Part 75 CEMS Equipment - What's Everyone Using?
A Look at Current Trends in CEMS Providers

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Introduction

Since 1993, continuous emission monitoring systems (CEMS) have been installed and certified on the vast majority of utility fossil-fired generating units to meet the requirements set forth in EPA's 40 CFR Part 75 "Acid Rain Program" (ARP). Under Part 75, sources are required to report emissions data on a quarterly basis. The quarterly reports, which are also known as Electronic Data Reports (EDRs), must include the monitoring plan information that identifies the source, power generating units, the emissions being monitored, analyzer manufacturer, and the sample acquisition methods. These data are found in the 500 group records of the quarterly EDRs submitted to the EPA.

This report presents data from the raw EDR files submitted to the EPA for the third quarter of 2002, which was extracted and compiled using a custom application designed by RMB. The third quarter of 2002 was used since it represents the most recent ozone season so it includes the Ozone Transport Commission (OTC) NO_x Budget units. It, however, does not include the additional NO_X budget units that will begin monitoring this year per Subpart H of Part 75 under the NO_X SIP Call.

This report presents the Data Acquisition and Handling Systems (DAHS), analyzer types, sample acquisition methods, and CEMS manufacturers for all EDRs submitted in the third quarter of 2002. This analysis only considered those systems that were reported as "Primary" and did not include any analyzers identified as backup, redundant backup, or "like-kind" replacements. This report presents market share represented by the various manufacturers of the DAHS, SO_2, NO_x, CO_2, O_2, and opacity monitoring equipment. To help identify the recent trends, these results are compared to a similar analysis performed in 1997. Additionally, the sample acquisition methods and their respective percentage presence are presented. The types of gas and oil fuel flow meters used in accordance with Appendix D of Part 75 are also addressed.

Monitoring Data

The following tables and figures summarize the breakdown of the CEMS manufacturers as well as the sample acquisition methods of the monitors from the third quarter of 2002 EDR data. The tables also show a comparison of the current data to those found during a previous examination of the monitoring plan data for the fourth quarter of 1997, which RMB presented at an earlier EPRI CEMS Conference.[1]

While the EDR database used is arguably the most accurate source of information for identifying CEMS equipment, the accuracy of the data presented in the following tables and figures is only as good as the data reported in the EDR files. The quality of the EDR data has improved significantly in recent years, however, some records are still improperly reported. While we believe that we were able to resolve many of the improperly reported records, it is possible there may also be missing, outdated, or false information in the database that was not, or could not be identified.

[1] Jernigan, J. Ron, *Compilation of Part 75 DAHS & CEM Sampling Equipment Serving the Utility Industry,* EPRI CEMS Users Group Meeting, New Orleans, Louisiana, May 1998. (RMB did present an even earlier evaluation of the 1995 monitoring plan data in 1996; however, because the quality of the EDR data reported at the time was considerably poorer, the 1997 data were deemed preferable for this presentation.)

When identifiable, most providers are shown in the tables. Within the figures that illustrate current market share, all vendors with over a 2% share (1.5% for SO_2) are presented.

DAHS Software

The DAHS information is presented in Table 1 and illustrated in Figure 1. The totals indicate the number of "DAHS monitoring systems," which roughly corresponds to the number of EDR files reported,[2] for each software provider. The total for Teledyne/Monitor Labs includes not only its RegPerfect and DASx software but also sources that reported using Odessa software. The totals for Cartwright, CISCO and CONTEC were grouped together since the Cartwright software serves as the EDR generation engine for both the CISCO and CONTEC database/data acquisition platforms.

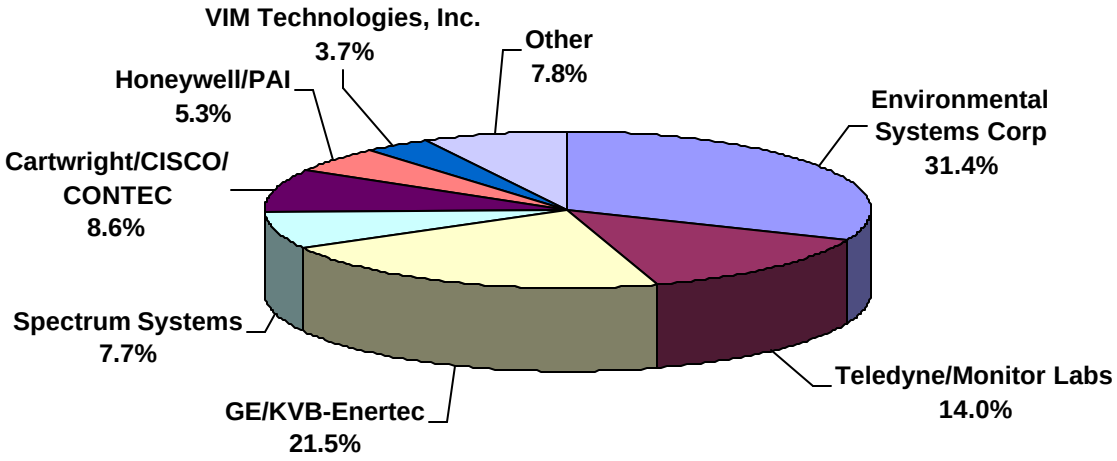

Figure 1. DAHS Software Provider Market Share (2002)

[2] The " DAHS monitoring system" approach identifies a DAHS component for every CEMS location at the plant. For example, a common stack would be identified as a single DAHS monitoring system unless NO_X was monitored on an individual unit basis. Then, in the example, one DAHS monitoring system would be identified for the common stack and additional DAHS monitoring systems for each additional unit where NO_X is monitored. Separate DAHS monitoring systems would also be identified for multiple stack units if CEMS components are identified for each stack.

