Can Coal Be Clean and Efficient?

The single largest source of energy around the world is oil.[i] When it comes to generating electricity, however, coal is king. Around the world, coal produces 39% of the energy used to generate electricity, more than double the next leading source. When coal is burned to generate electricity, the process is dirty and on average only 36% efficient. Most of the energy goes up the smokestack. Thus, there are powerful incentives to find cleaner, more efficient ways to use coal.[ii]

In the standard process, coal is pulverized to dust and injected into a boiler. There it is burned where it heats water to steam, and the steam drives the generators. Chemical and physical processes can be used to reduce pollution and increase efficiency, but in the best new plants this process tops out at 45% efficient. Older plants can be as low as 5% efficient.

There has been much interest in the Integrated Gasification Combined Cycle (IGCC) process. Coal is heated in the absence of oxygen, so it doesn't burn. It gives off a variety of gas products; some can be collected and sold for industrial purposes; others are flammable and can be used as fuel *(syngas)*. The syngas is burned to heat water which drives a generator. But instead of just being cooled for reuse, sophisticated plumbing captures heat from the steam a second time, using it to drive a second set of generators. IGCC plants are more efficient, above 50%, produce less pollution, and the pollution can be captured, processed into a useful form, and sold for industrial uses.[ii] There are downsides, however. These plants cost about 25% more than a conventional plant, and we have only one federally funded test facility in the U.S. Thus, to convert would require a complete rebuilding of the country's generating infrastructure. Further, while IGCC is better for some pollutants, it does nothing for others, especially CO_2, the principle global warming gas.[iii] Creating electricity with coal creates more CO_2 than it does with either natural gas. Coal-fired electricity generation is perhaps the single largest contribution that humans make to global warming.

Carbon Capture and Sequestration (CCS) is a plan to chemically capture CO_2 out of the flue gasses of a power plant and pump them underground for permanent burial. Conceptually, it is an interesting idea: we get the carbon out of the ground when we mine the coal, why not send it back? While the technology seems solvable[iv], practical constraints raise questions about this process. Esimated to cost $150 per ton of CO_2, the bill would quickly exceeds $1 billion per plant per year.[v] Once captured, the CO_2 would have to be transported to geological formations that are capable of holding it forever, as a release would be catastrophic.[iv] This would involve a huge system of pipelines. Plus, energy is required for every step in the process, reducing the efficiency of both regular and IGCC plants by an estimated 19-24%.[iii] That's a huge energy offset, bringing even the best new plants back down to the 35% efficiency range.

The overall conclusion is that hopes for "clean coal" are premature. The hoopla notwithstanding, issues involving infrastructure, cost, and energy offsets make a "clean coal" solution highly problematic. As coal remains our most abundant fossil fuel, efforts towards clean, efficient coal must continue. But oil and gas have historically been preferred over coal for sound reasons. We would be unwise to stake our energy future on "clean coal."

[i] *International energy annual, 2004*. U.S. Energy Information Administration, http://www.eia.doe.gov/iea/.
[ii] Nersesian, Roy. (2007). *Energy for the 21st Century.* Armonk, NY: M.E. Sharpe.
[iii] Robertson, Henry. (October, 2007). The price of "clean coal." *Missouri Sierran, 39,* (4), 1-3.
[iv] Katzer, James (Executive Director). ()2007). *The future of coal.* Cambridge, MA: Massachusetts Institute of Technology.
[v] *Carbon capture research.* U.S. Department of Energy, http://www.fossil.energy.gov/programs/sequestration/capture, viewed online 10/2007.