# EXECUTIVE SUMMARY

# THE ECONOMIC EFFECTS OF ENVIRONMENTAL REGULATIONS ON THE POLLUTION CONTROL INDUSTRY

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Prepared by

ARTHUR D. LITTLE, INC.
Cambridge, Massachusetts 02140

Prepared for

The U.S. Environmental Protection Agency
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ABSTRACT

THE ECONOMIC EFFECTS OF ENVIRONMENTAL REGULATIONS ON
THE POLLUTION CONTROL INDUSTRY
by Arthur D. Little, Inc., (August 1978 - Cambridge, Massachusetts)
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(Report No. EPA/230/1-78-002)

The objectives of this study included: identifying constraints on the ability of the pollution control industry (PCI) to support future regulatory needs; evaluating the performance of participating companies; estimating markets and associated employment; and updating an earlier (1972) analysis. The analysis is both descriptive and diagnostic, addressing the impact of the regulatory process upon the industry and, conversely, the impact of the industry upon the regulatory process.

The business segments covered in the study are: the equipment and instrumentation systems used in the control of air pollution from stationary sources; the equipment, instrumentation, and chemicals associated with water pollution control; and the systems being developed to recover energy and materials from municipal solid waste.

The recent history (1972-1976) of the PCI has been one of better than average growth and only average profitability. Leading companies in each PCI sector enjoyed growth rates in the range of 16-22% per year (versus 9% for all U. S. manufacturing). However, the level of profitability was only about average for all U. S. manufacturing or comparable industrial segments (e.g., 10-11% after-tax return on stockholders' equity). An important exception has been the water treatment chemicals segment which has been among the most profitable in American industry.

The larger of the leading PCI companies typically have annual sales of $200-$700 million and are not among the multi-billion dollar firms which command the greater financial resources within the U. S. manufacturing industry. Hence, the PCI has been limited by the resources of its leading participants as well as by disappointing profitability.

In 1977, the markets for these pollution control products totalled $1.8 billion. These markets are projected to grow to $3.5 billion by 1983 or at a pace of 11-12% per year (in current dollars and assuming 5-7% inflation). Faster growing segments include those of flue gas desulfurization systems and resource recovery systems.

Current employment by the PCI in association with these markets is estimated to be 35,850 jobs. Assuming that the amount of sales generated per employee will continue to increase as well, employment is projected to grow to 43,900 in 1983. These employment benefits to the economy do not include pollution control jobs provided by consulting engineering firms, fabricators, and construction contractors.

A diagnostic examination of the impact of the regulatory process upon the industry focuses on four major issues of concern to the PCI and of importance to future regulation: the municipal bidding process; the role of Federal R&D; the effects of technology forcing standards; and the operability and maintenance of control systems.

The municipal bidding process is the issue believed to be having the greatest impact upon the PCI. This is the process by which Federal construction grant monies are expended for specialized sewage treatment equipment and instrumentation systems. Problems recommended for further examination within the municipal bidding process include bid-shopping practices, implications for plant operation, and responsibilities for system performance.

Federal support of R&D may be more critical to U. S. technological leadership in pollution control than in other regulatory program areas. Manufacturing industries seeking to solve their own pollution control problems do not have the right motivation for developing new technology. The pollution control industry has neither the corporate resources, the historical capability, or the profitability needed to pursue basic research.

The effects of technology forcing standards are raised with regard to the possible setting of new particulate emission targets for utility boilers. The point of concern developed here is that particulate control has been the mainstay both of the air pollution control business and of the regulation of national air pollution levels. The possible placement of new standards at the frontier of technological capability may introduce problems of overextended guarantees, system failures, lack of user confidence, and unsatisfactory performance.

The operation and maintenance of pollution control systems is of growing concern to environmental regulators. The major focus of enforcement, to date, has been placed upon the installation of systems directed at achieving the installation of control systems may work against maintaining the desired operation and performance of those systems. The municipal bidding process and technology forcing particulate control standards are cited as possible illustrations of this problem.

