FACTSHEET FOR PARTNERSHIP FIELD VALIDATION TEST

Partnership Name	West Coast Regional Carbon Sequestration Partnership (**WESTCARB**)		
Contacts:	Name	Organization	E-Mail
DOE/NETL Project Mgr.	Dawn Deel	Environmental Projects Division	Dawn.Deel@NETL.DOE.gov
Principal Investigator	Larry R. Myer	California Energy Commission	LRMyer@lbl.gov
Field Test Information: Field Test Name	Rosetta Resources Gas Reservoir and Saline Formation CO_2 Storage Project		
Test Location	Thornton, California		
Amount and Source of CO_2	Tons: 4000	Source: Manufactured (i.e., commercial)	
Field Test Partners (Primary Sponsors)	Rosetta Resources, Inc.		

Summary of Field Test Site and Operations:

Two pilot tests involving CO_2 injection will be performed at the Rosetta CO_2 Storage project site. We worked closely with our industrial partner, Rosetta Resources Inc., an oil and gas exploration and production company, to perform a thorough review of existing and abandoned natural gas fields in the southern Sacramento Valley, California. The proposed field site for the pilot test is in a small-depleted and abandoned natural gas field located north of Thornton, California (Figure 1). Gas production began in the mid 1940s and continued through the late 1980s, producing nearly 1.52 x 10^9 m^3 (53.6 billion cubic feet, Bcf) of gas from 14 wells. The Thornton Gas Field is an excellent geologic analog to numerous gas fields in the Sacramento Valley, including the much larger 9.3 x 10^{10} m^3 (3.3 Tcf) Rio Vista Gas Field located a few miles away near Rio Vista, California. The Rio Vista Gas Field is the largest onshore gas field in California. Thornton was also selected based on evidence of a favorable set of stacked gas reservoirs and saline formations, its close proximity to major transportation corridors, shallow depth to the gas pay zone 928 (3044 feet) and geologic evidence of a well-defined stratigraphic gas trap that would safely hold the CO_2.

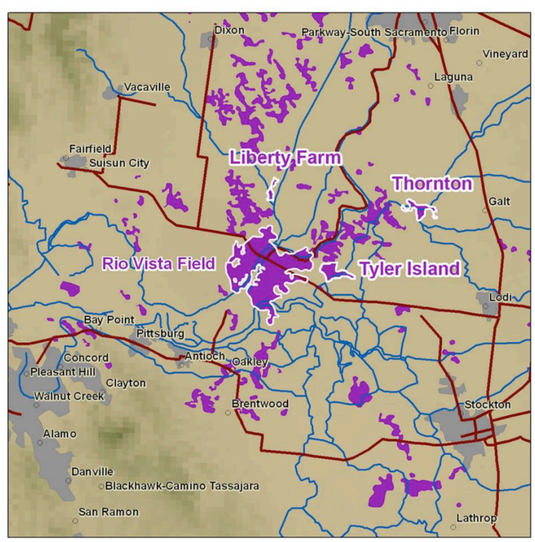


Figure 1. Thornton gas field and vicinity.

The first pilot test or experiment will involve injecting up to 2000 tons of CO_2 into a brine-filled zone in the McCormick sand, a very fine to medium grained, quartzitic sandstone (Figure 2). Two wells, a CO_2 injector and an observation well, will be installed in a saline zone located beneath the gas trap in the McCormick sand. Our current best estimate for the target depth of the saline test is 1037 to 1067 m (3400 to 3500 ft). Both wells will be drilled to approximately the same depth and the casing will initially be perforated in the saline zone. CO_2 injection will commence after logging and testing the wells.