Table 1. DAHS Software Providers

DAHS Software Providers	1997		2002	
	EDRs	% of Total	EDRs	% of Total
ESC	430	26.5	1047	31.4
GE/KVB-Enertec	367	22.6	716	21.5
Teledyne/Monitor Labs	278	17.1	465	14.0
Cartwright/CISCO/CONTEC	37	2.3	286	8.6
Spectrum Systems	152	9.4	258	7.7
Honeywell/PAI	-	-	176	5.3
VIM Technologies, Inc.	-	-	123	3.7
Alabama Power Company	21	1.3	44	1.3
EPA/MDC[3]	-	-	35	1.1
Graseby/STI (TEI)	42	2.6	24	0.7
Foxboro	35	2.2	21	0.6
LA Dept. of Water & Power	19	1.2	16	0.5
Oil Systems Inc./Duke Power	16	1.0	16	0.5
Trace Environmental	-	-	16	0.5
JDL	-	-	14	0.4
Analytical Process Systems	25	1.5	13	0.4
SAIC/Ameren	12	0.7	12	0.4
ROVISIS	-	-	11	0.3
Eagle Mountain Scientific	-	-	5	0.2
Enviroplan, Inc.	42	2.6	4	0.1
EC Systems/ORR Safety	71	4.4	1	0.0
Anarad, Inc.	27	1.7	-	-
Commonwealth Edison	19	1.2	-	-
Black & Veatch	16	1.0	-	-
NY State Electric & Gas	15	0.9	-	-
Other/Unknown	-	-	28	0.8
Grand Total	**1624**	**100.0**	**3331**	**100.0**

The table show that, while there have been a significant increase in the number of DAHS systems installed during the past five years, the top three DAHS supplier have continued to retain there relative positions and still represent about two-thirds of the market. The table does show the entry of some new providers and the exodus of several others such as Enviroplan, EC Systems/ORR Safety, Anarad, and Black & Veatch. The data also suggests that some sources, such as NY State Electric & Gas, that may have initially developed there own DAHS software have since elected to turn to commercially available options.

[3] The sources that identified EPA's MDC software as their DAHS software, along with some of the sources included in the "Other/Unknown" category appear to be mostly OTC NO_X Budget Units using the low mass emitter provisions under §75.19.

SO_2 Analyzers

Unlike the NO_X analyzers, the number of SO_2 analyzers has remained relatively consistent during the past five years, reflecting the fact that nearly all the SO_2 analyzers are installed on coal-fired units, which have not seen the growth that combustion turbines have seen. Most of the SO_2 analyzers use pulsed- or continuous-fluorescence technology in dilution systems. About 10% are ultraviolet spectrophotometric used in dry extractive systems. Thermo Environmental and Teledyne/Monitor Labs have maintained about 85% of the market, with Thermo Environmental holding the bulk of the market.

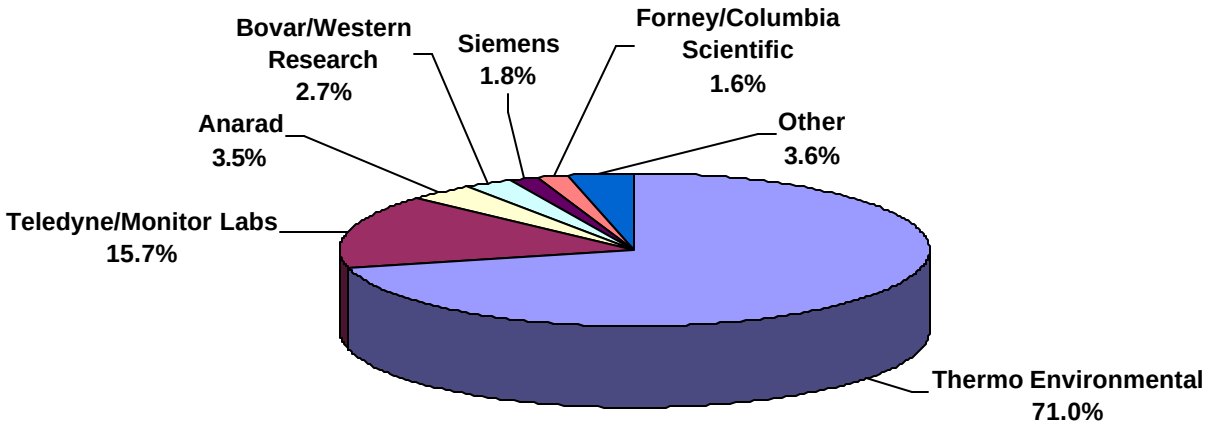

Figure 2a. SO_2 Analyzer Market Share (2002)

Table 2a. SO_2 Analyzer Manufacturers

SO_2 Analyzer Manufacturers	1997		2002	
	Analyzers	% of Total	Analyzers	% of Total
Thermo Environmental	669	64.9	744	71.0
Teledyne/Monitor Labs/API	194	18.8	165	15.7
Anarad	44	4.3	37	3.5
Bovar/Western Research/Ametek	25	2.4	28	2.7
Siemens	14	1.4	19	1.8
Forney/Columbia Scientific	45	4.4	17	1.6
ABB Opsis	26	2.5	15	1.4
Environment SA	-	-	7	0.7
Horiba	5	0.5	6	0.6
Dasibi	6	0.6	4	0.4
Altech	-	-	3	0.3
Sick Maihak	-	-	2	0.2
Perkin Elmer MCS-100	3	0.3	1	0.1
Rosemount	3	0.3	-	-
Grand Total	1031	100.0	1048	100.0

