Redesign of the 2005 Pollution Abatement Costs and Expenditure Survey

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Working Paper Series

Working Paper # 08-01
January, 2008

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Abstract

The Pollution Abatement Costs and Expenditures (PACE) survey is the only comprehensive source of pollution abatement costs and expenditures related to environmental protection in the manufacturing sector of the United States. The PACE survey was conducted annually from 1973 to 1994, with the exception of 1987. The PACE survey was reinstituted again in 2000 to collect pollution abatement cost data for reference year 1999. The survey has not been administered since 2000 in order for the EPA to evaluate the accuracy of the survey responses. To accomplish this, the EPA engaged in an evaluation process which took approximately a year-and-a-half and included two major phases. The first phase involved working with an expert panel and one-on-one interviews with facilities and trade associations to develop the 2004 PACE survey and guidance document. The second phase of the project included a pretest and pilot test of the 2004 PACE survey and guidance document. This paper will present the results of the pretest, including findings from an independent engineering cost assessment, and discuss how feedback obtained during the site visits shaped the 2005 PACE survey and guidelines.

Keywords: survey design, survey evaluation, environmental costs, manufacturing, engineering estimates

Subject Matter Classification: Costs of Pollution Control

The opinions and conclusions expressed are those of the authors and not the U.S. Environmental Protection Agency. The authors wish to thank Brian Murray, Rebecca Nicholson, and Martin Ross from RTI; Bill Moody and Gayle Klein from ICF Consulting; Kelly Maguire from EPA; Randy Becker from Center for Economic Studies; Wayne Gray from Clark University; Kerry Smith from Arizona State University; and Arik Levinson from Georgetown University. Senior authorship is shared.

Introduction

The Pollution Abatement Costs and Expenditures (PACE) survey is the only comprehensive source of pollution abatement costs and expenditures related to environmental protection in the manufacturing sector of the United States. Pollution abatement costs and expenditures include installation or retrofit of capital equipment, annual operating costs, and certain other environmentally-related expenses. The PACE survey collects facility-level data on pollution abatement capital expenditures and operating costs associated with compliance with local, state, and federal regulations and voluntary or market-driven pollution abatement activities.[1] The PACE data are used by the Environmental Protection Agency (EPA) to estimate the costs of their regulations.[2] Furthermore, the data are also used by trade associations, manufacturers, marketing and research companies, university researchers, financial and environmental institutions, other federal agencies, state and local governments, and environmental reporters. In particular, trade associations use the PACE data to track the costs of complying with environmental regulations to their members, while university researchers use the data to examine the impact of regulations on important economic variables such as international competitiveness, productivity, and job growth in the manufacturing sector.

The PACE survey is designed to capture expenditures whose *primary purpose* is environmental protection. Investments or activities that increase profits or efficiency in the absence of environmental considerations should not be included, even if pollution abatement occurs as a side benefit. Furthermore, only incremental costs of pollution

[1]Because cost data are collected at the facility level, costs incurred at the corporate level (such as research and development) are not included in the survey unless they are billed directly to the facility.

[2] EPA has used PACE data in the 1990 Cost of Clean Environment, Annual Office of Management and Budget Reports to Congress on Costs and Benefits of Federal Regulation (Thompson Report), and Section 812 Clean Air Retrospective Cost Analysis.

abatement are intended to be captured by the PACE survey. These incremental costs are the additional costs associated with the *environmental portion* of an investment project that is part of a larger investment project or of annual operating and maintenance costs such as the time a lab technician spends analyzing samples of wastewater.

The PACE survey disaggregates pollution abatement capital expenditures and operating costs into four activity categories: treatment, recycling, disposal, and pollution prevention, and by three types of media: air emissions, water discharges, and solid waste. Total pollution abatement operating cost are separated into five cost categories: 1) salaries, wages, and benefits, 2) energy costs, 3) materials and supplies, 4) contract work, leasing and other purchased services; and 5) depreciation. The survey also collects information on the costs of permits and fees, site cleanup, product redesign or reformulation, as well as cost offsets and gross book value of pollution abatement capital assets.

The PACE survey was conducted annually between 1973 and 1994, with the exception of 1987, when no survey was conducted.[3] After a 5-year lapse due to budgetary reasons, the PACE survey was reinstituted in 2000 to collect data for reference year 1999.[4] The survey has not been administered since 2000 in order to evaluate the accuracy of the survey responses. To do this, the EPA engaged in an evaluation process which took approximately a year-and-a-half and included two major phases.

[3]The microdata for 1983 is missing. However, the aggregate data for this year is available in PACE publications.

[4] The 1999 PACE survey is considerably different from the preceding surveys. For example, the 1999 PACE survey did not preserve the longitudinal consistency of the data making comparisons with past PACE surveys extremely difficult. For a comprehensive comparison of the 1994 and 1999 PACE surveys see Becker and Shadbegian (2005). For more background on previous PACE surveys see Streitwieser (2005) and Ross et al (2004).

The first phase included three activities: 1) an expert panel and an EPA workgroup provided comments and feedback on the first draft of the PACE survey[5,6], 2) four on-site interviews were conducted with facilities to gain insights into the types of environmental cost information they track that may be used to calculate the costs associated with pollution abatement, and 3) nine one-on-one interviews were conducted with facilities and industry trade associations to obtain comments on the second draft of the PACE survey. The feedback obtained from the first phase was used to develop the 2004 PACE survey and guidance document. The second phase of the project included a pretest and pilot test of the 2004 PACE survey and guidance document. Eighteen facilities participated in the pretest conducted by RTI International (under subcontract to ICF Consulting) while approximately 2,000 facilities received the pilot survey conducted by the U.S. Census Bureau. The final product of this evaluation effort was the 2005 PACE Survey and Guidelines. This paper will focus on the results of the pretest, including an independent engineering cost assessment, and discuss how the feedback obtained during the site visits shaped the 2005 PACE survey instrument and guidelines.

Accuracy of the PACE Survey

Data from the PACE survey have been used to analyze a wide variety of policy questions, ranging from the overall costs of environmental regulations to how these costs influence economic activities such as international competitiveness, facility location

[5] A hybrid of the 1994 and 1999 PACE survey was used as a starting point in the first phase. Changes were made to this draft based on recommendations from the expert panel and information garnered during the on-site visits.

[6] A panel of four experts – two economists, a survey design expert, and an environmental engineer - was convened at the beginning of the project to provide reviews and advice on all aspects of survey instrument and guidance document development, including data collection and analysis of the pretest and pilot data.

decisions, investment and labor demand, and economic efficiency. Previous use of the PACE data by government agencies and academic researchers has led to a number of concerns with respect to the PACE data and the survey instrument. For a variety of reasons, the PACE survey may not capture all pollution-related costs such as costs due to the facility's cost accounting structure and changes in productivity (Jorgenson and Wilcoxen, 1990; Levinson, 1996; Boyd and McClelland, 1999; Becker and Henderson, 2001; Joshi, Krishnan, and Lave, 2001; Gray and Shadbegian, 1998, 2002, 2003; Shadbegian and Gray, 2005). Therefore, PACE will tend to underestimate the true costs of pollution abatement. On the other hand, researchers including Berman and Bui (2001) and Morgenstern et al (2001) have found that the PACE survey estimates may overstate the "true" costs of pollution abatement.

The contradictory findings on whether the survey data under- or overestimate pollution abatement costs can be found throughout the literature. One of the main reasons for this debate lies in the difficulty of accurately estimating pollution prevention costs. Some argue that these costs are underestimated because of the exclusion of activities that include some aspect of pollution abatement but are not conducted with the primary purpose of protecting the environment. This issue is more prominent in pollution prevention activities than in treatment activities; pollution prevention activities tend to be part of a larger project, while pollution treatment activities tend to occur at the end of the production process and are therefore more likely to be captured by the PACE survey. Others suggest that even though pollution prevention activities meet environmental objectives, in many instances they result in some increase in profitability because of more efficient process techniques—implying that these expenditures should not be included,

and hence, costs are overestimated. This argument underscores the need for more detailed and accurate data on pollution prevention.

Phase I: On-site Visits

The purpose of the four on-site visits was threefold: (1) to collect firsthand information regarding how facility representatives track capital and operating costs associated with compliance with environmental regulations; (2) to determine the availability and usefulness of these data for responding to the PACE survey; and (3) to solicit comments regarding the format, content, and clarity of the 1994 and 1999 versions of the PACE survey instruments. One facility from the pulp and paper, iron and steel, petroleum, and electric utility industries was visited by an engineer and economist from RTI during March and April 2004. Facilities in these industries were targeted because historically, they represent four of the top five industries in terms of aggregate pollution abatement expenditures.[7] Participants from the facilities included environmental managers, directors of environmental affairs, environmental committee/department staff, process and project engineers, accounting or finance analysts, and others who help calculate the costs associated with pollution abatement at the facility or corporate level. The participants discussed the process by which they collect, record, and track pollution abatement operating costs and capital expenditures data that are used to complete the PACE survey. The feedback provided during the on-site interviews was used to develop a preliminary version of the PACE survey and guidelines document.

[7]The chemical industry has the largest pollution abatement expenditures. However, this industry was viewed as too diverse to be included as a targeted industry for a site visit.

The version of the survey and guidelines document developed after these four visits was then discussed in nine one-on-one interviews with representatives from trade associations and facilities in the same four industries. Participants from the trade associations and facilities included accountants, engineers, statisticians, economists, and environmental managers along with representatives from departments responsible for compliance and testing and air and water quality. The purpose of these nine interviews was to obtain feedback on the new survey and guidelines document, and determine how facilities measure and track pollution abatement capital expenditures and operating costs.

Phase I: Issues and Recommendations

The PACE survey asks facilities to report pollution abatement capital expenditures section by the four activity categories: treatment, recycling, disposal, and pollution prevention. During the on-site visits, facilities indicated that they could separate capital expenditures into these categories, and that these categories help facilities catalog expenditures related to pollution abatement. These four activity categories are summed to obtain total pollution abatement capital expenditures.

Total pollution abatement operating costs are divided into four categories: 1) salaries and wages, 2) fuels, electricity and other utilities and energy costs, 3) materials and supplies; and 4) contract work, leasing and other purchased services.[8] During the preliminary on-site visits, facilities indicated that they were most likely to track operating costs by these categories. Total pollution abatement operating costs are the sum of these four cost categories.

[8] At this point in the redevelopment process, depreciation was treated as a separate item on the survey and not part of operating costs as it was historically.

Facilities indicated that they do not track operating costs by pollution media (air, water and solid waste), but that they had a reasonable idea as to what fraction of their pollution abatement operating costs were devoted to each media. As a result, facilities are first asked to report total pollution abatement operating costs and then are asked to disaggregate the *total* by media by providing an estimate of the percentage of total pollution abatement operating costs accounted for by each type of media.

All of the facilities visited expressed some difficulty in calculating pollution abatement operating costs, especially those associated with air emissions, because many of the pollution prevention systems, such as air handling, are integrated with normal operating activities. Several facilities suggested the survey ask about environmental controls (number and/or capacity) because this information helps facilities identify controls and calculate operating costs associated with air emissions. As suggested, a list of air pollution control devices operating and newly installed at the facility was included on the survey. Facilities indicated they had little trouble completing this section.

In the 1999 and 2004 PACE survey, disposal and recycling are reported in separate categories, whereas in previous versions of the PACE survey they are combined. During the on-site visits, facilities all said they have increased their recycling activities over time and try to track this information separately. However, the difference between recycling and disposal was not always clear to facilities. For example, facilities frequently pay disposal fees to contractors that remove waste of which part is then recycled. Examples were added to the *Guidelines and Definition* document to help make the distinction between recycling and disposal.

Facilities expressed some confusion about what costs should be included as part of pollution prevention activities especially related to projects that were not undertaken exclusively for environmental reasons, but had an environmental component. For example, many routine equipment upgrades lead to more efficient use of energy and consequently, less pollution. Explicit instructions are provided on the survey and guidance document for facilities to report only the incremental costs related to the pollution abatement, and not the total cost of the project. Additionally, examples of how to estimate incremental costs for pollution abatement capital expenditures and pollution abatement operating costs are provided in the guidance document.

During the site visits, facilities questioned where on the survey form they should report labor costs related to completing forms for permits. Labor costs and contract work associated with permits should be included as part of salaries and wages. However, some facilities included labor costs as part of payments to government for permits and fees. Therefore, explicit instructions were provided that *all* labor and administrative costs related to permits should be included as part of salaries and wages in pollution abatement operating costs. The instructions also indicate that permit costs (one- time or annual) should not be included as part of pollution abatement capital expenditures. Annual or one-time permit charges and fees should be reported as part of total payments to government entities for permits and fees related to pollution abatement.

Product redesign includes capital expenditures and operating costs of product reformulation intended to reduce the pollution generated by consumers or users of products manufactured at the facility. Although these costs are not related to pollution generated at the facility, and therefore are not in the scope of the PACE survey, they can

represent a large part of the cost of regulatory compliance for certain industries. Some of the participants in the one-on-one interviews, particularly those in the petroleum industry, requested the inclusion of this question. Refineries cited large capital expenditures for desulferization equipment to support regulations that are phasing in low-sulfur gasoline requirements. Since EPA and Census felt that facilities would report these cost incorrectly elsewhere on the form if this question was not included, it was decided to keep the question on the survey to avoid potential misreporting.[9]

Phase 2: Pretest of the 2004 PACE Survey

The comments from the one-on-one interviews, the expert panel, and the EPA workgroup gathered during phase 1 were used to draft the 2004 pretest PACE survey and guidance document. The pretest targeted facilities from the largest polluting industries but also included facilities from lesser polluting industries, based on previous PACE expenditures. The eighteen facilities that were recruited to participate in the pretest were sent a copy of the survey form and the *Guidelines and Definitions* document and were instructed to complete and return the survey form within four weeks (see the Appendix for a copy of the 2004 PACE pretest survey and the *Guidelines and Definitions* document).

