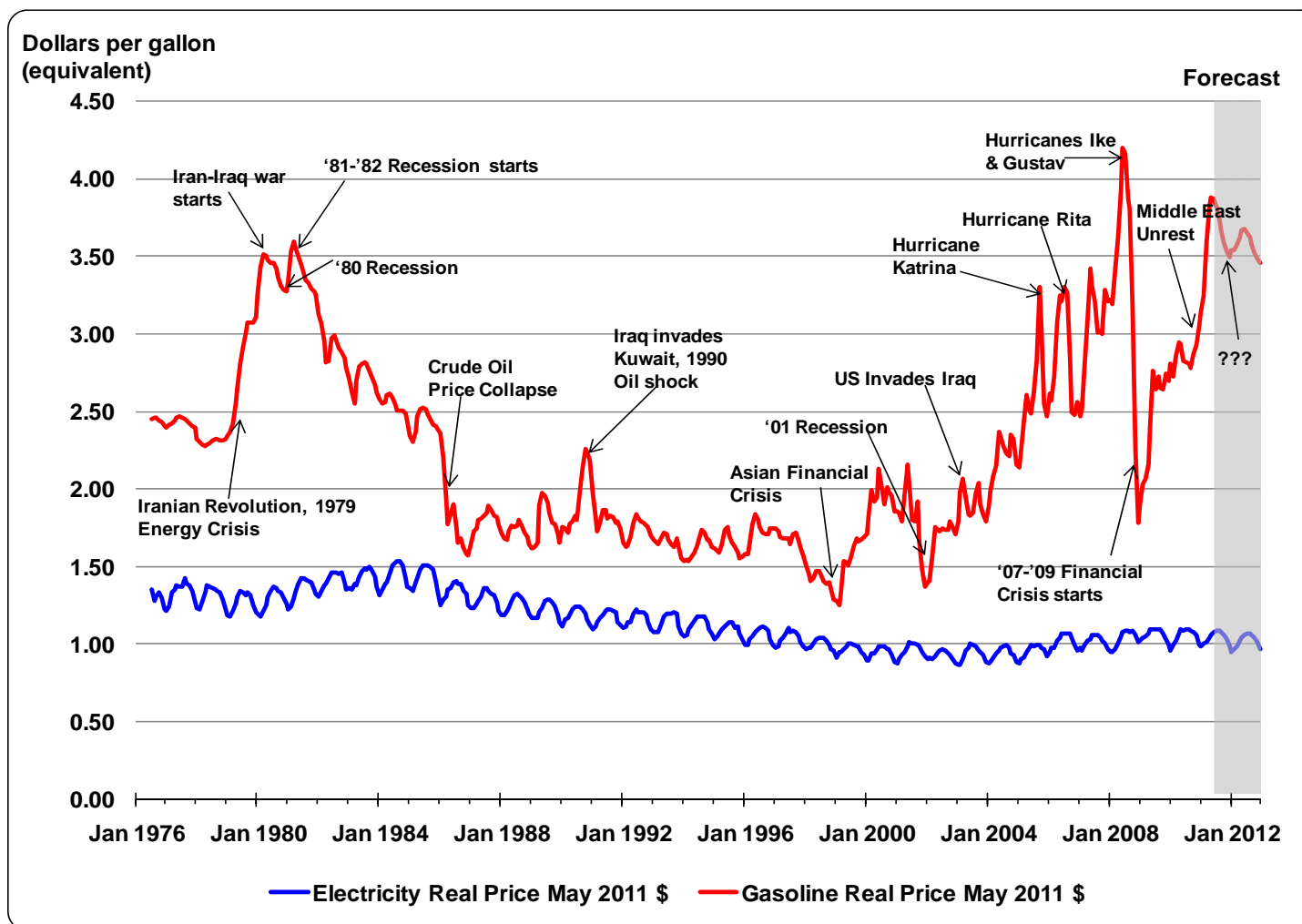
**Volvo C30 Electric Launch 2013**

**Volvo V70 PHEV Launch 2014**

Source: EEI



# Electricity Pricing for Plug-in Electric Vehicles



**Electricity ~ \$1/Gallon (equiv.) ... less expensive ... relatively stable**



# Three Ways to Charge a Plug-in Electric Vehicle

## 120V – Level 1

Portable cordset  
