

Plug-in Vehicles & the Grid

NC Sustainable Energy Conference

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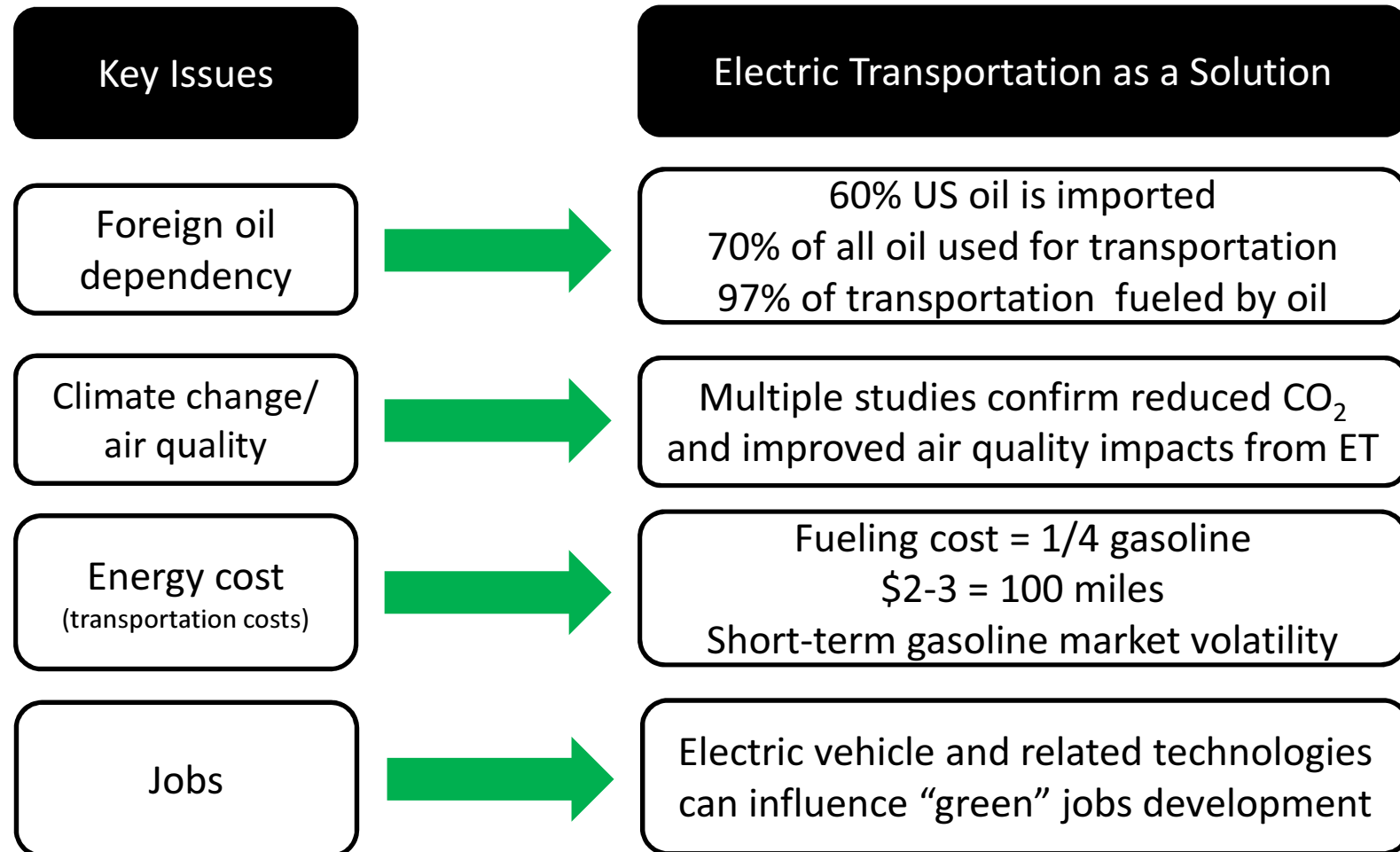
Progress Energy



