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ELECTRIC POWER
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Plug-In Electric Vehicles and the Electric Grid



Johns Hopkins SAIS:
Global Energy and Environment Initiative
Speakers Bureau

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The Electric Power Research Institute: RD&D Consortium for the Electricity Industry

- Independent, unbiased, tax-exempt collaborative research organization
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 - *Nuclear*
 - *Generation*
 - *Environment & Renewable Energy*
 - *Power Delivery & Utilization*
- Over 1000 research funders from over 40 countries
- Major offices in Palo Alto, CA; Charlotte, NC and Knoxville, TN



Four Questions

- 1. How “green” are plug-in electric vehicles (PEVs)?**
2. What opportunities do PEVs present to the electric industry?
3. What challenges do PEVs pose for the electric industry and how can those challenges be met?
4. To what extent will PEVs help reduce GHG emission and contribute to a low-carbon economy?

Collaborative Study



Environmental Assessment of Plug-in Hybrid Vehicles

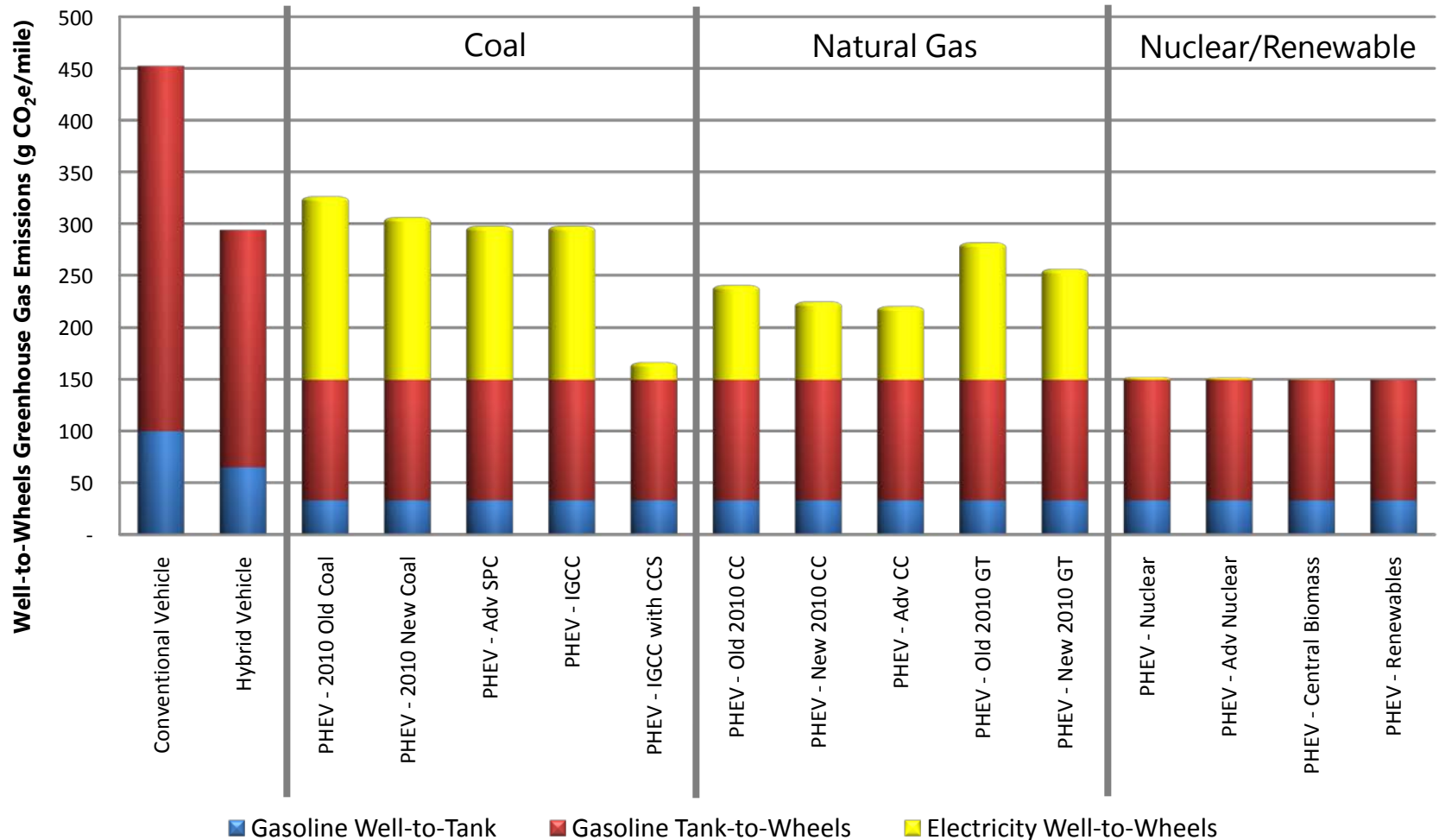
Volume 1: Nationwide Greenhouse Gas Emissions

