

feet of natural gas is technically recoverable in the lower 48 States--about 8 times more than current proved reserves. To realize the potential of these oil and gas resources requires continued development of advanced exploration and extraction technologies. The Department is working with industry to develop advanced computing technologies to improve drilling success rates, rock drilling systems for natural gas, and advanced oil recovery technologies, as well as carrying out related research and analytical activities. By enhancing the efficiency and competitiveness of U.S. industry, these research and development efforts will increase domestic energy production, reduce dependence on imports, and create jobs.

Polycrystalline Diamond Drill Bits

Research and development sponsored by the Department of Energy produced one of the most important advances in drilling technology, a new drill bit design that uses polycrystalline diamond cutters. Previous diamond cutting bits failed when the cutting assembly would break away from the bit after prolonged drilling. This technology, which was spawned by Defense Programs basic research at Sandia National Laboratories, permanently bonds the cutters to the bit. In timecritical drilling situations, this drill bit can **save as much as \$1 million per well**. Worldwide, 13 companies now fabricate this synthetic diamond drill bit. U.S. companies produce approximately 4,000 bits per year.

Mudpulse Telemetry for Measurement While Drilling

One of the most important timesaving innovations used today in the drilling industry is the "measurement-while-drilling" instrument. Before its invention, operators needing to determine drill bit direction had to cease drilling, remove hundreds or thousands of feet of drill pipe, and lower an instrument into the well. Readings would then be taken, the instrument retrieved, and drilling would recommence. In the 1970s, the Department of Energy helped Teleco, Inc., pioneer a wireless system that could transmit the location of a drill bit by sending pressure pulses through the drilling mud that circulated from the bit face to the surface. Today, mudpulse telemetry has gained wide acceptance in the drilling industry and is estimated to have **saved the natural gas and oil industry at least \$1 billion over the past 20 years**.

Carbon Dioxide Sand Fracture Production Technology

The Department of Energy's Morgantown Energy Technology Center developed, tested, and helped commercialize this technology for stimulating production from natural gas wells. A nondamaging treatment process, it won the natural gas industry's **1994 Best Technology in the Northeast Award**. Of special importance to small, independent producers, the technology has been shown to increase production by 200 to 500 percent. At \$2.00 per thousand cubic feet, a 3 to 9 million cubic foot well using carbon dioxide sand fracturing **will generate \$20 million more revenue over its productive life**.

Hot Oiling Paraffin Treatment

Buildup of paraffin in the wellbore and near-wellbore formation can cause severe reductions in production of waxy crudes and result in lifting equipment failures. Traditional batch treatments are expensive and can result in formation damage if sound hot oiling practices are not followed, that is, if melted paraffin solidifies before it reaches the bottom of the well and plugs the formation. The Department of Energy developed a computer model that optimizes hot oiling paraffin treatments and aids in determining good practices. The use of this software, to estimate downhole temperatures and effectiveness of hot oiling, helps both producers (especially independents) and service companies by reducing operating and maintenance costs. For example, application of the software by an independent producer in a West Texas field increased the efficiency of production equipment, reduced equipment failures, and resulted in about \$1.00 per barrel-equivalent reduction in average lifting cost. Industrywide use of the software and good hot oiling practices could result in **more than \$150 million per year in reduced operating cost**, and also reduce well abandonments.