# 1.0 EXECUTIVE SUMMARY

## 1.1 OBJECTIVES AND METHODOLOGY

In its Contract (68-01-4660) with Arthur D. Little, Inc. (ADL), the U. S. Environmental Protection Agency (EPA) asked for a diagnostic analysis of the pollution control industry (PCI). The objectives of the study were to aid EPA decision-making by:

- identifying constraints on the ability of the PCI to meet the needs and market demands deriving from EPA's regulatory initiatives;
- evaluating the performance of PCI member companies and their derivative attitudes towards future investments;
- estimating markets and associated employment associated with the PCI and its role in serving environmental regulatory requirements; and
- updating an earlier (1972) economic impact analysis of this industry.*

Two kinds of impacts were addressed in this study: (1) the impact of the regulatory process upon this industry and, conversely, (2) the impact of this industry upon the regulatory process.

### 1.1.1 Definitions and Scope

The primary focus of this study was placed upon the companies which supply specialized equipment, systems, and products for use in pollution control applications. Companies which participate in activities related to these systems and products were not a part of our analysis, e.g., construction firms, consulting engineers, fabricators, etc.

*"Economic Impact Study of the Pollution Abatement Equipment Industry," Report to EPA by Arthur D. Little, Inc., December 1972 (EPA Contract No. 68-01-0553).

The major sectors of the PCI covered by this study include:

1) Air Pollution Control (APC)

   Our analysis covered the equipment and instrumentation associated with the control of particulate and gaseous emissions from stationary sources. It did not cover products associated with the control of emissions from mobile sources.

2) Water Pollution Control (WPC)

   Attention was given to three kinds of WPC products: specialty equipment, instrumentation, and specialty chemicals.

3) Resource Recovery

   The study was limited to the emerging business for systems designed to recover energy and materials from municipal solid waste (MSW). It did not include the businesses associated with the collection transportation, and landfilling functions in solid waste management (SWM).

The time horizon of our analysis extended through the 1980's. Markets were reported in 1977 dollars. Geographically, the study was limited to the domestic industry and its domestic markets. Foreign opportunities and competition were considered to the extent that they are important in characterizing U. S. companies and the domestic marketplace. Generally speaking, pollution control businesses do not have important differences among major U. S. regions; therefore, a region-by-region analysis was not part of this work.

### 1.1.2 Approach

As we began work, EPA priorities for this updated analysis of the PCI began to change from that of the 1972 study.* The major change was one of focus and emphasis. In addition to developing a descriptive study of the PCI, we were directed to provide a more diagnostic study of the problems facing this industry. We were asked to identify critical issues, the ways in which EPA policies appear to affect them, and to recommend potentially fruitful ways in which EPA's policies might better sustain a healthier pollution control industry while still fulfilling EPA's statutory responsibilities.

*Supra.

Our major resource for doing this study was a series of interviews with representative pollution control companies. With the change in focus and emphasis, however, we postponed our industry interviews until we had gained a better understanding of some of the issues of interest to EPA and the PCI. We developed this preliminary understanding through discussions with EPA, other Federal agencies, and industry associations. We talked to about 20 EPA staff members from at least seven different areas of activity. We met with representatives from the Department of Commerce, the Council of Environmental Quality, and the Department of Energy. We also solicited issues related to our study from representatives of the Environmental Industry Council (EIC), the Industrial Gas Cleaning Institute (IGCI), the Water and Wastewater Equipment Manufacturers Association (WWEMA), and the Water Pollution Control Federation (WPCF). On the basis of those discussions, we developed nine issue categories. These categories are listed in Table 1-1, below. Specific points for discussion which we used within each of these categories may be found in Appendix 1.

Table 1-1

ISSUE CATEGORIES

1. Regulatory Impacts upon the:
    - A) Operation and Performance of the PCI
    - B) Customer Purchase and Operation of Pollution Control Systems
    - C) Costs and Benefits of Pollution Control Compliance
2. Industry Capabilities for:
    - A) Meeting the Changing Bases of Demand
    - B) Developing Needed Technologies
    - C) Providing Sufficient Production Capacity
    - D) Achieving Attractive Financial Returns
    - E) Sustaining Sufficient Competition
3. Company-Specific Capabilities and Attitudes for:
    - A) Continued Investment in the Pollution Control Business

Our interviews with pollution control companies extended over a period of four months from November 1977 through February 1978. These interviews were handled by a team of six ADL staff members. We visited more than 30 companies from which roughly 80 people gave of their time and effort. Several of these companies participate in more than one PCI sector. Hence, 15 of these companies were resources to us on the APC equipment business and 17 were resources on WPC equipment. APC equipment and WPC equipment received the greatest emphasis as the "heart" of their respective business sectors. We also contacted four suppliers of WPC chemicals and another four suppliers of air and/or water instrumentation systems. We also talked with eight companies participating in the resource recovery business.