As part of the pretest, an economist and engineer from RTI visited each facility to evaluate the results provided on the survey instrument and obtain feedback on both the survey instrument and guidance document. The visit also included a walk-through of the facility with facility representatives to identify pollution abatement techniques in

[9] On the pilot survey conducted by U.S. Census Bureau 75% of petroleum refineries reported capital expenditures for product redesign.

operation that RTI would later use to develop independent cost estimates. Based on the information garnered from the on-site visits, changes were made to the survey and guidance document with the intent of increasing the accuracy and reliability of the estimates of pollution abatement capital expenditures and operating costs in any future, full-scale implementation of the PACE survey.[10] The results of the pretest are presented in the next sections.

Pretest of the PACE Survey and Guidelines

The pretest of the PACE survey was conducted during the summer of 2005 collecting information on pollution abatement operating costs and capital expenditures incurred in 2004. Eighteen facilities participated in the pretest of the PACE survey. The industry sectors represented by these facilities include chemical, computer and electrical equipment, electric utility, fabrication metal, iron and steel, pulp and paper, furniture, plastics and petroleum. The petroleum sector is included under the "other" category because of confidentiality issues. Table 1 lists the industry sectors, along with average employment and value of shipments at the facilities in each industry sector. The industry sectors were selected to be representative of high and medium emission sources, and both large and medium-size facilities were included. Facilities ranged in size from 115 to

[10] In addition to the pretest of the draft survey instrument and *Guidelines and Definitions* document, the process of finalizing the 2005 PACE survey also included a pilot survey. The pilot survey was a mandatory survey administered by the U.S. Census Bureau to a sample of approximately 2000 manufacturing facilities. The goal of the pilot survey was to determine if there were any systematic problems with the survey content and any issues with the ability of facilities to respond to the survey. Given this objective, the pilot sample targeted facilities that were deemed to have significant levels of pollution abatement activity. Hard copies of the survey were mailed to facilities and asked to be returned within 30 days. The response rate from the pilot survey was approximately 65%. Findings from the pilot test were discussed at the expert panel meetings, and recommendations were incorporated into the 2005 PACE survey and guidance document. For a description of the pilot survey see Becker and Shadbegian (2007).

2,700 employees, with value of shipments ranging from approximately $20 million to $6.2 billion.

As shown in Table 2, fourteen of the facilities reported capital expenditures of less than $1 million, with six of the facilities reporting no capital expenditures in 2004. Due to the infrequent nature of capital expenditures (at the facility level) this pattern is not unexpected. Average capital expenditures were greatest for the electric utilities. These facilities reported capital expenditures of approximately $50 million for the installation of new selective catalytic reduction (SCR) systems. These were correctly classified as "treatment" and hence dominated all other pollution abatement activity categories.

Pollution abatement operating costs were relatively evenly distributed across the cost categories (see Table 3). Salaries and wages account for the largest share at 31 percent. The iron and steel sector reported the largest operating costs, followed by the electric utility and paper sectors.

Follow-Up Visits

After each facility returned their completed pretest PACE survey form, RTI staff conducted an on-site visit to discuss their responses and tour the facility. RTI asked about the tracking and accounting systems the facility used to obtain cost data and the processes used to distinguish between environmental and non-environmental costs. RTI also asked about the types of abatement equipment and activities used to develop the cost estimates reported in the survey. RTI used this information to develop their own pollution abatement operating cost and capital expenditure estimates which are then

compared to the costs reported by the facility on the PACE survey.[11] In the next sections we discuss the feedback provided by facilities on the survey instrument and guidance document during the pretest. In the last section we present the independent cost estimates and then discuss how these estimates compare to the values reported by facilities.

Completing the Survey

Researchers have expressed concerns that facilities may have an incentive to overstate pollution abatement costs and expenditures. However, the interviews with facilities indicated no evidence of such behavior.[12] In many instances, respondents had questions about what should and should not be included in certain items, such as air handling units or non-hazardous waste disposal. However, there was no evidence that respondents were trying to bias the results. In fact, in several instances facilities appeared to be conservative by not including some costs, such as air permit costs (which should have been included) where no pollution abatement was involved, leading to an understatement and not an overstatement of pollution abatement costs.

Most facilities obtained cost information directly from the company's main accounting system and this information, coupled with the professional judgment of the environmental manager, was used to complete the survey.[13] Even though no facility

[11] Although the limited sample size does not allow for drawing statistical inferences, the comparisons do provide insights into the reasonableness and consistency of pollution abatement costs reported by facilities. This is the first time in the history of PACE that this type exercise has been done.

[12] However, this could be the result of self-selection bias. Since these facilities volunteered to participate, they may be facilities who in general spend more time trying to provide accurate estimates.

[13] From the site visits RTI learned that many industries are already collecting some form of pollution abatement cost data which was often motivated by other industry surveys administered by trade associations. For example, some facilities in the pulp and paper industry had developed an internal tracking process to estimate environmental costs in response to periodic cost surveys distributed by the American Forest and Paper Association (AF&PA).

visited had a system dedicated to tracking environmental costs, several flagged capital projects and operating costs as environmental expenses.

Capital expenditures, as opposed to operating costs, were more likely to be tracked by accounting systems. Capital projects for environmental purposes are simpler to identify because each entry is frequently coded to identify the purpose of the expenditure (e.g., environmental, process maintenance, quality improvement). However, when capital equipment is temporarily shut down to perform an environmental project, facilities may perform other types of maintenance, and these additional non-environmental costs can be difficult to isolate.

Accounting systems typically track all purchases, labor costs, utility costs, and contracting costs. In most cases, there is no separate account of environmental costs; however, all environmental managers stated that they could identify the environmental portions from the details in the accounting system. For example, associated pollution abatement operating costs were determined using equipment utility requirements, solvent recovery data and costs, and estimated labor hours for all environmental staff (including technicians and operators running the solvent recovery center).

Assessment of *Guidelines and Definitions* Document

Item 9 of the pretest survey included three questions related to the *Guidelines and Definitions* document that accompanied the survey. These questions were designed to determine if respondents used the *Guidelines and Definitions* document and if they found the document and examples adequate useful. The item also included four "quiz" questions designed to test a respondents understanding of pollution prevention versus

pollution treatment. These questions presented example projects and respondents were asked to classify the project as either pollution treatment, pollution prevention, or not to be included because the primary motivation was not pollution abatement.

All of the facilities indicated that they used the *Guidelines and Definitions* document while completing the survey (Item 9A). Eight-two percent reported that the document and the instructions include on the survey form were sufficient to complete the survey (Item 9B) and 88 percent responded that the illustrative examples on pages 13 through 15 were useful (Item 9C). Overall facilities answered 88 percent of the "quiz" questions correctly, indicating a basic understanding of the key underlying definitions. Ninety-two percent answered Item 9D (treatment) correctly, 82 percent answered Item 9E (not included) correctly, and 88 percent answered Item 9E (pollution prevention) correctly.

Although all respondents had suggestions for improvements to the *Guidelines and Definitions* document, most of them thought the instructions were straightforward. They were generally in favor of adding additional examples to help clarify the definitions. They also indicated that examples that were related to unique activities conducted at their facility would be useful.

Many facilities had questions about which costs should be included as pollution prevention and how to interpret definitions of pollution abatement activities (such as recycling versus disposal). In general, individuals who had been involved in completing the survey in prior years had much less trouble understanding the definitions (about one third of respondents had completed a previous PACE survey).

The concept of an investment or activity being motivated by profit rather than pollution abatement was straightforward for most facilities. However, frequently an investment generated co-benefits (increased efficiency as well as decreased emissions), and because investment decisions were typically made at corporate headquarters, respondents sometimes had difficulty assessing the motivation of the investment.

Facilities were familiar with the concept of incremental costs associated with pollution abatement. Several facilities indicated that they purchased low-sulfur fuels, and in these instances they used the price difference between the high-sulfur and low-sulfur fuels to calculate costs reported on the survey. Difficulties in identifying incremental costs typically did not arise from a lack of understanding of the concept, but because, in many instances, equipment or fuel upgrades also resulted in increases in production efficiency. For example, a manufacturing facility indicated that it had recently upgraded its coating spray guns, but it was not sure if the motivation for the investment was to lower material coating costs because of the improved accuracy of the guns or to reduce VOC emissions by using less coating. Therefore, this facility was unsure whether to include the costs of upgrading its coating spray guns as pollution abatement expense.

The distinction between recycling and disposal was an area of confusion. Much of what solid waste facilities dispose of is recycled prior to being placed in a landfill. For example, metals are recovered from baghouse dust and slag is recovered in the iron and steel industry after they leave the facility. The facility pays a reduced disposal fee but typically does not receive revenues (offsets) from materials recovered.

Assessment of Item Survey Responses

Item 1: Facility Information. Certain non-pollution abatement questions are asked to enable the Census Bureau to analyze the quality of the PACE responses and in most cases these questions proved to be very straightforward. For example, in most cases, the number of full-time equivalent (FTE) employees was obtained directly from the company's human resource records. However, in a few cases, the facility was unsure how to determine "production" workers versus "all other employees" and guessed at the division between the two categories. Respondents found it difficult to indicate the production capacity "units" in Part 1D. Many facilities did not know what units to use, and the units provided by the facility in the "other" category varied greatly. Because of the difficulty facilities had in identifying consistent "units," the capacity question was dropped from the 2005 PACE survey.

To keep reporting burden to a minimum the questions on FTEs and production capacity were replaced with their Annual Survey of Manufactures (ASM) counterparts on the 2005 PACE survey: total employment and total value of shipments. However, not all facilities were required to report these values - facilities in the concurrent ASM were exempt from reporting total employment and total value of shipments. Because of the infrequent nature of capital investment, all facilities are asked to report total capital expenditures on the 2005 PACE survey. Facilities are also asked to report their total ASM capital investment.

Item 2: Pollution Abatement Activities. Facilities generally had no trouble indicating the number of air pollution control devices (APCDs) operating or newly installed (Item 2A). Most facilities indicated they liked the question and thought that it should remain on the

survey. Based on comments by facilities, several new devices, such as Continuous Emissions Monitoring Systems and Non-Venturi wet scrubbers, were added to the list.

In Item 2B, there was some confusion about whether the annual quantity of waste water treated and discharged water should be additive. Some facilities said that all treated wastewater is discharged (hence the values are the same). Other facilities treat and reuse wastewater, re-circulating it many times a day in closed loop systems and have no discharge. In most instances, the facilities interpreted and answered the question correctly. However, because of the confusion, the 2005 PACE survey asked facilities to report the quantity treated "on-site" and treated "off-site" and additional examples were included in the Guidelines.

The annual quantity of solid waste treated or disposed of was the most difficult question in Item 2 to answer (Item 2Cd). One issue cited by several facilities is that there is no place to enter disposal, treatment, or recycling of solvents or sludge. This caused problems for several facilities because waste solvents and sludge are classified as solid waste under the Toxic Release Inventory (TRI). In the 2005 PACE survey, facilities were asked to report the quantity of solid waste treated "on-site", disposed of "on-site", and disposed of "off-site" and additional examples were included in the Guidelines.

Item 3: Capital Expenditures. In general, facilities track actual capital expenditures and most said they could easily identify which investment projects included an environmental component. The large majority of the reported capital expenditures were associated with relatively few treatment projects. These included installation of new selective catalytic reduction (SCR) systems on boiler units. Many of these larger capital intensive projects were multiyear projects, and expenditures were partitioned over several years.

Even though recycling, disposal, and pollution prevention represented significantly less capital expenditures, they were spread over a larger number of (smaller) projects. Disposal projects included holding ponds (such as ash retention) and storm water retention ponds along with associated pumping stations. Pollution prevention typically included capital projects for spill prevention and containment. In one instance, an underground storage tank (which was not leaking) was removed as a preventative measure and replaced with an above-ground storage tank.

Allocating capital expenditures by pollution media was relatively simple for all of the facilities. Capital projects are typically associated with a single media (air, water, or solid waste) and are easily partitioned. Most projects were related to air emissions. It is unclear if facilities fully understood the category "multimedia pollutants." Only three facilities reported a percentage for this category: one facility reported that 100 percent of their total capital expenditures were spent for multimedia pollutants while two facilities reported less than one percent was spent on multimedia pollutants. Because it appeared facilities had trouble with the concept of multimedia pollutants, this option was dropped from Item 3C on the 2005 PACE survey.

The percentage of total capital expenditures spent for hazardous pollutants was difficult for most facilities to estimate. In several instances, the facility decided to count 100 percent of the cost of the project to bring the facility into compliance with EPA regulations as "hazardous" because the goal of most regulations is to achieve reductions in hazardous pollutants (even though both hazardous and non-hazardous are emitted from the facility). Other facilities said that their estimate of the percentage of total capital expenditures spent on hazardous pollutants was a rough estimate, and some openly stated that it was simply a guess. Therefore, this item was dropped from the 2005 PACE survey.

Item 4: Operating Costs. The operating costs of pollution abatement were the most difficult items for facilities to estimate. Frequently, pollution abatement operating costs are not tracked separately - they are included as part of the overall business expenses.

The reported value for salaries and wages was typically based on the number of environmental managers, and hourly labor associated with operation and maintenance (O&M) of pollution abatement equipment was added to this value. The salaries and hourly wages used in the cost calculations were generally obtained from the facilities' accounting or human resources systems and in most cases, represented fully compensated wages (loaded with benefits).[14]

However, sporadic O&M activities were frequently not captured in the hourly labor estimates. For example, one facility did not include labor activities associated with the operation of a wastewater treatment system or cumulative hourly labor for work orders issued for environmental equipment maintenance. Furthermore, in some cases, the

[14] In past PACE surveys facilities were asked to report salaries and wages without benefits. However, the expert panel believed that salaries and wages loaded with benefits is the correct measure of labor costs and that researchers, who need longitudinally consistent data, could make the appropriate adjustments to the data without too much difficulty.

environmental manager filling out the survey was not sure if benefits had been included. As a result, reported salaries and wages are likely to be slightly understated due to the misreporting of labor costs for small or infrequent environmental activities and some wage rates not being loaded with benefits to account for full compensation. In an effort to mitigate this reporting problem, several examples were added to the *Guidelines and Definitions* document to provide guidance to facilities on how to estimate environmentally-related salary and wages.

