

**FINDING OF NO SIGNIFICANT IMPACT**  
**PILOT EXPERIMENT FOR GEOLOGICAL SEQUESTRATION OF CARBON DIOXIDE IN SALINE**  
**AQUIFER BRINE FORMATIONS**  
**Frio Formation, Liberty County, Texas**

**AGENCY:** U.S. Department of Energy (DOE)

**ACTION:** Finding of No Significant Impact (FONSI)

**SUMMARY:** DOE has prepared an Environmental Assessment (EA), DOE/EA-1482, to analyze the potential environmental consequences of a proposal to provide approximately \$2.5 million for a field test of the geological sequestration of carbon dioxide (CO<sub>2</sub>) in saline aquifer brine formations.

DOE has sponsored a variety of research projects over recent years to separately investigate methods for capturing CO<sub>2</sub> from emission sources and for sequestering the CO<sub>2</sub> using practical, affordable, and environmentally safe methods. With support from DOE, the Bureau of Economic Geology (BEG) at The University of Texas at Austin has participated in studies of the potential for sequestering CO<sub>2</sub> in geologic formations of the United States. As a result of their work, BEG has identified brine formations of the upper Texas Gulf coast as having excellent potential for geological sequestration and has proposed a controlled experiment to inject a limited quantity of CO<sub>2</sub> into a brine formation of the South Liberty oil field in Liberty County, Texas, about 56 kilometers northeast of Houston. BEG would closely monitor and model the subsurface disposition of the injected CO<sub>2</sub> to determine the long-term potential of brine formations for effective sequestration of CO<sub>2</sub>.

While injection of CO<sub>2</sub> is commonly used in some oil fields to enhance the production potential of the field, the controlled and well-monitored experiment proposed by BEG would be designed to fill gaps in scientific understanding by capturing data needed to accurately establish the fate of the CO<sub>2</sub> and the value of CO<sub>2</sub> injection into geologic formations as an acceptable approach for long-term sequestration.

Based on the analyses in the EA, DOE has determined that the proposed action is not a major Federal action significantly affecting the quality of the human environment, within the meaning of the National Environmental Policy Act (NEPA) of 1969, 42 United States Code 4321, *et seq.* Therefore, preparation of an Environmental Impact Statement is not required, and DOE is issuing this FONSI.

**COPIES OF THE EA ARE AVAILABLE FROM:**

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**FOR FURTHER INFORMATION ON THE DOE NEPA PROCESS, CONTACT:**

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**DESCRIPTION OF THE PROPOSED ACTION:** The proposed action is for DOE to provide approximately \$2.5 million to the BEG for a field experiment on CO<sub>2</sub> injection at a depth of about 1,500 meters into a high-porosity, high-permeability geologic formation of the type that might be viable for future consideration as a sink for sequestering CO<sub>2</sub> and mitigating its greenhouse gas effects. The pilot experiment proposed by BEG would be performed onshore to facilitate adequate monitoring to determine the extent of CO<sub>2</sub> retention in the injection zone and to maximize scientific understanding. The experiment would be performed at a site that would build on historical data developed on the subsurface geotechnical characteristics of an operating oil field and would use existing oil field infrastructure. The proposed experiment would be conducted in the active South Liberty oil field on the upper Texas Gulf coast to (a) pioneer the permitting process, (b) determine the extent of environmental risks, and (c) obtain results quickly by performing a well-structured, short-term field test.

The South Liberty oil field contains 654 wells, although several hundred of the wells are idle. At an existing idle well site within the oil field, BEG would inject CO<sub>2</sub> into a brine-bearing sandstone of the Frio Formation. Intermittent injection tests would be performed over a time period of less than 60 days. Two existing idle wells would be upgraded and used to monitor behavior of the injected CO<sub>2</sub> for up to 1 year, and the resulting data would be used to enhance models for predicting the behavior of CO<sub>2</sub> injected into brine formations.

