

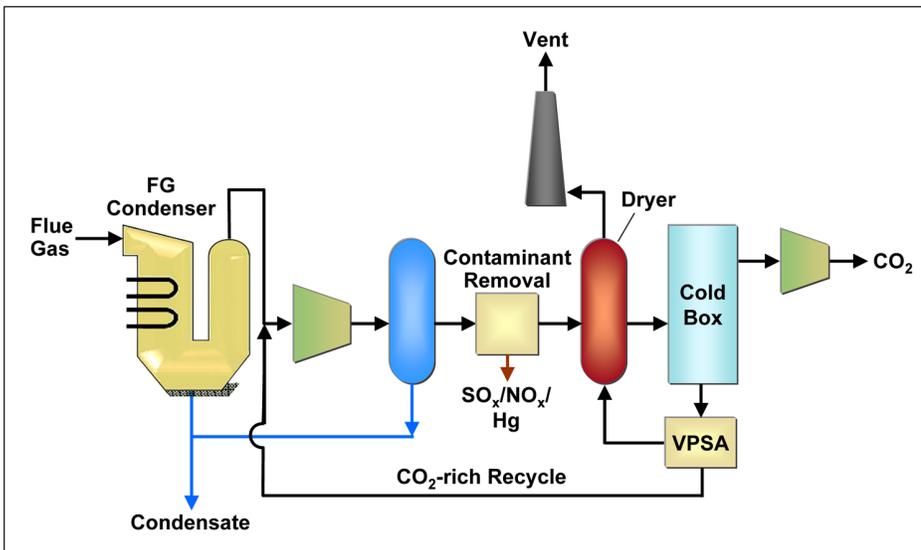


# Near-zero Emissions Oxy-combustion Flue Gas Purification

## 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<sub>2</sub>) emissions control technologies and CO<sub>2</sub> 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<sub>2</sub> 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<sub>2</sub> stream. Further treatment of the flue gas may be needed to remove water, excess oxygen, nitrogen, sulfur oxides (SO<sub>x</sub>), nitrogen oxides (NO<sub>x</sub>), 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<sub>2</sub> stream intended for long-term storage.



Schematic diagram of the CO<sub>2</sub> Processing Unit

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## PARTNERS

Foster Wheeler  
AES  
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## 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<sub>2</sub> capture rates. This oxy-combustion technology will cost-effectively capture more than 95 percent of CO<sub>2</sub> emissions from a boiler with high air ingress, compared to traditional technology, which is limited to less than 65 percent CO<sub>2</sub> capture. The technology will also lower atmospheric emissions of SO<sub>x</sub>, NO<sub>x</sub>, 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<sub>2</sub> 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<sub>2</sub> capture from an existing PC-fired power plant.
- Remove contaminants of SO<sub>x</sub>, NO<sub>x</sub>, and Hg from the concentrated CO<sub>2</sub> stream.
- Enable DOE to achieve a CO<sub>2</sub> 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<sub>2</sub> capture with oxy-combustion in existing PC-fired power plants and achieve greater than 95 percent CO<sub>2</sub> recovery by integrating a unique combination of existing technologies for contaminant removal (NO<sub>x</sub>, SO<sub>x</sub>, Hg) with an advanced CO<sub>2</sub> 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<sub>2</sub> 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<sub>2</sub> 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.

