Current Competitive Positioning Pending EPA New Source Performance Standard and the Clean Power Plan

There is ample information on various DOE websites defining cost and performance baselines for the various types of power plant options currently in today's available mix. I used DOE/NETL- Baseline 341/082312, August 2012, and DOE/NETL- Baseline 2010/1397, November 2010.

The competitive scenario is totally dictated by the 1000 lb- CO_{2}/MWh emissions standard promulgated in the EPA New Source Performance Standard (NSPS), first released in 2014. Under that requirement a new Supercritical Pulverized Coal plant (SCPC) with Carbon Capture (CCS), **Case 12**, is competing against a Natural Gas Combined Cycle (NGCC) plant without CCS, **Case 13**.

I use the term "competition" loosely, because given this threshold level; it is hardly a fair fight. How unlevel is it?

Grossly unlevel.

Case Coz Capture No Yes No Yes No Yes Sol 400 G62,800 564,700 511,000 Auxilliary Power Requirements - kWe Report Net Power Output - kWe Sol 400 662,800 564,700 511,000 Auxilliary Power Requirements - kWe Report Net Power Output - kWe Sol 49,990 549,990 549,990 556,080 473,570 Net Plant HHV Efficiency - % Net Plant HHV Heat Rate - BtulkWh 8,687 12,002 6,798 7,968 7		Supercritical PC		NGCC	
Auxilliary Power Output - kWe S80,400 662,800 564,700 511,000	Case	11	12	13	14
Auxilliary Power Requirements - kWe Report Net Power Output - kWe S49,990 549,970 555,080 473,570 549,990 549,970 555,080 473,570 549,990 549,990 555,080 473,570 549,990 549,990 555,080 473,570 555,080 473,570 549,990 555,080 473,570 555,080 473,570 549,990 555,080 473,570 473,570 555,080 473,570 555,080 473,570 473	CO2 Capture	No	Yes	No	Yes
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Net Plant HHV Efficiency - % Net Plant HHV Heat Rate - Btu/kWh 39.30% 8,687 28.40% 50.20% 12,002 50.20% 6,798 42.80% 7,968 Total Plant Cost - \$ikW Total Overnight Cost - \$ikW Total as Spent Cost - \$ikW LODE - mils/kWh 2452 252 4391 3583 725 1986 1509 1842 1986 1848 1986 1848 1986 1842 1986 1842 1986 1848 1986 1848 1986 1848 1986 1848 1986 1848 1986 1848 1986 1848 1986 1848 1986 <	Auxilliary Power Requirements - kWe	30,410	112,830	9,620	37,430
Net Plant HHV Heat Rate - Btu/kWh 8,687 12,002 6,798 7,968 Total Plant Cost - \$/kW 1995 3583 725 1509 Total Overnight Cost - \$/kW 2452 4391 891 1842 Total as Spent Cost - \$/kW 2782 5006 957 1986 LCOE - mils/kWh 80.95 137.28 59.59 86.58 CO2 Emissions - lb/MWh 1768 244 804 94 \$/MMBtu 2.94 2.94 6.13 6.13 Load Factor 85% 85% 85% 85% KW Nominal Gross 580,411 662,836 559,532 593,471 550,000 550,000 550,000 550,000 550,000 Total as Spent Capital Cost Premium vs. NGCC Case 13 \$1,529,834,783 \$2,753,292,297 \$526,223,607 \$1,092,280,160 KWh/year MMBtu/year 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000	Report Net Power Output - kWe	549,990	549,970	555,080	473,570
Net Plant HHV Heat Rate - Btu/kWh 8,687 12,002 6,798 7,968 Total Plant Cost - \$/kW 1995 3583 725 1509 Total Overnight Cost - \$/kW 2452 4391 891 1842 Total as Spent Cost - \$/kW 2782 5006 957 1986 LCOE - mils/kWh 80.95 137.28 59.59 86.58 CO2 Emissions - lb/MWh 1768 244 804 94 \$/MMBtu 2.94 2.94 6.13 6.13 Load Factor 85% 85% 85% 85% KW Nominal Gross 580,411 662,836 559,532 593,471 550,000 550,000 550,000 550,000 550,000 Total as Spent Capital Cost Premium vs. NGCC Case 13 \$1,529,834,783 \$2,753,292,297 \$526,223,607 \$1,092,280,160 KWh/year MMBtu/year 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000				<u> </u>	
Total Plant Cost - \$'k\W Total Overnight Cost - \$'k\W Total as Spent Cost - \$'k\W LODE - mils/k\Wh 80.95	Net Plant HHV Efficiency - %	39.30%	28.40%	50.20%	42.80%
Total Overnight Cost - \$/kW 2452 4391 891 1842 1986 1957 1986 1986 1987 1986 1986 1987 1986 1986 1987 1986 <t< th=""><th>Net Plant HHV Heat Rate - Btu/kWh</th><th>8,687</th><th>12,002</th><th>6,798</th><th>7,968</th></t<>	Net Plant HHV Heat Rate - Btu/kWh	8,687	12,002	6,798	7,968
Total Overnight Cost - \$/kW 2452 4391 891 1842 1986 1957 1986 <t< th=""><th></th><th></th><th></th><th></th><th></th></t<>					
