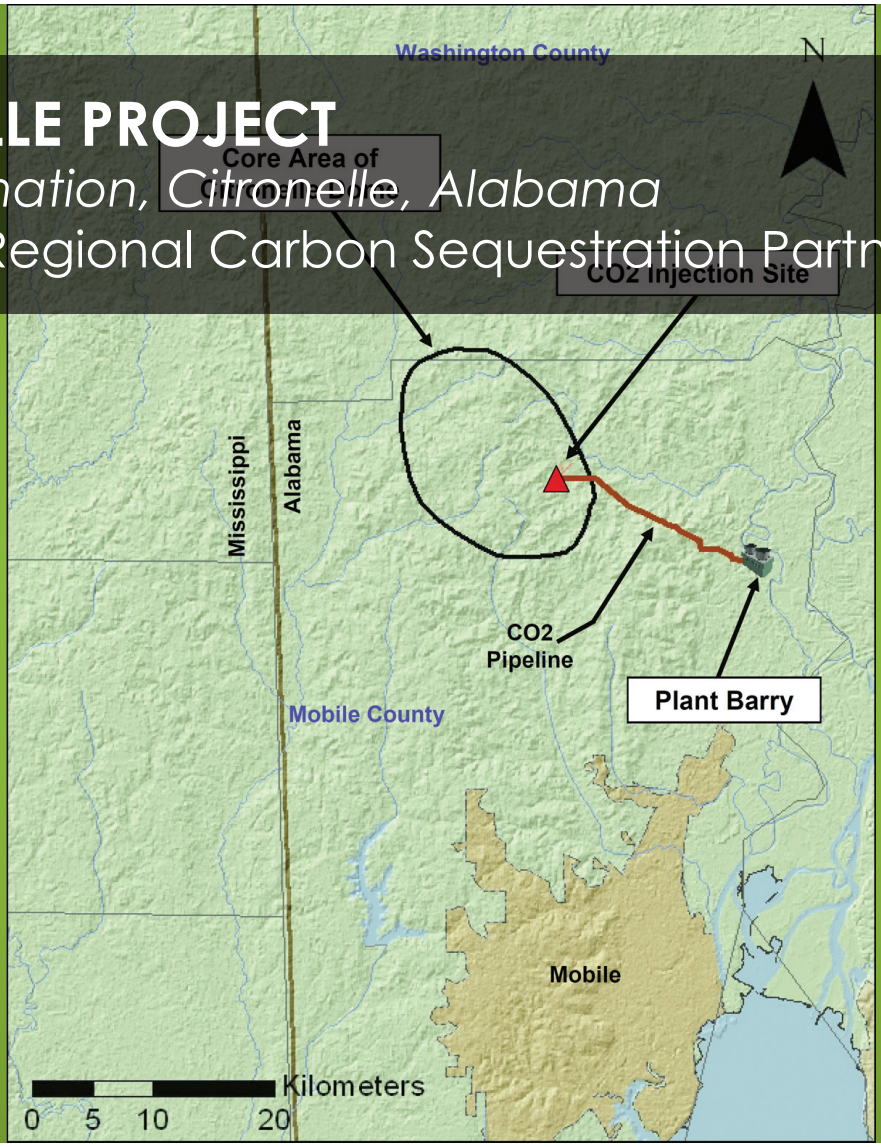
CITRONELLE PROJECT

Paluxy Formation, Citronelle, Alabama

Southeast Regional Carbon Sequestration Partnership



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BACKGROUND

The Southeast Regional Carbon Sequestration Partnership (SECARB) Citronelle Project has a goal of safely demonstrating large-scale, long-term carbon dioxide (CO_2) injection and storage in a saline reservoir that holds significant promise for future development. This project is the largest demonstration of a fully integrated, pulverized coal-fired carbon capture and storage (CCS) project in the United States as of 2016, and supports a commercial prototype of CO_2 capture; transportation; subsurface storage; and monitoring, verification, and accounting (MVA), and assessment.

The Citronelle Project's geologic storage and MVA sites are located on the flanks of the Citronelle Dome, approximately three miles southeast of the city of Citronelle. The injection zone, the Paluxy Formation, a saline formation that occurs at approximately 9,400 feet and overlies the oil production horizon of the Citronelle oilfield, presents a favorable injection reservoir in terms of areal extent and petrophysical characteristics. The confining zone, the basal shale of the overlying Washita-Fredericksburg Formation, is persistent throughout the Citronelle area and possesses the appropriate criteria to act as an effective CO_2 seal.

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PROJECT OVERVIEW

In addition to its ideal geology for the safe and long-term containment of CO_2, the Citronelle Dome was selected for its close proximity to the James M. Barry Electric Generating Plant (Plant Barry) in Bucks, Alabama. This demonstration-scale, post-combustion CO_2 capture facility provides CO_2 for the project by diverting a small amount of flue gas from its #5 coal burning unit and capturing the CO_2 using Mitsubishi Heavy Industries KM-CDRTM advanced amine technology. The captured CO_2 is compressed at Plant Barry and transported by pipeline to the injection location southeast of Citronelle, Alabama.

The project was designed to inject up to 150,000 metric tons per year of CO_2 captured from the pilot facility at Plant Barry for a period of up to 3 years. CO_2 injection began in August 2012, and as of September 2014, more than 114,000 metric tons have been injected and safely stored at this site. The project is currently in its post-injection monitoring phase.

Since the project is located in an active oilfield, operated by Denbury Onshore, LLC, the SECARB team examined the potential risk of CO_2 migration along existing wellbores in the area as part of its site characterization activities. The team cataloged data and well completion records for wells within the modeled plume area, or Area of Review (AoR). In addition, Denbury Onshore, LLC, maintains an active mechanical integrity test program for the oilfield, and cement bond logs were run on selected wells in the AoR. Adequate cement bonds were observed across the injection interval and confining units. Currently, the team performs active well maintenance, testing, and monitoring to mitigate any well integrity issues.

The Citronelle MVA team, led by the Southern States Energy Board and its partners, Electric Power Research Institute and Advanced Resources International, Inc., is applying proven and experimental MVA technologies to monitor CO_2 movement in the subsurface during and post-injection.

PROJECT SUCCESSES

The Citronelle Project demonstrated a fully integrated, pulverized coal-fired carbon capture with saline storage. The captured CO_2 was compressed and deliveredthrough a dedicated approximately 12 mile pipeline to the storage location southeast of Citronelle, Alabama.

CO_2 was injected into a saline formation that overlies the oil production horizon of the Citronelle oilfield, demonstrating saline storage in conjunction with oil field operations.

Citronelle has become a proving ground for breakthrough fiber optic cable technologies, and several research technologies are deployed at the site. These include distributed temperature sensing, distributed acoustic sensing, and testing of vertical seismic profiling using various types of seismic sources. In addition, experimental continuous heating cable technology is deployed to work in conjunction with the fiber optic sensors to prove a new method to verify wellbore integrity.

Citronelle's proven saline storage occurs in the regionally significant Gulf Coast Reservoir, with substantial promise for future development.

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