

P R O J E C T
facts

DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY

OIL recovery
PROGRAM

HORIZONTAL CO₂ INJECTION WELLS PHILLIPS' PROJECT IN WEST TEXAS

PRIMARY PROJECT PARTNER

**Phillips Petroleum
Company**
Odessa, TX

FOSSIL ENERGY PROGRAM

**Oil Recovery Field
Demonstration**

MAIN SITE

South Cowden Field
Ector Co., TX
near Odessa, TX

TOTAL ESTIMATED COST

\$21.1 million

COST SHARING

DOE - \$7.0 million
Non-DOE - \$14.1 million

DE-FC22-94BC14991

Project Description

Phillips Petroleum is applying horizontal well technology to inject CO₂ in a depleted reservoir in the South Cowden Field, Texas Permian Basin. Typically, horizontal production wells are used to contact more of the reservoir, intersect fractures which may contain oil, or prevent the production of gas from above or water from below a thin oil interval.

Phillips plans to show that drilling horizontal CO₂ injection wells from a central location will reduce the number and cost of new injection wells, concentrate injection equipment, and minimize the cost of CO₂ distribution.

Gas injection rates can be higher in horizontal wells because of increased contact with more of the reservoir. However, the quantity of CO₂ necessary to maintain a sufficient distribution within the reservoir may actually be lower. This reduces the number of injection wells and the capital costs required to recover additional reserves.

For horizontal well application to be successful, there must be a good understanding of the reservoir characteristics and the interaction of CO₂ and oil within the reservoir. Optimum locations for the horizontal injectors must be selected and the wells properly completed within the productive interval of the reservoir.

Phillips has completed all of the scheduled reservoir studies, and is preparing (January 1996) to implement drilling of the horizontal wells and begin injection of CO₂ to test the efficiency of the technology. A reservoir model has been developed to integrate the rock, fluid, and seismic data. Laboratory tests are underway to identify surfactants and gelled polymers for control of fluid movement within the reservoir. The size, design, and location of the injection wells are being determined. Project economics are being evaluated.

Program Goal

Prolonging the productive life of the nation's domestic oil fields is a principal goal of the Department of Energy's Oil Program. Once a field is abandoned, the wells are lost to future production. If kept open, however, the application of current and developing technologies could result in significantly increased production of oil still remaining in those reservoirs.

The DOE Oil Recovery Field Demonstration Program used industry input to determine technologies needed to overcome barriers to production in various reservoirs. Phillips Petroleum chose horizontal drilling, a recently resurgent technology, as a potential means of increasing the efficiency of injecting CO₂ in gas flooding recovery operations.

If the project is successful, Phillips estimates it will produce an additional 8 million barrels of oil from the South Cowden field, and application of the technology to other Permian Basin fields could add additional production measured in billions of barrels.

Project Partners

PHILLIPS PETROLEUM CO.
Odessa, TX

FINA OIL & CHEMICAL CO.
Midland, TX

EIGHT SMALL INDEPENDENT COMPANIES
Midland, Odessa, Abilene, Ft. Worth, Houston

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Project Benefits

San Andres and Grayburg reservoirs have produced approximately 42% (9.8 billion barrels) of the total cumulative oil from the Permian Basin of West Texas and Southeast New Mexico. The amount of oil produced from each reservoir has typically been less than 30% of the original oil in place, and significant quantities of mobile oil remain after primary recovery.

This low ultimate recovery is due mainly to the rapid lateral changes in rock properties typical of carbonate reservoirs. Injecting water into this type of reservoir is often unsuccessful, leaving oil trapped in the rock. New techniques must be developed to recover additional reserves. This remaining mobile oil is the target of CO₂ flooding.

Over half of the oil production from CO₂ projects in shallow water carbonate reservoirs has come from a few, very large projects with over 500 wells where economies of scale can greatly improve project economics. Most of the remaining CO₂ flood potential reserves is found in a large number of smaller, mature fields. These smaller fields will face abandonment within the next decade or two unless innovative technologies can be developed and implemented. Wells will be plugged and abandoned, leaving over 60% of the oil reserves to never be produced.

The South Cowden field was first produced in 1940 and has been waterflooded since 1965. Production from the Grayburg/San Andres reservoir to date is over 32.5 million barrels, representing 28% of the original oil in place. The technologies applied by Phillips should recover more than 8 million additional barrels of oil.

Successful application of the CO₂ flood techniques developed will demonstrate the economic benefits and improved efficiency of CO₂ flooding. The abundant source of CO₂ in the Permian Basin will enable the process to be readily applied. Horizontal CO₂ injection wells, while not widely used, can be an economically viable recovery option for smaller reservoirs and for independent operators.

CONTACT POINTS

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Cost Profile (Dollars in Millions)

	Budget Period 1		Budget Period 2	
	06/30/94	06/02/95	06/02/95	01/02/01
Department of Energy*	\$0.9		\$6.1	
Private Sector Partners	\$1.2		\$12.9	

* Obligated Funding

Key Milestones

