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DOE Electric Drive Activities

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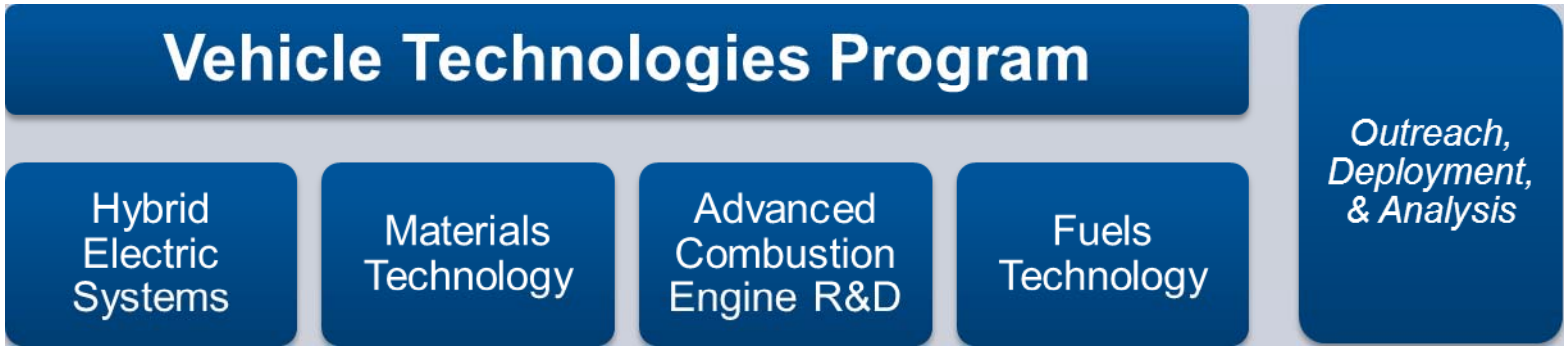
Unprecedented Investment in Advanced Vehicle Technologies



- 50% increase in Vehicle Technologies Program budget in the last 2 years
  - Approximately half of $311M VTP budget supports vehicle electrification initiatives
- $25 billion Advanced Technology Vehicle Manufacturing Loan Program
- Launch of ARPA-e
- Grants totaling $2.8 billion through American Recovery and Reinvestment Act
  - Electric Drive Battery & Component Manufacturing Initiative ($2.0 B)
  - Transportation Electrification Initiative ($400 M)
  - Clean Cities ($300 M)
  - Super Truck / Advanced Technology Powertrains – Light Duty ($115 M)

