ControlNET
Emissions Inventory and Control Technology Tool

Frank Divita, Leif Hockstad and Patricia Horch
E.H. Pechan & Associates, Inc.
Springfield, VA 22151
and
Larry Sorrels and Barry Gilbert
U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

ABSTRACT
ControlNET is a database and control technology analysis tool developed by Pechan to support EPA in its analyses of air pollution policies and regulations. ControlNET provides data on emission sources, potential pollution control measures and emission reductions, and the costs of implementing those controls. In essence, ControlNET is a system that creates a comprehensive database of control measures and cost information for reducing the emissions of criteria pollutants (e.g., NO_x, SO_2, CO, VOC, PM_{10}, $PM_{2.5}$, NH_3) from point, area, and mobile sources emissions inventories supplied in EPA's National Emission Inventory (NEI) format. A new front-end to the application has been created that allows viewing and analysis of the database.

ControlNET relies heavily upon EPA emission inventory data. If EPA wishes to improve its ability to examine the costs and benefits of control technologies, continued improvements in inventory parameters are needed. Often times, data fields not needed for air quality modeling are either not accurate or not complete in EPA inventories. An improvement in the quality of inventory parameters, such as, but not limited to, control efficiency, throughput, fuel use, and emission factors would enhance the ability of ControlNET to produce accurate and precise data useful for regulatory impact analysis of EPA air programs.

INTRODUCTION

In recent years, EPA has developed an annual emission inventory for criteria pollutants called The National Emission Trends (NET) Inventory. This inventory has recently been updated to also include emission estimates of toxic pollutants and is now known as the National Emissions Inventory (NEI). The inventory contains emission estimates of stationary point, area, and mobile sources for all 50 States. The source of the data is through a combination of EPA (utility, mobile, and nonroad sectors) and state supplied data (non-utility point and area sources).

One of the major uses of this national emission inventory is to provide emissions inputs for grid-based air quality modeling performed as part of EPA requirements to conduct regulatory impact analysis for major regulatory initiatives. The most important inputs for modeling purposes are emission rates, locations, and point source stack parameters. EPA performs extensive quality assurance (QA) on these data fields to assure they are as accurate as possible.

The NEI is also used by other EPA programs as inputs to technical analyses other than air quality modeling. These include analyses related to the costs and applicability of add-on control measures. One tool developed by EPA called ControlNET uses relies on the control efficiency, throughput, fuel use, and emission factor data provided in the NEI. Often times however, these data fields are either not accurate or not complete, as some feel these data are not as important as those needed for air quality modeling.

EPA CONTROL SCENARIO AND COST ANALYSES

EPA develops and maintains data on emission sources and potential control measures to support its development and implementation of air quality standards. The ControlNET emissions inventory and control technology tool has been developed to support EPA in its analyses for these standards. ControlNET utilizes emissions inventory data and control technology data to calculate emission reduction scenarios which can be used to support EPA's policies to improve air quality.

ControlNET is a relational database system in which control technologies are linked to sources within point, area, and mobile sources emissions inventories. The database of control measures contains comprehensive information on each measure, including control efficiency and costing data. Currently, ControlNET contains 453 source category and pollutant-specific control measures, applied within a 759,733 record data file. Controls are supplied for all criteria pollutants and NH_3. The control measure data file in ControlNET includes not only the technology's control efficiency, and calculated emission rteduction for that source, but also estimates the costs (annual and capital) for application of the control measure.

In determining the costs each control measure, ControlNET links basic cost information from EPA studies to input parameters contained in the emission inventory. Table 2 lists an example of the costing considerations and inputs utilized by control measures for reducing PM emissions from coal-fired industrial boilers. This sample table presents the control efficiency, capital cost, operating and maintenance (O&M) cost, annualized cost, cost effectiveness, and dollar year for each PM control measure for coal-fired industrial boilers. Though cost effectiveness per ton PM removed is provided, this is only an approximate cost estimate. Many control measures are highly dependent upon specific application needs and varying inlet conditions, which may result in a wide range of cost values.

Table 1 provides an example for stationary source PM controls and shows one the dependences of ControlNET cost results on the NEI database. This example shows its dependence on stack flow rate. This sample shows that the capital, O&M, and annualized costs are calculated from $/ standard cubic feet per minute estimates. Ideally, the costs for this pollutant/source category are calculated using the typical values of normalized capital and O&M costs in the table coupled with the stack gas flow rate provided in an emission inventory. If an inventory lacks the requisite input parameters, the most accurate costing analysis of the control measures cannot be performed. While many coal-fired industrial boilers in the most recent EPA inventory list stack flow rate, there are also many that have either no stack flow rate listed or a stack flow rate that seems unreliable.