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LCOE - mils/kWh CO2 Emissions - lb/MWh S/MMBtu Load Factor kW Nominal Gross kW Nominal Net S50,000 Total as Spent Capital Cost Premium vs. NGCC Case 13 kWh/year MMBtu/year Annual Fuel Fuel Cost vs. NGCC Case 13 LCOE Fuel% S60.00 Per tonne S9.95 137.28 ← 59.59 86.58 244 804 94 6.13 6.13 6.13 6.13 6.13 6.13 559,532 593,471 662,836 559,532 593,471 550,000 50,000					
CO2 Emissions - Ib/MWh \$/MMBtu 2.94 2.94 2.94 6.13 6.13 6.13 Load Factor 85% 85% 85% 85% 85% 85% 85% 85					
\$/MMBtu	LCOE - mils/kWh	80.95	137.28 <	59.59	86.58
\$/MMBtu	COO Fasianiana III/MANI	4700	244	00.4	0.4
Load Factor 85% 85% 85% 85% 85% 85% 85% 85% 85% 85%	W2 Emissions - ID/MWn	1768	244	804	94
Load Factor	¢/MMP+	2.04	2.04	6.12	6.12
KW Nominal Gross 580,411 662,836 559,532 593,471	Φ/IVIIVIDtu	2.94	2.94	0.13	0.13
KW Nominal Gross 580,411 662,836 559,532 593,471	Load Factor	85%	85%	85%	85%
550,000 \$50,000 \$50,000 \$50,000 \$550,000 \$4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000	Eodd i detoi	0370	6570	0070	0070
Total as Spent Capital Cost Premium vs. NGCC Case 13 KWh/y ear MMBtu/y ear MMBtu/y ear MMBtu/y ear Fuel Cost vs. NGCC Case 13 LCOE Fuel% S104,593,061 S144,506,264 S170,658,277 S200,030,178 S29,371,901 S25,7% S204,38,927 S354,571,074 S60.00 Per tonne S197,051 S27,194 S90,438 S9,021	kW Nominal Gross	580,411	662.836	559,532	593,471
Cost Premium vs. NGCC Case 13 KWh/year MMBtu/year 4,095,300,000 4,095,3	550,000 kW Nominal Net	550,000	550,000	550,000	550,000
Cost Premium vs. NGCC Case 13 KWh/year KWh/year MMBtu/year 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000 4,095,300,000 35,575,871 49,151,791 27,839,849 32,631,350	· · · · · · · · · · · · · · · · · · ·	,	•	·	·
kWh/year MMBtu/year 4,095,300,000 35,575,871 4,095,300,000 49,151,791 4,095,300,000 27,839,849 4,095,300,000 32,631,350 Annual Fuel Fuel Cost vs. NGCC Case 13 \$104,593,061 \$144,506,264 \$170,658,277 \$200,030,178 \$29,371,901 \$29,371,901 LCOE Fuel% \$331,514,535 \$562,202,784 \$244,038,927 \$354,571,074 56.4% \$31.6% 25.7% 69.9% 56.4% \$60.00 per tonne \$197,051 \$27,194 \$90,438 \$9,021	Total as Spent Capital	\$1,529,834,783	\$2,753,292,297	\$526,223,607	\$1,092,280,160
MMBtu/y ear 35,575,871 49,151,791 27,839,849 32,631,350 Annual Fuel Fuel Cost vs. NGCC Case 13 \$104,593,061 \$144,506,264 \$170,658,277 \$200,030,178 LCOE Fuel% \$331,514,535 \$562,202,784 \$244,038,927 \$354,571,074 \$31.6% 25.7% 69.9% 56.4% \$60.00 per tonne \$197,051 \$27,194 \$90,438 \$9,021	Cost Premium vs. NGCC Case 13	1,003,611,175	2,227,068,690	-	566,056,553
MMBtu/y ear 35,575,871 49,151,791 27,839,849 32,631,350 Annual Fuel Fuel Cost vs. NGCC Case 13 \$104,593,061 \$144,506,264 \$170,658,277 \$200,030,178 LCOE Fuel% \$331,514,535 \$562,202,784 \$244,038,927 \$354,571,074 \$60.00 per tonne \$197,051 \$27,194 \$90,438 \$9,021					
Annual Fuel Fuel Cost vs. NGCC Case 13 (\$66,065,216) (\$26,152,012) - \$200,030,178 \$29,371,901 \$29,371,901 \$29,371,901 \$200,030,178 \$29,371,901 \$29,371,901 \$200,030,178 \$200,0					
Fuel Cost vs. NGCC Case 13 (\$66,065,216) (\$26,152,012) - \$29,371,901 LODE Fuel% \$331,514,535 \$562,202,784 \$244,038,927 \$354,571,074 56.4% \$60.00 per tonne \$197,051 \$27,194 \$90,438 \$9,021	MMBtu/year	35,575,871	49,151,791	27,839,849	32,631,350
Fuel Cost vs. NGCC Case 13 (\$66,065,216) (\$26,152,012) - \$29,371,901 LODE Fuel% \$331,514,535 \$562,202,784 \$244,038,927 \$354,571,074 56.4% \$60.00 per tonne \$197,051 \$27,194 \$90,438 \$9,021		4404 500 004	4444 500 004	4.70.050.077	4000 000 470
LODE Fuel% \$331,514,535 \$562,202,784 \$244,038,927 \$354,571,074 56.4% \$60.00 per tonne \$197,051 \$27,194 \$90,438 \$9,021			. , ,	\$170,658,277	
Fuel% 31.6% 25.7% 69.9% 56.4% 560.00 per tonne \$197,051 \$27,194 \$90,438 \$9,021	Fuel Cost vs. NGCC Case 13	(\$66,065,216)	(\$26, 152,012)	-	\$29,371,901
Fuel% 31.6% 25.7% 69.9% 56.4% 560.00 per tonne \$197,051 \$27,194 \$90,438 \$9,021	LOOF	¢224 E44 E2E	\$560 000 704	¢244 020 027	\$254 574 O74
\$60.00 per tonne \$197,051 \$27,194 \$90,438 \$9,021			. , ,		
	Fuel%	31.070	Z3.170	09.970	30.470
	\$60.00 per tonne	\$197.051	\$27 194	\$90.438	\$9.021
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	332 333. 13. 113 30 3430 10	4 .00,0.2	(400,211)		(40.,)
tonnes-CO2/year 3,284 453 1,507 150	tonnes-CO2/year	3,284	453	1,507	150

