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**To:** Jim Eddinger, EPA SPPD
**From:** Amanda Singleton, ERG
**Subject:** Preliminary Small Entity Cost and Emission Impacts for Boiler and Process Heater Rulemakings
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This memo summarizes the preliminary cost estimates for add-on control devices, work practice standards; and testing and monitoring requirements anticipated for boilers and process heaters subject to the hazardous air pollutants (HAP) emission standards. All costs are presented in year 2007$. This memo also discusses the emission reductions corresponding to the regulatory options for various hazardous air pollutants (HAP) and HAP surrogates that are targeted under the emission standards. The memo is separated into two sections to separately summarize the cost and emission impacts for units at area and major sources of HAP.

## 1.0 Summary of Cost and Emission Impacts for Boilers at Area Sources of HAP

Model units were created to represent approximately 1.37 million boiler area source population database so that an impacts analysis could be performed on a reasonable number of units and could be conducted in a practical and timely manner. The development of model units involved reviewing parameters that distinguish and characterize unit characteristics, such as the materials combusted, existing (baseline) air pollution control devices and heat input capacity (in million British thermal units per hour (MMBtu/hr)). Model units were defined based on various combinations of the parameters so that the boiler population would be accurately represented by the models.

### 1.1. Model Units for Area Source Boilers

Table A-1 presents the estimated population of 1.37 million boilers at area sources of HAP. These estimates were derived from boiler inspector inventories from 13 states. These inventories were then extrapolated nationally using a ratio of boiler heat input to state population. The distribution of boiler fuels was assigned based on a state-specific distribution of fuels used in industrial and commercial applications.[1] The distribution of unit size and baseline control was assigned based on the distribution of boiler sizes in the 13-state boiler inspector inventory.

As shown in table A-1, 90 percent of the area source boiler population is gas-fired without any type of air pollution control device or monitoring equipment. These units have only trace emissions of PM, mercury, and metallic HAP. However, gas-fired units do produce organic HAP during the combustion process. Since emission factors at units of a similar fuel and control device are expected to be similar for units regardless of whether or not they are located at area or major sources of HAP, the baseline emission rates shown in the summary table are based on data collected during the vacated industrial, commercial and institutional boiler NESHAP (40 CFR Part 63 Subpart DDDDD).

### 1.2 Preliminary Emission Limits for Boilers at Area Sources

Section 112(d)(5) of the Clean Air Act (CAA) allows for area source standards to be based on GACT (Generally Available Control Technology). GACT may consider costs and economic impacts. However, since solid and liquid fuel industrial boilers and institutional/commercial boilers at area sources are on list of CAA 112(c)(6) source categories for Mercury (Hg) and polycyclic organic matter (POM), EPA is required to make these source categories subject to a MACT (Maximum Achievable Control Technology) for Hg and POM. EPA can use GACT for other HAP.

Table A-2 summarizes preliminary numerical MACT floor emission limits for the best controlled 12 percent of units for CO (as a surrogate to organic HAP) and mercury (Hg) at solid and liquid fuel boilers. Table A-2 also summarizes preliminary numerical GACT emission limits for PM and metallic HAP at all boilers as well as GACT limits for CO and Hg at gas-fired boilers.

*MACT Floor for Mercury (Hg)*

[1] 2001 EIA State Fuel Consumption Data by Sector. Accessed online at:
http://www.eia.doe.gov/emeu/states/sep_sum/html/sum_btu_res.html
http://www.eia.doe.gov/emeu/states/sep_sum/html/sum_btu_com.html

No air pollution control devices were installed to reduce Hg at area sources. The Hg limits in Table A-2 were based on the average coal mercury contents in the 13 states with boiler inspector inventories. The lowest 12 percent of boiler coal mercury contents were comprised of Nebraska boilers (assumed to be firing Wyoming coal), Colorado boilers, and Utah boilers. Mercury limits at biomass units were based on Hg contents of wood fuels from five of the 13 states with boiler inspector inventories. The lowest 12 percent of boiler wood mercury contents were based on Hg contents for New York and North Carolina boilers. Variability factors were applied to these floors to account for the standard deviations of each fuel's mercury content. [2] Hg limits at liquid fuel units were based on AP-42 emission factors for distillate oil boilers.