CONCLUSION

If EPA wishes to improve its ability to examine emerging control technologies, continued improvements in inventory parameters would prove helpful. Capacity factors, for example, are important to providing accurate control cost estimates for the latest technologies like SNCR and SCR. Careful recording of existing control efficiencies on sources, as another example, increases the accuracy in determining the proper add-on control measures.

An improvement in the quality of inventory parameters would enhance the ability of ControlNET to produce accurate and precise data useful for regulatory impact analysis of EPA air programs. The more accurate the underlying data is, including, but not limited to, control efficiency, throughput, fuel use, and emission factors, the more accurately ControlNET can apply new and emerging control technologies while calculating their costs and benefits.

Table 1
Stationary PM Controls and Control Cost Factors Based on Flowrate

PM Group	Source Category/Control Measure	PM_{10} Control Efficiency	$PM_{2.5}$ Control Efficiency	Capital Costs ($/scfm)			O&MCosts ($/scfm)			Annualized Costs ($/scfm)			Cost Effectiveness ($/ton PM removed)			Dollar Year
				Min	Max	Typical	Min	Max	Typical	Min	Max	Typical	Min	Max	Typical	
UT1	**Utility Boilers - Coal**															
	Dry ESP-Wire Plate Type	98	95	15	50	27	4	40	16	5	40	17	40	250	110	1995
	Fabric Filter (Mech. Shaker Type)	99.5	99	8	71	29	4	24	11	5	45	18	37	303	126	1998
	Fabric Filter (Pulse Jet Type)	99	99	6	26	13	5	24	11	6	39	17	42	266	117	1998
	Fabric Filter - Reverse-Air Cleaned Type	99	99	9	84	34	6	27	13	8	50	22	53	337	148	1998
UT2	**Utility Boilers - Oil**															
	Dry ESP-Wire Plate Type	98	95	15	50	27	4	40	16	5	40	17	40	250	110	1995
201	**Industrial Boilers - Coal**															
	Fabric Filter (Pulse Jet Type)	99	99	6	26	13	5	24	11	6	39	17	42	266	117	1998
	Dry ESP-Wire Plate Type	98	95	15	50	27	4	40	16	5	40	17	40	250	110	1995
	Fabric Filter - Reverse-Air Cleaned Type	99	99	9	84	34	6	27	13	8	50	22	53	337	148	1998
	Venturi Scrubber	82	50	3	28	11	4	119	42	5	123	44	76	2100	751	1995
	Industrial Boilers - Wood															
202	Fabric Filter (Pulse Jet Type)	99	99	6	26	13	5	24	11	6	39	17	42	266	117	1998
	Dry ESP-Wire Plate Type	98	95	15	50	27	4	40	16	5	40	17	40	250	110	1995
	Fabric Filter - Reverse-Air Cleaned Type	99	99	9	84	34	6	27	13	8	50	22	53	337	148	1998
	Venturi Scrubber	93	92	3	28	11	4	119	42	5	123	44	76	2100	751	1995
203	**Industrial Boilers - Oil**															
	Dry ESP-Wire Plate Type	98	95	15	50	27	4	40	16	5	40	17	40	250	110	1995
	Venturi Scrubber	92	89	3	28	11	4	119	42	5	123	44	76	2100	751	1995
204	**Industrial Boilers - Liquid Waste**															
	Dry ESP-Wire Plate Type	98	95	15	50	27	4	40	16	5	40	17	40	250	110	1995
205	**Commercial Institutional Boilers - Coal**															
	Fabric Filter (Pulse Jet Type)	99	99	6	26	13	5	24	11	6	39	17	42	266	117	1998
	Dry ESP-Wire Plate Type	98	95	15	50	27	4	40	16	5	40	17	40	250	110	1995
	Fabric Filter - Reverse-Air Cleaned Type	99	99	9	84	34	6	27	13	8	50	22	53	337	148	1998

