

# Plug-In Hybrid Electric Vehicle (PHEV) Value Proposition Study Workshop

Breakout Session # 5 Report  
Consensus View For 2030-2040

December 12, 2007



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# Progression of Technology

1985

2007

2030



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# Objective

- To develop consensus view of energy, regulation and markets under which PHEV's will operate in the 2030-2040 time frame



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# Why 2030?

- A viable scenario assumes that PHEV manufacturing infrastructure will be in place and no government subsidies will be required to sustain sales by 2030.



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# From here to 2030

- Enabling the PHEV market to achieve sustainable sales through:
  - Regulatory requirements (CAFE, carbon tax, emission standards, etc.)
  - Technology breakthroughs in battery and other systems technologies
  - Deploying advanced manufacturing technologies and investment in battery manufacturing facilities
  - Incentives monetary and non-monetary for early adopters
  - Development of industry standards for components and technologies



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# Barriers

- Uncertain safety standards
- Uncertain emission certifications



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# Consensus View For 2030 Regulatory Environment

- CAFE Standards
  - Greater than 35 mpg
  - Higher CAFÉ standards improve conventional vehicle performance demanding better performance from PHEVs
- Carbon Containment Cost
  - There will be cost associated with carbon emissions (could be \$30-\$50/ton in current dollars).
  - Cost of carbon emissions will be regulated on an international scale.



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# Consensus View For 2030 Regulatory Environment (Cont.)

- Mandates
  - Expanding ZEV mandates promoting PHEV vehicles
  - Congestion taxes in cities under consideration (could lead to fees for emissions in city environments)
  - It is unlikely that city centers will become pure electric.
- Non-monetary incentives such as HOV usage in cities will be in place.
- Urban Air Quality Regulations will be incrementally strengthened.



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# Consensus View For 2030: Energy Future

- Energy: Oil
  - Oil prices will probably be greater than \$150/ barrel with continuing price volatility.
  - The Middle East will be supplying a greater fraction of that oil.
  - Energy security will become an important issue to the public as supply is increasingly controlled by OPEC countries.
  - Worsening petroleum balance of trade may encourage more domestic energy usage.



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# Consensus View For 2030: Energy Future

- Energy: Electricity
  - Generation mix will change with a significant increase in lower-emitting/non-emitting technologies (domestic).
    - More nuclear
    - More renewable
    - More clean coal technology development and deployment
    - Rate of deployment dependent on climate change issue
  - Price of electricity will increase but with less volatility than oil.
- Price differential between liquid fuels (including renewable liquids) and electricity will drive the PHEV market. This differential will likely increase, but there will be linkage between oil and electricity price.



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# Consensus View For 2030 (Cont.)

- Number of motor vehicles will increase
  - Will increase from 700 million to 1.2 billion by 2020, globally.
  - Global vehicle miles traveled (VMT) increases
- Increasing pressures on oil prices and emissions will favor more efficient vehicles and petroleum displacement vehicles, including PHEVs.
- Globally, reliance on public transit will increase but will have no discernible impact on VMT or the total number of vehicles.



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# Consensus View For 2030 (Cont.)

- Communications
  - New unforeseen technologies could change work and driving patterns resulting in a different mix of vehicles.
  - Communication architecture will be in place by 2030 for PHEV.
  - V2G is unlikely to be broadly implemented, while V2B possibly adopted, due to battery warranty and other issues.
  - Value of power input to the grid is also effected by the location of the vehicle.
  - Vehicle and utility grid managers need to be able to communicate in real time, including Smart Grid and ITS systems.



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# Consensus View For 2030 (Cont.)

- Battery recycling capabilities will be in place due to regulations; Europe requires 95% recycling of batteries today.
- Market for stationary batteries may be larger than vehicle batteries.
- Domestic manufacturing infrastructure is needed to increase battery production.
- Appropriate infrastructure to share CO<sub>2</sub> cost/benefit among all stakeholders



# Consensus View For 2030: Charging Infrastructure

- Charging infrastructure availability will expand PHEV market.
- Liability Issues resolved to expand PHEV market.
  - Charging Stations
  - Extension Cords
  - Vehicle to Home
- Charging Stations
  - Infrastructure
  - Codes and Standards



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# Consensus View For 2030 Vehicle Parameters

	Conventional Vehicle	Non-Plug-in HEV	PHEV
Fuel Economy	Base Case	-35%	-70%
AER	--	--	32 miles
Market Share		NiMH & Li-ION will be used	5-10% - affected by battery manufacturing capacity and CAFÉ requirements
Price Premium	Base Case	\$2k-3k above Base	\$4k-6k above HEV
Performance	Base Case	Comparable in performance & maintenance	Comparable in performance & maintenance with reduced gradeability



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