We were not able to extend our coverage to other industries having relevant inputs to many of the issues in this study. For that reason, the issues and recommendations in this study may be parochial to our major source of information in this study: the manufacturers of specialized pollution control products.

## 1.2 INDUSTRY CHARACTERISTICS

### 1.2.1 Financial Performance

A typical leading supplier of pollution control products participates in several other businesses. Very few of the larger firms can associate more than 50% of their annual sales volume to environmentally related businesses. As a result, our financial analyses of representative pollution control activities are largely limited to financial statistics on entire corporate activities. This has the danger of misrepresenting the financial returns of pollution control businesses, but it has been our experience that overall corporate returns for the leaders of the PCI are fairly good indicators of their returns in their component pollution control businesses.

Representative growth rates and profitabilities for companies in five major sectors of the PCI are summarized in Tables 1-2 and 1-3 covering the the period 1972-1976. Comparable statistics are provided for ALL U. S. MANUFACTURING and larger industry segments reasoned to be comparable to the individual PCI sectors. The historical growth rates and profitabilities in Tables 1-2 and 1-3 were developed from composite performance data for groups of companies participating in each of the sectors. The companies used for this analysis are listed in Appendix 5. The companies used for the analysis were those believed to have 10% or more of their total corporate sales in environmentally related businesses. The instrumentation companies generally reflect an even smaller participation in this business area.

TABLE 1-2

AVERAGE ANNUAL GROWTH IN SALES AND NET INCOME FOR COMPANIES IN MAJOR POLLUTION CONTROL INDUSTRY SECTORS: 1972-1976

| PCI Sectors: | Average Sales Growth 1972-1976 (%/yr) | Average After-Tax Income Growth 1972-1976 (%/yr) |
|---|---|---|
| APC/WPC Instrument | 16 | 25 |
| APC Equipment | 20 | 23 |
| WPC Equipment | 18 | 19 |
| Resource Recovery Systems | 18 | 13 |
| Water Treatment Controls | 22 | 20 |
| **Comparative Industry Composites:** | | |
| All Manufacturing | 9 | 15 |
| Industrial Machinery | 18 | 11 |
| Industrial Chemicals | 17 | 18 |
| Instrumentation | 16 | 25 |

Source: Corporate Annual Reports, Security Exchange Commission Forms 10-K, Moody's Industrial Manual, and Standard and Poors' Industry Survey.

TABLE 1-3

AVERAGE RETURNS ON EQUITY AND SALES FOR
COMPANIES IN MAJOR POLLUTION CONTROL INDUSTRY SECTORS: 1972-1976

| PCI Sectors: | Average ROE 1972-1976 (%) | Average ROS 1972-1976 (%) |
|---|---|---|
| APC/WPC Instrument | 11 | 5 |
| APC Equipment | 10 | 4 |
| WPC Equipment | 11 | 4 |
| Resource Recovery Systems | 11 | 5 |
| Water Treatment Controls | 15 | 7 |
| **Comparative Inudstry Composites:** | | |
| All Manufacturing | 13 | 5 |
| Industrial Machinery | 14 | 6 |
| Industrial Chemicals | 14 | 7 |
| Instrumentation | 10 | 4 |

Source: Corporate Annual Reports, Security Exchange Commission Forms 10-K, Moody's Industrial Manual, and Standard and Poors' Industry Survey.

The average annual growth in sales (calculated in current dollars) for the PCI sectors was clearly stronger than the 9% per year growth for ALL MANUFACTURING. The range of growth for the equipment systems sectors (APC, WPC, Instrumentation, and Resource Recovery) was similar to that for the comparative industrial machinery industry composite, or between 16-20% per year. The WPC chemicals business enjoyed a greater growth (22% per year) than that for industrial chemicals generally (17% per year).

In terms of the growth in profits, all sectors did as well, if not better, than their industry composites. On an annual basis, this growth in profit ranged from 18-25% per year across these company groups.