Table 1
Stationary PM Controls and Control Cost Factors Based on Flowrate

PM Group	Source Category/Control Measure	PM_{10} Control Efficiency	$PM_{2.5}$ Control Efficiency	Capital Costs ($/scfm)			O&MCosts ($/scfm)			Annualized Costs ($/scfm)			Cost Effectiveness ($/ton PM removed)			Dollar Year
				Min	Max	Typical	Min	Max	Typical	Min	Max	Typical	Min	Max	Typical	
206	**Commercial Institutional Boilers - Wood**															
	Fabric Filter (Pulse Jet Type)	99	99	6	26	13	5	24	11	6	39	17	42	266	117	1998
	Dry ESP-Wire Plate Type	98	95	15	50	27	4	40	16	5	40	17	40	250	110	1995
	Fabric Filter - Reverse-Air Cleaned Type	99	99	9	84	34	6	27	13	8	50	22	53	337	148	1998
207	**Commercial Institutional Boilers - Oil**															
	Dry ESP-Wire Plate Type	98	95	15	50	27	4	40	16	5	40	17	40	250	110	1995
208	**Non-Ferrous Metals Processing - Copper**															
	Fabric Filter (Mech. Shaker Type)	99	99	8	71	29	4	24	11	5	45	18	37	303	126	1998
	Dry ESP-Wire Plate Type	98	95	15	50	27	4	40	16	5	40	17	40	250	110	1995
	Wet ESP - Wire Plate Type	99	95	30	60	40	6	45	19	10	50	23	55	550	220	1995
	Fabric Filter - Reverse-Air Cleaned Type	99	99	9	84	34	6	27	13	8	50	22	53	337	148	1998
209	**Non-Ferrous Metals Processing - Lead**															
	Fabric Filter (Mech. Shaker Type)	99	99	8	71	29	4	24	11	5	45	18	37	303	126	1998
	Dry ESP-Wire Plate Type	98	95	15	50	27	4	40	16	5	40	17	40	250	110	1995
	Wet ESP - Wire Plate Type	99	95	30	60	40	6	45	19	10	50	23	55	550	220	1995
	Fabric Filter - Reverse-Air Cleaned Type	99	99	9	84	34	6	27	13	8	50	22	53	337	148	1998
210	**Non-Ferrous Metals Processing - Zinc**															
	Fabric Filter (Mech. Shaker Type)	99	99	8	71	29	4	24	11	5	45	18	37	303	126	1998
	Dry ESP-Wire Plate Type	98	95	15	50	27	4	40	16	5	40	17	40	250	110	1995
	Wet ESP - Wire Plate Type	99	95	30	60	40	6	45	19	10	50	23	55	550	220	1995
	Fabric Filter - Reverse-Air Cleaned Type	99	99	9	84	34	6	27	13	8	50	22	53	337	148	1998
211	**Non-Ferrous Metals Processing - Aluminum**															
	Fabric Filter (Mech. Shaker Type)	99	99	8	71	29	4	24	11	5	45	18	37	303	126	1998
	Dry ESP-Wire Plate Type	98	95	15	50	27	4	40	16	5	40	17	40	250	110	1995
	Wet ESP - Wire Plate Type	99	95	30	60	40	6	45	19	10	50	23	55	550	220	1995
	Fabric Filter - Reverse-Air Cleaned Type	99	99	9	84	34	6	27	13	8	50	22	53	337	148	1998
212	**Non-Ferrous Metals Processing - Other**															
	Fabric Filter (Mech. Shaker Type)	99	99	8	71	29	4	24	11	5	45	18	37	303	126	1998

