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EV's, PHEV's, NEV's and the Utility Grid and DR – the BIG Picture

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Overview

- Vehicle Descriptions
- The latest in federal policy
- The Big Questions and Answers
- The “small questions” and answers
- Q & A

Vehicle Terms

- PHEV – Plug In Hybrid Electric Vehicle, contains a battery that can operate the vehicle primarily or solely on electricity for a range of 7 to 40 miles.
- NEV – Neighborhood Electric Vehicle, an all electric vehicle that typically has a top speed of 30 mph and a range of less than 20 miles. It is designed for campus or residential type roads only.
- BEV – Battery Electric Vehicles, also called EV's, are all electric vehicles designed for all roads, with ranges from 75 to 225+ miles.

Federal Government $(1)

- President Obama announced that the US Government would be purchasing 17,600 high-efficiency vehicles this year (including 2,500 hybrid sedans).
- General Services Administration will spend $285 Million for these vehicles, and will also purchase all-electric vehicles by 9/30/09.

Federal Government $(2)

- DOE ($2.4 Billion)
  - $2.0 Billion for Advanced Battery Manufacturing (for facilities in the United States)
  - $400 Million Plug-In Electric Drive Vehicle Program
- DOE Loan Guarantee Program ($25 Billion)
  - For manufacturing of high-efficiency vehicles and components in the US
- Department of Transportation ($17.7 Billion)
  - Intercity Passenger Rail Service ($8 Billion), Transit Capital Assist ($6.9 Billion), Amtrak ($1.3 Billion)

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Federal Legislation supporting AFVs

- EPACT 1992 – AFV requirements for fleets
- Economic Stimulus Act of 2002 – tax deductions for hybrid vehicles
- EPACT 2005 – tax credits for hybrid vehicles and infrastructure tax credits
- Emergency Economic Stabilization Act of 2008 (HR 1424) – PHEV tax credits + extension of inf tax credits
- American Recovery and Reinvestment Act of 2009 (HR 1) – Increased tax credits + more vehicles eligible

Individual / Homeowner Incentives

- Plug-In Hybrid Electric Vehicles
  - $2,500 to $7,500 federal tax credit, based on battery size, up to 200,000 sold per manufacturer (in 2008, the limit was for the first 200,000 sold in the US). The battery must have a capacity of at least 4 kWh.
  - Conversions – 10% tax credit , up to $4,000
  - Electric Low-speed vehicles and motorcycles – 10% tax credit, up to $2,500
- Infrastructure – tax credits of 50% up to $1000 for installing AFV infrastructure in homes

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Business Incentives

- Plug-In Hybrid Electric Vehicles
  - $2,500 to $7,500 federal tax credit, based on battery size.
  - Conversions – 10% tax credit , up to $4,000
  - Electric Low-speed vehicles and motorcycles – 10% tax credit, up to $2,500
- Incentives for medium and heavy duty AFVs, based on vehicle weight.
- Infrastructure – tax credits of 50% up to $30,000 for installing AFV infrastructure at commercial or industrial buildings.

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Big Questions

- Impact on oil imports
- Impact on GHG's
- Impact on Grid?
- Impact on consumers?
- Infrastructure costs?
- Impact on DR?

Big Question 1 – Oil Imports

- What would be the impact on oil imports?
- According to a July 2007 EPRI/NRDC study, the "widespread" adoption of PHEV's would:
  - Reduce petroleum consumption (oil imports) by 3 to 4 Million Barrels per Day (MBD) by 2050
    - 4 MBD @ $50/Barrel = $200 Million/Day, $73 Billion/yr
    - 4 MBD @ $150/Ba = $600 Million/Day, $219 Billion/yr
  - Compare this to the current US consumption of 20 Million Barrels per day

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Big Question 2 – GHG Emissions

- What would be the impact on US GHG's ?
- Again, based on the July 2007 EPRI study, the "widespread" adoption of PHEV's would:
  - Reduce GHG emissions from vehicles by 450 Million Metric tons per year by 2050 (that is a net amount, including power plant emissions) – equal to taking 82.5 Million cars of the road.
  - Compare to 7,150 gross MMTC in 2007 or 6,083 net MMTC in 2007 in the US (1887 was transportation)

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Big Question 3 – Grid Impacts (1)

