UMI Number: 1380389

UMI
300 North Zeeb Road
Ann Arbor, MI 48103

ABSTRACT

POLLUTION PREVENTION IN THE NEW JERSEY CHEMICAL INDUSTRY: MOTIVATIONS AND BARRIERS TO COMMITMENT

This study of the New Jersey Chemical Industry identifies the primary elements that lead to or inhibit company commitments to pollution prevention. A direct measure of facility pollution prevention commitment is developed that takes into account: organizational support attributes, past reductions achievements, current methods implementation, process reduction goals, and special environmental initiatives. The "P2 Commitment Index" allows for categorization of facilities so that the needs and interests of varying groups may be differentiated.

Higher level commitments are associated with: establishment of company pollution prevention policy, setting of prioritized facility goals, and measurement and reporting on pollution prevention progress. Facilities at above average commitment levels are motivated by a drive for improved quality, market competitiveness, and consumer demand for "green" products and investment opportunities. Firms of below average commitment are driven primarily by regulatory requirements and often lack the awareness of pollution prevention opportunities and techniques, needed to fully participate.

POLLUTION PREVENTION IN THE NEW JERSEY CHEMICAL INDUSTRY: MOTIVATIONS AND BARRIERS TO COMMITMENT

by

Judith A. Thornton

A Thesis
Submitted to the Faculty of
New Jersey Institute of Technology
in Partial Fulfillment of the Requirements for the Degree of
Master of Science

Department of Environmental Policy Studies

May 1996

APPROVAL PAGE

POLLUTION PREVENTION IN THE NEW JERSEY CHEMICAL INDUSTRY: MOTIVATIONS AND BARRIERS TO COMMITMENT

Judith A. Thornton

Dr. Peter B. Lederman, Ph.D., P.E., DEE, Thesis Advisor — Date
Director, Center for Environmental Engineering and Science, NJIT
Research Professor of Chemical Engineering

Dr. W. Patrick Beaton, Ph.D., Committee Member — Date
Professor of Social Science and Policy Studies
Institute for Transportation, NJIT

Dr. Bruce Kirchhoff, Ph.D., Committee Member — Date
Professor of Management, School of Industrial Management, NJIT

BIOGRAPHICAL SKETCH

Author: Judith A. Thornton

Degree: Master of Science

Date: May 1997

Undergraduate and Graduate Education:

- Master of Science in Environmental Policy Studies,
  New Jersey Institute of Technology, Newark, NJ, 1997

- Bachelor of Science in Civil Engineering,
  Duke University, Durham, NC, 1982

Major: Environmental Policy Studies

Current Position:

- Zoning Officer
  Borough of Califon, New Jersey, 1989-present

- Planning Board/Board of Adjustment Member,
  Borough of Califon, New Jersey, 1990-present

Dedicated to pollution prevention practitioners the world over...

ACKNOWLEDGMENT

Sincerest thanks to Dr. Peter Lederman, my Thesis Advisor, for the guidance, direction, professional advice, and moral support that has made this project possible.

My thesis committee members, Dr. Patrick Beaton and Dr. Bruce Kirchhoff, have rendered invaluable assistance in reviewing and fine tuning the components of my research and data analysis. Their availability and tireless efforts have been an inspiration and are very much appreciated.

My thanks to Dr. Marcus Healey, Executive Director of the New Jersey Technical Assistance Program, NJIT, and Dr. Daniel Watts, Executive Director of the Emission Reduction Research Center, NJIT, for their reviews and suggestions toward improving the survey instruments and supporting documentation, as well as their professional input as members of the panel of pollution prevention experts.

Michael Aucott, Research Scientist with the New Jersey Department of Environmental Protection (NJDEP) Office of Pollution Prevention, provided me with the Pollution Prevention Plan Summary database and has been available to answer the many technical, as well as regulatory questions that have come up along the way. His time and assistance are most appreciated.

My thanks to Theodore Berger, President of Environmental & Safety Associates, Nutley, NJ, for his reviews and input toward the survey instruments and supporting documentation, and to the following professionals for their time and willingness to serve on the panel of pollution prevention experts: Carolyn Nunley, INFORM, New York, NY; Jeanne Herb, Director, NJDEP Office of Pollution Prevention; Thomas Zosel, Manager, 3M Pollution Prevention Programs, St. Paul, MN; Harry Freeman, Chief, Pollution Prevention Research

Branch, US Environmental Protection Agency; Curtis Fisher, Attorney, NJ Public Interest Research Group; Sally Dudley, Executive Director, Association of NJ Environmental Commissions; and Marie Curtis, Spokesperson, NJ Environmental Lobby.

Special thanks are extended to the many members of the New Jersey Chemical and Allied Products Industry who graciously responded to telephone interviews and/or the study questionnaires. Their kind reception of my telephone calls and insightful discussion of pertinent pollution prevention issues made the daunting task of completing 232 telephone interviews, an unexpected pleasure. The care with which respondents completed the study questionnaires (many were typed), inclusive of a great deal of additional, very knowledgeable commentary was extraordinary. May the results of the study serve them well.

Finally, my deepest appreciation must go to my family and loving husband, Dana, for the patience, support, and understanding that were so crucial to seeing this thesis to its conclusion.

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

TABLE OF CONTENTS
(Continued)

Chapter **Page**

LIST OF TABLES

LIST OF TABLES
(Continued)

LIST OF TABLES
(Continued)

LIST OF TABLES
(Continued)

Table **Page**

LIST OF TABLES
(Continued)

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1 Background

Accelerated industrial development in the United States since World War II has made the use, generation, storage and disposal of hazardous and/or toxic chemical materials an integral part of the day-to-day business activity of many companies. Legislative attention focused on the creation of stringent regulations to govern toxic substances and to protect the public health, after the occurrence of a number of chemical waste events in the 1970's. These include such well-known incidences as the Kepone contamination of the James River in Virginia, Dioxin pollution of Times Beach, Missouri, and the 'Love Canal' predicament, in which land-deposited toxic chemicals later surfaced in the homes and drinking water of residents in Niagara Falls, NY (Herzik 1992). The 1984 chemical explosion in Bhopal, India, in which the release of methyl isocyanate resulted in over 3500 deaths and 200,000 injuries, underscored the need for responsible handling and led to further strengthening of hazardous substances laws in the United States (Keoleian and Menerey 1993).

The result today is a rather complex web of rules and regulations that focus on management and control of pollution, by segregated media (i.e., land, air, water). This legislation is primarily of the "command and control" genre, wherein compliance is mandated with the threat of enforcement via fine or penalty. The most significant of these environmental laws are outlined in Table 1.1.

While the traditional pollution control approach has achieved some success, for example in improved air quality (Mounteer 1994), toxic waste materials continue to be released to the environment in large quantities. Toxics Release Inventory (TRI) data (required

Table 1.1. Major Federal Environmental Laws Governing Hazardous and Toxic Substances

Resource Conservation and Recovery Act (RCRA) 1976 and Hazardous & Solid Waste Amendments (HSWA) 1984	Defines hazardous substances, requires tracking of waste "from cradle to grave" via manifest system, and requires permitting of facilities treating, storing or disposing (TSD) of listed hazardous wastes. Amendments seek reduction/elimination of hazardous waste generation, "wherever feasible."
Comprehensive Environmental Response, Compensation and Liability Act (CERCLA or Superfund) 1980, and 1986 Superfund Amendment and Reauthorization Act (SARA)	Establish funding and authorize EPA along with state and local officials, to identify, prioritize, stabilize and remediate defunct hazardous waste dump sites. Further, provides enforcement authority to identify and aggressively seek financial compensation from responsible parties.
Emergency Planning and Community Right to Know Act (EPCRA - also a part of SARA 1986)	Requires establishment of local and state emergency response commissions charged with formulating and when necessary, implementing response plans in case of hazardous substance emergencies. Further, requires facilities to report to planning commissions regarding the presence, inventory, and release of extremely hazardous substances.
SARA Title III (also part of SARA 1986)	Mandates annual submission of a toxics chemical release inventory (TRI) report, identifying quantities of chemical releases to air, water, and land, and amounts transferred off site.
Toxic Substances Control Act (TSCA) 1976	Authorizes EPA to identify and evaluate potential hazards from, and regulate production, use, distribution and disposal of chemical substances.
Clean Air Act (CAA) 1970 with amendments 1977, 1990	Regulation of air pollutants from stationary and mobile sources, including toxic emissions; acid rain provisions governing fossil-fueled power plants, ozone protection requiring phase-out of CFC's.
Clean Water Act (CWA) 1977 (Originally, Federal Water Pollution Control Act 1972) with amendments 1987	Sets water quality standards, establishes National Pollutant Discharge Elimination System (NPDES) to require discharge permits with mandated effluent limitations, requires waste treatment areawide, to manage point and nonpoint sources.
Federal Insecticide Fungicide and Rodenticide Act (FIFRA) 1947 with amendments 1972, 1988, 1991	Requires EPA registration and classification of pesticides, fungicides, rodenticides; mandates labeling procedures and certification of "absence of unreasonable adverse effects on the environment when used" (Keoleian and Menerey 1993).
Occupational Health and Safety Act (OSHA) 1970 amended 1990	Sets standards and enforcement procedures for worker safety and health protection, from electrical, mechanical, chemical hazards; includes worker right to know provisions, training and education, and requirements for hazardous materials labeling.

(Source: USEPA Life Cycle Design Guidance Manual 1993) under SARA Title III - see Table 1.1) for 1993, for example, show a total national release by reporting facilities, of 2.79 billion pounds: 271 million pounds to water sources, 1.66 billion pounds in air emissions, 289 million pounds disposed to land, and 576 million pounds injected into underground wells (USEPA 1995a:182). Releases for 1989 through 1993 (the most current data year available) are shown in Table 1.2. While it appears that releases are decreasing overall, several studies suggest that these may largely represent only "phantom reductions," caused by changes in reporting practices (i.e., accounting methods, estimation procedures, interpretation of instructions) (Mounteer 1994, Riley, Warren and Goidel 1994, Freeman 1992).

Table 1.2. National Toxics Release Inventory Data

Reporting Year	Quantity Released (billion pounds)	Quantity Transferred for Off-Site Treatment/Disposal (billion pounds)	Totals (billion pounds)
1989	4.38	1.45	5.83
1990	3.69	1.31	5.00
1991	3.39	3.73	7.12
1992	3.19	4.51	7.70
1993	2.79	4.70	7.49

(Source: Toxic Release Inventory Public Data Releases, USEPA 1991-1995)

Those required to report TRI data include owner/operators of manufacturing facilities (Standard Industrial Classification [SIC] codes 20-39) having ten or more full-time employees, and using a listed toxic chemical in excess of 10,000 lbs/year, or manufacturing/processing one in excess of 25,000 lbs/year. Requirements were expanded in 1991 to include reporting of quantities transferred off-site for recycling and energy recovery. This change is reflected in the marked increase shown in quantities transferred between 1990 and 1991. It must be noted that TRI data do not take into account certain factors, such as the following: "production level fluctuations over time; new treatment technologies that reduce reported amounts of waste while not changing generation rates; changes that shift wastes to the product itself; and material substitutions that result in new waste types, which in turn are regulated differently or not at all" (US GAO 1994).

TRI data for the state of New Jersey, are shown in Table 1.3. The most current breakdown available, again for the 1993 reporting year, indicates a total release of 19.4 million pounds: 15.4 million pounds in air emissions, 3.30 million pounds to surface waters, and 637 thousand pounds released to land (USEPA 1995b:New Jersey).

Table 1.3. Toxics Release Inventory Data - New Jersey

Reporting Year	Quantity Released (million pounds)	Quantity Transferred for Off-Site Treatment/Disposal (million pounds)	Totals (million pounds)
1987	not available	N/A	174.7
1988	N/A	N/A	167.4
1989	N/A	N/A	124.3
1990	25.9	88.9	114.8
1991	23.1	180.2	203.3
1992	21.4	191.4	212.8
1993	19.4	181.0	200.4

(Source: Toxics Release Inventory Public Data Releases, USEPA 1991-95)

1.1.1 Pollution Prevention (P2)

In the 1970's-1980's several forward-looking industries introduced the notion of "pollution prevention." This concept advocates avoidance of the costs, safety problems, liabilities, and regulatory headaches inherent in hazardous/toxic materials management, by eliminating or reducing the use and generation of such substances, to begin with. The 3M Company was one of the first to explore this new territory with its program, "Pollution Prevention Pays." 3M found that it is feasible to design products with materials substitutes which are less hazardous when in the mid-1970's the company was denied permits for an instant fire extinguisher for jet airplane cockpits, because of its toxicity. 3M scientists identified the miscreant substances in its product and discovered substitutes that were one fortieth as harmful as well as less costly to produce (US EPA 1993:2). Since 1975, 3M's Pollution Prevention Pays program has saved the company $500 million and reduced its pollution 50 percent per unit of production (Zosel 1990:70).

Success stories like 3M's have surfaced more and more frequently in the years since 1975, with a number of innovative companies able to show reductions in pollutant discharges and overall toxics handling as well as significant cost savings. The most important aspect of the pollution prevention philosophy is its shift in focus from the capture, treatment and disposal of "end-of-pipe" contaminants, to upfront product/process design. Ideally, environmental impacts are identified and eliminated before manufacturing even begins. An overview of the primary pollution prevention (also known as, "waste minimization") techniques is shown in Figure 1.1.

While several states began to implement pollution prevention laws of their own by 1989, it was not until 1990 that the philosophy was clearly delineated in national law, with passage of the federal Pollution Prevention Act (PPA). The PPA of 1990 established the following hierarchy of objectives (USCA Title 42, 1990:723):

a) Prevention or reduction of pollution at the source;

b) Recycling of pollutants that cannot be prevented;

c) Treatment of pollution that cannot be prevented or recycled;

d) Disposal of pollutants "only as a last resort," when no other options are feasible.

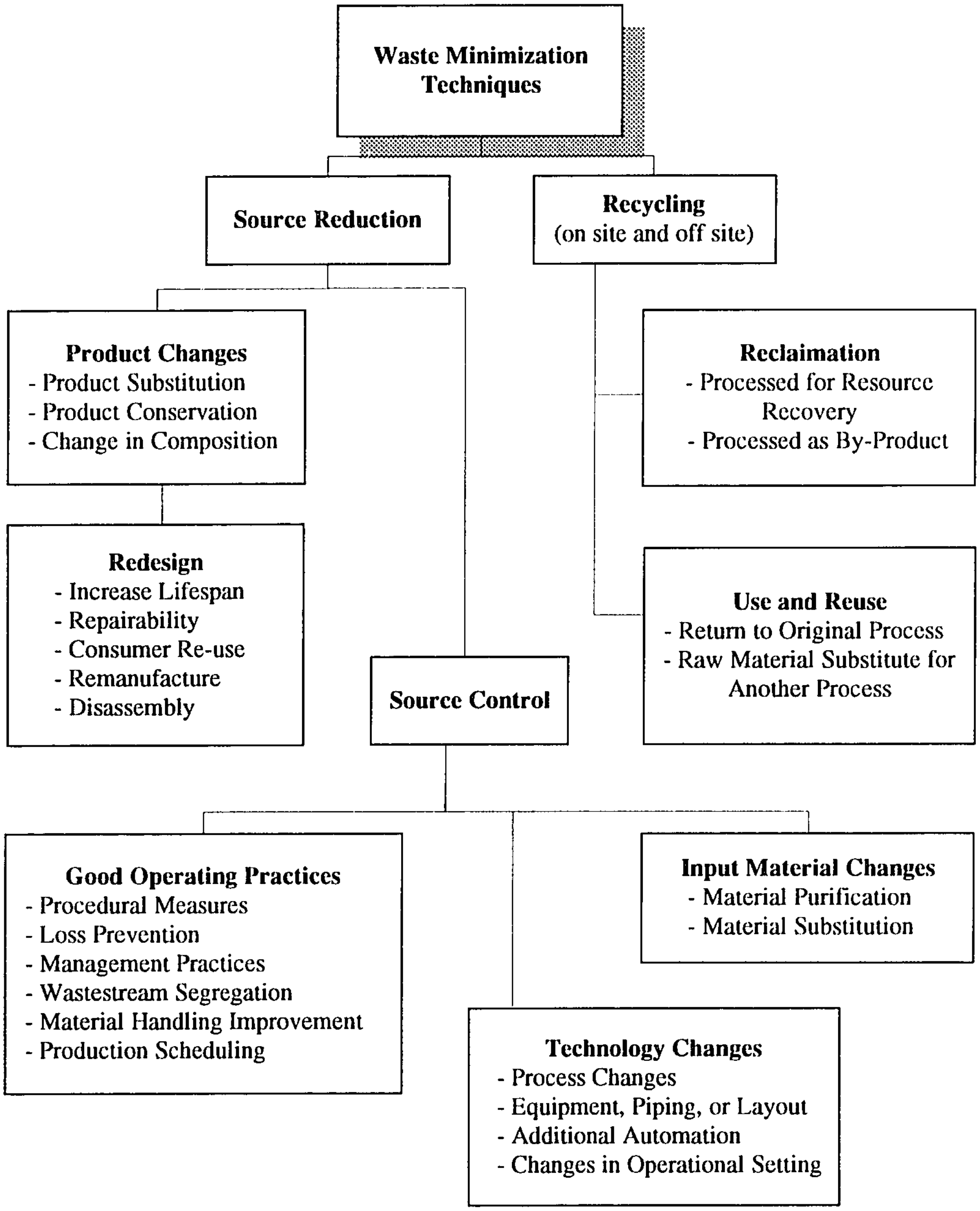


Figure 1.1. Waste Minimization Techniques (Sources: Freeman 1990, Beaumont 1993)

The Act further stipulates that all facilities required to report releases of toxic substances (TRI data) under SARA Title III must also report on source reduction (defined to include reductions achieved through process or product redesign, materials substitution, improved facility housekeeping, and the like) and provide recycling information for each pertinent toxic chemical. Like TRI data, all reported information is made available to the public.

The PPA is different from other environmental regulations in two important ways. First, congruent with pollution prevention philosophy, it shifts the focus from end-of-pipe regulation of segregated wastestreams, to upfront manufacturing design considerations. Second, and representing a change that could prove to be of historic significance, the PPA outlines a voluntary compliance ideology rather than the usual "command and control" approach. Companies are required to report on quantities of chemicals entering the wastestream and on progress made toward reducing releases to the environment each year. However, they are neither compelled to make specific process changes nor mandated to achieve use or generation reductions. The PPA serves to challenge and to encourage business managers to meet the policy goals of prevention and source reduction, and to do so in any fashion they find suitable.

1.1.2 The New Jersey Pollution Prevention Act

The New Jersey Pollution Prevention Act (NJPPA) was enacted by the legislature in 1991. Because this study will examine certain characteristics of businesses regulated by and with specific reference to the NJPPA, it is important to highlight the differences between it and the federal PPA. While similar to the federal version in shifting focus from control of end-of-pipe pollutants to prevention and in also employing a voluntary compliance structure, the NJPPA differs significantly in other areas. The New Jersey statute assumes the objectives hierarchy of the national model, but carefully defines pollution prevention and outlines acceptable versus unacceptable strategies, as illustrated in Table 1.4. Further, the policy goal is more ambitious, seeking a "significant reduction" in use and a fifty percent (50%) statewide reduction in generation of hazardous substances, over five years.

Table 1.4. New Jersey Pollution Prevention Act Definitions

Pollution Prevention Is:	Pollution Prevention Is Not:
• Redesign of Production Processes	• Control of Pollution
• Reformulation of Products	• Treatment of Hazardous Substances
• Reduction in Use of Toxic Raw Materials	• Disposal/Destruction of Wastes
• Improvement of Facility Housekeeping	• Out-of-Process Recycling
• Reduction in Use & Generation of Hazardous Substances	• Transfer of Risk to Workers or Other Media

(Source: NJ Pollution Prevention Act, NJAC 13:1D-35)

The regulatory requirements of the NJPPA are more rigorous than the national Act, in that they require facility pollution prevention planning. The law applies to the same SIC industries required to report TRI data under the federal code (as mentioned above), and requires comprehensive, chemical-specific reporting of use/generation/storage data at both process and facility levels. Owner/operators must establish estimated reductions targets and must outline intended strategies for achieving these reductions. Covered facilities must prepare three planning documents: a five-year plan, to be posted at the facility; a five-year plan summary, and an annual plan progress report, each to be submitted to the NJ Department of Environmental Protection (NJDEP) for review (NJSA 13:1D-35 1991). As of November 1, 1995, 426 of the initially required 549 covered New Jersey facilities had submitted their five-year plan summaries (NJDEP 1995, NJDEP 1994:1).

New Jersey's pollution prevention statute also provides for initiation of a "facility-wide permitting" pilot program. With preference given to businesses voluntarily implementing pollution prevention, the NJDEP will select some eighteen facilities for issuance of multi-media operations permits, regulating all air, water, and land releases in one comprehensive, streamlined package. This initiative is in keeping with the holistic approach that is characteristic of pollution prevention, wherein a facility and all its emissions components are considered as one. Traditional pollution-control regulatory policies tend to segregate the various components for elemental analysis. This promotes transfer of pollutants from one medium to another and discourages plant managers from the perspective of an integrated systems analysis. Facility-wide permitting allows for streamlining of the regulatory process and is desirable to regulated industries for its inherent cost savings and expediency.

Additionally, the NJPPA authorizes funding for the state's Technical Assistance Program (TAP), which is a part of the Hazardous Substances Management Research Center at the New Jersey Institute of Technology (NJIT). Through this program, representatives of small to medium-sized companies in New Jersey can receive technical assistance and instruction on waste minimization opportunities for their facilities.

The NJPPA joins the national PPA (and other states' pollution prevention laws) in a remarkable approach to state and federal policy implementation. Although facility managers must complete the pollution prevention *planning* process, an exercise intended to assist in discovery of opportunities for waste minimization and toxics use reduction, any further commitment, including implementation of any of the proposed measures, is completely optional. Despite all the differences between the New Jersey and the national pollution prevention policies, the most critical element necessary to accomplish the objectives of either is voluntary compliance.

1.2 Study Purpose: Making Sense of Voluntary Compliance

What then, inspires companies to bother with voluntary compliance? Why do some companies aggressively commit to internal pollution prevention policies, while others do not? What factors inhibit company implementation of pollution prevention measures?

The purpose of this study is to arrive at answers to these questions and to determine which factors are most influential in company decisions opting both for and against a commitment to pollution prevention. A clear understanding of these issues will enable policymakers to create a climate more conducive to voluntary compliance, which will advance the realization of pollution prevention policy objectives.

To begin to explore the matters at hand, one must draw upon research findings from an array of cross-disciplinary fields. Not unlike any other environmental issue, voluntary pollution prevention compliance involves fundamental principles relating to such diverse areas as: public policy and environmental regulation, social sciences and ethics, environmental economics, and business management and finance. While subjects *related* to the issue of voluntary compliance are investigated in the pertinent cross-disciplinary literature, this researcher finds no evidence of studies attempting to directly measure it, or fully explaining the characteristics which are most influential in inducing, or discouraging it. Burby and Paterson (1993) specifically suggest that research be undertaken to better understand the concept of commitment, while Altman and Petkus (1994) urge further work in analyzing stakeholder needs and interests in the formation of public policy.

This study will show that these two objectives are tightly interwoven and will build upon previous findings to: a) propose a direct measure of company pollution prevention commitment; b) use this measure to categorize research study subjects into groups based upon levels of commitment; and finally, c) differentiate the needs and interests of each commitment group (stakeholders) in implementing pollution prevention programs.

CHAPTER 2

SURVEY OF PERTINENT CROSS-DISCIPLINARY LITERATURE

2.1 Public Policy and Environmental Regulation

2.1.1 Enforcement: Mandates vs. Voluntary Compliance

Policy analysts disagree broadly on the issue of regulatory enforcement. With a primary focus on gaining *compliance,* the possibility that industrial commitments might negate the need for regulatory mandates is scarcely considered. The whispers of such a future are present only amongst those advocating flexibility and encouragement of industrial innovation as the preferred path.

A wide body of the policy sciences literature argues in favor of stringent enforcement for successful policy implementation (Barnett 1990, Davis and Feiock 1992, Magat and Viscusi 1990, Ringquist 1993, Weimer 1992b). Barnett (1990) uses the failure of Superfund enforcement to make his case. He points to the higher success rate achieved under the Ruckelshaus and Thomas EPA administrations, which each relied upon aggressive, stringent enforcement strategies, as opposed to the Burford EPA administration, which was characterized by an accommodative compliance approach. Davis and Feiock (1992) suggest that "vigilant policing" of industries ensures equity among the regulated parties, by guaranteeing that noncompliant firms will not escape inspection or penalty. Magat and Viscusi (1990) discuss the unusual success achieved in gaining compliance with EPA water pollution regulations governing the pulp and paper industry (1972-1985) to highlight the importance of monitoring, inspection, and overall rigorous enforcement. Ringquist (1993), in an analysis of state versus federal enforcement of air pollution control programs, concludes that the stronger, better-funded enforcement standards of federal laws are the more successful.

Weimer's (1992b) examination of policy design also concludes with support for strong prescription. He suggests mandated assignment of organizational individuals charged with monitoring and enforcement duties, similar to FDA requirements for quality control inspectors in pharmaceutical manufacturing.

An equally substantial assemblage of policy analysts advocate the opposite approach to enforcement, that is, one of accommodation, flexibility, and/or persuasion (Brown 1994, Burby and Paterson 1993, Dyerson and Mueller 1993, McDonnell and Elmore 1987, and Scholtz 1984). Brown's (1994) study of occupational health and safety regulation in British Columbia illustrates a history of noncompliance and concludes with the finding that relationships between regulators and business managers are the crucial element in evoking compliance. Originated by Scholtz (1984), this theory holds that as relationships improve via demonstration of cooperation by the regulated party, regulating agencies can revert to softer tactics, and ultimately to little or no monitoring or enforcement at all. Burby and Paterson (1993) further the argument for cooperative enforcement in their evaluation of the success of the North Carolina Sedimentation and Erosion Control Act of 1973. They explain that in regulations that seek achievement of performance standards (such as the NJPPA), cooperation allowing for flexibility in the determination of means and methods results in the highest rate of compliance.

The Dyerson and Mueller (1993) and McDonnell and Elmore (1987) studies each discuss policy implementation methods, the former framed around educational issues, the latter around government industrial policies. While deviating in subject matter, the authors contend that intervention often results in assignment of responsibility to parties lacking the capacity to carry out initiatives. They contend that regulated actors can best meet goals and objectives without outside interference. For instance, technological development alternatives are more likely to be innovative and successful if left to the industrial sector than if imposed by government (McDonnell and Elmore 1987). McDonnell and Elmore (1987) point out further, that government mandates stifle creativity by setting *minimum* standards, which tend to discourage the discovery of superior alternatives.

Finally, while current pollution prevention laws allow for voluntary compliance, many industrial representatives express concern that implementation may become mandatory in the future (Azar 1993, Graham 1993, Sheridan 1992). This consideration may inspire proactive involvement in pollution prevention, simply in order to stay ahead of the regulations.

2.1.2 Policy Design and Stakeholder Support

The importance of policy design in gaining compliance is detailed throughout the public policy literature, with author after author falling back on the work of Sabatier and Mazmanian (1980). Under this early implementation analysis framework, several of the most important considerations are defined to include the following:

- Clarity & Ranking of Policy Objectives
- Clarity & Consistency of Regulations with Policy Objectives
- Stakeholder Involvement in Formulation
- Commitment & Support of Legislators

The value of stakeholder involvement in the creation of successful policy is further underscored by Ingram and Schneider (1990), and in the context of social marketing of environmental policy, by Altman and Petkus (1994). The authors conclude that involvement of all concerned parties will ensure that decisions are backed with comprehensive information, that the process will promote better understanding of the pertinent issues, and that the result will be a greater commitment to compliance.

2.1.3 Regulatory Agency Characteristics

Characteristics of the regulatory agency which are deemed important to the success of pollution prevention initiatives are outlined in a number of studies (Levin 1990, White, Becker and Goldstein 1991, Baas and Huisingh 1993, Jones 1994), as follows:

- Flexibility in Allowing for Plant-Specific Compliance Options
- Flexibility in Adapting to Multi-Media Approach
- Ability to Build Partnership with Regulated Community
- Ability to Provide Technical/Technological Assistance

The literature suggests that agency flexibility is the priority necessity in gaining pollution prevention commitments from industry, since regulators must be willing to view industrial facilities with an overview perspective and may face judgment calls concerning nontraditional facility changes. Further, regulators must work in concert with plant managers to ensure that adequate information is available and to see that technical problems, regulatory inconsistencies, and program glitches are addressed. Although framed in different contexts, the findings of previously-cited studies on cooperative enforcement add credence to these conclusions.