Table 2a. SO_2 Analyzer Sample Acquisition Methods (2002)

Sample Acquisition Method	Totals	% of Total
Dilution	910	86.7
Dry Extractive	97	9.2
Wet Extractive	7	0.7
Point/Path InSitu	35	3.3
Grand Total	**1049**	**100.0**

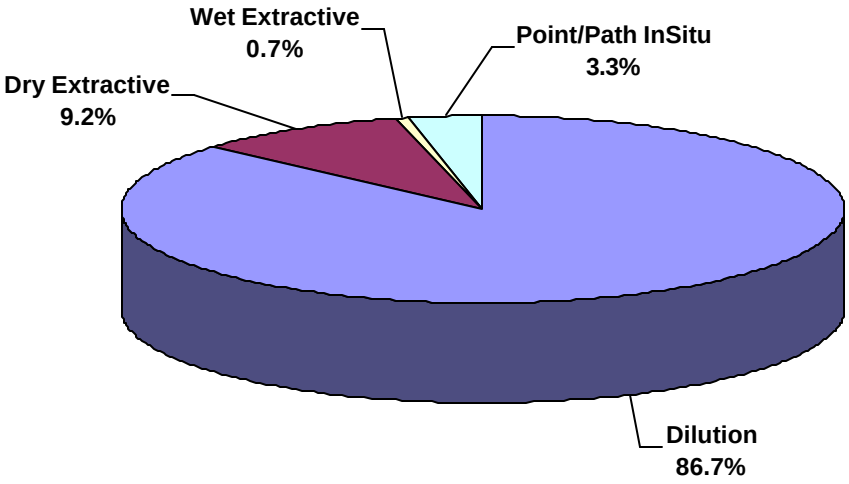

Figure 2a. SO_2 Analyzer Sample Acquisition Methods (2002)

NO_X Analyzers

The number of installed NO_X anlayzers under Part 75 has nearly doubled in the past five years, reflecting new anlyzers on combustion turbines, OCT NO_X Budget units, and low-range anlyzers added to units with selective catalytic reduction controls, etc. Over 90% of the analyzers use chemiluminescence technology with Thermo Envrionmental, Teledyne/Monitor Labs, and Rosemount representing over 85% of the market. The analyzers are split about evenly between dilution and dry extractive systems.

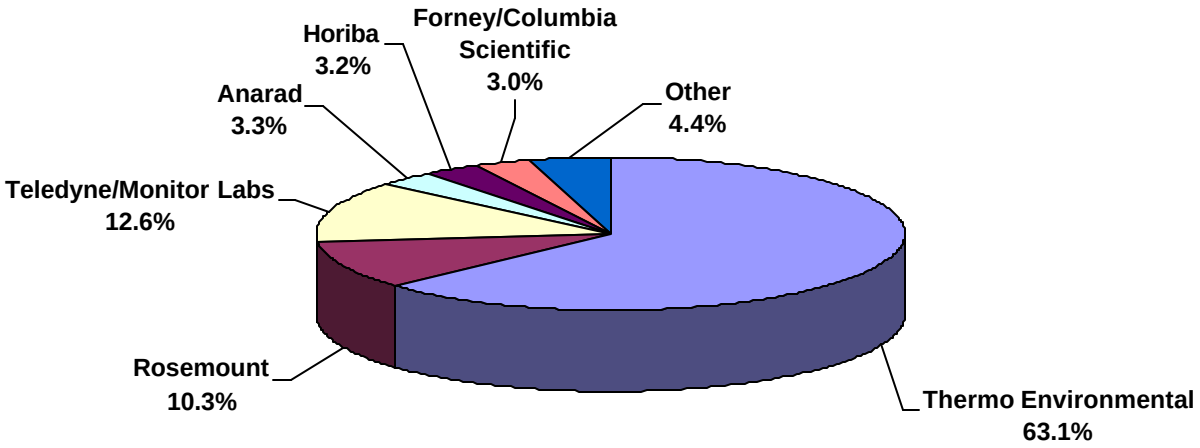

Figure 3a. NO_x Analyzer Manufacturers (2002)

Table 3a. NO_x Analyzer Manufacturers

NO_X Analyzer Manufacturers	1997		2002	
	Analyzers	% of Total	Analyzers	% of Total
Thermo Environmental	941	65.6	1746	63.1
Teledyne/Monitor Labs/API	166	11.6	349	12.6
Rosemount	35	2.4	285	10.3
Anarad	76	5.3	92	3.3
Horiba	34	2.4	88	3.2
Forney/Columbia Scientific	96	6.7	82	3.0
Perkin Elmer MCS-100	31	2.2	29	1.0
Bovar/Western Research/Ametek	20	1.4	20	0.7
ABB Opsis	25	1.7	16	0.6
Altech	-	-	11	0.4
Servomex	-	-	11	0.4
Siemens	6	0.4	8	0.3
ECOPhysics	-	-	8	0.3
Environment SA	-	-	7	0.3
Hartman & Braun	-	-	6	0.2
California Analytical Instruments	-	-	3	0.1
Dasibi	4	0.3	2	0.1
Sick Maihak	-	-	2	0.1
Grand Total	**1434**	**100.0**	**2765**	**100.0**

