

Passing gas

WHAT ABOUT THE CARBON THAT COMBINED CYCLES PUT OUT?

It seems that not a day goes by without some state public utility commission "passing gas." One after another, various states are refusing to permit "dirty coal" power plants in favor of "clean natural gas" without as much as a whisper about capturing the CO₂ from this kind of fossil fuel power plant. By one estimate, over 60 coal-fired power plants have been denied permits in the last few years.

Last month, Congressman Henry Waxman, Chairman of the House Committee on Oversight and Government reform wrote a letter to Stephen Johnson, Administrator of the U.S. Environmental Protection Agency (EPA), urging the agency to "pass gas." The Congressman was urging the EPA to take a more active role in the permitting process, following the earlier Supreme Court decision on CO₂. There was the suggestion, however, that the "use of a less CO₂-intensive fuel (such as natural gas instead of coal)" was acceptable.

This "clean natural gas" vs. "dirty coal" or "big coal" is the all too familiar "good vs. evil" polarization that always seems to get in the way of good decision making. Numbers are helpful for those that want to understand them.

What the numbers say

There are two principal factors in determining the emissions produced by a fossil fuel power plant; the "carbon factor," expressed in lbm CO₂/mmBtu and the power plant efficiency or "heat rate" expressed as Btu/KW-hr. The carbon factors are easily found on the Energy Information Agency (EIA) website, and the various current and projected power plant efficiencies can be found in the US Department of Energy's May 2007 Cost and Performances Baseline Report. The Table provides a summary of the values.

What I do not get is why 797 lbm-CO₂/MW for a Natural Gas Combined Cycle (NGCC) power plant, without capture, is acceptable? And, acceptable without issue or question. Why?

There are several reasons that I can

think of. The first is that there are many unknowns associated with Carbon Capture & Sequestration concepts. There are proven post-combustion capture processes that exist but they are relatively expensive and impose large operating cost burdens on the plant. No one really knows what to do and regulations either non-existent or in the formative stages. Secondly, there are no clear plans or options, for the use or long-term storage of CO₂ and the permitting processes seem daunting.

The current default decision is the \$554/kW, no-risk, business-as-usual NGCC, which appears to remain competitive, as long as competition from coal can be eliminated. Competitive in the U.S., that is. If other nations move to coal,

Of course, there is California, which has mandated that it will not buy power produced with an emission signature that exceeds that of a combined cycle gas turbine. Eliminating coal-fired power plants will certainly allow Californians to continue "living the dream."

Sadly, there seems to be an attempt to position "clean natural gas" vs. "dirty coal" to accomplish any one of the these objectives by playing on the collective public ignorance on the differences between clean burning gas turbines that have low NO_x, SO_x and particulate signatures, but still put out literally tons of CO₂.

If we are going to permit NGCC units at 797 lbm-CO₂/MW, then we should reduce the requirement on the coal power plant alternatives to the 60%-70% capture levels indicated in the Table in order to evaluate these alternatives on a level playing field. Either that or we can ask that those "clean natural gas" plants capture 70% of their emissions so that they may be at least equal to those "dirty coal" plants.

I think what is really going on here is a "business-as-usual strategy" dressed up to look like action on climate change. The last thing that the NGCC commu-

nity wants to do is capture carbon from its "very-dilute" flue gas stream because that cost would be disproportionately higher than that of "dirty coal." The regulators and politicians seem to be falling for the approach for the respective reason, but, shamefully, they will once again leave a residue of problems for others to solve. ■

Author

Peter Baldwin is an industry consultant (www.base-e.net) and former executive of Ingersoll-Rand Company's Northern Research and Engineering Corp. (NREC) subsidiary. Reach him at pete_baldwin@base-e.net.



	PC		SCPC		IGCC		NGCC	
	w/out	with	w/out	with	w/out	with	w/out	with
Gross Power	583,315	679,923	580,260	663,445	770,350	744,960	570,200	520,090
Net Power	550,445	549,613	550,150	545,995	640,250	555,675	560,360	481,890
Coal Flowrate - lbm/hr	437,699	646,589	411,282	586,627	489,634	500,379	-	-
Natural Gas Flowrate - lbm/hr	-	-	-	-	-	-	165,182	165,182
Net Plant Heat Rate - Btu/KW-hr	9276	13724	8721	12534	8922	10505	6719	7813
Net Plant Efficiency - HHV%	36.8%	24.9%	39.1%	27.2%	38.2%	32.5%	50.8%	43.7%
Carbon Factor - lbm-CO ₂ /mmBtu	203.3	203.3	203.3	203.3	196.7	196.7	118.5	118.5
Capacity Factor	85.0%	85.0%	85.0%	85.0%	80.0%	80.0%	85.0%	85.0%
Capture %	0.0%	90.0%	0.0%	90.0%	0.0%	90.0%	0.0%	90.0%
Capital Cost - \$/kW	\$1,549	\$2,895	\$1,575	\$2,870	\$1,813	\$2,390	\$554	\$1,172
LCOE - \$/kW-hr	\$ 0.0640	\$ 0.1188	\$ 0.0633	\$ 0.1148	\$ 0.0780	\$ 0.1029	\$ 0.0684	\$ 0.0974
CO ₂ lbm/MW-hr Net Output	1886	278	1773	254	1755	206	797	93
Capture % to Achieve 797 or 278 lbm/MW-hr	57.7%	71.4%	55.0%	68.7%	54.6%	61.4%	0.0%	70.0%
	797	797	797	797	797	797	797	278

Note: Baseline Report Cases 1 & 2

$$\text{tons/year} = (\text{power}_{net} \times 8760 \times \text{capacity factor} \times \text{heat rate}_{net} \times \text{carbon factor}) / 10^6$$

$$\text{CO}_2 \text{ lbm/MW-hr} = \text{heat rate}_{net} \times \text{carbon factor} \times (1 - \text{capture}\%) / 10^3$$

Table: Both combined cycles and pulverized coal should have the same capture requirement for a level playing field

which they appear to be doing, then the U.S. will have built a long-term dependency on Liquefied Natural Gas of \$10+ per mm Btu, and the associated long-term energy cost penalty into its future.

On the surface, the Cost of Electricity (COE) for a NGCC is not much different than that of a Pulverized Coal (PC) plant without capture, so "clean natural gas" will not trigger any angst over the electric rates and cost the politically minded any votes. I am guessing that there are a few people of these types in the decision making process.

And then, there is the existing fleet of NGCC units that cannot be economically dispatched because of current natural gas prices. But as prices rise all over and the competitive threat from coal is eliminated, these units may return to profitable status.