*MACT Floor for Carbon Monoxide (CO)*

No control devices were installed to reduce organic HAP and CO emissions. The MACT floors for CO at coal and liquid fuel boilers were based on available state permit limits for CO. Coal boiler permit limits consisted of 11 coal boilers in Illinois and Ohio while liquid boiler permit limits were comprised of limits from 46 boilers in Vermont, New Hampshire, Maine, and Rhode Island. The MACT floor for CO at biomass boilers was based on 27 state permit limits in Vermont, New Hampshire, Maine, and Rhode Island as well as actual CO emission data (with variability factors) from 14 boilers under the Department of Forestry Fuels for Schools program.[2]

*GACT for Particulate Matter (PM) and non-Mercury Metallic HAP*

Based on a review of available information and state regulations, GACT for the boiler source category was set to be an annual tune-up work practice standard. PM and non-mercury metallic HAP emissions are expected to decrease 5 to 10 percent below baseline levels as a result of implementing an annual tune-up.

1.3 National Impacts for Area Source Boilers

Table A-3 presents per boiler costs for fabric filters (if necessary), work practice standards (tune-ups, linkageless boiler management systems (LBMS), and energy audits) and testing and monitoring costs to demonstrate compliance with the numerical limits. Fabric filter costs are specific to each model boiler, because the control costs are based on exhaust flows, and required pollutant removal efficiencies. The costs for work practice standards, testing, and monitoring are constant across all model boilers.

The national costs and emission impacts are summarized in Tables A-4a, b, and c. To estimate the national costs of each regulatory option, the per boiler costs in Table A-3 were multiplied by the number of boilers represented by the model unit. In order to avoid double counting the control costs in the cost effectiveness summaries, the cost of the control is only assigned to the targeted pollutant of each regulatory option. The cost of a fabric filter was assigned to mercury reductions while the cost of an annual tune-up was assigned to polycyclic aromatic hydrocarbon (PAH) reductions.

*Regulatory Option 1 – MACT for Hg and CO and Work Practice Standard for PM and Metallic HAP (Table A-4a)*

Based on the distribution of coal and wood Hg contents, this preliminary analysis assumes that 12 percent of coal fired units and 14 percent of biomass fired units will fire fuels with mercury contents above the MACT floor emission limits. Since AP-42 emission factors represent an average of all available information, this analysis assumes 50 percent of liquid units are expected to have mercury contents higher than the MACT floor. A fabric filter will be required on units with fuels with Hg contents higher than the MACT floor. A fabric filter is expected to achieve 75 percent reduction in Hg and 99 percent reduction in PM and non-Hg metallic HAP. Based on the distribution of state permit limits and CO stack test data 27 percent of coal units, 68 percent of biomass units, and 4 percent of liquid fuel units will need to install enhanced combustion control equipment, such as a LBMS, to meet the CO MACT floor. The remaining coal, biomass, and liquid fuel units were assumed to conduct and annual tune-up and achieve 5 to 10 percent reduction in CO, Hg, non-Hg metallic HAP, and PAH. Gas units do have testing and monitoring costs to meet GACT CO limit, all other boilers have PM and Hg testing costs, and monitoring costs for opacity, mercury content and CO, O2 levels. Table 1 summarizes the national costs of option 1.

[2] Draft Memo. Eddinger, Jim. Approach for determining MACT floors for existing area source boilers. August 22, 2008.

**Table 1 National Annualized Control Costs for Regulatory Option 1 (2007 million$)**

| Add-On Control Costs | Combustion Control Costs | Testing Costs | Monitoring Costs | Total Costs |
|---|---|---|---|---|
| **222** | **4,099** | **2,962** | **16,386** | **$ 23,669** |

*Regulatory Option 2 – Work Practice Standard for All Pollutants (Table A-4b)*

Section 112(h) of the CAA allows EPA to promulgate a work practice standard, if it is not feasible to enforce an emission standard. *Not feasible* means the application of measurement methodology is not practicable due to technological and economic limitations. Given the high costs associated with testing and monitoring associated with the MACT floor under regulatory option 1, regulatory option 2 summarizes the costs associated with conducting an annual tune-up work practice standard on all units that are not already assumed to be conducting tune-ups in order to comply with existing state emission standards. This option considers the cost of a tune-up only (annualized costs of $2,219 per boiler) and it does not incorporate any costs for add-on controls, testing, or monitoring. A tune-up is expected to achieve 5 to 10 percent reductions in all pollutants. Table 2 summarizes the national costs of regulatory option 2.