Use any 120V outlet  
Up to 1.44 kW



## 240V – Level 2

Permanent charge station (EVSE)  
Typ. 3.3 – 6.6 kW, but up to 19.2 kW



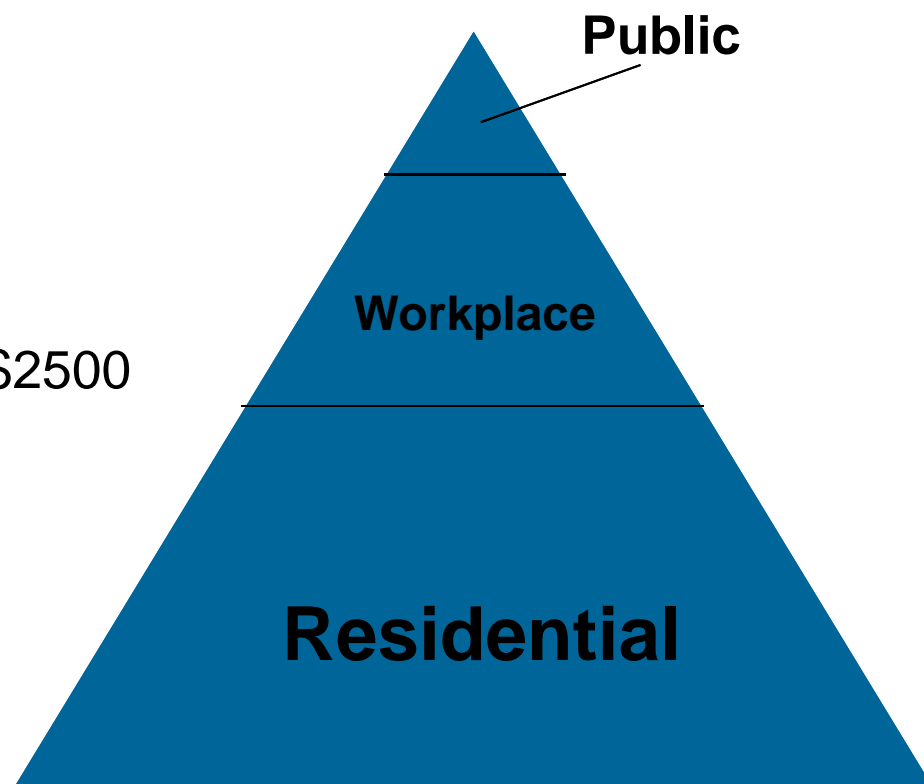
## DC Fast Charging

Up to ~ 50 – 60 kW  
Fast, expensive  
Standard not yet in place

## Three 'Places' to Charge

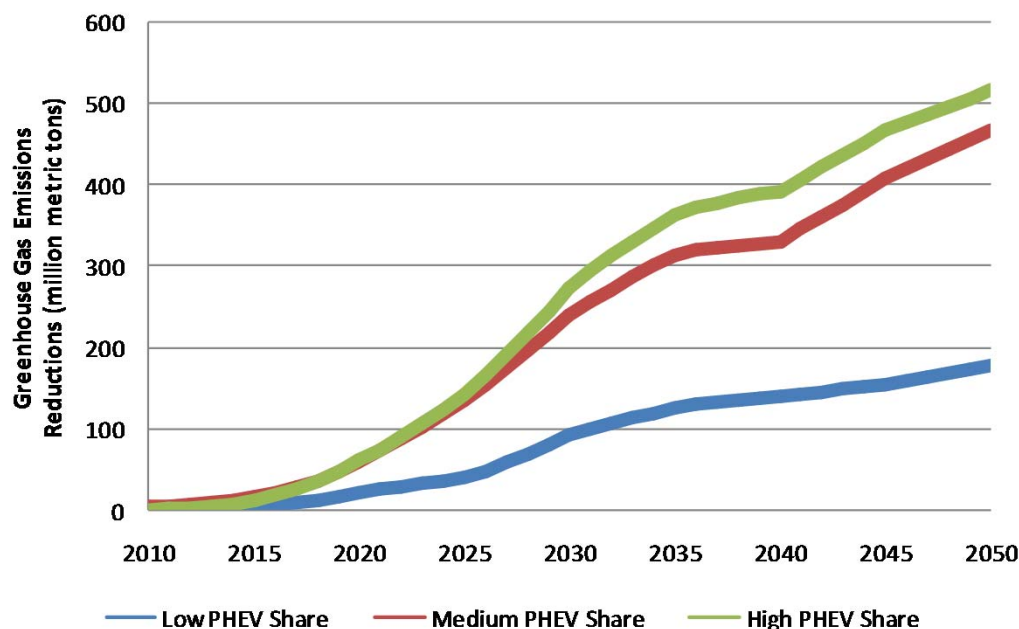
- **Build Today's Infrastructure Today**

