Insulating Doughnut for Steam Flood of Deeper Oil Wells
Steam injected into deeper heavyoil wells can lose significant amounts of heat during the trip from the surface to the reservoir. In fact, a phenomenon known as wellbore refluxing can result in up to six times the heat loss in an uninsulated tubing string than would be normally expected. Sandia National Laboratories, working under a Department of Energy program, devised a 2-inch-long "doughnut" of plastic insulation that, when inserted in the standard tubing coupling, prevents steam from contacting the thin outer coupling walls. Heat loss through refluxing is reduced substantially. This simple device is now standard in the industry, and the savings to the industry will amount to **hundreds of millions of dollars over the next decade.**

Improved Oil Recovery Technology for the Green River Formation
An oil recovery field demonstration program cosponsored by the Department of Energy has shown that by properly applying improved waterflooding technology in the Uinta Basin in Utah's Green River Formation, additional oil can be produced from fields that might otherwise have been abandoned. The Department's test has turned around conventional thinking in the region, giving Utah producers a technology that was previously thought to be unusable in the region's complex geology. The initial field test has already added **2.4 million barrels of producible oil to the region's reserves.** More importantly, neighboring operators have begun using the technology and will return more than $160 million in Federal taxes and royalties, well above the $112 million Federal investment to date. Ultimately, recoverable oil reserves in Utah could be expanded by 3.5 billion barrels because of the Department of Energy costshared project.

Carbon Dioxide Miscible Flooding Technology for Oil Recovery
Three percent of all domestic crude oil **(about 180,000 barrels per day)** is produced by injecting carbon dioxide into aging reservoirs to force out oil that conventional production techniques cannot recover. The gas mixes with some of the remaining oil in the reservoir, and creates a miscible bank of fluid that pushes additional oil to production wells. In large part, industry gained confidence in carbon dioxide flooding technology through a series of eight field tests conducted in the 1970s and co-financed by oil companies and the Department of Energy and its predecessors. Because of the success of carbon dioxide-enhanced oil recovery, carbon dioxide pipelines have been built throughout west Texas and eastern New Mexico, the principal regions of successful carbon dioxide miscible flooding. With the completion of the LaBarge pipeline, carbon dioxide-enhanced recovery has also been extended to oil fields in Wyoming and could reach others in North Dakota. Today, roughly **68,000 Americans are employed** directly and indirectly because of this oil recovery technology. Moreover, data developed through the Department's laboratory research has saved the domestic oil producers **at least $10 million** by allowing them to accelerate development of other recovery processes.

Computerized Oil Field Simulators
Closely related to predictive models is a family of oil field simulation software developed by the Department of Energy. BOAST (Black Oil Applied Simulation Tool) was introduced in 1982 as a way to simulate the movement of oil, gas, and water through an oil reservoir. BOAST has been upgraded to operate on personal computers and expanded to assess larger areas, larger numbers of wells, and more solution options. More than 2,400 copies of BOAST PC software have been distributed by the Department. Several oil industry consulting firms have modified the program to their own specifications. **More than 20 million barrels of oil** have been produced as a result of using these simulators, and the **return to the taxpayer is more than $1,000 for each $1 of Department of Energy investment.** Universities are also using BOAST as a textbook for reservoir simulation instruction. A second simulator, UTCHEM, has been developed specifically for chemical flooding. The simulator is being used by approximately 20 oil companies to project the behavior of tracers, polymers, polymer gels, surfactants, and alkaline agents injected into oil reservoirs. Better management of reservoirs has **saved**