The field test would have the following objectives:

- Demonstrate that CO<sub>2</sub> can be injected into a brine formation without adverse health, safety, or environmental effects
- Determine the subsurface location and distribution of the injected CO<sub>2</sub>
- Improve the application of computer models for predicting CO<sub>2</sub> behavior
- Demonstrate methods for monitoring the subsurface disposition of CO<sub>2</sub> injected into brine formations
- Establish a knowledge base for use in considering geological sequestration opportunities

The intermittent injection tests would be performed at rates not exceeding 8.5 tons-per-hour, using procedures that comply with regulations established by the Texas Commission on Environmental Quality. Following completion of the experiment, the injection and monitoring zone perforations in all wells would be plugged by cement following standard oil-industry

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practices. The wells would either be plugged and abandoned in accordance with the rules established by the Texas Railroad Commission or converted to uses approved by the responsible oversight agency.

**ENVIRONMENTAL CONSEQUENCES:** The environmental consequences anticipated from performing the pilot experiment were analyzed in the EA. The environmental factors included in the analysis were: aesthetics and land use; air emissions; floodplains and wetlands; ecological resources, including threatened and endangered species; transportation and traffic; waste management; groundwater; cultural resources; socioeconomics; noise; and health and safety. Environmental justice and long-term and cumulative impacts were also considered. No substantive adverse impacts or environmental concerns were identified from analyzing the effects on these environmental factors.

**AESTHETICS AND LAND USE:** The proposed site would be within an active oil field in a sparsely populated area. The project would use less than 5 acres of land within the oil field, where oil and gas production activities have extended over 17,000 acres. Directional drilling from the existing well pad would be used for CO<sub>2</sub> injection to minimize impacts to land surface, although one well pad would need to be slightly expanded to accommodate project work. About 1 kilometer of unpaved lease road would be improved by adding road base.

**AIR EMISSIONS:** Air emissions from equipment used for well drilling and completion activities and from subsurface characterization would be similar to emissions from comparable operations that are performed within the oil field. Carbon dioxide, although not a regulated pollutant, could potentially create air quality risks from post-injection leakage back to the surface or from leakages in CO<sub>2</sub> storage or handling equipment. Leakage to the surface would not be expected due to the existence of an intermediate thick shale seam between the layer of sandstone into which CO<sub>2</sub> would be injected and the surface. Pre-injection engineering, intermittent injections, training, and both during- and post-injection monitoring would be conducted to provide assurances against leaks that would create air emission hazards.

**FLOODPLAINS AND WETLANDS:** The existing well sites that would be used for the pilot experiment are located in an upland area that is above the 100-year flood plain, and the project sites are depicted as non-wetland areas based on National Wetland Inventory maps. Neither equipment installation nor operation would affect floodplains or wetlands.

**ECOLOGICAL RESOURCES:** The existing well sites proposed for the pilot experiment support almost no plant or animal communities and no unique or protected species. Consultation with the U.S. Fish & Wildlife Service confirmed that no Federally listed or proposed species are likely to exist at the project site and that the site would not be located within officially designated critical habitat.

**TRAFFIC AND TRANSPORTATION:** The pilot experiment would be performed using existing well sites that would be accessed from privately owned lease roads in the active South Liberty oil

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field. Traffic impacts from delivery of CO<sub>2</sub> to the project site and removal of wastes to disposal facilities would be minor and similar to on-going drilling activities that occur in the South Liberty oil field. About 10 deliveries per day of CO<sub>2</sub> would be required during the relatively brief (less than 2 months) injection phase of the proposed project. Shipments during heavy commuting hours would be avoided to minimize effects, and the delivery rates would be minimal in comparison with the existing moderate to heavy commercial, agricultural, industrial, and private vehicle traffic volume. The traffic and transportation requirements for the proposed project would not be expected to result in any discernable adverse effects to local roads and traffic conditions.

**WASTE MANAGEMENT:** Project wastes would consist of produced brine (a non-hazardous material), drilling fluids, and drill cuttings (natural earth materials extracted during well drilling). These products are typical of waste materials generated by drilling activities in the South Liberty oil field. Drill cuttings (about 400 cubic meters) would undergo disposal as municipal solid waste in accordance with Texas Administrative Code. Drilling fluids (less than 7,000 barrels) would be transported to an authorized disposal well within 48 kilometers of the project site. Other minor debris produced during well installation would be removed from the site for disposal in a municipal landfill. Brine produced during well tests (less than 3,000 barrels) would be temporarily stored onsite and then re-injected into the original well.