2.1.4 Other State/Federal Regulations

Finally, regulations other than the PPA or NJPPA may influence company decisions to implement pollution prevention. Reporting requirements under SARA Title III, for example, are frequently cited as being responsible for provoking toxics use reduction (Gouchoe, et al. 1994, Hearne and Aucott 1991).

2.2 Environmental Economics

The conventional rule espoused in the literature of environmental economics as it pertains to compliance, is a simple matter of cost/benefit ratios. That is, the profit-maximizing firm will employ compliance strategies until the marginal benefit equals the marginal cost of resultant fines (Nowell and Shogren 1994). With fines potentially eliminated from consideration when a firm commits itself to pollution prevention, the analysis takes on a different form. The benefits of the program, both tangible and intangible, must outweigh the costs of implementation (Langbein and Kerwin 1985). An overview of expenditures and cost considerations associated with start-up and/or expansion of pollution prevention initiatives, by White (1991), is provided in Table 2.1.

Table 2.1. Pollution Prevention Implementation Cost Elements

Capital Expenditures	Phase-Out of Displaced Processes
• Buildings & Equipment	• Retrofit Existing Facilities
• Utility Connections	• Removal of Outdated Equipment
• Equipment Installation	• Existing Facility/Equipment Debt Ratios
• Project Engineering	

(Source: White 1991)

2.2.1 Tangible Benefits

- Direct Cost Differentials: As in the case of the 3M Company, numerous studies show that substantial cost savings can be realized through pollution prevention (Huisingh 1986, Sarokin 1985, Watts, et al. 1992, White 1991). Savings are derived from various sources, including but not limited to: reduced raw materials costs, improved energy efficiency, enhanced productivity, reduced or eliminated disposal costs, decreased water usage, and reduction or elimination of the need for pollution control devices. Graham (1993) discusses Pollution Prevention Review's 1993 study of over 100 small manufacturing companies, service firms, government offices, and research laboratories, noting that 70 percent of respondents reported "considerable" cost savings achieved through P2 activities. Annual savings ranged from $10,000 to over $45 million, with levels most frequently reported at between $100,000 and $2 million.

- Competitiveness: The rising tide of public environmental concern since the 1970's frequently manifests itself in "green consumerism," or consumer demand for environmentally-responsible products and packaging. Business studies show that voluntary adoption of cleaner technologies and environmentally-sensitive product lines often results in increased company sales volumes (Beaumont 1993, Cairncross 1990, Pizzolatto 1993, Weimer 1992b). Management literature suggests that a business' environmental sensitivity may also attract investors seeking "green" portfolio investment opportunities (Sanyal 1991, Smith 1993). Further, companies tapping into the growing market for pollution prevention technologies have the advantage of early entry and could become leaders in the field on a national or global scale (Beaumont 1993, Cairncross 1990, Mullin et al. 1993).

2.2.2 Intangible Costs & Benefits

- Liability Accounting: Barker (1990) clearly illustrates the extensive cost of environmental liability in his review of E.I. du Pont de Nemours and Company. Du Pont was named as a potentially responsible party in more than 100 waste disposal sites, under CERCLA. Clean up costs for work on just fourteen of the sites had by 1990, reached a cost of $958 million. Keoleian and Menerey (1993) point out additional examples of liability costs, such as fines due to non-compliance, hiring of legal staff or consultants, and future liability for property damage or even customer injury. Hemphill (1993) expands upon the liablility issue in his discussion of the stronger criminal and civil sanctions incorporated into current environmental laws. Criminal statistics of the US Department of Justice's Environment and Natural

Resources Division indicate that more than 404 years of prison time were meted out for environmental offenses, with nearly 206 years of actual time served, over the FY 1983-92 period (Hemphill 1990).

- Regulatory Accounting: Regulatory costs can decrease using waste minimization techniques, due to reduced pollutant monitoring, notification/reporting recordkeeping, emergency preparedness and training, and/or permitting (Keoleian and Menerey 1993, Gouchoe 1994, White 1991).
- Regulatory Uncertainty: Weimer (1992) and Downing (1982) argue that uncertainty about future regulation is an important consideration in gaining regulatory compliance. Lynn (1992) and White (1991) take this position specifically in relation to pollution prevention programs. They remind that companies investing in different substances and/or processes face the risk that future regulations will ban alternate constituents or make new methods illegal.

2.3 Business Management

A number of studies in the area of business management, support the notion that organizational attitudes and structures are among the most important considerations for successful introduction of pollution prevention (Cebon 1993, Hawk 1994, Baas and Huisingh 1993, Weimer 1992). Cebon in fact, suggests that pollution prevention is a social, rather than simply technical activity. Not unlike the regulatory agency problem of isolated media analyses, corporations tend to organize around segregated systems of technical, marketing, management and communications personnel. Without an integrated company effort, Cebon contends that pollution prevention will not succeed.

Ferguson's (1993) case study on instituting a pollution prevention philosophy in the US Postal Service, emphasizes that changing the embedded corporate culture and adapting to organizational change requires education and training. Huisingh (1993) reinforces the previous findings, citing conceptual and attitudinal impediments as the major difficulties in his case studies promoting "clean production" for the Erasmus Centre for Environmental Studies in Rotterdam, The Netherlands.

2.4 Business Ethics

The survey literature highlights a vibrant discussion amongst business ethicists, concerning numerous corporate social and environmental conduct codes. Because company commitments to such codes are not unlike a voluntary commitment to pollution prevention, it is useful to outline this discussion.

The list of voluntary environmental conduct codes is impressive, including, to name but a few: the CERES (Coalition for Environmentally Responsible Economies) Principles, written in the wake of the Exxon Valdez incident; the Chemical Manufacturers Association (CMA) Responsible Care program; ISO-14000, from the International Organization for Standardization, in Geneva; the European Community's CEMAS, a voluntary environmental management and audit plan; the US EPA's Environmental Leadership Program, 33/50 Program, Green Lights Program, Energy Star Computers partnership, and Design for the Environment program; and New Jersey's Voluntary Environmental Audit/Compliance Guidelines code.

In the case of the CERES Principles, Smith (1993) and Sanyal and Neves (1991a, 1991b) explain that CERES is a coalition of social investors, environmental groups, religious organizations, and public interest groups gathered in the interest of socially/environmentally responsible investment. Companies that sign on to this code, agree to protect the biosphere, reduce health/safety/environmental risks to employees and communities, employ source reduction, reduce disposal of wastes, conserve energy, and submit annual auditing reports to be made available to the public. CERES members undertake company reviews and provide investors with assessments of company environmental responsibility. Along with the obvious moral value considerations, investors choose CERES companies for their improved chances of long-term financial health (Smith 1993). That is, responsible companies are less likely to be involved in multi-million dollar clean-up operations, or to incur various other regulatory costs/liabilities due to environmental carelessness.

The CMA's Responsible Care program is composed of six codes which identify 106 management practices aimed at improving health, safety, community awareness, environmental responsibility and product stewardship (Ainsworth 1993). CMA's 178 member companies are pledged to fully implement this program throughout their facilities. The EPA's 33/50 program is another voluntary initiative, in which the EPA targeted 17 chemicals for reductions of 33 percent by the end of 1992, and 50 percent by the end of 1995. As of February 1995, 1,272 companies were enrolled in the program, with release and transfer reduction targets totalling approximately 368 million pounds (USEPA 1995a).

Company reasons for signing on to voluntary codes are debated in the business ethics literature, primarily in reference to corporate motive. Manley (1991) and Sanyal and Neves (1991a) contend that such codes serve to promote good business conduct and self-regulation, even aiding in attracting company recruits, while others suggest that companies sign on only to realize financial and social marketing benefits (L'Etang 1994). Pizzolatto (1993) argues that environmental marketing merely caters to the current barrage of "green consumerism," while Mullin (1993) cites the need to stay competitive in world markets, where participation in voluntary code programs such as ISO-14000 and CEMAS are becoming essential to doing business.

Lastly, corporate social and environmental responsibility may be driven by a desire to maintain or improve company image (Downing 1982). Gouchoe (1994) and Hearne and

Aucott (1991) suggest that this is a factor which concerns industries required to submit publicly-obtainable TRI data.

2.5 Pollution Prevention (P2) Literature

2.5.1 Company P2 Organizational Attributes

A benchmarking study on facility-level pollution prevention programs conducted by The Business Roundtable (AT&T 1993), identifies a series of company attributes common to successful plant initiatives. Six specific facilities were selected for the study based upon the parameters listed in Table 2.2. The highlighted plants were representative of the following companies: 3M, Du Pont, Intel, Martin Marietta, Monsanto, and Procter & Gamble.

Table 2.2. Facility Selection Criteria for The Business Roundtable Benchmarking Study

• Facility size greater than 500 people with at least two facilities in the study in the 2,000-10,000 employee range.
• Facilities use chemicals in manufacturing process with at least two facilities being chemical manufacturers.
• Facilities have demonstrated significant results in reducing waste and/or emissions.
• Complexity of facility waste issues varies with at least two facilities with highly diverse waste issues.
• Facilities are located in the United States.

(Source: Facility Level Pollution Prevention Benchmarking Study, AT&T 1993)

Researchers conducted a comprehensive review of each facility, gathering information regarding company organizational support for pollution prevention efforts. The study results indicate that program elements are implemented in varying ways to address plant-specific needs and operations. Specific attributes, however, are common to each. These elements were ranked as "critical and essential," or "important" to "best-in-class" pollution prevention programs, and then grouped by priority, from high (Group A) to low (Group C). A summary of the chief attributes is as follows:

Group A

- Incorporation of Pollution Prevention into Company Policy
- Top Management Support For Pollution Prevention
- Designation of Program Leader or Facilitator
- Pollution Prevention Goal Setting

Group B

- Incorporation into Business Planning & Budgeting
- Development of Cross-Functional Teams for R&D, Manufacturing, Finance
- Designation of Responsible Individuals for Pollution Prevention
- Prioritization of Facility Waste Streams
- Measurement & Reporting of Pollution Prevention Progress

Group C

- Employee Incentives & Recognition for Prevention Achievement
- Communication to Increase Awareness of Pollution Prevention Options
- Integration of Pollution Prevention into Pre-Manufacturing Decisions

In addition to The Business Roundtable study, works by Baas and Huisingh (1993), Freeman (1990), Lynn (1992), and Spriggs (1994) all point to the importance of visible, active leadership and direction in achieving pollution prevention success. Spriggs emphasizes the role of senior management in quantifying facility opportunities, identifying the technologies to be used, and ensuring program implementation. Lynn argues that top management support is central to the coordination of important program elements, such as allocation of monetary resources, assignment of responsible individuals, education and training, employee incentives, and monitoring and measurement of progress. The Business Roundtable study suggests the importance of integrating pollution prevention philosophy into all company areas, including business planning and budgeting, research and development, manufacturing, and financial operations. However, this study is careful to point out that participant facilities are most successful when given latitude in their plant-specific approach to pollution prevention implementation.

Graham (1993) cites an EPA document issued in May 1993 entitled, "Guidance to Hazardous Waste Generators on the Elements of a Waste Minimization Program" (58 FR 3114), in which the EPA highlights precisely the attributes from The Business Roundtable study above, and proposes the following additions:

- Employee Pollution Prevention Training & Education
- Institution of a Waste Tracking System
- Full Cost-Accounting of Waste[1]
- Cost Allocation[2]

2.5.2 Company P2 Motivations

The 1993 Pollution Prevention Review study (Graham 1993), involved a survey of businesses representing the manufacturing sector, service firms, government offices, and research laboratories. Of 109 respondents, over fifty percent cited regulatory compliance as the chief motivating factor in company implementation of P2 activities. Thirty-three percent rated cost savings as the primary motivator, while concern about public opinion was ranked least significant, of all. Through its research, The Business Roundtable (AT&T 1993) finds that pollution prevention is considered a "core value" at most of the respondent facilities. This

[1] To include the less obvious cost considerations, as outlined in Section 2.2, above, "Intangible Costs & Benefits."

[2] Allocating waste costs to the processes that generate them (Graham 1993).

study also cites regulatory motivations for P2 programs from the stand-point of anticipating and alleviating future company compliance requirements, through proaction.

As to the issue of financial benefit, the latter study finds that sustainability of P2 programs *requires* that projects be cost-effective. Pollution prevention initiatives proposed at the study facilities compete for funding just as any other capital project, and are expected to provide a return on the investment.

CHAPTER 3

THEORETICAL APPROACH

3.1 Assumptions

- Company commitment is the most important element to successful implementation of pollution prevention programs.
- Company commitments to pollution prevention will ultimately determine the extent to which the voluntary PPA and NJPPA policy objectives are achieved (or exceeded).
- It is therefore important to gain an understanding of the motivations and barriers that lead companies to specific levels of P2 commitment.
- Only with such knowledge of the needs and concerns of industry participants, is it possible to facilitate and perhaps maximize P2 participation.

3.2 Study Hypothesis

3.2.1 Measuring P2 Commitment

Facility pollution prevention commitments can be measured, ranked, and categorized through an evaluation process that includes the following components:

a) Company P2 Organizational Attributes

b) Past Achievements in Reducing Use and/or Generation of Toxic/Hazardous Substances

c) Facility Implementation of Pollution Prevention Methods

d) Extent of Pollution Prevention Goals for Use and/or Generation Reductions

e) Special Facility Environmental Initiatives

Company P2 Organizational Attributes

Pollution prevention organizational attributes are drawn from the research findings detailed previously in Section 2.5.1. Essentially, these are company characteristics that promote and give structure to a facility pollution prevention program. As The Business Roundtable study (AT&T 1993) points out, successful facilities do not necessarily require the presence of every listed attribute, nor must they adhere to the same level of program complexity or formality. The rankings assigned by the Roundtable study, may therefore apply more appropriately to "best-in-class" facilities and are not assumed to hold across the board. To carry a P2 program for the long term, however, it is clear that some combination of the various supporting elements is essential. Pertinent P2 organizational attributes are summarized in Table 3.1.

Table 3.1. P2 Organizational Attributes

	Company P2 Organizational Support Attributes
A1.	Establishment of Pollution Prevention Standards in Company Policy
A2.	Top Management Support for P2 Implementation and Achievement
A3.	Incorporation of P2 into Product Design and/or Production Process Planning
A4.	Incorporation of P2 into Business Planning and Budgeting
A5.	Development of Cross-Functional Teams for P2 Company Integration
A6.	Designation of Specific Individuals with Responsibility for P2 Coordination
A7.	Provision of Employee P2 Training/Education
A8.	Establishment of Prioritized P2 Achievement Goals
A9.	Employee Incentives and/or Recognition for P2 Accomplishments
A10.	Evaluation of P2 Achievement in Employee Performance Ratings
A11.	Active Communications to Improve/Maintain Company P2 Awareness
A12.	Establishment of Formal Procedures to Monitor and Measure P2 Progress
A13.	Institution of Regular Company P2 Progress Reports

(Sources: AT&T 1993, Graham 1993)

Past Achievements in Reducing Use and/or Generation of Toxic/Hazardous Substances

Past achievements in reducing use and/or generation of toxics must be considered in the P2 commitment equation for several reasons. First, a company's environmental record serves as an indicator. In the same fashion as a student academic transcript, an employee evaluation, or a product safety record, past accomplishments demonstrate characteristics and capabilities that suggest future performance. Next, many firms succeeded in reducing use and/or waste generation long before the passage of legislation which brought such accounting into the public limelight. These early successes were not credited as "pollution prevention," but just as surely meet the definition of waste minimization as they would if begun today.

Lastly, facilities that *have* achieved significant past reductions, may now find P2 a more difficult, costly, and technically-challenging task. If a plant is already P2-optimized, continuous improvement will depend upon company ingenuity, technical innovation, and/or major changes in facility product lines. The published P2 reduction goals for such proactive facilities may appear meager in comparison to those for plants in the early stages of a pollution prevention program. Without recognition for past achievements, any measure of company P2 commitment would be seriously flawed.

Facility Implementation of Pollution Prevention Methods

Pollution prevention methods vary in sophistication, from simple improvements in scheduling, facility housekeeping, and inventory control, to raw materials substitution, process modification, and total re-design of products or facility processes. While certain methods seem to produce greater use/generation reductions than others (NJDEP 1995a), a preliminary review of New Jersey Pollution Prevention Plan Summaries (NJDEP 1995b) suggests that specific methods associate with certain manufacturing types. The Business Roundtable study corroborates this finding (AT&T 1993). Methods must be suited to the particular processes of a given facility, and in certain cases, may be plant-specific. It would thus seem of little practical use to rate facilities based upon implementation of specified, ranked, P2 methods.

No achievements (past or future) are possible without implementation of at least one technique, however. And a company able to research, institute, and support several different techniques, surely demonstrates depth in a P2 commitment. Further, it is not unreasonable to expect a facility committed to P2 to simultaneously exercise "best operating practices." Such standards would include the many basic P2 "first steps," such as optimizing production schedules, improving facility maintenance, instituting energy conservation measures, and improving inventory controls to avoid materials waste.

Pollution prevention methods are broadly categorized and defined in Table 3.2. With the exception of Methods 3, "Product Redesign, and 4, "Product Substitution," all techniques listed in this table are recognized and approved by the New Jersey Pollution Prevention Act.

Table 3.2. Pollution Prevention Methods

Method	Definition
M1. Product Modification	Change in product composition.
M2. Raw Materials Changes	Purification or substitution of input materials.
M3. Product Redesign	Reconfiguration to increase lifespan, repairability, re-use, or design for disassembly.
M4. Product Substitution	Alteration of product line to eliminate problem product.
M5. Process Modification	Changes to improve efficiency or decrease generation of waste/by-products.
M6. Improved Operating Practices	Improvements in facility maintenance, inventory control, housekeeping, process management.
M7. In-Process Recycling	Direct return of hazardous substances to process of origin, via dedicated, internal equipment.

(Sources: Freeman 1990, NJSA13:1D-35 (NJ Pollution Prevention Act) 1991)

Extent of Pollution Prevention Goals for Use and/or Generation Reductions

Facility P2 reduction goals can be evaluated based upon data contained in the Pollution Prevention 5-Year Plan Summaries submitted to the NJ Department of Environmental

Protection (NJDEP). A scheme for best-utilizing the various reported elements, is outlined in Table 3.3. To evaluate P2 goals appropriately, it is important to consider the overall number

Table 3.3. Evaluation of Pollution Prevention 5-Year Reduction Goals

P2 Goals Evaluation Elements
G1. Projection of 5-year USE reduction goals for *any* covered[1] substances.
G2. Projection of 5-year NPO[2] reduction goals for *any* covered substances.
G3. Projection of 5-year USE reduction goals for what *percentage* of covered substances.
G4. Projection of 5-year NPO reduction goals for what *percentage* of covered substances.
G5. *Extent* of 5-year USE reduction goals for covered substances.
G6. *Extent* of 5-year NPO reduction goals for covered substances.
G7. Percentage of targeted[3] processes slated for USE or NPO reductions.
G8. Percentage of all covered processes slated for USE or NPO reductions.

(Source: New Jersey Pollution Prevention 5-Year Plan Summaries, NJDEP 1995b)

of facility processes, as well as the total number of different hazardous/toxic substances involved. An analysis of Plan Summaries submitted as of November 1, 1995 (NJDEP 1995a) indicates that the mean number of processes operated at covered facilities is 5.2. The minimum number of processes is one, while the maximum is 133 (the grand total: 2,194). The reported number of substances used at each covered facility ranges from 1 to 51, with a mean of 4.2. Approximately 27 percent of facilities report use of only one hazardous/toxic substance, while seven percent report use of more than 10.

[1] "Covered" substances are those listed under SARA 313. for Toxic Release Inventory (TRI) reporting under EPCRA (see Table 1). Any TRI chemical used, processed, or manufactured in quantities greater than 10,000 pounds is subject to NJPPA pollution prevention planning and reporting. "Covered" processes are those involving "covered" substances (NJDEP 1993).

[2] "NPO" is "Nonproduct Output," defined by the NJPPA as material exiting a process which is neither intermediate product (desired process output in pre-completion form), co-product (unnecessary, but potentially marketable process output), nor product (desired process output intended for customer purchase) (NJDEP 1993).

[3] "Targeted" processes are defined by NJPPA as those responsible for 90% or more of facility use, generation, or release of hazardous substances (NJDEP 1993).

With a careful look at the percentages of used substances for which reductions are slated, as well as the extent of those reductions, the P2 goals evaluation can be applied whether facilities use one substance, or one hundred. Similar consideration of facility processes, based upon substance use within those processes, completes the goals assessment.

Special Facility Environmental Initiatives

To round out the P2 Commitment measure, special facility environmental initiatives must be recognized. Such efforts would include, for example, use of recycled rather than virgin materials wherever possible, implementation of a product and/or packaging take-back program, or facility use of Life-Cycle Analysis[4] in product design.

3.2.2 P2 Commitment Influence Factors

Factors influencing company P2 commitments are documented in the research findings of the cross-disciplinary literature. Because facilities at opposing ends of the "commitment scale" face differing sets of interests and concerns, certain of these factors identify more particularly with each group. The various elements can be ranked in importance as they apply to varying commitment levels. A summary of the many factors suggested by the survey of literature is outlined below. Items are adapted to apply to New Jersey firms covered under the NJPPA.

[4] Life-Cycle Analysis is a tool used to evaluate the environmental impacts associated with a product or process from inception to ultimate disposal. It includes effects associated with raw materials (and acquisition thereof), process operations, product use, and product disposal. (Hanson and Borkovic, Undated)

a) Policy & Regulatory Factors

- NJPPA Facility Planning Requirements
- Potential for Facility-Wide Permitting (FWP)
- PPA/NJPPA Voluntary Enforcement Mode
- Potential for Future P2 Mandated Enforcement
- NJPPA Policy Objectives
- Clarity/Consistency of NJPPA Rules & Regulations
- Stakeholder Involvement in NJPPA Policy Design
- NJDEP Flexibility in NJPPA Administration
- Regulations Other than PPA/NJPPA

b) Technical Considerations

- Technical Feasibility (Responsible Party Capability)
- NJ Technical Assistance Program (TAP) Availability

c) Financial Cost/Benefit Considerations

- P2 Implementation/Program Costs
- Potential for P2-Derived Cost Savings
- P2-Enhanced Sales/Investment ("Green") Market
- Pollution Prevention Technologies Market Advantage
- Potential for P2-Induced Regulatory Cost Reductions
- Potential for P2-Induced Liability Cost Reductions
- Possible P2 Regulatory Investment Risk

d) Management/Social Factors

- Company Flexibility/Adaptability
- Drive for Efficiency/Quality Improvement
- Concern for Employee Morale/Safety/Working Conditions
- Concern for Company Image
- Publication of Toxics Reporting Data
- Participation in Voluntary Conduct Code
- Self-Regulated Environmental Concern

CHAPTER 4

METHODOLOGY

4.1 Overview

To test the study hypothesis, this study centers on the New Jersey Chemical and Allied Products Industry. Information was gathered through a survey of companies covered under the New Jersey Pollution Prevention Act. The intent of the inquiry is to: a) evaluate each company's commitment to pollution prevention; and b) determine the relationship between that commitment and the various regulatory, economic, social, and organizational factors influencing it. The study is structured around written survey questionnaires and telephone interviews of participating business representatives. Supplementally, a panel of pollution prevention professionals was enlisted and surveyed to assist in development of the commitment evaluation process.

4.2 Study Population

The target study population is comprised of SIC (Standard Industrial Classification) Code 28 New Jersey Chemical and Allied Products Industry firms covered under the NJPPA (1991). This group includes by far, the most facilities of any industrial classification category covered by the first-round reporting requirements of the NJPPA. A breakdown of the five priority industries covered in this initial stage, including SIC Code 28 facilities, is shown in Table 4.1.

Of approximately 860 (NJ Dept. of Labor 1993) SIC Code 28 facilities in New Jersey, 248 are covered under the Act. Businesses under this classification are manufacturers of "chemicals and allied products," such as: plastics, drugs and pharmaceuticals, organic and inorganic chemicals, soaps and detergents, cleaning compounds, health and beauty aides, fragrances, paints and paint removers, fertilizers, insecticides, pesticides, anti-freeze

Table 4.1. Priority NJPPA-Covered Industry Facilities

SIC Code	Classification	Number Covered
28	Chemicals and Allied Products	248
34	Fabricated Metal Products (non-Machinery)	87
33	Stone, Clay, Glass and Concrete Products	63
30	Rubber and Miscellaneous Plastics Products	61
26	Paper and Allied Products	25
	Other	2
	Total	486

(Source: NJDEP 1994, 1995a)

compounds, adhesives and explosives (SIC Code Directory 1993). These facilities are required to report under EPCRA, for the Toxics Release Inventory, and were required to submit Pollution Prevention Plan Summaries to the NJDEP by July 1, 1994. These companies use, process, or manufacture one or more of the chemicals listed under SARA 313 in quantities greater than 10,000 pounds. They have 10 or more employees and have one or more NJDEP permits. A breakdown of the surveyed firms by product groupings, is provided in Table 4.2.

Table 4.2. Study Population: New Jersey Chemical & Allied Products Facilities

SIC 28 Product Groups	Number of Facilities	Percent of Total
Industrial Inorganic Chemicals (2819), Chemical Preparations (2899)	43	17.3%
Paints, Varnishes, Coatings (2851)	34	13.7%
Inks (2893), Dyes, Organic Crudes (2865), Pigments (2816)	31	12.5%
Medicinal (2833), Pharmaceutical (2834), Biological (2835,-36)	30	12.1%
Industrial Organic Chemicals (2869)	29	11.7%
Plastics, Synthetic Resins, Elastomers (2821)	23	9.3%
Soaps & Detergents (2841), Cleaners (2842), Surfactants (2843)	23	9.3%
Adhesives and Sealants (2891)	14	5.6%
Fragrances, Cosmetics & Toiletries (2844)	12	4.8%
Nitrogenous Fertilizers (2873), Pesticides (2879)	4	1.6%
Industrial Gases (2813)	3	1.2%
Alkalies and Chlorine (2812)	1	0.4%
Explosives (2892)	1	0.4%
Total	248	

(Source: NJDEP 1995b)

4.3 Sampling

To achieve the most representative and arithmetically satisfactory survey response, the entire study population is included in this survey. No sampling procedures are utilized. Public database listings of, a) facilities covered under the NJPPA, and b) Pollution Prevention Plan Summaries submitted to the NJDEP, provided the base information needed to identify the SIC28 facilities for this research. The total study population was determined, as follows:

Total Number SIC28 Facilities Listed:	263
Duplicates:	5
Plant Shut Downs:	6
Non-Locatable Facilities:	2
Facilities Exempt from NJPPA:	2
Total Study Population:	248

4.4 Mode of Observation

4.4.1 Telephone Interviews

Each study facility was initially contacted by telephone to establish personal contact, to request participation in the study, and to confirm contact name, title, department, and company address. The opportunity was taken at this time, to ask preliminary questions about company involvement in pollution prevention activities in order to categorize participants as P2 users/non-users. Participants were then asked to state the biggest reasons for the facility's use or non-use of pollution prevention, and last, to offer their opinions of the NJPPA as it impacted on the facility's use or non-use.

A transcript of the introductory telephone interview is shown in Appendix A.

4.4.2 Survey Questionnaires

Three versions of a similar survey questionnaire were devised to address potentially different population categories: firms using pollution prevention techniques (Q1.), firms that have explored P2 options but do not implement techniques (Q2.), and firms that have neither researched nor implemented P2 techniques (Q3.). Telephone interviews determined the respondent firm's status and triggered questionnaire selection.

Questionnaire #1 (Q1.) is arranged in four parts. The first section solicits basic facility information such as SIC product codes, number of employees, organizational structure, and a brief description of facility processes and types of products and/or services. The second portion gathers data used in the assessment of company P2 commitments: P2 organizational attributes, past use/generation reductions achievements, implementation of P2 techniques, and special environmental initiatives. The third section explores the various regulatory, technical, financial, organizational, and social influence factors. Respondents are asked to rank 25 different elements for their importance in the facility's implementation of P2. The fourth and final section, seeks a ranking of the overall factor categories, inquires as to company P2 program benefits, barriers, and negative impacts, and probes for commentary concerning NJPPA policy, regulations, and administration.

Questionnaires #2 (Q2.) and #3 (Q3.) do not include sections concerning P2 implementation of methods, nor P2 organizational attributes, since facilities targeted for these versions are not P2-users and would thus have no commitment, to evaluate. In other respects, these questionnaires are similar to Q1., with the exception of wording modifications to address the lack of the facility's P2 program and to explore the barriers to implementation of one.

Copies of the three survey instruments appear in Appendix B.