Analysis Informs Strategy

Projected Vehicle Technology for 2030

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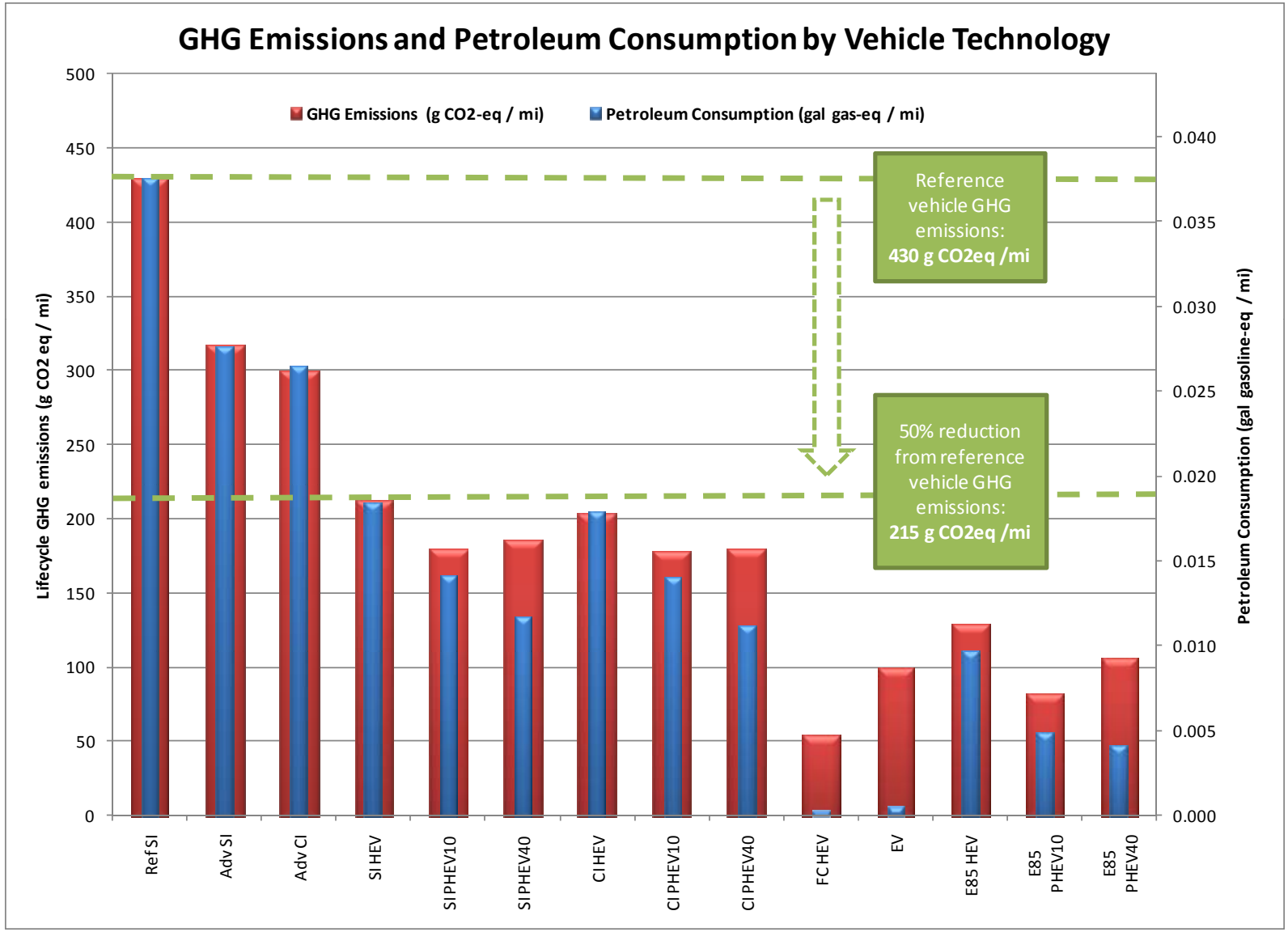
- Vehicle GHG emissions fall into 3 major groups:
  - Conventional
  - Electric-drive
  - Combination electric-drive & biofuel
- Petroleum consumption loosely mirrors GHG emissions