Table 3b. NO_x Analyzer Sample Acquisition Methods (2002)

Sample Acquisition Method	Totals	% of Total
Dilution	1361	49.2
Dry Extractive	1331	48.2
Wet Extractive	26	0.9
Point/Path InSitu	46	1.7
Grand Total	**2764**	**100.0**

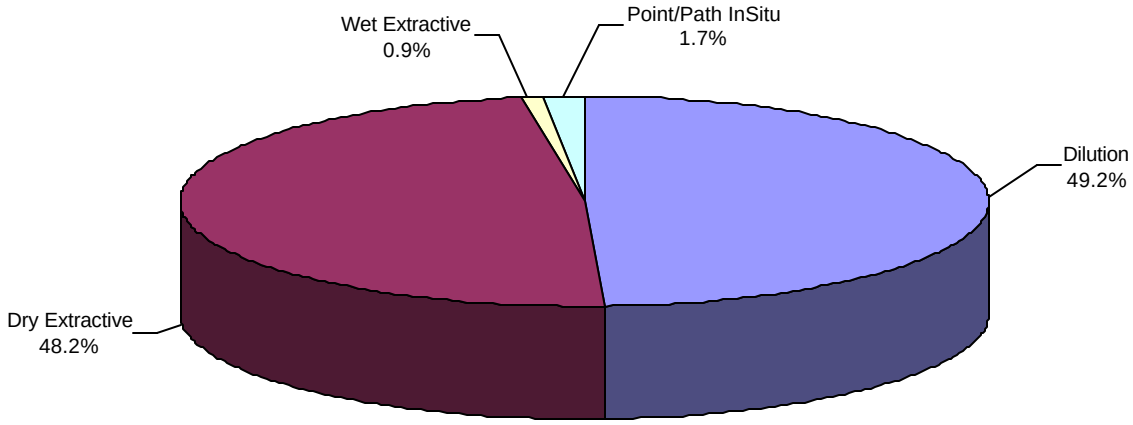

Figure 3b. NO_x Analyzer Sample Acquisition Methods (2002)

CO_2 Analyzers

California Analytical, Thermo Environmental, Siemens, and Teledyne Monitor Labs provide over 90% of the Part 75 CO_2 analyzers. Nearly all the CO_2 analyzers use non-dispersive infrared technology with over 90% in dilution system applications.

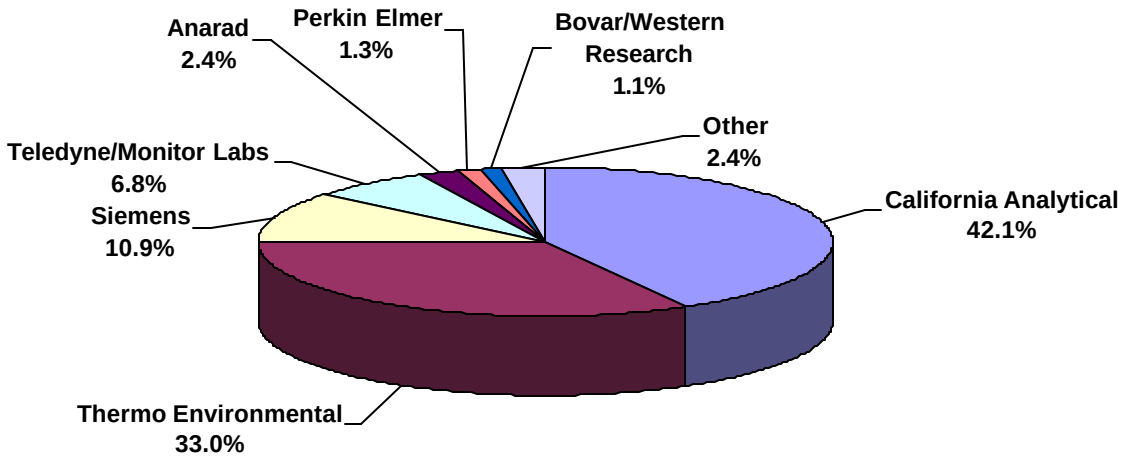

Figure 4a. CO_2 Analyzer Manufacturers (2002)

Table 4a. CO_2 Analyzer Manufacturers

CO_2 Analyzer Manufacturers	1997		2002	
	Analyzers	% of Total	Analyzers	% of Total
California Analytical	578	46.1	623	42.1
Thermo Environmental	388	30.9	488	33.0
Siemens	96	7.7	162	10.9
Teledyne/Monitor Labs	84	6.7	100	6.8
Anarad	36	2.9	36	2.4
Perkin Elmer	26	2.1	19	1.3
Bovar/Western Research/Ametek	16	1.3	17	1.1
ABB Opsis	25	2.0	14	0.9
Environment SA	-	-	9	0.6
Horiba	5	0.4	5	0.3
Altech	-	-	3	0.2
Servomex	-	-	2	0.1
Sick Maihak	-	-	2	0.1
Enviromax	-	-	1	0.1
Grand Total	**1254**	**100.0**	**1481**	**100.0**

Table 4b. CO_2 Analyzers Sample Acquisition Methods (2002)

Sample Acquisition Method	Totals	% of Total
Dilution	1346	90.9
Dry Extractive	89	6.0
Wet Extractive	19	1.3
Point/Path InSitu	27	1.8
Grand Total	**1481**	**100.0**