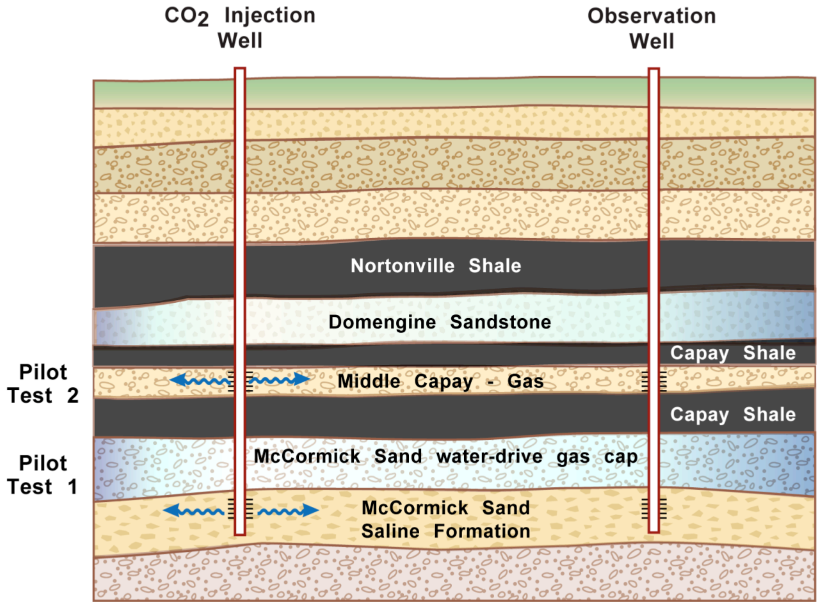


Figure 2. Geologic section at the Rosetta pilot site.

The second experiment will involve injecting up to 2000 tons of CO_2 into a depletion-drive, depleted gas reservoir located within the Middle Capay shale at a depth of approximately 928 m (3044 feet). The Capay shale represents a regionally extensive reservoir cap, containing pockets of natural gas in thin interbedded sand lenses. The top of the McCormick sand (Figure 2), a depleted water-drive reservoir at a slightly greater depth of 1003 to 1021 m (3290 to 3350), is an alternative location if the Capay sand stringer is absent at the location of the new wells. The casing will be perforated in the gas zone after completing the first experiment and cementing the well perforations shut in the lower saline zone. The second experiment will consist of injecting CO_2 into the depleted gas zone to assess the nature and extent of reservoir pressurization and displacement of methane by CO_2. CO_2 will be purchased from a local supplier and trucked to the pilot site.

Research Objectives:

The overall goal of the Rosetta Resources CO_2 Storage project is to gain practical experience and demonstrate the potential for supercritical CO_2 storage in representative geologic formations in an area with large CO_2 sources and storage potential. In addition, new monitoring approaches will be tested, existing risk assessment screening tools will be enhanced, and a two-way exchange of information with the regulators and public will be established. The Rosetta Resources CO_2 Storage Pilot has five major objectives:

1. Test the feasibility and safety of CO_2 storage in a depleted gas field in Northern California;
2. Evaluate the feasibility of CO_2 Storage with Enhanced Gas Recovery (CSEGR) associated with the early stages of a CO_2 storage project in a depleted gas field;
3. Demonstrate the safety and feasibility of CO_2 storage in saline formations in the vast northern regions of the Central Valley, California;
4. Demonstrate and test methods for monitoring CO_2 storage projects in gas fields; and
5. Gain experience with regulatory permitting and public outreach associated with CO_2 storage in gas reservoirs and saline formations in California.

The pilot test will be the first field-scale test in the United States used to study CSEGR processes. Depleted hydrocarbon reservoirs are especially promising targets for CO_2 storage because of the potential to use CO_2 to extract additional oil or natural gas. The benefit of enhanced oil recovery (EOR) using injected CO_2 to swell and mobilize oil from the reservoir toward a production well is well known. CSEGR involves a similar CO_2 injection process, but relies on sweep and methane displacement and has received far less attention. CO_2 injection may enhance methane production by reservoir repressurization or pressure maintenance. Based on the favorable results of numerous CSEGR modeling studies, WESTCARB sought out and selected the Thornton Gas Field for the dual purpose of demonstrating safe injection of CO_2 into a deep saline formation, coupled with a second injection into a depleted gas reservoir to demonstrate safety and to study CSEGR processes. Depleted natural gas reservoirs are attractive targets for sequestration of CO_2 because of their demonstrated ability to trap gas, proven record of gas recovery (i.e., sufficient permeability), existing infrastructure of wells and pipelines, and land use history of gas production and transportation.