Agenda

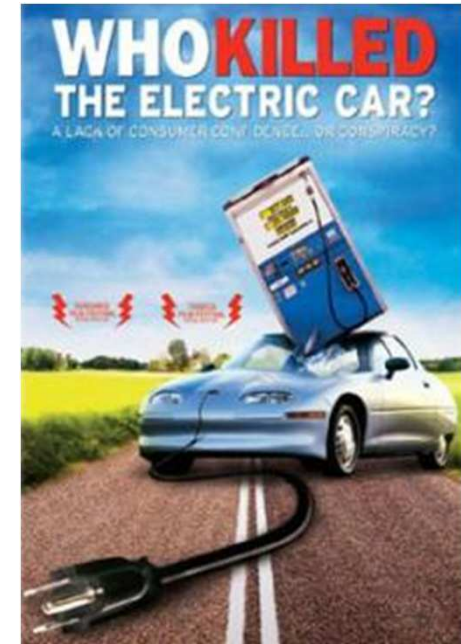
- Value Proposition
- Vehicles
- Charging Technology
- Grid Impact
- Utility Role
- Questions

Value Proposition



PEVs are not new... but this time it's different

- Technology
 - Plug-in *hybrid* electric technology
 - Improved batteries with higher energy density/longer range
- Marketplace
 - Driving factors include gas/oil prices, energy security, GHGs
 - Not just California
 - Broad support and incentives
- Customer Features
 - Instant torque
 - Preconditioning the cabin
 - Connectivity



Every Major Automaker Has a Plug-in Electric Vehicle Planned by 2013

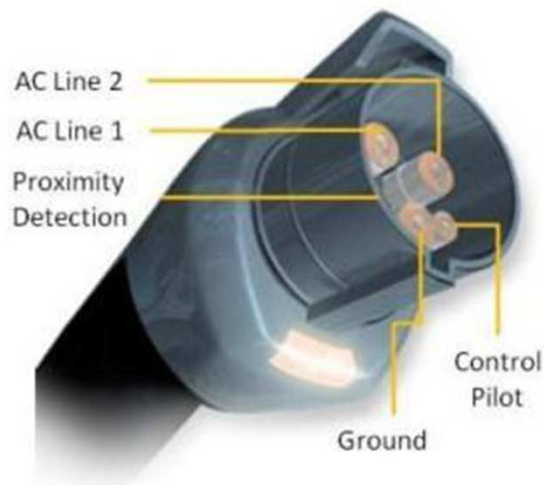
	PHEV or EREV			ALL ELECTRIC		
Demo/Concept ↑ Production						
	Chevrolet Volt	Toyota Prius	BYD 3DFM	Nissan Leaf	Smart ED	Mitsubishi iMIEV
						
	Mitsubishi PX-MiEV	BMW Concept	VW Golf TwinDrive	Ford Focus	Ford Transit Connect	Tesla
						
Hyundai Blue-Will	Volvo C30	Kia Ray	Chrysler/Fiat EV	Honda Fit EV	Toyota RAV4 EV	
						
GM PHEV (?)	Cadillac Converj	Fisker Karma	Mercedes BlueCell	Tesla Model S	Toyota FT-EV	

Charging Infrastructure Standards

Key Point: The industry has agreed up upon a single charging connection standard – SAE J1772

	Voltage	Max Current	Likely Current	Charge Time (average)	Charge Time (full charge BEV)	Reference
AC Level 1	120 V	16 A	12 A	8-12 hrs	16-20 hrs	Hair Dryer
AC Level 2	208/240 V	80 A	16-30 A	2-3 hrs	6-8 hrs	Clothes Dryer
DC Fast	<i>Under development; 80% charge in 15-25 minutes (500V, 100A, 50 kW)</i>					Small Building