The average return on stockholders' equity (Table 1-3) for these companies in the years 1972-1976 ranged from 10-11% for the equipment and instrumentation sectors to 15% for WPC chemicals. This compares to a range of 10-14% for the instrumentation, industrial machinery, and ALL MANUFACTURING categories and to 14% for the industrial chemical composite. Hence, on this return-on-investment measure, the PCI companies have been performing at only an average level of profitability for American industry; some have not even performed at that level. The same is true in terms of their average after-tax return on sales.

In summary, the PCI has generally enjoyed greater than average growth with only average profitability. An important exception to this is the WPC chemicals sector--really a water treatment chemicals sector--which has been among the most profitable in American industry. This kind of "profitless prosperity" mirrors the disappointment which many PCI companies have found in this "glamor industry." Growth markets usually provide higher than average profitabilities which in turn stimulate needed business investments. This history of average or lower than average profitability is working against investment in new plants and technologies by companies within the PCI.

A final and important characteristic of leading pollution control companies is that they typically do not have the financial strength of multi-billion dollar corporations. The largest PCI participants typically are intermediate in size, e.g., with corporate sales of from $200 to $700 million per year. EPA's dependence upon this industry to solve future pollution control problems is thereby more tenuous than other Federal regulatory efforts which depend upon industries comprised of multi-billion dollar corporations. The PCI is not only hampered by profitabilities which discourage further investment, but also by limited corporate resources to manage the risks associated with this enforcement-driven market.

### 1.2.2 Technological Capabilities

The availability of needed technology corresponds to the maturity of the major market segments within the PCI, i.e., there's a greater need for technological development in resource recovery at the present time than there is in air and water pollution control.

Needed technology for near-term water pollution control problems is believed by the PCI to be well-developed. An issue now is just how much tertiary or other advanced treatment is actually going to be required in the 1980's. One of the stimuli for new WPC product innovation in recent years has been the need for energy conserving technologies. Insofar as it takes three to five years to develop a new control technology, future pollutant-specific regulations (i.e., for toxics and hazardous materials) will probably be met through available technology.

It is reported that the rate of truly new product innovation in water pollution control has declined--as evidenced, for example, in industry tradeshows. Some of the motivation for developing new products has also changed. The traditional market of greatest focus for leading wastewater treatment equipment suppliers--the municipal market--has become less profitable. In earlier years, WPC equipment manufacturers would develop new products for the municipal market and then look for further applications in the industrial market. Now a reverse priority is in effect--there being indications that lesser grades of traditional equipment are being manufactured to meet the needs of a "low-price, bid-shopping" municipal business.

Air pollution control technologies are employed for either particulate or gaseous emission control. For some time, the PCI has believed that adequate particulate control technology exists to meet regulatory needs. A renewed emphasis by EPA on higher percentage removals of particulates has introduced a new phase of competitive activity in the utility segment of the particulate market. Hence, although technology has been available for the control of particulates, there have been recurrent opportunities for better performance from the established technologies.

Gaseous emission control remains a major frontier for new technological development. The proving of technologies for the control of $SO_2$ emissions has been going on for at least a decade. Controlling $NO_x$, hydrocarbons, carbon monoxide, and hazardous emissions still lies ahead. In the area of gaseous emission control, air pollution control progress can be viewed as having been partly technology constrained.

The proving of technology is very much a part of current resource recovery efforts in the municipal solid waste marketplace. Waterwall incineration has been proven abroad, but still must be considered to be in its early stages of commercialization in this country. Technologies directed at producing refuse derived fuels hold equal promise but are still to be proven. Recent domestic experience with pyrolysis systems has been disappointing, and the timetable for their commercial application has been set back accordingly.

The technological capabilities of the PCI vary from sector to sector and from company to company. Current capabilities may be related to at least two factors: the historical importance of R&D for these companies and the recent profitabilities of these businesses. Environmental regulation has created growth markets for what had been mature businesses for most of these leading companies. The mature businesses in these companies had not required R&D, and R&D budgets had been historically on the low side. The first waves of environmental regulation have been directed at "catching up" with pollution control problems with already available technologies. Hence, these early legislated markets have not really required great R&D capabilities either. In fact, this has proven to be a point of frustration to those who have developed modern technologies in advance of actual market need.