Realizing Benefits of Advanced Vehicle Technologies Takes Time

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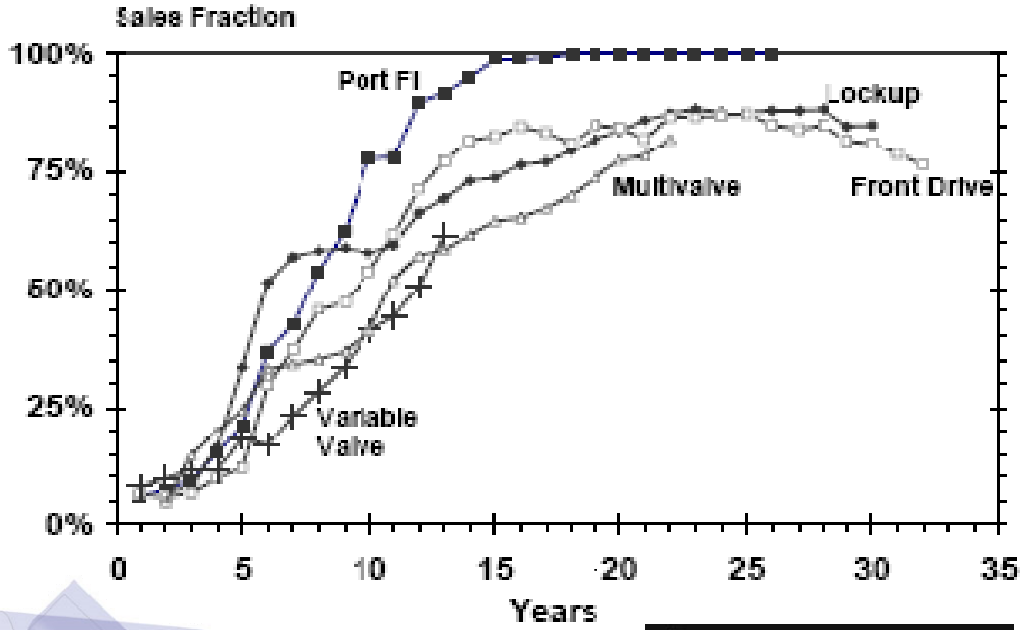
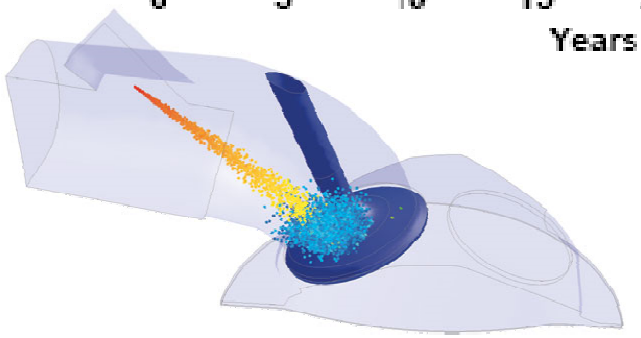
Vehicle Technology Penetration

Years After Initial Significant Use





U.S. Vehicle Market

- > 240 Million vehicles on the road
- Approximately 11.5M new cars & light trucks for 2010; average is 15.7 M/yr 2002-2007
- Hybrid vehicles <3% of sales

Very Important to Minimize Market Introduction Time

Overcoming Market Barriers

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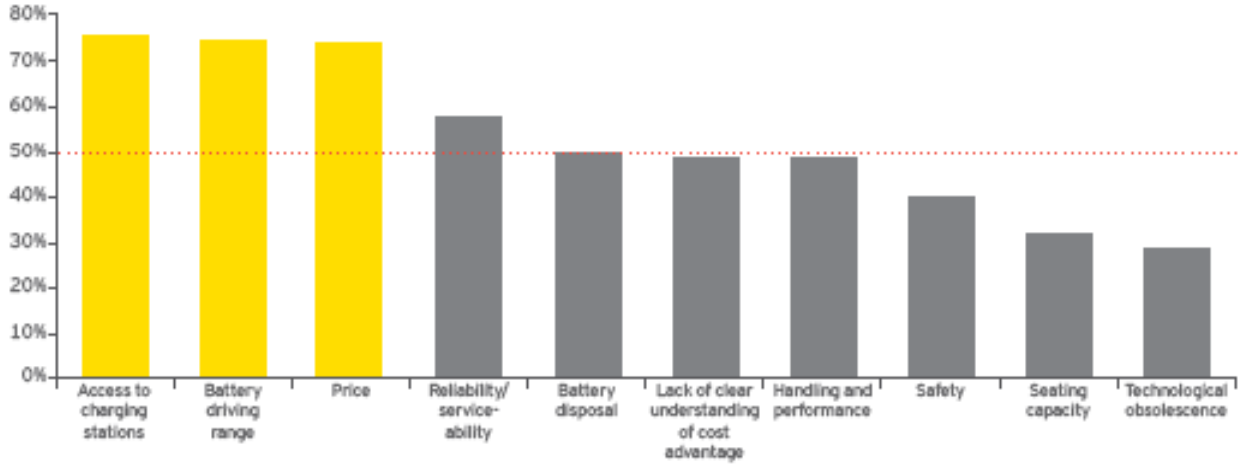
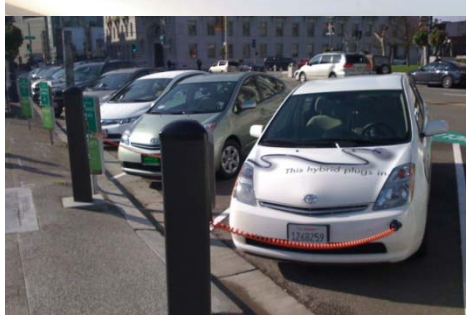
*It is imperative that adequate and appropriate charging infrastructure be deployed in order to overcome **Range Anxiety**.*

