



the **ENERGY** lab

**PROJECT FACTS**  
**Industrial Carbon Capture  
and Storage (ICCS)**

# Air Products and Chemicals, Inc.: Demonstration of CO<sub>2</sub> Capture and Sequestration of Steam Methane Reforming Process Gas Used for Large-Scale Hydrogen Production

## Background

Carbon dioxide (CO<sub>2</sub>) emissions from industrial processes, among other sources, are linked to global climate change. Advancing development of technologies that capture and store or beneficially reuse CO<sub>2</sub> that would otherwise reside in the atmosphere for extended periods is of great importance. Advanced carbon capture, utilization and storage (CCUS) technologies offer significant potential for reducing CO<sub>2</sub> emissions and mitigating global climate change, while minimizing the economic impacts of the solution.

Under the Industrial Carbon Capture and Storage (ICCS) program, the U.S. Department of Energy (DOE) is collaborating with industry in cost sharing arrangements to demonstrate the next generation of technologies that will capture CO<sub>2</sub> emissions from industrial sources and either sequester those emissions or beneficially reuse them. The technologies included in the ICCS program have progressed beyond the research and development stage to a scale that can be readily replicated and deployed into commercial practice within the industry.

## Project Description

The DOE selected Air Products and Chemicals, Inc. (Air Products) to receive ICCS program funding through the American Recovery and Reinvestment Act (ARRA) of 2009, for its project entitled "Demonstration of CO<sub>2</sub> Capture and Sequestration of Steam Methane Reforming Process Gas Used for Large-Scale Hydrogen Production". For this project, Air Products will demonstrate a state-of-the-art system to concentrate CO<sub>2</sub> from two steam methane reformer (SMR) hydrogen production plants located in Port Arthur, Texas.

Air Products is retrofitting its two Port Arthur SMRs with a vacuum swing adsorption (VSA) system to separate the CO<sub>2</sub> from the process gas stream, followed by compression and drying processes. This process will concentrate the initial stream containing from 10-20 percent CO<sub>2</sub> to greater than 97 percent CO<sub>2</sub> purity.

## CONTACTS

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## PARTNERS

Denbury Onshore, LLC

## PROJECT DURATION

### Start Date

11/16/2009

### End Date

09/30/2015

## NATIONAL ENERGY TECHNOLOGY LABORATORY

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## COST

### Total Project Value

\$430,648,802

### DOE/Non-DOE Share

\$284,012,496 / \$146,636,306

Government funding for this project is provided in whole or in part through the American Recovery and Reinvestment Act.



Port Arthur 2 plant

The compressed CO<sub>2</sub> will then be delivered to the Denbury pipeline for transport to Texas EOR projects in the West Hastings Field where a monitoring, verification and accounting (MVA) program will ensure the injected CO<sub>2</sub> remains in the underground geologic formation. The technology will remove more than 90 percent of the CO<sub>2</sub> from the process gas stream used in a world-class scale hydrogen production facility with negligible impact on the efficiency of hydrogen production.

Project activities already completed include engineering and design. All air permits have been secured and construction is in progress. Commissioning, startup, and the operation of all components of the project are scheduled to occur by February, 2013. The MVA program to monitor the injected CO<sub>2</sub> is being designed and will be implemented once CO<sub>2</sub> capture begins.

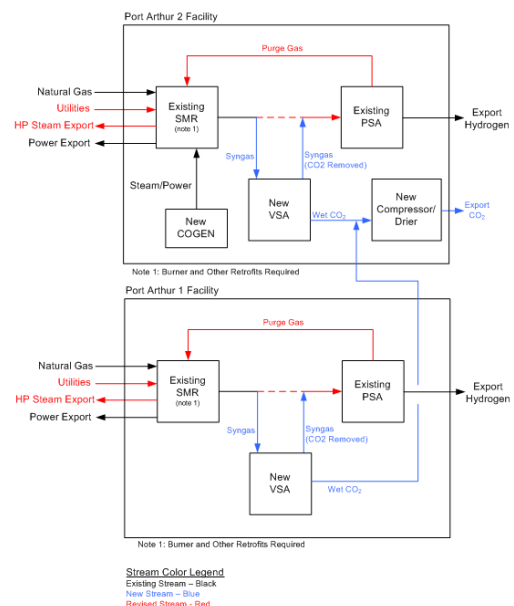
## Goals/Objectives

The project goal is to advance CCUS technologies from the demonstration stage to commercial viability. The project objective is to capture CO<sub>2</sub> from two SMR hydrogen production plants and store it in an oil reservoir for EOR in order to successfully demonstrate the technology and maximize the economic viability of commercial-scale CCUS.

## Benefits

Overall, the project will address climate change concerns, enhance U.S. economic and energy security, and boost domestic oil production. Specific project advantages and benefits include:

- Capturing approximately one million metric tons per year of CO<sub>2</sub>, that would otherwise be emitted to the atmosphere, for permanent storage in geologic formations for EOR applications.
- The CO<sub>2</sub> to be used for EOR will result in approximately 1.6 to 3.1 million barrels of additional domestic oil production.
- The technology application is significant with the U.S. on-purpose hydrogen market for refinery use estimated to be almost four million tonnes annually. The two Port Arthur SMRs represent 4.3 percent of this market.



CO<sub>2</sub> System Sketch