

## FutureGen: Hydrogen and Power Generation from Coal

FutureGen is a combined DOE and industry effort to build a 275-megawatt, near-zero emissions, coal-fired plant that will gasify coal to produce electricity and hydrogen. The \$1 billion project will employ the latest technology and serve as a large-scale engineering laboratory for testing new clean power, carbon dioxide capture, and coal-to-hydrogen technologies. The process involves the following basic steps.

- Oxygen separation from air.
- Coal is gasified with pure oxygen and steam.  
 $2\text{Coal(C-H)} + 1/2\text{O}_2 + \text{H}_2\text{O} = 2\text{CO} + 2\text{H}_2$
- Product gas from the gasifier is cleaned up to remove pollutants.
- Water Gas Shift reaction to produce more hydrogen  
 $\text{CO} + \text{H}_2\text{O} = \text{CO}_2 + \text{H}_2$
- Carbon dioxide separation and sequestration
- Hydrogen rich stream is mixed with nitrogen from the air separation unit and combusted to generate electricity. The combustion gas includes only nitrogen and steam.

UC has the following potential expertise for FutureGen programs:

- Use of wireless sensors and passive samplers to monitor environmental conditions and plant parameters.
- CO<sub>2</sub> sequestration and gas separation with membrane and other absorption methods. The NSF membrane center has various polymeric and ceramic membrane technologies suitable for effective CO<sub>2</sub> separation.
- Precombustion removal of multi pollutants such as Hg, S and NO<sub>x</sub> suitable for gasification.
- Gasification technology and coal pyrolysis.
- Coal properties and their effect on emissions.
- Minimization and control of NO<sub>x</sub> emissions.
- Development of novel sorbents for mercury, SO<sub>2</sub> and SO<sub>3</sub> removal.
- Expertise in gas-solid reaction for the use of calcium-based sorbent in furnace and gasifier.
- Byproduct utilization and the production of elemental sulfur.

UC will participate the FutureGen project through a consortium of Ohio Universities.

### Proposed Research

- Combining the gasification and the water-gas-shift reaction into one process will greatly reduce the cost of the system. Development of special catalyst, which has better performance under gasifier conditions.
- Development of catalytic membrane process for simultaneous hydrogen separation and water-gas-shift reaction.
- Development of combined membrane and cryogenic oxygen separation system.