Which factors would make you most hesitant to choose an EV as your next new vehicle?

(Ernst & Young PHEV/EV Survey January 2010)





- ***Access to charging stations*** and ***Battery driving range*** cited as 2 most important factors limiting consumer acceptance of EVs. This "Range Anxiety" is mitigated by:
  - Largest ever deployment of electric vehicle charging infrastructure as part of ARRA awards
  - Public awareness and consumer education campaigns to ensure consumers understand capabilities of EVs
  - Telematics/navigation systems/apps which can provide information regarding vehicle range and proximity to EV charging stations

Hybrid-Electric Systems

Petroleum Displacement via Fuel Substitution & Improved Efficiency

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Administration Goal:1 Million PHEVs by 2015

Types of Vehicles and Benefits

HEV →

Toyota Prius

50 MPG

PHEV →

Chevy Volt

37-94 MPGe

EV →

Nissan Leaf

99 MPGe

System Cost

	PHEV Battery Cost per kW·h	APEEM Cost per kW
2008	$1,000 - $1,200	$22
2010	$700 - $950	$19
2012	Goal = $500	Goal = $17
2014	Goal = $300	
2015		Goal = $12

Targets and Status

2014 PHEV: Battery that has 40-mile all-electric range and costs $3,400

2015 PEEM: Cost for electric traction system no greater than $12/kW peak by 2015

Status: $8,000-$11,000 for PHEV 40-mile range battery

Status: Current cost of on-the-road electric traction system is $34/kW

Recovery Act: Transportation Electrification Initiative

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The largest coordinated deployment of electric-drive vehicles and infrastructure ever undertaken in the U.S.

- Approximately $400 million in federal funding, leveraged through cost-shared grants with industry and educational institutions, to develop, demonstrate, and evaluate electric drive vehicles and charging infrastructure
- Supports the deployment of over 13,000 electric-drive vehicles in conjunction with over 20,000 charging stations in residential, commercial, and public locations in various geographic locations nationwide
- Two of eight demonstration projects specifically target EVSE deployment
  - ECOtality: The EV Project
  - Coulomb Technologies: ChargePoint America