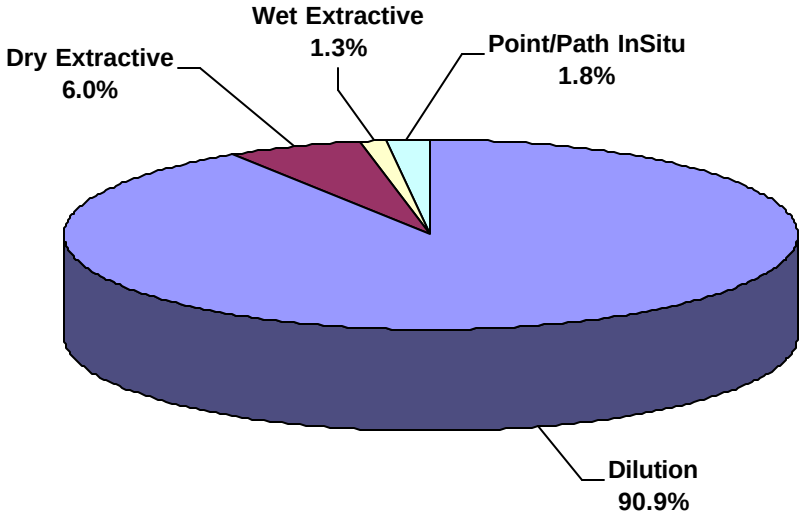

Figure 4b. CO_2 Analyzer Sample Acquisition Methods (2002)

O_2 Analyzers

The number of O_2 analyzers used under Part 75 has greatly increased in the past five years. The largest provider of O_2 analyzers is now Servomex, representing about 40% of the market. Nearly all the analyzers use paramagnetic technology and are used in dry extractive systems although there are some insitu analyzers and a number of wet extractive analyzers used in a differential O_2 configuration to determine stack moisture.

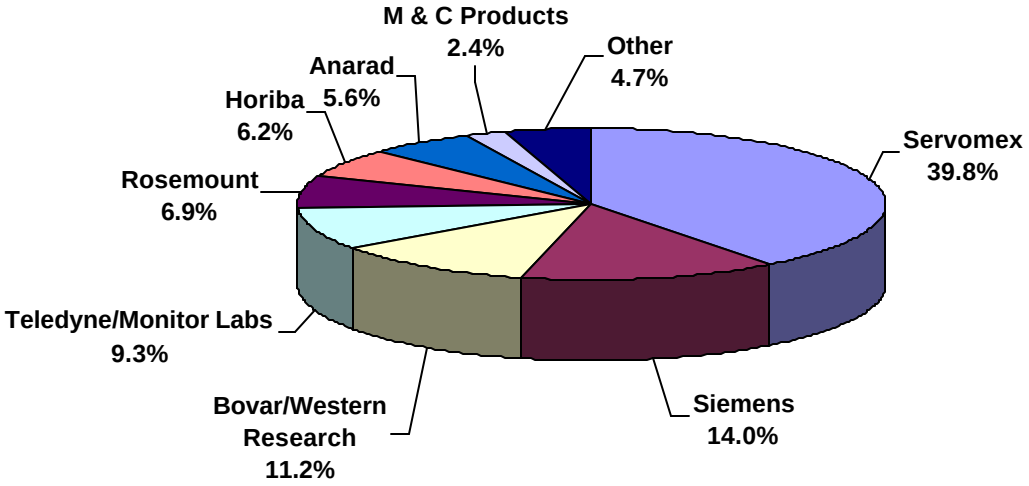

Figure 5a. O_2 Analyzer Manufacturers (2002)

Table 5a. O_2 Analyzer Manufacturers

O_2 Analyzer Manufacturers	1997		2002	
	Analyzers	% of Total	Analyzers	% of Total
Servomex	16	6.3	530	39.8
Siemens	46	18.2	187	14.0
Bovar/Western Research/Ametek	56	22.1	149	11.2
Teledyne/Monitor Labs/API	7	2.8	124	9.3
Rosemount	10	4.0	92	6.9
Horiba	31	12.3	82	6.2
Anarad	75	29.6	75	5.6
M & C Products	-	-	32	2.4
Forney/Columbia Scientific	-	-	12	0.9
Graseby/STI (TEI)	14	5.5	11	0.8
Johnson Yokogawa	9	3.6	11	0.8
Buhler	-	-	6	0.5
Hartman & Braun	-	-	6	0.5
California Analytical Instruments	-	-	4	0.3
Other*	7	1.6	13	0.2
Grand Total	**253**	**100.0**	**1332**	**100.0**

*Westinghouse/Hagen, Litton, Novatech, Datatest, ABB Kent each represent two analyzers. Perkin Elmer, Land, and Dynatron each represent one analyzer.

