

Industrial/Commercial/Institutional Boiler MACT

Combined Heat and Power A Technical & Economic Compliance Strategy

January 17, 2012

John Cuttica, Midwest Clean Energy Application Center

Bruce Hedman, ICF International



U.S. DEPARTMENT OF ENERGY

Midwest Clean Energy Application Center

Promoting CHP, District Energy, and Waste Heat Recovery

ICI Boiler MACT

- Standards for hazardous air pollutants from major sources: industrial, commercial and institutional boilers and process heaters (excludes any unit combusting *solid waste*)
- Major source is a facility that emits:
 - 10 tpy or more of any single Hazardous Air Pollutant, or 25 tpy or more of total HAPs
- Emissions limits applicable to new and existing units > 10 MMBtu/hr
 - Mercury (Hg)
 - Particulate Matter (PM) as a surrogate for non-mercury metals (alternative limits for total selective metals (TSM))
 - Hydrogen Chloride (HCl) as a surrogate for acid gases
 - Carbon Monoxide (CO) as a surrogate for non-dioxin organics)



Impacts of the Boiler MACT

- Compliance straight forward for natural gas fired units (tune-ups)
- Rule significantly impacts oil, coal and biomass boilers and process heaters
- Controls are potentially required for Hg, PM, HCl and CO
- Emissions limits must be met at all times except for start-up and shutdown periods
- Also includes monitoring and reporting requirements
- Limits are economically challenging for oil and coal units



Compliance Options

- The specific emissions limits depend on fuel type and combustor design, but all pollutants within a group (Hg, PM, HCl, CO) can be controlled with the same measures
- Required compliance measures for any unit depend on current emissions levels and control equipment already in place
- Fabric filters and activated carbon injection are the primary control devices for Hg
- Electrostatic precipitators may be required for units that need additional control for PM or TSM
- Wet scrubbers or fabric filters with dry injection are primary controls for HCl
- Tune-ups, replacement burners, combustion controls and oxidation catalysts for CO and organic HAPs control



Potential Opportunity for CHP?

- Compliance with MACT limits will be expensive for many coal and oil units - some users will consider switching to natural gas
- Potential opportunity to move to natural gas CHP
 - Trade off of benefits and additional costs
 - Economics now based on incremental investment over compliance costs
- Affected units (EPA ICR Database – all facilities)
 - 616 coal units (\$2.7 Billion capital cost)
 - 903 liquid fuel units (\$1.7 Billion capital cost)
 - 508 biomass units (\$0.6 Billion capital cost)



Affected Industrial/Commercial/Institutional Boilers

	EPA ICR Data	
Number of Facilities	652	
Fuel Class	# Units	Capacity (MMBtu/hr)
Coal	495	131,526
Heavy Liquid	287	38,020
Light Liquid	202	19,926
Biomass	442	97,131
Process Gas	<u>78</u>	<u>21,146</u>
Total	1,504	307,749

Excludes non-continental liquid, Gas 1 (NG/RG) and limited use units



Facilities with Affected Boilers by Region

Region	Number of Facilities	Number of Coal Units	Number of Oil Units	Number of Biomass Units	Number of Process Gas Units
Midwest	187	242	114	55	53
Southeast	270	153	200	248	7
Mid-Atlantic	56	68	58	14	18
North East	37	11	58	16	0
Mountain	8	10	7	0	0
Northwest	45	7	20	55	0
Gulf Coast	39	3	13	46	0
Pacific	<u>10</u>	<u>1</u>	<u>19</u>	<u>8</u>	<u>0</u>
Total	652	495	489	442	78

Includes only Industrial/Commercial/Institutional units



Affected Coal, Oil, and Process Gas Boilers by Industry (drops biomass boilers)