Transportation Electrification: Nationwide Demonstration

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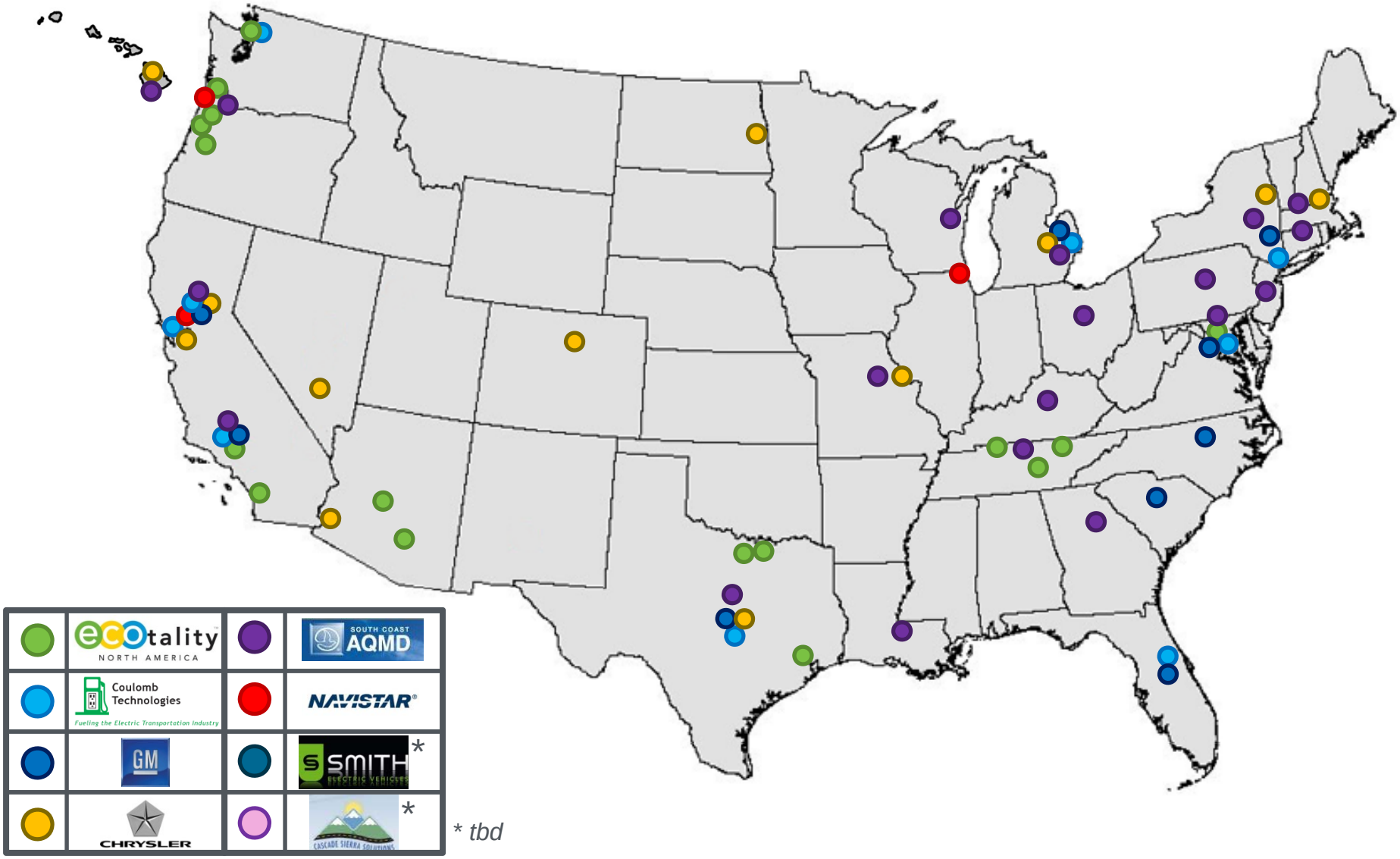

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ARRA: Transportation Electrification

