the ENERGY lab

PROJECT FACTS

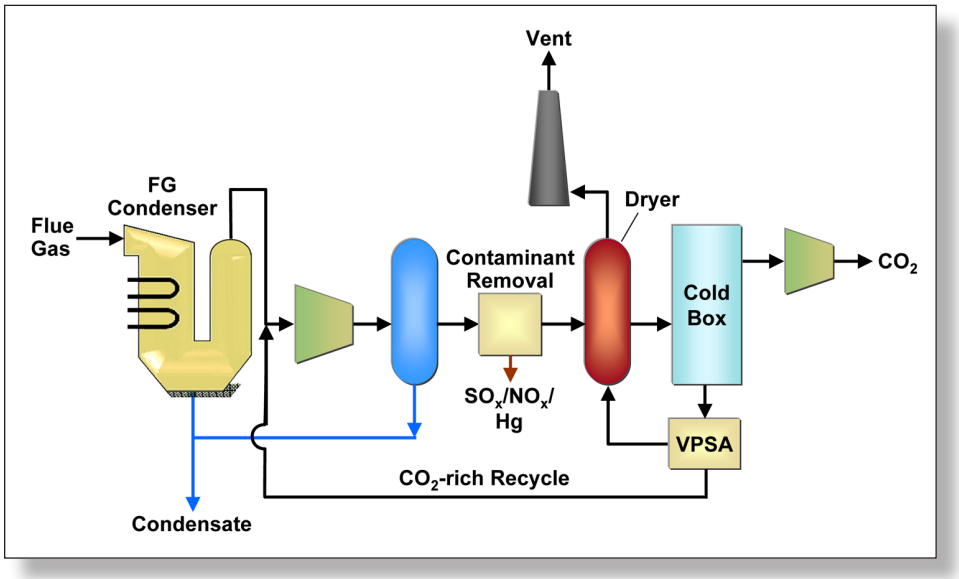
Existing Plants, Emissions & Capture

Near-zero Emissions Oxy-combustion Flue Gas Purification

Background

The mission of the U.S. Department of Energy's (DOE) Existing Plants, Emissions & Capture (EPEC) R&D Program is to develop innovative environmental control technologies to enable full use of the nation's vast coal reserves, while allowing the current fleet of coal-fired power plants to comply with existing and emerging environmental regulations. The EPEC R&D Program portfolio of post- and oxy-combustion carbon dioxide (CO_2) emissions control technologies and CO_2 compression and reuse is focused on advancing technological options for the existing fleet of coal-fired power plants in the event of carbon constraints.

Oxy-combustion is a promising near-term technology for CO_2 capture and sequestration from pulverized coal (PC) power plants. Oxy-combustion uses oxygen, with a purity of 95 to 99 percent, to combust coal and produce a highly-concentrated CO_2 stream. Further treatment of the flue gas may be needed to remove water, excess oxygen, nitrogen, sulfur oxides (SO_x), nitrogen oxides (NO_x), mercury (Hg), and other contaminants before it is sent to storage. DOE is funding research to develop low-cost, efficient methods to reduce these gas constituents from the concentrated CO_2 stream intended for long-term storage.



Schematic diagram of the CO_2 Processing Unit

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PARTNERS

Foster Wheeler
AES
Colt Engineering Corporation

PERIOD OF PERFORMANCE

1/1/2009 to 12/31/2011

COST

Total Project Value
$5,400,745

DOE/Non-DOE Share
$3,240,446/$2,160,298

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U.S. DEPARTMENT OF ENERGY

Description

This project will develop a near-zero emissions flue gas purification technology for existing PC-fired power plants retrofitted with oxy-combustion technology. The focus of technology development will be on two contaminant removal processes and a process for achieving high CO_2 capture rates. This oxy-combustion technology will cost-effectively capture more than 95 percent of CO_2 emissions from a boiler with high air ingress, compared to traditional technology, which is limited to less than 65 percent CO_2 capture. The technology will also lower atmospheric emissions of SO_x, NO_x, and Hg without the need for wet flue gas desulfurization (FGD) and selective catalytic reduction (SCR). As a result, PC-fired power plants with an existing FGD and SCR will be able to operate more economically. A CO_2 stream with very low concentrations of trace impurities will be recovered for sequestration or enhanced oil recovery.

Primary Project Goal

The primary goal of this project is to develop a near-zero emissions flue gas purification technology for existing PC-fired power plants retrofitted with oxy-combustion technology. Additionally, the project will:

- Demonstrate the feasibility of a process that will enable greater than 95 percent CO_2 capture from an existing PC-fired power plant.
- Remove contaminants of SO_x, NO_x, and Hg from the concentrated CO_2 stream.
- Enable DOE to achieve a CO_2 capture and storage technology with less than a 35 percent increase in cost of electricity (COE) by 2013.

Objectives

The primary objectives of this project are to reduce the cost of CO_2 capture with oxy-combustion in existing PC-fired power plants and achieve greater than 95 percent CO_2 recovery by integrating a unique combination of existing technologies for contaminant removal (NO_x, SO_x, Hg) with an advanced CO_2 compression and purification concept. The project will result in an integrated process that is ready for a pilot scale demonstration by 2011.

Benefits

The development of the near-zero emissions flue gas purification technology for existing PC-fired power plants retrofitted with oxy-combustion technology could lead to significant savings in the COE. Compared to the most up-to-date oxy-combustion technology, the proposed technology will lower CO_2 capture costs by 50 to 75 percent for older plants with high air ingress. This technology will mitigate the problem of air ingress in the PC-fired power plants that were not designed for oxy-combustion. Furthermore, it will allow for the conversion of plants using low-sulfur coal to high-sulfur coal without the need for wet-FGD and the opportunity to shut down wet-FGD in plants using high-sulfur coal to take advantage of substantial operating cost savings.

Planned Activities

- Develop sufficient bench-scale thermodynamic and reaction engineering data to enable the design of a contaminant removal system that enables PC-fired power plants to effectively operate on high sulfur coal without the need for wet-FGD and SCR units.
- Collect sufficient bench-scale experimental data for a catalytic system to design a contaminant removal system that enables PC-fired power plants to operate on low-sulfur coal without the need for wet-FGDs and SCRs.
- Perform bench-scale and pilot-scale experiments to enable development and design of a vacuum pressure swing adsorption (VPSA) process for attaining greater than 95 percent CO_2 recovery, even from PC-fired power plants with high air ingress.
- Carry out process simulations, techno-economic feasibility analysis and operability and integration evaluation to assess commercial viability of the proposed technology concepts.