For fuels, electricity, and other utilities and energy costs, several facilities stated that they were not able to include all electricity costs associated with pollution abatement activities because they are spread across many different electricity meters. The facilities indicated that it would be difficult and time-consuming to determine all estimates of energy usage for pollution abatement, especially at large facilities. In these cases, facilities omitted some costs as opposed to providing a rough estimate. For example, one facility indicated that they omitted the cost of electricity to operate fans and blowers in exhaust streams and the cost of electricity to operate centralized refrigeration units because they are difficult to estimate. Ironically, electric utilities accounted for the largest share of omitted electricity costs. Neither of the two electric utilities that participated in the pretest reported any electricity cost associated with pollution abatement (one facility reported $100,000 for fuel oil, which was determined should not have been included in PACE). The utilities indicated that even though 1 to 5 percent of total electricity generation at the facility is used to power pollution abatement equipment (primarily for flue gas desulphurization), they have no way of measuring this energy

usage. RTI estimated that annual energy costs at these facilities ranged from $5 to $20 million.

Determining the share of the energy costs associated with air-handling systems used for pollution abatement was confusing for many facilities. Some facilities said that they removed fumes and dust particles primarily for worker safety so they would be using their air-handling systems even if they did not have a baghouse. However, some facilities included all the horsepower required to pull the air into and through the baghouse in their estimate of energy costs. For facilities with large baghouses positioned hundreds of feet from the facility, the issue is clearer—motors that move air out of the facility are not related to pollution abatement - but the motors that pull the air in to and through the baghouse are associated with pollution abatement. However, for smaller manufacturing operations where the baghouses are attached or adjacent to the building, a single power source moves the air out of the facility and through the baghouse. Some of these smaller facilities included all energy costs associated with their air-handling systems, while others did not include any of the energy costs of their air-handling system.

Based on the on-site interviews, facilities are more likely to exclude energy costs since these units are not metered separately. When facilities did provide an estimate for energy costs, they typically determined this estimate using a spreadsheet that listed all motors, horsepower (hp), size, etc., and then summed up the electricity requirements' in total megawatt hours. Getting the electricity requirement information for pollution abatement equipment is not difficult, but it does take some time and effort. Examples of how to estimate electricity costs based on number of motors, total horsepower, or best judgment when this type of information is not available were provided in the Guidelines.

Facilities stated that it is relatively straightforward to track costs of materials and supplies. These costs are tracked by an accounting system and are easy to identify (e.g., chemicals used to treat wastewater are usually only associated with wastewater treatment). However, several facilities indicated that they may have missed some of the smaller costs for materials and supplies because they indicated these costs are minimal and not worth the effort of determining.

Contract costs are readily tracked and tend to be dominated by costs associated with solid waste management (e.g., sludge handling, operation of on-site landfill, and dredging of ash ponds). However, determining which contract maintenance costs to include or exclude from contract work is difficult and the decision was typically a judgment call made by the environmental manager. If contract maintenance work is included as a lump sum without extracting all the non-environmental costs, then data could be biased slightly high. For example, for some smaller facilities, all waste was typically combined (e.g., manufacturing, cafeteria, office) and disposed of under a single contract.

Most facilities were able to determine the percentage of total operating costs spent for each pollution abatement activity category. However, there were some issues related to distinguishing between pollution treatment and pollution prevention and between recycling and disposal. In particular, two facilities indicated that "treatment" typically included some type of a chemical process. This narrower definition of treatment led to confusion and the inappropriate classification of some operating costs as pollution prevention by these facilities. Specifically, they did not think the baghouses fit the definition of treatment because they are simply capturing and removing particles from the

air. To clarify the meaning, the activity was expanded from "treatment" to "treatment and capture" in the 2005 PACE Survey.

Some facilities had trouble distinguishing between off-site recycling and disposal costs. One facility was adamant that they did not dispose of their waste; they sent it off-site to be recycled (even though they received no cost offset, just conceptually a lower disposal cost). However, these are disposal costs, even though some recycling is taking place prior to the waste being disposed of in a landfill. As a result, the share of recycling costs is likely to be overstated in these instances. Examples were added to the *Guidelines and Definitions* document to help clarify the distinction between recycling and disposal.

There were very few pollution prevention activities occurring at the facilities visited by RTI. However, some facilities reported a large percentage of their pollution abatement operating costs as pollution prevention, but in most instances, these were incorrect. For example, baghouses were classified as pollution prevention and not as treatment because the baghouse was not treating the dust; it was preventing it from entering the atmosphere. Adding "treatment and capture" should greatly reduce this problem.

Determining the percentage of total operating costs spent for hazardous pollutants was difficult for many facilities. The typical method used to estimate the percentage spent on hazardous waste was to link it to the media percent. For example, if only solid waste was hazardous, then Item 4E would be equal to Item 4Dc. If a facility was unable to make this link, then they provided a rough estimate. No facility used spreadsheets or calculations to estimate the percentage of costs associated with hazardous waste. As noted above this item is no longer part of the survey.

Item 5: Costs Not Included in Previous Items. Most facilities did not have trouble reporting the total payment to government entities for permits and fees related to pollution abatement. In one case of misreporting a facility did not include the cost of their air permits because they said they were not abating pollution—they were simply paying for the right to vent pollution to the atmosphere; thus, they thought the cost associated with the permits was not a pollution abatement cost. In another case a facility included water discharge fees ($200,000) even though the water was clean and the discharge was required as part of normal manufacturing operations. In an effort to clarify the types of permits and fees that should be reported in this category, examples were added to the Guidelines and Definitions document.

Only one facility, a petroleum refinery, reported costs for product redesign in 2004 – the costs were over $100 million. Although the costs were not associated with reducing pollutants at the facility, the redesign resulted in cleaner-burning fuel. As mentioned earlier, respondents indicated that they wanted to report these costs so this item remains on the survey even though it is not a cost related to pollution abatement at the facility and hence is not in scope of the PACE survey.[15] Facilities that participated in the pretest did not report any costs associated with traded permits in 2004.[16] Since this question is most relevant for electric utilities, which are no longer part of the PACE sample, this question was dropped from the survey.[17] Facilities typically use contracting services for site cleanup and used their accounting systems to obtain cost information.

[15] These costs will not be tabulated for the final 2005 PACE report.
[16] The electric utilities participating in the study reported that they did not conduct any formal trades during the previous year. However, they did reallocate permits across facilities within their organization.
[17] Electric utilities are not included in the 2005 PACE survey because costs related to electric utilities are collected by EIA-767.

Item 6: Cost Offsets. Facilities seemed to understand the difference between cost offsets motivated by pollution abatement and cost reductions that would be profitable in the absence of environmental concerns. In many cases, the accounting systems used by facilities captured the recycling revenue related to pollution abatement. For large recovery operations such as recovery and regeneration of expensive metals like cobalt and platinum, facilities have special accounting systems in place to track the revenue returned. However, some smaller offsets may not be captured by accounting systems. For example, relatively small waste reduction or recycling efforts (e.g., cardboard and fiber drum compacting, can and drum crushing), or where revenue is returned to the plant as reclaimed product (solvents), appear to be difficult to track.

Several facilities indicated that the main cost savings from recycling are associated with extending the life of their landfill because recycling reduces the amount of material put in their landfill. For example, one facility said that selling sludge extended the life of the landfill from 25 to 50 years. Consequently, landfill closure costs are estimated to be $200,000 each year instead of $800,000 per year.

Item 7: Depreciation. Depreciation expense for pollution abatement structures and equipment was obtained from the facilities' accounting system. In general determining depreciation expenses for large equipment, such as wastewater treatment systems, are relatively straightforward because they are commonly treated as a separate business unit compared to equipment that may be part of several different business units.[18]

[18] Economic depreciation is the most appropriate measure of the decrease in value of an asset, but it is too difficult for facilities to determine. Therefore, the expert panel decided that facilities would most likely report accounting depreciation. Thus, to avoid confusion, the PACE survey asks for facilities to report accounting depreciation.

Determining the gross book value of pollution abatement capital was a time consuming task for many facilities and the accuracy and completeness of the underlying information used in the calculation varied. The intent of this question is to obtain information on the total pollution abatement equipment in place and to potentially use the information as a "reasonableness" check for plant-level pollution abatement operating costs. However, the reliability of the reported value is questionable. If the equipment was fully depreciated, some facilities did not include the value of the equipment in the reported value. In other instances, facilities noted that they did not always have historical records that specified if capital investment projects were for environmental versus non-environmental purposes.

Assessment of the 2004 PACE Pretest

RTI generated independent engineering cost estimates to assess the accuracy of the costs reported by facilities that participated in the pretest. These independent cost estimates were developed using various cost references and information provided by the facility during the on-site visit. If more detailed information was needed after the site visit, RTI contacted the facility again. Overall, RTI was able to develop independent cost estimates for 74 percent of costs reported on the PACE pretest. The remaining 26 percent of the costs are primarily associated with materials and contract services, for which facilities obtained their cost estimates directly from their accounting systems. For these costs there was insufficient information available for RTI to develop independent cost estimates. However, since these cost estimates are taken directly from their accounting systems, RTI believes they should be relatively accurate.

In general, RTI believes it is more likely for RTI to underestimate, rather than overestimate, pollution abatement costs. For example, many plants tend to over-design their abatement systems, either to accommodate future expansion, handle surges, or ensure that they remain in compliance by performing well below their allowable limits for air and water discharges. RTI would not be able to determine if a system had been over-designed and may be using more labor, energy, or materials than standard engineering cost manuals would predict. In these cases, by using standard engineering costs, RTI would underestimate the capacity of the units and hence underestimate the associated pollution abatement capital expenditures and operating costs. Plants also incur site-specific expenses due to plant configurations, space limitations, and piping distances that cannot be incorporated accurately in the independent estimates. As a result, one would expect the independent engineering cost analysis to underestimate, rather than overestimate, the facility-reported costs.

Independent Estimates for Pollution Abatement Capital Expenditures. For capital expenditures, RTI relied on a variety of secondary sources to develop cost estimates. These sources include the following:

- EPA publications,
- industry-specific publications (e.g., American Forest and Paper Association cost documents),
- federal agencies (e.g., Energy Information Administration),
- other facilities with similar equipment/operations,
- general industrial cost references (e.g., Means Building Construction Cost Data, 2005, Ed. 63), and
- equipment vendor websites to identify costs for similar items.

Costs were frequently adjusted depending on the site-specific conditions and, if needed, further adjusted to a base year of 2004 using cost indices from sources such as the *Chemical Engineering Journal* (www.che.com). In cases where multiple cost estimates were available, the most representative and most recent information was selected for the independent cost estimate. For example, estimates of the cost of new electrostatic precipitators (ESPs) installed at pulp and paper mills were available from both EPA and industry sources. The industry estimates were used because they represented a base year of 2003 compared to 1991 for the EPA estimates. These industry estimate were also more representative of the ESPs installed at the pulp and paper mills included in the PACE pretest.[19]

In some cases, the estimate of pollution abatement capital cost included smaller components or less frequently used components whose costs are not traditionally found in the available literature on costs. Where possible, RTI assessed the order of magnitude of these costs relative to larger capital projects to determine if they seemed reasonable.

One issue that frequently needed to be addressed involved situations where large capital projects spanned several years (e.g., a $100 million dollar, 3-year project), and thus, the reported 2004 costs represented only a portion of these costs. In these cases, cost estimates were develop for the entire project and the facility was asked what percentage of the multi-year costs should be attributed to 2004 in order to compare the facility-reported costs to RTI's estimates.

Independent Estimates for Pollution Abatement Operating Costs. In general, the facility respondents found that quantifying operating costs required more effort than quantifying

[19] Industry cost estimates were for oversized ESPs that can be operated with at least one field out of service to allow for online maintenance, whereas EPA estimates were for standard high-efficiency ESPs sized to match actual flow rates.

capital costs because, unlike most capital costs, environmental operating costs were closely intertwined with other operating costs, particularly for items such as electricity and materials and supplies. In most cases, it was difficult for the facility to provide specific information from which RTI could generate independent cost estimates. RTI often had to rely on secondary sources to generate independent estimates.

For salaries and wages, the facility was able to provide the number of FTEs and labor category that were used to estimate the salaries and wages reported on the survey. Generally the total figure included all of the staff in the environmental department (including administrative staff), wastewater treatment system operators (if applicable), a portion of the maintenance labor tracked by the facility's accounting system, and a portion of the time spent by laboratory technicians to collect and analyze wastewater and solid waste. In some cases, facilities included corporate staff salaries if these salaries were charged directly to the facility. Given this information, RTI generated independent cost estimates based on the total FTEs involved in environmental activities and average salary data for environmental engineers, operators, and laboratory technicians, as reported by the Bureau of Labor Statistics (BLS) (http://www.acinet.org/acinet). These salaries were also loaded to account for benefits using an average overhead rate of 34 percent of wages obtained from the U.S. Department of Commerce, Bureau of Economic Analysis (BEA) (http://www.bea.doc.gov/bea/regional/sqpi/default.cfm).