**Table 2 National Annualized Control Costs for Option 2 (2007 million$)**

| Add-On Control Costs | Combustion Control Costs | Testing Costs | Monitoring Costs | Total Costs |
|---|---|---|---|---|
| **0** | **2,906** | **0** | **0** | **$ 2,906** |

*Regulatory Option 3 – Energy Audit on All Solid Fuel Boilers with Tune-up on all Other Units (Table A-4b)*

Regulatory Option 3 analyzes work practice standards more stringent than the tune-ups analyzed under option 2. The cost to conduct an energy audit and implement any audit findings with less than a 3-year payback was analyzed for all solid units. The one-time cost of an energy audit was estimated as $245. Costs associated with implementing the findings of the energy audit were not included in this analysis, because it was assumed that the cost for implementation would be offset by fuel savings. Table 3 summarizes the national costs of regulatory option 3.

**Table 3 National Annualized Control Costs for Option 3 (2007 million$)**

| Add-On Control Costs | Combustion Control Costs | Testing Costs | Monitoring Costs | Total Costs |
|---|---|---|---|---|
| **0** | **2,909** | **0** | **0** | **$ 2,909** |

1.4 Example Small Entity Costs for Area Source Facilities with Boilers

Tables A-5a, b, c present example facility costs for typical area source facilities to comply with regulatory options 1, 2, and 3 outlined above. The example costs are based on actual area source facilities that responded to the 2008 combustion survey. According to table A-6 there is an average of two boilers per area source facility. The types of controls necessary and corresponding emission reduction potentials will depend on the blend of fuels and boiler sizes at each facility.

*Regulatory Option 1*

Under option 1, the annualized costs for the example facilities are $2,200 for a church with one small gas boiler, and $399,100 for a public sector training facility with two coal and two liquid fuel boilers.

*Regulatory Option 2*

Under option 2, the annualized costs for the example facilities are $2,200 for a church with one small gas boiler, and $11,100 for a not-for profit hospital with five gas boilers.

*Regulatory Option 3*

Under option 3, the annualized costs for the example facilities are $2,200 for a church with one small gas boiler, and $101,000 for a public sector training facility with two coal and two liquid fuel boilers.

## 2.0 Summary of Cost and Emission Impacts for Boilers and Process Heaters at Major Sources of HAP

Similar to the discussion in Section 1.0 model units were created to represent the boiler major source population database so that an impacts analysis could be performed on a reasonable number of units and could be conducted in a practical and timely manner. Table M-1 summarizes the distribution of small entity facilities to various types of facilities. On average there are 3.2 boilers per major source facility, compared with 2 boilers per area source facility. The majority of small entity major sources are located in private industries; however there are some small entities in the public and non-profit sectors.

### 2.1 Model Units for Major Source Boilers and Process Heaters

Table M-2 presents the estimated population of boilers at major sources of HAP. These estimates are based on the estimates in the vacated boiler MACT rulemaking. The actual population of units will be modified to reflect the results of the 2008 combustion survey. At this time, model units were not yet developed based on the recent survey. Based on preliminary screening of the survey results, the total population of units is much less. There are approximately 12,000 boilers and process heaters at major sources, compared to the 58,200 boilers summarized in Table M-2. However, the distribution of units in the survey contains proportionately much less coal-fired units than what is shown in Table M-2. The baseline emission rates shown in the summary table are based on data collected during the vacated boiler maximum achievable control technology (MACT) standard. Only baseline PAH emission rates are summarized for gas units.

### 2.2. MACT Floor Emission Limits for Boilers and Process Heaters at Major Sources

Based on the current status of data from the 2008 combustion survey, it is premature to estimate numerical emission limits (and corresponding emission reductions) based on the best performing 12 percent of units. Despite the lack of a numerical limit, it is expected the level of control technology required to meet the emission limits of the new MACT standard will be comparable to the controls analyzed in the vacated boiler MACT standard.