Volume 2: United States Air Quality Analysis Based on AEO-2006 Assumptions for 2030

Joint report available at: www.epri.com/et

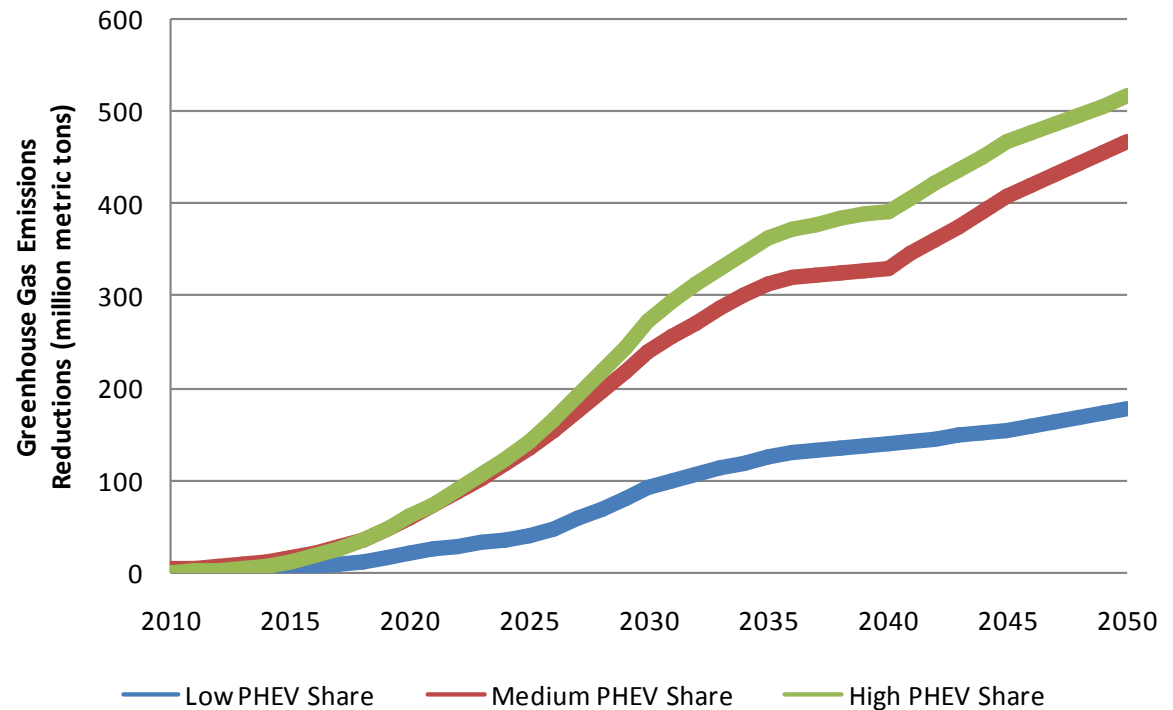
Power Plant-Specific PHEV Emissions in 2010

PHEV 20 – 12,000 Annual Miles



Greenhouse Gas Emissions Reduction Potential due to Plug-In Hybrid Electric Vehicles

- Electricity grid evolves over time
- Nationwide fleet takes time to renew itself or “turn over”
- A potential 400-500 million metric ton annual reduction in GHG emissions



Annual Reduction in GHG Emissions due to PHEV Adoption

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Plug-In Hybrid Electric Vehicle Value Proposition

