

PROJECT facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Combustion
Technologies

09/2004



CONTACT POINTS

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PROJECT COST

Total Project Value:

\$3,994,095

DOE/Non-DOE Share:

\$3,195,276 / \$798,819

PROJECT DURATION

9/30/03 - 9/30/05



HYBRID COMBUSTION—GASIFICATION CHEMICAL LOOPING COAL POWER TECHNOLOGY DEVELOPMENT

Background

The future of combustion-based power generation is one of high technology. The range of the NETL Combustion Technologies programs and initiatives holds exciting opportunity for the continued use of combustion technologies. The program is currently in a transitional phase, moving away from evolutionary combustion technology towards revolutionary systems that include CO₂ mitigation. One program that will receive future development is chemical looping, a program offering considerable promise for meeting our nation's energy growth needs while providing a cleaner environment.

Flexibility

The hybrid combustion-gasification process utilizing advanced chemical and thermal looping technology can be alternatively configured for one of the following:

- A combustion-based steam power plant with CO₂ capture;
- A hybrid combustion-gasification process producing a syngas for gas turbines or fuel cells; or
- An integrated hybrid combustion-gasification process producing hydrogen for gas turbines, fuel cells or other hydrogen-based applications while also producing a separate stream of CO₂ for use or sequestration.



ALSTOM Power Plant Laboratories

WEBSITE

www.netl.doe.gov/coal

PARTNERS

ALSTOM

Windsor, CT

Parsons I & T

Wyomissing, PA

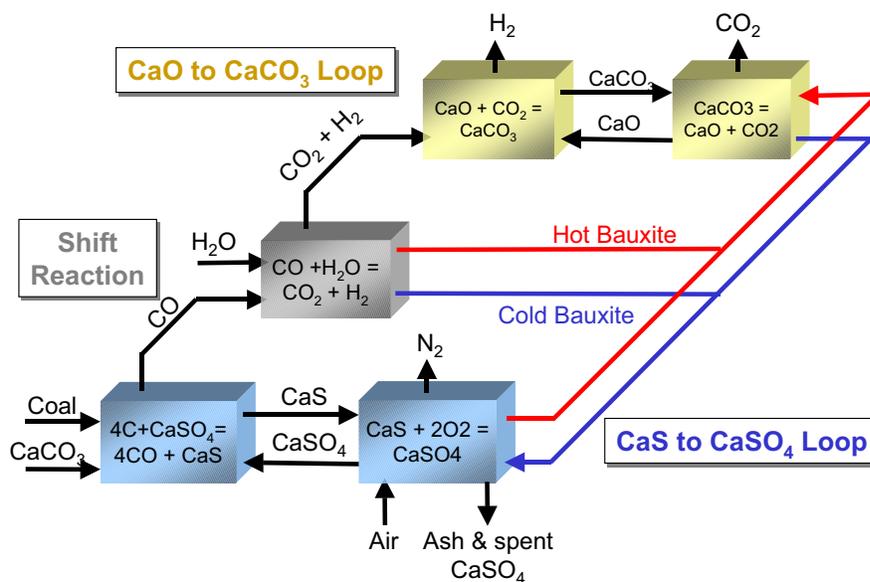
ABB Lummus Global, Inc.

Houston, TX

PEMM Corporation

Fishkill, New York

An example of the integrated hybrid combustion-gasification process is shown in the following diagram. In this chemical looping process, calcium compounds are used to carry oxygen and heat between the various reaction loops. The first chemical loop uses CaS & CaSO₄ reactions to gasify the coal. With the addition of steam, this gas is converted to hydrogen and carbon dioxide. The carbon dioxide is then removed from the gas using another chemical loop based on CaO & CaCO₃. These compounds are then directed to another reactor where a “thermal” loop, using a bauxite heat transfer medium, drives off the carbon dioxide for use or sequestration.



Advanced Chemical Looping Process

Based on previously performed engineering and economic studies at ALSTOM, hybrid combustion-gasification chemical looping coal power technology has been shown to have the potential to achieve near-zero CO₂ emissions, exceed all current environmental regulations, meet or beat IGCC efficiency, and cost less than \$800 per kilowatt without CO₂ capture and less than \$1000 per kilowatt including CO₂ capture for the world-wide power generation market.

Goals

The overall objective of this project is to develop and verify the high temperature chemical and thermal looping process concept at a small-scale pilot facility to enable ALSTOM to design, construct, and demonstrate a pre-commercial, prototype version of this advanced system. In the initial phase, ALSTOM will fund and build the required process development unit at its Power Plant Laboratories in Windsor, Connecticut.

Next, reaction rates, as well as the sustainability of the chemical reactivity of the circulated solids will be determined. Ongoing engineering will also be performed to provide supplemental information for the prototype program to follow. Finally, the prototype system design and economics of the power plant concept will be updated, and a pre-commercial prototype plant concept will be completed.