If these companies are to change their emphasis on technological development, potential profitability would need to be sufficiently attractive to encourage that investment. However, the PCI is not currently in a good position to be a strong resource for developing new technologies--R&D has not been an important part of its history and the recent average profitability of this business does not encourage a change in that pattern.

Increased emphasis upon in-process approaches to pollution control presents a further challenge to the PCI. It is difficult to document (and it will continue to be so) how much of this is being done. As it gains importance, it is not clear to what extent the traditional PCI companies will share in the new opportunity. Those PCI companies which now participate in process equipment or combustion technology are in a better position to benefit from this transition. The problem is that these approaches may tend to be handled by internal customer engineering staffs or process engineering firms, and that the markets for in-process approaches will not be identifiable as environmentally-driven demand.

### 1.2.3 Capacity, Supply, and Competition

Normally, these three subjects would deserve separate sections in a microeconomic impact study of an industry. In this study, we have attempted to place more emphasis upon diagnosing problems and constraints than upon providing an evenly distributed descriptive study of the PCI.

There are simply no apparent major constraints (i.e., shortages) in the PCI at this time with regard to either capacity, supply, or competition. In terms of capacity and competition, current problems are not ones of "too little" but more those of "too much." Shortages of material and other bottlenecks are constraints which are largely beyond the control of this industry and which can appear at any time. Except for some items which have seemed to have always had long delivery times (e.g., specialty pumps), no serious shortages are being experienced now or envisioned for the near future.

Any potential problems in manufacturing capacity in the near future are buffered by the extended use of outside fabricators by the equipment companies. There is no concern about the near-term availability of good fabricating shops. The greater limitation upon capacity in periods of peak demand is believed to more likely come from a shortage of skilled manpower than from one of manufacturing capability.

Between 500 and 1,000 firms participate in the major sectors of the PCI covered by this report. In mature businesses such as air and water pollution control equipment markets, the top 15-30 firms account for 60-80% of the total business.

The problem of "too much" competition has been most evident in the markets for new technologies. Markets for flue gas desulfurization systems and resource recovery systems are outstanding examples in which more than a sufficient number of competitors have appeared to supply available markets. There can be no question that competition has been working in these frontier markets. It has been working so well that most of the companies have yet to make any profits in these markets.

While foreign technology appears to be playing an increasing role in the U. S. market, foreign companies have not been notably successful in achieving U. S. market positions. The greatest influence of foreign competition has come through licensing relationships with U. S. manufacturers. More significant inroads have been made by foreign companies in pollution control instrumentation, but that is more characteristic of international competition in instrumentation than it is of the pollution control business. Even there, the proportion of the domestic market held by foreign suppliers is probably 10% or less.

The dominant source of competitive advantage in pollution control markets tends to be marketing position. Defined to include marketing capability, customer know-how, and business experience, it is market position which has provided the basis for growth by PCI companies and protected them from attempts by multi-billion dollar companies to enter these markets.

After a decade of "growth and glamor" attributed to PCI businesses, not a single billion-dollar corporation has entered a major sector of this business and successfully carved out a broad leadership position in it. This has been most notably illustrated in the water treatment specialty chemical business where the profits have been sufficiently attractive to draw the attention of even the most profitable segments of American industry. There, the leading suppliers are the same as those who led the industry five and ten years ago, and their market shares have not suffered.

Many participants in PCI businesses foresee a significant shakeout of competition--because of low profitability and the overabundance of competitors. With that is anticipated an improvement in profitability and stability. We cannot agree with that projection because of the continued strong interest by potential new entrants in its markets. We

expect as many companies to enter these businesses over the next decade as drop out of them. In short, we foresee that turnover--not shakeout--will characterize this market over the near-term; but that turnover may be significant.

### 1.2.4 Demand and Employment Estimates

The estimated demand and associated employment for the major sectors of the PCI covered in this study are summarized in Table 1-4. The markets for specialty equipment and products in 1977 totaled roughly $1.8 billion and are projected to grow to a level of $3.5 billion by 1983.

WPC equipment markets in 1977 represented the sum of about $290 million from municipal sewage treatment and about $260 million from industrial wastewater treatment. This represents a reversal from the breakdown in recent years when the industrial market had been the larger of the two. With the passing of the 1977 deadline for industrial treatment compliance, the industrial market has quieted down while the Federal funding program has sustained the municipal market. Over the next five to ten years, the municipal market is expected to grow at a pace of 10-12% per year and in the industrial market is expected to grow at a pace of 8-10% per year.

