

materials that **exceed the strength, durability, and reliability requirements for transportation applications**. The Department has developed a process, with a U.S. company, to reduce the cost of producing silicon nitride ceramic powder from \$30 per pound to slightly more than \$10 per pound. The ultimate goal is \$6 per pound. Manufacturers are beginning to use this material for a variety of parts in production engines. Allied Signal, for example, is manufacturing ceramic oil pump spacers for use in commercial aircraft, including Boeing, Gulfstream, and Airbus. As another example, more than 15,000 ceramic cotter pins have been sold for aircraft applications.

Nickel Metal Hydride Cells, Modules, and Vehicle Batteries

Nickel metal hydride batteries are one of three midterm batteries being developed by the Department of Energy through the United States Advanced Battery Consortium. This battery technology is approaching all of the consortium's midterm goals, with the exception of cost. The consortium is now concentrating on developing lower cost materials and improved production processes. Given the performance of this technology, General Motors has formed a joint venture with the Ovonic Battery Company. Replacing the lead acid battery in the General Motors Impact car with this nickel metal hydride battery will increase the range of the vehicle from 70 miles to 140 miles between recharges. A conservative market estimate for this battery, as the result of the mandates for zero emission vehicles in California and the Northeastern States, is **approximately \$350 million in 2003**.

Biomass Feedstock Technology

Hybrid poplar "supertrees," which are being commercially planted by six major pulp and paper companies in the Pacific Northwest, were developed through Department of Energy investment in research programs for producing biofuels feedstocks. This portion of the Department's Biofuels Feedstock Development Program, focused in the Northwest, has invested approximately \$2 million over 17 years to produce genetically superior trees and improved agricultural production techniques. **Acreage planted is expected to double from the 25,000 acres planted now to well over 50,000 acres within the next 2 years**. Two mills are already using the fiber to produce paper as well as energy for their boilers, and two new nursery companies have emerged to supply high-quality cuttings to private industry and landowners. The Western Washington plantings established along rivers provide habitat to an endangered deer species and other wildlife. Each acre of hybrid poplars planted displaces the need to harvest 10 acres of Douglas Fir for fiber.

DYNA3D Finite Element Analysis Technology

The Department of Energy sponsored research that developed DYNA3D, a dynamic finite element analysis tailored to simulate high energy impacts, such as car crashes or aircraft collisions with birds. DYNA3D is available at near-zero cost to the public and has had a major impact on U.S. industry. It is used by more than 300 U.S. companies, including GE Aircraft Engines, General Motors, Chrysler, the Boeing Company, ALCOA, General Atomics, FMC Corporation, and Lockheed Missiles and Space Company. The technology is used by all U.S. car manufacturers and has sharply reduced the need for costly vehicle crash testing. An independent study placed the **savings to U.S. industry as a result of using the model at \$350 million**.

***Zymomonas Mobilis* Organism**

In 1994, research sponsored by the Department of Energy developed a new, genetically engineered organism, *Zymomonas mobilis*. This organism enhances the fermentation of cellulose, increasing the rate of conversion and yields of ethanol for use as fuel. It is estimated that this new technology, which was described in the prestigious journal, *Science*, and widely written about by the Associated Press, has **significantly reduced the cost of ethanol** from \$3.60 per gallon to less than \$1.00 per gallon, making ethanol a more competitive alternative fuel.