

Objective

The University of Utah Institute for Clean and Secure Energy's Clean Coal Program is pursuing interdisciplinary, cradle-to-grave research and development of energy for electric power from the abundant domestic coal resources, with an emphasis on minimizing carbon footprints, through the use of CO₂ capture for subsequent storage (sequestration). The Institute is also educating a new generation of professionals in the energy field to replace the current aging population of experienced energy professionals. We are conducting research to support the development of technologies for the clean and efficient utilization of coal and options for the mitigation of CO₂ emissions. The magnitude of the CO₂ mitigation problem will require a multitude of responses, including increased efficiency, co-firing with biomass, retrofitting of existing power plants, and CO₂ capture and sequestration.

Research within the Utah Clean Coal Program is directed at the elimination of pollutants and greenhouse gases, and safeguarding human health and the environment. Building on the existing expertise at the University of Utah and Brigham Young University developed over a long history of basic and applied research in coal science and combustion processes, the Utah Program serves as a State and national resource with an international reach.

Our research focuses on addressing current problems with the existing coal-fired electricity generating fleet, accelerating the introduction of near-term solutions for CO₂ capture and sequestration (CCS), and longer term issues of developing the next generation of low-cost CCS technologies.

The current challenges being addressed include the control of mercury emissions and corrosion of high-temperature materials used in the very efficient high-temperature and high-pressure (supercritical and ultrasupercritical) coal-fired boilers. The near-term problems being addressed are related to Integrated Gasification Combined Cycle (IGCC) and oxyfuel systems which represent two of the three options (the third is flue gas scrubbing) being pursued for CCS. These technologies although proven to be technically feasible will increase the price of electricity significantly. The longer term challenge is to reduce the cost of CCS using technologies such as chemical looping combustion, which can reduce the cost of carbon capture by eliminating the need for the expensive air separation unit used in both IGCC and oxyfuel systems.

Simulation and validation will be used together to guide the design and optimization of technologies for mitigating greenhouse gas emissions and to reduce the time and cost from inception of a technology to commercialization. The Utah Clean Coal Program also performs research on complementary issues relating to coal utilization including carbon sequestration studies led by the Energy and Geosciences Institute at the University of Utah and legal and environmental constraints, in association with the Stegner Center at the University of Utah. The Utah Clean Coal Program benefits greatly from support from, collaboration with, and student internships at the Department of Energy's National Energy Technology Laboratory.



RESEARCH CONTACTS:

RONALD J. PUGMIRE & ADEL F. SAROFIM
(801) 581-7236

UTAH CLEAN COAL PROGRAM

THE INSTITUTE FOR CLEAN AND SECURE ENERGY

Coal is the nation's largest fossil-fuel resource and is responsible for over 50% of the United State's electricity generation (approximately 90% of Utah's electricity generation). With a 250-year reserve/production ratio of this domestic, low-cost fuel, the U.S. is likely to continue using coal as a major component of its energy portfolio for the foreseeable future. Our challenge is to find ways to efficiently and effectively reduce the environmental footprint of coal while transitioning to renewable energy sources.



Above Ground

Current solutions

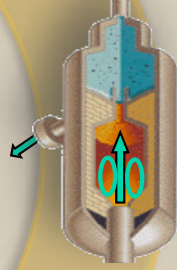
Pulverized Coal Boilers



- USC corrosion
- Hg control
- models for sorbent injection

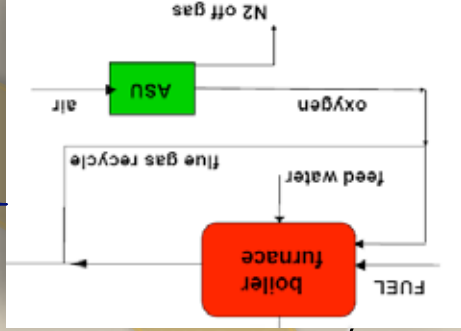
Near-term solutions

Gasifiers



- C/CO₂ & C/H₂O kinetics
- ash deposition
- refractory wear
- one-dimensional-turbulence model of 2-phase flow

Oxy-Fuel Combustion



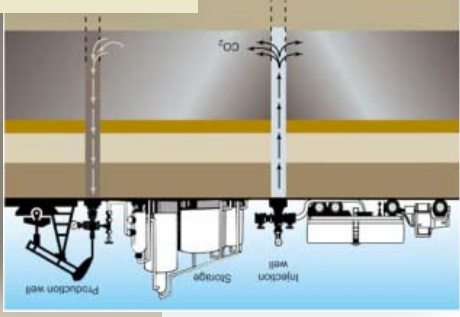
- Coal injector studies: experimental & simulation

Long-term solutions

Chemical Looping Combustion

Simulation

CO₂ Sequestration in partnership with the Energy & Geosciences Institute at the University of Utah



- contaminants
- model mixing
- CO₂ and brine

Carbon Sequestration Options



Below Ground