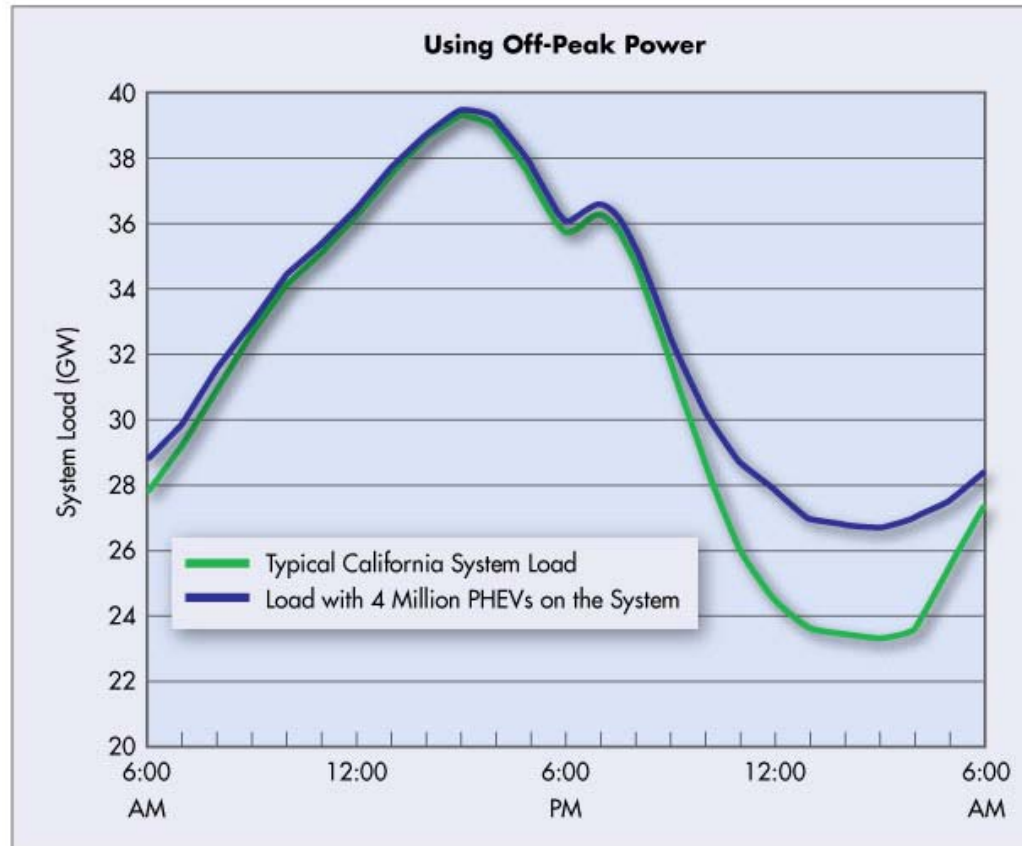
- Electricity as Transportation Fuel
- PHEVs as Energy Storage
- Synergism with Smart Grid



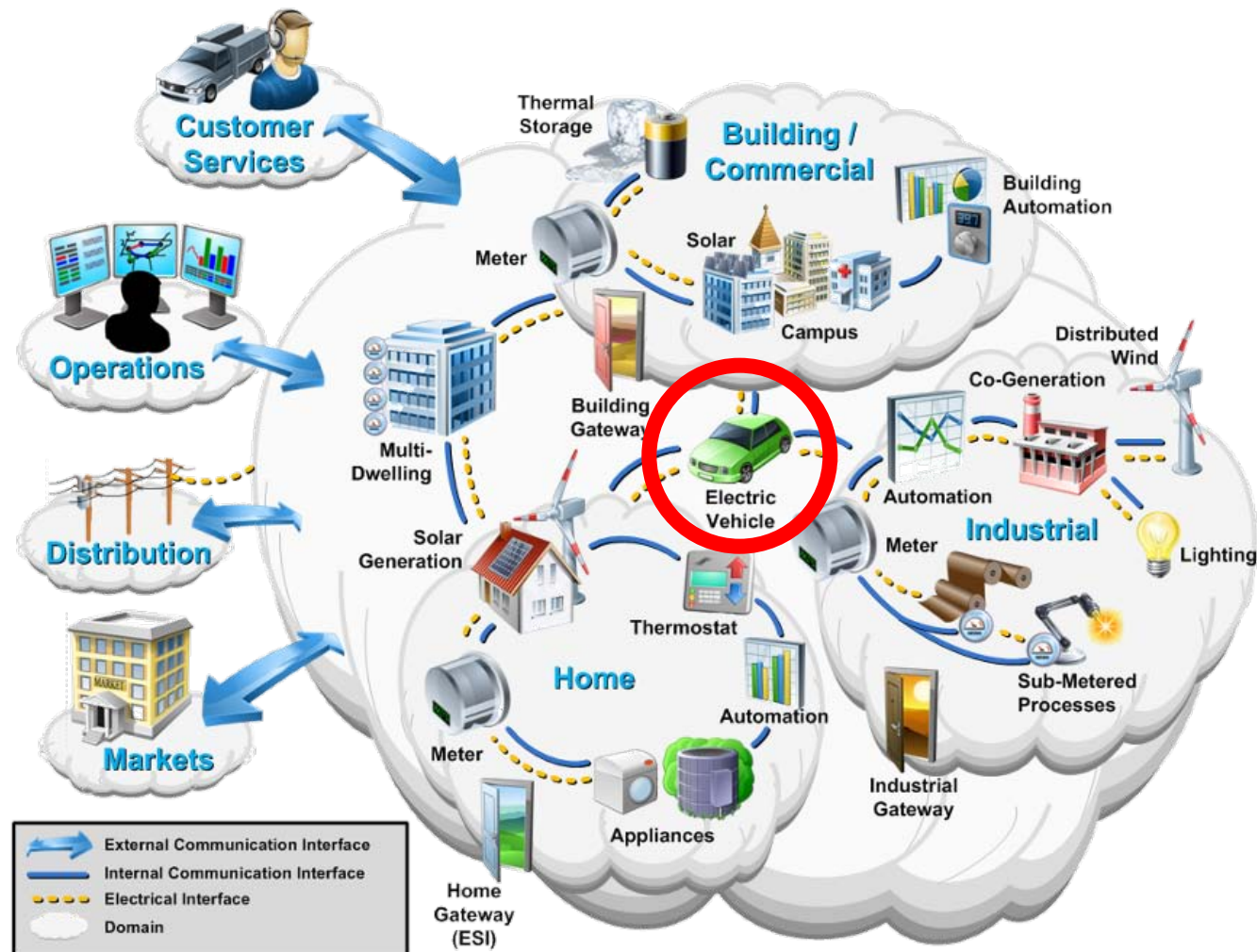
- Demand response
- Energy efficiency
- Load Management
- Integration of Renewables
- Improved Asset Utilization
- Improved System Efficiency
- Lower Cost of Stationary Energy Storage