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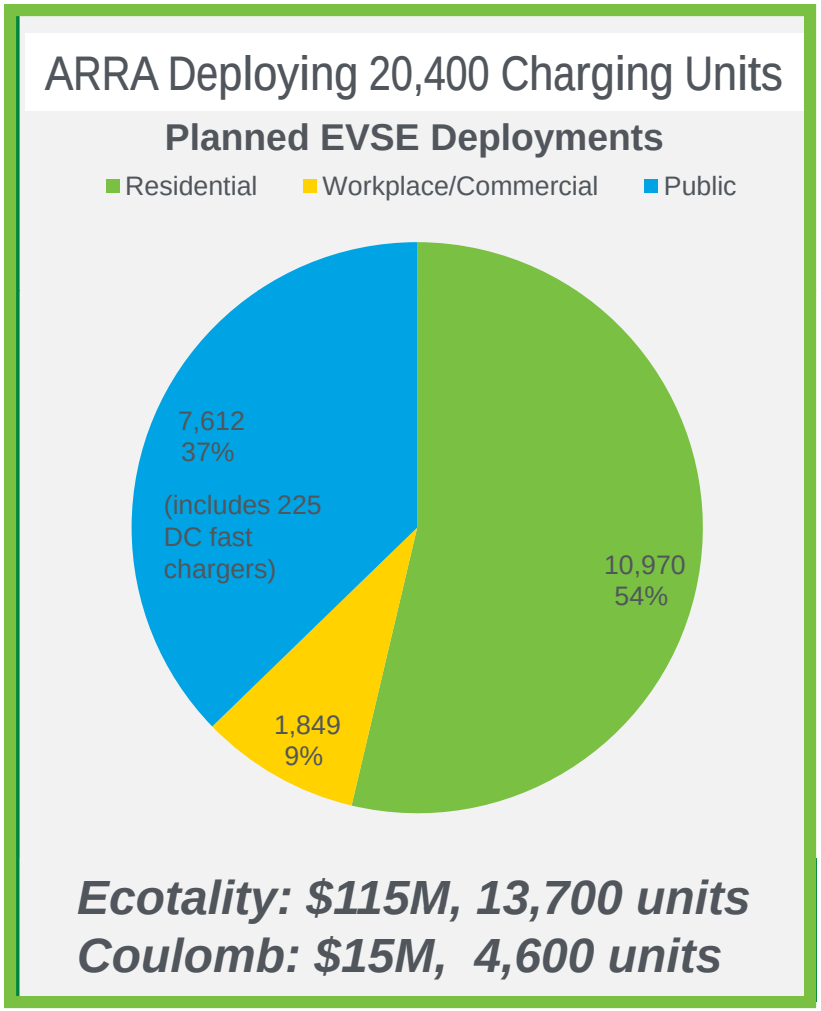
ARRA Deployment Projects Focus on Residential Installations



- About 2/3 of the installations will be Residential or workplace/fleet.
- ARRA charging infrastructure is important:
  - Allows data collection to quantify utilization of public EVSE
    - What public locations will be most popular?
    - How often will people recharge? Mostly at home? Opportunity charging?
    - What is the average trip length?
    - How important is fast charging?
- Provides reassurance to consumers to alleviate “range anxiety” and to accelerate the initial PEV market

Transportation Electrification: Data Collection

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- Charge event data (collected from the EVSE):
  - Connect, start charge, end charge, and disconnect times
  - Average power (kW), max peak power (kW), total energy (kWh), and rolling 15 minute average peak power (kW)
  - Charger ID, event ID, and date/time stamp

- Driving event data (collected from the vehicle):
  - Data recorded for each key on/key off event
  - Event Type (key on/off), date/time stamp
  - Vehicle ID, Odometer, GPS location
  - Battery SOC, Liquid Fuel consumption