4.4.3 Facility Pollution Prevention 5-Year Plan Summaries

The database of Pollution Prevention 5-Year Plan Summaries (NJDEP 1995b) provides detailed process and chemical-specific information which is used to assess facility P2 Goals. In addition, these elements allow for an overview perspective of the study population as a whole, and by specific product groupings. Plan summaries are used where possible, to complete missing factual information in the questionnaire data, such as SIC codes and P2 methods implementation (past and planned).

A sample of the 1993 Pollution Prevention Plan Summary form that facility representatives were required to submit to the NJDEP is included in Appendix C.

4.5 Procedure

The study survey was initiated in July/August 1995, with a primary notification mailing, completion of telephone interviews, and first-round mailing of survey questionnaires. Follow-up mailings continued through October, with the bulk of responses received by the end of that month. The last four questionnaire returns trickled in from November to as late as January of 1996.

a) Notification Mailings. Personalized letters of introduction were sent out in batches, from 7/5/95 to 7/26/95, to inform facilities of the study, explain its importance and objectives, and give notice of intent to call each firm by telephone. (Sample of introductory letter: Appendix D.)

b) Telephone Interviews. Conducted from 7/19/95 through 8/30/95, to seek participation, confirm participant name, title, and company address (from NJDEP databases), ask preliminary questions to discern company involvement in pollution prevention (or lack thereof), and discuss opinions of NJPPA. (See Interview Transcript: Appendix A.)

c) Questionnaire Mailings. Questionnaires were sent to each participant within 24 hours of completion of the telephone interview (Q1., Q2., or Q3. was sent dependent upon interview responses). Each questionnaire was coded and sent with a pre-addressed return envelope, and personalized cover letter thanking participants for their telephone interviews, briefly explaining the study aims and the importance of responses once again, and providing contact names, telephone and fax numbers, and address for the "Environmental Policy Institute" at NJIT. This process took place from 7/20/95 through 8/31/95, with a total study mailing of 244 questionnaires. (Sample questionnaire cover letter: Appendix D.)

d) Thank You Mailings: Letters thanking respondents for their time and participation were sent within 24 hours of receipt of each returned questionnaire. This mailing began with the first returns, as of 8/8/95, and continued through the last, on 1/19/95. (Sample thank you letter: Appendix D.)

e) Follow-Up Questionnaire Mailings. A second copy of the questionnaire was sent to non-respondents 2-3 weeks after each original questionnaire mailing, with a second personalized cover letter and return envelope. Between 8/15/95 and 9/22/95, 192 follow-up questionnaires were sent to facility representatives. (Sample follow-up reminder cover letter: Appendix D.)

f) Final Follow-Up Questionnaire Mailing. A third copy of the questionnaire was sent to 150 remaining non-respondents, along with yet a third cover letter and return envelope, on 10/14/95. (Sample final reminder cover letter: Appendix D.)

4.6 P2 Professional Panel: A Survey Within a Survey

As previously mentioned, a panel of pollution prevention professionals was enlisted to assist in development of the facility P2 commitment evaluation scale. Panelists hail from a cross-section of P2-related fields representing the chemical industry, state and federal regulatory agencies, environmental organizations, and P2 academic research specialties. Thirteen individuals were identified and contacted, with nine ultimately participating in a P2 "commitment survey."

4.6.1 Panel Members

A minimum of seven members were sought to serve on the panel of "experts." Although the intent was to enlist a group that would fairly represent the various P2-related fields, the final panel composition is skewed, as outlined below. To address the inequities, panel data is weighted to bring each representation group up to the equivalent level of the environmental category, or four.

Environmental Representatives:	4
Regulatory Representatives:	2
Industrial Representatives:	1
Academic Research Representatives:	2
Total:	9

4.6.2 Panel Questionnaire

The questionnaire developed for the panel of experts mirrors certain of the elements of the overall study questionnaires. Using the same scale of importance, panelists are asked to rank the many items outlined previously in Chapter 3 Section 2.1, which comprise elements of the P2 commitment measure. The first part of the questionnaire concerns the P2 Organizational Attributes, while the second surrounds P2 implementation, past reductions achievements, P2 goals, and special facility environmental initiatives.

Questionnaires were sent to panel members in December 1995 along with cover letters and return envelopes. All responses were received by the end of January 1996. A copy of the panel questionnaire appears in Appendix B.

CHAPTER 5

STATISTICAL DESIGN

5.1 Study Variables

Study variables are summarized and outlined in Tables 5.1-5.12, following. Definitions and methods of measurement are provided for each variable included in the study questionnaires. Part A variables are used to evaluate and rank company commitments to pollution prevention; Part B variables, to assess the motivations and barriers to those commitments. The dependent study variable is the level of facility commitment to pollution prevention.

5.1.1 Part A: Evaluation of Commitment Variables

Table 5.1. P2 Organizational Attributes: Definitions

Independent Variables	Definitions
Company P2 Organizational Support Attributes	
Incorporation into Company Policy	P2 Established as Company Standard
Top Management Support	Management Commitment to P2 Results
P2 Principles Used in Product/Process Design	P2 Integrated into Pre-Manufacturing Decisions
Incorporation into Business Planning/Budgeting	Resources Allocated for P2 Program
Development of Cross-Functional Teams	Teams to Integrate Facility P2 Operations
Designation of Responsible Individuals	Assignment of Responsibility for P2 Results
Training & Education for Pollution Prevention	Increase Awareness, Technical Knowledge
Prioritized Pollution Prevention Goal Setting	Reduction Goals Prioritized by Waste Stream
Employee Incentives & Recognition	Recognition to Sustain Employee Motivation
P2 Achievement in Performance Evaluations	P2 Valued in Employee Performance Reviews
Communication to Increase Awareness	Attend Conferences, Trade Group Networking
Monitoring & Measurement of P2 Progress	Formal Procedures Used to Measure Progress
Regular Company Reporting on P2 Progress	P2 Achievements Published for Review

(Sources: AT&T 1993, Baas and Huisingh 1993, Freeman 1990, Lynn 1992, Spriggs 1994, Keoleian and Menerey 1993)

Table 5.2. P2 Organizational Attributes: Measurement

Independent Variables	Method of Measurement
Organizational Pollution Prevention Attributes	
Incorporation into Company Policy	Composite Index
Top Management Support	Composite Index
P2 Principles Used in Product/Process Design	Composite Index
Incorporation into Business Planning/Budgeting	Composite Index
Development of Cross-Functional Teams	Composite Index
Designation of Responsible Individuals	Composite Index
Training & Education for Pollution Prevention	Composite Index
Prioritized Pollution Prevention Goal Setting	Composite Index
Employee Incentives & Recognition	Composite Index
P2 Achievement in Performance Evaluations	Composite Index
Communication to Increase Awareness	Composite Index
Monitoring & Measurement of P2 Progress	Composite Index
Regular Company Reporting on P2 Progress	Composite Index

(Source of Measures: Babbie 1994)

Table 5.3. Past Facility Reductions Achievements: Definitions

Independent Variables	Definitions
Facility Reductions Achievement Elements	
Achievement of Reductions in Use *and/or* Generation of Hazardous/Toxic Materials	Reductions Achieved Over 10-Year Period Encompassing 1985-95
Extent of Facility Use Reductions	Percent Use Reduction Over 1985-95 Period
Extent of Facility Generation Reductions	Percent Generation Reduction 1985-95 Period

Table 5.4. Past Facility Reductions Achievements: Measurement

Independent Variables	Method of Measurement
Facility Reductions Achievement Elements	
Achievement of Reductions in Use *and/or* Generation of Hazardous/Toxic Materials	Composite Index
Extent of Facility Use Reductions	Composite Scale
Extent of Facility Generation Reductions	Composite Scale

(Source of Measures: Babbie 1994)

Table 5.5. P2 Implementation Strategies: Definitions

Independent Variables	Definitions
Pollution Prevention Implementation Strategies	
Product Modification	Change in Product Composition
Raw Materials Changes	Input Materials Purification/Substitution
Product Redesign	For Increased Lifespan/Repairability/Re-Use
Product Substitution	Alteration/Elimination of Product Line
Process Modification	Changes to Improve Efficiency/Decrease Generation of Waste and/or By-Products
Improved Operating Practices	Improved Facility Housekeeping/Management
In-Process Recycling	Return of Hazardous Substances to Process of Origin via Dedicated, Internal Equipment

(Sources: Freeman 1990, NJSA13:1D-35 NJPPA, 1991)

Table 5.6. P2 Implementation Strategies: Measurement

Independent Variables	Method of Measurement
Pollution Prevention Implementation Strategies	
Product Modification	Composite Index
Raw Materials Changes	Composite Index
Product Redesign	Composite Index
Product Substitution	Composite Index
Process Modification	Composite Index
Improved Operating Practices	Composite Index
In-Process Recycling	Composite Index

(Source of Measures: Babbie 1994)

Table 5.7. Pollution Prevention 5-Year Reduction Goals: Definitions

Independent Variables	Definitions
P2 5-Year Facility Reduction Goals	
Projected Covered-Substance Use Reductions	Any Use Reductions Proposed
Projected Covered-Substance NPO Reductions	Any NPO Reductions Proposed
Covered Substances Proposed for Use Reductions	Percent Substances w/Use Reduction Goals
Covered Substances Proposed for NPO Reductions	Percent Substances w/NPO Reduction Goals
Extent of Use Reduction Goals	Percentage Use Reduction Proposed
Extent of NPO Reduction Goals Targeted Process Use or NPO Reduction Goals	Percentage NPO Reduction Proposed Percent Targeted Processes w/Reductions
Covered Process Use or NPO Reduction Goals	Percent Covered Processes w/Reductions

Table 5.8. Pollution Prevention 5-Year Reduction Goals: Measurement

Independent Variables	Method of Measurement
P2 5-Year Facility Reduction Goals	
Projected Covered-Substance Use Reductions	Composite Index
Projected Covered-Substance NPO Reductions	Composite Index
Covered Substances Proposed for Use Reductions	Composite Scale
Covered Substances Proposed for NPO Reductions	Composite Scale
Extent of Use Reduction Goals	Composite Scale
Extent of NPO Reduction Goals	Composite Scale
Targeted Process Use or NPO Reduction Goals	Composite Scale
Covered Process Use or NPO Reduction Goals	Composite Scale

(Source of Measures: Babbie 1994)

Table 5.9. Special Facility Environmental Initiatives: Definitions

Independent Variables	Definitions
Special Facility Environmental Initiatives	
Use of Recycled Materials	Policy Seeking Recycled over Virgin Materials
Product or Packaging Take-Back Program	Consumer Returns Managed/Returned to Process
Life-Cycle Analysis Used in Product Design	Evaluation of "Cradle to Grave" Product Impacts

Table 5.10. Special Facility Environmental Initiatives: Measurement

Independent Variables	Method of Measurement
Special Facility Environmental Initiatives	
Use of Recycled Materials	Composite Index
Product or Packaging Take-Back Program	Composite Index
Life-Cycle Analysis Used in Product Design	Composite Index

(Source of Measures: Babbie 1994)

5.1.2 Part B: Assessment of Influence Factor Variables

Table 5.11. Motivations/Barriers: Definitions

Independent Variables	Definitions
Regulatory/Technical Factor Variables	
NJPPA Facility Planning Requirements	Use/Gen/Storage Audit & Reductions Targeting
Potential for Facility-Wide Permit (FWP)	Streamlined Overall Operations Permit (NJDEP)
PPA/NJPPA Enforcement Mode	Voluntary Compliance/No Mandates
Potential Future P2 Mandated Enforcement	Concern About Mandates (May Yield Proaction)
NJPPA Policy Objectives	Objectives are Prioritized and Understandable
Clarity/Consistency of Rules & Regulations	Rules & Regulations Clear/Consistent w/NJPPA
Stakeholder Involvement in Policy Design	Affected Parties Needs/Concerns Considered
NJDEP Flexibility in NJPPA Administration	Flexibility re Plant-Specific P2 Approach
Regulations other than PPA/NJPPA	Other State/Federal Toxics Mgmt/Control Laws
Technical Feasibility	Knowledge, Capability, Support
NJTAP Availability	Technical Assistance Provides Support
Financial Factor Variables	
P2 Implementation/Program Costs	Capital Expenses for Equipment/Engineering
Potential for P2-Derived Cost Savings	P2 Changes in Processes/Materials Save Money
Sales/Investment Market Competitiveness	Attract/Satisfy "Green" Consumer Demand
P2 Technologies Market Advantage	Early Entry in P2 Technologies Market
Potential Regulatory Cost Reductions	Costs of Monitoring/Reporting/Recordkeeping
Potential Liability Cost Reductions	Costs of Liability/Fines for Non-Compliance
Potential Regulatory Investment Risk	Future Regulations Effect on P2 Investments
Management/Social Factor Variables	
Company Flexibility/Adaptability	Corporate Culture Does/Doesn't Lend to P2
Drive for Efficiency/Quality Improvement	Management Standards/Total Quality
Concern for Morale/Safety/Working Conditions	Management Concern for Employees
Concern About Company Image	Attractiveness to Investors/Consumers/Recruits
Publication of Toxics Reporting Data	Required TRI/NJPPA (or other) Reporting
Participation in Voluntary Conduct Code	Require Conformity to Environmental Standards
Self-Regulated Environmental Concern for	P2 Potential for Reduced Environmental Impact

Table 5.12. Motivations/Barriers: Measurement

Independent Variables	Method of Measurement
Regulatory/Technical Factor Variables	
NJPPA Facility Planning Requirements	Likert Scale
Potential for Facility-Wide Permit (FWP)	Likert Scale
PPA/NJPPA Enforcement Mode	Likert Scale
Potential Future P2 Mandated Enforcement	Likert Scale
NJPPA Policy Objectives	Likert Scale
Clarity/Consistency of Rules & Regulations	Likert Scale
Stakeholder Involvement in Policy Design	Likert Scale
NJDEP Flexibility in NJPPA Administration	Likert Scale
Regulations other than PPA/NJPPA	Likert Scale
Technical Feasibility	Likert Scale
NJTAP Availability	Likert Scale
Financial Factor Variables	
P2 Implementation/Program Costs	Likert Scale
Potential for P2-Derived Cost Savings	Likert Scale
Sales/Investment Market Competitiveness	Likert Scale
P2 Technologies Market Advantage	Likert Scale
Potential Regulatory Cost Reductions	Likert Scale
Potential Liability Cost Reductions	Likert Scale
Potential Regulatory Investment Risk	Likert Scale
Management/Social Factor Variables	
Company Flexibility/Adaptability	Likert Scale
Drive for Efficiency/Quality Improvement	Likert Scale
Concern for Morale/Safety/Working Conditions	Likert Scale
Concern About Company Image	Likert Scale
Publication of Toxics Reporting Data	Likert Scale
Participation in Voluntary Conduct Code	Likert Scale
Self-Regulated Environmental Concern	Likert Scale

(Source of Measures: Babbie 1994)

5.2 Methods of Data Analysis

Because the key study variables reduce to nominal and/or ordinal data types, analysis primarily involves nonparametric statistics. It is *not* assumed that the Likert-type scale incorporated into this research is an equal interval measure, in which the distance between each rank of "importance" could be considered one standard, always equivalent unit. While it is necessary to code the ranks in order to complete the analysis, the numbers applied are considered only as ordinal identifiers. This determination is based upon the definition of ordinal measurement, which entails rank ordered data, as opposed to that of interval level measurement (Babbie

1994, Mason 1982), which requires equal units having formal arithmetic manipulative properties (associative, commutative, etc.).

The analysis is completed using SPSS® for Windows™ computer software, Release 6.1 (1993), and draws frequently upon the following: Chi-square tests of independence, Spearman zero-order correlation matrices, Mann-Whitney U (Wilcoxon Rank Sum W) tests for two independent samples, Kruskal-Wallis (H) one-way analysis of variance tests for several independent samples, and Kendall's W tests for concordance among related samples. A significance level of at least 0.05 is required to spark statistical attention, while levels of .005 or better, are considered impressive.

Study data is scrutinized to determine associations occurring between key variables, and to reveal relationships organizing categorically, over components such as facility size, SIC product groups, and company structure. To fulfill the primary study objective - determining relationships between influence factors and P2 commitment levels - it is first necessary to establish the commitment evaluation measure.

5.3 The P2 Commitment Index

5.3.1 Panel of Experts: Results

The P2 professional panel questionnaire sought an evaluation on twenty-nine elements, for use in evaluating facility P2 commitments. Again, the areas of interest covered: P2 organizational attributes, past facility reductions achievements, implementation of P2 methods, facility P2 5-year reductions goals, and special facility environmental initiatives. Each item is measured using a version of the Likert scale. Panelists scored the P2 organizational attributes as "very important," "important," "somewhat important," or "not important," in ensuring the success of a company pollution prevention program, while tagging the remaining elements as "very indicative," "indicative," "somewhat indicative," or "not indicative," of a company's commitment to pollution prevention.

The data was weighted to balance the panel's lopsided representation and variables were evaluated individually, using the Kruskal-Wallis H one-way analysis of variance. This test statistic is computed based upon rank-ordered sums and approximates the chi-square distribution under the hypothesis that all groups have the same distribution (Norusis 1993). Acceptance of the null hypothesis for any particular test item, then, is indicative of panel agreement (all groups have the same distribution, or have assigned the same rank to the item in question). At very low significance levels the null hypothesis is rejected, indicating that the response distribution is not the same for all groups (the panel disagrees). (Only 5 of the total 261 possible responses are "don't know's," which are eliminated from this analysis.)

Samples of the output from just two of the variable tests appear in Figure 5.1. The significance of 1.000 for variable A2, " Top Mgmt P2 Commit," indicates the perfect agreement among panelists, concerning the importance of this attribute (i.e., all groups have the same distribution). In fact, every member ranked this item at the top of the scale, as "very important." Alternately, the very low significance of .0089 for variable A9, "Empl Incent/Recog" (company provision of employee incentives/recognition for P2 achievement), causes rejection of the null hypothesis, indicating opposing distributions and a lack of panel consensus.

Continuing in this fashion, the analysis finds panel agreement on only eight of the commitment evaluation items: five organizational attributes and three P2 implementation elements. Using Kendall's coefficient of concordance, these variables are ranked to illustrate the panel's prioritization of the items. The rank order as well as the Kruskal-Wallis significance levels are denoted in Table 5.13. Note that the examples provided comprise the

- - - - - Kruskal-Wallis 1-Way Anova

A2 Top Mgmt P2 Commit
by TYPE Respondent Type

Mean Rank	Cases		
8.50	4	TYPE = 1	Environmental Rep
8.50	4	TYPE = 2	Regulatory Rep
8.50	4	TYPE = 3	Industry Rep
8.50	4	TYPE = 4	Academia Rep
	16	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
.0000	3	1.0000	.0000	3	1.0000

- - - - - Kruskal-Wallis 1-Way Anova

A9 Empl Incent/Recog
by TYPE Respondent Type

Mean Rank	Cases		
11.50	4	TYPE = 1	Environmental Rep
4.75	4	TYPE = 2	Regulatory Rep
13.00	4	TYPE = 3	Industry Rep
4.75	4	TYPE = 4	Academia Rep
	16	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
10.1250	3	.0175	11.5909	3	.0089

Figure 5.1. Sample Kruskal-Wallis 1-Way Anova Panel Data Variables Tests

data extremes (i.e., perfect agreement vs. very clear dichotomy of opinion). With the exceptions of "top management support" and "facility implementation of one P2 method," the areas of panel agreement (denoted by a significance greater than .05) are tenuous, at best.

Table 5.13. Professional Panel Evaluation Results

Kendall Rank Order	Variable of Panel Agreement	Kruskal-Wallis Test Significance
	Organizational Attributes	
1	Top Management P2 Support	1.000
2	Formal Measurement of P2 Progress	.061
3	Regular Reporting on P2 Progress	.143
4	Use of Cross-Functional P2 Teams	.071
5	P2 Achievement in Employee Evaluation	.194
	Methods Implementation	
1	Facility Uses Methods beyond Good Operating Practices	.139
2	Facility Implementation of more than One Method	.177
3	Facility Implementation of One Method	.970

The ultimate purpose of the panel input was to provide a weighting scheme for each commitment evaluation element, which could then be applied in construction of a P2 commitment index. Clearly, the results do not lend themselves to this approach. While several variables are agreed upon and ranked, twenty-one additional elements remain without placement in the scale. These findings could be interpreted to mean that only the variables of agreement are of any importance, however, previous research and the study data itself, suggest otherwise. Further, while a rank order for the eight variables of agreement is established, their placement relative to all the remaining items cannot be assumed. They could be first, last, centered, or scattered throughout. Unfortunately, the lack of panel consensus renders the data inconclusive.

The panel results do suggest an intriguing starting point for further research. It is of interest to note, for example, that the dispersion of panel opinion is aligned variously across (and within) the representative categories. Over the organizational attributes, environmental and industrial representatives' opinions frequently align. Occasionally, this alignment is in opposition to the joint opinion of the regulatory and academic research panelists, whose opinions also frequently align. On the topics of past achievement, special initiatives, and P2 implementation, alignments most often take the form of environmentalist/regulators versus industrialist/academics. Finally, on the issue of facility P2 goals, the industrialists stand alone, primarily ranking the items "least indicative" of a commitment, while the others oppose, labeling each item "most indicative."

A complete listing of the panel data statistical output appears in Appendix E.

5.3.2 From Scratch: The P2 Commitment Index

The discordant findings of the study panel are not without merit. It is clear from these results that rating and ranking the various commitment elements is not a simple or intuitive matter. Absent a listing of specifically-assigned, weighted elements of evaluation, the study employs the less cumbersome approach of measurement by comparison. Collective data from the study facilities themselves, reveal the "average" facility P2 behavior and allow for clear delineation of those falling well-above or below that status.

A very simple index is constructed here, to use in evaluating (comparing) facility P2 commitments. Each of the areas of evaluation are first considered individually, and assigned point scores as illustrated in Figure 5.2. Point scores are then standardized to: a) take the study group average scores into account, and b) assign an equivalent value to each of the commitment areas. Standardized scores are summed and then broken into ascending group categories to represent facility P2 commitment levels.

P2 Organizational Attributes	
A1. Incorporation into Company Policy	
A2. Top Management Support	
A3. P2 Principles Used in Product/Process Design	Nominal: No/Yes
A4. Incorporation into Business Planning/Budgeting	Points: 0-1
A5. Development of Cross-Functional Teams	
A6. Designation of Responsible Individuals	Total Point Range: 0-13
A7. Training & Education for Pollution Prevention	
A8. Prioritized Pollution Prevention Goal Setting	
A9. Employee Incentives & Recognition	
A10. P2 Achievement in Performance Evaluations	
A11. Communication to Increase Awareness	
A12. Monitoring & Measurement of P2 Progress	
A13. Regular Company Reporting on P2 Progress	

Past Facility Reductions Achievements	
P1. Achievement of Reductions in Use *and/or* Generation of Hazardous/Toxic Materials	Nominal: No/Yes Points: 0-1
P2. Extent of Facility Use Reductions	Scale: (0): 0, (<50%): 1, (>=50%): 2
P3. Extent of Facility Generation Reductions	Total Point Range: 0-5

Facility Implementation of P2 Methods	
M1. Product Modification	
M2. Raw Materials Changes	Nominal: No/Yes
M3. Product Redesign	Points: 0-1
M4. Product Substitution	
M5. Process Modification	Total Point Range: 0-7
M6. Improved Operating Practices	
M7. In-Process Recycling	

Facility P2 Reductions Goals	
G1. Projected Covered-Substance Use Reductions	Nominal: No/Yes
G2. Projected Covered-Substance NPO Reductions	Points: 0-1
G3. Covered Substances Proposed for Use Reductions	
G4. Covered Substances Proposed for NPO Reductions	Point Scale:
G5. Extent of Use Reduction Goals	(0): 0, (1-25%): 1, (26-50%): 2,
G6. Extent of NPO Reduction Goals	(51-74%): 3, (76-100%): 4
G7. Targeted Process Use or NPO Reduction Goals	
G8. Covered Process Use or NPO Reduction Goals	Total Point Range: 0-26

Special Environmental Initiatives	
D1. Use of Recycled Materials	Nominal: No /Yes
D2. Product or Packaging Take-Back Program	Points: 0-1
D3. Life-Cycle Analysis Used in Product Design	Total Point Range: 0-3

Figure 5.2. Point Scoring of Commitment Elements

Standard units of measure, or z scores, are computed by the normal deviate for the sample mean (Mason 1982):

$$z = \frac{X - \overline{X}}{S} \qquad \textbf{(Equation 5.1)}$$

where:

X is the individual observation (or point score for the individual case in a particular commitment area);

$\overline{X}$ is the mean of the sample distribution (or mean of all point scores for the particular commitment area);

S is the sample standard deviation (or standard deviation calculated from all point scores for the particular commitment area).

A simple tally of the standardized scores yields the following P2 Index equation:

$$\text{P2 Index} = z(\Sigma\,\text{A}) + z(\Sigma\,\text{P}) + z(\Sigma\,\text{M}) + z(\Sigma\,\text{G}) + z(\Sigma\,\text{D}) \qquad \textbf{(Equation 5.2)}$$

where:

z(x) is the z-score of x;

A is Facility P2 Organizational Attributes (0-13);

P is Past Facility Reductions Achievements (0-5);

M is P2 Methods Implementation (0-7);

G is P2 5-Year Reduction Goals (0-26);

D is Special Facility Environmental Initiatives (0-3).

Resultant P2 Commitment scores cluster in negative and positive values around a mean of zero. Finally, scores are broken into group categories based upon distance from the mean and assigned generalized category labels, such as: below average, average, above average.

The disadvantage in using the comparative commitment scale is that it precludes the development and application of an objective, independently-wrought "golden P2 commitment standard." While the comparative scale allows for ranking of study facilities, the total group placement in relation to the elusive P2 "gold standard," remains unknown. On the other hand, the comparative scale grounds the findings in reality, allowing for a clear view of just what's happening right now, "in the P2 trenches." Highly-committed facilities employing ingenuity and technical wizardry, push the limits of the "real" P2 ceiling themselves, every day. It is their accomplishments that ultimately set the industry standard and that can be expected to pressure the less-than-committed facilities to strive for greater heights.

CHAPTER 6

STATISTICAL DATA: SURVEY RESULTS

The collected study data is presented in three major sections which coincide with the selected modes of observation of the population: telephone interviews, written survey questionnaires, and NJDEP-required facility pollution prevention plan summaries. Each section contains participant response rates, a detailed presentation of the results, and the additional background information needed to represent the response group within the overall New Jersey Chemical and Allied Products Industry.

6.1 Telephone Interviews

Facilities were most often represented in telephone interviews, by environmental compliance managers, plant or environmental engineers, plant managers, or project managers, each with direct responsibility for facility P2 program initiatives. Occasionally, company CEO's, presidents, or vice-presidents insisted on fielding the calls, with written questionnaires then directed to environmental/safety or engineering departments. Frequently, in the case of smaller companies (often family-operated), the respondent was an individual of many faces: owner and financial manager, chief engineer, systems operator, and officer for environmental, health and safety compliance.

Approximately 950 calls were necessary to successfully reach study participants. Interviews did not proceed until the appropriate facility representative was contacted and had confirmed his/her availability for discussion. Although this procedure entailed numerous contact attempts, often spanning several days or weeks, it ensured the participation of the most knowledgeable and preferably, P2-responsible individual at each study facility.

In general, telephone respondents seemed to take a keen interest in the topics of discussion, they were helpful in providing explanatory details, and frequently, conversations continued well beyond the survey questions to encompass numerous related issues.

6.1.1 Facility Response: 94%

Of the total study population of 248 NJPPA-covered SIC Code 28 facilities, 232, or **94%** of the overall group, participated in telephone interviews. In only 14 cases, the appropriate contact person could not be reached in the study timeframe, while in an another two, major company transitions (i.e., re-organization surrounding sale of a facility to a newowner) precluded the facility's participation.

The telephone interview response group comprises 48% of all NJPPA-covered New Jersey facilities. Of the 232 participating facilities, 202 had filed Plan Summaries with the NJDEP as of November 1, 1995. According to this information, this group represents 1500 (or 77%) of the total 1940 covered processes reported on for all of New Jersey.

6.1.2 Telephone Interview Results

Question #1.

Is your company currently using pollution prevention techniques (as defined by NJPPA) in any processes, and if so, what methods are you using?

Part A.

Using P2 Techniques	206	or 89%
Not Using P2 Techniques	23	or 10%
Don't Know	3	or 1%
	232	

Question #1. (Continued)

Part B.

Methods Cited*	
In-Process Recycling	48%
Raw Materials Substitution	37%
Process Modification	30%
Improved Housekeeping/Inventory Control	27%
Product Substitution/Elimination	5%
Product Reformulation/Modification	5%
No Comment	5%

*(Frequently more than one method cited - percentages do not add to 100%.)