- CO₂ Emissions Reductions
- Air and Water Quality Benefits
- Improve Reliability
- Improve Customer Rate Structure

Benefits from and to the Grid



Objective: Full Integration of Plug-In Electric Vehicles (PEVs) with the Smart Grid



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Components of Grid Integration



Open communication standards



Standard Interface

AMI Path



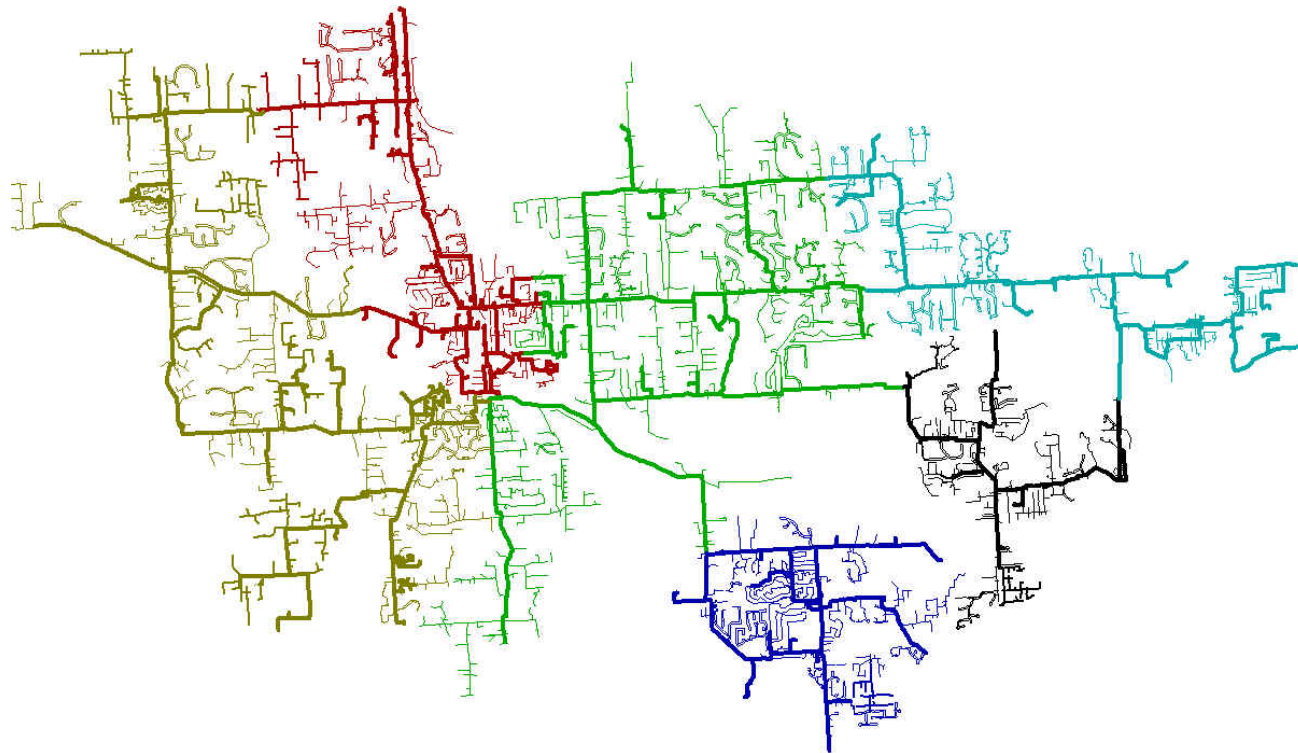
Non-AMI Path



Smart Charging Back End
Energy Management, Customer ID, Billing

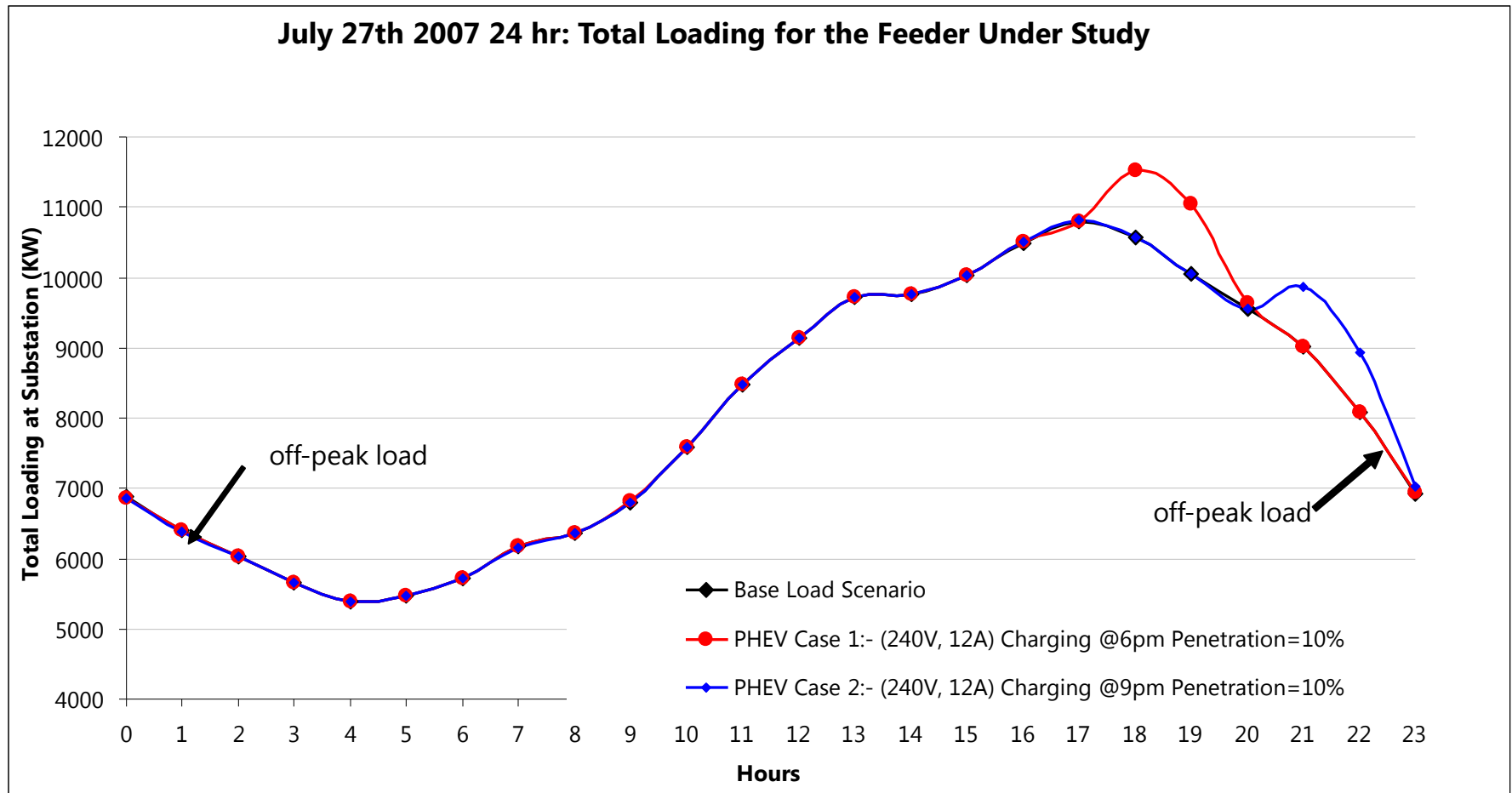
Distribution System Impacts

- Evaluate localized impacts of PHEVs to utility distribution systems



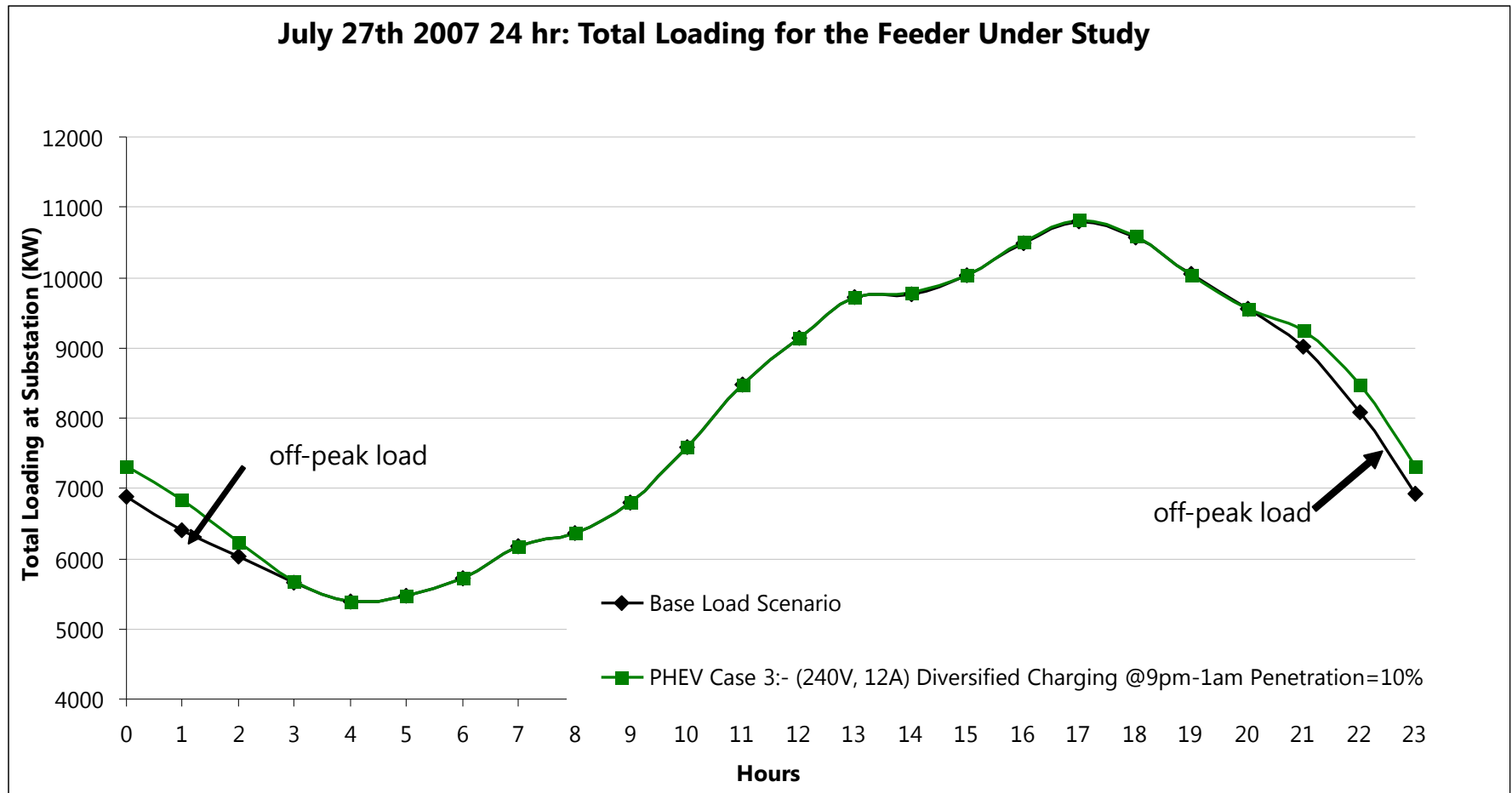
Distribution System Analysis

Smart Charging is a Key Technology to Reduce Impacts



Distribution System Analysis

Smart Charging is a Key Technology to Reduce Impacts



Ford PHEV Program: First OEM-Utility Demonstration of PHEV Passenger Vehicles



- Vehicle-to-smart meter connectivity demos at each utility
- Utility, automaker, and customer value propositions
 - Including secondary, primary stationary battery use



