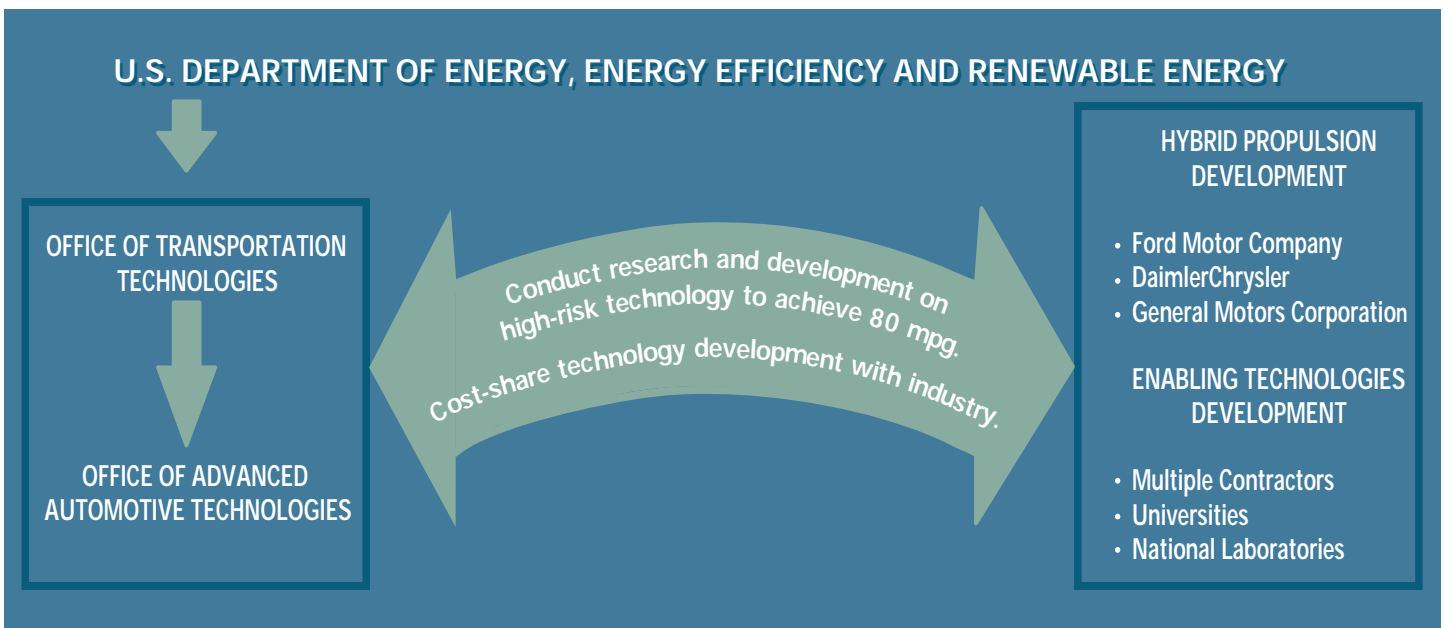


OFFICE OF TRANSPORTATION TECHNOLOGIES

DOE Hybrid Electric Vehicle Program . . . Why HEVs?

A growing dependence on imported oil, along with a heightened concern about the environmental impact of personal transportation, has led the U.S. government to sponsor research into advanced transportation concepts. One of these future technologies is the Hybrid Electric Vehicle (HEV). The development goals for this progressive technology include emissions reduction, while obtaining superior fuel economy, as well as the flexibility of using either petroleum or alternative fuels. The Department of Energy (DOE) is committed to making HEVs commonplace on American highways during the next decade and has created the HEV Propulsion Program to accelerate their development. HEVs combine the heat engine and fuel tank of a conventional vehicle with the battery and electric motor of an electric vehicle. This combination offers the extended range and rapid refueling that consumers expect from a conventional vehicle, with a significant portion of the energy and environmental benefits of an electric vehicle. The inherent flexibility of HEVs will allow their use in a wide range of applications including personal transportation, public transit, and commercial hauling.

DOE Accelerates R&D to Enable Market Introduction of the HEV



The HEV Program is carried out through the Vehicle Systems Technology Area, which applies a systems-driven, barrier-focused approach to hybrid development. The three elements of this approach are requirements definition, technology development, and system validation. These elements are carried out through simulation, testing, and technology development, both at our national labs and with our industrial partners. The HEV effort is also central to the Partnership for a New Generation of Vehicles (PNGV), a

broad-based partnership among several Federal agencies and the automotive industry. The PNGV has targeted the goal of an 80-mpg automobile (tripling current fuel economy) by 2004, and hybrid propulsion has been identified as a core technology. The DOE Office of Advanced Automotive Technologies (OAAT) manages the HEV Program, with technical program support from the National Renewable Energy Laboratory (NREL).

The HEV Program Mobilizes Industry and National Laboratory Resources

Hybrid Propulsion System Development

Hybrid Propulsion System Development is focused on systems-driven design and development, integration, and testing. Phase I of the two-phased effort focused on the development of a 50-mpg capable hybrid propulsion system. In this first phase of the effort, DOE supported three versatile system development teams led by General Motors Corporation, Ford Motor Company, and DaimlerChrysler Corporation through 50/50 cost-shared contracts. These teams, with oversight by NREL, have successfully mobilized the extensive internal resources of the three major automakers and their key suppliers. They are pursuing series and parallel

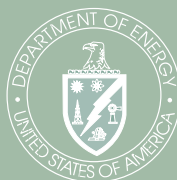
hybrid configurations for combining engine-driven and electric propulsion, as well as a range of HPU (hybrid power unit) and advanced energy storage technologies. Phase II will combine further advances in the hybrid propulsion systems with other vehicle advances (in materials, etc.) to achieve the PNGV goal of 80-mpg by 2004. In addition, the HEV technologies must meet future Environmental Protection Agency light-duty emission standards; be acceptable to consumers with respect to performance, driving range, safety, and cost; and support the introduction of alternative fuels.

Enabling Technologies Development

Enabling Technologies Development is focused on improving the technical and economic performance of key technologies that will ensure HEVs will be marketplace-acceptable. A major challenge is to achieve a sizable reduction in the manufacturing cost of the complete hybrid drivetrain. The key technologies are fuel-efficient, low-emission engines; high-power energy storage devices; and cost-effective, high-efficiency power electronics. In 1998, DOE established the Advanced Powertrain Test Facility (APTF) at Argonne National Laboratory to combine component and systems-level testing for HEVs. This facility can measure energy flows between all the HEV system components as well as exhaust emissions from hybrid power units. Its component/powertrain dynamometer can generate performance plots of individual components. These components can then be configured as complete powertrains and operated over standard or custom driving cycles. Other R&D projects are coordinated through the national laboratories and include:

- High-power energy storage including the nickel/metal hydride and lithium-ion batteries.
- Automotive Integrated Power Module (AIPM) development for power electronics.
- The Advanced Vehicle Simulator (ADVISOR) tool for systems analysis of various HEV configurations with test data derived from prototype vehicles.
- Application of lightweight structural materials to a prototype mid-size vehicle.
- The Cooperative Automotive Research for Advanced Technologies (CARAT) and Graduate Automotive Technology Education (GATE) Programs, which provide small businesses and universities with an opportunity to solve critical technology barriers.

For additional information, contact:



Robert Kost
U.S. Department of Energy, EE-32
1000 Independence Avenue, SW
Washington, DC 20585
(202) 586-2334
robert.kost@ee.doe.gov

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