

2009 DOE Annual Merit Review

Plug-in Hybrid (PHEV) Vehicle Technology Advancement and Demonstration Activity

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Project ID #: vss_02_sell



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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



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

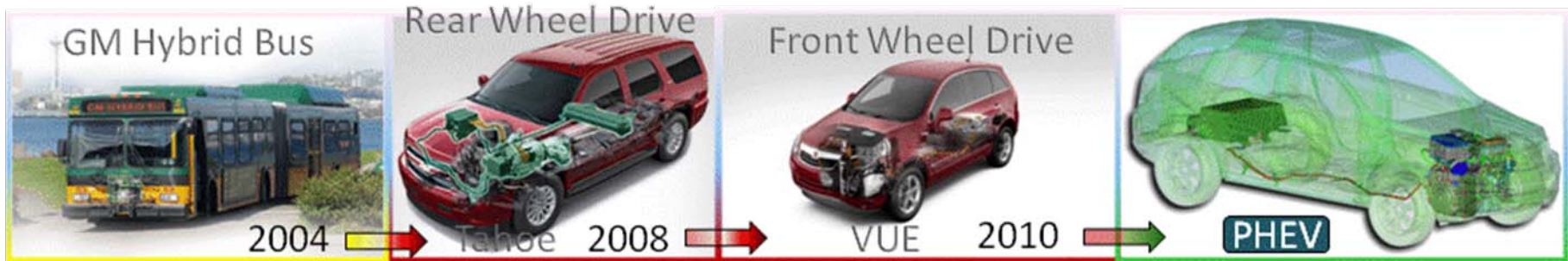
Phase I – Engineering Development of Year 1 Prototype Vehicles

- 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

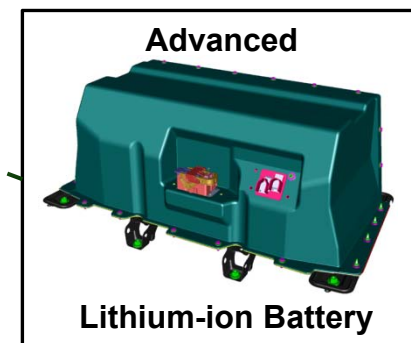
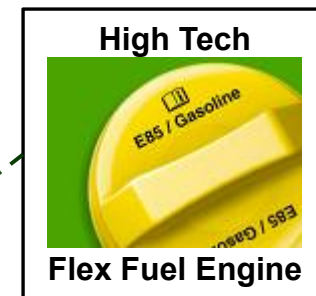
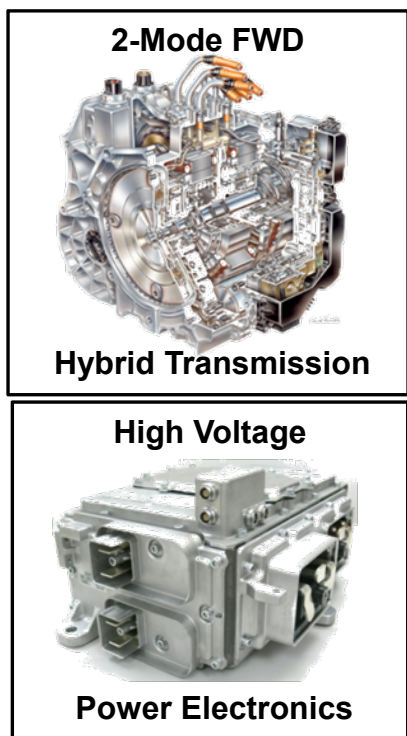
Prototype Vehicles

- 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