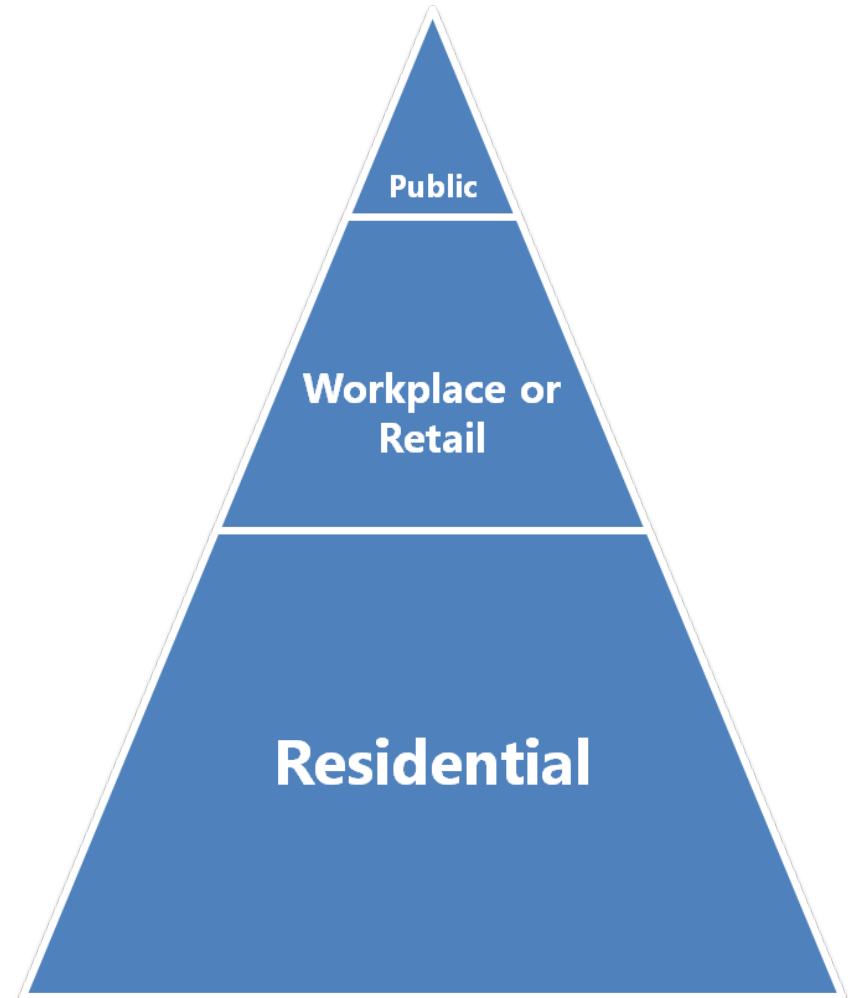
EPRI – GM Smart Charging and Vehicle Demonstration

- Address critical issue of vehicle connectivity
- Data intensive, standards-based smart charging program



Charging Infrastructure

- Residential
 - Seamless Installations for Homeowners
- Workplace or Retail
 - Commercial/Industrial Customers
- Public Charging
 - Support Municipalities



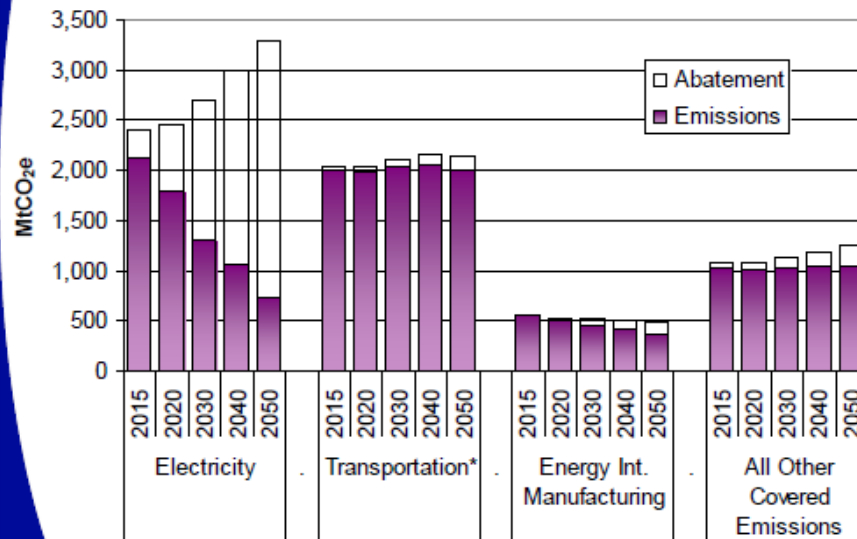
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American Clean Energy and Security Act of 2009 (Waxman-Markey H.R. 2454)