Summary of Modeling and MMV Efforts: (Refer to Table 1 for MMV)

Preliminary computer simulations conducted by Lawrence Berkeley National Laboratory using TOUGH2/EOS7C in support of the pilot tests at the conceptual design level. The questions addressed at the conceptual design level include the following:

1. How much CO_2 should be injected and at what rate?
2. What are the expected pressure and temperature changes in the reservoir associated with the injection?
3. What kind of monitoring and sampling should be conducted in the observation well?

Using preliminary estimates of formation properties (permeability 10^{-12} m^2 and porosity 35%), and boundary and initial conditions, preliminary simulations showed that breakthrough of supercritical CO_2 will occur during the saline test within 10 days at an observation well located 39 m from the injector (Figure 3). Approximately 2250 tonnes of CO_2 injected at two rates (150 tonne/day and 300 tonnes/day) into the upper-most 4 m of the McCormick Sand is required to produce this result.

In contrast, breakthrough of CO_2 gas will occur in the 2-3 m thick Capay Shale interval at the same 39 m distance within a couple of days (Figure 4) using far less CO_2 (1000 tonnes injected at a rate of 1.2 kg/s). Pressure changes caused by injection are small in both cases and temperature effects are minimal.

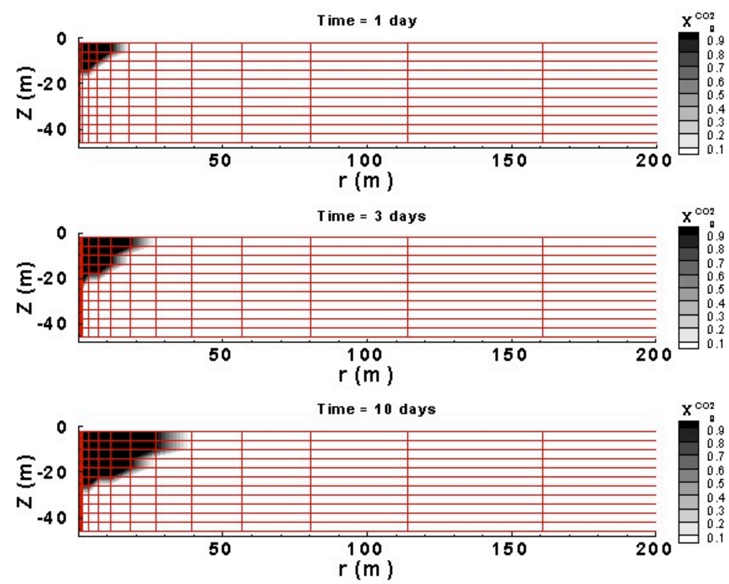
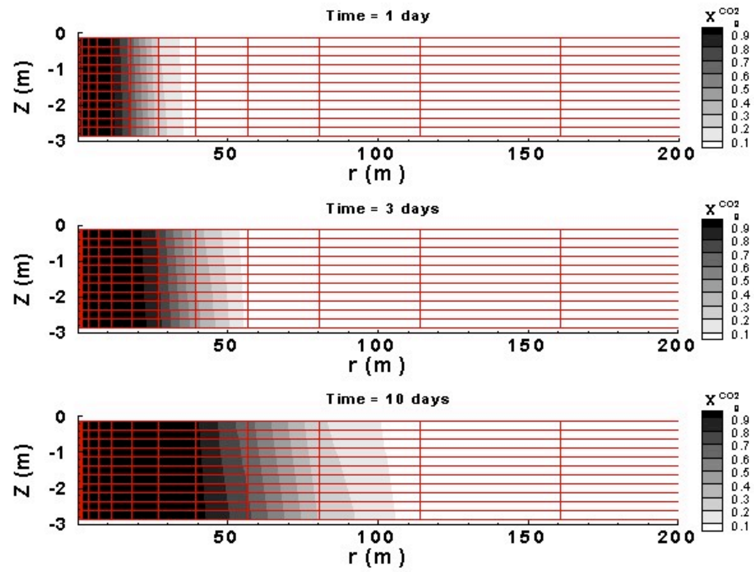


Figure 3. Mass fraction of CO_2 in the gas (X_g^{CO2}) at three times after injection into the upper-most 4 m of the McCormick Sand at a rate of 2 kg/s,

Figure 4. Two-dimensional *r-z* results showing CO_2 mass fraction in the gas phase (X_g^{CO2}) at three times for injection into the gas interval, assuming radial symmetry in the Capay Shale sand stringer.