Table 5b. O_2 Analyzer Sample Acquisition Methods (2002)

Sample Acquisition Method	Totals	% of Total
Dry Extractive	1270	95.3
Wet Extractive	32	2.4
Point/Path InSitu	29	2.2
Unknown	2	0.2
Grand Total	**1333**	**100.0**

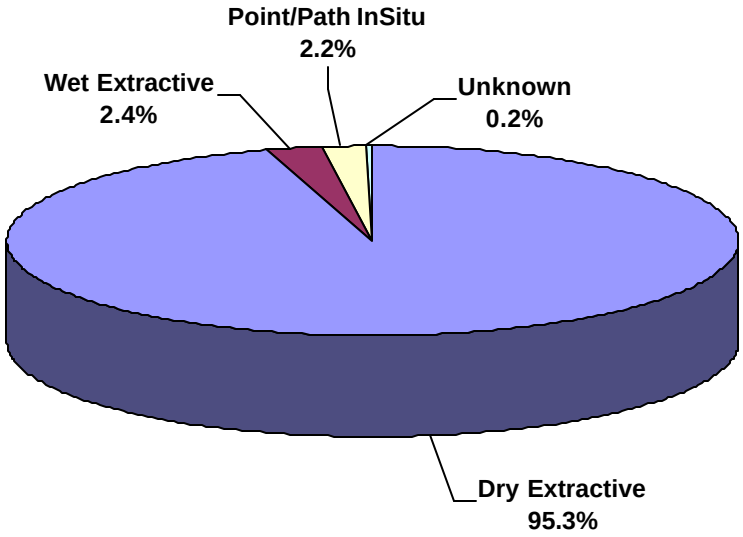

Figure 5b. O_2 Analyzer Sample Acquisition Methods (2002)

Flow Monitors

About two-thirds of the volumetric flow monitors are ultrasonic flowmeters, with differential pressure making up the bulk of the rest of the flow monitors. The largest provider of flowmeters is Teledyne/United Sciences, and EMRC is the priciple provider of differential pressure type flow monitors.

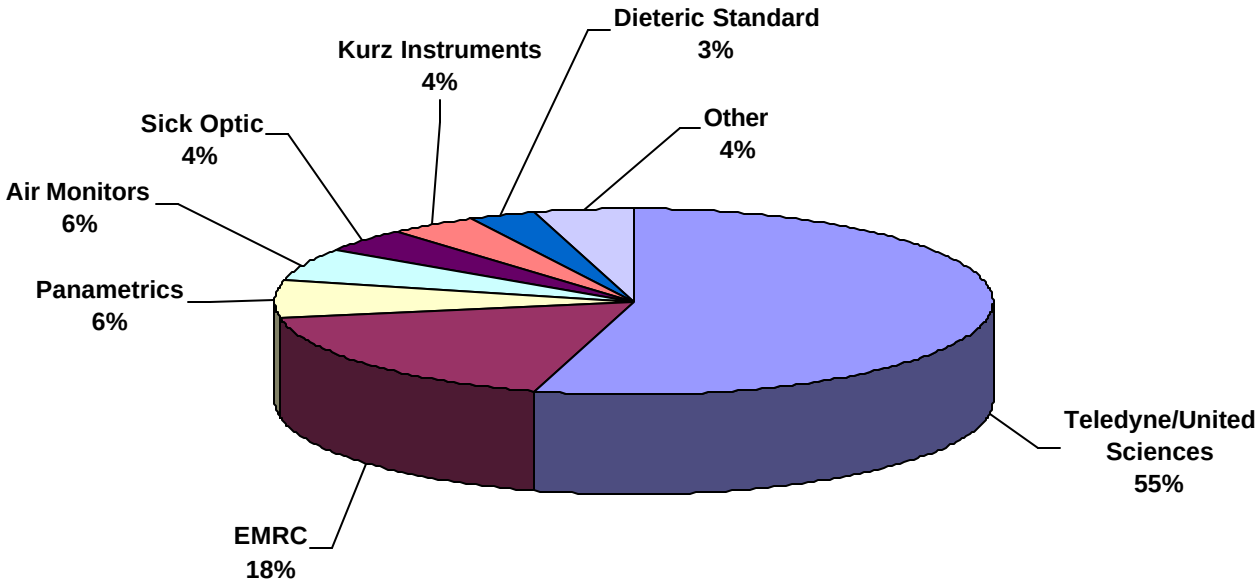

Figure 6a. Flow Monitor Manufacturers (2002)

Table 6a. Flow Rate Monitor Manufacturers

Flow Analyzer Manufacturers	1997		2002	
	Analyzers	% of Total	Analyzers	% of Total
Teledyne/United Sciences	551	52.4	608	54.4
EMRC	167	15.9	199	17.8
Panametrics	70	6.7	71	6.4
Air Monitors	90	8.6	65	5.8
Sick Optic	36	3.4	47	4.2
Kurz Instruments	48	4.6	44	3.9
Dieteric Standard	32	3.0	34	3.0
Scientific Engineering Inc.	21	2.0	21	1.9
Sierra Instruments	34	3.2	16	1.4
Optical Scientific	-	-	7	0.6
Thermo Environmental	2	0.2	5	0.4
Grand Total	**1051**	**100.0**	**1117**	**100.0**

Table 6b. Flow Monitoring Equipment Types (2002)

Flow Monitor Type	Analyzer	% of Total
Ultrasonic	769	67.9
Differential Pressure	312	27.5
Thermal	44	3.9
Other	8	0.7
Grand Total	**1133**	**100**