In addition to the FTEs the facilities used to calculate their costs, RTI assessed whether certain activities and the associated labor were omitted, and if so, estimated what the total salaries and wages value would have been had these costs been included. For example, some facilities did not report salaries and wages associated with operating and

maintaining pollution abatement equipment. EPA estimates that the amount of labor required to run and maintain air pollution control devices (APCDs) is about 0.5 hours per device per shift. If a facility operates 10 APCDs, runs 3 shifts per day, and operates 351 days per year, the total labor hours for APCD operation would be 5,625 hours per year calculated as follows:

(10 devices) x (0.5 hr/shift) x (3 shifts/day) x (351 days/year) = 5,625 hrs/yr

To arrive at a labor cost estimate, RTI then multiplied this figure by the average labor rates from the BLS, with the 34 percent overhead applied. If RTI assumed the operator labor rate was $30 per hour, then the total cost estimate for labor to operate and maintain the APCDs would be $226,125 per year, as follows:

(5,625 hrs/yr) x ($30/hr) x (1.34) = $226,125

Fuel costs, such as natural gas for incinerators dedicated to air pollution abatement, were estimated by RTI based on equipment specifications provided by the facility. For example, to estimate the amount of fuel expected to be consumed by an incinerator, design information supplied by the facility was combined with procedures in EPA's *Control Cost Manual* to estimate annual consumption. This was then multiplied by the cost of natural gas (dollars per 1,000 cubic foot) for 2004, which was obtained from the Energy Information Administration's (EIA) *Natural Gas Monthly*. Expected steam usage rates were estimated based on facility information, and an average per-unit cost of steam that was available from EPA documents.[20]

As noted previously, facilities often could isolate electricity costs for on-site wastewater treatment units because the wastewater treatment system is typically treated

[20] Steam costs were obtained from *Standard Support and Environmental Impact Statement Volume 1: Proposed Standards of Performance for Petroleum Refinery Sulfur Recovery Plants* (EPA-450/2-75-016-a) and adjusted to reflect current input prices.

as a separate business unit. In these instances, RTI estimates for electricity costs were developed using total electricity requirements for the pollution abatement equipment (megawatt-hours) and the cost of electricity ($/megawatt-hour) in that facility's location. Industrial electricity rates for each state were obtained from the EIA.[21] Facilities often quoted lower rates, which is not unusual since industrial facilities are able to negotiate lower rates. However, RTI had no way to verify these rates so RTI used the EIA published rates in their cost estimates.

Energy consumption for running some devices, such as APCDs, was more difficult for facilities to isolate, and therefore these energy costs were sometimes omitted. For those cases RTI estimated the electricity requirements for the APCDs reported at the facility based on industry and EPA reference documents. The total electricity usage was converted to megawatt hours (MW-hr) using standard conversions (e.g., 1MW = 1,341 horsepower) and the known or assumed operating hours per year. This number was then multiplied by electricity rates ($/MW-hr) to obtain total electricity cost.

For a number of facilities, the wastewater treatment system represented the bulk of the materials and supplies costs. Facilities could easily extract this information from the accounting system since these materials (e.g., flocculants, nutrients, caustic) were often used only for wastewater treatment, and because in many cases the wastewater treatment system costs were tracked separately. However, in some cases RTI was unable to replicate material cost estimates reported by a facility because very few details were available in the facilities' accounting systems on the quantities and types of materials.

When facility personnel were able to provide information on the amount of chemicals purchased, the costs could be checked by comparing the unit costs paid by the

[21] http://www.eia.doe.gov/cneaf/electricity/epm/epm.pdf

facility to costs reported in publications such as the *Chemical Market Reporter*. The EPA *Control Cost Manual* was also used as a source of information for costs of certain items such as replacement bags for baghouses. Because some facilities omitted material and supply costs for APCDs, for example, RTI generated estimates of these costs using assumptions in the EPA *Control Cost Manual*. For most APCDs, the EPA *Control Cost Manual* assumes that that materials and supplies are equal to the maintenance labor cost (e.g., 0.5 labor hours per device per shift).

Facilities generally were able to estimate the operating costs associated with contract work, leasing and other purchased services because they represented actual payments to outside entities and were typically isolated from costs incurred during manufacturing operations. However, it was difficult for RTI to generate independent estimates for contract work because facilities were not able to provide many details about the operations.

Solid waste management represented a significant portion of the contract work, leasing, and other purchased costs for a number of facilities. In some cases, RTI was able to compare these costs to costs incurred by similar facilities. For those facilities that did not operate on-site landfills, RTI obtained information on landfill tipping fees from local government websites. Information on the cost of incineration of industrial wastes was obtained from the Environmental Technology Council (ETC).[22] EPA documents published by the Office of Solid Waste also contained useful cost data.

[22] http://www.etc.org/costsurvey8.cfm

Cost Comparison by Pollution Abatement Category

RTI's cost estimates and costs provided by facilities by pollution abatement category are reported in Table 4. The first column in Table 4 lists the total costs reported on the survey by the facility. As noted previously RTI was not able to estimate costs for all items on the survey. The second column shows the share of the costs reported in column one in which RTI was able to develop independent cost estimates (74 percent). The third column presents RTI's independent cost estimates. The fourth column shows the facility costs as a percentage of RTI's cost estimate. A percentage less than (greater than) 100% indicates that RTI's cost estimate is higher (lower) than the facility reported cost estimate.

In general, when EPA estimates the cost of a proposed regulation, the Agency does not make any claim for a greater accuracy than a nominal level of +/– 30 percent. In addition, the lack of site-specific information can increase the uncertainty to +/– 50 percent. Uncertainty is greater for operating costs estimates (as compared to capital expenditures) because in many instances these estimates involve work practices where the level of effort is unknown or difficult to quantify and because costs are frequently based on incremental activities that build on existing practices.

RTI's estimate of total pollution abatement capital expenditures was $160,997 compared to $156,927 reported by the facilities. RTI's estimate of total pollution abatement operating cost was $60,529 compared to $45,848 reported by facilities. Fuels and material and supplies accounted for the majority of difference between the costs reported by facilities and RTI estimates. Total costs reported by facilities for fuels, electricity and other utilities and energy costs were $16,698 compared to RTI's cost estimate of $41,689. Most of this difference is the result of two electric utilities not reporting any electricity usage associated with pollution abatement equipment.

RTI's cost estimates slightly exceeded the survey responses for capital expenditures primarily because of the evaluation of one large project at an electric utility where RTI's cost estimate exceeded that reported by the facility. RTI's estimates of operating costs were higher than the estimates reported by facilities. However, the majority of the difference is because two facilities did not include an estimate of their electricity costs for pollution abatement equipment. If these two facilities are removed, operating costs reported on the survey are 34 percent greater than RTI estimates, with 9 of 16 facilities reporting operating costs greater than RTI's estimates.

Whereas in the aggregate costs reported on the survey were relatively close to RTI's cost estimate, there was more variance in the individual components. As seen in the last column of Table 4, reported expenditures for disposal and pollution prevention capital expenditures and salaries/wages, materials, and contract work operating costs were larger than RTI's estimates.

RTI was only able to develop estimates for about a quarter of reported costs of materials and supplies and contract work, leasing and other purchased services. In

general, materials and supplies and contract work were the most difficult categories for RTI to verify because of the limited information available to explain what was included in the facilities' reported costs. On the other hand, these costs were easy for facilities to estimate because they were generated from their accounting system, and hence, RTI believes they should be relatively accurate.

There was also variance across individual facilities when comparing RTI's cost estimates and survey values. Table 5 shows the percentage of total expenditure estimated by RTI and the facility estimate as a percentage of RTI's estimate for both capital expenditures and operating costs. Total capital expenditures reported by the facilities and RTI's estimates were relatively close and in all instances were within the range of +/– 30 percent. RTI's estimates ranged from 89 percent to 114 percent of the costs reported by facilities on the survey.

For operating costs, RTI was able to generate independent cost estimates for about half of the reported costs and there was greater variance between costs reported on the survey and RTI estimates. For 8 of the 18 facilities, RTI's estimates of operating costs estimates were within +/– 30 percent of facilities cost estimates. The largest differences were for the two electric utilities. These facilities did not report any electricity costs for pollution abatement equipment because internal electricity consumption is not metered.

Conclusion

The PACE survey has been conducted annually for over 20 years but this is the first time in the history of PACE that the survey has undergone an extensive evaluation. The evaluation process included two major phases. The first phase included the use of an

expert panel and one-on-one interviews with facilities and trade associations to develop a version of the PACE survey and Guidelines that would undergo broader testing during the second phase. The second phase incorporated a pretest with eighteen facilities (with independent cost estimation for comparison) and a pilot test of the survey with 2000 facilities conducted by the U.S. Census Bureau. The results from each phase were reviewed by the expert panel and EPA staff and changes were made to the survey instrument and Guidelines accordingly. The final product of this evaluation effort was the 2005 PACE Survey and Guidelines.

This paper focuses on the findings of the 2004 PACE pretest with eighteen manufacturing facilities along with a comparison of reported values with independent engineering cost estimates developed by RTI. Some of the major changes to the survey form resulting from the site visits include removing multimedia pollutants from questions regarding media, removing the questions regarding the percentage spent on hazardous pollutants, removing the question on tradable permits, keeping and expanding the list of pollution abatement activities, and keeping the question on product redesign. Furthermore, during the site visits RTI was able to determine the items that caused facilities the most difficulty (e.g. treatment versus disposal of waste water). To help alleviate the confusion associated with these items, the questions on the survey form were sometimes modified and additional examples were added to the Guidelines. Tables listing examples of the types of costs to include or exclude were also expanded based on information provided by facilities were also included in the Guidelines.

Facilities indicated that capital expenditures and many operating costs were relatively straightforward to estimate. However, there were some data items that

facilities indicated were difficult to calculate. The most difficult cost item to estimate appears to be electricity costs associated with operating pollution abatement equipment. Facilities that participated in the pretest indicated that they can not directly measure electricity costs of pollution abatement equipment because it is not metered separately. Examples were added to the Guidelines to illustrate how fuel and electricity costs for pollution abatement equipment could be estimated.

In the aggregate, RTI's independent cost estimates appear to confirm that PACE survey responses – within some margin of error – reflect actual pollution abatement capital expenditures and operating costs. However, a comparison of RTI's estimates and individual facility costs show different levels of consistency across cost categories. Overall RTI's estimate for capital expenditures was within a range of +/- 30% of the facility estimate. On the other hand, there was more variation between RTI's estimate of operating costs and facility estimates. For example, RTI's operating cost estimates are much lower than the operating cost estimates reported by the electronic equipment facility and much higher than costs reported by fabrication metal facility 1 (see Table 5). In general, discrepancies appear to be largely offsetting and do not represent a significant source of bias at the aggregate level. However, the differences do have implications for facility-level analyses and micro users need to be cautious.

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Table 1. Average Facility Size by Industry Sector

Sector	Average Employment	Average Value of Shipments
Chemical	492	$414,934,000
Computer and electrical equipment	1,646	NP
Electric utility	221	$494,146,500
Fab metal	267	$91,385,500
Iron and steel	407	$407,293,667
Paper	774	$471,155,750
Other[a]	1,537	$2,159,449,333

[a]Other includes furniture, petroleum, and plastics facilities.

NP: Facility viewed this information as confidential and did not provide it.

Table 2. Average Pollution Abatement Capital Expenditure: Items 3A and 3B

Sector	Treatment	Recycling	Disposal	Pollution Prevention	Total Capital Expenditures
Chemical	$4,500	—	$524,500	$23,000	$552,000
Computer and electrical equipment	$5,500	—	$12,500	$205,500	$223,500
Electric utility	$58,672,000	—	$830,500	$96,000	$59,598,500
Fab metal	—	—	—	—	—
Iron and steel	$21,000	—	—	$264,333	$285,333
Paper	$1,547,750	$6,500	$131,500	$274,750	$1,960,500
Other[a]	$11,778,667	—	—	$158,333	$11,936,667
Total Average	$8,830,778	$1,444	$181,167	$167,556	$9,180,889

[a]Other includes furniture, petroleum, and plastics facilities.

Table 3. Average Operating Costs per Facility: Item 4A

Sector	Salaries/ Wages	Fuels	Materials	Contract Work	Total Operating Costs	Cost per Value of Shipments
Chemical	$1,449,000	$560,500	$852,500	$1,019,500	$3,881,500	$0.010
Computer and electrical equipment	$983,500	$1,027,000	$438,000	$239,500	$2,688,000	NP
Electric utility	$1,661,500	$50,000	$3,888,500	$1,065,000	$6,665,000	$0.015
Fab metal	$189,500	$67,500	$151,000	$146,000	$554,000	$0.008
Iron and steel	$919,333	$6,181,000	$1,181,333	$2,355,667	$10,637,000	$0.030
Paper	$1,666,250	$1,658,750	$1,234,000	$1,797,500	$6,356,500	$0.027
Other[a]	$1,715,667	$42,667	$10,333	$1,561,667	$3,330,333	$0.003
Percentage	31%	22%	22%	25%	100%	$0.015

[a]Other includes furniture, petroleum, and plastics facilities.

NP: Facility viewed this information as confidential and did not provide it.

Table 4. Comparison of Survey Costs and Independent Engineering Estimates

Cost Type	Survey ($1,000s)	Cost Checks		Facility Costs as % of RTI Costs
		Facility Costs[a]	RTI Costs	
Capital Expenditure	**$165,256**	**$156,927**	**$160,997**	**97.5%**
Treatment	$158,954	$156,493	$160,667	97.4%
Recycling	$26	—	—	—
Disposal	$3,261	$274	$194	141.2%
Pollution prevention	$3,016	$151	$120	125.8%
Operating Costs	**$94,905**	**$45,848**	**$60,529**	**75.7%**
Salaries/wages	$23,137	$17,681	$12,785	138.3%
Fuels	$28,716	$16,698	$41,689	40.1%[b]
Materials and supplies	$19,171	$6,712	$2,945	227.9%
Contract work	$23,882	$4,757	$3,110	153.0%
Costs Not Included Previously	**$14,091**	**$32**	**$32**	**100.0%**
Permits and fees	$3,628	$32	$32	100.0%
Site cleanup	$10,463	—	—	—
Cost Offsets[c]	**–$14,426**	**–$1,965**	**–$124**	**1,584.7%**

[a]This column represents the subset of reported survey costs that correspond to the pollution abatement activities for which RTI was able to develop independent engineering cost estimating.

[b]The large difference is caused by two facilities that did not report $26 million in electricity costs for pollution abatement equipment because internal electricity consumption is not metered.

