2009 DOE Annual Merit Review
Plug-in Hybrid (PHEV) Vehicle Technology
Advancement and Demonstration Activity

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Overview

Timeline
• Project Start: 9/30/08
• Project End: 5/31/14
• Percent Complete: 8%

Budget
• Estimated Project Funding: $54 M
  – DOE Share: $10 M
  – MEDC Share: $2 M
  – GM Share: $42 M
• Funding received in FY08: $4.8 M
• Funding received in FY09: TBD

Barriers
• Performance/Durability
  – Balancing vehicle performance targets with battery life
• Energy Storage System (ESS)
  – Integration of advanced ESS
• Infrastructure
  – Interface and interaction with electric power grid

Partners
• Electric Power Research Institute (EPRI) – Vehicle Operators
• Michigan Economic Development Corporation (MEDC) - Funding
• University of Michigan Advanced Battery Coalition for Drivetrains – Development
• University of Michigan Transportation Research Institute (UMTRI) – Consumer Behavior

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Objectives

Program Objective

• Develop one of the first commercially available plug-in hybrid electric vehicles (PHEV) produced by an automotive manufacturer
  – Incorporate advanced lithium-ion battery technology
  – Feature high tech E85-capable Flex Fuel engine technology
  – Balance fuel economy, emissions, vehicle performance and battery life trade offs

• Develop, fully integrate, and validate plug-in specific systems and controls under General Motors’ corporate-wide global vehicle development process (GVDP) for production vehicles

• Build and deliver a fleet of saleable PHEVs in geographically-dispersed locations
Milestones

Phase I – Engineering Development of Year 1 Prototype Vehicles

- Project Management and Planning
- Vehicle and Powertrain Development
- Charge Depleting (CD) and Charge Sustaining (CS) Development
- Lithium-ion Battery Development
- Battery System Integration
- Charger Development
- Vehicle and Systems Integration
- Calibration/Buy-off Ride
Approach

• Build upon the success of the GM 2-mode strong hybrid family

• PHEV is a blended gas and electric drive propulsion system

• PHEV is an extension of the 2-mode hybrid charge sustaining technology
  – Two electric motors/generators for traction and regenerative braking
  – Four fixed mechanical gears for performance and fuel economy
  – Replaced nickel metal hydride power battery pack with lithium-ion energy battery pack

• PHEV is real-time optimized for fuel economy
Technical Accomplishments

• Program kickoff meeting with DOE in October, 2008

• Kickoff with University of Michigan Advanced Battery Coalition for Drivetrains in March, 2009

• Phase I – Engineering Development of Year 1 Prototype Vehicles

  – Vehicles have been updated with prototype batteries, thermal systems and chargers

  – Charge depleting (CD) and charge sustaining (CS) hybrid functionality has been successfully completed and demonstrated to DOE

  – Cold weather testing was performed and exceeded technical specifications

  – Preliminary fuel economy testing has been performed
Technical Accomplishments

• OnStar data collection was customized to meet DOE reporting requirements
• Virtual modeling and simulation of vehicle hardware completed
Future Work

• Phase I – Engineering Development of Year 1 Prototype Vehicles
  − Achieve performance targets and proceed to Phase II
    − Hot weather and altitude development
    − Continue to report quarterly data from prototype vehicles

• Phase II – Engineering Development of Year 2 Integration Vehicles (2010)
  − Release and build engineering integration vehicles with production intent content
  − Significant hardware testing
    − Component, subsystem, vehicle level
  − Data submissions and reports as required
Project Summary

• Production program, building on proven GM 2-mode strong hybrid technology
• On track to meet program milestones and project deliverables
• Significant challenges remain in lithium-ion battery technology and vehicle integration