Transportation Electrification: Data Collection Plan

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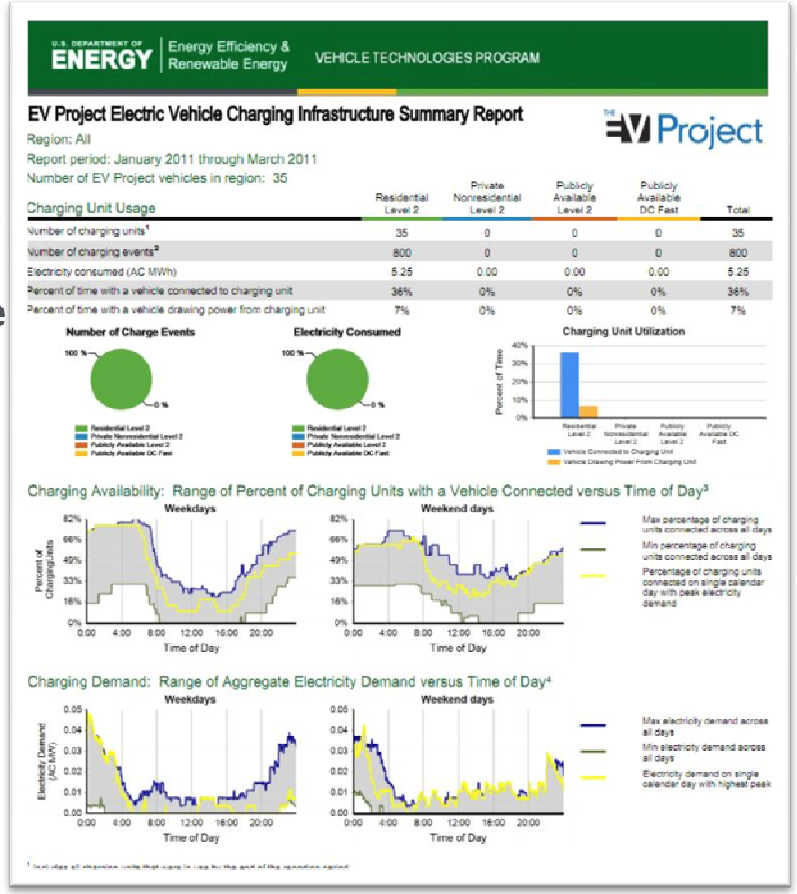
- Data will be collected by INL and NREL
- Data Analysis and Reporting will focus on:
  - Vehicle and charger performance, efficiency, utilization, and use patterns
  - Monitoring how use patterns change over time
  - Impact of various rate structures on charging habits
  - Impact of vehicle charging on electric grid
- Report dissemination:
  - Internet based via INL/NREL websites
  - Fact Sheet reporting commenced end Q2 FY 2011
  - Annual Utilization / impacts reports beginning late 2011
- Raw vehicle and infrastructure data will not be available
  - Considered "Generated Data with Delivery Restrictions"
  - Raw data will not be delivered to DOE in any format



NREL NATIONAL RENEWABLE ENERGY LABORATORY

INL Idaho National Laboratory

Vehicle Electrification: Grid Impacts

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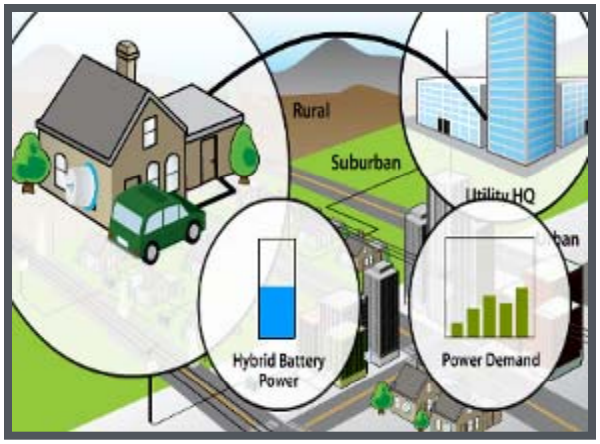
- Current grid capacity could supply about 70% of our vehicles without adding capacity, but assumes:
  - vehicle would charge only during off-peak
  - “perfect” distribution of electricity
  - No localized affects such as overburdening neighborhood transformers
- EVs and PHEVs are unlikely to overburden the grid in the near term
  - Initial impacts are likely to be seen at local distribution/transformer level
  - We clearly need to work fast as vehicles are rolled out to reduce impacts
- Smart Charging will be key to lowering cost and minimizing impacts
- Rate structures/incentives (such as time-of-use pricing) will also be important



Build-Out of Charging Infrastructure – Home Charging is Most Important

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Key Today: Home Charging

- Initial barriers are cost and installation processes.

Public Charging

- Expensive if not well utilized
- Can provide confidence to EV buyers

Market pull is needed to drive public infrastructure build out

- PHEVs do not require public infrastructure, but can create market demand which enables BEVs.

