



UCDAVIS

PLUG-IN HYBRID ELECTRIC VEHICLE RESEARCH CENTER

of the Institute of Transportation Studies



Market Research for Plug-in Hybrid Electric Vehicles (PHEVs)

Jonn Axsen, Reid (Rusty) Heffner, Kenneth Kurani, Thomas Turrentine, Kevin Nesbitt, Dahlia Garas

Background – PHEV Technology

Plug-In Hybrid Electric Vehicle (PHEV): a PHEV can be powered by an internal combustion engine or an electric motor. The electric battery (or another energy storage system) can be plugged in to an electric outlet to be recharged.



Benefits: Reduced greenhouse gas emissions, air pollution and gasoline use. However, the magnitude of these benefits depends on design and driver behavior.

PHEV Design: Potential Driving Modes

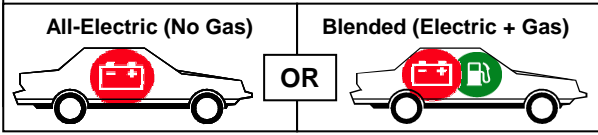
Electric or Blended Mode

- Vehicle powered by grid electricity (charged via plug)
- Range (miles) of this mode depends on battery size (kWh)
- Two PHEV design options:



Gasoline Only Mode

- Vehicle powered solely by gasoline engine
- Operates like a conventional hybrid vehicle (improved fuel efficiency from electric motor)



When battery charge reaches minimum, vehicle switches to gasoline only mode



Consumer Research Questions

Recharging and Refueling

- How much electricity and gasoline will PHEV drivers use?
- When and where will recharging occur?
- Can energy use information influence driving patterns?

Early Market Issues

- Does the existing electricity infrastructure impose constraints or create opportunities?
- How will consumers learn about PHEVs?
- What are the images of electricity as a transportation fuel?
- Are incentives necessary to encourage consumer purchase?



PHEV Design Considerations

- All-electric capability or blended?
- What all-electric range (miles)?
- What all-electric power/speed?
- Recharge speed?
- Energy use (gasoline and electricity) instruments?



3-Phase Research Project to Investigate These Questions:

Phase I: Early User Interviews (Completed Dec/06 – Mar/07)

- **Sample:** 23 PHEV users: fleets and individuals
- **Method:** Personal and telephone interviews
- **Observations of Sample:**
 - Recharging:*
 - Wide variety in recharging behavior
 - Recharge opportunities beyond home
 - Technology Preferences:*
 - Saw PHEVs as a progression to electric vehicles
 - Prefer all-electric driving over blended
 - Want electric range = one way commute (20-40 miles)
 - Instrumentation:*
 - Feedback enables changes to driving style
 - Excitement from achieving 100+ MPG

Does this sample represent the mass market?



Phase II: Nation-Wide Survey (Completed By Dec/07)

- **Sample:** 2,200 US households: new vehicle buyers
- **Method:**
 - 3-Stage Internet Survey:*
 1. Technology knowledge and attitudes
 2. Household access to recharging
 - 1-day 'Plug In' diary
 - Assessment of current infrastructure constraints
 3. PHEV attribute priorities and valuation



Phase III: Household Trials (Planned for 2008 - 2009)

- **Sample:** 100 California households and businesses
- **Methods:** Multi-week PHEV trials and interviews
 - Monitor Consumer Behavior:*
 - Driving patterns (GPS)
 - Electricity usage (plugging-in)
 - Energy (gasoline and electricity) feedback to drivers
 - Changes in driver and observer perceptions

