Exelon

Fact Sheet

Carbon Capture & Sequestration

One potential tool for addressing climate change is carbon capture and sequestration (CCS), which is viewed as promising yet challenging. Exelon believes CCS or "clean coal" technologies must be pursued since coal is an abundant and low-cost energy source used heavily around the world. Coal-fired power plants are the source of about 50 percent of U.S. electricity, but also account for almost one-third of U.S. CO_2 emissions.[1]

Since these technologies are still under development and not yet proven, we should recognize that CCS will not have any significant affect on curbing carbon output for at least another 20 years. Developing and scaling CCS technologies will be expensive and require government funding. CCS will also face similar challenges as other forms of electricity generation such as siting, waste disposal and safety issues. Exelon believes other tools will be needed to reduce GHG emissions including new nuclear, renewables and energy efficiency.

What is CCS?

Carbon Capture and Sequestration is defined as the following:

- **Capture** - Separating CO_2 from the exhaust gas of industrial processes such as electricity generation from fossil fuels
- **Transport** - Processing and transporting CO_2 by pipeline
- **Sequestration** - Injecting CO_2 into deep geologic formations for indefinite storage

How is CO_2 captured?

The first step is to extract a concentrated stream of CO_2 from the exhaust gas. Currently three approaches for capturing CO_2 from power plants appear the most promising: post-combustion capture, pre-combustion capture, and oxy-fuel combustion.

Post-combustion CO_2 capture

Post-combustion CO_2 capture is the extraction of CO_2 from a power plant's exhaust gas by chemical reaction. This occurs after a fossil fuel has been combusted to create steam used to generate electricity. In theory, post-combustion capture technology can be deployed with new power plants and retrofitted to existing power plants. Retrofit equipment requires a substantial amount of space and energy, and retrofits are not technically feasible at all plant sites. Several pilot-scale projects are under consideration and in development in the U.S. in states such as West Virginia, Wisconsin, Ohio and Texas.

Pre-combustion CO_2 capture

Pre-combustion CO_2 capture is employed with Integrated Gasification Combined Cycle (IGCC) technology. IGCC is a relatively new advancement in electricity generation. An IGCC power plant combines a gasification system with a modern, highly efficient "combined cycle" electric power system

(consisting of one or more gas turbines integrated with a steam turbine). IGCC begins with gasification, which yields a synthetic gas stream comprised primarily of hydrogen and CO_2. This gas stream can then be separated. The hydrogen is burned to generate electricity and the CO_2 stream can be captured.

The result is a complex facility that requires a wide array of operational maintenance and engineering skills not typically found in the power generation industry. Currently, there are only four coal-based IGCC pilot-scale power plants worldwide.

In effort to further deploy IGCC, the federal government announced in 2003 FutureGen, a $1 billion initiative to create a 275-MW IGCC power plant equipped with capture capability. In January 2008, FutureGen as designed was cancelled and the program is reportedly being restructured by the U.S. DOE in response to the cost of the project, which had reportedly more than doubled.[2]

Oxy-fuel Combustion

Oxy-fuel combustion is the combustion of coal in a pure oxygen environment instead of air. This process produces an exhaust gas that is mostly CO_2 and water, which are then separated. The process has been employed in the metallurgical and glass-making industries for years. For a utility-scale power plant, the process to separate oxygen from air requires a significant amount of energy and reduces plant efficiency.

Oxy-fuel combustion technology is still in the research phase of the development cycle in part because temperatures for pure oxygen combustion (about 3,500ºC) are far too high for a typical power plant.

How is CO_2 transported?

After capture, the CO_2 gas is purified, dehydrated and sometimes compressed, allowing it to be transported as a liquid to a storage site by pipelines. Development of an expansive, nationwide CO_2 pipeline network will be necessary to support CCS at a large scale.

How is CO_2 sequestered?

After capture and transport, CO_2 must be stored where it cannot escape into the atmosphere. Scientists believe that storage in geologic formations will work best. The U.S. DOE is investigating several types of underground formations for geologic sequestration, the most promising being oil and natural gas reservoirs, deep unmineable coal seams, and deep saline formations. Domestic deep saline formations are estimated to have the greatest capacity, with potentially enough room to store 100 years worth of CO_2.[3]

Endnotes

1 The Pew Center on Global Climate Change, “Coal and Climate Change Facts”, 2007. http://www.pewclimate.org/global-warming-basics/coalfacts.cfm

2 US Department of Energy, *FutureGen* Clean Coal Projects, http://fossil.energy.gov/programs/powersystems/futuregen/index.html

3 The Pew Center on Global Climate Change, “Congressional Policy Brief: Addressing Emissions from Coal Use in Power Generation”, Fall 2007.