Public Charging Innovations

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Innovative Business Models Are Emerging But Are Unproven

Amenity

- Provided as a service to attract customers
- Increased revenue from "inside" sales
- Popular for restaurants, hotels, etc.
- Suitable for host/operator relationship

Battery Swap/Subscriptions

- Requires substantial infrastructure investment
- Swapping in Pilot phase, requires OEM buy-in
- Subscription model not fully established, but is being received well

DC Fast Charging

- 30 minutes for 80% charge (not as quick as "filling up")
- Expensive to install and operate (utility demand charges)
- Important for corridor travel for BEV owners

Recovery Act Efforts in Maryland

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- Transportation Electrification
  - Coulomb Technologies: ChargePoint America
    - 267 EVSEs planned for D.C. metropolitan area
    - In Maryland, 92 EVSEs ordered, 20 installed to date
    - 50 EVSEs planned for City of Baltimore
    - 9 EVSEs planned for the University of Maryland
  - ECOtality: The EV Project
    - 150 EVSEs planned for D.C. metropolitan area (residential)
  - General Motors: Chevy Volts deployed through Dominion, Pepco
  - Navistar: eStar Electric Trucks deployed in Maryland through Coca-Cola

- Electric Drive Battery & Component Manufacturing Initiative
  - General Motors: $105 M to construct second-generation GM global rear-wheel electric drive system in White Marsh, MD

- Maryland Hybrid Truck Initiative Recovery Act Project
  - Run through State Energy Office
  - $5.9 million in federal funding, $10 million in cost share
  - 5 national fleets involved, 143 heavy-duty diesel electric vehicles
  - Annual fuel displacement: 450,000 gasoline gallons equivalent estimated
  - Video about the project: http://www.afdc.energy.gov/afdc/videos/343/search/maryland#343

Clean Cities Efforts in Maryland

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- 78 public electric vehicle charging points state-wide
- Reduced 2.9 million gasoline gallon equivalents in 2009
- Located within the Maryland Energy Administration
- Working with the Maryland Public Service Commission on the regulatory treatment of EV re-charging stations
- Working with the Maryland Department of Transportation to form the Maryland Electric Vehicle Infrastructure Council
- Electric Vehicle Excise Tax Credit Program
- Coordinator: Chris Rice crice@energy.state.md.us

Maryland Clean Cities
Sponsored by the U.S. Department of Energy

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Clean Cities Community Readiness and Planning for Plug-In Electric Vehicles and Charging Infrastructure

Funding Opportunity Number: DE-FOA-0000451

$5 million (Competitive)
10-15 projects ($250-500K)
Cost-share encouraged

Applications Due: 6/13/11
Awards: Early Fall 2011
Planning/Policy/Procedures

OBJECTIVES

- This pilot project involves planning and policy activities that will prepare communities for successful deployment and implementation of plug-in electric drive vehicles.
- Focus on determining best practices for EVSE deployment, streamlining permitting processes, and locating EVSE infrastructure.
- Will highlight model communities that have identified and implemented policies and procedures that promote successful development of EV microclimates.

Clean Cities Electric Infrastructure Deployment

$200 million (Competitive/open solicitation)
Up to 30 projects ($5-10M each)
50% cost share required
Nation-wide implementation of $5M Pilot Project

OBJECTIVES

- Put in place the principles/practices/policies learned from the $5M *Community Readiness* program and the ARRA Transportation Electrification projects.
- Provide local or regional incentives to buy down the cost of EVSE installation to encourage home recharging.
- Support infrastructure primarily for workplace and fleet vehicle recharging.
- Streamline and improve the EVSE installation experience for consumers.
- Provide training for workforce development for vehicle repairs and installation of electric vehicle supply equipment.
- Provide coordination between building code officials, public utility commissions, permitting officials.
- Facilitate collaboration to provide infrastructure to develop electrified corridors to strategically connect EV-ready cities.

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