[c]Cost offsets are not included in calculation of the total cost row of this table.

Table 5. Capital Expenditures and Operating Cost Comparison by Facility

Sector Facility Number	Capital Expenditures		Operating Costs	
	% of Total Expenditure Estimated by RTI[a]	Facility Estimate as % of RTI's Estimate[b]	% of Total Expenditure Estimated by RTI[a]	Facility Estimate as % of RTI's Estimate[b]
Chemical facility 1	100.0%	88.7%	96.3%	97.7%
Chemical facility 2	0.0%[c]	—	50.4%	101.9%
Computer facility 1	0.0%	—	36.9%	141.2%
Electronic equipment facility 1	0.0%	—	99.4%	200.8%
Electric utility facility 1	98.5%	92.9%	0.0%	0.0%[e]
Electric utility facility 2	98.6%	94.7%	1.8%	1.8%[e]
Fabrication metal facility 1	—[d]	—	98.0%	55.8%
Fabrication metal facility 2	—	—	33.3%	100.1%
Furniture facility 1	—	—	44.6%	90.5%
Iron and steel facility 1	0.0%	—	36.9%	154.2%
Iron and steel facility 2	—	—	18.3%	136.2%
Iron and steel facility 3	0.0%	—	54.4%	162.8%
Paper facility 1 (Pulp)	81.1%	100.0%	100.0%	294.5%
Paper facility 2 (Integrated)	58.0%	113.6%	49.4%	72.0%
Paper facility 3 (Integrated)	96.5%	100.0%	61.5%	86.2%
Paper facility 4 (Integrated)	78.5%	101.7%	71.5%	80.0%
Plastics facility 1	92.9%	113.0%	52.4%	129.2%
Petroleum facility 1	—	—	3.5%	19.3%
Total Costs	**95.0%**	**97.5%**	**48.3%**	**75.7%**
Total Costs (Less Electric Utility Facilities 1 and 2)	**85.7%**	**111.1%**	**56.1%**	**134.0%**

[a]These columns represent the % of facility reported capital costs and operating costs, respectively, for which RTI was able to develop independent engineering cost estimates

[b] (Facility Cost Estimate/RTI Cost Estimate) *100

[c]RTI was not able to develop independent cost estimates for any of the facilities capital expenditures.

[d]The facility reported no capital expenditures.

[e]These facilities reported no electricity operating costs. However, RTI estimated electricity costs in the millions of dollars. As a result, the facility operating costs as a percentage of RTI estimates are approximately zero

Appendix. 2004 PACE Pretest Survey and Guidelines and Definitions Document

2004 POLLUTION ABATEMENT COSTS AND EXPENDITURES (PACE) - PRETEST

NOTICE – All information provided on this pretest of the PACE survey will remain confidential.

IMPORTANT

Please read guidelines, definitions, and examples before completing this survey form.

Report for the facility located at the address below.

Please correct errors in name, address, and ZIP code. ENTER street and number if not shown.

Item 1 **FACILITY INFORMATION**

A. Check ONE box that best describes the status as of December 31, 2004, of the facility identified in the address box above.

- ☐ In operation as of December 31, 2004.
- ☐ Temporarily idle (intend to resume operations) — Months
  - → How long as of December 31, 2004?
- ☐ Sold or leased to another company
  - → **SOLD OR LEASED TO**
    - Name
    - Street
    - City | State | ZIP Code
- ☐ Permanently ceased operations
  - → Date closed? Month | Year

B. Report data for the calendar or fiscal year 2004. If your fiscal year ends between October 31 and February 28, fiscal-year figures are acceptable; otherwise report calendar year data. If you are reporting for a fiscal year, provide the period covered by the fiscal year.

- ☐ Calendar year 2004 data reported
- ☐ Fiscal year 2004 data reported → Period covered? From (Month | Year) To (Month | Year)

C. Check ONE box that best describes this facility's pollution abatement and other environmental protection expenditures for 2004.

- ☐ These expenditures were $0 (zero) in 2004. (There were NO pollution abatement expenditures for 2004.)
- ☐ These expenditures were included in rent, taxes, or lease agreements.
- ☐ These expenditures were between $1 and $999.

→ You do not need to report any expenditures. ***Please complete Item 10*** *of the form and return it.*

- ☐ These expenditures were more than $999. → ***Continue with Item 1D.***

D. Report the following information for this facility in 2004.

a. Average number of full-time equivalent (FTE) employees (include leased employees) .....

Provide this estimate by the following two categories for 2004. Lines i and ii should sum to equal line 1Da.

i. Production workers directly involved in production or manufacturing of facility output .....

ii. All other employees at your facility.....

b. Production capacity at your facility

c. Actual production in 2004

Indicate units. *(Check only one box.)*

- ☐ Short tons of product (per year)
- ☐ Barrels (per day)
- ☐ Megawatts (per hour)
- ☐ Tons of pulp (per year)
- ☐ Tons of paper (per year)
- ☐ Other *Describe:*_____

d. Report the dollar value of production in 2004, based on estimated sales price(s) of what was produced at this facility during 2004. Do not report annual sales. Report in thousands of dollars. *(Value of production = value of shipments + value of ending inventory – value of beginning inventory)*

Value of production in 2004 ..... $,000

Item 2 **POLLUTION ABATEMENT ACTIVITIES**

The questions in this section refer to different types of pollution abatement activities that may have occurred at your facility in 2004.

A. How many air pollution treatment control devices were operating at the beginning of 2004? How many were newly installed by the end of 2004? If no control devices were installed or operating in 2004, check the box in the "Zero" column.

Control Device	Total Number of Devices Operating Facility-Wide (beginning of 2004)	Zero	Number of Devices Newly Installed (end of 2004)	Zero
a. Electrostatic precipitator (ESP)		☐		☐
b. Baghouses/fabric filters		☐		☐
c. Venturi scrubbers		☐		☐
d. Acid-gas scrubbers		☐		☐
e. Carbon adsorbers		☐		☐
f. Incinerators/thermal oxidizers/catalytic oxidizers		☐		☐
g. Flares		☐		☐
h. Refrigerated condensers		☐		☐
i. Biofilter/bioreactor		☐		☐
j. Selective non-catalytic reduction (SNCR)		☐		☐
k. Selective catalytic reduction (SCR)		☐		☐
l. Other *Describe:*_____		☐		☐

Questions B and C ask about water/liquid and solid waste pollution abatement techniques.

B. What water/liquid pollution abatement techniques were used at this facility in 2004?	Yes	No
a. Physical (containing, screening, filtration, UV disinfection, underground injection, etc.).....	☐	☐
b. Biological (activated sludge, aeration lagoon, biological filter, etc.)	☐	☐
c. Chemical (oxidation, reduction, neutralization, etc.).....	☐	☐
d. Thermal (incineration, pyrolysis, etc.).....	☐	☐

e. Annual quantity of wastewater

Treated

Discharged

Indicate units. *(Check only one box.)*

- ☐ Gallons per day
- ☐ Other *Describe:*_____

C. What solid waste pollution abatement techniques were used at this facility in 2004?

	Yes	No
a. Physical (containment, dewatering, landfilling, underground injection, etc.)	☐	☐
b. Biological (composting, landfarming, phytoremediation, etc.)	☐	☐
c. Thermal (incineration, pyrolysis, etc.)	☐	☐

d. Annual quantity of solid waste

Treated ☐

Disposed of ☐

Indicate units. *(Check only one box.)*

☐ Short tons per day

☐ Other *Describe:* _____

Item 3 CAPITAL EXPENDITURES

The questions in this section ask about capital costs of pollution abatement in 2004. First, report your capital cost expenditures by type of pollution abatement activity. Add these values together to determine TOTAL CAPITAL EXPENDITURES of pollution abatement. **Provide an estimate of TOTAL CAPITAL EXPENDITURES even if you are unable to provide separate estimates for each component of capital expenditures.**

- Report only capital expenditures for abatement activities whose primary purpose is pollution abatement.
- Do NOT report capital expenditures from a previous year. (Depreciation expense is recorded in Item 7.)
- Include all installation and start-up costs for pollution abatement expenditures. Include labor only when contracted specifically for installation.
- Include capital expenditures related to monitoring and testing.
- Exclude capital expenditures related to site clean up. (This information is recorded in Item 5.)
- Exclude capital expenditures related to product redesign or reformulation intended to reduce the pollution generated by consumers or uses from products manufactured at this facility. (This information is recorded in Item 5.)
- Report in thousands of dollars. If your facility had no capital expenditures or capital expenditures less than $500 for pollution abatement in 2004 in a specific category, check the box in the "Zero" column.

A. Provide estimates of capital expenditures by the following four pollution abatement activity categories for this facility in 2004. (See pages 4–5 in the guidelines for definitions.)

		Zero
a. Treatment	$,000	☐
b. Recycling	$,000	☐
c. Disposal	$,000	☐
d. Pollution prevention	$,000	☐

Indicate which of the components to the right are included in the POLLUTION PREVENTION estimate you reported in Item 3Ad above. *(Check all that apply.)*

☐ Raw materials modifications

☐ Leak and spill prevention

☐ Process/equipment modification/redesign

B. Add Items 3Aa–d to calculate TOTAL CAPITAL EXPENDITURES for pollution abatement in 2004. Provide an estimate of TOTAL CAPITAL EXPENDITURES even if you are unable to provide separate estimates for 3Aa–d.

		Zero
TOTAL CAPITAL EXPENDITURES	**$,000**	☐

C. What percentage of pollution abatement TOTAL CAPITAL EXPENDITURES in Item 3B was spent for each of the four types of media for this facility in 2004? (See page 7 in the guidelines for definitions.)

		Zero
a. Air emissions	%	☐
b. Water discharges	%	☐
c. Solid wastes	%	☐
d. Multimedia pollutants (not included in other media categories above)	%	☐

a + b + c + d = 100 %

D. What percentage of pollution abatement TOTAL CAPITAL EXPENDITURES in Item 3B was spent for hazardous pollutants for this facility in 2004? (See pages 7–8 in the guidelines for definition.)

	Zero
%	☐

Item 4 OPERATING COSTS

The questions in this section ask about operating costs of pollution abatement. First, report your operating cost expenditures by type of pollution abatement activity. Add these values together to determine TOTAL OPERATING COSTS of pollution abatement. **Provide an estimate of TOTAL OPERATING COSTS even if you are unable to provide separate estimates for each component of operating costs.**

- Report only operating costs for abatement activities whose primary purpose is pollution abatement.
- Exclude depreciation expense. (This information is recorded in Item 7.)
- Include operating costs related to monitoring, testing, and on-site administration costs associated with regulatory compliance.
- Exclude operating costs related to site cleanup. (This information is recorded in Item 5.)
- Exclude operating costs related to product redesign or reformulation intended to reduce the pollution generated by consumers or uses from products manufactured at this facility. (This information is recorded in Item 5.)
- Cost offsets, such as revenue from recycling, should NOT be deducted. (This information is recorded in Item 6.)
- Report in thousands of dollars. If your facility had no operating costs or operating costs less than $500 for pollution abatement in 2004 in a specific category, check the box in the "Zero" column.

A. Provide estimates of operating costs of pollution abatement by the following four cost categories for this facility in 2004.

		Zero
a. Salaries/wages (for all time spent by professional, administrative, operating, and maintenance employees on pollution abatement activities)	$,000	☐
b. Fuels, electricity, and other utilities and energy costs	$,000	☐
c. Materials and supplies	$,000	☐
d. Contract work, leasing, and other purchased services	$,000	☐

B. Add Items 4Aa–d to calculate TOTAL OPERATING COSTS for pollution abatement in 2004. Provide an estimate of TOTAL OPERATING COSTS even if you are unable to provide separate estimates for Items 4Aa–d.

		Zero
TOTAL OPERATING COSTS	**$,000**	☐

C. What percentage of pollution abatement TOTAL OPERATING COSTS in Item 4B was spent for each of the four pollution abatement activity categories for this facility in 2004? (See pages 4–5 in the guidelines for definitions.)

		Zero
a. Treatment	%	☐
b. Recycling	%	☐
c. Disposal	%	☐
d. Pollution prevention	%	☐

a + b + c + d = 100 %

Indicate which of the components to the right are included in the POLLUTION PREVENTION estimate you reported in Item 4Cd above. *(Check all that apply.)*

- ☐ Raw materials modifications
- ☐ Leak and spill prevention
- ☐ Process/equipment modification/redesign

D. What percentage of pollution abatement TOTAL OPERATING COSTS in Item 4B was spent for each of the four types of media for this facility in 2004? (See page 7 in the guidelines for definitions.)

		Zero
a. Air emissions	%	☐
b. Water discharges	%	☐
c. Solid wastes	%	☐
d. Multimedia pollutants (not included in other media categories above)	%	☐

a + b + c + d = 100 %

E. What percentage of TOTAL OPERATING COSTS in Item 4B for pollution abatement was spent for hazardous pollutants for this facility in 2004? (See page 7–8 in the guidelines for definition.)

	Zero
%	☐

Item 5 COSTS NOT INCLUDED IN PREVIOUS ITEMS

The questions in this section ask about other costs NOT included in previously provided estimates. Report in thousands of dollars. If your facility had no costs or costs less than $500 for pollution abatement in 2004 in a category below, check the box in the "Zero" column.

A. What were the total payments to government entities for PERMITS AND FEES related to pollution abatement for this facility in 2004? (See page 6 in the guidelines for definition.)

	Zero
$,000	☐

B. What were the capital expenditures and/or operating costs for SITE CLEANUP for pollution abatement for this facility in 2004? (See page 6 in the guidelines for definition.)

		Zero
a. Capital expenditures	$,000	☐
b. Operating costs	$,000	☐

C. What were the capital expenditures and/or operating costs related to PRODUCT REDESIGN or reformulation intended to reduce the pollution generated by consumers or users from products manufactured at this facility (downstream pollutants) in 2004? (See page 6 in the guidelines for definition.)