Application	Number of Facilities	Number of Units	Boiler Capacity (MMBtu/hr)
Mining (except Oil and Gas)	7	14	4,767
Food Manufacturing	64	134	27,745
Textiles	13	28	1,851
Wood and Furniture	18	27	2,508
Paper Manufacturing	87	149	48,566
Petroleum Refining	19	65	10,491
Chemical Manufacturing	74	199	34,347
Plastics and Rubber Manufacturing	22	54	4,500
Primary Metal Manufacturing	20	107	35,048
Transportation Equip. Manufacturing	23	80	11,151
Other Industrial	11	28	8,877
Educational Services	26	68	10,400
National Security and Int'l Affairs	9	64	4,695
Other Institutional	<u>17</u>	<u>45</u>	<u>5,673</u>
Total	410	1062	210,618

Includes only industrial, commercial and institutional boilers



Affected Boilers in the Midwest

Fuel Type	Number of Units	Capacity (MMBtu/hr)
Coal	242	62,071
Heavy Liquid	63	10,351
Light Liquid	51	4,461
Process Gas	<u>53</u>	<u>14,820</u>
Total	409	91,705

Includes only coal, oil, and process gas industrial, commercial and institutional boilers (drops out biomass boilers)



Affected Coal, Oil, and Process Gas Boilers in the Midwest

Application	Number of Facilities	Number of Units	Boiler Capacity (MMBtu/hr)	Existing CHP Sites	Existing CHP Capacity (MW)
Mining and Agriculture	5	14	4,397	2	134
Food Processing	42	89	20,299	19	676
Wood Products	4	8	421	0	0
Paper Products	29	55	13,716	19	739
Refining	5	10	857	1	40
Chemicals	21	48	7,135	2	6
Plastic and Rubber Products	5	13	781	0	0
Primary Metals	9	64	23,529	5	547
Transportation Equipment	12	40	6,840	1	3
Other Industrial	11	27	6,787	2	24
Colleges/Universities	13	34	6,294	9	268
Hospitals	1	3	191	1	1
Other Institutional	<u>2</u>	<u>4</u>	<u>456</u>	<u>0</u>	<u>0</u>
Total	159	409	91,705	61	2,439



Affected Boilers in the Southeast

Fuel Type	Number of Units	Capacity (MMBtu/hr)
Coal	153	39,353
Heavy Liquid	110	11,716
Light Liquid	90	7,422
Process Gas	<u>7</u>	<u>1,322</u>
Total	360	59,814

Includes only coal, oil, and process gas industrial, commercial and institutional boilers (drops out biomass boilers)



Affected Coal, Oil, and Process Gas Boilers in the Southeast

Application	Number of Facilities	Number of Units	Boiler Capacity (MMBtu/hr)	Existing CHP Sites	Existing CHP Capacity (MW)
Food Processing	10	16	2,258	2	31
Beverage and Tobacco	3	5	1,123	2	25
Textile Mills	8	16	1,387	0	0
Wood Products	8	10	412	0	0
Paper Products	36	60	24,612	25	1,706
Chemicals	31	102	17,028	6	301
Plastics and Rubber Products	11	30	2,354	0	0
Transportation Equipment	4	16	1,794	0	0
Other Industrial	8	24	2,801	1	40
Colleges and Universities	6	12	1,511	3	44
National Security and Int'l Affairs	6	56	3,623	0	6
Other Institutional	5	13	910	0	0
Total	136	360	59,813	39	2,152



CHP as a Compliance Alternative

- Compliance with MACT limits will be expensive for many coal and oil users
- Many are considering switching to natural gas
 - Conversion for some oil units
 - New boilers for most coal units
- Some are considering moving to natural gas CHP
 - Potential for lower steam costs due to generating own power
 - Higher overall efficiency and reduced emissions
 - Higher capital costs, but partially offset by avoided costs for emissions controls or new gas boiler



Example – Affected Facility in Pennsylvania

- Four existing coal boilers at the site

Boiler Capacity	Fuel	Annual Hours	Existing Controls
10.2 MMBtu/hr	Coal	8000	Cyclone
17.0 MMBtu/hr	Coal	8000	Cyclone
20.4 MMBtu/hr	Coal	8000	Cyclone
20.4 MMBtu/hr	Coal	4000	Cyclone