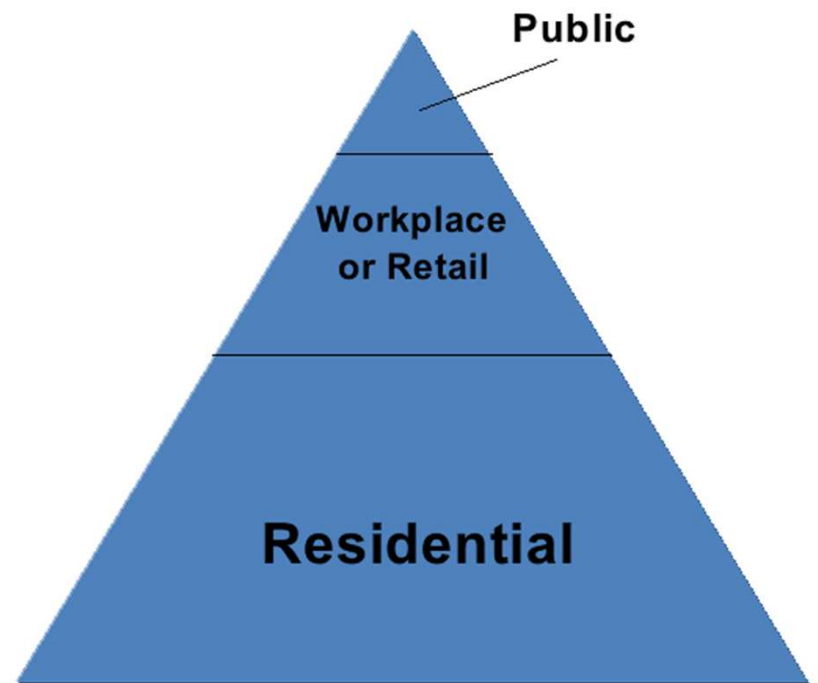
Level 1 can utilize a standard household outlet and stand alone cord set, but Level 2 requires a hardwired cord set into a special box with safety electronics.



Charging Locations

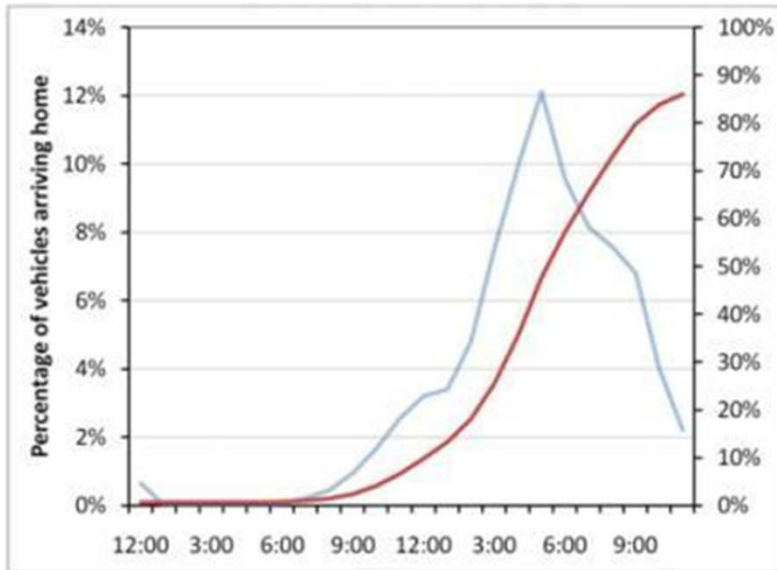
Key Point: Charging infrastructure is critical; majority will occur at home

- Residential
 - Default charging
 - AC Level 1 or 2
 - \$500-\$2,000 hardware (L2)
 - \$500-\$1,500+ installation
- Workplace/Retail
 - 2nd most common location
 - AC Level 2
 - \$2,000-8,000 hardware
 - Similar range for installation
- Public
 - Retail, decks, curbside
 - AC Level 2, DC Fast
 - Costs:
 - AC L2 similar to workplace
 - DC fast charging unknown