### 2.3 National Impacts for Major Source Boilers and Process Heaters

The control, testing, and monitoring costs shown in table M-3 represent the controls analyzed under the vacated standard. Tables M-4a and b present the national costs for regulatory options 1 and 2. To estimate the national costs of each regulatory option, the per unit costs in Table M-3 were multiplied by the number of boilers and process heaters represented by the model unit.

*Regulatory Option 1 – National Cost to Achieve MACT Floor for Hg, HCl, Metallic HAP and POM (CO) Emissions (Table M-4a)*

The costs in regulatory option 1 include control costs for fabric filter, venturi scrubber, and ESP, as needed. These costs also include monitoring costs such as process monitors for control devices if a control device is installed otherwise fuel content monitoring. Costs also include monitoring opacity and CO, O2 levels as well as testing for HCl, PM, and Hg. Table 4 summarizes the national costs of regulatory option 1.

**Table 4 National Annualized Control Costs for Option 1 (2007 million$)**

| Add-On Control Costs (TAC) | Testing Costs (TAC) | Monitoring Costs (TAC) | Total |
|---|---|---|---|
| **1,878** | **208** | **1,558** | **3,644** |

*Regulatory Option 2 – National Cost to Achieve MACT Floor Assuming Certain Coal and Wood-Fired Units Comply with the HCl and Manganese Exclusion Health-Based Compliance Alternatives (HBCA) (Table M-4b)*

If a facility can demonstrate that facility-wide emissions of HCl and Cl2 do not pose significant risks, the facility does not have to comply with the HCl MACT floor limit on individual boiler basis. To analyze the reduce costs of compliance for facilities estimated to comply the the HCl HBCA, the HCl (scrubber) control costs on approximately 220 boilers and process heaters were removed. These units were assumed to comply with the HCl emission standard using the facility-wide HCl health-based compliance alternative.

Similarly, if a facility can demonstrate that facility-wide emissions of manganese do not pose significant risks, the facility can exclude manganese emissions when determining compliance with the total selected metals (TSM) limit on an individual boiler basis. To analyze the reduce costs of compliance for facilities estimated to comply the TSM HBCA, the PM (fabric filter or ESP) control costs on an additional 202 boilers and process heaters were removed. These units were assumed to qualify for exempting their Manganese emissions from the TSM emission limit and thus avoid the need to install controls to comply with the TSM standard.

Although these 400 units were exempt from control costs under the HCl and TSM HBCA, costs for testing and monitoring are still applicable in order to demonstrate compliance with the standard. The portion of units eligible for the HCl and TSM HBCA standards was based on a memorandum prepared for the vacated Boiler MACT standard.[3] Table 5 summarizes the national costs of regulatory option 2.

**Table 5 National Annualized Control Costs for Option 2 (2007 million$)**

| Add-On Control Costs (TAC) | Testing Costs (TAC) | Monitoring Costs (TAC) | Total |
|---|---|---|---|
| ***1,687*** | ***208*** | ***1,520*** | ***3,415*** |

2.4 Example Small Entity Costs for Major Source Facilities with Boilers and Process Heaters

Tables M-5a and b present example facility costs for typical major source type facilities that were identified as small entities to comply with regulatory options 1 and 2 outlined above. The example costs are based on actual major source facilities that responded to the 2008 combustion survey. The types of controls necessary at each unique facility will depend on the blend of fuels and boiler and process heater subcategories at each facility.

*Regulatory Option 1*

Under option 1, the annualized costs for the example facilities are $148,000 for a small wood products facility with one biomass boiler and one gas-fired boiler, and $1 million for a facility with three boilers firing a blend of coal, biomass and non-fossil solid fuels.

*Regulatory Option 2*

Assuming the two facilities mentioned above could comply with the HBCA, the annualized costs for the small wood products facility decreased from $148,000 to $64,200. The cost for the facility with three solid fuel boilers decreased from $1 million to $451,400.

[3] Eddinger, J. Estimating Impact on Control Costs and Emissions Reductions of the Health-Based Compliance Alternatives. February 2004.