Table 1
Stationary PM Controls and Control Cost Factors Based on Flowrate

PM Group	Source Category/Control Measure	PM_{10} Control Efficiency	$PM_{2.5}$ Control Efficiency	Capital Costs ($/scfm)			O&MCosts ($/scfm)			Annualized Costs ($/scfm)			Cost Effectiveness ($/ton PM removed)			Dollar Year
				Min	Max	Typical	Min	Max	Typical	Min	Max	Typical	Min	Max	Typical	
	Dry ESP-Wire Plate Type	98	95	15	50	27	4	40	16	5	40	17	40	250	110	1995
	Wet ESP - Wire Plate Type	99	95	30	60	40	6	45	19	10	50	23	55	550	220	1995
	Fabric Filter - Reverse-Air Cleaned Type	99	99	9	84	34	6	27	13	8	50	22	53	337	148	1998
213	**Ferrous Metals Processing - Coke**															
	Fabric Filter (Mech. Shaker Type)	99	99	8	71	29	4	24	11	5	45	18	37	303	126	1998
	Fabric Filter - Reverse-Air Cleaned Type	99	99	9	84	34	6	27	13	8	50	22	53	337	148	1998
	Venturi Scrubber	93	89	3	28	11	4	119	42	5	123	44	76	2100	751	1995
214	**Ferrous Metals Processing - Ferroalloy Production**															
	Fabric Filter (Mech. Shaker Type)	99	99	8	71	29	4	24	11	5	45	18	37	303	126	1998
	Dry ESP-Wire Plate Type	98	95	15	50	27	4	40	16	5	40	17	40	250	110	1995
	Fabric Filter - Reverse-Air Cleaned Type	99	99	9	84	34	6	27	13	8	50	22	53	337	148	1998
215	**Ferrous Metals Processing - Iron & Steel Production**															
	Fabric Filter (Pulse Jet Type)	99	99	6	26	13	5	24	11	6	39	17	42	266	117	1998
	Fabric Filter (Mech. Shaker Type)	99	99	8	71	29	4	24	11	5	45	18	37	303	126	1998
	Dry ESP-Wire Plate Type	98	95	15	50	27	4	40	16	5	40	17	40	250	110	1995
	Wet ESP - Wire Plate Type	99	95	30	60	40	6	45	19	10	50	23	55	550	220	1995
	Fabric Filter - Reverse-Air Cleaned Type	99	99	9	84	34	6	27	13	8	50	22	53	337	148	1998
	Venturi Scrubber	73	25	3	28	11	4	119	42	5	123	44	76	2100	751	1995
216	**Ferrous Metals Processing - Gray Iron Foundaries**															
	Fabric Filter (Mech. Shaker Type)	99	99	8	71	29	4	24	11	5	45	18	37	303	126	1998
	Dry ESP-Wire Plate Type	98	95	15	50	27	4	40	16	5	40	17	40	250	110	1995
	Fabric Filter - Reverse-Air Cleaned Type	99	99	9	84	34	6	27	13	8	50	22	53	337	148	1998
	Impingement-plate scrubber	64	64	2	11	7	3	70	25	3	71	26	46	1200	431	1995
	Venturi Scrubber	94	94	3	28	11	4	119	42	5	123	44	76	2100	751	1995
217	**Ferrous Metals Processing - Steel Foundaries**															
	Fabric Filter (Pulse Jet Type)	99	99	6	26	13	5	24	11	6	39	17	42	266	117	1998
	Fabric Filter (Mech. Shaker Type)	99	99	8	71	29	4	24	11	5	45	18	37	303	126	1998
	Dry ESP-Wire Plate Type	98	95	15	50	27	4	40	16	5	40	17	40	250	110	1995
	Wet ESP - Wire Plate Type	99	95	30	60	40	6	45	19	10	50	23	55	550	220	1995