		Zero
a. Capital expenditures	$,000	☐
b. Operating costs	$,000	☐

D. What were the number of TRADABLE PERMITS bought from the government or another entity exercised and their total cost by the following types of tradable permits? (See page 6 in the guidelines for definition.)

	Number	Total Cost	Zero
a. SO_2		$,000	☐
b. NO_x		$,000	☐
c. Other *Describe:*_____		$,000	☐

Item 6 COST OFFSETS

Estimate the cost offsets for your facility in 2004. Include only cost offsets for activities whose primary purpose is pollution abatement. Do NOT include cost reductions from energy-efficiency improvements or revenue from recycling activities that are profitable in the absence of environmental concerns.

- Only cost offsets associated with the activities for the costs reported in Item 4 should be included.
- Do not reduce the costs reported in Item 4 by the estimates of cost offsets reported in this item.
- Report in thousands of dollars. If your facility had no cost offsets or cost offsets less than $500 in 2004, check the box in the "Zero" column.

A. What was the total value of cost offsets for this facility in 2004? (See page 6 in the guidelines for definition.)

	Zero
$,000	☐

B. Which types of cost offsets were included in COST OFFSETS in Item 5A above? *(Check all that apply.)*

- ☐ Revenue from recycling
- ☐ Energy cost savings
- ☐ Reduced material costs
- ☐ Other *Describe:*_____

Item 7 DEPRECIATION

Estimate depreciation expense for all pollution abatement equipment operating at this facility in 2004, including equipment installed prior to 2004. Report in thousands of dollars. If your facility had no deprecation costs or depreciation costs less than $500 for pollution abatement equipment in 2004, check the box in the "Zero" column.

A. What was your depreciation expense for pollution abatement structures and equipment in 2004? (See pages 6–7 in the guidelines for definition.)

	Zero
$,000	☐

B. What depreciation method was used to compute this estimate? *(Check only one box.)*

- ☐ Straight-line
- ☐ Accelerated (e.g., double declining balance)
- ☐ Other *Describe:*_____

C. What was the gross book value of pollution abatement capital at your facility at the beginning of 2004 (not adjusted for depreciation)? (See page 7 in the guidelines for definition.)

$,000 ☐ Zero

Item 8 BURDEN

Estimate the number of hours spent filling out this form. Include the time you and all other staff spent completing the survey form.

Item 9 REVIEW

Thank you for participating in the pretest of the PACE survey. To assist us in revising the questionnaire, please answer the following questions related to the Guidelines and Definitions document accompanying this survey form. Check one box for each question.

A. Did you read/use the Guidelines and Definitions document while completing this form?
☐ Yes
☐ No

B. Did the Guidelines and Definitions document and the instructions embedded in the survey form provide adequate/sufficient information to complete the survey?
☐ Yes
☐ No

C. Were the illustrative examples on pages 13–16 of the Guidelines and Definitions document useful?
☐ Yes
☐ No

One of the main objectives of the redesign of the survey is to better clarify the distinction between pollution treatment and pollution prevention. To help in this process, please provide your assessment of the following example projects as to whether they should be classified as

- pollution treatment expenditures,
- pollution prevention expenditures, or
- not to be included in PACE cost estimates because the primary motivation was not pollution abatement.

Check one box for each question.

D. A facility installs a new flotation clarifier as part of an on-site wastewater treatment unit. The capital expenditures for this project should be classified as
☐ Pollution treatment expenditures
☐ Pollution prevention expenditures
☐ Not to be included in PACE cost estimates because the primary motivation was not pollution abatement

E. Capital expenditures of $10,000 were made to install a unit to capture hazardous waste. The unit has a life expectancy of 10 years and has negligible operating costs. The collected waste can be recycled and will provide revenue of $5,000 per year. The primary purpose for implementing the project was to increase profitability. The capital expenditures of this project should be classified as
☐ Pollution treatment expenditures
☐ Pollution prevention expenditures
☐ Not to be included in PACE cost estimates because the primary motivation was not pollution abatement

F. To meet new regulations, existing boilers must be retrofitted so they can burn cleaner fuel. The fuel is slightly more expensive but has the same BTU content. The fuel would not have been changed without the regulation and does not increase profitability. The costs associated with this retrofit project should be classified as
☐ Pollution treatment expenditures
☐ Pollution prevention expenditures
☐ Not to be included in PACE cost estimates because the primary motivation was not pollution abatement

Item 10	CERTIFICATION

A. Provide the following information on the person to contact regarding this survey.

Name of person to contact regarding this report *(Please print)*	Telephone		
			Ext.
E-mail address	Fax number		

B. Provide the name, title, and signature of a person who verifies that the information reported in this survey is to the best of your knowledge accurate. The authorizing official may be a plant manager, vice president, or environmental health and safety official.

	Title
	Date

Feel free to add any comments about the survey in the space provided below. Thank you for your participation.

Comments:

The public reporting and recordkeeping burden for this collection of information is estimated to average 10 hours per response. Send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including through the use of automated collection techniques to the Director, Collection Strategies Division, U.S. Environmental Protection Agency (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460. Include the OMB control number in any correspondence. Do not send the completed form to this address.

Return this form by Month Day, 2005, in the enclosed prepaid envelope to

RTI International
Attention: PACE Survey
Post Office Box 12194
Research Triangle Park, NC 27709-2194

If you have any questions, contact Wanda Throneburg of RTI at 1-800-334-8571 (extension 6261) or by e-mail at wthroneburg@rti.org.

Guidelines and Definitions for Completing the Pollution Abatement Costs and Expenditures (PACE) Survey Pretest

Page

SURVEY GUIDELINES

BACKGROUND

The Pollution Abatement Costs and Expenditures (PACE) survey was conducted by the Census Bureau annually between 1973 and 1994 (excluding 1987) and again in 1999. This survey is a pretest of the redesigned survey instrument being considered for use in reinstating the annual PACE survey.

This survey collects information on costs and expenditures in 2004 for pollution abatement activities for a specific **facility** (the single location at the address listed on the front of the survey form). Pollution abatement includes treatment, recycling, disposal, and pollution prevention. Costs and expenditures include new capital equipment, annual operating costs, and other expenses, such as payments to the government in the form of charges, permits, and fees. Only activities whose primary purpose is pollution abatement (as opposed to activities undertaken primarily for financial reasons) are included.

The data from this survey are used by the Environmental Protection Agency (EPA) to satisfy legislative and executive requirements to track the costs of regulatory programs and to provide aggregate national statistics. Other users of these data include trade associations, manufacturers, marketing and research companies, universities, financial and environmental institutions, other federal agencies, state and local governments, and environmental reporters.

AUTHORITY AND CONFIDENTIALITY

Participation in the pretest of the PACE survey is voluntary. Facilities are not required to participate by law. However, the findings from the pretest will be used to develop the final version of the survey questionnaire, which historically has been administered by the Census Bureau, so your participation is important. For more information on previous PACE surveys, see http://www.census.gov/econ/www/mu1100.html.

The pretest of the survey is being conducted on behalf of EPA by RTI International (RTI), a not-for-profit research organization. Only project team members, including RTI employees, project consultants, and the two to three EPA employees who are developing the final version of the PACE survey form will have access to the survey responses. Information collected in the pretest will not be publicly available and will be destroyed after five years. If you have any questions about data confidentiality, please contact Wanda Throneburg of RTI at 1-800-334-8571 (extension 6261) or by e-mail at wthroneburg@rti.org.

WHO SHOULD REPORT

Complete the survey form only for the facility identified on page 1 of the survey form. If your company operates more than one location, REPORT ONLY FOR THE FACILITY TO WHICH THIS SURVEY WAS ADDRESSED. **DO NOT COMBINE** responses with other facilities owned by your company even though operations may jointly use the same pollution abatement equipment or staff. If such equipment or personnel sharing occurs, allocate the costs and expenditures according to the number of annual hours the pollution abatement equipment or staff are distributed across facilities.

This survey is directed to manufacturing, mining, and electric utility operations. The information requested supplements the data collected in the Annual Survey of Manufactures. If you think that your facility is ***not a manufacturing, mining, or electric utility establishment*****,** contact Wanda Throneburg of RTI at 1-800-334-8571 (extension 6261) or by e-mail at wthroneburg@rti.org.

REPORTING PERIOD

Report data for the 2004 calendar year. If your fiscal year ends between October 31 and February 28, fiscal-year figures are acceptable; otherwise report calendar year data.

WHEN AND WHERE TO REPORT

Complete the form and return it by Month Day, 2005, in the enclosed prepaid envelope to

RTI International
Attention: PACE Survey
Post Office Box 12194
Research Triangle Park, NC 27709-2194

If you need ***additional time*** to complete the form or if you need a ***duplicate form,*** please contact Wanda Throneburg of RTI at 1-800-334-8571 (extension 6261) or by e-mail at wthroneburg@rti.org.

RESPONSE TIME

The public reporting and recordkeeping burden for this collection of information is estimated to average 10 hours per response. Send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including through the use of automated collection techniques to the Director, Collection Strategies Division, U.S. Environmental Protection Agency (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460. Include the OMB control number in any correspondence. Do not send the completed form to this address.

HOW TO ESTIMATE

Answer all questions. If you cannot answer a question from your plant records, please estimate the answer carefully. In some cases, identification of pollution abatement expenditures may require the joint efforts of your facility's financial and environmental staff. If there were no expenditures or expenditures were less than $500 for a specific category, check the box in the "Zero" column.

Report the incremental capital expenditures and operating costs of pollution abatement. These are costs above and beyond what would have been incurred in the absence of environmental concerns.

When reporting costs, **please use actual costs whenever possible, and provide estimated costs if actual costs are not available**. For situations where environmental costs are not tracked separately from the facility-level operating costs, please use available resources and judgment to estimate how much of the facility-level costs are attributable solely to pollution abatement activities. Sources of data include accounting records and engineering estimates. For example, if estimated operating costs were provided by a pollution control device vendor as part of an investment proposal, these estimated operating costs could be used to help determine the portion of the facility-level actual operating costs that is attributable to pollution treatment.

Provide total cost estimates even if you are unable to provide estimates of each cost component. Specific instructions on how to complete each item are included in the survey instrument along with the page number referring to the key definitions in this document.

Round all figures to the nearest thousands of dollars. To facilitate rounding, "000" has been placed in each entry field.

KEY DEFINITIONS

Definitions are provided for the **activity** categories and **cost** categories used in the survey. Activity categories identify ongoing pollution abatement activities (i.e., treatment, recycling, disposal, and pollution prevention). Cost categories separate expenditures into components such as capital versus operating costs or wages versus fuel expenditures. Costs are also linked to various pollutant media and classifications (e.g., air, water, solid waste, hazardous, or nonhazardous).

Definitions are for the purpose of this survey only and are not intended to be representative of official federal, state, or local statutory language. In certain cases, the definitions may be similar to those found in a particular rule or regulation; however, for the purpose of this survey, please use the terms as they are defined in these guidelines.

Facility is a single physical location where business is conducted or where services or industrial operations are performed. Facilities are often referred to as establishments or plants. A company may have one or more facilities. For this survey, report only for the designated facility located at the address printed on the front of the survey form. Do NOT include data for other facilities owned by the same company when responding to the survey questions.

Pollution is the presence of a substance in the environment that because of its chemical composition or quantity prevents the functioning of natural processes and produces undesirable environmental and/or human health effects. For the purpose of this survey, consider only the pollutants generated at the designated facility as part of the production process.

ACTIVITY CATEGORIES

Pollution abatement refers to ALL pollution management activities that occur at the designated facility, whose primary purpose is protecting the environment. These activities may be in response to federal, state, or local regulations or voluntary initiatives. Investments or activities that increase profits or efficiency in the absence of environmental considerations should not be included, even if pollution abatement occurs as a side benefit. For the purpose of this survey, pollution abatement is divided into four major activities: treatment, recycling, disposal, and pollution prevention. All costs associated with pollution abatement, including monitoring, testing, administration of environmental programs, and permit preparation, should be distributed among these four categories.

- **Treatment** is any method, technique, or process designed to remove pollutants after their creation from air emissions, effluents, or solid waste. In general, pollution treatment includes the use of retrofit technologies, on-site management, and/or contract services (off-site) that are designed to change the physical, chemical, or biological character or composition of any hazardous substance, pollutant, or contaminant entering any waste stream or otherwise released to the environment (including fugitive emissions) to render such waste nonhazardous or less hazardous or safer to transport, store, or dispose of. These pollution treatment activities are also commonly referred to as “end-of-pipe” activities.

- **Recycling** is the on-site (postproduction) processing or off-site processing of waste for an alternative use. Recycling includes recovering liquid, solid, or gaseous wastes and reusing them in the same or another production process and partially reclaiming materials (e.g., drying materials that contain recoverable metals for the purpose of enhancing a subsequent recovery activity). Activities that closely resemble treatment for the purpose of destruction or disposal and burning waste materials for fuel are not included in this category. Recycling only includes activities whose primary purpose is pollution abatement and does NOT include activities done primarily for financial reasons.

- **Disposal**, in an environmentally sound manner, is the final placement, destruction, or disposition of waste after pollution treatment or recycling has occurred. This includes the discharge of treated pollutants into the environment. For example, solid waste is often managed by landfill disposal, and certain liquid wastes may be disposed of using injection wells. **For the purpose of this survey, do not report disposal expenditures associated with municipal solid waste (e.g., office and cafeteria trash).**

- **Pollution prevention** includes any practice that reduces the amount of any pollutant generated during the production process *prior to* postprocess recycling, treatment, or disposal. Pollution prevention practices include equipment or technology modifications; process or procedure modifications; reformulation or

redesign of products (to reduce pollution from the manufacturing process); substitution of raw materials; and improvements in housekeeping, maintenance, training, or inventory control that result in fewer emissions, effluents, or solid waste. The incremental cost of activities involving the redirection of "used" material inputs, which would otherwise be wasted, back into the production process (also called in-process recycling or closed loop recycling) should also be included in pollution prevention if the primary purpose of this activity is pollution abatement rather than for financial reasons.