A comprehensive set of hydrologic and geophysical monitoring techniques will be evaluated and deployed as part of the tests, aimed at monitoring CO_2 movement in the formation as well as checking for any leakage outside the primary storage formation. The combination of subsurface and surface measurements listed in Table 1 will be evaluated to determine which will be most effective for tracking CO_2 movement before deciding which methods to deploy.

Table 1. Measurement Technologies Evaluated for Potential Use at Field Test Site.

Measurement technique	Measurement parameters	Application

Vertical seismic profiling and crosswell seismic imaging	P and S wave velocity Reflection horizons Seismic amplitude attenuation	Detecting detailed distribution of CO_2 in the storage formation Detection leakage through faults and fractures
Cap rock integrity (if feasible)	Leakoff test	Natural stress state
Electrical and electromagnetic techniques (if feasible)	Formation conductivity Electromagnetic induction	Tracking movement of CO_2 in and above the storage formation Detecting migration of brine into shallow aquifers
CO_2 land surface flux monitoring using flux chambers or eddycovariance (if feasible)	CO_2 fluxes between the land surface and atmosphere	Detect, locate and quantify CO_2 releases
Soil gas sampling	Soil gas composition Isotopic analysis of CO_2	Detect elevated levels of CO_2 Identify source of elevated soil gas CO_2

Accomplishments to Date:

- A new site was selected for the pilot test, which is owned by the California Department of Water Resources (DWR) and referred to as the Grizzly Slough Property (GSP). Negotiations with the DWR began in mid February 2007 after lengthy negotiations with an adjacent private landowner failed to produce an access agreement.
- A detailed project description was prepared and submitted to the DWR for review in early April 2007. Preparation and submittal of the project description was required by the DWR.
- A second DWR requirement included the preparation of an environmental study satisfying the California Environmental Quality Act (CEQA). The lead agency for CEQA, the California Division of Oil, Gas and Geothermal Resources (DOGGR), prepared a Negative Declaration (ND) and supporting Initial Study (IS). Based on this document, DOGGR determined that the proposed project would not have any significant effects on the environment. The CEQA IS/ND was finalized in early October 2007 after responding to DWR and California Department of Transportation comments. No comments were received from the general public.
- The third DWR requirement includes the preparation and execution of a property lease. The terms and conditions of this lease are currently being negotiated with the DWR.
- The NEPA environmental questionnaire was prepared and submitted to the DOE for review and concurrence in late May 2007. The DOE categorical exclusion is pending review.
- Sandia Technologies, LLC was contracted as the site project manager responsible for overseeing the drilling operations and performing the CO_2 injection test.
- Prepared draft Underground Injection Control permit application for saline experiment
- Approximately 85 percent of the test equipment needed for the experiment has been purchased and is ready for deployment.

Summarize Target Sink Storage Opportunities and Benefits to the Region:

