Background
Following the oil crisis of the 1970s and the passage of the federal Electric and Hybrid Vehicle Research, Development and Demonstration Act of 1976, the U.S. Energy Research and Development Administration (ERDA) initiated an ambitious Electric and Hybrid Vehicle (EHV) technology research and development program. When ERDA was disbanded and its activities assigned to the newly formed Department of Energy (DOE), this EHV program was moved to the DOE.

Working with strong industrial teams that included major U.S. auto manufacturers, DOE took a systems approach to developing fully integrated experimental electric vehicles from the ground up. These vehicles served as research platforms and allowed DOE to develop sets of advanced EV technologies that collectively demonstrated practical vehicle performance and were suitable for automotive applications.

Initially, DOE focused on developing advanced direct-current (DC) powertrain technologies, which exhibited excellent torque-starting capabilities but were heavy, bulky, and continually drew full current from the battery. Over time, the researchers changed their focus to alternating (AC) technologies, which were inherently less complex, more reliable, and lighter in weight, and demonstrated higher output and greater efficiency. To harvest these benefits, however, investigators had to develop suitable technology for effective control of motor speed and torque, and the transaxle that transfers the mechanical energy of the electric motor to the wheels. In AC powertrains, the power electronics incorporates an inverter to convert DC battery output to the AC energy required for AC motor operation. The vehicle testing laboratory at the Idaho National Engineering and Environmental Laboratory validated the benefits of these drivetrains.

Commercialization
The Ford Motor Company incorporated an advanced AC powertrain into its Ranger EVs in 1998, and sold over 600 Ranger EVs by 2000. General Motors (GM) also capitalized on the improved technology, leasing more than 600 GM EV1s and 500 Chevrolet S-10 pickup trucks with the AC powertrains in 1998 and increasing the production of each model in 1999. DaimlerChrysler also incorporated the technology into 200 of its EVs. The major U.S. auto manufacturers have announced plans to produce hybrid electric and fuel cell vehicles in the next few years that will incorporate AC electric powertrain technologies.

Benefits
- In 2010: AC powertrain technology will save 7 million gallons of gasoline annually
- Cost reduction of 50%/shaft hp
- 10% improvement in peak efficiency
- 15% increased driving range with regenerative braking
- Improved reliability and safety (fewer moving parts)

Success Story
The 70-hp AC drivetrain developed for Ford’s ETX-II electric vehicle

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