Question #2. (A or B, dependent on Question #1 response.)

A. What are the biggest reasons for your company's implementing pollution prevention techniques? (206)

Reasons Cited*		
Cost Effective	67%	(139)
Regulatory Compliance	41%	(85)
Environmental Responsibility	12%	(24)
Company/Corporate Policy	12%	(24)
Public Relations/Company Image	8%	(17)
Safety	8%	(17)
NJPPA	5%	(11)
Pro-Action to Keep Ahead of Regulations	5%	(11)
CMA Responsible Care/ISO Certification	5%	(10)
Reduce Liability	2%	(5)
Customer Demand for "Green" Products	2%	(5)
No Comment	4%	(8)
		356*

*(Frequently more than one reason cited - tally is 150 greater than number of respondents.)

B. Why isn't your company implementing pollution prevention techniques? (23)

P2 Doesn't Apply/Not Amenable to Facility Operations	65%
Not Cost Effective	17%
Regulations Just Rolled Back - Intended P2 No Longer Necessary	13%
Impeded by FDA Regulations	13%
Options Limited due to Customer Demand for Specific Products	13%
P2 Implementation Not Mandatory	13%
Resources not Available due to Lack of Management Support	9%

Question #3.

Do you feel that the NJPPA encourages, discourages, or has no impact on your company's implementation of pollution prevention? And why?

Part A.

Encourages P2	107	or 46%
Discourages P2	34	or 15%
No Impact on P2	68	or 29%
Both Encourages & Discourages	5	or 2%
No Comment/Undecided	18	or 8%
	232	(total w/comments: 214)

Part B. (Categorized by Part A. Responses)

1. For Those Responding: "NJPPA Encourages P2" (107/214)
(Using P2: 98) (Not Using P2: 9)

Reasons NJPPA Encourages P2	
Mandates Audit/Planning	55%
Good Approach (Voluntary, User-Friendly)	44%
Increases Awareness	30%
NJPPA Audit/Plan Caused New/Expanded P2	32%

Respondents' Additional Comments	
Overburdensome (Paperwork, Cost)	17%
P2 Definitions Should Include Other Activities (i.e., Out-of-Process Recycling)	6%
P2 Should be Mandatory (Not Voluntary)	1%
Facilities Should Get Credit for Past P2 Achievements	1%

2. For Those Responding: "NJPPA Discourages P2" (34/214)
(Using P2: 31) (Not Using P2: 3)

Reasons NJPPA Discourages P2	
Too Burdensome to Comply (Paperwork, Cost)	56%
P2 Definitions Should Include Other Activities (i.e., Out-of-Process Recycling)	32%
Using P2 Regardless of NJPPA	24%
Focus on Sara 313 Substances too Narrow	12%
Poor Approach (Redundant, Micromanages)	9%
Audit/Planning Unproductive	6%

Respondents' Additional Comments	
Good Approach (i.e., Voluntary Implementation)	21%

Question #3. (Continued)

Part B. (Continued)

3. Those Responding: "NJPPA has No Impact on P2" (68/214)
(Using P2: 57) (Not Using P2: 11)

Reasons NJPPA has No Impact on P2	
Using P2 Regardless of NJPPA	62%
Audit/Planning Not Productive	25%
Law Not Applicable/ P2 Not Amenable to Operations	12%
Poor Approach (Redundant, Micromanages)	12%
P2 Definitions Should Include Other Activities (i.e., Out-of-Process Recycling)	9%
Focus on Sara 313 too Narrow	7%

Respondents' Additional Comments	
Overburdensome (Paperwork, Cost)	37%
Good Approach (User-Friendly, Increases Use of P2)	21%
P2 Should be Mandatory (Not Voluntary)	13%
Should Get Credit for Past P2 Ach.'s	6%

4. "NJPPA Both Encourages and Discourages P2" (5/214)
(Using P2: 5) (Not Using P2: 0)

Reasons	
Good that NJPPA Mandates Audit/Planning	3/5

But...	
Overburdensome (Paperwork, Cost)	5/5
P2 Definitions Should Include Other Activities (i.e., Out-of-Process Recycling)	1/5

Most Frequently Cited Comments - Grand Totals
(214 Respondents with Comments)

NJPPA Takes Good Approach (Voluntary Implementation, User-Friendly)	32%
NJPPA Compliance Overburdensome (cost, paperwork)	32%
NJPPA Audit/Planning Triggered New/Expanded Facility P2 Initiatives	16%
P2 Definitions Should Include Other Activities (i.e., Out-of-Process Recycling)	11%
P2 Options Limited Due to Customer Demand for Specific Products	6%
P2 Implementation Should be Mandated, Not Voluntary	5%
Need More P2 Technology (Info Sharing, Expanded R&D)	5%
P2 Options Limited Due to FDA Regulations (i.e., Quality Control)	4%
Focus on SARA 313 Substances too Narrow - P2 Should Include All Areas	4%
Should Get Credit for Past P2 Achievements	3%
Lack Upper Management Support for P2	2%

6.2 Survey Questionnaire Data

As discussed earlier, survey questionnaires were selected for facilities based upon telephone interview responses (Q1. for P2-users, Q2. for non-users aware of P2, and Q3. for non-users unaware of P2). Of the total 232 representatives taking part in the telephone interviews: 206 stated that their facilities use P2, 23 that their facilities do not use P2, and 3 that they don't know whether their facilities use P2 or not. Of the 23 stating that their facilities are non-users, two suggested that P2 implementation is imminent. In the cases of the three "don't know's," Pollution Prevention Plan Summaries were consulted for clues as to P2 goals and past activities - P2 use at the facilities appears to be in progress. In no case for P2 non-users, was a facility completely unaware of P2 opportunities. Additionally, to seek the maximum possible response rate, questionnaires were sent to an additional one dozen facilities, despite the lack of previous telephone contact.

The final study questionnaire break down is as follows:

Q1. for Participants Using P2:	223	Facilities
Q2. for Participants Not Using P2:	21	Facilities
Q3. for Participants Unaware of P2:	0	
Total Number Receiving Questionnaires:	244	Facilities

6.2.1 Facility Response: 49%

Questionnaire returns break down as follow:

Total Q1. Returns:	109	or 49%
Total Q2. Returns:	11	or 52%
Total Overall Questionnaire Survey Response:	120	**or 49%**

Among the total Q1. responses, three respondents indicate that in fact, P2 methods are *not* used at their facilities. Among the Q2. responses, seven indicate that P2 methods *are* used at their facilities. The remaining four *valid* Q2. surveys are simply too few in number to infer meaningful findings. Because of these discrepancies, these fourteen questionnaires are not included in the study data analysis. However, it is useful to include this data in reporting results pertaining to questionnaire Parts I (descriptive information) and IV (P2 opinion poll data and commentary). Aside from these areas, all reporting and data analysis surrounds the remaining 106 valid Q1. returns, only.

6.2.2 Response-Group Facility Representation

The following chart (Table 6.1) places the study response group in relation to New Jersey NJPPA-covered facilities, overall. The response group is representative of 48% of total covered SIC Code 28 New Jersey facilities, and 25% of *all* covered NJ facilities (all SIC Codes). Further, this group reports a total of 724 covered facility processes, representing 46% of all covered SIC Code 28 NJ processes, and 37% of *all* covered NJ processes.

Table 6.1. Study Response-Group Representation

NJ Chemical & Allied Products Industry: Proportion of Total NJPPA-Covered Facilities		
NJPPA-Covered Facilities (All SIC Codes):	486	
Study Population Covered SIC28 Facilities:	248	or 51%
Study Response Group SIC28 Facilities:	120	48% of SIC28 - 25% of Total
Total NJ Plan Summaries Filed as of 11/1/95:	426	or 88% of Total Required
Study Population SIC28 Plan Summaries Filed as of 11/1/95:	210	85% of SIC28 - 43% of Total
Study Response Group SIC28 Summaries Filed as of 11/1/95:	105	88% of Required 25% of Total Filed
Total NJ Covered Processes Reported:	1940	
Study Population SIC28 Processes Reported:	1559	or 80% of Total
Study Response Group SIC28 Processes Reported:	724	46% of SIC28 37% of Total NJ

(Source: Pollution Prevention Plan Summaries, NJDEP 1995b)

The study response group is represented as a proportion of total NJ SIC28 covered facilities in Table 6.2, and illustrated in the corresponding graph in Figure 6.1. As shown, response rates vary over SIC product categories. Industrial Gases, Alkalies, and Soap/Detergent/Surfactants groupings post the highest return rates, while Fertilizer/Pesticides, Fragrance/Cosmetics, Adhesives/Sealants, and Inorganic Chemicals post the lowest. The response group is isolated and shown by SIC Product Groupings in Figure 6.2.

Table 6.2. Study Response Group Representation: SIC Product Groupings

SIC Product Group	NJ SIC 28 Facilities	Response Group Facilities	% of Total
Inorganic Chemicals/Chem Preparations	43	16	37%
Paints and Coatings	34	15	44%
Inks/Dyes/Pigments	31	17	55%
Medical/Pharmaceutical/Biological	30	17	57%
Organic Chemicals	29	14	48%
Plastics	23	11	48%
Soaps/Detergents/Surfactants	23	16	70%
Adhesives/Sealants	14	5	36%
Fragrances/Cosmetics	12	4	33%
Fertilizers/Pesticides	4	1	25%
Industrial Gases	3	3	100%
Alkalies	1	1	100%
Explosives	1	0	0
	248	120	

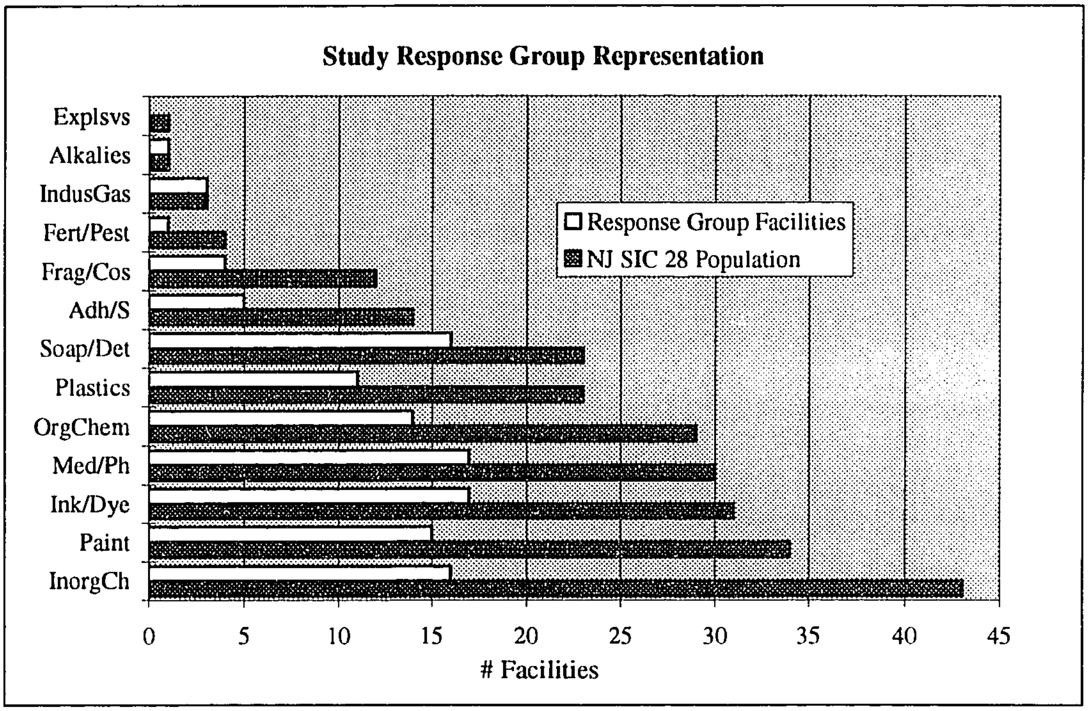


Figure 6.1. Study Response Group Representation by SIC Product Groupings

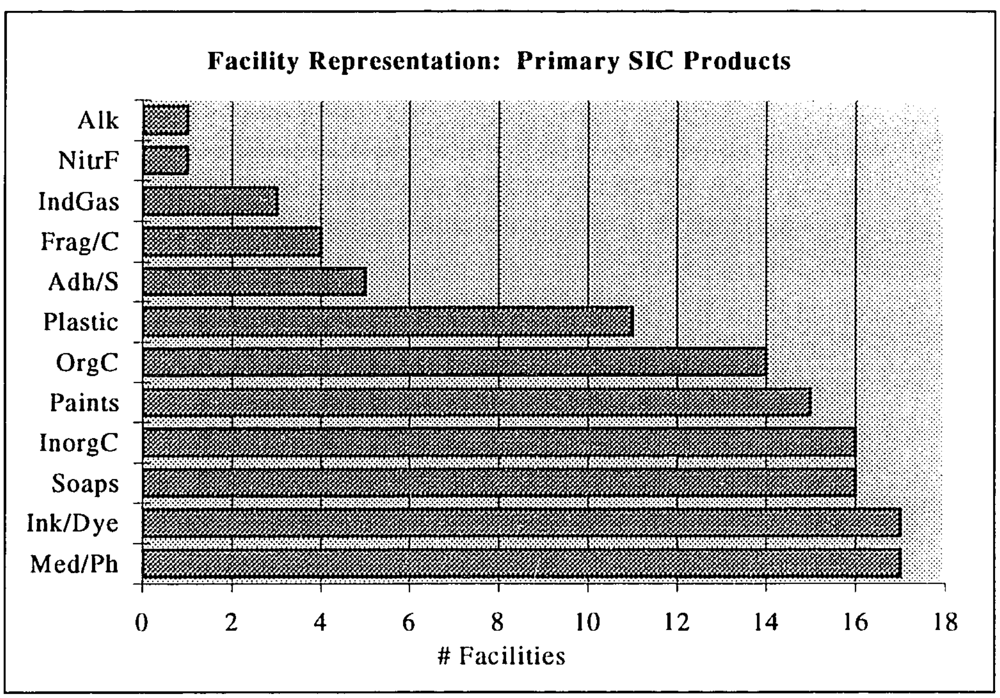


Figure 6.2. Study Response Group Facility Representation by SIC Product Groups

Facility representation by number of employees is illustrated in Table 6.3 and the accompanying pie chart, show in Figure 6.3. The minimum number of employees reported is four, while the maximum is as high as 4500. Most study facilities, however, fall into the three small to moderate size categories, of 26-50, 51-100, or 101-250 employees.

Table 6.3. Study Facilities by Number of Employees Categories

Number Employees	A 1-25	B 26-50	C 51-100	D 101-250	E 251-500	F 501-4500	Total
Number of Facilities	19	28	30	27	5	11	120

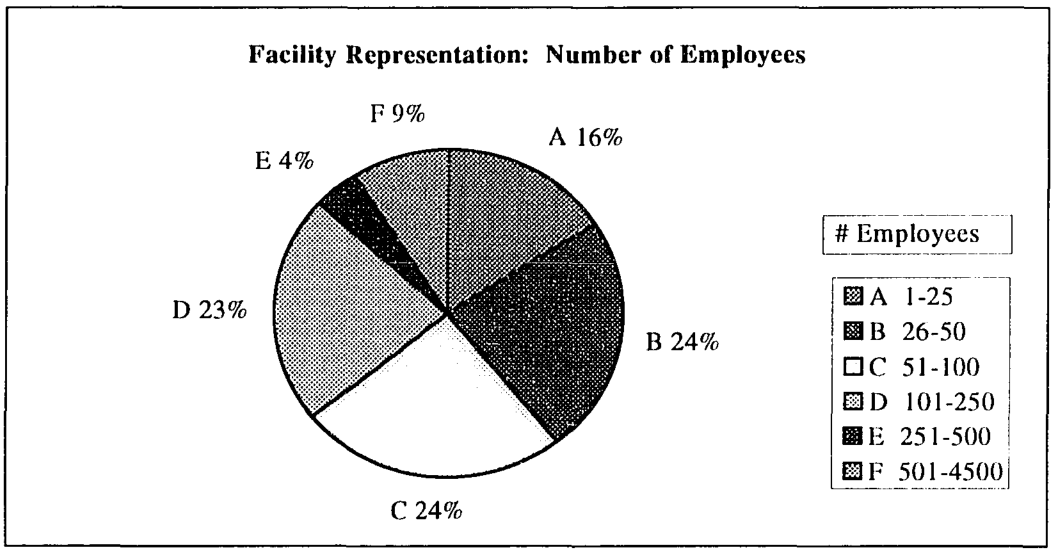


Figure 6.3. Study Response Group by Number of Employees

Finally, the study response group can be broken down to illustrate the variation in company sizes (by number of employees) within each SIC product group. This break down is outlined in Table 6.4 and graphically depicted in Figure 6.4. It is of interest to note that the product category groups are spread over facilities of primarily small, to moderate size. The very large facility size (F 501-4500) is almost completely composed of medicinal, pharmaceutical, and/or biological products manufacturing firms.

Table 6.4. Study Group Representation: Facility Employee Categories by SIC Product Group

	Number of Employees						
	A 1-25	B 26-50	C 51-100	D 101-250	E 251-500	F 501-4500	Totals
Med/Pharm/Bio	1	1	3	3	1	8	17
Ink/Dye/Pigment	4	4	2	6	1		17
Soap/Deterg/Surfac	3	6	3	4			16
Inorganic Chemicals	3	4	5	4			16
Paints/Coatings	1	6	6	2			15
Organic Chemicals	1	2	4	4	2	1	14
Plastics	1	2	2	4		2	11
Adhesives/Sealants	3	1	1				5
Industrial Gases	1	1	1				3
Fragrance/Cosmetics		1	2		1		4
Nitrous Fertilizers	1						1
Alkalies			1				1
Totals	19	28	30	27	5	11	120

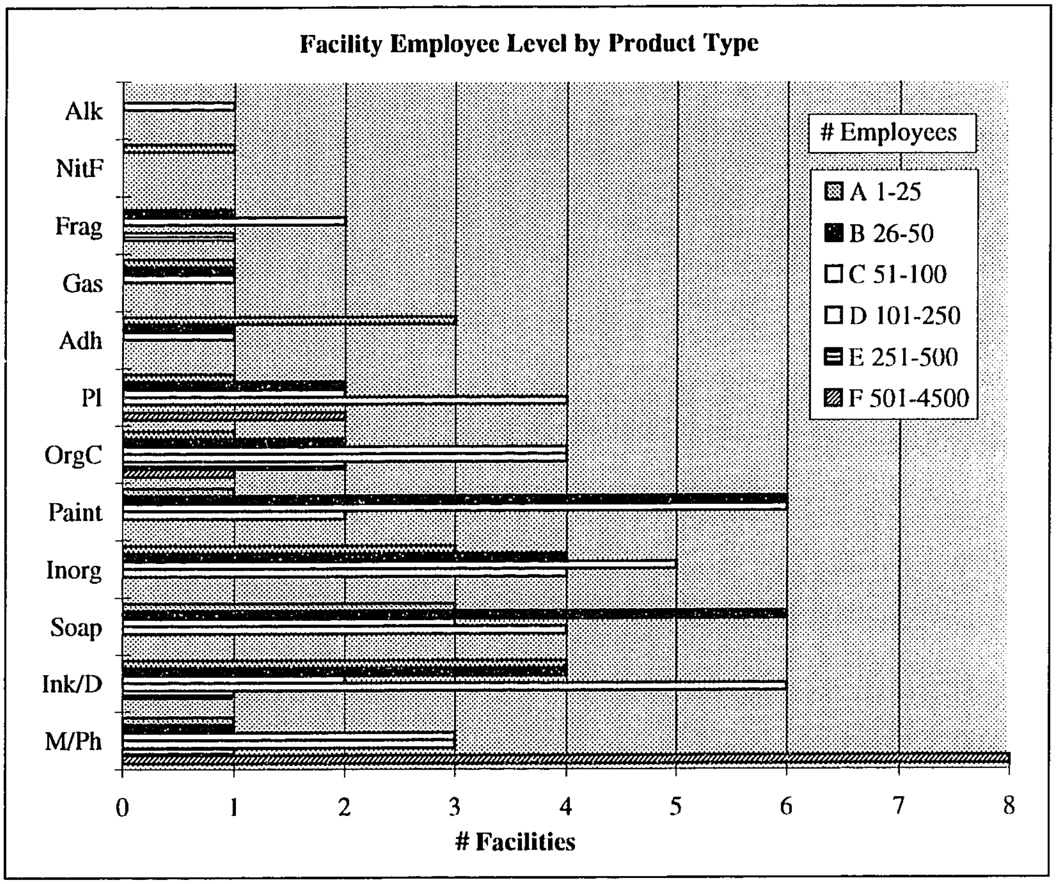


Figure 6.4. Response Group Representation: Employee Categories by Product Group

6.2.3 Survey Questionnaire Results

6.2.3.1 Questionnaire Part I. Facility Basis Information

1. Facility Organizational Structure (Maximum Total 120)

	Yes	No	Valid N
Facility Owned by Larger Company (LgCo)	74 or 62%	46 or 38%	120
P2 Assisted by Parent Company (P2By)	33 or 45%	41 or 55%	74

The majority of facilities are owned by a larger company, but only about half of these are assisted in their P2 efforts by the parent company. As a proportion of the overall 120 response group, assisted facilities make up about 28%.

6.2.3.2 Questionnaire Part II. Facility P2 Review

1. Company Environmental Affairs (Maximum Total 120)

	Yes	No	Valid N
Use Recycled Materials (D1)	66 or 56%	52 or 44%	118
Offer Product/Packaging Take-Back Program (D2)	40 or 34%	77 or 66%	117
Use Life-Cycle Analysis (D3)	21 or 19%	91 or 81%	112
Manufacture "Green" Products (D4)	34 or 32%	72 or 68%	106
P2 Implementation Has Resulted in Cost Savings (D5)	61 or 59%	43 or 41%	104*
Achieved Use/Generation Reductions 1985-95 (D6)	99 or 85%	18 or 15%	117

**(This question asked only on Q1. for P2-Users - maximum total 109)*

Use of recycled materials is the most highly reported of the special environmental initiatives, at nearly 60% of respondent facilities. Product or packaging take-back programs are offered by over 30% of response group firms. A closer look at these respondents, indicates that they are comprised primarily of soaps/detergents (20%) and plastics (20%) SIC product types. Inks/dyes/pigments (14%), inorganic chemicals (14%), and paints/coatings (11%) firms are

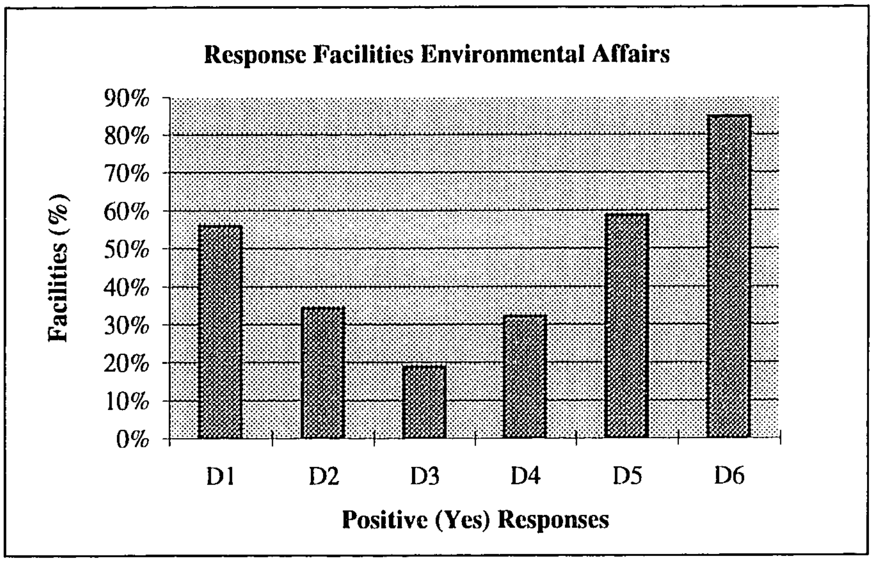


Figure 6.5. General Environmental Affairs Responses

next highest in offering take-back programs, with the remainder scattered in increments, but representing each of the other product categories.

Life-cycle analysis (LCA) is the least used of the special initiatives, reported at only 19% of response facilities. A breakdown by product groupings indicates that these firms are primarily: medicinal/pharmaceutical, soaps/detergents, organic chemicals, and plastics (approximately 16% each), and inorganic chemicals and paints/coatings (10% each). The question concerning manufacture of "green" products is clearly a subjective issue. With no specific definition, responses are indicative of individual perceptions of what "green" products consist of. The 32% of respondents answering this question in the affirmative consist largely of soap/detergent manufacturers (30%), followed by organic and inorganic chemical producers (17% each), and trailing, paints/coatings and plastics processors (10% each).

Asked whether implementation of pollution prevention techniques has resulted in cost savings, nearly 60% of the response group replies positively. On the issue of past reductions achievements (whether derived from activities defined specifically as P2, or not), a whopping

85% of the study group reports having reduced use and/or generation of hazardous or toxic materials. Of the 99 respondents stating that the facility has achieved either use or generation reductions, 84 provided reduction estimates:

	Average	Min	Max	Mode	Valid N
1985-95 Use Reduction Estimate	22.9%	0	90%	0	84
1985-95 Generation Reduction Estimate	35.3%	0	100%	10%	84

Reported facility reductions are illustrated in Figures 6.6 and 6.7, with a breakdown over reduction ranges. Use reductions fall mainly (45% of reporting facilities) in the lower ranges, from 1-20%. An additional 20% of respondents indicate reductions of 21-50%, with only 12% reporting in the highest use reduction ranges of 51-90%.

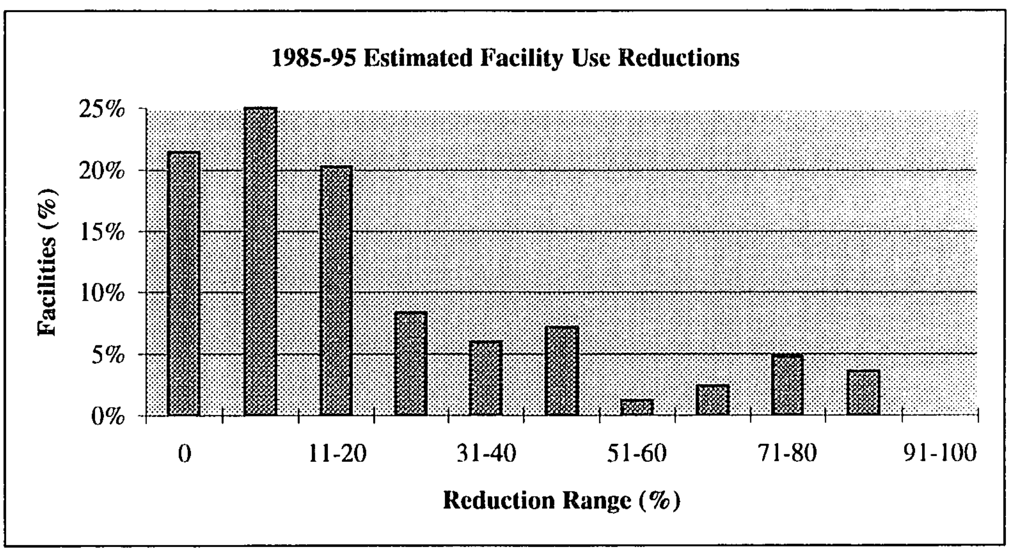


Figure 6.6. Response Group 1985-95 Estimated Facility Use Reductions

Facility reported generation reductions are scattered more evenly over the various ranges, with the exception of the 1-10% category, reported by 29% of response facilities. An additional 37% report reductions from 11 to 50%, while 26% of facilities claim achievements as high as 51-100%. In comparing the estimated use and generation reduction achievements, it is of interest to note that far fewer reports of zero percent reduction are apparent in the generation reduction category. Of the 84 facilities responding overall, 66 (79%) report use reductions while 77 (92%) report generation reductions. Facilities reporting both use and generation reductions total 58, or 69% of the response group.