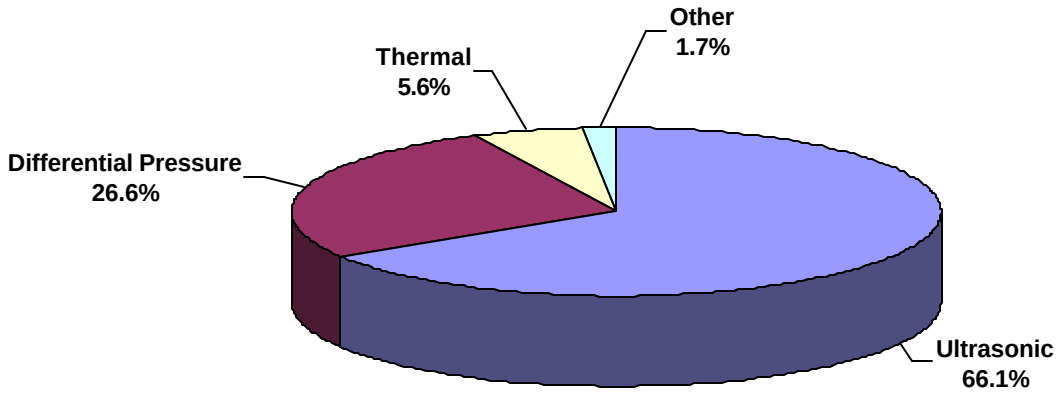

Figure 6b. Flow Monitoring Equipment Types (2002)

Opacity Analyzers

Some of the opacity monitors represented in the EDR database predate the Acid Rain Program. Reflecting the age of the equipment, a significant amount of opacity analyzer replacement has occurred in the past five years. While the market is more fractured than it was in 1997, Teledyne/Monitor Labs still maintains the majority of the analyzers.

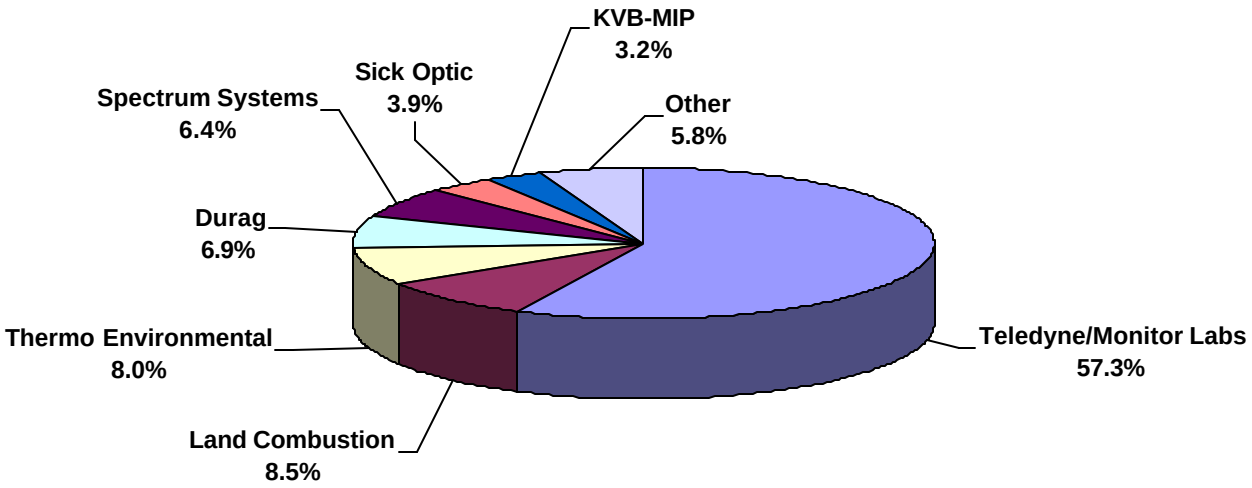

Figure 7b. Opacity Monitors Manufacturers (2002)

Table 7a. Opacity Monitor Manufacturers (2002)

Opacity Analyzer Manufacturers	1997		2002	
	Analyzers	% of Total	Analyzers	% of Total
Teledyne/Monitor Labs	807	75.1	685	57.3
Land Combustion	52	4.8	102	8.5
Thermo Environmental	108	10.1	96	8.0
Durag	71	6.6	82	6.9
Spectrum Systems, In.	4	0.4	76	6.4
Sick Optic	4	0.4	47	3.9
KVB-MIP	1	0.1	38	3.2
Phoenix Instruments, Inc.	-	-	23	1.9
Rosemount	18	1.7	22	1.8
Environmental Monitoring Services	-	-	20	1.7
RAI	-	-	4	0.3
Research Compliance Company	7	0.7	-	-
DataTest	2	0.2	-	-
Grand Total	**1074**	**100.0**	**1195**	**100.0**

Gas Fuel Flow Meters

The distribution of the types of flow meters used to measure gas flow under Appedix D of Part 75 is shown in below. Orifice plate type flow meters are used most frequently (62.3%), followed by turbine (16.9%) and vortex-type (11.0%) meters.

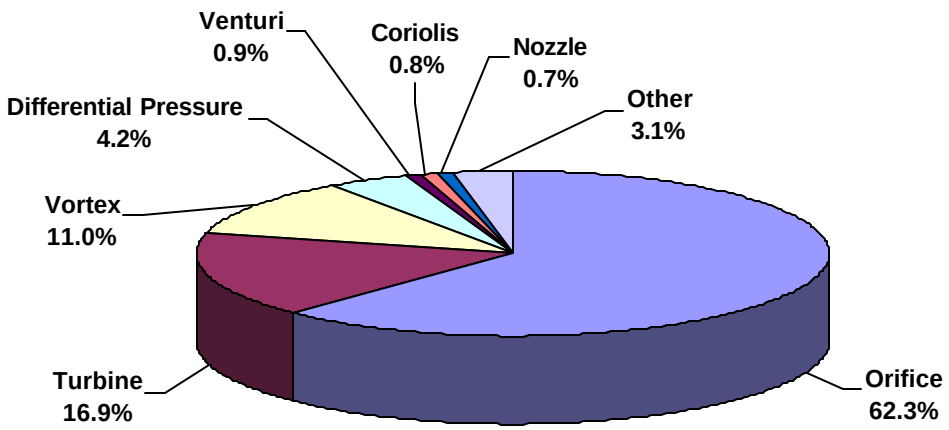

Figure 8. Gas Fuel Flow Meter Types (2002)

