Alternate BMACT Cost Analyses for Coal and Liquid Units

Amy Marshall, URS

CIBO Quarterly Meeting

March 2013

Alternate Cost Analyses

- Original cost analyses assumed all boilers would install controls to reduce emissions and comply with limits. Did not address replacement units or fuel switching.
- EPA's final BMACT cost assumes that any liquid units that do not comply and have ability to fire gas will fuel switch rather than install controls.
- Our alternate cost analysis looks at replacement natural gas units and fuel switching for coal and liquid units.
- We also made some refinements to the base cost analysis to reflect differences in approaches between types of boilers that would install controls.

Refinements to Base Capital Cost Analysis

- CO Upgrade cost – base cost for 250 MMBtu/hr unit is $3M. For biomass units, need to consider fuel storage and fuel consistency, boiler and combustion controls, steam demand stability. A woodyard upgrade could be $3MM by itself, so changed CO base upgrade cost for biomass wet stokers to $6MM.
- For coal stokers, added information on existing NOx controls to the analysis. If CO is >500 ppm and there are no NOx controls, changed base cost to $5M to account for addition of NOx controls to prevent NOx emissions increase with addition of CO controls.

Operating Cost Analysis

- Tune up cost
  - $5k for gas and liquid
  - $10k for any stoker, any biomass, any fluidized bed
  - $15k for PC
- Energy assessment cost
  - EPA assumed $75k for facilities in certain NAICS codes. We started with $75k for facilities that have the highest annual heat input (based on unit design capacity and assumed 55% utilization) and then ratioed that cost down for the other 2 tiers of the energy assessment requirement.
- Annual costs for controls and testing based on combination of EPA analysis and site examples.

Summary of Base Capital Cost Analysis

Fuel	Sum of PM Upgrade Cost	Sum of HCl Upgrade Cost	Sum of Hg Upgrade Cost	Sum of CO Upgrade Cost	Sum of Total Capital Cost
Bagasse	$0	$0	$1M	$49M	$50M
Coal	$1.2B	$3.3B	$71M	$1.0B	$5.6B
Dry Biomass	$18M	$28M	$5M	$96M	$147M
Heavy Liquid	$1.1B	$1.4B	$303M	$4.9M	$2.9B
Light Liquid	$878M	$1.2B	$254M	$0	$2.3B
Process Gas	$0	$28M	$1M	$0	$29M
Wet Biomass	$865M	$129M	$6M	$102M	$1.1B
Grand Total	**$4.1B**	**$6.1B**	**$641M**	**$1.3B**	**$12.1B**

Subcategory	Total # Units	# No Capital Cost Units	% No Capital Cost Units
Biomass Wet Stoker	290	135	47%
Biomass Kiln-Dried Stoker	70	50	71%
Biomass FB	24	18	75%
Biomass Dutch/Pile	15	13	87%
Biomass Suspension Burner	48	45	94%
Biomass Fuel Cell	14	12	86%
Biomass Hybrid Suspension/ Grate	20	7	35%
Coal pulverized	185	31	17%
Coal stoker	387	10	3%
Coal FB	34	13	38%
Coal FBHE	1	1	100%
Oil - Heavy	295	32	11%
Oil - Light	262	26	10%
Oil non-continental	19	1	5%
Gas2	78	76	97%
	1742	**470**	**27%**

Analysis No. 1

- For all coal and liquid boilers, compare cost of controls to cost of new gas-fired package boiler.
- We assumed that biomass units would not fuel switch to natural gas, so we only looked at coal and liquid units.
- $10MM base cost for 250MMBtu/hr unit, size new unit 3% bigger than existing unit.
- It seems to be more cost effective from a capital cost standpoint for most of the liquid units to make the change, but not as cost effective for most coal units other than Stoker units.

Analysis #1 Results

Category	# of Units	Total Capital BMACT Cost	Number Where New Gas Fired Package Boiler Cheaper	Total Capital BMACT Cost with Replacement Unit If Cheaper	Percent Replaced Instead of Controlled
Coal	**607**	**$5.6B**	**381**	**$4.6B**	**63%**
FB	34	$274M	0	$274M	0%
FB-HE	1	$ -	0	$-	0%
PC	185	$1.7B	73	$1.5B	39%
Stoker/Other	387	$3.7B	308	$2.8B	80%
Heavy Liquid	**312**	**$2.9B**	**266**	**$1.9B**	**85%**
Light Liquid	**264**	**$2.3B**	**239**	**$1.5B**	**91%**
Grand Total	**1183**	**$10.8B**	**886**	**$7.9B**	**75%**