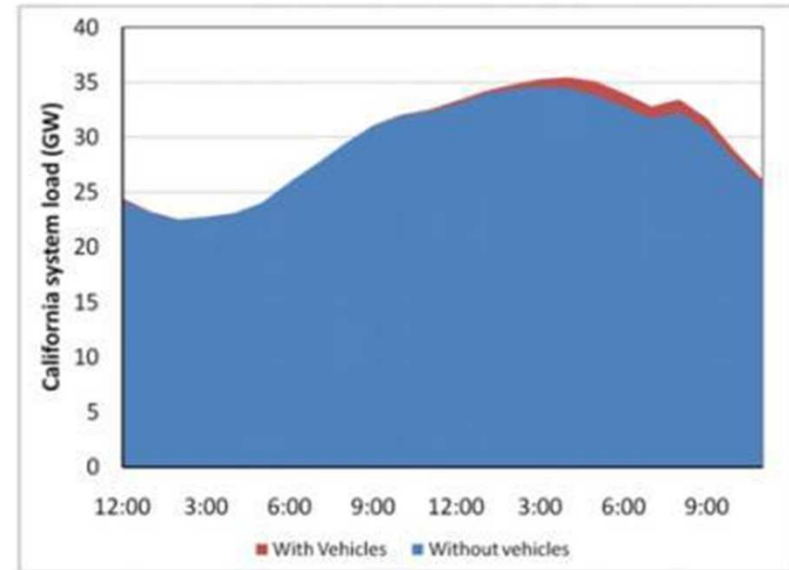


System Impacts

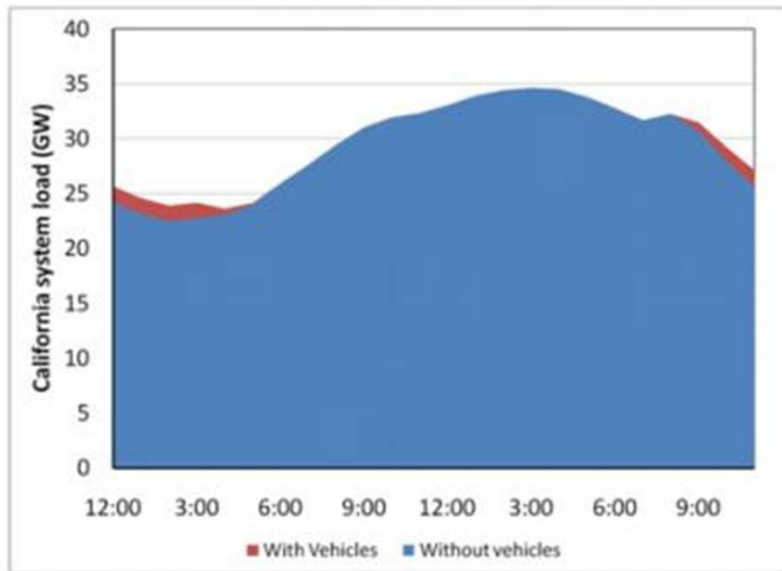
Source; Effects of transportation electrification on the electricity grid
 Marcus Alexander Manager, Vehicle Systems Analysis
 Workshop 4 – Plug-in Electric Vehicle Integration Issue July 15, 2009



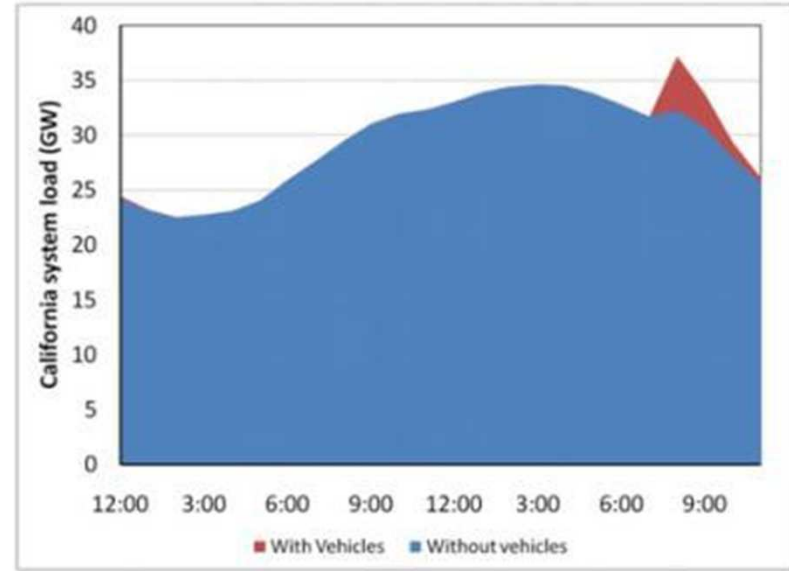
Maximum home arrival is 12% at 5 PM
 By 8 PM, 70% of drivers have arrived home



This is the demand for 2 million simulated vehicles versus the demand for July 7, 2009; average load is 700W per vehicle