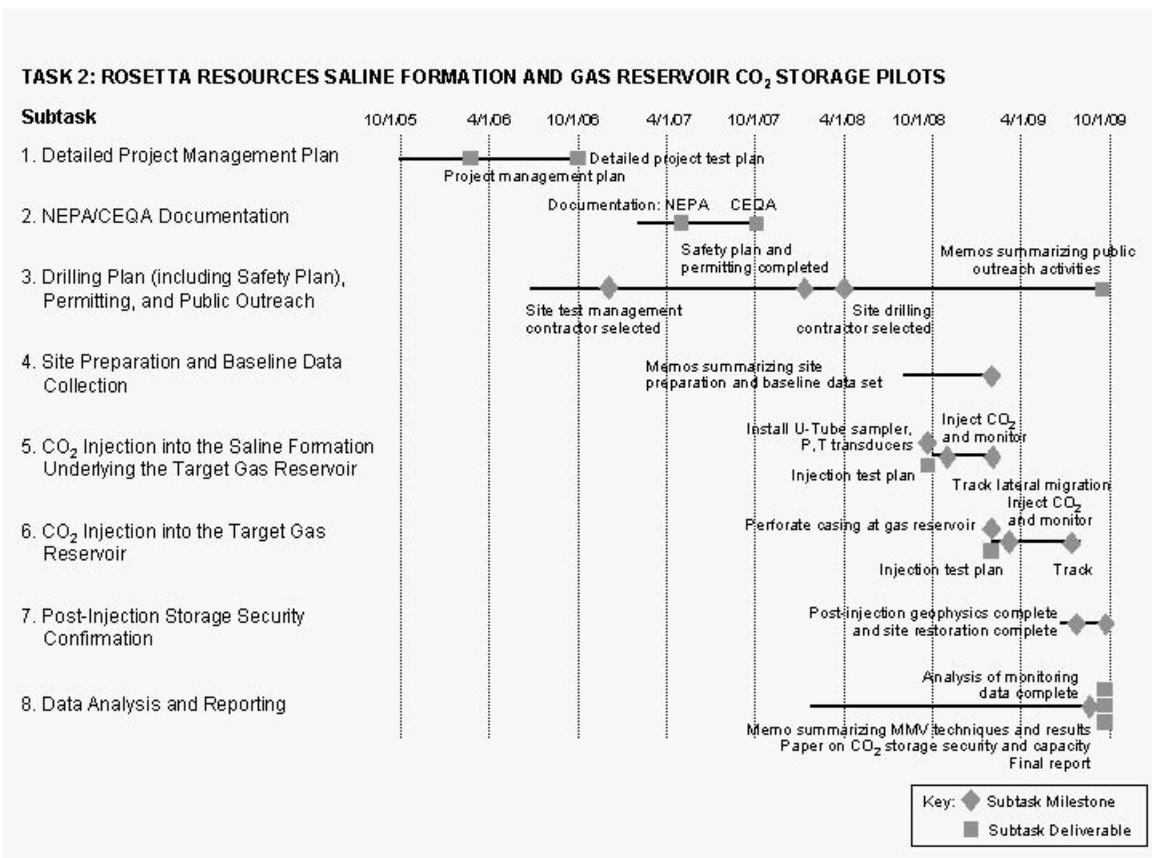
The Central Valley of California, composed of the Sacramento River basin in the north and San Joaquin River basin in the south, contains numerous saline formations and oil and gas reservoirs that could be used for geologic storage of CO_2. Enhanced oil and gas production using CO_2 will provide an important, initial economic incentive to store CO_2 in the Central Valley. California's energy infrastructure is very dependent on natural gas; therefore, enhanced gas production using CSEGR promotes affordable energy and potential economic growth.

Long-term storage of CO_2 in California, however, will be realized through utilization of high capacity saline formations. Storage capacity estimates for saline formations alone (50 to 250 billion tonnes of CO_2) far exceed oil and gas reservoir capacity, making them widespread targets for communities scattered throughout the Central Valley, benefiting the entire region. The success of California's recent legislation to reduce greenhouse gas emissions may partially depend on the successful deployment of geologic sequestration and the efficient use of these high capacity saline formations in the future.

Cost:	**Field Project Key Dates:**
Total Field Project Cost: **$ 5,925,223** **DOE Share:** $ 3,545,000 **___60_____%** **Non-DOE Share:** $ 2,380,223 **___40_____%**	**Baseline Completed: 10/08** **Drilling Operations Begin: 9/08 ***** **Injection Operations Begin: 11/08** **MMV Events: 11/08-3/09 and 4/09-7/09**

Field Test Schedule and Milestones (Gantt Chart):

*** Negotiations have been underway since February 2007 with the mineral-right owner and surface owner to gain legal access to the property. Once permission is granted, site preparation activities will begin and drilling will commence upon securing a drill rig through our industry partner Rosetta. Baseline characterization, CO_2 injection, and monitoring will follow drilling in 2008. Unforeseen delays in contractual agreements or adverse fall weather conditions could potentially impact the drilling/field schedule.



Additional Information:
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