- Infrastructure installation cost
  - ~ \$1500 home, \$2500+ public
- Focus on Residential
  - 95% of vehicles end day at home
  - Some costs can exceed \$2200 - \$2500
  - Cost and lead time minimization
- Workplace
  - 2<sup>nd</sup> priority in terms of use
- Public Charging
  - Critical vs. convenience
  - Understand DC Fast Charging
  - Long-term sustaining of infrastructure



# Environmental Benefits of Plug-In Vehicles

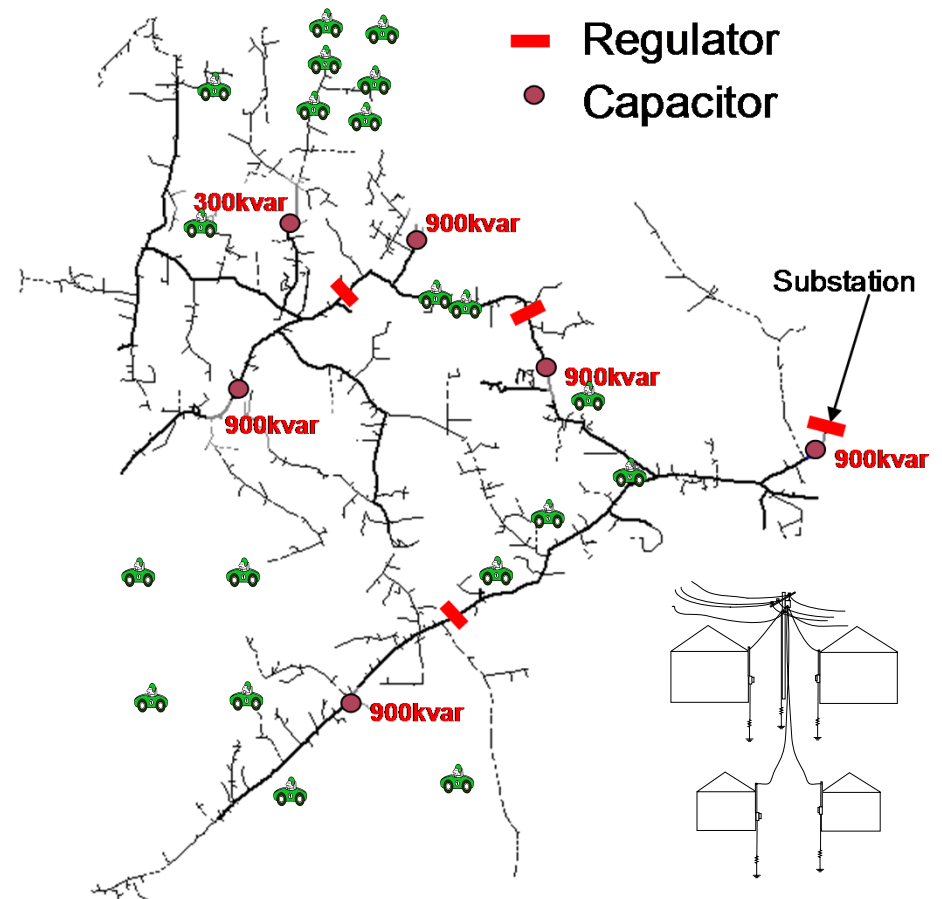
- Electricity is a low-carbon fuel
- Nationwide air quality benefits – under all generation source scenarios
- 3-4 million barrels/day petroleum reduction
- Significant increase to regional economic output, jobs, household income