Table 1
Stationary PM Controls and Control Cost Factors Based on Flowrate

PM Group	Source Category/Control Measure	PM_{10} Control Efficiency	$PM_{2.5}$ Control Efficiency	Capital Costs ($/scfm) Min	Capital Costs ($/scfm) Max	Capital Costs ($/scfm) Typical	O&MCosts ($/scfm) Min	O&MCosts ($/scfm) Max	O&MCosts ($/scfm) Typical	Annualized Costs ($/scfm) Min	Annualized Costs ($/scfm) Max	Annualized Costs ($/scfm) Typical	Cost Effectiveness ($/ton PM removed) Min	Cost Effectiveness ($/ton PM removed) Max	Cost Effectiveness ($/ton PM removed) Typical	Dollar Year
	Fabric Filter - Reverse-Air Cleaned Type	99	99	9	84	34	6	27	13	8	50	22	53	337	148	1998
	Venturi Scrubber	73	25	3	28	11	4	119	42	5	123	44	76	2100	751	1995
218	**Mineral Products - Cement Manufacture**															
	Fabric Filter (Pulse Jet Type)	99	99	6	26	13	5	24	11	6	39	17	42	266	117	1998
	Fabric Filter (Mech. Shaker Type)	99	99	8	71	29	4	24	11	5	45	18	37	303	126	1998
	Dry ESP-Wire Plate Type	98	95	15	50	27	4	40	16	5	40	17	40	250	110	1995
	Paper/Nonwoven Filters - Cartridge Collector Type	99	99	7	13	9	9	25	14	13	38	21	85	256	142	1998
	Fabric Filter - Reverse-Air Cleaned Type	99	99	9	84	34	6	27	13	8	50	22	53	337	148	1998
219	**Mineral Products - Coal Cleaning**															
	Fabric Filter (Pulse Jet Type)	99	99	6	26	13	5	24	11	6	39	17	42	266	117	1998
	Fabric Filter (Mech. Shaker Type)	99	99	8	71	29	4	24	11	5	45	18	37	303	126	1998
	Paper/Nonwoven Filters - Cartridge Collector Type	99	99	7	13	9	9	25	14	13	38	21	85	256	142	1998
	Fabric Filter - Reverse-Air Cleaned Type	99	99	9	84	34	6	27	13	8	50	22	53	337	148	1998
	Venturi Scrubber	99	98	3	28	11	4	119	42	5	123	44	76	2100	751	1995
220	**Mineral Products - Stone Quarrying & Processing**															
	Fabric Filter (Pulse Jet Type)	99	99	6	26	13	5	24	11	6	39	17	42	266	117	1998
	Fabric Filter (Mech. Shaker Type)	99	99	8	71	29	4	24	11	5	45	18	37	303	126	1998
	Dry ESP-Wire Plate Type	98	95	15	50	27	4	40	16	5	40	17	40	250	110	1995
	Wet ESP - Wire Plate Type	99	95	30	60	40	6	45	19	10	50	23	55	550	220	1995
	Paper/Nonwoven Filters - Cartridge Collector Type	99	99	7	13	9	9	25	14	13	38	21	85	256	142	1998
	Fabric Filter - Reverse-Air Cleaned Type	99	99	9	84	34	6	27	13	8	50	22	53	337	148	1998
	Venturi Scrubber	95	90	3	28	11	4	119	42	5	123	44	76	2100	751	1995
221	**Mineral Products - Other**															
	Fabric Filter (Pulse Jet Type)	99	99	6	26	13	5	24	11	6	39	17	42	266	117	1998
	Fabric Filter (Mech. Shaker Type)	99	99	8	71	29	4	24	11	5	45	18	37	303	126	1998
	Dry ESP-Wire Plate Type	98	95	15	50	27	4	40	16	5	40	17	40	250	110	1995
	Wet ESP - Wire Plate Type	99	95	30	60	40	6	45	19	10	50	23	55	550	220	1995
	Paper/Nonwoven Filters - Cartridge Collector Type	99	99	7	13	9	9	25	14	13	38	21	85	256	142	1998
	Fabric Filter - Reverse-Air Cleaned Type	99	99	9	84	34	6	27	13	8	50	22	53	337	148	1998

Table 1
Stationary PM Controls and Control Cost Factors Based on Flowrate

PM Group	Source Category/Control Measure	PM_{10} Control Efficiency	$PM_{2.5}$ Control Efficiency	Capital Costs ($/scfm)			O&MCosts ($/scfm)			Annualized Costs ($/scfm)			Cost Effectiveness ($/ton PM removed)			Dollar Year
				Min	Max	Typical	Min	Max	Typical	Min	Max	Typical	Min	Max	Typical	
222	**Asphalt Manufacture**															
	Fabric Filter (Pulse Jet Type)	99	99	6	26	13	5	24	11	6	39	17	42	266	117	1998
	Fabric Filter (Mech. Shaker Type)	99	99	8	71	29	4	24	11	5	45	18	37	303	126	1998
	Paper/Nonwoven Filters - Cartridge Collector Type	99	99	7	13	9	9	25	14	13	38	21	85	256	142	1998
	Fabric Filter - Reverse-Air Cleaned Type	99	99	9	84	34	6	27	13	8	50	22	53	337	148	1998
223	**Grain Milling**															
	Fabric Filter (Pulse Jet Type)	99	99	6	26	13	5	24	11	6	39	17	42	266	117	1998
	Paper/Nonwoven Filters - Cartridge Collector Type	99	99	7	13	9	9	25	14	13	38	21	85	256	142	1998
	Fabric Filter - Reverse-Air Cleaned Type	99	99	9	84	34	6	27	13	8	50	22	53	337	148	1998
224	**Wood Pulp & Paper**															
	Dry ESP-Wire Plate Type	98	95	15	50	27	4	40	16	5	40	17	40	250	110	1995
	Wet ESP - Wire Plate Type	99	95	30	60	40	6	45	19	10	50	23	55	550	220	1995
225	**Chemical Manufacture**															
	Wet ESP - Wire Plate Type	99	95	30	60	40	6	45	19	10	50	23	55	550	220	1995
226	**Municipal Waste Incineration**															
	Dry ESP-Wire Plate Type	98	95	15	50	27	4	40	16	5	40	17	40	250	110	1995
227	**Fabricated Metal Products - Abrasive Blasting**															
	Paper/Nonwoven Filters - Cartridge Collector Type	99	99	7	13	9	9	25	14	13	38	21	85	256	142	1998