The WPC instrumentation market is estimated to have been about $150 million in 1977 including both its municipal and industrial segments. Growth rates over the next five to ten years are expected to be similar to those for WPC specialty equipment. APC instrumentation is somewhat less than a $50 million market and is expected to grow at a 6-8% annual growth rate into the late 1980's.

The markets for WPC chemicals (both bulk and specialty) were around $250 million in 1977. An associated market of $650 million is enjoyed by many of the same companies in water treatment applications. The growth rate for wastewater treatment chemicals is forecasted at 15-19% per year out of a total business for water and wastewater treatment chemicals which is expected to grow at 12% per year.

The APC equipment business in 1977 is estimated at $700 million annually. About 10% of that was associated with the control of gaseous emissions, primarily $SO_2$. The remainder represents business associated with the control of particulates--the traditional market for air pollution control suppliers. These market estimates represent the "flange-to-flange" equipment business. These companies also participate in the design and construction activities which, in general, can provide a further business which is equal to or twice that of the flange-to-flange business. Growth rates of 6-8% and 18-20% are anticipated for particulate control and $SO_2$ control systems, respectively--i.e., an overall growth rate in the order of 8-10%.

TABLE 1-4

ESTIMATED DEMAND AND EMPLOYMENT ASSOCIATED WITH THE SUPPLY OF POLLUTION CONTROL PRODUCTS

(1977 and 1983)

| Major PCI Sectors | Level of 1977 Demand (MM$/yr) | Associated Job Equivalents-1977 |
|---|---|---|
| WPC Equipment | 550 | 11,000 |
| WPC Instrumentation | 150 | 3,750 |
| WPC Chemicals | 250 | 3,850 |
| APC Equipment | 700 | 14,000 |
| APC Instrumentation | 50 | 1,250 |
| Resource Recovery | 100 | 2,000 |
| TOTAL | $1,800 | 35,850 |

| Major PCI Sectors | Level of 1983 Demand (MM$/yr) | Associated Job Equivalents-1983 |
|---|---|---|
| WPC Equipment | 1,000 | 12,500 |
| WPC Instrumentation | 300 | 5,000 |
| WPC Chemicals | 600 | 6,000 |
| APC Equipment | 1,250 | 15,600 |
| APC Instrumentation | 100 | 1,700 |
| Resource Recovery | 250 | 3,100 |
| TOTAL | $3,500 | 43,900 |

Source: Arthur D. Little, Inc., estimates.

Resource recovery markets have been in the order of $50-$100 million in the last few years. Growth rates should average 15-20% over the next decade--contingent upon the proving of resource recovery technologies in the next two to three years.

The annual employment associated with the 1977 level of demand is estimated at 35,850 jobs; employment is projected to grow (at 3.5% per year) to 43,900 in 1983. Employment projections are based on an overall growth in PCI demand of 11.5% per year but also an 8.0% per year increase in the sales-per-employee ratio. This increase in the sales-per-employee ratio is proportionally the same as that in 1972-77 and assumes that inflation and other business factors will continue to affect the ratio.

Employment estimates are based on average sales/employee ratios developed from groups of leading companies serving each of the PCI sectors. The average sales/employee ratio used for the different sectors of the industry was roughly $50,000 per person. As the demand estimates in Table 1-4 include only those associated with flange-to-flange equipment and other specialty products, the employment estimates are accordingly only those associated with those businesses. They do not include jobs associated with the design and construction of pollution control facilities. Those estimates would be derived from a similar analysis of the consulting engineering business, the fabrication business, and the construction business.

### 1.2.5 Corporate Commitment and Business Risk

One reason that turnover may be high among PCI companies is that the commitment of some of them to these businesses is waning. Profitability has been disappointing, as some companies expanded their environmental businesses on an opportunistic basis in anticipation of relatively short-term rewards. In addition, the role of proprietary technology has been disappointing. Some companies, therefore, are showing signs of diverting their future investments towards other opportunities, if not getting out of the pollution control business altogether.

A larger number of companies have expressed strong commitments to remaining in these businesses. These commitments are based on a belief in the long-term growth of the business and a satisfactory improvement in profitability.