**Annual Reduction in GHG Emissions  
due to PHEV Adoption**  
Source – 2007 EPRI-NRDC Study

# EPRI PEV Distribution System Impact Study

- Detail electrical model of selected feeders that includes each customer
- Assessment of different PEV charging type and penetration mode
- Hourly analysis using 8760 hours load profile to assess localized hotspots



**Provide Planning Tool to Assess Potential of Localized Hotspots in Distribution System**



# Solar Assisted PEV Charging Stations

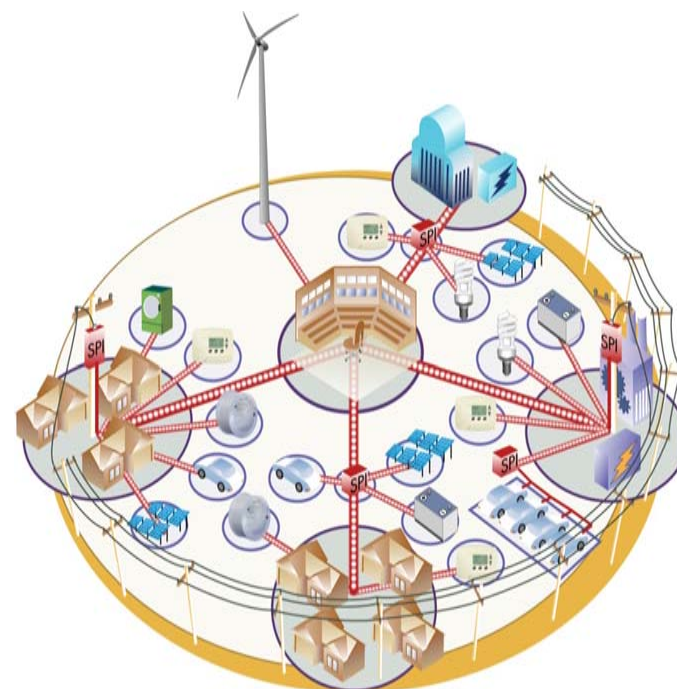
- Combines vehicle charging with solar power and battery storage along with smart grid interface
- First of it's kind (TVA - EPRI @ Knoxville, TN)



**Provides a field laboratory for evaluation of different charging infrastructure integrated with distributed resources and smart controls**

# Smart Charging - Key to Reducing Grid Impacts

- ‘Smart charging’ is a compact between utility and vehicle owner
  - Low in cost and convenient for vehicle operator
  - Minimize system impacts
- Implement with Automated Metering (AMI), Home Area Networks (HAN), internet communications, etc.
- Vary time-of-day and charge power



**Vision – By 2015, all plug-in electric vehicles can communicate to the smart grid and charging is intelligently controlled**

# What Does EV Readiness Mean?

- Organized and effective stakeholders
- Understanding the “local and regional” drivers of PEV adoption
- Education and outreach
- A comprehensive plan for charging infrastructure
  - Addressing residential charging first
    - Streamlining the process
    - Establish tariffs and utility role
  - A sensible plan for public infrastructure



# EPRI Public Reports on Plug-In Electric Vehicles

*“Transportation Electrification – A Technology Overview”*, Electric Power Research Institute, Palo Alto, CA: 2011. #1021344.

*“Characterizing Consumers' Interest in and Infrastructure Expectations for Electric Vehicles: Research Design and Survey Results”*, EPRI, Palo Alto, CA and Southern California Edison, Rosemead, CA: 2010. #1021285

*“Environmental Assessment of Plug-In Hybrid Electric Vehicles – Volume 1: Nationwide Greenhouse Gas Emissions”*, Electric Power Research Institute, Palo Alto, CA: 2007. #1015325

*“Environmental Assessment of Plug-In Hybrid Electric Vehicles – Volume 2: United States Air Quality Analysis Based on AEO-2006 Assumptions for 2030”*, Electric Power Research Institute, Palo Alto, CA: 2007. #1015326



# Together...Shaping the Future of Electricity