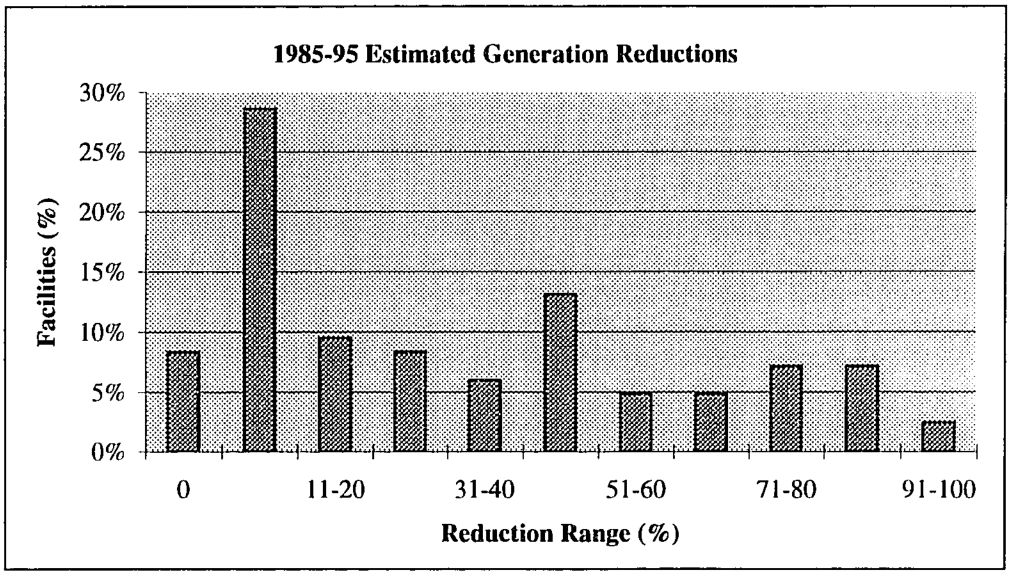


Figure 6.7. Response Group 1985-95 Estimated Facility Generation Reductions

6.2.3.2. Questionnaire Part II. (Continued)

2. Implementation of Pollution Prevention Methods (Maximum Total 106)

The information requested in this section of the questionnaire pertains only to the 106 facilities using P2 techniques. (The section was deleted from Q2. and Q3.) The P2 methods listed for respondent selection are *not* all NJDEP/NJPPA-defined and accepted techniques. Neither product substitution nor product redesign make the State-defined P2 methods listings. Product substitution involves altering the product line to completely eliminate use/generation problem areas. Primarily this "method" infers a process shut-down which often results subsequently, in relocation of the process to another state. Product redesign (for increased lifespan, repairability, re-use, disassembly) does not necessarily accomplish NJPPA-defined P2 objectives. In the event that its various applications do reduce/eliminate non-product output, or reduce/eliminate hazardous substance use, however, this "method" may fall under several of the other accepted definitions. Product redesign is included as a separate listing, simply as an area of special interest since it represents a newly-developing philosophy in environmental preservation.

Pollution prevention methods reported by response facilities are listed in Table 6.5 and charted for visual illustration, in Figure 6.8. The most-used P2 method obviously, is improved operating practices, while the least often-cited, are the previously-discussed product redesign and product substitution "methods." Most facilities report using more than one method, with the average number of methods implemented being 2.9. Just four facilities report using as many as six or seven methods, while the bulk of facilities (over 50%) use two or three.

Table 6.5. Response Facility P2 Methods Use* (Total 106)

		Facilities (#)	(%)
M6.	Improved Operating Practices	80	75.5
M5.	Process Modification	60	56.6
M2.	Raw Materials Changes	48	45.3
M7.	In-Process Recycling	42	39.6
M1.	Product Modification	30	28.3
M4.	Product Substitution	23	21.7
M3.	Product Redesign	4	3.8

**Facilities frequently cite more than one method.*

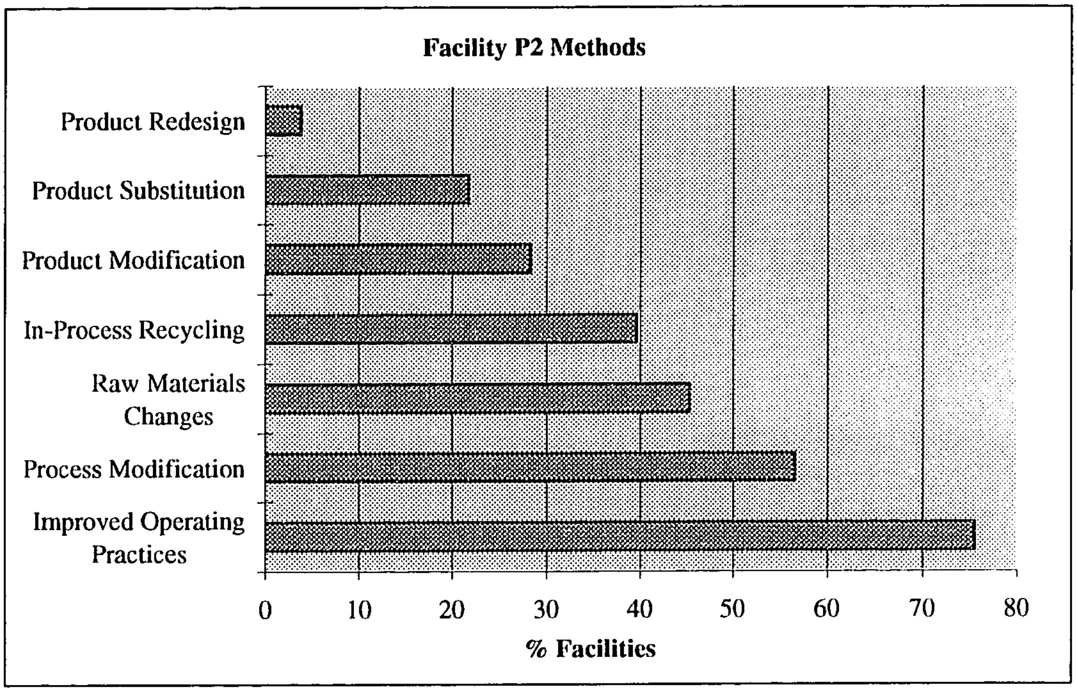


Figure 6.8. Facility Pollution Prevention Methods Reported

For each method reported, respondents were also asked to provide the earliest date of plant implementation, the percentage of processes the method is applied in, and to indicate whether methods not now employed, are planned for future implementation. The responses to these questions are tabulated in Tables 6.6-6.8. Response rates on this particular set of inquiries are slim, as denoted by the "Valid N" category, which at its maximum would be 106, as above.

Implementation dates listed in Table 6.6 are demarcated by pre- and post-1993, the first year of required reporting under the NJPPA. Respondents listed dates going back as far as 1948, but for the most part - in 76% of cases - P2 implementation took place in the 1990's. In 17% of cases, implementation occurred in the 1980's and in just 4% of cases, dates encompass the 1970's. It is of interest to note that certain methods were put into effect in significantly higher percentages in the post-1993 period. Implementation of both process

Table 6.6. Earliest P2 Methods Implementation Dates

	P2 Methods	Implementation Dates Pre-1993* % Facilities	1993/Post-'93	Valid N
M6	Improved Operating Practices	41.7%	58.3%	48
M5	Process Modification	30.4%	69.6%	46
M2	Raw Materials Changes	34.3%	65.7%	35
M7	In-Process Recycling	53.9%	46.2%	26
M1	Product Modification	41.0%	59.1%	22
M4	Product Substitution	46.7%	53.3%	15
M3	Product Redesign	100.0 %	0	1

**1993: First NJPPA Reporting Year*

modification and raw materials changes, increase 30 to 40%. Product modification and improved operating practices implementation each increase by nearly 20%.

Improved operating practices are applied to more than 50% of facility processes at nearly 60% of respondent facilities, as shown in Table 6.7. Other P2 techniques are primarily used in less than 50% (or 50%) of facility processes, as expected, due to their more specialized nature. It is somewhat surprising to note that nearly 40% of facilities using in-process recycling, employ it in greater than 50% of processes, as this is one method that respondents indicate having significant difficulty with. Both in telephone interviews and questionnaire commentary, respondents repeatedly voice the opinion that out-of-process recycling should be included in NJPPA accounting, since in-process recycling is considered very difficult - and impractical - to implement. (Approximately 40% of the overall 106 respondents report facility use of in-process recycling. - see Table 6.5.)

Process modification is the choice method for future P2 implementations, as shown in Table 6.8. Improved operating and raw materials changes follow closely behind.

Table 6.7. Extent of P2 Methods Implementation - Percent of Processes

	P2 Methods	Percent of Processes <=50%	>50%	Valid N
		Percent of Facilities		
M6	Improved Operating Practices	40.35%	59.65%	57
M5	Process Modification	69.39%	30.61%	49
M2	Raw Materials Changes	87.50%	12.50%	40
M7	In-Process Recycling	60.71%	39.29%	28
M1	Product Modification	84.00%	16.00%	25
M4	Product Substitution	100.00%	0	15
M3	Product Redesign	100.00%	0	2

Table 6.8. Methods Planned for Future Implementation

	P2 Methods Planned for Future Implementation	# Facilities	% of Total 106
M6	Improved Operating Practices	19	18.87%
M5	Process Modification	25	24.53%
M2	Raw Materials Changes	18	16.98%
M7	In-Process Recycling	13	12.26%
M1	Product Modification	14	13.21%
M4	Product Substitution	8	8.49%
M3	Product Redesign	7	7.55%

6.2.3.2. Questionnaire Part II. (Continued)

3. Facility P2 Organizational Attributes (Total 106)

Facility P2 organizational attributes are indicated with simple "yes/no/don't know" responses, on survey questionnaires. This section of the questionnaire also applies only to facilities using P2 methods, for a total maximum of 106 respondents. Responses are outlined both in the Table 6.9 and the chart in Figure 6.9, following. The most frequently occurring attribute is A6, the designation of specific individuals with P2 program responsibility. The next most

Table 6.9. Response Facility P2 Organizational Attributes

P2 Organizational Attributes		Yes (#)	Yes (%)	No (#)	No (%)	Don't Know	Valid N
P2 in Company Policy	A1	72	69%	31	30%	2	105
Top Management P2 Support	A2	84	80%	5	5%	16	105
P2 in Planning/Design	A3	83	78%	14	13%	9	106
P2 in Budgeting	A4	56	53%	40	38%	10	106
Use of Cross-Functional Teams	A5	32	30%	68	64%	6	106
Specific P2-Responsible Individuals	A6	97	92%	9	8%	0	106
Provision of P2 Training/Education	A7	58	55%	45	42%	3	106
Established Prioritized P2 Goals	A8	84	79%	18	17%	4	106
Employee P2 Recognition	A9	37	35%	64	60%	5	106
P2 in Employee Performance Eval	A10	30	28%	70	66%	6	106
P2 Communications	A11	72	68%	32	30%	2	106
Measurement of P2 Progress	A12	69	65%	34	32%	3	106
P2 Progress Reports	A13	56	53%	46	43%	4	106

common elements in response facility programs, are top management support for P2, establishment of prioritized P2 goals, and integration of P2 into planning and product/process design. The least common of the attributes is incorporation of P2 achievement in employee performance evaluations. Employee recognition for P2 achievement is not far behind, at just 35%. Rounding out the bottom three is the use of cross-functional teams to integrate P2 activities throughout facility areas (30%). It is of interest here, also, to note the high number of respondents (15%) indicating they "don't know" whether top management is committed to pollution prevention, or not.

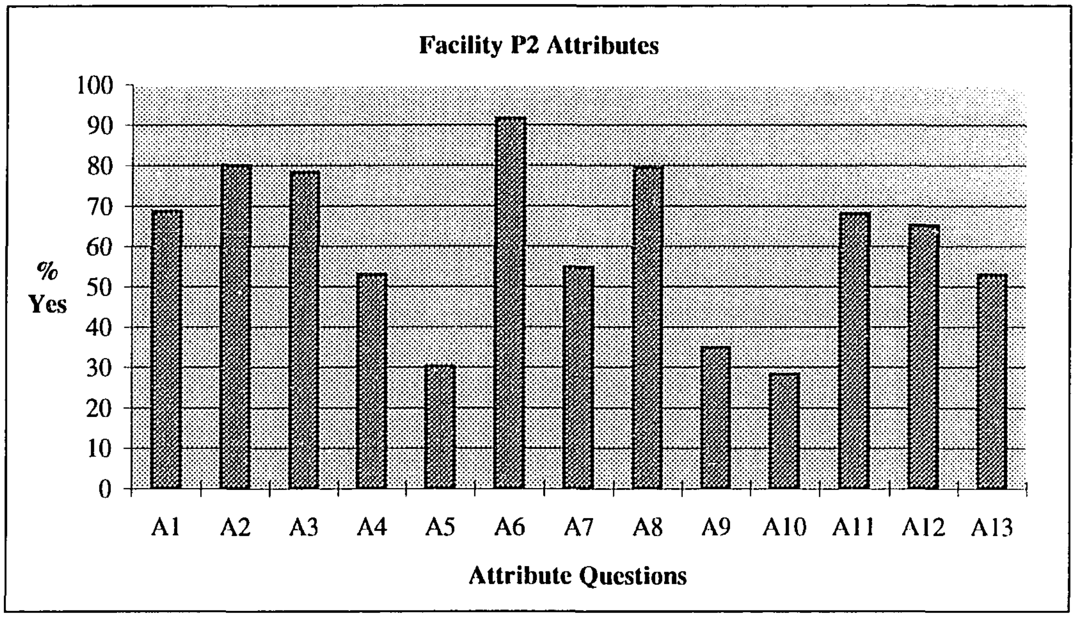


Figure 6.9. Response Facility P2 Organizational Attributes

Response facility P2 organizational attributes are represented by frequencies in Table 6.10, which is then charted in Figure 6.10. The average facility sum of the various P2 organizational attributes is 7.8. The median sum is 8, while the mode is 10. Seven facilities report having every attribute listed on the questionnaire, while another twenty have more than ten attributes. Ten facilities have fewer than four, while two facilities report having no attributes, at all.

Table 6.10. Frequencies Table: Sum of Organizational Attributes

Number of Attributes	0	1	2	3	4	5	6	7	8	9	10	11	12	13	Total
Number of Facilities	2	1	2	5	8	12	11	8	8	8	14	11	9	7	106

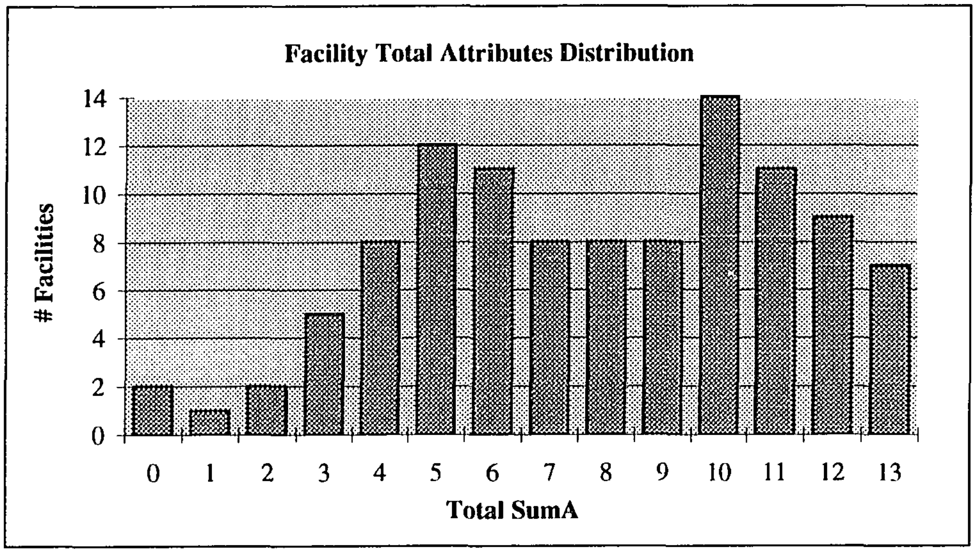


Figure 6.10. Sum of Facility Organizational Attributes

Finally, organizational attributes are depicted cumulatively, in Table 6.11 and Figure 6.11. Note that the *number* of facilities and the *percentage* of facilities are very nearly equal, due to the response group size of 106. From Table 6.11, it is clear that the percentage of facilities decreases as the cumulative number of attributes increases. For instance, while 98% of facilities have at least one attribute and 72% have as many as six, only 15% report having up to twelve attributes in place to support the facility's P2 program.

Table 6.11. Cumulative P2 Organizational Attributes

Number of Attributes	# Facilities	% Facilities
1	104	98
2	103	97
3	101	95
4	96	91
5	88	83
6	76	72
7	65	61
8	57	54
9	49	46
10	41	39
11	27	25
12	16	15
13	7	7

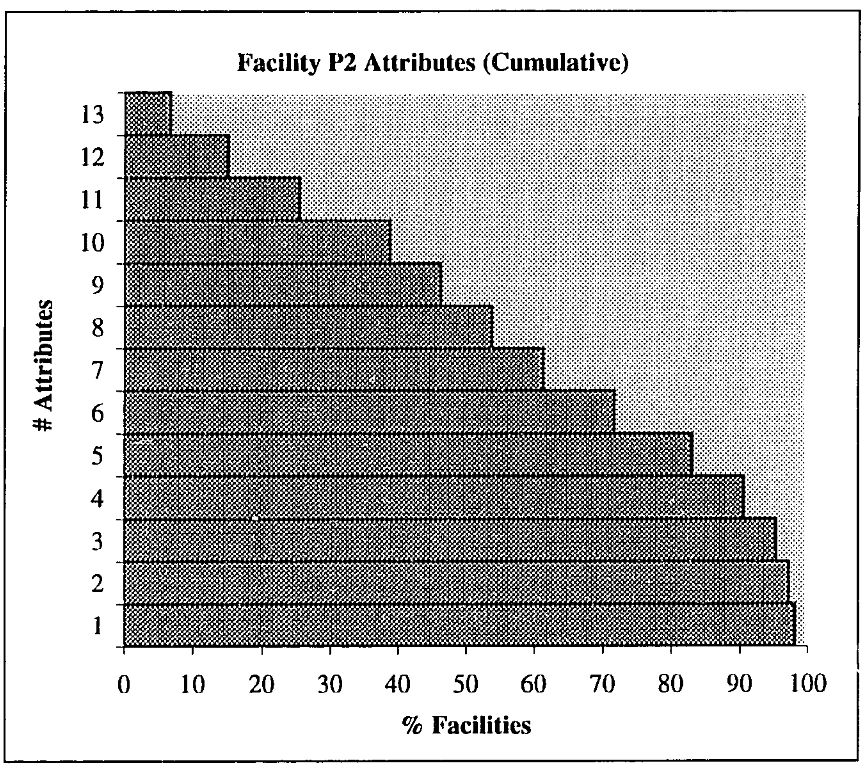


Figure 6.11. Cumulative Facility P2 Organizational Attributes

6.2.3.3 Questionnaire Part III. P2 Influence Factors

1. Regulatory/Technical Factors

Table 6.12. Regulatory/Technical Influence Factor Responses (Percentages)

		Very Important	Important	Somewhat Important	Not Important	Does Not Apply	Valid
		4	3	2	1	0	N
NJPPA Planning Requirements	RT1	0.21	0.31	0.24	0.21	0.03	105
Potential Facility-Wide Permit	RT2	0.13	0.21	0.30	0.29	0.07	103
NJPPA Voluntary Enforcement	RT3	0.15	0.33	0.33	0.17	0.03	103
Potential Future P2 Mandates	RT4	0.30	0.30	0.24	0.13	0.03	105
NJPPA Policy Objectives	RT5	0.06	0.43	0.32	0.16	0.03	104
NJPPA Clear/Consistent Rules	RT6	0.24	0.35	0.21	0.15	0.05	105
Rep in NJPPA Formulation	RT7	0.18	0.30	0.24	0.20	0.08	105
DEP Flexibility	RT8	0.38	0.26	0.16	0.13	0.06	104
Reg's other than P2 Laws	RT9	0.27	0.40	0.26	0.05	0.02	104
Technical Feasibility	RT10	0.43	0.42	0.13	0.02	0.00	105
NJTAP Assistance Availability	RT11	0.10	0.20	0.31	0.37	0.03	104

2. Financial Considerations

Table 6.13. Financial Influence Factor Responses (Percentages)

		Very Important	Important	Somewhat Important	Not Important	Does Not Apply	Valid
		4	3	2	1	0	N
Cost to Implement	F1	0.62	0.30	0.07	0.01	0.00	106
Potential Cost Savings	F2	0.40	0.40	0.13	0.06	0.02	106
Customer Demand for Green	F3	0.03	0.23	0.36	0.20	0.17	103
P2 Technologies Market	F4	0.07	0.16	0.21	0.36	0.21	106
Reduce Recordkeeping	F5	0.25	0.32	0.25	0.11	0.06	106
Reduce Liability	F6	0.48	0.26	0.18	0.06	0.02	106
Potential P2 Investment Risk	F7	0.25	0.34	0.23	0.18	0.00	106

3. Organizational/Social Elements

Table 6.14. Management/Social Influence Factor Responses (Percentages)

		Very Important	Important	Somewhat Important	Not Important	Does Not Apply	Valid
		4	3	2	1	0	N
Company Flexibility	OS1	0.23	0.48	0.18	0.08	0.03	106
Quality Goals	OS2	0.47	0.38	0.13	0.02	0.00	106
Employee Safety	OS3	0.51	0.32	0.16	0.01	0.00	106
Company Image	OS4	0.27	0.38	0.25	0.09	0.00	106
Public Toxics Reporting	OS5	0.16	0.41	0.29	0.12	0.02	106
Environmental Conduct Code	OS6	0.24	0.36	0.26	0.12	0.02	105
Reduce Environmental Impact	OS7	0.35	0.49	0.14	0.02	0.00	106

4. Overall Category Ranks

Table 6.15. Overall Factor Category Rank Responses (Percentages)

		Most Important		Least Important	
Factor Category		1	2	3	Valid N
Regulatory/Technical	RTF	0.53	0.35	0.12	106
Financial	FF	0.42	0.43	0.15	105
Organizational/Social	OSF	0.15	0.20	0.65	106

5. Most Important P2 Benefits

Table 6.16. Most Important P2 Benefits Responses (Percentages)

		Most Important					Least Important	Valid
P2 Benefit		1	2	3	4	5	6	N
Cost Savings	CS	0.33	0.24	0.22	0.12	0.02	0.06	99
Impr Mkt Competitive	IMC	0.10	0.12	0.12	0.23	0.32	0.12	91
Enhanced Co Image	ECI	0.12	0.10	0.19	0.21	0.22	0.15	97
Reduced Liability	RL	0.23	0.31	0.23	0.12	0.09	0.02	101
Reduced Env'l Impact	REI	0.38	0.23	0.20	0.13	0.05	0.01	100
Facility-Wide Permit	FWP	0.08	0.01	0.08	0.08	0.17	0.57	84

Table 6.17. Most Important Benefits: "Other" Category Responses

"Others"	Valid N	Rank Assigned
Increased Productivity	1	2
Social Responsibility	1	2
Reduced Reporting/Recordkeeping	1	1
No Benefits	1	--

6.2.3.4 Questionnaire Part IV. Pollution Prevention Commentary

1. Out-of-Process Recycling Opinion Poll (Maximum Total Responses: 120)

Should Out-of-Process Recycling be Included in the
NJPPA Definition of Pollution Prevention?

Yes	No	Don't Know	Null	Total N
90	17	3	10	120

Yes: 75%
No: 14%
No Comment: 9%
Don't Know: 3%

Table 6.18. Reasons Out-of-Process Recycling (OPR) Should be Included

"Yes" Response Rationale (Total 90)	(#)	(%)
OPR reduces or eliminates waste/emissions/waste disposal.	24	27%
Out-of-process recycling is pollution prevention.	19	21%
In-process recycling is not always feasible due to cost, product quality, and/or technical issues (i.e., batch processing).	15	17%
OPR reduces or eliminates *use* of hazardous/toxic substances and raw materials (saves resources).	11	12%
OPR is valid, environmentally sound, beneficial.	10	11%
OPR is cost effective.	8	9%
OPR should be encouraged.	4	4%
OPR should receive NJPPA credit.	2	2%
OSHA covers exposure/safety issues - NJPPA shouldn't address these.	2	2%
Excluding it skews materials balance accounting.	1	1%
No comment.	8	9%
Total (Some cases: more than one response.)	104	

Table 6.19. Reasons Out-of-Process Recycling (OPR) Should Not be Included

"No" Response Rationale (Total 17)	**(#)**
OPR is not pollution prevention.	3
OPR inclusion would eliminate the NJPPA incentive to improve processes.	1
OPR involves increased handling and thus greater cost and spill risk.	1
Inclusion of OPR would increase NJPPA program complexity.	1
Industry should choose methods.	1
No comment.	10
Total	17

2. Negative Impacts of P2 Program

Table 6.20. P2 Program Negative Impacts Responses

Negative Impacts (Total Response Pool 120)	(#)	(%)
Increased Costs	31	26%
Increased Paperwork	25	21%
None	25	21%
Drain on Resources (Manpower,Time)	24	20%
Increased Regulatory Burden	4	3%
Hinders Competitiveness	4	3%
Product Quality/Performance Decrease	3	3%
Poor Customer Acceptance	1	1%
No Comment	16	13%
Total (Some cases: more than one response.)	133	

3. Improving NJPPA to Increase Participation

Table 6.21. Improving NJPPA Responses (Total Response Pool 120)

To Increase INDUSTRY Participation			To Increase FACILITY Participation	
(%)	(#)	**Improvement Suggestions**	(#)	(%)
39%	47	Provide More Recognition for P2 Efforts	29	24%
	(23)	• Credit for Past Achievements	(13)	
	(13)	• Recognition for Out-of-Process Recycling	(6)	
	(7)	• Recognition for P2 in areas o/than TRI Substances	(6)	
	(3)	• Recognition Award Programs	(4)	
	(1)	• Credit for P2 Designed into Processes/Products		
27%	32	Provide Technical Assistance (i.e., Site visits to provide P2 evaluation and recommendations, Info-sharing, Seminars)	20	15%
28%	33	Simplify Reporting	13	11%
	(2)	• Integrate w/other Regulatory Reporting	(2)	
	(3)	• Revamp Financial Analysis Req.'s - Confusing		
19%	23	Less Stringency in Planning Requirements	15	13%
22%	26	Provide Financial Assistance	24	20%
	(9)	• Grant/Loan Program	(13)	
	(7)	• Tax Credits/Incentives	(6)	
	(5)	• Research Funding	(5)	
16%	19	Provide Regulatory Assistance		
	(7)	• Improve NJPPA Regulatory Guidance	7	6%
	(7)	• Decrease Enforcement Emphasis - Inc. Cooperation	(4)	
	(3)	• Provide Reg'y Incentives (i.e., re permit approvals)	(1)	
	(1)	• Pass Reg's to Increase Demand for "Green"	(1)	
	(1)	• Make P2 Mandatory	(1)	
18%	21	No Comment/Don't Know	37	31%

(Numbers do not add up to 100%.)

4. Barriers to Initiation or Expansion of P2 Program

Table 6.22. Biggest P2 Barriers Responses (Total Response Pool 120)

Barriers	(#)	(%)
Cost	42	35%
Lack Technology/Technical Feasibility	24	20%
Lack Personnel Resources (including training)	19	16%
Not Amenable to Operations	10	8%
Product Design (Quality/Performance)	10	8%
None	9	8%
Lack of Management Commitment/Awareness	6	5%
Regulatory Disincentives	5	4%
FDA Regulations	2	2%
Out-of-Process Recycling not Included	2	2%
Lack Facility Planning/Organization	2	2%
Lack of Flexibility in NJPPA Program	1	1%
Focus on TRI Chemicals	1	1%
Batch Operations	1	1%
Only Covered Substance Facility Uses: De-Listed	1	1%
No Comment	12	10%
Total (Frequently more than one answer.)	147	

5. Final Additional Comments

Table 6.23. Final Responses: Items Important in Company Embrace or Rejection of P2

• NJDEP administration of NJPPA has been cooperative, helpful to industry.	5
• Industry P2 is driven strictly by cost/cost savings.	3
• P2 should be mandated; not voluntary.	2
• P2 should be worldwide/universal; not just for industry.	2
• P2 is driven by TRI Reporting.	2
• Need top management involvement/education in P2.	2
• P2 Regulations are too difficult for small companies to comply with.	2
• NJPPA should exclude facilities where substance use is under low threshold quantities or where chemicals used are being de-listed.	2
• For batch processes, it is difficult to provide accurate product-level information (especially financial) required for NJPPA reporting.	1
• NJDEP inspectors/agents need stronger chemistry knowledge.	1

6.3 Pollution Prevention 5-Year Plan Summaries

A great deal of additional information is available regarding survey response facilities in the P2 5-Year Plan Summaries filed with NJDEP. The tables and charts following, present supplemented information regarding facility methods implementation and depictions of the P2 5-year goals projected by study facilities. Through this data, the information regarding P2 goals - needed for the P2 Commitment Index - is collected.