For the purpose of this survey, pollution prevention practices are grouped into the following three primary categories:

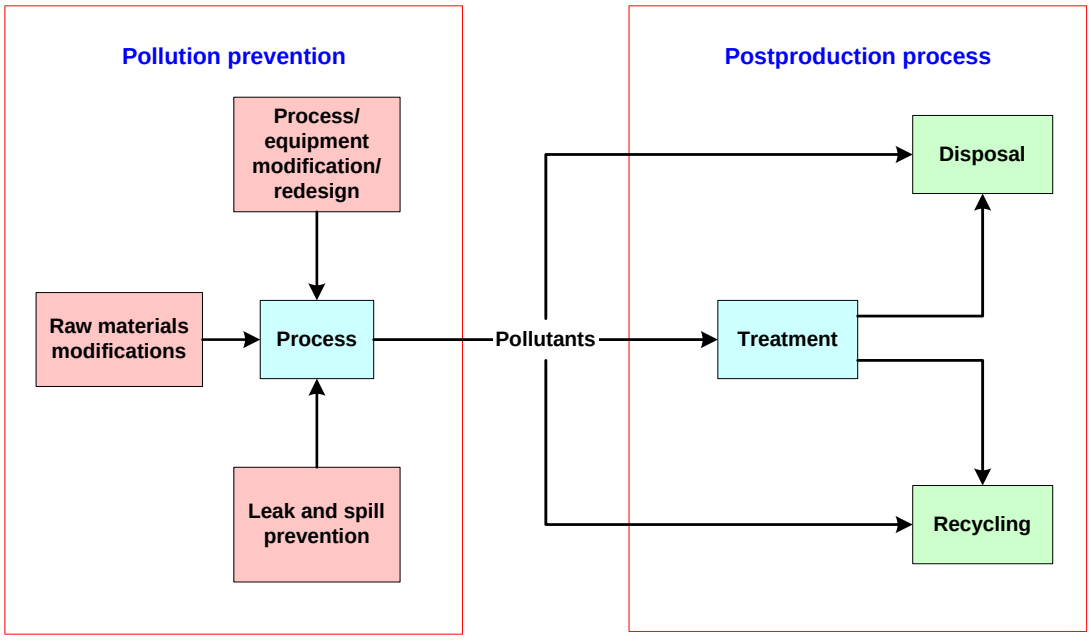
- **Raw materials modifications**: altering inputs to reduce or modify pollutants during the manufacturing process. Also referred to as substitution of raw materials.

- **Leak and spill prevention**: improvements in housekeeping, maintenance, training, or inventory control that result in decreased leaks/spills/disposal of raw materials, in-process materials, products, or by-products.

- **Process/equipment modification/redesign**: equipment or technology modifications, process or procedure modifications, reformulation or redesign of products to reduce pollution from the manufacturing process, or in-process recycling.

As shown in Figure 1, a general distinction between pollution prevention and the other pollution abatement activities is that the latter (treatment, recycling, and disposal) are postproduction activities used to manage pollutants **after** they are generated by the production process. In contrast, pollution prevention activities reduce or eliminate the pollutants generated **during** the production process.

Figure 1. Overview of the Pollution Management System



COST CATEGORIES

The survey asks about three types of cost categories: **capital expenditures, operating costs,** and **other costs**:

- **Capital expenditures** include any installation and retrofit that occurred during 2004 for separately identifiable methods, techniques, or process technologies installed primarily to eliminate pollutants through pollution treatment, recycling, disposal, and/or pollution prevention. Total expenditures for equipment installation and startup are included. These expenditures are often referred to as "one-time-costs."

- **Operating costs** include annual costs for operating and maintaining all pollution abatement technology operating in 2004, including technology brought online prior to 2004. Operating costs include all costs of salaries and wages; fuels, electricity, and other utilities and energy costs; materials and supplies; and contract work, leasing, and other purchased services. Labor costs of administration of environmental programs and permit preparation should be included in operating costs.

- **Other costs** include expenditures not captured by total capital expenditures or total operating costs.

    - **Permits and fees**—Payments to local, state, and federal government agencies related to purchasing permits or paying fees associated with pollution abatement (e.g., Title V permit fees, publicly owned treatment works (POTW) fees, and landfill tipping fees). Tradable permits are not included in this category. In addition, labor costs associated with permit preparation should be excluded; these costs are captured in operating costs.

    - **Site cleanup**—Remediation of contamination due to leaks, spills, waste disposal, or other releases from current or past on-site production processes. Asbestos removal should be included in site cleanup. Costs of site assessments, sampling, analysis, and other activities associated with the site should also be included. The pollution must be on the site of the facility named on the survey form.

    - **Product redesign**—Expenditures and costs of product redesign or reformulation intended to reduce the pollution generated by consumers or users from products manufactured at the facility. This is also referred to as downstream pollutants. Product redesign to reduce pollution from the manufacturing process should be excluded; these costs are captured under pollution prevention.

    - **Tradable permits**—Number and cost of tradable permits exercised in 2004. Include permits bought from the government or another entity in a previous year that were exercised in 2004. Exclude permits that were purchased in 2004 and banked for future use. Average purchase price or current market value may be used if actual purchase price is not known. Do not subtract permits sold in 2004. Report for SO_2, NO_x, and other trading programs, including federal, state, and other regional regulatory permits (or credits).

Cost offsets are related to operating costs but reported in a separate item in the survey**.** Cost offsets are pollution abatement operating expenses recovered as a result or an offshoot of pollution abatement techniques. This is usually the value of recovered (recycled) materials or reduced energy. In addition, cost reductions from waste minimization for environmental protection and energy recovery for environmental protection are cost offsets. Cost offsets must be motivated by pollution abatement; cost reductions from energy-efficiency improvements or revenue from recycling activities that are profitable in the absence of environmental concerns are not to be included.

Depreciation is related to capital expenditures but reported in a separate item in the survey. Depreciation and amortization charged during the year is attributed to the wear and tear on equipment or structures and obsolescence due to changing technology. Depreciation expense recorded on the survey is for all pollution abatement equipment operating in the facility in 2004, including equipment installed prior to and during 2004. This includes the depreciation against fixed assets acquired since the beginning of the year and those sold during the year or retired and no longer carried on the books at the end of the year. At the end of the expected life of the equipment or structure, the entire cost of the equipment or structure will have been depreciated. Common methods used include

straight-line depreciation and accelerated depreciation (such as double declining balance). Custom methods may also be used.

Included under the item of depreciation is the **gross book value** of pollution abatement capital. This is the sum of the purchase prices of all pollution abatement equipment in place at the beginning of 2004. Do NOT adjust this figure for depreciation. Exclude the effects of inflation, deflation, and vintage. Do not include equipment retired prior to 2004.

ALLOCATION OF COSTS BY MEDIUM AND TYPE

The survey asks about total capital expenditures and total operating costs by type of medium and hazardous versus nonhazardous pollutants.

- **Medium** is used to link expenditures to the types of pollutants (air emissions, water discharges, and solid wastes) that are being managed by pollution abatement activities.
    - **Air emissions** are any substances released into the air that could, in high enough concentration, pose a threat to the environment and/or human health.
    - **Water discharges** are any substances or pathogens released into water that could, in high enough concentration, pose a threat to the environment and/or human health.
    - **Solid wastes** are any discarded materials, including solid, liquid, semi-solid, or contained gaseous materials, that pose a threat to the environment and/or human health by contaminating soil and groundwater.
    - **Multimedia pollutants** comprise the remaining pollution abatement category and are simply those expenditures not attributable primarily to one type of pollution or that deal with pollution affecting more than one medium.
- **Hazardous pollutants** are those regulated under Section 112 of the Clean Air Act, listed by the Clean Water Act (including toxic metals, toxic inorganic compounds, and toxic organic compounds), and defined within the Resource Compensation and Recovery Act (RCRA) Subtitle C. Examples of hazardous and nonhazardous pollutants are provided in Table 1.

  When estimating the share of costs associated with hazardous pollutants, the **incremental** capital and operating costs of abating hazardous pollutants should be used. Do NOT include the total cost if the equipment is used to abate both hazardous and nonhazardous pollutants, only the incremental components associated with the hazardous pollutants. Also, do NOT estimate the share of costs based on the relative volume (tons, gallons, etc.) of hazardous versus nonhazardous pollutants abated. For example, if 1% of the quantity of pollutants abated from a piece of equipment is hazardous, the cost associated with abating the hazardous pollutants is not necessarily equal to 1% of the total cost of the equipment (see the “Hazardous” section in the Examples for more detailed examples).

Table 1. Examples of Hazardous and Nonhazardous Pollutants

Media	Hazardous Pollutants	Nonhazardous Pollutants
Air	Metals, other particles, gases absorbed onto particles, and certain vapors from fuels and other sources. Examples include emissions of toluene, benzene, methanol, chlorine, and vinyl chloride. For this survey, lead and lead compounds fall under this category.	Criteria air pollutants and their precursors (except lead). Examples include emissions of particulate matter, sulfur dioxide, nitrogen oxide, carbon monoxide, and volatile organic compounds (VOCs). This category also includes Section 111-d designated air pollutants (e.g., total reduced sulfur compounds).
Water	Toxic metals and inorganic compounds including antimony, arsenic, beryllium, cadmium, chromium, copper, cyanide, lead, mercury, nickel, silver, thallium, and zinc. Examples of organic compounds include benzene, chlorethane, toluene, and xylene.	Discharges of nutrients, fecal coliform, and suspended solids and adverse changes in temperature and pH balance.
Solid	Hazardous solid wastes possess one or more of the following characteristics: ignitability, corrosivity, reactivity or toxicity; appear on special EPA lists; or are designated as hazardous under state hazardous waste laws. Mixed wastes are defined as any waste containing both RCRA Subtitle C hazardous waste and radioactive waste. The expenditures associated with mixed wastes are to be included with hazardous waste expenditures.	Industrial D wastes are wastes that are neither municipal wastes nor wastes that are currently identified as hazardous wastes under RCRA Subtitle C. Nonhazardous industrial wastes (Industrial D wastes) consist primarily of manufacturing process wastes, including wastewater, and wastewater and nonwastewater sludges and solids.

COSTS AND EXPENDITURES INCLUDED AND EXCLUDED FROM THE SURVEY

For this survey, include only those activities with the primary purpose of pollution abatement. Although certain expenditures may have multiple benefits, only consider those expenditures for which pollution abatement is the primary purpose. Investments or activities that increase profits or efficiency in the absence of environmental considerations should not be included, even if pollution abatement occurs as a side benefit. For example, some pollution prevention practices, particularly process modifications, may have been undertaken primarily as a financially motivated cost-cutting activity. In addition, do not report expenditures intended to meet worker safety and health requirements. Below is a list of general types of costs and expenditures that are excluded from the survey. Table 2 lists examples of included and excluded costs and expenditures by activity category.

The following are general examples of excluded costs and expenditures

- activities that are a normal operating procedure and whose primary purpose is not pollution abatement;
- costs that did not occur in 2004;
- research and development services;
- corporate expenditures that cannot be attributed to a specific facility;
- health, safety, aesthetics, or employee comfort (OSHA); and
- habitat protection.

Table 2. Capital Expenditures and Operating Costs Included and Excluded by Activity Category

Activity Category	Capital Expenditures	Operating Costs	Excluded Costs and Expenditures
Treatment	Purchase, installation, and startup costs of pollution treatment equipment and materials	Operating and maintaining pollution treatment equipment Fuel and utilities costs for operating pollution treatment equipment Leasing of pollution treatment equipment Cost for pollution treatment equipment replacement and repair	Manufacture of pollution treatment equipment for sale Manufacture of products related to pollution abatement (such as low-sulfur gasoline) for sale
Recycling	Equipment and other one-time costs for on-site (postproduction process) and off-site recycling	Annual costs of on-site (postproduction process) and off-site recycling	Recycling equipment if your primary product is recycling; that is, you are a recycling plant Recycling for profitability reasons (not with the primary purpose of pollution abatement)
Disposal	Equipment and other one-time costs associated with on-site and off-site disposal	Annual costs of on-site and off-site disposal Payments to a private or government contractor for solid waste disposal	Disposal of municipal solid waste (e.g., office and cafeteria trash)
Pollution Prevention	Purchase and installation of new or retrofit technology that reduces pollution generated Cost of leak prevention and monitoring equipment	Incremental cost increase of operating the new or retrofit technology relative to conventional technology Cost of running leak detection programs Incremental cost increase associated with using new raw material versus the conventional/standard raw material	Equipment or technology that reduces pollutants generated but was installed primarily for financial reasons Use of a new raw material that reduces pollutants generated but is less expensive than previously used raw material

COMPLETING THE SURVEY

STRUCTURE OF THE SURVEY

The survey is segmented into 10 items. Figure 2 illustrates how activity components and cost components discussed previously are included in each Item.

- **Item 1** asks about the operational status of the facility, the number of employees (including leased employees), production capacity, and value of production.

- **Item 2** identifies some of the different types of pollution abatement activities used at this facility in 2004.

- **Item 3** reports all capital expenditures related to pollution abatement in 2004. Capital expenditures include all one-time equipment, installation, and start-up costs; include labor only when contracted specifically for installation.

- **Item 4** reports all operating costs related to pollution abatement in 2004. Operating costs include all time spent by all facility staff supporting pollution abatement activities and all related expenditures for fuel, materials, and contract services. Cost offsets (Item 6) and depreciation (Item 7) should be excluded from operating costs.

- **Item 5** reports costs, NOT previously included in the previous items, of payments to government entities for permits and fees, capital expenditures and operating costs for site cleanup, capital expenditures and operating costs for product redesign, and number of tradable permits and their total cost. Associated labor costs should not be included because they are part of operating costs (Item 4).

- **Item 6** reports cost offsets of pollution abatement in 2004 and identifies what types of cost offsets are included. Cost offsets include revenue from recycling projects that are environmentally motivated. Recycling activities that are profitable in the absence of environmental concerns should be excluded.