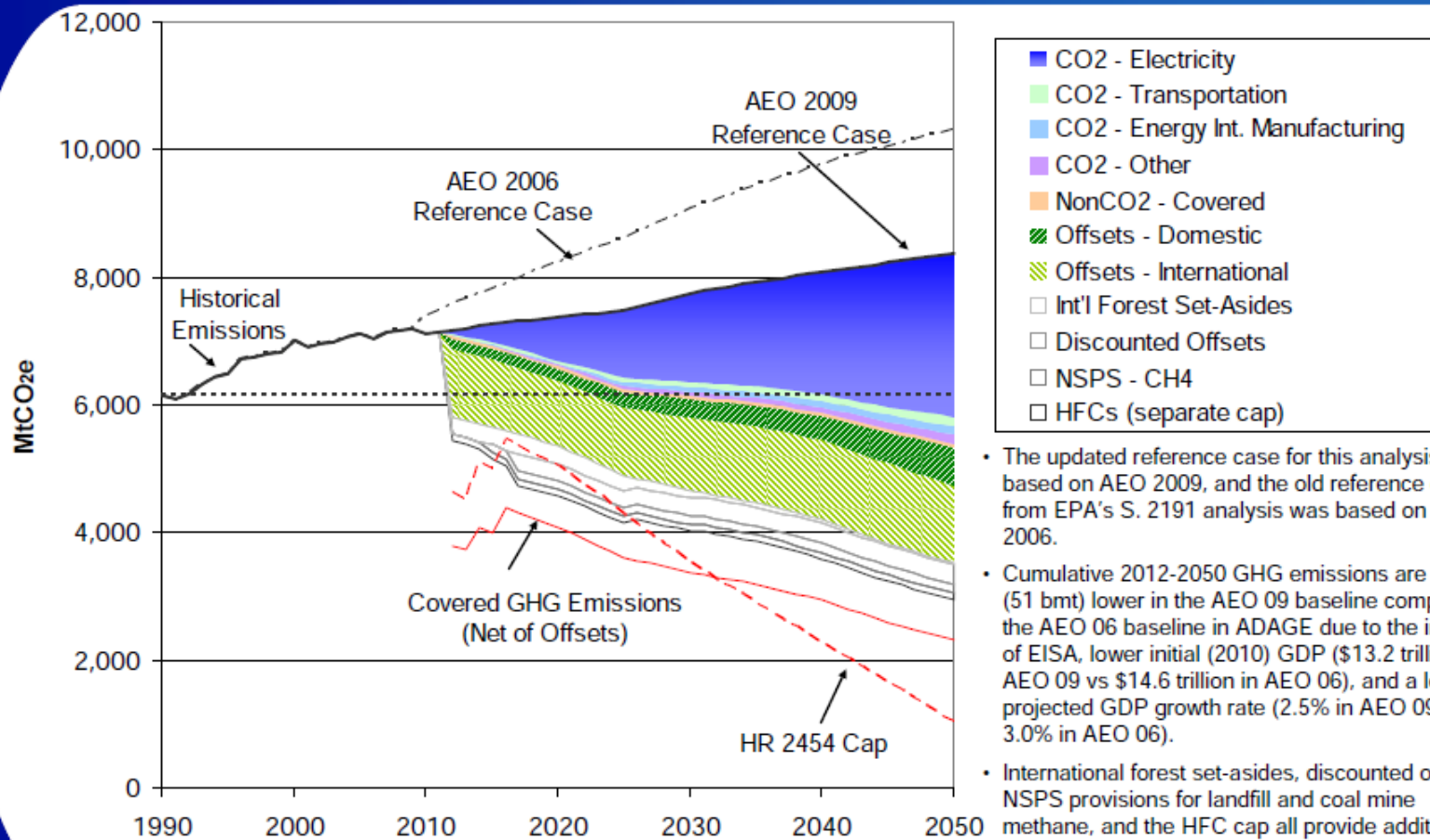
- CO₂ emissions from the electricity sector represent the largest source of domestic reductions.

Covered GHG Emissions by Sector
Scenario 2 - H.R. 2454t



* Transportation emissions consist of the ADAGE transportation category and residential category (which is primarily made up of personal automobile use).

American Clean Energy and Security Act of 2009 (Waxman-Markey H.R. 2454)



- The updated reference case for this analysis is based on AEO 2009, and the old reference case from EPA's S. 2191 analysis was based on AEO 2006.
- Cumulative 2012-2050 GHG emissions are 14% (51 bmt) lower in the AEO 09 baseline compared to the AEO 06 baseline in ADAGE due to the inclusion of EISA, lower initial (2010) GDP (\$13.2 trillion in AEO 09 vs \$14.6 trillion in AEO 06), and a lower projected GDP growth rate (2.5% in AEO 09 vs 3.0% in AEO 06).
- International forest set-asides, discounted offsets, NSPS provisions for landfill and coal mine methane, and the HFC cap all provide additional abatement that does not help to meet the main cap.

Summary

- Plug-in electric vehicles can provide significant reductions in greenhouse gas emissions.
- Plug-in electric vehicles can play an important role within the smart grid enabling more efficient use of electric resources.
- The main challenge for the electric industry will be to prevent any distribution system impacts through asset replacement or smart grid strategies. **Demonstration programs are essential.**
- Infrastructure deployment with a focus on residential charging will also be a priority.
- Updated energy-economic models are necessary to evaluate the role of PEVs in environmental policy under various assumptions.

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