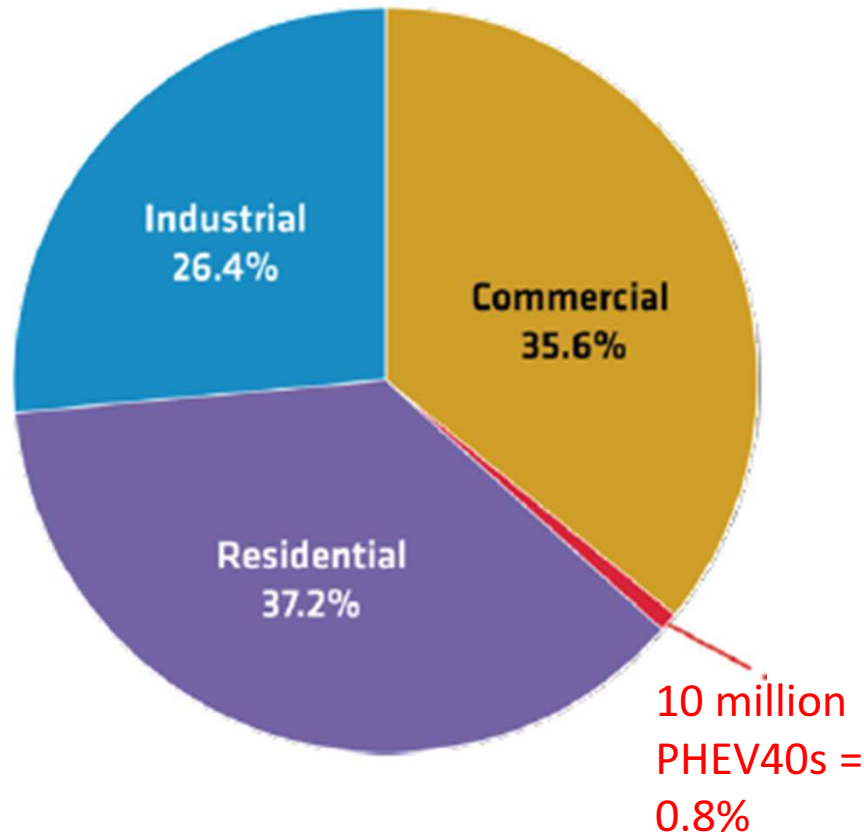


The same 2 million vehicles can be charged overnight with no increase in peak load



2 million badly controlled vehicles can create a new peak
 This would be a serious disruption

Grid System Impact in Perspective



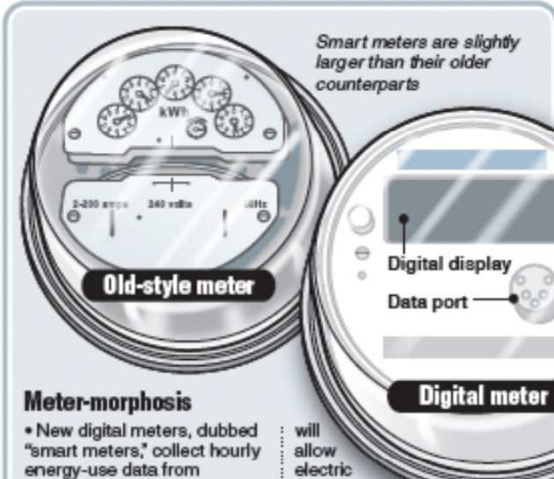
Source: EPRI

- PNNL study indicated there is sufficient underutilized grid capacity to power 73% of today's vehicles as PHEVs
- ORNL study indicated smart charging can help minimize future power plant needs to between zero and 8
- 10 million PHEV40s (e.g. Chevy Volt) would account for less than 1% of national electricity generation

PEVs and the Smart Grid

With digital technology, the grid grows smarter

Little has changed in the way utilities manage electric grids since 1882, when Thomas Edison opened his Pearl Street power station in lower Manhattan. Digital technology over the next few years, however, will create a "smart grid" that promises to transform utilities and customer habits.