- What would be the impact on the grid:
- Again, based on the July 2007 EPRI study, the "widespread" adoption of PHEV's would:
  - A **60%** market share for PHEV's by 2050 (and 50% by 2025) would use about 7-8% of the grid supplied electricity in 2050.
  - Much of this usage would be off-peak, where there is excess capacity, minimizing the need for new power plants.
  - 29 States and DC have a Renewable Portfolio Std

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Big Question 3 – Grid Impacts (2)

- Other Grid impacts (125 Million residences in US):
- Plasma TV's
  - 1% market share in 2004, 8% in 2007, 10 Million homes
  - Energy Use: 300 to 650 Watts (typical is 350 Watts)
- Video Games
  - According to industry information, 38% of US homes have at least 1 game console (47.5 Million homes/apartments)
  - Energy Use: Wii 19 Watts, PS and Xbox 187-197 Watts
- DVR – 9% market share in 2004, 35% in 2007 33 Watts

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Big Question 3 – Grid Impacts (3)

- The grid has also survived:
- Refrigerators
  - 1970's – 1,500 kWh per year for a typical 18 cubic foot ref
  - 2004 – **500** kWh per year for a typical 21 cubic foot ref
- Central AC, HP
  - 1978 – 7.34 SEER average efficiency
  - 1992 – 10 SEER federal minimum
  - 2006 – 13 SEER federal minimum
- Other appliances – at least 22-40% more efficient now

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Big Question 4 – Consumer Impacts

- Upfront costs (higher) and operating costs (lower):
- Federal tax credit of $2,500 to $7,500 for OEM vehicles and 10% up to $4,000 for conversions.
- Operating costs of PHEV 35, 7 miles / kWh
  - 5 kWh * 11 cents / kWh = 55 cents, or 1.57 cents / mile (all electric mode) for 35 miles (off peak 7 cents, then $0.01/mile)
- Standard vehicle that gets 35 mpg
  - $2.05 per gallon for 35 miles, or 5.86 cents / mile
  - $4.05 per gallon for 35 miles, or 11.57 cents / mile

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Big Question 5 – Infrastructure Costs

- It all depends on:
- Battery size
- Speed of charging and
- One-way versus two-way charging capability
- Example: 5 kWh battery
  - 5 hour charge: 1 kW, 120 Volts, 8.5 Amps, Extension Cord
  - 1 hour charge: 5 kW, 220 Volts, 22.7 Amps, dedicated circuit and SAE charger
- To minimize infrastructure costs, all PHEV, BEV, and NEV's should have "Tier 1" (120 Volt) charging capability.

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And speaking of PHEV's…

Big Question 6 – Impact on DR (1)

- How is the car battery going to be treated?
- Like another appliance that may use 0.9 to 5 or 10 kW when charging?
  - DR strategy (smart meter): stop the charging, reduce demand by 0.9 to 5 or 10 kW for a few hours.
  - Under smart rates, why would people charge on-peak?
- Like a grid support system?
  - DR strategy (smart meter): Have battery send power back to the grid via special 2-way charger at a certain kW rate based on the capacity of the battery and speed of discharge.

Big Question 6 – Impact on DR (2)

- Let's go back to my example:
- Operating costs of PHEV 35, 7 miles / kWh
  - 5 kWh * 11 cents / kWh = 55 cents, or 1.57 cents / mile (all electric mode) for 35 miles (off peak 7 cents, then $0.01/mile)
- Standard vehicle that gets 35 mpg on gasoline
  - $2.05 per gallon, or 5.86 cents / mile (I save $1.50)
    - Don't bother me, RTO/ISO, if you offer < $0.30 / kWh
  - $4.05 per gallon, or 11.57 cents / mile (I save $3.50)
    - Don't bother me if you offer < $0.70 / kWh

Big Question 6 – Impact on DR (3)

- Other motivations:
- 1) Driving in the electric mode, I displace gasoline, & hurt:
  - Al Qaida
  - League of _____ (Saudi Arabia, Iran, Venezuela, etc.)
- 2) Sending electricity back to the grid, I help displace:
  - Natural gas combustion turbine?
  - Wind or solar?
  - Battery depleted, use more gasoline.

Conclusions

- Federal policies are in place.
- Electric drive represent the best option for reducing oil imports and GHG's from the transportation sector.
- Utilities can handle the new loads (especially as homes, buildings, and appliances become much more efficient)
- The electric grid is getting "greener."
- Tier 1 (120 Volt) charging on all light-duty vehicles will minimize infrastructure (and consumer) costs.
- For DR, treat as an appliance first to minimize costs.

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Q & A

- The floor is open!