**GROUNDWATER:** The base of subsurface usable quality water, defined as containing less than 3,000 parts-per-million (ppm) of total dissolved solids, extends to a depth of 670 meters at the project site. The base of potentially usable quality water, which is the base of the lowermost drinking water standard and which is established as water containing less than 10,000 ppm total dissolved solids, extends to a depth of 1,035 meters. The CO<sub>2</sub> would be injected at a depth of about 1,500 meters, and the injection point would be separated from potentially usable water by more than 75 meters of shale.

**CULTURAL RESOURCES:** Historic and cultural resources of significance would not be expected to exist on the previously disturbed well sites that would be used for the proposed experiment. In addition, consultation with the curator of archaeological and historical sites for the State of Texas verified that no recorded archaeological or historical sites exist in areas to be affected by the proposed project. Nonetheless, before site work is initiated, all work areas associated with the drilling pad, drilling operations, and seismic tests would be surveyed by archaeologists to ensure the absence of resources of potential interest.

**SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE:** The workforce requirements for the proposed project would be minimal. The proposed experiment would involve activities that have historically existed within the South Liberty oil field. Due to the sparse nature of the local population and the short duration of the experiment, no disproportionately high or adverse impact on minority or low-income communities would be expected.



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**NOISE:** Standard oil field equipment and techniques would be used to drill wells and study subsurface characteristics within the project area. Noise generated by the proposed project would be similar to noise levels produced by other well drilling and testing activities within the South Liberty oil field. Due to the short-term nature of the proposed project and the distance (about 0.5 kilometer) to the nearest resident, no adverse noise effects would be anticipated.

**HEALTH AND SAFETY:** Safety and health risks would exist at the project site due to the presence of stored volumes of CO<sub>2</sub> that would be used for injection tests. Based on a combination of factors, including (a) the short duration (less than 60 days) of planned intermittent injections, when CO<sub>2</sub> would be stored onsite, (b) the historic practices developed and commonly used for safe CO<sub>2</sub> storage and handling in other industrial applications, and (c) the extensive and focused monitoring and training that would be devoted to handling CO<sub>2</sub>, the risks from significant leaks that could potentially be hazardous would be low. Drilling practices that are commonly used in the oil production industry would be applied for the proposed project, and compliance with those historic practices would be expected to avoid adverse effects from well installation and closure.

**LONG-TERM AND CUMULATIVE IMPACTS:** The planned short duration testing and the planned use of 3 existing well sites within the 654-well South Liberty oil field would not be expected to create or trigger any adverse long-term or cumulative effects.

**ALTERNATIVES CONSIDERED:** In addition to the proposed action, alternatives that were considered included conducting the pilot experiment at another field site within the same sedimentary basin, conducting the experiment in another geographic area, conducting the experiment in an oil- or gas-bearing interval, and no action. None of the alternatives would provide the technical and scientific value and the operational perspective needed by DOE to achieve rigorous testing of a potential technological option for reducing atmospheric concentrations of CO<sub>2</sub>.

**PUBLIC AVAILABILITY:** The draft EA was distributed for review and comment to Federal and State agencies and to the public; copies were made available for review at both the Dayton Library in Dayton, Texas, and the Liberty Municipal Library in Liberty, Texas. The draft EA was also posted on the National Energy Technology Laboratory's web site for public review and comment. Public notices announcing availability of the draft EA for review and comment were published in the Liberty Gazette on August 27 and September 3 and in The Vindicator on August 24 and 27. Both newspapers are printed in Liberty, Texas, and are generally circulated within Liberty County. By the close of the public comment period on September 12, 2003, neither adverse comments regarding the proposed action nor suggestions for consideration in finalizing the environmental analysis were received. Since closing of the comment period, no comments have been received.

**DETERMINATION:** Based on the information and analyses in the EA, DOE has determined that the proposed Federal action, to provide funds for testing the geological sequestration of CO<sub>2</sub> in a

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subsurface brine formation of the South Liberty oil field in Liberty County, Texas, does not constitute a major Federal action that would significantly affect the quality of the human environment within the meaning of the National Environmental Policy Act. Therefore, an Environmental Impact Statement is not required and DOE is issuing this FONSI.

Issued in Pittsburgh, PA, this 8<sup>th</sup> day of October, 2003.

*Carl O. Bauer for*

Rita A. Bajura  
Director  
National Energy Technology Laboratory