These businesses are viewed as risky ones by a large portion of the PCI. While legislated markets and Federal funding programs would appear to ensure business volume, PCI companies have found that the enforcement process can affect the timing of that business, and timing can make all the difference.

Risk is further embodied in the requirement of performance guarantees in a regulatory environment of technology forcing standards. Guarantees of system performance across a variety of situations at the frontier of

technological practice practically assure some amount of vendor risk, customer disappointment, and enforcement delay. PCI managements simply cannot step away from such contracts, given the healthy competition which exists in most of these markets.

Other elements make up risk for the PCI. It has experienced above average inflation rates--and in 1973-75, against fixed-price contracts. Research and development is risky because it may take five years to develop a new system while regulatory initiatives can bloom or change direction within a year's time. There is the financial risk in the potential overinvestment in people and facilities in anticipation of a demand which may then fade with unrealized legislative deadlines. Although pollution control markets have not followed the general economic cycle, they have their own business cycles and the risks associated with such cycles. Finally, supplier reputations are at risk insofar as they are tied to the operating performance of their products. This performance, in turn, is controlled largely by customers who may not be sufficiently motivated or skilled to properly maintain pollution control systems.

## 1.3 MAJOR REGULATORY EFFECTS AND ISSUES

### 1.3.1 The Municipal Bidding Process

The municipal bidding process is the area offering the greatest potential for EPA to have a positive impact upon the health and performance of the Pollution Control Industry (PCI). The current procedures governing the municipal bidding process are widely believed by the PCI to be a major cause of disappointing profitability in the water pollution control business.

The predominance of "low bid" purchasing in the municipal market segment is believed to be impeding technological innovation. It is also believed that "low bid" purchasing will result in expensive operating and maintenance problems for municipal plants in the future.

The widespread practice of (post-award) bid-shopping in the municipal marketplace compounds the problems of "low bid" purchasing. With bid-shopping, there is the possibility that the actual costs of treatment systems are not closely correlated to the award prices paid by municipalities. The federal construction grant program may not be enjoying the full benefits of competition to the degree that the most serious price competition takes place after the construction awards have been made.

A by-product of the current municipal bidding process which should be of concern to EPA is that two grades of products are reported to have appeared in the water pollution control business: an industrial grade and an inferior municipal grade. This development illustrates the predominance of price over performance or technology in this marketplace.

It also reflects a competitive response to bid-shopping practices which are highly sensitive to price differences and relatively less sensitive to product differences.

We have focused on the views of the PCI and have added our own perspective and judgment in this analysis. As these are not the only relevant perspectives, other points-of-view need to be balanced against those reported here. Other interested parties include the municipalities, the consulting engineers, the contractors, the manufacturers' representatives, the materials suppliers, and the federal and state governments.

We are reporting that this remains an area of the utmost concern to the PCI. We are also reporting that there may be competitive, technological, and economic by-products of the current municipal bidding process which were not intended in the legislation (or by its supporting procedures) and which warrant EPA's further attention.

### 1.3.2 The Role of Federal R&D

A first question is whether there is a need for new control technologies to support current and near-term regulatory initiatives. From the points of view of many in the Pollution Control Industry (PCI), the needed technologies are generally available. Others find that position untenable in a field like pollution control where users will continue to seek lower cost solutions for what are viewed as "non-productive" investments.

If it is accepted that there are needs for new control technologies or control technologies appropriate for new regulatory initiatives, then the issue becomes that of determining the most dependable source of technological innovation.

Consistent with broader Federal efforts to depend as much as possible on the private sector for the development of new and proprietary technologies, EPA's R&D budgets have been declining with regard to the development of new control technologies.

In the case of technological innovation in new pollution control technologies, however, the existence of sufficient motivation and capability in the private sector may be subject to question. The private sector, in this case, may refer to either the PCI or to manufacturing industries seeking to solve their own pollution problems.

Industries seeking to solve their own pollution problems are also the traditional "reluctant customers" of the PCI. This reluctance to purchase pollution control systems may reasonably describe their limited motivation for funding R&D on new control technologies. In short, this largest segment of the private sector provides only a limited foundation for developing new technology in this Federal regulatory area.