Table 8. Gas Fuel Flow Meter Types (2002)

Gas Flow Meter Type	Meters	% of Total
Orifice	1786	62.3
Turbine	485	16.9
Vortex	315	11.0
Differential Pressure	121	4.2
Venturi	26	0.9
Coriolis	24	0.8
Nozzle	21	0.7
Thermal	17	0.6
Ultrasonic	11	0.4
Positive Displacement	6	0.2
Other	54	1.9
Grand Total	**2866**	**100**

Oil Fuel Flow Meters

The distribution of the types of flow meters used to measure oil flow under Appedix D of Part 75 is shown in below. Positive displacement, coriolis, and turbine meters make up over 80% of all meters used.

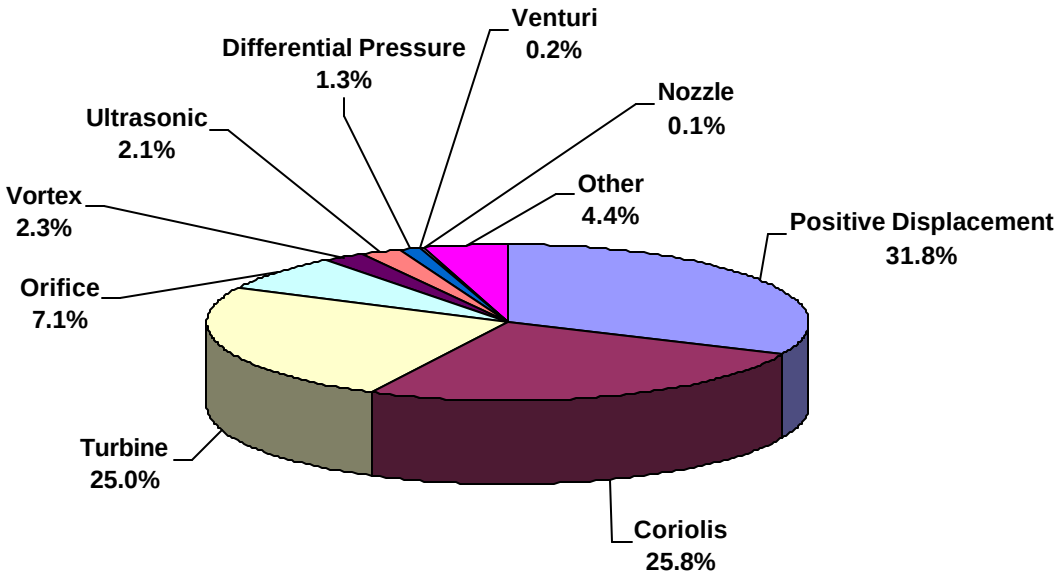

Figure 9. Oil Fuel Flow Meter Types (2002)

Table 9. Oil Fuel Flow Meter Types (2002)

Oil Flow Meter Type	Meters	% of Total
Positive Displacement	601	31.8
Coriolis	489	25.8
Turbine	473	25.0
Orifice	134	7.1
Vortex	43	2.3
Ultrasonic	40	2.1
Differential Pressure	24	1.3
Venturi	4	0.2
Nozzle	1	0.1
Other	83	4.4
Grand Total	**1892**	**100**

Summary

The data generally show only moderate changes since 1997, with the manufacturers who had the "lion's share" of the market typically retaining that position. ESC, GE/KVB-Enertec, and Teledyne/Monitor Labs together represent about two-thirds of the DAHS software market. Thermo Environmental has provided the majority of the SO_2 and NO_X analyzers used under Part 75 (over 70% and 60%, respectively). Most volumetric stack flow monitors installed under the Acid Rain Program have been ultrasonic flow meters with Teledyne/United Sciences providing the majority of this equipment. California Analytical leads in the number of installed CO_2 analyzers, with California Analytical and Thermo Environmental representing over 70% of the market combined.

The number of O_2 analyzers installed in Part 75 service had dramatically increased, and significant changes in the market shares represented by each manufacturer were seen. Servomex has provided the most with about 40% of the market, followed by Siemens (14.0%) and Bovar/Western Research/Ametek (11.2%). Changes were seen in the data reported for opacity monitors, with the market being considerably more fractured although Teledyne/Monitor Labs still represents the majority of installed systems. For fuel flow monitoring under Appendix D, orifice plate type flow meters (62.3%) are used most frequently for gas, followed by turbine (16.9%) and vortex-type (11.0%) meters. For oil, positive displacement, coriolis, and turbine meters together make up over 80% of all meters used.

While there do seem to be some technologies that are being "weeded out" of the market, it should be realized that downward trends market share may not necessarily convey poor analyzer performance, but may reflect marketing choices, analyzer/utility consolidations, or a variety of other factors. Also, again, while the EDR database used is arguably the most accurate source of information for identifying CEMS equipment, the accuracy of the data presented in the report is only as good as the data reported in the EDR files. While the quality of the EDR data has improved in recent years, it is possible there may be missing, outdated, or false information in the database that was not or could not be identified in our evaluation.