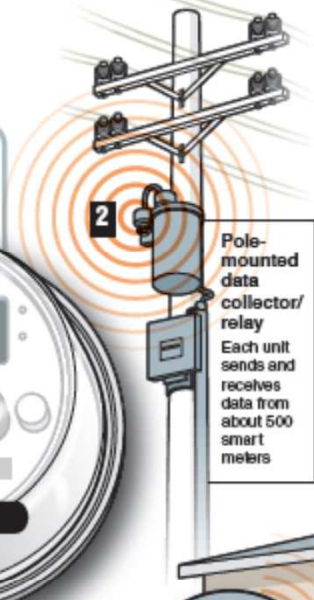
Old-style meter

Digital meter

Smart meters are slightly larger than their older counterparts

Meter-morphosis

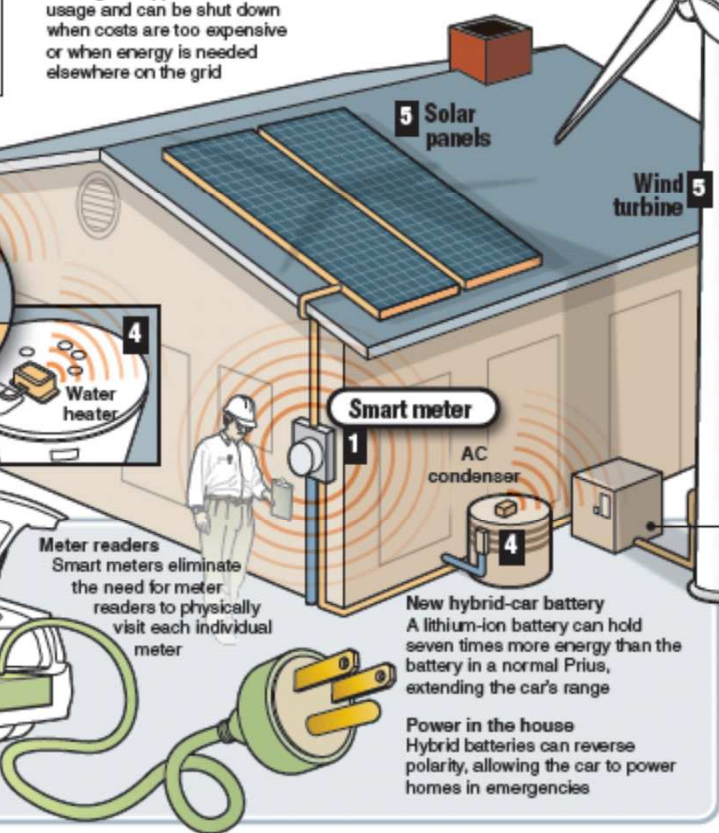
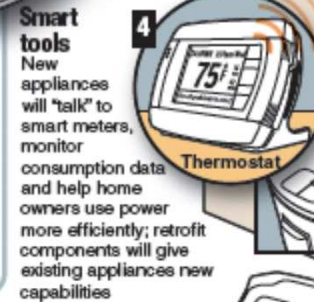
- New digital meters, dubbed "smart meters," collect hourly energy-use data from individual homes and relay that information via wireless radio signals to the electric utility
- Customers will be able to view their data online, or with mobile devices, playing active roles in managing their energy consumption and costs; by tracking hourly charges incurred by users, including energy costs, the smart grid will allow electric utilities to send out detailed monthly bills that resemble other monthly statements such as for cellphones
- New technology will help utilities monitor power distribution across the grid, and in conjunction with other "smart" technology in the home, to more efficiently use electricity



- Inside the smart grid**
- 1 Smart meter**
A digital smart meter monitors home energy consumption and transmits that data by radio
 - 2 Data collector/relay**
Pole-mounted relays collect data from up to 500 smart meters and monitor power flows on the grid
 - 3 Utility control room**
Real-time data will be monitored around the clock, allowing more efficient distribution of power
 - 4 Smart tools**
"Intelligent" appliances monitor usage and can be shut down when costs are too expensive or when energy is needed elsewhere on the grid



5 Microgenerators
Smart-grid customers with solar panels or wind turbines could sell excess energy to the grid and get paid as microgenerators



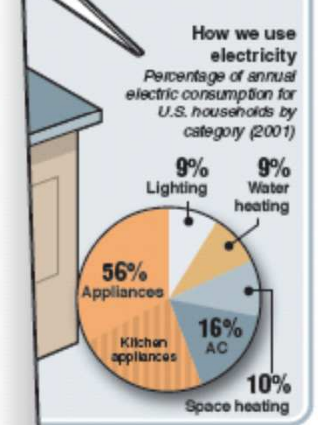
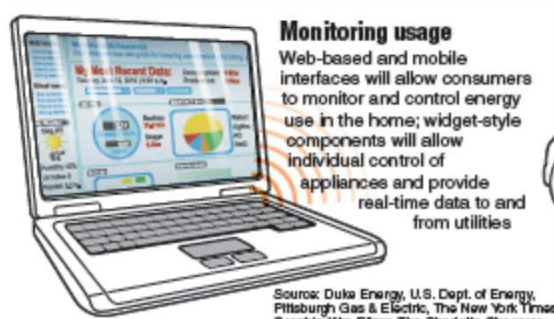
Self-healing grid