6.3.1 Supplemented Facility P2 Methods Information

Table 6.24. Response Facilities P2 Methods (Supplemented by Filed Plan Summaries)

		Facilities Using Method (106 Total Facilities)		As Reported on Questionnaires
Method		(#)	(%)	% Facilities
Improved Operating Practices	M6	91	86	75
Process Modification	M5	80	75	57
Raw Materials Changes	M2	63	59	45
In-Process Recycling	M7	46	43	40
Product Modification	M1	36	34	28
Product Substitution	M4	23	22	22
Product Redesign	M3	4	4	4

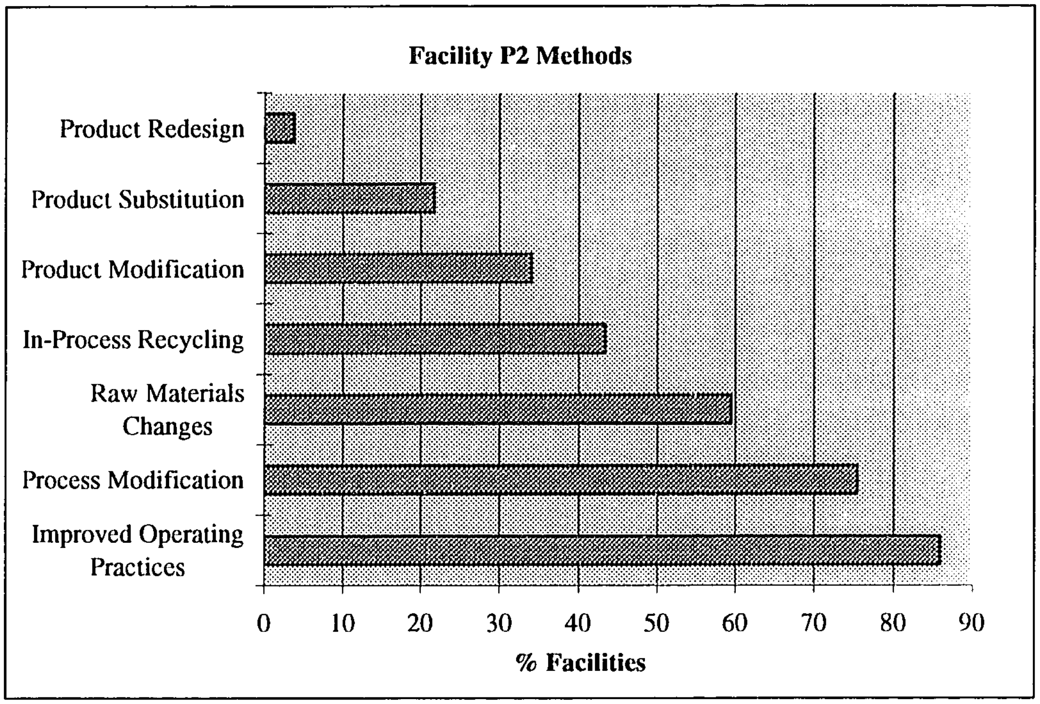


Figure 6.12. Response Facility P2 Methods - Supplemented by Filed Plan Summary Data

6.3.2 Facility 5-Year Reduction Goals

6.3.2.1 Response Facility 5-Year Process Goals

Total Response Group: 120 Facilities with Plan Summaries Filed: 105 (88%)
Facilities with Process Reduction Goals: 83 (82%)
Total Processes with Reduction Goals: 39%

Table 6.25. Response Facilities by SIC Product Group: Process Use/NPO Reduction Goals

SIC Product Group	Total Number Covered Processes	Number of Covered Processes with Projected Reductions (#)	Percent Covered Processes with Projected Reductions (%)
Med/Pharmaceutical	135	56	41%
Organic Chemicals	124	43	35%
Ink/Dye/Pigments	118	40	34%
Paints/Coatings	107	69	64%
Inorganic Chemicals	101	33	33%
Soap/Deterg/Surfactants	57	20	35%
Adhesive/Sealants	47	8	17%
Plastics	27	10	37%
Fragrance/Cosmetics	5	2	40%
Industrial Gases	2	2	100%
Nitrous Fertilizers	1	0	0
Overall Totals	724	283	39%

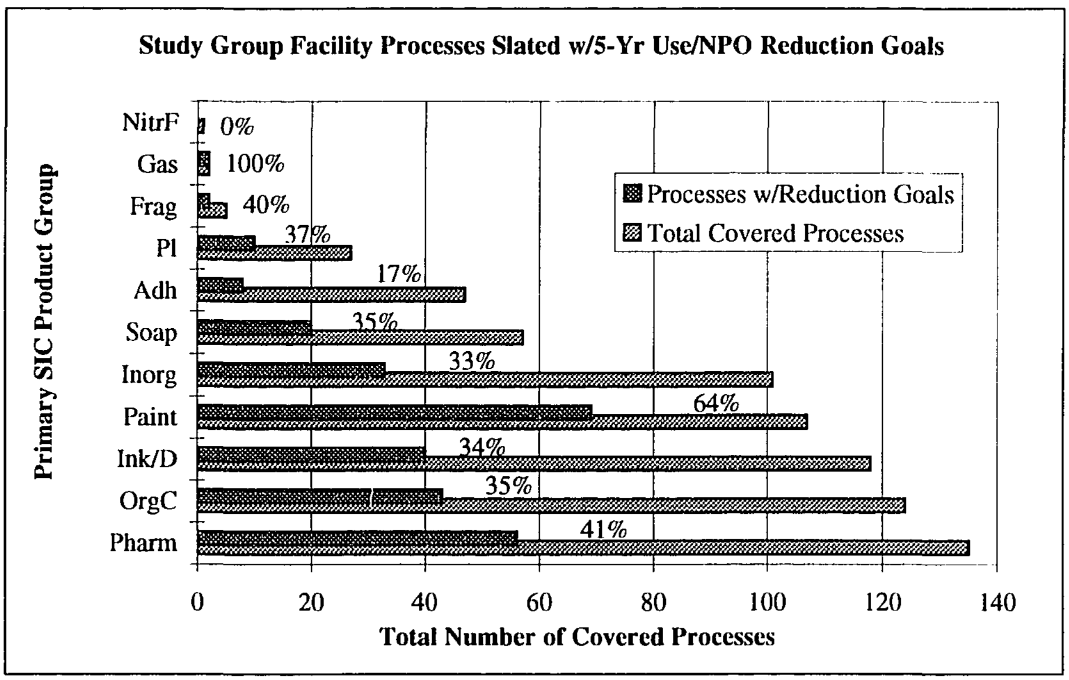


Figure 6.13. Response Facility 5-Year Covered Process Goals

6.3.2.2 Response Facility 5-Year Use Reduction Goals

Total Study Group: 120

Facilities with Plan Summary Filed: 105
Facilities with Use Reduction Goals: 62 (59%)
Facilities with Use Reduction Goal of Zero: 43 (41%)
Facilities with Missing Data: 5

Table 6.26. Response Facility 5-Year Use Reduction Goals (57 Facilities)

SIC Product Group	USE Reduction Goal (million pounds)	Total *Targeted* Use (million pounds)	Reduction Percentage (%)
Ink/Dye/Pigment	1.82	39.94	4.6
Inorganic Chemicals	8.63	38.15	22.6
Med/Pharmaceutical	5.60	23.74	23.6
Organic Chemicals	1.39	22.16	6.3
Paints/Coatings	1.22	3.146	38.8
Soap/Deterg/Surfactants	0.84	2.70	31.2
Plastics	1.00	1.38	72.5
Adhesives/Sealants	0.26	0.75	35.1
Fragrance/Cosmetics	0.01	0.07	13.4
Overall Totals	20.8	132.1	**16%**

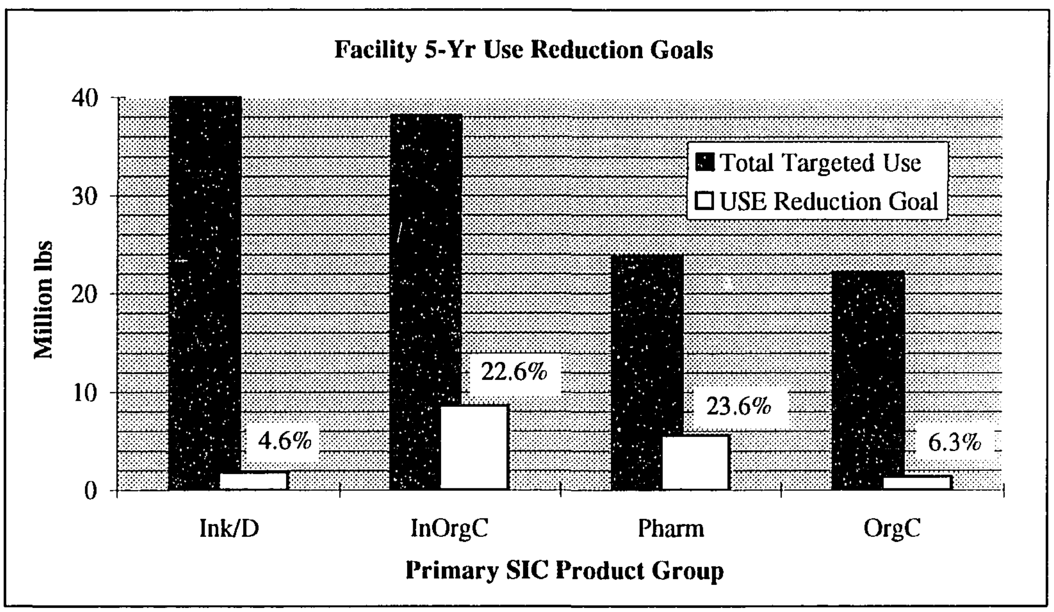


Figure 6.14. Study Facility 5-Year Use Reduction Goals by SIC Groups (57 of 105 Facilities)

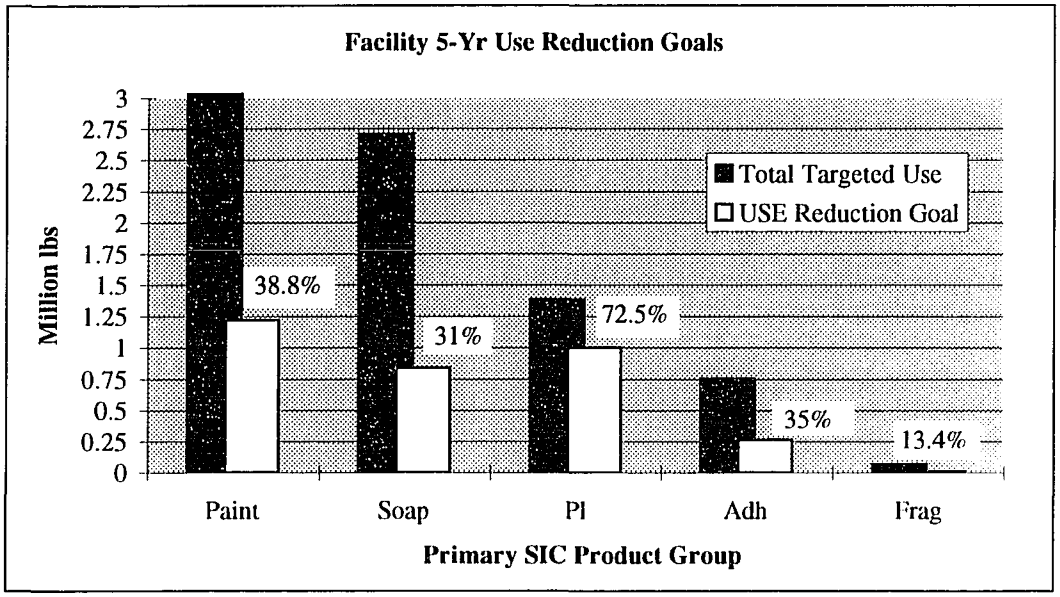


Figure 6.15. Study Facility 5-Year Use Reduction Goals by SIC Groups (Continued)

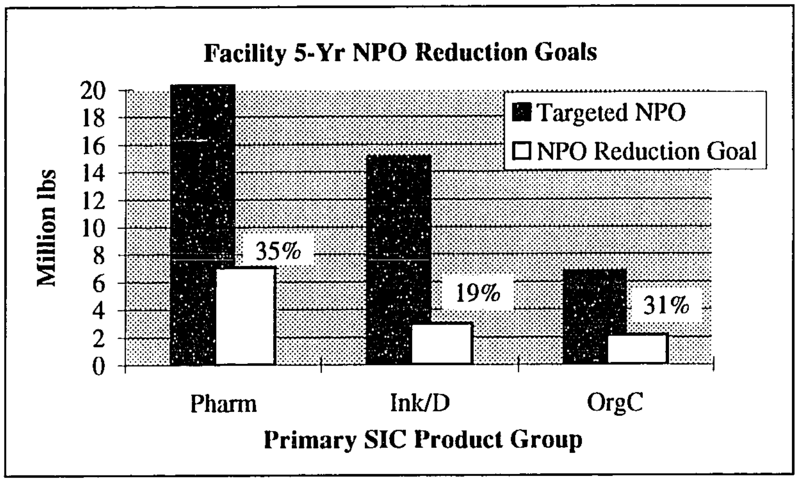
6.3.2.3 Response Facility 5-Year NPO Reduction Goals

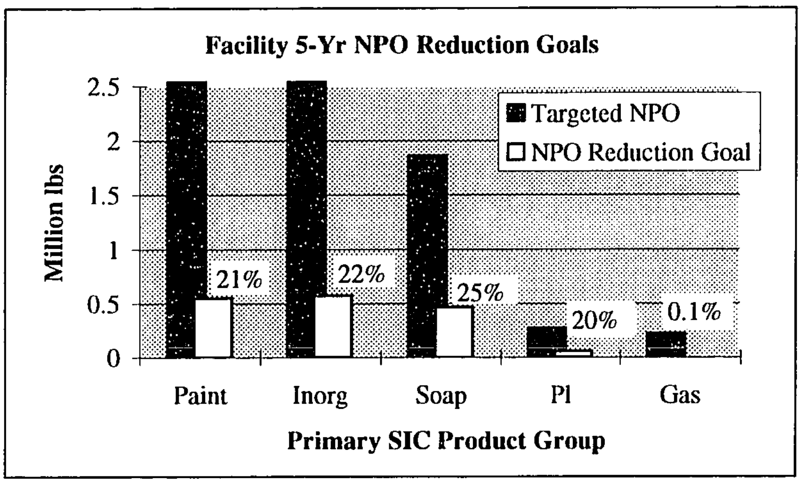
Total Study Group: 120

Facilities with Plan Summary Filed: 105
Facilities with NPO Reduction Goals: 77 (73%)
Facilities with NPO Reduction Goal of Zero: 28 (27%)
Facilities with Missing Data: 2

Table 6.27. Response Facility 5-Year NPO Reduction Goals (77 Facilities)

SIC Product Group	NPO Reduction Goal (million pounds)	Total *Targeted* NPO (million pounds)	Percentage Reduction (%)
Med/Pharmaceutical	7.03	20.27	34.7
Ink/Dye/Pigment	2.94	15.08	19.5
Organic Chemicals	2.09	6.76	31.0
Paints/Coatings	0.55	2.62	21.0
Inorganic Chemicals	0.57	2.59	22.1
Soaps/Deterg/Surfactants	0.46	1.86	25.0
Plastics	0.05	0.27	19.8
Industrial Gases	0.00022	0.22	0.1
	NPO Reduction Goal (pounds)	*Targeted* NPO (pounds)	(%)
Adhesives/Sealants	1379	1604.79	85.93
Fragrance/Cosmetics	600	800	75
Nitrous Fertilizers	0	0	0
Overall Totals	13.70 million lbs	49.67 million lbs	**28%**





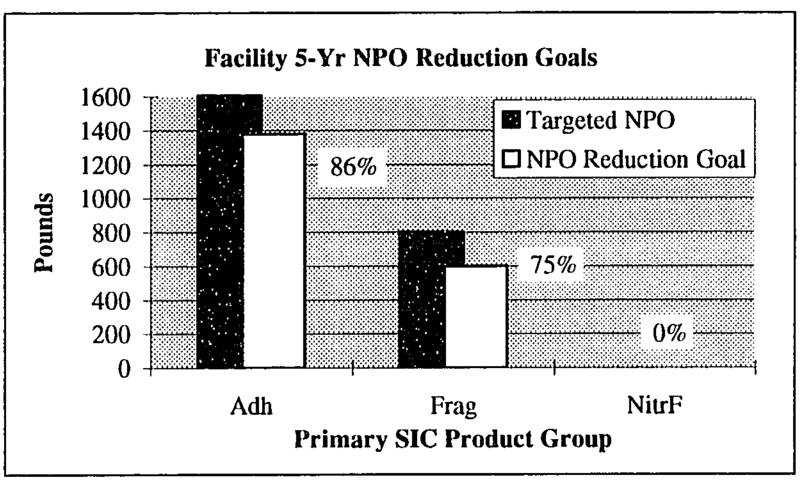


Figure 6.16. Response Facility 5-Year NPO Reduction Goals by SIC Product Groups (77 of 105 Facilities)

CHAPTER 7

DATA ANALYSIS

Analysis of the study data proceeds in sections. First, the major components of the commitment index are examined to: a) discern their individual distributions and b) determine their associations with one another. Next, influence factors are scrutinized to evaluate the overall response group opinions and to distinguish areas deemed most important to various subgroup samples. Finally, to achieve the study objective, commitment index scores are calculated, categorized, and analyzed to determine their correlations with the pertinent P2 influence factors.

7.1 Study Facility Representation

Because the study data analysis centers on the 106 "Q1." response facilities, these are first delineated by SIC product groups to distinguish the group from the total response field (Table 7.1). Further, employee categories are re-grouped to eliminate tiny category E (251-500) and thus improve the facility-size distribution (Table 7.2). This change is illustrated in Figure 20.

Table 7.1. Study Group SIC Product Group Distribution

SIC Product Group	N	Percent of Total
Med/Pharmaceutical/Bio	16	15%
Ink/Dye/Pigments	14	13%
Soap/Deterg/Surfactants	14	13%
Inorganic Chemicals	12	11%
Paints/Coatings	13	12%
Organic Chemicals	14	13%
Plastics	11	10%
Adhesives/Sealants	5	5%
Industrial Gases	3	3%
Fragrance/Cosmetics	3	3%
Nitrous Fertilizers	1	1%
Total	106	

Table 7.2. Study Facility Employee Category Frequencies

Employee Categories	A 1-25	B 26-50	C 51-100	D 101-500	E 501-4500	Total
Number Facilities	17	22	27	25	15	106

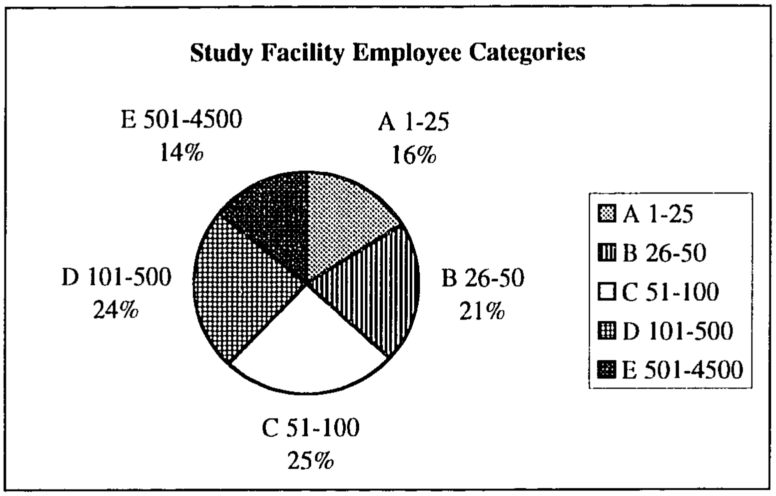


Figure 7.1. Study Facility Employee Categories

The majority of study facilities are owned by larger companies (63%). Of this group, 32 (or 48%) are assisted in P2 efforts by the parent company. Parent company assisted facilities make up approximately 30% of the overall study group (106). The breakdown over SIC product groups is illustrated in Table 7.3.

Table 7.3. Study Facility Ownership and P2 Program Assistance

SIC Product Group	Owned by Larger Company (% of Total)	P2 Assisted by Parent Company (% of Total)
Med/Pharmaceutical/Bio	68.8	12.5
Ink/Dye/Pigments	64.3	28.6
Soap/Deterg/Surfactants	50.0	42.9
Inorganic Chemicals	75.0	50.0
Paints/Coatings	46.2	7.70
Organic Chemicals	64.3	35.7
Plastics	81.8	54.5
Adhesives/Sealants	60.0	20.0
Industrial Gases	66.7	33.3
Fragrance/Cosmetics	66.7	0
Nitrous Fertilizers	0	0

7.2 Analysis of P2 Commitment Index Components

7.2.1 Implementation of P2 Methods

The three most-frequently cited facility P2 implementation methods are: improved operating practices, process modification, and raw materials changes. P2 methods use over SIC product groups is broken down as shown in Table 7.4. It is clear that certain methods are cited more frequently by specific product category facilities, than others.

To determine statistically, whether methods associate with SIC product categories, Chi-Square tests for independence are appropriate. Under the null hypothesis that the two (nominal) variables are independent, individual product categories are tested against each P2 method. Observed values are compared with values expected as a result of the marginal probabilities of each variable. The Chi-Square statistic is computed by summation of the squared residuals (observed minus expected values) divided by frequencies. Where test significance levels are .05, or less, critical values of the statistic are exceeded and the null hypothesis is rejected. The resulting significance levels represent the probability that the observed values would occur by chance, even if the variables are independent. A significance

Table 7.4. Study Facility P2 Methods - Percent by Product Group

SIC Product Group	Product Modif. (%)	Raw Matls Ch (%)	Product Redesign (%)	Product Subst. (%)	Process Modif. (%)	Improved Operating (%)	In-Process Recycl. (%)	Cases (N)
Med/Ph/Bio	6.3	62.5	0	12.5	68.8	68.8	62.5	16
Ink/Dye/P	35.7	50.0	7.1	35.7	57.1	71.4	21.4	14
Soap/Deterg	35.7	64.3	0	21.4	78.6	85.7	42.9	14
InorgC	58.3	66.7	8.3	25.0	83.3	100	75.0	12
Paints	53.8	69.2	7.7	23.1	76.9	92.3	53.8	13
OrgC	14.3	42.9	0	28.6	92.9	92.9	28.6	14
Plastics	27.3	54.5	9.1	9.1	90.9	90.9	45.5	11
Adh/S	80.0	100	0	40.0	40.0	100	40.0	5
IndusGas	0	0	0	0	100	100	0	3
Frag/Cos	66.7	100	0	0	33.3	66.7	0	3
NitrF	0	0	0	0	100	100	0	1
Overall	34.0	59.4	3.8	21.7	75.5	85.8	43.4	106

level of .05, for instance, indicates that the observed values could be expected to occur randomly in just five cases out of every one hundred (or 1 in 20). At such significance levels, it is reasonable to suspect that the distribution is not random. Rather, the use (or non-use) of certain P2 methods is most likely a representation of the applicability of each method to each SIC product category.

Test results indicate that greater use of in-process recycling amongst inorganic chemical firms (Chi-Square significance level P = .019), and of product modification (P = .026) amongst adhesive/sealant manufacturers, are each significant. In the case of adhesive/sealant firms however, the frequencies of expected values are too small to properly apply the Chi-Square test. Fisher's exact test is a suitable alternative which is similar to the Chi-Square test for independence, but which requires small sample sizes. Under this test statistic, the observed frequencies are significant to the .044 level.

The use of both improved operating practices (Chi-Square P = .033) and product modification (P = .011) is significantly lower in medicinal/pharmaceutical firms. Lesser use of product modification by these businesses may be explained by FDA regulations, which respondents in this group cite frequently as an impediment to P2 implementation.

While the average facility-wide number of methods implemented is three, firms in the following SIC categories use an average of four different techniques: inorganic chemicals, paints/coatings, and adhesives/sealants. Table 7.5 provides a frequency distribution for study facilities overall, illustrating the total number of methods implemented.

Table 7.5. Number of P2 Methods Implemented

Number of Methods	Number Facilities	Percent of Total
1	7	7%
2	30	28%
3	28	26%
4	21	20%
5	14	13%
6	4	4%
7	2	2%
	106	

To discern possible relationships between parent-company ownership and methods implementation (independent of SIC product categories), Chi-Square testing is again appropriate. Results indicate that facilities owned by larger companies are more likely to use process modification (Chi-Square significance level P = .011), yet less likely to implement *product* modifications (P = .043). Facilities receiving P2 program-assistance from the parent company moreover, are far less likely to implement either product modification (P =.029), or raw materials changes (P = .002). These results suggest that neither ownership by a larger company, nor P2 program assistance from the parent company, serve to increase across-the-board implementation of P2 methods.

7.2.2 Past Reductions Achievements

Approximately 88% of study respondents indicate their facilities have achieved past use and/or generation reductions. Over the SIC product groupings this percentage varies somewhat, ranging from a low of 67% of facilities, to a high of 100%. These percentages, along with average estimates for past use and generation reductions, are illustrated in Table 7.6. Case numbers vary due to incomplete information and/or instances where facilities achieved use or generation reductions, but not both.

Table 7.6. Average 10-Year Reduction Estimates by SIC Product Group

SIC Product Group	Total Cases (N)	Ach'd Use or Generation Reductions (N)	Ach'd Use or Generation Reductions (%)	Mean Use Reduction (%)	Cases (N)	Mean Generation Reduction (%)	Cases (N)
Med/Ph/Bio	16	14	87.5	23.1	13	23.6	11
Ink/Dye/P	14	11	78.6	23.0	13	26.9	13
Soap/Deterg	14	12	92.3	16.8	11	24.9	10
InorgC	12	11	91.7	14.7	10	30.0	12
Paints	13	10	76.9	22.9	13	31.4	13
OrgC	14	14	100	22.7	12	43.6	12
Plastics	11	10	90.9	16.8	10	41.8	10
Adh/S	5	4	80.0	22.5	4	27.5	4
IndusGas	3	3	100	13.3	3	20.8	3
Frag/Cos	3	2	66.7	1.0	2	0	2
NitrF	1	1	100	0	1	33.0	1
Overall	106	92	87.6	19.6	92	30.5	91

Reduction means are not significantly different over SIC product groups, but generation reductions of 41% to nearly 44% by plastics and organic chemical manufacturers, respectively, are the highest stand-outs. The very low mean reductions in the cases of fragrance/cosmetics and nitrous fertilizer firms are excluded from the analysis, due to the very small number of cases.

Chi-Square tests for independence suggest associations between reported P2 methods and reductions achievements. While reduction achievements are prevalent regardless of methods used, product substitution stands out as the only method wherein every respondent citing its use, also reports achievement of past reductions (P = .041). Grouping reductions estimates (0, 1-49%, 50-100%), allows for further Chi-Square analysis based upon the extent of past achievements. Associations are evident between high use reduction levels and both raw materials changes (P = .010), and product substitution (P = .007). T-tests for equality of mean use reduction estimates between groups using and not using each method, confirm the significant differences. For those implementing raw materials changes the mean use reduction is 24.3%, while for non-users the mean is just 12.2% (T-test two-tailed P = .010). Facilities implementing product substitution average use reductions of 31.8%, while non-users average just 16.6% (P = .016).

If facilities have achieved past reductions, do they also indicate that P2 implementation has resulted in cost savings? A relationship does appear to exist (Chi-Square P = .009). Where respondents indicate past achievements, 64% also indicate cost savings. Conversely, 95% of respondents indicating cost savings also indicate achievement of past reductions. Higher generation reductions are also associated with cost savings (P = .004). Where past generation reductions are in the 50-100% range, 80% of respondents indicate cost savings; at reductions of less than 50%, only 50% of respondents indicate cost savings. Table 7.7 provides a tabulation on facilities reporting P2-derived cost savings, as delineated by SIC product groups.

Table 7.7. Respondents Reporting P2 Cost Savings

SIC Product Group	Total Cases (N)	Report Past P2 Cost Savings (N)	Report Past P2 Cost Savings (%)
Med/Ph/Bio	16	10	63
Ink/Dye/P	13	4	31
Soap/Deterg	12	8	67
InorgC	12	7	58
Paints	12	8	67
OrgC	13	9	69
Plastics	11	9	82
Adh/S	5	1	20
IndusGas	3	2	67
Frag/Cos	3	2	67
NitrF	1	0	0
	101	60	59%

7.2.3 5-Year P2 Reduction Goals

Facility 5-Year P2 Reduction Goals are broken down by SIC product groups as shown in Tables 7.8-7.9. Overall, 62% of facilities plan substance use reductions, while 75% project substance NPO reductions. The mean percentage of covered processes assigned with either use or NPO reduction goals is 48%. The mean percentage of substances slated for use reductions is 36%, while that for NPO reductions is 48%. For use reductions of 50% or more, the mean percentage of targeted substances is just 13%; for NPO reductions of 50% or more, the mean percentage is 19%.

