vehicle, a Chrysler T-115 mini-van, that uses a nickel-iron battery.

Gel Cell Lead-Acid Battery-Powered Electric Vehicles

DOE has sponsored numerous research activities with the goal of achieving viable, cost-effective electric vehicle technology. Maintenance costs of EVs were identified as a major barrier to their marketability. Beginning in 1982, DOE initiated an aggressive research effort with universities, the private sector, and federal agencies, to develop technology to reduce EV maintenance costs. Gel cell lead-acid batteries were identified as a technology that could reduce EV maintenance requirements and improve safety conditions and efficiency levels. Through research program support, DOE has stimulated private sector investment in automated gel cell production facilities that will decrease overall production costs by 50 percent and thus reduce the capital costs of gel cell batteries. Specific results of the gel cell battery research program include a 50 percent reduction in EV maintenance costs, an increase in EV energy efficiency of over 50 percent, 50 percent longer battery life, and increased levels of operating safety due to the sealed design of gel cell batteries. Gel cell battery technology developed in this program also can be used in mobile communications systems, mining, computer power supplies, and other applications requiring low-maintenance, long-life, and high-efficiency batteries.

Low-Cost/High-Temperature Alloy

Stirling engine technology uses power from an external heat source to fuel vehicles. The engine transmits thermal energy and must operate in adverse environments of extreme heat, corrosion, stress, and repeated cycling. Engine efficiency increases with higher operating temperatures which require special alloy materials for high efficiency, reliability, and longer lifetimes. Prior to 1981, Stirling engine structural components were fabricated from high-cost imported materials, such as cobalt, chromium, and nickel. Although these alloys performed well, commercial introduction of Stirling engine technology was impeded by economic factors and by the lack of a reliable source of the alloy components. DOE, in conjunction with NASA, sponsored research by academic institutions and private sector firms to develop a low-cost replacement alloy with equivalent properties. Surpassing expectations, the new alloy exhibits superior lifetimes, is far cheaper, and relies upon the use of entirely domestic resources, with the exception of nickel imported from Canada. In addition to its Stirling engine applications, this alloy has the potential to penetrate high-temperature structural materials markets throughout the U.S., particularly markets for conventional automotive heat engine applications. Energy efficiency benefits are expected to rise as the alloy achieves market penetration, because this material will make higher engine operating temperatures possible. By reducing dependence on strategic imported materials, this research effort has directly enhanced national security in the United States.

Nonautomotive Stirling Engine Applications

Stirling engines employ an external heat source to provide usable mechanical energy. Stirling engines feature low noise, high efficiency, low pollution, and low vibration levels, making this unique technology particularly useful in certain applications. The capability to use any source of heat as fuel, including solar or nuclear heating, makes this technology an attractive candidate for remote applications such as in-orbit power supplies, where conventional power systems are not feasible. As DOE-sponsored Stirling engine technology research began to demonstrate the validity of using Stirling engines in automobiles, other uses for this technology became apparent, including applications in solar power modules, irrigation systems, and mobile power generation systems. Associated research programs, such as high-temperature/low-cost alloys projects, will result in increased levels of Stirling engine efficiency. Limited market penetration in remote