- Average steam demand of 40 MMBtu/hr
 - Pays \$0.08/kWh for power and \$3.10 MMBtu for coal
- Projected compliance costs
 - Additional controls required for PM, HCl and CO
 - \$4,100,000 Capital cost
 - \$723,000 annual operating and maintenance costs



Comparative Steam Costs

	Existing Coal Boilers	New Natural Gas Boilers	Natural Gas CHP
Steam Capacity, MMBtu/hr	60	60	60
Avg Steam Demand, MMBtu/hr	40	40	40
Boiler Efficiency	76%	80%	N/A
CHP Capacity, MW	0	0	8
CHP Electric Efficiency	N/A	N/A	29%
Fuel Use, MMBtu/year	416,842	396,000	752,993
Annual Fuel Cost	\$1,292,211	\$2,772,000	\$4,901,985
Annual O&M Cost	\$1,242,189	\$502,920	\$1,154,664
Annual Compliance O&M	\$723,000		
Annual Electric Savings			(\$4,692,557)
Annual Steam Operating Costs	\$3,257,400	\$3,274,920	\$1,364,092

Based on delivered coal price of \$3.10/MMBtu, natural gas price of \$7.00/MMBtu, and industrial electricity price of \$0.08/kWh (CHP avoids 90% of retail rate)



CHP Paybacks

		Existing Coal Boilers	Natural Gas Boilers	Natural Gas CHP
1	Annual Steam Operating Costs	\$3,257,400	\$3,274,920	\$1,364,092
2	Annual Operating Savings (coal compliance)			\$1,893,308
3	Annual Operating Savings (gas boiler)			\$1,910,828
4	Installed Costs	\$4,103,000	\$2,643,750	\$16,000,000
5				
6	CHP Incremental costs (coal compliance)			\$12,000,000
7	CHP Payback (coal compliance)			6.3 years
8				
9	CHP Incremental costs (gas boiler)			\$13,355,000
10	CHP Payback (gas boiler)			7.0 years

CHP Benefits

- Compliance with MACT
- Investment versus Operating Cost
- Payback between 6 and 7 years
- Increase Electric Service Reliability
- Enhance Economic Competitiveness
- Reduce Carbon Emissions



Potential CHP Capacity

Fuel Type	Number of Facilities	Number of Affected Units	Boiler Capacity (MMBtu/hr)	CHP Potential (MW)
Coal	227	495	131,526	13,155
Heavy Liquid	120	287	38,020	3,803
Light Liquid	91	202	19,926	1,993
Process Gas	<u>14</u>	<u>78</u>	<u>21,146</u>	<u>2,115</u>
Total	452*	1062	210,618	21,065

*Some facilities are listed in multiple categories due to multiple fuel types; there are 410 affected facilities

CHP potential based on average efficiency of affected boilers of 75%; Average annual load factor of 65%, and simple cycle gas turbine CHP performance (power to heat ratio = 0.7)



Boiler MACT Assistance Available

- List of available state incentives for emissions controls, energy efficiency measures, boiler replacements/tune-ups, CHP, and energy assessments (DOE)
 - http://www1.eere.energy.gov/industry/states/pdfs/incentives_boiler_mact.pdf
 - Will be updated when final reconsidered rule signed
- Extensive assistance materials for Area Source rule available from EPA
 - Tune-up guidance, fast facts, brochure, table of requirements, small entity compliance guide, etc.
 - www.epa.gov/ttn/atw/boiler/boilerpg.html
- DOE technical assistance for Major Source rule (when final reconsidered rule signed)
 - Site-specific technical and cost information for evaluation of clean energy compliance options for facilities with coal/oil-fired boilers through Regional Clean Energy Application Centers. Includes site visits.



Thank You!



U.S. DEPARTMENT OF ENERGY

Midwest Clean Energy Application Center

Promoting CHP, District Energy, and Waste Heat Recovery