Look at Cases 12, the SCPC w/CCS and compare it to Case 13, the NGCC w/out CCS.

- The SCPC w/CCS plant is 5X the first cost
- And, the efficiency of an SCPC w/CCS is ½ at 28.4% vs. 50.2%
- The Levelized Cost of Electricity (LCOE) for the NGCC without/CCS is ½ that of the SCPC w/CCS and this is based on \$6.13/mmBtu cost for natural gas.
- If the current price for natural gas is considered, the LCOE is 1/3 that of the SCPC

And, you wonder why gas turbines have had record levels of sales??

There are some who would have you believe that this is purely the result of low gas prices, and that this is "just the market place exerting itself". This is hardly the case. Yes, the price of gas is a factor, but the real driver is that CCS is required in **Case 12**, but not for **Case 13**. Yes, the price of natural gas is a huge accelerant, but still that of an accelerant.

The Coal Industry has been spending its political capital trying to make the NSPS threshold simply go away, in which case the competitive comparison would be **Case 11** vs. **Case 13**. In such a comparison, the first cost for the SCPC is 3X and the efficiency at 39.3% vs. 50.2%.

The Coal Industry might want to consider a strategy to push full CCS, which would then position their **Case 12** against the NGCC **Case 14**. The first cost difference would be 2.5X and the efficiency would be 28.4% for the SCPC w/CCS vs. 42.8% for the NGCC w/CCS. Not pretty, but they could actually have the environmentalist community on their side.

The recently announced Clean Power Plan pretends to be agnostic on how each of the states reach their assigned targets, but behind the targets themselves is the built-in assumption that NGCC's without will provide a \sim 70% contribution, which would then be driven by the same 1000 lb-CO₂/MWh threshold.

The unanswered question in all of this is whether or not this 1000 lb- CO_2/MWh threshold, either explicit or implied, reaches the presumed target of 2°C/450ppm. It should be noted that neither the NSPS nor the CPP mention a target, let alone a target of 2°C/450ppm.

It is hard to reach a target if you don't have one, but on second thought it is actually easier to reach a target if you don't have one!