To test for relationships between the use of particular P2 methods and the extent of projected reduction goals, Mann-Whitney U (Wilcoxon Rank Sum) statistics are useful. This test procedure determines whether or not two independent samples come from the same population (or from populations having the same distribution) (Mason, 1982). In this case, the independent samples consist of P2 method users versus non-users. The null hypothesis is that

Table 7.8. Study Facility 5-Year P2 Reduction Goals

SIC Product Group	Total Cases (N)	Any Substances Slated for Use Reductions (% of Facilities)	Any Substances Slated for NPO Reductions (% of Facilities)	Mean Percentage Targeted Processes with Reduction Goals (%)	Mean Percentage Covered Processes with Reduction Goals (%)
Med/Ph/Bio	13	69	77	71	46
Ink/Dye/P	14	71	71	72	44
Soap/Deterg	12	42	83	66	41
InorgC	11	73	91	90	55
Paints	10	90	90	90	58
OrgC	13	62	85	79	46
Plastics	10	50	60	65	41
Adh/S	4	75	50	75	35
IndusGas	2	0	50	100	100
Frag/Cos	3	33	33	67	67
NitrF	1	0	0	0	0
Overall	93	62%	75%	75%	48%

Table 7.9. Study Facility 5-Year P2 Reduction Goals (Continued)

SIC Product Group	Total Cases (N)	Mean Percentage Substances Slated for Use Reduction (%)	Mean Percentage Substances Slated for NPO Reduction (%)	Mean Percentage Substances Slated for Use Reductions of 50% or More	Mean Percentage Substances Slated for NPO Reductions of 50% or More
Med/Ph/Bio	13	48	48	22	18
Ink/Dye/P	14	43	47	12	20
Soap/Deterg	12	22	50	13	28
InorgC	11	56	62	15	22
Paints	10	43	67	17	26
OrgC	13	24	47	3	8
Plastics	10	18	26	7	11
Adh/S	4	57	50	42	35
IndusGas	2	0	50	0	0
Frag/Cos	3	33	17	0	17
NitrF	1	0	0	0	0
Overall	93	36%	48%	13%	19%

there is no difference in projected percentage reductions, whether a particular method is used, or not. The alternative hypothesis is that use of particular methods do result in different reduction goals. Because the alternate hypothesis seeks only a difference, as opposed to a finding of greater or lesser reduction goals, the test involves a two-tailed significance finding. Computation of the test statistic involves summing the ranks for each of the two samples and determining the number of times values in one sample precede values in the other. If the two distributions are equal, values from one group should not consistently precede values in the other (Norusis, 1993). At significance levels of .05 or less, the computed test statistic (transformed to a standard normal deviate) falls outside the critical values of acceptance, and the null hypothesis is rejected.

Test results indicate that significantly higher percentages of substances are targeted for use reductions at facilities using product modification (P = .040), raw materials substitution (P = .020), or product substitution (P = .054). Mean percentages compare as follow: product modification users target an average 51% of substances while non-users target just 29%; raw materials substitution users target a mean 43% of substances vs. 27% for non-users; and product substitution users target a mean 49% of substances as opposed to 32% for non-users. Higher percentages of substances are targeted for use reductions of *50% or more,* where facilities institute raw materials substitution (P = .007) (mean 17% of substances vs. 8%), or product substitution (P = .005) (mean 22% vs. 10%). Finally, using Chi-Square tests for nominal data types, positive associations appear between facilities planning *any* substance use reductions and the use of raw materials substitution (P = .005), or product substitution (P = .031).

A search for association between P2 goals and past reductions achievements turns up little of significance. The only noteworthy correlation regards the percentages of substances slated for NPO reductions. Where facilities report no past reductions achievements, higher percentages of substances (mean 77%) are targeted for NPO reductions, now (Mann-Whitney P = .017). Where past reductions achievements are reported, facilities now slate lower percentages of substances (mean 45%) for NPO reductions. Neither use nor process goals are significant as they relate to past reductions achievements.

7.2.4 Special Environmental Initiatives

SIC product group use of the three special environmental initiatives is outlined in Table 7.10. Of particular note is the very low use of recycled materials in the ink/dye/pigments product category, and the very high percentage of facilities offering product/packaging take-back programs in the plastics industry.

Chi-Square tests for associations amongst the initiatives indicate a strong positive relationship between using life-cycle analysis and using recycled materials (P = .019). Facilities reporting manufacture of "green" products are significantly more likely to use life-cycle analysis (P = .004) and/or to offer a product/packaging take-back program (P = .043). Life-cycle analysis is further associated significantly with: P2 cost savings (P = .019), implementation of product redesign (P = .004) and/or product modification (P = .026), and large facility-sizes in the 501-4500 employee category (P = .019). Finally, facilities reporting use of recycled materials are more likely to cite past use/generation reduction achievements (P = .020) and to receive P2 program-assistance from a parent company (P = .033).

Table 7.10. Study Facility Use of Special Environmental Initiatives by SIC Code

SIC Product Group	Use Recycled Materials Total Responses (N)	Use Recycled Materials (%) of Total	Offer Prod/Pkg Take-Back Program Total Responses (N)	Offer Prod/Pkg Take-Back Program (%) of Total	Use Life-Cycle Analysis Total Responses (N)	Use Life-Cycle Analysis (%) of Total
Med/Ph/Bio	16	62.5	15	13.3	15	20.0
Ink/Dye/P	13	38.5	14	35.7	14	7.1
Soap/Deterg	13	61.5	14	50.0	13	23.1
InorgC	12	75.0	12	41.7	11	18.2
Paints	13	61.5	13	30.8	13	15.4
OrgC	14	57.1	13	7.7	13	23.1
Plastics	11	63.6	10	70.0	9	33.3
Adh/S	5	80.0	5	20.0	5	20.0
IndusGas	3	66.7	3	66.7	3	33.3
Frag/Cos	3	0	3	33.3	2	0
NitrF	1	100	1	100	1	0
Overall	104	59.6%	103	35.0%	99	19.2%

7.2.5 P2 Organizational Attributes

Because P2 organizational attributes serve as the glue that hold facility P2 programs together, their associations with the various study variables are extensive. To outline these relationships clearly, this section is divided into parts. Associations of importance are tabulated with test significance levels indicated. To begin, facility P2 attributes are broken down by SIC product groups, as shown in Tables 7.11 and 7.12.

7.2.5.1 P2 Organizational Attributes Over SIC Product Groups

Table 7.11. Facility P2 Organizational Attributes by SIC Product Group

SIC Product Group	P2 in Company Policy	Top Mgmt P2 Support	P2 in Prod/Process Design	P2 in Budget Planning	Use of Cross-Fn Teams	Specific P2 Responsible Individuals	Provide P2 Training/ Education
				Percent of Facilities (%)			
Med/Ph/Bio	50	56	56	56	38	100	31
Ink/Dye/P	57	79	79	57	29	79	36
Soap/Det	71	79	86	50	29	93	57
InorgC	83	100	83	75	33	92	58
Paints	62	69	77	31	31	77	69
OrgC	71	86	93	64	21	100	64
Plastics	91	100	91	55	55	100	82
Adh/S	60	80	60	40	0	100	60
IndusGas	100	50	33	33	0	67	67
Frag/Cos	100	100	100	0	33	100	33
NitrF	0	100	100	100	0	100	0
Overall	69%	80%	78%	53%	30%	92%	55%

Table 7.12. Facility P2 Organizational Attributes by SIC Product Group

SIC Product Group	Establish Prioritized P2 Goals	Employee Incentives/ Recognition	P2 Ach in Employee Evaluation	P2 Networking/ Communication	Measurement of P2 Progress	Regular P2 Progress Reports
			Percent of Facilities (%)			
Med/Ph/Bio	94	13	19	56	63	50
Ink/Dye/P	57	50	50	50	50	43
Soap/Det	79	21	21	64	64	50
InorgC	92	8	50	67	75	50
Paints	77	15	15	69	54	54
OrgC	86	50	36	71	79	79
Plastics	82	82	36	100	82	82
Adh/S	80	60	0	60	60	0
IndusGas	33	33	0	10	67	33
Frag/Cos	100	33	0	100	67	33
NitrF	0	100	0	0	0	0
Overall	79%	35%	28%	68%	65%	53%

It is clear that certain attributes are cited more frequently by certain SIC product groups, than others. Statistical associations (positive and negative) are evident between SIC product groups and three organizational attributes, in particular. Notably: a) the use of P2 in product/process design is particularly low in the medicinal/pharmaceutical and industrial gas product categories; b) setting of P2 goals is substantially higher in the medicinal and pharmaceutical category, while lower in the ink/dye/pigment, and nitrous fertilizer categories; and c) provision of employee incentives and recognition for P2 achievement is significantly more likely to occur in the plastics group, while less likely in the medicinal/pharmaceutical category.

Fisher's Exact Test one-tailed significance levels are outlined for each of these findings, as well as several others, in Tables 7.13 and 7.14. Where significance levels indicate that the observed attribute frequencies are not likely the result of chance, notations are included to indicate whether frequencies are "high" or "low" in comparison with the remainder of the study group. Fisher's Exact Test is applied where Chi-Square tests for independence between attributes and SIC categories result in frequencies lower than five in 20% or more of the test cells.

Table 7.13. Fisher's Exact Test Results: Frequency of Attributes Over SIC Groups

SIC Product Group	P2 in Company Policy	Top Mgmt P2 Support	P2 in Prod/Process Design	P2 in Budget Planning	Use of Cross-Fn Teams	Specific P2 Responsible Individuals	Provide P2 Training/ Education
(Significance Levels)							
Med/Ph/Bio		Low (.016)	Low (.007)				Low (.028)*
Ink/Dye/P							
Soap/Det							
InorgC				High (.030)			
Paints				Low (.030)*			
OrgC							
Plastics							
Adh/S							
IndusGas			Low (.054)				
Frag/Cos							
NitrF							

*Chi-Square Significance

Table 7.14. Fisher's Exact Test Results: Frequency of Attributes Over SIC Groups

SIC Product Group	Establish Prioritized P2 Goals	Employee Incentives/ Recognition	P2 Ach in Employee Evaluation	P2 Networking/ Communication	Measurement of P2 Progress	Regular P2 Progress Reports
(Significance Levels)						
Med/Ph/Bio	High (.042)	Low (.029)				
Ink/Dye/P	Low (.016)					
Soap/Det						
InorgC						
Paints						
OrgC						High (.055)*
Plastics		High (.002)		High (.014)		High (.054)
Adh/S						
IndusGas						
Frag/Cos						
NitrF						

*Chi-Square Significance

The average total number of attributes reported by SIC groups varies, as outlined in Table 7.15. With the overall average total number of P2 organizational attributes being eight, plastics manufacturing facilities clearly lead the field in comparison with other product groups.

Table 7.15. Average Total Number of P2 Organizational Attributes by SIC Group

SIC Product Group	Total Cases (N)	Minimum Number of Attributes	Maximum Number of Attributes	Mean Number of Attributes
Med/Ph/Bio	16	2	13	7
Ink/Dye/P	14	0	13	7
Soap/Deterg	14	2	13	8
InorgC	12	4	12	9
Paints	13	0	13	7
OrgC	14	3	12	9
Plastics	11	6	13	10
Adh/S	5	3	10	7
IndusGas	3	4	8	6
Frag/Cos	3	7	9	8
NitrF	1	5	5	5
Overall	106	0	13	8

7.2.5.2 P2 Organizational Attributes by Company Size and Structure

A. Attributes by Company Size

The distribution of organizational attributes over facility size categories appears in Tables 7.16 and 7.17. Obvious differences in the presence of attributes appear between facilities of varying employee number categories. Four attribute areas are particularly noteworthy, as confirmed by very low Chi-Square significance levels on tests for independence between attributes and

Table 7.16. Facility P2 Organizational Attributes by Facility Size (No. Employees)

Number of Employees	P2 in Company Policy	Top Mgmt P2 Support	P2 in Prod/Process Design	P2 in Budget Planning	Use of Cross-Fn Teams	Specific P2 Responsible Individuals	Provide P2 Training/ Education
			Percent of Facilities (%)				
1-25	50	69	71	53	12	94	41
26-50	46	77	77	36	23	91	50
51-100	85	89	78	52	44	85	74
101-500	79	86	90	66	24	93	52
501-4500	73	64	64	55	55	100	46
Overall	69%	80%	78%	53%	30%	92%	55%

company size categories. Establishment of P2 philosophy in company policy is clearly less frequent at smaller study facilities having 1-50 employees, than at larger firms (P = .027). Top management support is cited significantly less often at very large study facilities, than at most other firms (P = .011). Establishment of prioritized P2 goals is least common to small facilities, and increases in frequency with increasing company size (P = .033).

Table 7.17. Facility P2 Organizational Attributes by Facility Size (No. Employees)

Number of Employees	Establish Prioritized P2 Goals	Employee Incentives/ Recognition	P2 Ach in Employee Evaluation	P2 Networking/ Communication	Measurement of P2 Progress	Regular P2 Progress Reports
	Percent of Facilities (%)					
1-25	59	47	24	71	59	35
26-50	73	27	23	64	64	50
51-100	85	33	26	78	74	56
101-500	83	31	41	59	55	59
501-4500	100	46	18	73	82	64
Overall	79%	35%	28%	68%	65%	53%

Finally, (though not Chi-Square test-significant) it is of interest to note that cross-functional teams are most frequently used in very large (501-4500 employees) facilities; that integration of P2 into product and/or process design, as well as evaluation of employee P2 achievement in performance ratings, are each most evident at facilities of 101-500 employees; and that provision of P2 training and educational support is most often cited at facilities of 51-100 employees. Average total P2 organizational attributes are outlined in Table 7.18 with a break down over employee category groups.

Table 7.18. Average Total P2 Attributes by Facility Size (No. Employees)

Number of Employees	Total Cases (N)	Minimum Number of Attributes	Maximum Number of Attributes	Mean Number of Attributes
1-25	17	3	13	7
26-50	22	0	13	7
51-100	27	1	13	9
101-500	29	0	13	8
501-4500	11	2	13	8
Overall	106	0	13	8

B. Attributes by Company Structure

Facilities owned and assisted by a parent company tend to report a higher average number of organizational support elements. Average total P2 organizational attributes as distributed over facilities assisted and/or owned by parent companies, are outlined in Table 7.19.

Table 7.19. Average Total Attributes by Ownership and P2 Assistance

	Total Cases (N)	Minimum Number of Attributes	Maximum Number of Attributes	Mean Number of Attributes
Owned by Larger Company	67	1	13	9
Independent	39	0	13	6
P2 Assisted by Parent Company	32	3	13	10
P2 Program Unassisted	74	0	13	7
Overall	212	0	13	8

A closer look at individual attributes, using Chi-Square tests for independence suggest a number of associations with both larger company ownership and P2 program assistance. Where facilities are owned by a larger company: P2 philosophy is more likely established in company policy and incorporated into budget planning, P2 training and education are more often provided, prioritized P2 goals are most likely established, and P2 progress is usually formally monitored and measured. Where facility P2 programs are owned and *assisted* by a parent company, the following attributes are also more likely to be cited: P2 achievement in employee evaluations, P2 networking and communications, and regular publication of P2 progress reports. Chi-Square test significance levels leading to these findings appear in Tables 7.20 and 7.21.

Table 7.20. Attributes Associated with Larger Company Ownership

P2 Organizational Attribute	Percent Facilities with Attribute (%) Independent	Owned	Chi-Square Significance Level
P2 Established in Company Policy	26%	74%	(P = .004)
P2 in Budget Planning	27%	73%	(P = .032)
Provision of P2 Training/Education	26%	74%	(P = .007)
Prioritized P2 Goals	31%	69%	(P = .039)
Measurement of P2 Progress	27%	73%	(P = .023)

Table 7.21. Attributes Associated with P2 Program Assistance from Parent Company

P2 Organizational Attribute	Percent Facilities with Attribute (%) Unassisted	Assisted	Chi-Square Significance Level
P2 in Budget Planning	46%	69%	(P = .029)
Provision of P2 Training/Education	45%	78%	(P = .005)
P2 Achievements in Employee Evaluation	18%	53%	(P = .0009)
P2 Networking/Communications	63%	78%	(P = .013)
Regular Publication of P2 Progress Reports	42%	78%	(P = .0007)

7.2.5.3 Attributes and P2 Methods Implementation

Implementation of both process modification and improved operating practices associate with numerous P2 organizational attributes, as shown in Table 7.22. Average total attributes are also significant at facilities using these methods. While the mean attribute total is eight regardless of use or non-use of any other methods, facilities not using these particular methods average just five total attributes. Further, facilities implementing process modification have a higher mean attribute number, of nine. It is important to recall here, the association between larger company ownership and increased use of process modification. This correlation, along with the association between larger company ownership and attributes noted in Section 7.2.5.2., coincides with each of the most significant relationships for the process modification category.

Table 7.22. P2 Methods v. P2 Attributes: Chi-Square Significance Levels

P2 Organizational Attribute	Raw Matls Changes	Product Substitution	Process Modification	Improved Operating	In-Process Recycling
P2 Established in Company Policy			(+) .0007	(+) .019	
Top Management P2 Support					
P2 in Product/Process Design			(+) .057	(+) .045	
P2 in Business Planning/Budget			(+) .009		
Use of Cross-Functional Teams					
Assignment of P2 Individuals			(+) .038		
Provide P2 Training/Education			(+) .026	(+) .054	
Set Prioritized P2 Goals		(+) .021	(+) .003	(+) .031	
Employee P2 Incent/Recognition			(+) .045		
P2 in Employee Evaluation					
P2 Networking/Communications					
Measurement of P2 Progress			(+) .00007	(+) .001	
Regular P2 Progress Reporting	(-) .049		(+) .002	(+) .038	(+) .019

(-) Negative Relationship; (+) Positive Relationship

Higher mean attribute totals tend to coincide with higher numbers of methods implemented at study facilities, as shown in Table 7.23. Although the relationship is not strong with a Spearman correlation coefficient between these variables of just 0.194, the correlation is positive with a significance level of .047.

Table 7.23. Total Facility P2 Methods v. Mean Number of P2 Attributes

Total Facility P2 Methods Implemented	Total Cases (N)	Minimum Number of Attributes	Maximum Number of Attributes	Mean Number of Attributes
1	7	0	12	5
2	30	2	13	7
3	28	3	13	9
4	21	0	13	8
5	14	1	13	8
6	4	5	12	10
7	2	6	11	9
	106			

7.2.5.4 Attributes and Past Reductions Achievement

The average number of facility P2 organizational attributes varies with past reductions achievements. The average is a bit lower for no or low past achievements, and average to higher for high achievements. Average total attributes over facility past use and generation reduction achievements, are outlined in Table 7.24.

Chi-Square testing for independence between achievement of past reductions and the various attributes indicates three cases where the null hypothesis is rejected. That is, past reduction achievements are cited significantly more often at study facilities where: specific individuals are assigned with P2 responsibility (P = .002), prioritized P2 goals are established (P = .007), or P2 progress is formally monitored and measured (P = .019). Differences in mean use/generation reduction percentages between facilities demonstrating or lacking each attribute, are substantial in just two cases. First, where facilities have designated P2 individuals the mean use reduction is 21%, as compared with just 5% for facilities lacking specific P2 personnel (T-test two-tailed P = .002). Second, where facilities issue regular P2 progress reports, the average generation reduction is 38%, as compared with 19.6% for those that do not (T-test two-tailed P = .002).

Table 7.24. Past Reductions Achievements v. Mean Number of P2 Attributes

	Total Cases (N)	Minimum Number of Attributes	Maximum Number of Attributes	Mean Number of Attributes
No Past Reductions	13	0	12	6
Achieved Past Reductions	92	0	13	8
Past Use Reductions of Less Than 50%	49	0	13	8
Past Use Reductions of 50% or More	14	2	13	8
Past Generation Reductions of Less Than 50%	41	0	13	8
Past Generation Reductions of 50% or More	31	2	13	9

7.2.5.5 Attributes and P2 5-Year Reduction Goals

P2 5-year reduction goals associate positively with four organizational attributes. Where facilities are supported by these attributes, significantly higher substance and process goals are projected. The emphasis falls upon one attribute, in particular: monitoring and measurement of P2 progress. Chi-Square tests for independence support the associations between nominal variables ("any substances slated for reductions") and P2 attributes, while Mann-Whitney U tests point to the significant differences in reduction goals for the remaining cases. Test significance levels resulting from these tests appear in Table 7.25. Mean reduction goals are tabulated for comparison, along with T-test two-tailed significance levels (from tests for equality of the means), in Table 7.26.

Table 7.25. P2 5-Year Goals v. P2 Attributes (Mann-Whitney Significance Levels)

P2 5-Year Goal Elements	Assign Specific P2 Individuals	Establish Prioritized P2 Goals	P2 Networking and Communication	Monitor & Measure P2 Progress
Any Substances Slated for Use Reductions	(+) .033*	(+) .020*		(+) .033*
Any Substances Slated for NPO Reductions		(+) .010*		(+) .006*
Percentage Substances Slated for Use Reduction				(+) .026
Percentage Substances Slated for NPO Reduction				(+) .009
Use Reductions of 50% or More				(+) .044
NPO Reductions of 50% or More				(+) .040
Percent Targeted Processes Slated for Reduction				(+) .034
Percent Covered Processes Slated for Reduction			(+) .017	

* Chi-Square Test Significance

Table 7.26. Mean Percentage Reduction Goals Comparison (t-test 2-tailed significance)

P2 5-Year Goal Elements	P2 Networking & Communication			Monitor & Measure P2 Progress		
	Yes	No	P	Yes	No	P
Percentage Substances Slated for Use Reduction				41%	24%	.046
Percentage Substances Slated for NPO Reduction				55%	33%	.013
Use Reductions of 50% or More (% Substances)				16%	7%	.091
NPO Reductions of 50% or More (% Substances)				24%	9%	.004
Percent Targeted Processes Slated for Reduction				83%	60%	.028
Percent Covered Processes Slated for Reduction	54%	33%	.012			

7.2.5.6 Attributes and Special Environmental Initiatives

Facilities involved in special environmental initiatives have average attribute totals except in the case of life-cycle analysis, where the mean increases from eight to nine. Use of recycled materials is frequently cited in conjunction with both P2 budgeting (Chi-Square test significance P = .039), and P2 networking/communications (P = . 023). Product or packaging take-back programs associate only with employee P2 achievement evaluation in performance reviews (P = .042). Life-cycle analysis, meanwhile, is more likely cited by facilities with P2 in budgeting and business planning (P = .029), cross-functional P2 teams (P = .013), and/or incentives/recognition offered to employees for P2 achievements (P = .010).

As an additional note, facilities reporting P2-derived cost savings tend to also: assign specific individuals with P2 responsibility (P = .004), set prioritized P2 goals (P = .017), formally monitor and measure P2 progress (P = .032), and issue regular P2 progress reports (P = .006).

7.2.5.7 Attribute Inter-Associations

The strongest associations occurring between the P2 organizational attributes most often involve: a) the establishment of P2 philosophy in company policy, and b) regular company reporting on P2 progress. Facilities citing either of these attributes are significantly more likely to also cite a number of others.

The strength of the inter-attribute relationships can be compared through computation of the "phi coefficient" for each variable pair. This coefficient is a Chi-Square-based measure of association suitable for nominal variables. It is calculated by dividing the Chi-Square test statistic by the sample size and then taking the square root of the result. In the case of the 2x2 Chi-Square table, the coefficient is equal to the Pearson correlation coefficient (used to measure linear association), which ranges in value from -1 to 1. The coefficients are presented in matrix form in Figures 7.2 and 7.3, with the strongest associations printed in boldface, for clarity. Significance levels used to test the null hypothesis that the measure is zero, are Chi-Square probabilities.

As is evident from the matrices, P2 progress reporting associates strongly with: use of cross-functional teams, provision of P2 training and education, consideration of P2 achievement in employee evaluation, and predictably, with formal measurement of P2 progress. P2 establishment in company policy associates strongly with: top management P2 support, P2 integration in product/process design decision-making, company provision of P2 training and education, and formal monitoring and measurement of P2 progress. While top management support for pollution prevention programs associates significantly with several attributes, including establishment of P2 philosophy in company policy, the matrices suggest that P2 company policies play the stronger role. Also of interest are the strong relationships apparent between: a) top management support and incorporation of P2 principles into product and/or process design; b) P2 networking and provision of training/education; c) setting prioritized P2 goals and measurement of results; and d) employee P2 incentives/recognition and evaluation of P2 achievement in performance reviews.

P2 ORGANIZATIONAL ATTRIBUTES PHI COEFFICIENT MATRIX

	P2 in Company Policy	**Top Mgmt Support**	P2 in Design	P2 in Budget	Cross-Fn Teams	Specific Individuals	
	A1	A2	A3	A4	A5	A6	
A1	1.0000 (103) P= .						P2 in Company Policy
A2	**.4526** (88) P=.0000	1.0000 (89) P= .					**Top Mgmt P2 Support**
A3	**.4828** (96) P=.0000	**.6484** (85) P=.0000	1.0000 (97) P= .				**P2 in Product/ Process Design**
A4	.2572 (94) P=.0126	.2450 (81) P=.0274	.2263 (91) P=.0308	1.0000 (96) P= .			P2 in Budget Planning
A5	.3084 (98) P=.0023	-.0161 (84) P=.8824	.1740 (92) P=.0952	.2942 (92) P=.0048	1.0000 (100) P= .		Use of P2 Cross-Functional Teams
A6	.0468 (103) P=.6346	.3236 (89) P=.0023	.1122 (97) P=.2691	.2356 (96) P=.0209	.0659 (100) P=.5098	1.0000 (106) P= .	Assignment of P2 Individuals
A7	**.4044** (101) P=.0001	.2071 (87) P=.0534	.3474 (95) P=.0007	.2050 (95) P=.0457	.3493 (98) P=.0005	.0740 (103) P=.4525	**Provision of P2 Training/Education**
A8	.2867 (101) P=.0039	.1488 (87) P=.1652	.1158 (95) P=.2590	.0357 (93) P=.7305	.0891 (98) P=.3776	.1795 (102) P=.0698	Establishment of P2 Goals
A9	.3102 (98) P=.0021	.1859 (85) P=.0865	.2459 (92) P=.0183	.3718 (93) P=.0003	.3298 (96) P=.0012	.1266 (101) P=.2034	Employee P2 Incent/Recognition
A10	.1529 (98) P=.1300	.1779 (84) P=.1030	.2147 (94) P=.0374	.3548 (93) P=.0006	.3555 (95) P=.0005	.1296 (100) P=.1949	P2 in Employee Performance Eval
A11	.2721 (101) P=.0063	.2818 (89) P=.0079	.2444 (97) P=.0161	.3077 (95) P=.0027	.2397 (98) P=.0177	.0912 (104) P=.3524	P2 Networking/ Communications

Figure 7.2. Phi Coefficient Matrix (Coefficient /N Cases/Chi-Square Probability)

P2 ORGANIZATIONAL ATTRIBUTES PHI COEFFICIENT MATRIX (CONTINUED)

	P2 in Company Policy	Top Mgmt Support	P2 in Design	P2 in Budget	**Cross-Fn Teams**	Specific Individuals	
	A1	A2	A3	A4	A5	A6	
A12	**.3815** (102) P=.0001	.1719 (88) P=.1068	.2004 (97) P=.0484	.1804 (95) P=.0787	.2865 (98) P=.0046	.1048 (103) P=.2873	**Formal Monitoring/ Measurement of P2 Progress**
A13	.2892 (101) P=.0037	.1936 (87) P=.0709	.1620 (96) P=.1125	.3159 (95) P=.0021	**.5280** (98) P=.0000	.1753 (102) P=.0766	**P2 Progress Reporting**

	P2 Training Education	**Est. P2 Goals**	**Empl. P2 Recog**	**P2 in Eval**	P2 Comm	**Meas. P2 Progress**	
	A7	A8	A9	A10	A11	A12	
A7	1.0000 (103) P= .						Provision of P2 Training/Education
A8	.1091 (100) P=.2754	1.0000 (102) P= .					Establishment of P2 Goals
A9	.2262 (99) P=.0244	.0696 (98) P=.4909	1.0000 (101) P= .				Employee P2 Incent/Recognition
A10	.2047 (99) P=.0417	.0738 (97) P=.4674	**.3873** (96) P=.0002	1.0000 (100) P= .			**P2 in Employee Performance Eval**
A11	**.5456** (101) P=.0000	.1362 (100) P=.1732	.2965 (99) P=.0032	.1661 (98) P=.1000	1.0000 (104) P= .		**P2 Networking/ Communications**
A12	.2615 (101) P=.0086	**.4478** (101) P=.0000	.3190 (98) P=.0016	.2050 (98) P=.0424	.2265 (102) P=.0222	1.0000 (103) P= .	**Formal Monitoring/ Measurement of P2 Progress**
A13	**.3945** (100) P=.0001	.2664 (100) P=.0077	.3048 (98) P=.0026	**.4269** (97) P=.0000	.2966 (101) P=.0029	**.4876** (102) P=.0000	**P2 Progress Reporting**

Figure 7.3. Phi Coefficient Matrix (Continued) (Coefficient/N Cases/Chi-Square Probability)

7.2.5.8 Attributes Unknown

A final note in the analysis of facility P2 organizational attributes involves cases where respondents most frequently selected the "don't know" category. Most surprising here, are the approximately 15% of respondents who don't know whether top management supports the facility P2 program, or not. An additional 8.5% are unsure as to facility integration of P2 philosophy in product and/or process design, and another 9% are unaware of the facility P2 business planning and budgeting process.