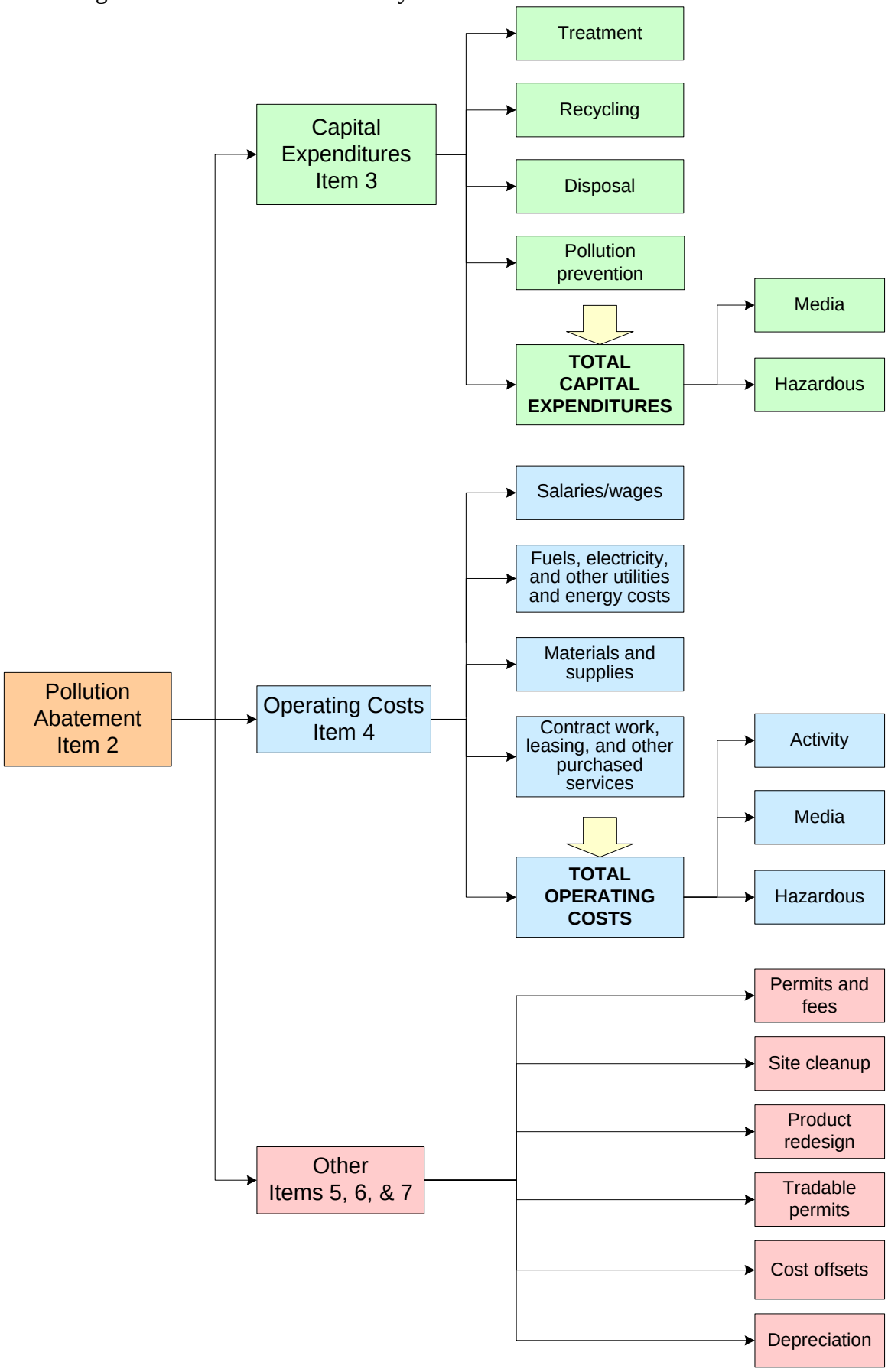
- **Item 7** reports depreciation expense of pollution abatement structures and equipment in place in 2004 and identifies the depreciation method used. Gross book value of pollution abatement capital is also reported in this item.

- **Item 8** reports the burden in terms of the number of hours it took to fill out the survey.

- **Item 9** asks several questions to assist the redesign of the survey instrument and instructions.

- **Item 10** provides certification information on the person at the facility to contact regarding this report and the name, title, and signature of a person who verified that the information reported in this survey is to the best of your knowledge accurate.

Figure 2. Overview of the Survey Structure



HOW TO REPORT

Specific instructions on how to complete each item are included in the survey instrument along with the page number referring to the key definitions.

Provide total cost estimates even if you are unable to provide estimates of each cost component. For example, if you have data for the total capital expenditures associated with pollution abatement but are unable to break down the total value into its component parts requested in Item 3A (i.e., treatment, recycling, disposal, and pollution prevention), please provide the total capital expenditures in Item 3B.

Round all figures to the nearest thousands of dollars. To facilitate rounding, "000" has been placed in each entry field.

Example: Capital expenditures for pollution treatment for 2004 are $25,652,950.

		Zero
INCORRECT	$ 25,652,950 ,000	☐
INCORRECT	$ 25 MM ,000	☐
CORRECT	$ 25,653 ,000	☐

All **support activities**, such as monitoring and testing or administrative staff to support permitting, are to be included in total capital expenditures and operating costs and in the appropriate activity categories.

The number of **full-time equivalent (FTE) employees** (Item 1Da) is conceptually the number of total labor hours at the facility in 2004 divided by 2,000 hours (8 hours per day x 5 days per week x 50 weeks per year, assuming two weeks vacation). FTE does not mean the number of employees.

EXAMPLES

This section provides example activities and projects and indicates how they link to the definitions and the items in the survey instrument.

TREATMENT

- A facility installs an electrostatic precipitator (ESP) to reduce particulate matter (PM) emissions from one of its process units. The facility also installs a continuous opacity monitoring system (COMS) at the outlet of the ESP to monitor opacity as a surrogate for PM emissions. The total capital expenditure on the ESP (including installation, fans, and ductwork, for example) and the COMS should be included in the **capital expenditures** for pollution treatment. The costs associated with operating the ESP and the COMS (e.g., electricity costs to run the ESP and COMS and labor involved in collecting and reporting COMS data) should be included in the **operating costs** for pollution treatment.

- A facility installs a new flotation clarifier as part of its on-site wastewater treatment unit. All capital expenditures associated with the purchase, installation, and start-up of the new clarifier should be included in the **capital expenditures** for pollution treatment. All costs associated with operating the new clarifier (e.g., cost of electricity to run the compressor, cost of flocculating chemicals) plus the costs for operating the other wastewater treatment equipment should be included in the **operating costs** for pollution treatment.

- A facility hires an environmental consulting company to conduct an emission source test to measure air pollutant emissions from the facility's control device. The contractor costs associated with conducting this source test should be included as **operating costs**. The labor costs for facility personnel to supervise and assist in conducting this source test should be included as **operating costs**.

RECYCLING

- A facility installs and operates equipment used to recycle former waste streams to comply with environmental regulations or for other environmental reasons. Costs associated with installing the equipment (e.g., purchased equipment, engineering, site preparation, installation, and other associated costs) should be included as **capital expenditures.** Costs associated with operating the equipment (e.g., cost of electricity, operating labor, and maintenance labor) should be included as **operating costs.**

DISPOSAL

- A facility constructs a new on-site landfill for disposing of solid waste. All costs associated with constructing the landfill (including the capital expenditures of equipment and machinery necessary for managing the landfill) should be included as **capital expenditures** for disposal.

- A facility generates solid waste from several sources including sludge from an on-site wastewater treatment operation and solid waste generated during the manufacturing process. All of the solid waste is sent to an on-site landfill operated by a contractor. The payments to the on-site contractor should be reported as **operating costs** under disposal.

- A facility hires an outside contractor to periodically pick up spent process catalyst for disposal. Contract fees for disposing of spent process catalyst should be included as **operating costs**.

POLLUTION PREVENTION

- A facility switches to using a new, more expensive raw material that either contains fewer pollutants or releases fewer pollutants when used in the production process. The facility makes some slight modifications to the process to accommodate the use of the new raw material. The **capital expenditures** associated with the equipment modifications should be included in pollution prevention. The incremental cost increase

associated with using the new raw material versus the conventional/standard raw material should be included as an **operating cost** for pollution prevention.

- A facility implements a new leak detection and repair (LDAR) program to reduce equipment leaks. The **capital expenditures** associated with the LDAR program (e.g., cost of equipment for leak prevention, such as pump seals, and the cost of leak monitoring equipment, such as handheld organic vapor detectors) should be included in pollution prevention. The **operating costs** associated with running the LDAR program (e.g., labor for staff to monitor for leaks and prepare periodic reports) should be included in pollution prevention.

- A facility installs a new technology that results in fewer air pollutants released per ton of product manufactured. The new technology has slightly higher electricity and labor costs than the conventional technology. The **capital expenditures** associated with purchasing and installing the new technology should be included in the capital expenditures for pollution prevention. The incremental cost of the new technology relative to the conventional technology should be included in the **operating costs** for pollution prevention.

HAZARDOUS

- A facility operates a process unit that emits both hazardous and nonhazardous air pollutants. An add-on air pollution control device was installed prior to 2004 to control the nonhazardous air pollutants. In 2004, the facility upgraded the existing control device to increase the overall pollutant reduction efficiency to a level required by a new regulation that targets the hazardous portion of the air emission stream. The **capital expenditures** of the upgrade would be included in the total capital expenditure for pollution abatement at the facility. Because the total cost of the upgrade was specifically targeted to hazardous air pollutants, 100 percent of the upgrade cost would be attributed to hazardous air pollutants. For **operating costs**, the percentage that is for hazardous pollutant control should be based on the incremental increase in the control device operating costs directly attributable to the upgrade of the control technology (including any increases in monitoring or record-keeping costs).

- A facility operates a process unit that emits both hazardous and nonhazardous air pollutants. An add-on air pollution control device was installed prior to 2004 to control the nonhazardous air pollutants. The performance of the air pollution control device is sufficient such that no changes were made to the device to comply with new regulations for the hazardous air pollutants. In this example, the **capital expenditures** are zero for 2004, and 0 percent of the control device **operating costs** are attributed to hazardous air pollutants.

OTHER COSTS NOT INCLUDED IN PREVIOUS ITEMS

Permits and Fees

- A facility plans a major expansion and completes and submits a new application to the state permitting agency for approval. The permit application fee should be reported under **permits and fees**.

Site Cleanup

- Capital expenditures and operating costs associated with Superfund site cleanup operations, replacement of leaking or inferior underground storage tanks (USTs), cleanup of leaks and spills of hazardous substances, and other soil or groundwater contamination cleanup are included as site cleanup. A facility should also report payments to a private company for site cleanup of the site on which the facility is located. Compliance and environmental auditing and environmental studies undertaken to assess the extent of the contamination prior to site cleanup are also included as costs of site cleanup. For example, if a facility decides to treat contaminated soil on-site via soil vapor extraction and, in the process, purchases a vacuum system and carbon treatment unit, the cost of the treatment equipment should be considered **site cleanup capital expenditures**. The cost to operate this equipment and labor and materials associated with conducting any follow-on soil testing and monitoring activities should be considered **site cleanup operating costs**. In many cases, the cleanup is conducted by a contractor, and the facility pays the contractor rather

than purchasing any cleanup equipment itself. In these cases, the payments made to the contractor should be considered **site cleanup operating costs**.

Product Redesign

- A facility that sells petroleum products changes its production process to generate low-sulfur diesel and gasoline fuels that decrease pollution expelled by motor vehicles. This change was made to meet the requirements of environmental regulations. The capital expenditures and operating costs associated with changing the production process for the new product specifications are considered product redesign that reduces the pollution generated by consumers or users of the products manufactured. These costs should be reported as **product redesign capital expenditures** and **product redesign operating costs.**

- A surface coatings manufacturer reformulates its product to reduce the amount of hazardous air pollutants (HAP) contained in its coating product to help its customers comply with federal environmental regulations that require the use of low-HAP coatings in certain surface coating operations. This product reformulation does not reduce air emissions from the surface coatings manufacturing process; however, the use of the low-HAP coatings in its customers' surface coating operations will reduce air emissions from its customers' facilities. The capital expenditures and operating costs associated with reformulating the product should be considered product redesign. These costs should be reported as **product redesign capital expenditures** and **product redesign operating costs.**

Tradable Permits

- A facility purchased SO_2 permits prior to and during 2004. Three of the permits were exercised during the year. The number "3" should be recorded in the **number** column of the tradable permits item for SO_2. To calculate the **total cost** of the three exercised permits, the facility should estimate the average purchase price for SO_2 permits and multiply this figure by three.

COST OFFSETS

- As an environmental protection alternative to used oil disposal, a printing plant has used machinery oil picked up by a hazardous waste collection and treatment service. The service charges a fee. The fee is reported in disposal operating costs. The service returns the oil clean. Thus, the printer avoids buying new oil. The value of the oil is a **cost offset** to the service's fees.

- A manufacturer purchases a cardboard baler to recycle cardboard containers associated with the manufacturing process. The capital expenditure should be reported in recycling capital expenditures. The costs of operating the baler should be reported in recycling operating costs. The manufacturer sells the cardboard to a recycler. The activity is not a potentially profit-making venture; it is conducted for pollution abatement. The revenues received from the recycler are **cost offsets**.

- A manufacturer installs a closed-loop recovery system in the production process to prevent the dumping of chemicals into the water system. Because the closed-loop recovery system recaptures and reuses the chemicals in the production process, it reduces expenses for chemicals. The pollution abatement portion of the capital expenditure pertaining to the closed-loop recovery system is reported in pollution prevention capital expenditures. The operating expenses to maintain the system are reported in pollution prevention operating costs. The value of the recovered chemicals should be reported as a **cost offset**.