FACT SHEET: 'Clean Coal' Power Plants

Energy Justice Network

Coal-Fired Power Generation

Over half of the electricity generated in the U.S. comes from coal-fired power plants, which are the largest source of greenhouse gases. Coal-fired power plants emit 66% of sulfur oxides (SOx, or acid rain), 40% of carbon dioxide (CO_2), 33% of mercury and 22% of nitrogen oxides (NOx).[1]

Coal is the most CO_2-intensive fossil fuel, emitting about 3 pounds of CO_2 for every pound of coal burned. The U.S. burns over 1 billion tons of coal every year. There are 492 coal power plants in the U.S., with an average size of 667 megawatts (MW) and an average age of 40 years.[2] One 500 MW coal-fired power plant produces about 3 million tons/year of CO_2. If 60% of the CO_2 from all these plants were captured and compressed to a liquid for underground injection, its volume would equal the U.S. oil consumption of 20 million barrels/day.[3] A large coal-fired power plant emits the CO_2 equivalent from one million SUVs.

What is IGCC?

IGCC (Integrated Gasification Combined Cycle) is a type of power plant that gasifies coal into synthetic gas (syngas) to power a gas turbine. The heat from the gas turbine exhaust then generates steam to run a steam turbine. None of the basic technologies – coal gasification, gas turbines, and steam turbines – are new. It is the *integration o*f these into electric power plants that is new, and presents engineering challenges.

There are 160-250 proposed new coal-fired power plants in the U.S.; 32 proposed to be IGCC.[4] Despite a long history of gasification, only two IGCC power plants have been built.[5] Although IGCC is promoted as being "ready" or "able" to capture and store CO_2, none actually do and almost no IGCC proposals intend to. Conventional coal plants operate at 32-38% efficiency, while IGCC plants operate at 36-39% efficiency.[6]

IGCC Feasibility / Billions in Subsidies

The Bush administration's Energy Policy Act of 2005 included $1.8 billion for "clean coal," plus billions in federally guaranteed loans for IGCC. In June 2001, the Government Accountability Office found that of the 13 "clean" coal projects examined, 8 had serious delays or financial problems, 6 were behind schedule by 2-7 years, and 2 projects went bankrupt and were abandoned.[7]

Wabash River IGCC Project
West Terre Haute, Indiana

Recent Bush administration policies have ramped up the push for "clean" coal. IGCC "uncertainties" include lack of standard plant design, no performance guarantees, and high capital costs.[8] IGCC veteran Stephen D. Jenkins testified in January 2007 that IGCC technology won't be ready for 6-8 years, has limited performance and emissions guarantees, and that commercial-scale CO_2 capture and storage has not been demonstrated.[9]

High Costs

Capital costs for IGCC plants are estimated to be 20-47% higher than traditional coal plants.[10,11] In 2004, Indeck Energy Services testified before the Illinois State EPA that IGCC's "capital costs are 30% higher."[12] General construction costs (concrete, steel and labor) have risen 100-300% in recent years, driving up the costs of all power plants.[13] The Department of Energy (DOE) reports that IGCC is seen as too risky for private investors, and requires large subsidies from the federal, state and local governments.[14]

In 2006, the EPA estimated that capturing 90% of CO_2 emissions from IGCC plants would increase capital costs 47%; and the total cost of electricity 38%.[15] "Capture" does not include transportation of gas or storage.

Compression costs have been estimated at $17/ton CO2, so a 600 MW plant emitting 4-5 million tons/year of CO2 would cost approximately $68-85,000,000/year <u>just</u> for compression.[16]

5 IGCC's Cancelled and 4 on Hold – Oct 2007

As of October 2007, 5 IGCC's have been cancelled and 4 put on hold in the U.S. Five cancelled plants include NRG in DE, TECO in FL, Tondu in TX, Bowie in AZ and Buffalo Energy in WY; 4 plants on hold: Mesaba in MN, Madison Power and Tenaska/ERORA, both in IL, NRG in New York.[17] Capital costs are estimated at about $3,300/kW.[18]

In April 2007, Minnesota's Office of Administrative Hearings found: the IGCC plant isn't the least-cost resource, NOx and mercury emissions aren't any better than a conventional coal plant with modern pollution controls, the technology does not qualify as an "Innovative Energy Project," and the plant would cost 9-11 cents/kWh; and capturing and transporting the carbon would add at least 5 cents/kWh.[19]

Gasification Contaminates Water

IGCC more closely resembles a chemical plant than a traditional pulverized coal power plant. Using water to clean the gas creates water contamination problems. Coal gasification wastewater has an average pH of 9.8, similar to the pH of hand soap (pure water has a pH of 7.0).[20]

The principal contaminant of "process wastewater" is NO_3 (nitrate). The Great Plains Coal Gasification plant in