Analysis No. 2

- For liquid, coal stoker, and PC boilers – compare cost of controls to cost to upgrade unit to natural gas firing.
  - base stoker conversion cost $1.5MM for 250 MMBtu/hr unit,
  - base PC conversion cost $5MM for 250 MMBtu/hr unit,
  - base liquid conversion cost $1MM for 250 MMBtu/hr unit,
  - size new unit 3% bigger than existing unit.
- Assumed FB boiler would not convert to gas.
- Assumed Biomass would not convert to gas.
- This seems to be very cost effective across the board, especially for the liquid units and the Stoker units.

Analysis #2 Results

Category	# of Units	Total Capital BMACT Cost	Number of Natural Gas Conversion Cheaper	Total Capital BMACT Cost with NG Conversion if Cheaper	Percent Fuel Switching
Coal	**572**	**$5.4B**	**512**	**$1.5B**	**90%**
PC	185	$1.7B	135	$1.0B	73%
Stoker/Other	387	$3.7B	377	$460M	97%
Heavy Liquid	**312**	**$2.9B**	**303**	**$196M**	**97%**
Light Liquid	**264**	**$2.3B**	**264**	**$12M**	**100%**
Grand Total	**1148**	**$10.5B**	**1079**	**$1.8B**	**94%**

Analysis No. 3

- Objective is to compare operating cost of keeping current fuel and installing/operating controls as a coal or liquid unit vs. operating costs as a natural gas unit.
- Fuel cost:
  - coal $4/MMBtu
  - gas $4.50/MMBtu if you have gas, $7.50/MMBtu if you don't
  - light liquid $22/MMBtu
  - heavy liquid $17/MMBtu
  - Assumed 55% capacity when calculating annual fuel costs
- Compare the year 1 operating costs – initial tune up, initial energy audit, initial testing, purchase of new monitors, operating cost of control equipment, fuel cost, etc.

Simple Analysis for Site with 2 Units

Cost Item	Coal	Natural Gas at Site	Natural Gas not at Site
Labor	$2,736,000	$952,000	$952,000
APCD Operation	$1,150,000		
Testing/Monitoring	$100,000	$30,000	$30,000
Fuel	$8,431,500	$12,647,250	$20,235,600
Maintenance	$2,000,000	$1,000,000	
Ash disposal	$200,750		
Total	$14,618,250	$14,629,250	$22,217,600

CIBO Analysis #3 Initial Cost

Category	Count of Units	Total Initial BMACT Cost	Count of Natural Gas Conversion Cheaper	Total Initial BMACT Cost with NG Conversion if Cheaper	Percent Convert to Natural Gas
Coal	**572**	**$5.5B**	**516**	**$1.5B**	**90%**
PC	185	$1.7B	139	$1.05B	75%
Stoker/ Other	387	$3.7B	377	$473M	97%
Heavy Liquid	**312**	**$2.9B**	**305**	**$204M**	**98%**
Light Liquid	**264**	**$2.35B**	**264**	**$157M**	**100%**
Grand Total	**1148**	**$10.8**	**1085**	**$1.9B**	**95%**

Includes monitor installation, initial testing, energy assessment, initial tune-up, capital cost of APCD.

CIBO Analysis #3 Annual Cost

Category	# of Units	Total Annualized BMACT Cost	Number With Cheaper Natural Gas Costs	Total Annualized BMACT Cost with NG Conversion if Cheaper	Percent Cheaper to Switch to Natural Gas
Coal	**572**	**$4.2B**	**341**	**$3.7B**	**60%**
PC	185	$1.8B	85	$1.7B	46%
Stoker/ Other	387	$2.3B	256	$2.0B	66%
Heavy Liquid	**312**	**$1.5B**	**240**	**$1.2B**	**77%**
Light Liquid	**264**	**$1.1B**	**196**	**$923M**	**74%**
Grand Total	**1148**	**$6.7B**	**777**	**$5.84B**	**68%**

Includes annualized capital costs, annual operating costs, annual fuel cost, annual testing cost.

Summary

- Compliance costs for add-on controls are significant for coal and liquid units.
- Replacement with a natural gas fired package boiler or conversion of the unit to natural gas firing may provide a less costly compliance approach.
- Both capital and annual operating costs should be evaluated to determine which approach to implement.
- Consider importance of fuel flexibility to the site, other environmental requirements (current and future), and future cost and availability of natural gas.