Smart grids can redirect power flow across the grid to avoid blackouts:

Data collected by smart meters help the utility identify potential power failures during peak-demand periods

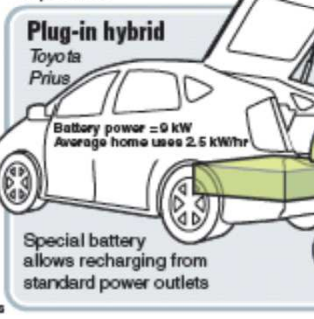
Utility adjusts power on the grid by automatically adjusting smart thermostats and smart appliances in homes via radio signals

Pole-mounted sensors also allow the utility to redirect power around line breaks caused during storms or by an accident, isolating the site and minimizing outages

Monitoring usage

Web-based and mobile interfaces will allow consumers to monitor and control energy use in the home; widget-style components will allow individual control of appliances and provide real-time data to and from utilities



Plug-in hybrid

Toyota Prius

Battery power = 9 kW
Average home uses 2.5 kW/hr

Special battery allows recharging from standard power outlets

Meter readers

Smart meters eliminate the need for meter readers to physically visit each individual meter

New hybrid-car battery

A lithium-ion battery can hold seven times more energy than the battery in a normal Prius, extending the car's range

Power in the house

Hybrid batteries can reverse polarity, allowing the car to power homes in emergencies

Battery backup

Customers who have their own solar panels and wind turbines could save excess energy, storing it in large-format batteries for use at night or during power outages

Local efficiency

Generating power locally avoids the energy loss (about 15 percent) that occurs over long-distance lines

Source: Duke Energy, U.S. Dept. of Energy, Pittsburgh Gas & Electric, The New York Times
Graphic: Wm. Pflizer, The Charlotte Observer

The Utility Role

- Maintain a safe and reliable grid
- Explore approaches to manage costs
 - Mitigate impacts from distribution upgrades and peak generation
- Ensure positive customer experience
 - Seamless access to charging infrastructure
 - Identify service upgrade necessity and process
 - Initial purchase and on-going customer service
- Assist key stakeholder groups in planning efforts
- Support technology standards and research
- Edison Electric Institute pledge

1	2	3	4	5
Infrastructure	Customer Support	Customer and Stakeholder Education	Vehicle and Infrastructure incentives	Utility Fleets

Summary

- Plug-in vehicles are real and will be on the streets this year
- On/off road vehicle electrification can improve air quality while reducing GHG and petroleum dependence
- Impact to the grid is minimal although local issues may occur on a case by case basis
- Simple “smart” charging can help shift load/avoid peaks
- Progress Energy is committed to partnering with our communities to prepare for plug-in vehicles
- NC is a recognized leader in the country – join the effort!



www.progress-energy.com/environment/plugins

www.GoElectricDrive.com

Progress Energy Electric Vehicle (Then...)