Beulah, ND generated 4.83 million metric tons of wastewater in 1988. Another 766,000 metric tons of contaminated "cooling tower blowdown" water and 245,000 metric tons of gasifier ash, which will ultimately leach contaminants into the groundwater where it's dumped. Groundwater in the area has been contaminated with high pH, sulfates, chlorine, arsenic and selenium.[21]

DOE's IGCC pilot project in Wabash River, Indiana found selenium and cyanide limits were "routinely exceeded."[22]

CO_2 Capture and Transport

IGCC is being promoted by the coal industry as having the potential to "capture" CO_2. However, capturing CO_2 reduces plant efficiency and increases water use. An Electric Power Research Institute study found CO_2 capture equipment decreased plant output by at least 25%;[23] and increases water consumption by approximately 23%.[24]

Additional "capture" costs beyond the plant gate, plus transportation and storage costs, are not factored into the efficiency loss or cost increase. The Minnesota Department of Commerce estimated CO2 sequestration costs for Mesaba at roughly $1.107 billion in 2011; and pipeline costs at $635.4 million.[25]

A July 2006 EPA report estimated CO_2 capture costs at $24/ton, and says that "widespread introduction" of carbon capture and sequestration technology into the commercial market is "highly uncertain."[26]

Pipeline costs for the proposed Mesaba IGCC plant in Minnesota were estimated to cost $25,000 to $60,000 per inch (diameter of the pipe) per mile [27], [28] plus the cost of repressurization stations to keep the gas flowing. A natural gas pipeline costs about $2-4 million/mile, using a 30 inch pipeline.[29]

CO_2 Storage and Sequestration

CO_2 sequestration differs from "storage" in that it is a more permanent storing of the gas, and must be stored without leaking for thousands of years. We have been unable to safely store solid and liquid radioactive wastes for 50-60 years without leakage. It's unlikely that we'll be able to store a significant part of the world's 28 billion metric tons of CO_2 gas emitted every year without leakage problems.

If stored CO_2 leaks out, the concentrated CO_2 can cause suffocation because it is heavier than air.[30] In 1986, a large release of CO_2 from a volcanic crater, Lake Nyos in West Africa, suffocated and killed 1,700 people. A similar event happened at Lake Monoun in Cameroon. Researchers continue to work on degassing the lakes to prevent another tragedy.[31] Further research is needed on CO_2 migration and seismic shifts from storing large amounts of CO_2 underground.

Carbon sequestration costs are highly uncertain. The National Energy Technology Laboratory states, "the economics of CO_2 recovery are poor in all scenarios…."[32]

A December 2006 DOE Environmental Impact Statement reported that geologic sequestration of CO_2 "is not a reasonable option because [the] technology is not sufficiently mature to be implemented at production scale during the demonstration period for the proposed facility;" and isn't expected to be "technically practicable" for large-scale commercial development within the next 15 years.[33] A 2006 presentation on IGCC by Xcel Energy stated that the "wild card" in the IGCC cost equation is CO_2 capture.[34]

The world's largest CO_2 sequestration project is in Sleipner, Norway, where Statoil has been pumping one million tons of CO_2/year since 1996 into a reservoir beneath the North Sea. It would take 5-10 of these projects to store the CO_2 from a single large coal plant.[35]

Poor Emissions Profile / More Mercury

Power plants emit more pollutants during start-up than in steady-state operation. Because gasification plants require about 60 start-up/shut-down events every year (as opposed to 2-3 for pulverized coal), and because it takes a few days for a plant's cold start, pollution emission rates are estimated to increase an average of 38%.[36] Start-up/shut-down emissions are far higher than steady-state emissions, and regulations limiting pollutants generally don't apply during start-up/shut-down.

Mercury emissions per megawatt-hour (MWh) from the proposed Mesaba IGCC plant are 15-27% higher than a newly built conventional (pulverized coal) plant equipped with modern pollution control technology.[37]

Renewables: Lower Total Cost

When the currently unaccounted-for, "externalized" costs for coal plants, including CO_2 capture, pipeline and transportation costs, storage and sequestration costs, increased risk, liability for explosion or the release of large amounts of CO_2; plus the future cost of global warming, acidified lakes, mercury-poisoned fish, air pollution, asthma, heart attacks, fetal deformities, coal sludge and waste, and the destruction caused by coal mining in our communities, the "higher" costs of renewables aren't so high. Renewables really are cheaper:

- Energy efficiency costs 1-3 cents/kWh;
- Wind costs 3-6 cents/kWh;
- Concentrating Solar Power facilities over 50 MW cost 11 cents/kWh (an average electrical generation plant is about 250 MW); and
- Solar photovoltaic power costs 14-25 cents/kWh.

IGCC is being promoted as "clean" coal, but there's nothing clean about coal, whether you burn it as a solid or if you gasify it, or liquefy it first.

We should invest in clean, renewable energy, not doom our children to a 50-year investment in dirty energy.

Footnote references available in the detailed web version.