

CIBO Estimated Capital Costs For Air Pollution Control Equipment For Liquid-Fired Industrial Boilers and Process Heaters

Pollutant	<u>Particulate Matter (PM)</u>	<u>Hydrogen Chloride (HCl)</u>	<u>Carbon Monoxide (CO)</u>	<u>Mercury (Hg)</u>
Likely Additional Control Required	Fabric Filter (FF)	Scrubber (e.g., spray dryer or wet scrubber)	Catalytic Oxidation (CATOX) or other combustion improvement projects	Carbon Injection (CI)
# of Liquid-Fired Boilers and Process Heaters	535 of the 587 liquid-fired units will need a new FF or an upgrade to their current FF or electrostatic precipitator (ESP).	554 of the 587 liquid-fired units need scrubbers or upgrades	533 of the 587 liquid-fired units need CATOX or combustion improvements	1 of the 587 liquid-fired units need CI
Comments/ Assumptions	<ul style="list-style-type: none"> • If a unit did not already have a FF or ESP and there was information that indicated the unit cannot meet the limit or there was no emissions information, we assumed a new FF based on EPA baseline emission factors for various control devices for coal fired boilersⁱ. • If the unit already had a FF or ESP and there was information that indicated the unit cannot meet the limit, we assumed an upgrade to the existing FF or ESP. • FF base capital cost \$7 MMⁱⁱ; FF/ESP base upgrade capital cost \$4 MM.ⁱⁱⁱ 	<ul style="list-style-type: none"> • If there was information that indicated the unit cannot meet the limit, we assumed either a scrubber upgrade or new scrubber depending on whether the unit currently had a scrubber.ⁱ • Scrubber base capital cost \$8 million; scrubber base upgrade capital cost \$4 million.ⁱⁱⁱ 	<ul style="list-style-type: none"> • If there was information that indicated the unit cannot meet the limit, then we assumed that capital would be necessary to either perform combustion/fuel feed improvements or other boiler improvement projects to reduce CO or install a CO catalyst. • Base capital cost of \$3 million was assumed for CO controls (either projects to improve combustion or fuel feed or installation of a CO catalyst).ⁱⁱⁱ • NOTE: It is uncertain whether a CO catalyst can be applied effectively and efficiently to liquid-fired industrial boilers. 	<ul style="list-style-type: none"> • If there was information that indicated the unit cannot meet the limit, we added carbon injection.ⁱ • A fixed cost of \$1 million was assumed for installation of a Carbon Injection system for Hg control, as these systems do not vary much in cost by boiler size.
Total Capital Cost to Liquid-Fired Units: \$5.95 billion	\$2.2 billion	\$2.7 billion	\$999 million	\$1 million
Capital Cost Per Unit	<ul style="list-style-type: none"> • Range of Costs Per Unit: \$1.0 to 16.9MM • Average Per Unit Cost: \$4.2MM^{iv} 	<ul style="list-style-type: none"> • Range of Costs Per Unit: \$1.2 to 19.4MM • Average Per Unit Cost: \$4.9MM 	<ul style="list-style-type: none"> • Range of Costs Per Unit: \$435k to 7.3MM • Average Per Unit Cost: \$1.9MM 	<ul style="list-style-type: none"> • \$1 million per unit

ⁱ Where no emissions data were available in the EPA database for a particular type of unit, EPA's baseline emission factors identified in the memorandum "Revised Development of Baseline Emission Factors for Boilers and Process Heaters at Commercial, Industrial, and Institutional Facilities," January 2012, Appendix D were used to determine if typical emissions from the type of unit (fuel/design/control device) would meet the MACT limits.

ⁱⁱ MM stands for million

ⁱⁱⁱ The base cost assumes a size of 250 MMBtu/hr, the boiler specific cost was calculated using a 0.6 power function and the actual boiler size in MMBtu (e.g., for a 100 MMBtu/hr boiler or process heater, the cost is the base cost times $(100/250)^{0.6}$).

^{iv} Average cost was calculated by adding up the per unit cost for every unit requiring controls to get the total cost for all units and then dividing the total cost by the number of units requiring controls.