The PCI is likewise a limited source of private sector R&D. Leading PCI companies continue to enjoy only average profitability within American industry. While PCI returns are consistent with those for similar manufacturing operations, they have not been conducive to investments in technological innovation. This constraint in motivation is in addition to the historically low level of R&D capability needed by PCI companies in serving their customers prior to the environmental era.

Further, the leading PCI companies are not among the largest companies in our economy. The larger PCI firms are typically in the range of $200-$700 million in annual sales. Their size as well as their recent profitability do not allow for substantial in-house efforts in basic research. Most of their R&D emphasis has become focused upon making refinements to existing technology. Larger, billion-dollar corporations looking to enter PCI markets face the different risks associated with their lack of PCI business know-how. These risks have been reflected in the failure thus far of many PCI ventures by these larger corporations.

An analysis seems thus warranted of the relative merits of Federal support of R&D in pollution control technology versus similar needs in other domestic, non-defense programs. As it stands, existing resources for enhanced technological innovation are questionable if the United States is to depend on its own technical leadership in this area. The increasing importance of foreign technology in the domestic pollution control market seems to underline a diminished pace of U.S. developments.

### 1.3.3 The Role of Technology Forcing Standards in Air Pollution Control Regulation

The promulgation of more stringent air pollution standards for particulate and sulfur oxide emissions from stationary sources promises to have significant impacts upon the Pollution Control Industry (PCI), raises the possibility of counterproductive effects on achieving and maintaining compliance, and presents some issues regarding the use of technology forcing standards.

In recent years, market instability and delayed enforcement have contributed to disappointing profits and performance for companies in the air pollution control business. Thus far, only a few companies may have made any profit from their participation in the flue gas desulfurization (FGD) segment of the business. Increasingly stringent standards for sulfur oxide emissions will extend the period of uncertainty for FGD suppliers in times of technological capability, operating experience, and market position.

The most stable and profitable part of the air pollution control business has been that of particulate control for utility boilers. The setting of more stringent particulate control standards thus promises to shake up the only sustained business that these companies have known in recent years. By itself, this impact is noteworthy but not sufficient cause for altering regulatory policy.

More important are issues related to the ultimate achievement and maintenance of compliance with these emission standards. These issues arise from an understanding of probable PCI impacts and their derivative implications for regulatory effectiveness.

Just as particulate control has been the steadiest part of the air pollution control business, it has also been the most dependable element of air pollution regulation. The setting of new standards at the frontier of current technological capability might then possibly interrupt the steady progress in particulate emissions control.

Competing at the frontier of technology will require that the PCI overextend their ability to guarantee particulate control performance to a level of little operating experience. At worst, technologies will be "created in the contract" and not in the pilot plant. In short, a substantial number of system failures are likely under these circumstances. System failures may then frustrate regulatory programs by leading to operational problems, by undermining the confidence of users, by providing evidence to reluctant buyers that the systems don't work, by delaying compliance and operation of new utility boilers or by resulting in a net increase of particulates in the atmosphere.

The role of technology forcing standards may differ in a situation--as in particulate control--in which there exists an established and proven technology to control a pollutant to a certain level. Environmental concerns may require higher performance in controlling this pollutant, but a technology forcing standard may be less effective than it is in a situation in which no technology exists to control any satisfactory amount of a pollutant.

### 1.3.4 System Operation and Maintenance

The main concern for customers of the Pollution Control Industry (PCI) has been to install the systems needed to meet minimum regulatory requirements. In this context, greater emphasis has been placed upon capital investment and appropriate technology, and less attention has been given to eventual operating costs and performance.

As pollution control regulation moves from a stage of "catching up" to one of "keeping up" or even of "keeping ahead," EPA is paying more attention to the maintenance, operation, and performance of pollution control systems. This transition in regulatory focus is likely to uncover many relationships between current pollution control business practices and the long-term operability of pollution control systems.

Several of the issues confronting the PCI hint at some of the problems which may arise in EPA's efforts to regulate operation and maintenance. In the business of resource recovery from solid wastes, the trade-offs between public and private operation of sophisticated systems bear on the prospects for future solid waste management operations. In the air pollution control business, the setting of new emission standards at the frontier of technological capability may reduce the operating dependability of the resulting control systems. In the water pollution control segment, bid shopping and other capital cost-dominated purchasing may work against the operability of municipal sewage treatment plants.