4/27/2011

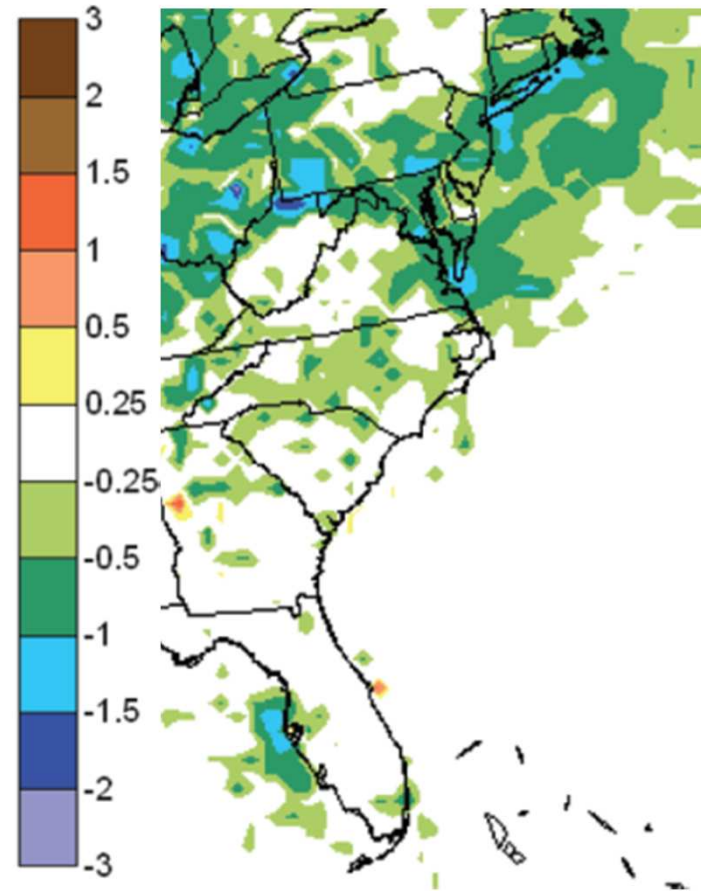
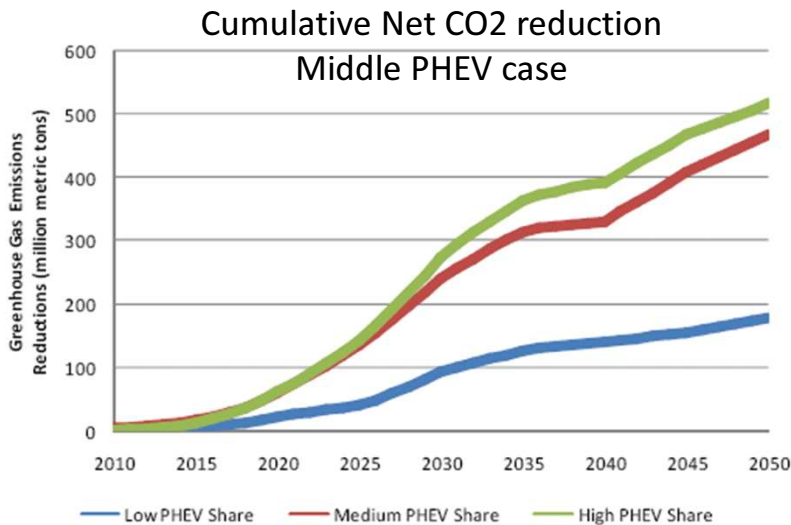
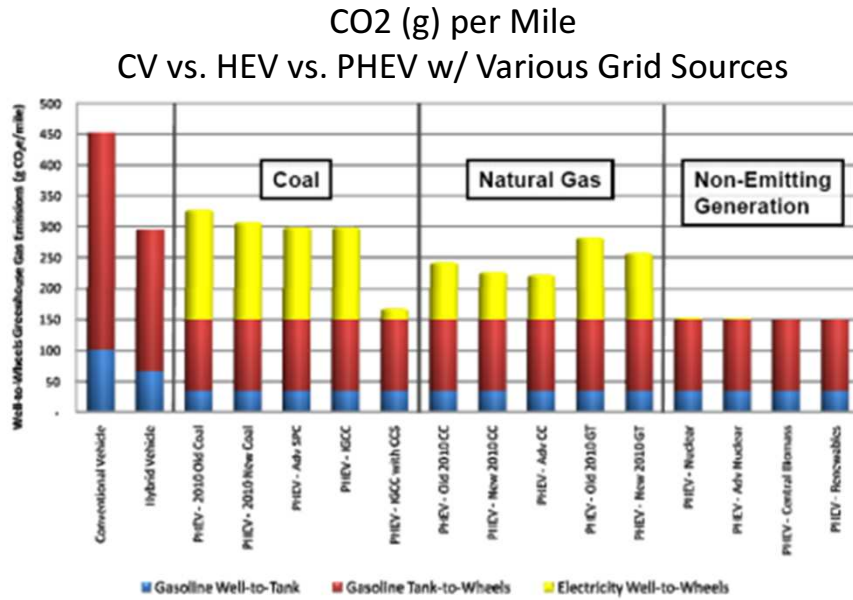
Progress Energy Electric Vehicles (Now)



Appendix Slides

Helping Improve the Environment

Key Point: Net emissions are reduced with PEVs and can be further reduced with nuclear/renewables



Annual 4th Highest 8-hr Ozone Difference (ppb): PHEV middle case vs. base case

Source: EPRI/NRDC 2007 Impact Study