Of those unsure as to top management commitment, 62.5% come from smaller facilities of up to fifty employees. One-fourth of the group are from the medicinal/pharmaceutical product category, another two-fifths are evenly split over soap/detergent and paint/coating groups, with the remainder spread over four other SIC product categories. In the case of unknown product/process P2 decision-making, most employee categories as well as SIC product groups, are represented. Of note here, however, is that approximately 25% more of these facilities are assisted by parent companies in facility P2 programs, than for the overall study group. Last, as to unknown P2 budget planning, respondents hail from various employee categories and five different SIC product groups with the largest emphasis (30%) on plastics manufacturing. Approximately 10% more of these facilities are assisted by a parent company in implementing P2 programs than the overall study group. Parent company assistance, which may be provided "from a distance," may explain respondents' uncertainty on these issues.

7.3 Analysis of P2 Influence Factors

The complete tally on respondent rankings of the various influence factor categories (regulatory/technical, financial, organizational/social) appears in Section 6.2.3.3. A summary of the overall study group response appears in Table 7.27, following. Percentages of all respondents labeling factors "important" to *any* level (somewhat important, important, very important) are listed, along with Kendall's Coefficient of concordance, through which factors are ordered by mean rank - or perceived degree of importance, to the overall study group.

Table 7.27. P2 Influence Factors: Response and Overall Rank Order

P2 Influence Factors		Total Cases (N)	Respondents Designating Important to Any Level (%)	Kendall Coefficient Mean Rank (Includes "Not Imp.") (Listwise Deletion of Missing Cases: N=56)
Implementation Costs	F1	106	99.1	18.44
Employee Safety	OS3	106	99.1	17.17
Drive for Quality	OS2	106	98.1	16.98
Potential for Reduced Liability	F6	104	94.2	16.44
Reduced Environmental Impact	OS7	106	98.1	16.01
Technical Feasibility	RT10	105	98.1	15.71
Potential Cost Savings	F2	104	94.2	15.49
NJDEP Flexible NJPPA Administration	RT8	98	85.7	14.63
Potential Future P2 Mandates	RT4	102	86.3	13.88
Regulation Other than P2 Laws	RT9	102	95.1	13.87
Company Flexibility	OS1	103	91.3	13.67
Company Image	OS4	106	90.6	13.16
Reduce Monitoring/Recordkeeping	F5	100	88.0	12.98
NJPPA Planning Requirements	RT1	102	78.4	12.83
Clear/Consistent NJPPA Rules/Reg's	RT6	100	84.0	12.63
Potential P2 Investment Risk	F7	106	82.1	12.49
Environmental Conduct Code	OS6	103	87.4	11.59
Public Toxic Data Reporting	OS5	104	87.5	11.53
Representation in NJPPA Formulation	RT7	97	78.4	10.84
NJPPA Policy Objectives	RT5	101	83.2	10.79
NJPPA Voluntary Enforcement Mode	RT3	100	83.0	10.34
Potential for Facility-Wide Permit (FWP)	RT2	96	68.8	9.58
NJTAP Availability	RT11	101	62.4	8.71
Consumer Demand for "Green" Products	F3	85	75.3	8.00
Early Entry into P2 Technologies Market	F4	84	54.8	7.25

Chi-Square "goodness of fit" test results indicate a uniform distribution of importance rankings for three influence factors: potential P2 investment risk, NJPPA planning requirements, and representation in NJPPA formulation. The even distribution indicates greater *disagreement* amongst respondents concerning the importance of these attributes, since the spread is approximately even over ranks "1" (not important) through "4" (very important). This does not infer agreement on every other attribute, but points out the areas of greatest disagreement in the overall response.

7.3.1 Influence Factors by Facility Characteristics

7.3.1.1 Factors and SIC Product Groupings

Kruskal-Wallis one-way analysis of variance and Mann-Whitney U tests provide the basis for discerning differences in the importance of each factor over SIC product groups. Kruskal-Wallis testing first assigns the product group rank for each influence factor. Where significant differences occur, Mann-Whitney tests then allow for the closer look at individual product categories needed to determine their difference from the overall study group.

Very high Kruskal-Wallis test significance results suggest agreement (equivalent distributions) among SIC groups as to the importance rankings on the following influence factors: demand for green ($P = .924$), potential for facility-wide permitting ($P = .990$), need for clear and consistent NJPPA rules ($P = .911$), and technical feasibility ($P = .960$). Significant differences over SIC groups are noted only in regard to the potential for reduced liability ($P = .044$). This factor is ranked highest in importance by industrial gas manufacturers and lowest by adhesive/sealant, nitrous fertilizer, and fragrance/cosmetic product firms. Substantial (not significant) additional differences, include rankings on employee safety (ranked highest by plastics firms; lowest by industrial gases, fragrance/cosmetics and nitrous fertilizers $P = .074$) and participation in environmental conduct codes (ranked most important by inorganic chemical, plastics, and ink/dye/pigments manufacturers; least important by nitrous fertilizers P = .070).

Mann-Whitney U tests comparing influence factor rankings for individual SIC product categories, with the remainder of study group participants, provide the following:

- Plastics firms rank both P2-derived cost savings (P = .019), and company image (P = .045) significantly more important than other respondents;
- Paint and coatings manufacturers rank P2-reduced monitoring and recordkeeping much more important (P = .024), while ranking NJPPA policy objectives far less important (P = .012) than the overall group;
- Medicinal/pharmaceutical producers rate company flexibility significantly more important (P = .035) than other respondents;
- Manufacturers of adhesives and sealants find both P2 investment risk (P = .025) and environmental conduct codes (P = .008) much less important;
- Ink/dye/pigment businesses rank public toxics data reporting (P = .021) and NJTAP availability (P = .056) more important than the remainder of the study group.

7.3.1.2 Factors and Facility Employee Categories

Kruskal-Wallis testing of factors over employee categories, indicates that ranks on the potential for P2 cost savings increase significantly (P = .031) with larger facility sizes. Mann-Whitney analysis pinpoints the significance to the difference in rank between the smallest size category (1-25 employees), which rates this factor much less important (P = .019) than any other respondents, and the larger size (101-500 employee) category, which ranks cost savings much higher (P = .044) than any others.

Similarly, the importance of environmental conduct codes increases with facility size, differing significantly to the .033 level. Mann-Whitney analysis highlights the very low ranking by smallest facility sizes (P = .016) and the somewhat higher ranking by larger (101-500 employee) facility sizes (P = .056).

7.3.1.3 Factors and Company Structure

Mann-Whitney test analysis turns up a number of factors which are ranked significantly more important by respondents of facilities owned by larger companies, than by independent firms. Facilities assisted by parent companies in their P2 efforts also consider a number of factors much more important than others in the study group. Mann-Whitney significance findings for each of these cases are listed in Table 7.28.

Table 7.28. Factors Most Important to Owned/P2-Assisted Facilities

P2 Influence Factors	Mann-Whitney Test Significance
Owned by Larger Company	
Employee Safety	.028
Participation in Voluntary Environmental Conduct Code	.0002
Potential for Reduced Environmental Impact	.003
Potential for P2 Cost Savings	.023
Early Entry P2 Technologies Market	.018
Potential P2 Investment Risk	.028
Technical Feasibility	.044
P2 Program Assisted by Company	
Employee Safety	.040
Participation in Voluntary Environmental Conduct Code	.0005
Early Entry P2 Technologies Market	.030
Potential P2 Investment Risk	.026

7.3.2 Influence Factors and P2 Implementation Methods

Using Mann-Whitney test analysis, several negative associations become apparent between influence factors and P2 implementation methods. Facilities implementing raw materials changes (59% of respondents) rate three factors less important than those maintaining their materials base: a) publication of toxics reporting data (P = .017), b) potential future P2 mandates (P = .018), and c) clear, consistent NJPPA rules (P = .051). The lesser importance of these items seems indicative of facilities which seek P2 results regardless of P2 regulations and laws.

Respondents implementing product substitution (22% of respondents) rank a number of factors significantly less important than others, including: reduced monitoring and recordkeeping (P = .002), company image (P = .044), environmental conduct codes (P = .050), potential P2 cost savings (P = .009), and early entry into P2 technologies markets (P = .035). These findings suggest that facilities accomplishing P2 objectives via product substitution (frequently inferring process shutdown(s)) actually embrace little in the way of P2 philosophy. Processes may simply be shut down or moved to other states to avoid New Jersey regulatory scrutiny. Positive associations are listed in Table 7.29, along with the resulting Mann-Whitney significance levels.

Lastly, where facilities implement the greatest number of different P2 methods (5, 6, or 7, total - only 19% of respondents), the following factors are significantly more important: the NJ Technical Assistance Program (P = .039), potential for reduced environmental impact (P = .024), and employee safety (P = .023).

Table 7.29. Factors Most Important to Specific Methods Implementation

P2 Influence Factors	Mann-Whitney Test Significance
Users of Product Modification (34%)	
NJTAP Availability	.031
Users of Process Modification (75%)	
Company Flexibility	.031
Employee Safety	.022
Participation in Voluntary Environmental Conduct Code	.0005
Potential for P2 Cost Savings	.010
Potential for Reduced Liability	.051
Users of Improved Operating Practices (86%)	
Company Flexibility	.031
Company Drive for Quality	.001
Employee Safety	.035
Concern About Company Image	.013
Participation in Voluntary Environmental Conduct Code	.010
Customer Demand for Green Products	.036
Potential for Reduced Liability	.037
Users of In-Process Recycling (43%)	
Technical Feasibility	.006
Potential P2 Investment Risk	.014

7.3.3 Influence Factors and Past Reduction Achievement

Where facility use reduction achievements are less than 50%, publication of toxics reporting data is considered of much greater import (Kruskal-Wallis $P = .014$) than in cases where reductions are either 0%, or, 50% or greater. This could infer that larger reductions achievers feel that company image is unaffected or perhaps even bolstered by publication of substantial reductions reports. Low achievers, on the other hand, may be concerned that their reporting data negatively impacts on company image. Low achievers also rank voluntary NJPPA enforcement significantly more important ($P = .026$), while non-achievers are more concerned about technical feasibility than achievers at any level ($P = .014$).

7.3.4 Influence Factors and P2 5-Year Goals

Where facilities project higher percentage 5-year reduction goals, four influence factors in particular, rank significantly more important: a) customer demand for green products, b) regulations other than P2 laws, c) NJDEP flexible administration of the NJPPA, and d) the NJPPA voluntary enforcement style. For this analysis, influence factor rankings are compared at grouped reduction levels of 1-50% and 51-100%. Resulting Mann-Whitney test significance levels for the four factors appear in Table 7.30.

Table 7.30. Factors Most Important at High 5-Year Reduction Goals

P2 5-Year Reduction Goals	Mann-Whitney Test Significance
Customer Demand for "Green" Products	
Any Substances Slated for NPO Reduction	.035
Regulations Other than P2 Laws	
51-100% of Targeted Processes Slated for Reductions	.042
NJDEP Flexible NJPPA Administration	
51-100% of Covered Processes Slated for Reductions	.009
Voluntary NJPPA Enforcement Mode	
51-100% of Targeted Processes Slated for Reductions	.019
51-100% of Covered Processes Slated for Reductions	.048
51-100% Covered Substances Slated for NPO Reductions	.019

7.3.5 Influence Factors and Special Initiatives

Facilities using recycled materials cite three factors as significantly more important than other respondents: potential P2 cost savings ($P = .024$), customer demand for "green" products ($P = .034$), and potential reduced environmental impact ($P = .021$). Where respondent firms offer product or packaging take-back programs, participation in voluntary environmental conduct codes is deemed much more important ($P = .005$), and facilities using life-cycle analysis consider consumer demand for "green" products significantly more meaningful ($P = .015$).

An added note of interest: where facilities report P2 cost savings, environmental conduct codes are more important (P = .054), as are technical feasibility (P = .011) and the potential for (*additional*) P2 cost savings (P = .003).

7.3.6 Influence Factors and Organizational Attributes

Numerous influence factors associate with the P2 organizational attributes. The many positive correlations are outlined in Table 7.31, following.

For only two attributes, the associations are negative - that is, influence factors are deemed of *less* importance. First, the potential for reduced monitoring and recordkeeping is less important at facilities citing the assignment of specific individuals with P2 responsibility (P = .027). And second, in cases where facilities offer employee incentives and/or recognition for P2 achievement, both NJPPA plan requirements (P = .029) and clarity/consistency of NJPPA rules (P = .039), are significantly less important than to remaining study respondents. This finding suggests that these facilities (just 35% of respondents) may represent proactive P2-achievers who simply are not fueled in their activities by NJPPA rules and plan requirements.

Finally, certain factors become significantly more important with increasing P2 organizational attribute *totals*. Grouping attributes into ordinal categories (1-4, 5-7, 8-10, 11-13) allows for Kruskal-Wallis one-way analysis of variance testing. Results indicate that the importance of both reduced environmental impact (P = .027) and voluntary environmental conduct codes (P = .0009) increase with increasing attribute sums. Further, for facilities with 11-13 attributes, employee safety (P = .043) and customer demand for green (P = .029) products each are significantly more important.

Table 7.31. Most Important Factors over Organizational Attributes

P2 Influence Factors	Mann-Whitney Test Significance
P2 Established in Company Policy	
Company Drive for Quality	.023
Employee Safety	.016
Participation in Voluntary Environmental Conduct Code	.003
P2 Integrated into Product/Process Design	
Company Drive for Quality	.012
Employee Safety	.007
Participation in Voluntary Environmental Conduct Code	.015
Potential Reduced Environmental Impact	.042
P2 in Business/Budget Planning	
Potential for Reduced Liability	.013
Company Drive for Quality	.017
Concern About Company Image	.012
Publication of Toxics Reporting Data	.042
Participation in Voluntary Environmental Conduct Code	.024
Potential Reduced Environmental Impact	.007
Technical Feasibility	.039
Use of Cross-Functional P2 Teams	
Company Drive for Quality	.035
Participation in Voluntary Environmental Conduct Code	.002
Potential for Facility-Wide Permit	.041
Provision of P2 Training/Education	
Potential for Reduced Liability	.004
Employee Safety	.001
Company Drive for Quality	.007
NJDEP Flexible Administration of NJPPA	.003
P2 Achievement in Employee Evaluation	
Potential P2 Investment Risk	.013
Concern About Company Image	.021
Publication of Toxics Reporting Data	.012
Participation in Voluntary Environmental Conduct Code	.0003
Potential Reduced Environmental Impact	.021
NJPPA Policy Objectives	.033
Representation in NJPPA Formulation	.011
P2 Networking/Communications	
Concern About Company Image	.009
Participation in Voluntary Environmental Conduct Code	.039
NJDEP Flexible Administration of NJPPA	.029
Formal Monitoring/Measurement of P2 Progress	
Customer Demand for "Green" Products	.005
Company Drive for Quality	.028
Potential Reduced Environmental Impact	.012
Regular P2 Progress Reporting	
Customer Demand for "Green" Products	.048
Company Drive for Quality	.043
Participation in Voluntary Environmental Conduct Code	.006
Representation in NJPPA Formulation	.047

7.3.7 Influence Factors and NJPPA Opinion Poll

A brief review of influence factor rankings as they break down over respondent telephone responses regarding the NJPPA, provides several items of note. First, and not surprisingly, the potential for facility-wide permitting is significantly less important to those stating that the NJPPA discourages their company's P2 program ($P = .018$). Next, the NJPPA planning requirements ($P = .0000$) and policy objectives ($P = .0003$) are far more important to those stating that the Act encourages their company P2 programs (41 of the 78 total remaining after listwise deletion of missing cases for the Kruskal-Wallis test statistic). Last, early entry into the P2 technologies market is ranked of greater importance to respondents finding that the NJPPA encourages company P2 programs ($P = .031$).

7.3.8 Factor Inter-Associations

Numerous P2 influence factors correlate with one another. A Spearman correlation matrix indicates that the strongest relationships occur amongst both financial factors, and organizational/social factors. Relationships also appear *between* financial and organizational/social factors. The most significant associations, all of which happen to be positive correlations, are shown in Tables 7.32 and 7.33. Regulatory/technical factors do not correlate strongly with financial or organizational/social factors and are listed separately.

Table 7.32. Regulatory/Technical Factor Spearman Correlations
(Listwise Deletion of Missing Cases - 78 Cases in Analysis)

P2 Influence Factor	P2 Influence Factor	Spearman Correlation Coefficient	Spearman Correlation 2-Tailed Significance
NJPPA Planning Req.'s	Potential FWP	.4412	.000
	NJPPA Policy Objectives	.4484	.000
Potential FWP	NJTAP Availability	.4442	.000
Voluntary NJPPA Mode	NJPPA Policy Objectives	.4256	.000
Potential P2 Mandates	Clear/Consistent Rules	.4057	.000
	Representation in NJPPA	.4439	.000
Clear/Consistent Rules	Representation in NJPPA	.5184	.000
	NJDEP Flexibility	.4973	.000
Representation in NJPPA	NJDEP Flexibility	.4295	.000

Table 7.33. Financial and Organizational/Social Factor Spearman Correlations
(Listwise Deletion of Missing Cases - 70 Cases in Analysis)

P2 Influence Factor	P2 Influence Factor	Spearman Correlation Coefficient	Spearman Correlation 2-Tailed Significance
Implementation Costs	Company Flexibility	.4634	.000
Potential Cost Savings	Drive for Quality	.4513	.000
Demand for "Green"	Early Entry P2 Tech Mkt	.5913	.000
	Reduced Liability	.4096	.000
Early Entry P2 Tech Mkt	Employee Safety	.4188	.000
	Company Image	.5022	.000
Reduced Recordkeeping	Reduced Liability	.5987	.000
Company Flexibility	Drive for Quality	.4978	.000
	Employee Safety	.4155	.000
Drive for Quality	Employee Safety	.6713	.000
	Company Image	.6228	.000
	Public Toxics Data	.4309	.000
	Reduced Env'l Impact	.4162	.000
Employee Safety	Company Image	.5645	.000
	Public Toxics Data	.4013	.001
	Reduced Env'l Impact	.4861	.000
Company Image	Public Toxics Data	.4625	.000
	Env'l Conduct Code	.4654	.000
Env'l Conduct Code	Reduced Env'l Impact	.4523	.000

7.4 Analysis of Overall Influence Factor Categories

An overview look at the P2 influence factor categories points to discrepancies between the perceived importance of each area, overall, and the summed evaluation of the individual factors within each category. The three overall categories are selected *most* important by the following respondent percentages:

- Regulatory/Technical Factors: 49%
- Financial Factors: 41%
- Organizational/Social Factors: 10%

At the same time, however, the five top-ranked individual factors draw from the financial and organizational/social areas. By summing the ranks assigned to each individual factor (4: very important, 3: important, 2: somewhat important, 1: not important), overall factor "scores" are available for each respondent, which indicate the cumulative rank given to each general category. Taking these "scores" together for the study group indicates that 44% of respondents most often rank the individual organizational/social factors "important" to "very important," while just 25% and 16%, respectively, most often rank the individual financial and regulatory/technical factors "important" to "very important."

Individual organizational/social factors are cumulatively ranked significantly higher, by those selecting this category as overall most important (Kruskal-Wallis P = .002). Individual regulatory/technical factors are cumulatively ranked significantly lower by those ranking the regulatory/technical category overall *least* important (K-W P = .022), but ranks are otherwise comparable. Cumulative ranks on the individual financial factors, on the other hand, are not significantly different, regardless of which overall category is deemed most important.

The three general category ranks do not segregate significantly over SIC product groups, employee categories, or company structure characteristics. Certain individual factors however, take on significantly more or less importance depending upon which overall category is considered most important. Where the regulatory/technical category is cited most important, respondents rank both NJPPA planning requirements (Mann-Whitney P = .0005) and potential reduced liability (P = .029) much more important, while ranking potential P2 cost savings (P = .013) far less important than other respondents. Respondents deeming financial factors overall most important, rank both implementation costs (P = .054) and potential P2 cost savings (P = .035) much more important than others, while rating NJPPA planning requirements significantly less important (P = .026). For those citing organizational/social factors overall most important, both NJPPA planning requirements (P = .033) and representation in NJPPA formulation (P = .046) are considered *less* crucial, while employee safety (P = .049) and reduced environmental impact (P = .004) are each deemed far *more* significant.

Comparing the three overall category rankings over past reductions achievements, methods of P2 implementation, 5-year reduction goals, attributes, and special initiatives, results in a number of additional areas of significance. For simplicity, these findings are outlined, as follows.

1. The overall organizational/social category is ranked significantly more important, where:
   - Facilities implement five or more P2 methods (P = .057);
   - P2 is established in company policy (P = .015);
   - P2 is integrated into product/process design (P = .014);
   - Employees receive recognition for P2 achievement (P = .026);
   - P2 achievement is considered in employee evaluations (P = .050);
   - P2 networking and communications are on-going (P = .058); and/or
   - P2 programs are supported by five or more organizational attributes (P2 = .013).
2. The overall financial factor category is ranked significantly *less* important where:
   - P2 is integrated into product/process design (P = .020);

- Facilities provide P2 training and education (P = .012);
- P2 progress is monitored and measured (P = .037); and/or
- P2 programs are supported by eight or more organizational attributes (P = .034).

7.5 Analysis of Primary P2 Program Benefits

Kendall's coefficient of concordance provides the following overall study group rank order for the six principal P2 program benefits (listed from most important to least):

1. Reduced Environmental Impact (Most Important: 34%)
2. P2-Derived Cost Savings (Most Important: 33%)
3. Reduced Liability (Most Important: 18%)
4. Enhanced Company Image (Most Important: 7%)
5. Improved Market Competitiveness (Most Important: 3%)
6. Facility-Wide Permitting (Most Important: 5%)

(Based on 81 total cases after listwise deletion of missing cases and deletion of cases where respondents labeled items with the same ranks.)

Analysis of the primary P2 program benefits as they relate to SIC product groups, results in three points of interest: a) P2-improved market competitiveness is most important to plastics manufacturers (Mann-Whitney P = .009); b) P2-enhanced company image is significantly more pertinent in the cases of fragrance/cosmetics (P = .028) and adhesive/sealant (P = .028) producers; and c) P2-reduced liability is of primary interest to soap/detergent study facilities (P = .050). Over company size categories, the only highlighted difference involves P2-reduced liability. At smaller firms (26-50 employees), concern about liability is heightened as compared with remaining respondents (P = .014), while at very large facilities (501-4500 employees) P2-reduced liability is deemed significantly less important (P = .007).

It is interesting to note that the P2 cost savings benefit is ranked much more important by respondent facilities which have in fact, cited previous company P2 cost savings (P = .0001), than by those which have not. Cost savings are also perceived as a very important benefit to those citing past use/generation reductions achievements (P = .007). The importance of cost savings actually increases in rank as the extent of past use (P = .052) or generation (P = .058) reductions increase (from 0, to 1-50%, to 51-100%).

Additional points of significance:

- P2-reduced environmental impact is less important to those implementing just one P2 method than to those implementing more than one (P = .045);
- P2-enhanced company image is more important to respondents indicating that employees are recognized for P2 achievement (P = .052);
- P2-improved market competitiveness increases in rank with: a) increasing percentages of substances slated for reductions of 50% or more (P = .011); and b) increasing importance rankings on early entry into P2 technologies markets;
- NJPPA policy objectives are considered much more important by respondents citing either reduced liability, or facility-wide permitting as the most important P2 benefit (P = .014);
- Potential facility-wide permitting ranks significantly higher where respondents select regulatory/technical factors as the overall most important category (P = .003); and
- Enhanced company image is of significantly less concern to respondents citing the organizational/social factor category as least important in their P2 implementation (P = .0001).

7.6 Analysis of Primary P2 Program Barriers

The principal barriers to initiation or expansion of P2 programs which were mentioned in the survey written commentary, are summarized for the response group in Table 7.34, following. Certain barriers have a significantly higher incidence among specific SIC product groups. Technical feasibility is particularly troublesome for inorganic chemical manufacturers (Fisher's Exact Test P = .053), for example, while significantly less problematic for

Table 7.34. Principal P2 Program Barriers

P2 Program Barriers (Total Respondents: 96)	Valid N	Percent of Total (%)
Cost	43	45
Technical Feasibility	32	33
Lack Resources (Personnel, Time, Space)	16	17
Regulatory Disincentives	13	14
Company Culture	10	10
Product Quality	7	7
Program Already Maximized	3	3
No Barriers	10	10

medicinal/pharmaceutical manufacturing firms (P = .043). Company culture is cited by 31% of paint/coating facility respondents, which is significantly more than any other group (P = .028). Soap/detergent facilities claim to be P2-maximized more frequently than any other group (P = .034), while P2-related product quality problems are cited by 40% of adhesive/sealant manufacturers (P = .041). Lastly, regulatory concerns are most often attributed to the medicinal/pharmaceutical product group (P = .054) (again, most likely related to stringent FDA regulations).

It is interesting to note that those citing "no barriers" are far more likely to be owned and assisted by a parent company (P = .030). As to P2 implementation methods, only raw materials changes appears as an area of association. Respondents using this method are more likely to cite product quality problems (Chi-Square P = .023), often mentioning difficulty in finding materials substitutes with the specified characteristics.

7.6.1 Barriers and P2 Organizational Attributes

Several correlations exist between organizational attributes and program barriers. Primarily these are negative associations, wherein certain barriers are cited far less frequently when respondents indicate the presence of specific organizational attributes. Respondents mention company culture problems (i.e., lack of organizational commitment, awareness, employee discipline, P2 integration) far less often when facilities are supported by top management P2 commitment, for instance. It is interesting to note that "no barriers" is listed significantly *less* often where prioritized P2 facility goals have been established. This finding may simply point to the importance of facility awareness. Problems may not even be identified until the auditing, planning, and goal-setting stages are complete. Attribute-barrier associations are listed in Table 7.35, along with Chi-Square test significance levels.

Table 7.35. P2 Program Barriers and Attributes Associations

Organizational Attribute	P2 Program Barrier	Association	Chi-Square Test Significance
P2 Established in Company Policy	Lack Resources	(+)	.027
Top Management P2 Support	Company Culture	(-)	.003
Use of Cross-Functional P2 Teams	- Lack Resources - Technical Feasibility	(+) (-)	.020 .033
Assignment of Specific P2 Individuals	Company Culture	(-)	.009
Provision of P2 Training/Education	- Product Quality - P2 Maximized	(-) (-)	.029 .034
Setting of Prioritized P2 Goals	- Lack Resources - No Barriers	(+) (-)	.044 .007
Provision of Employee Incentives/Recognition for P2 Achievement	No Barriers	(+)	.046
P2 Achievement in Employee Evaluation	No Barriers	(+)	.036

7.6.2 Barriers and P2 Influence Factors

Associations between P2 program barriers and influence factors are outlined, with Mann-Whitney U test significance results, in Table 7.36. Of particular note, are the many factors ranked significantly more important by respondents stating that the facility has no P2 program barriers. The factors listed are suggestive of facilities either aggressive in pursuing P2 activities for self-motivated reasons (i.e., voluntary environmental conduct code, company image, early entry to P2 technologies market), or proactively seeking to stay at the forefront to avoid regulatory and/or image problems (i.e., public toxics reporting, reduced monitoring and recordkeeping, reduced liability, potential facility-wide permitting).

A closer look at these facilities indicates that all employee categories are represented, except for the very largest (501-4500 employees). Of the 10 firms, three are ink/dye/pigment manufacturers, two are plastics firms, while the remaining are spread (one each) over five other product categories. Only medicinal/pharmaceutical, fragrance/cosmetic and nitrous fertilizer firms are not represented. A full 80% are owned by larger companies, with 60% assisted in their P2 programs (overall study group: 63% owned, 30% assisted). Five of the ten: have P2 attributes sums of 11-13, implement a total of just two P2 methods, and stated in telephone interviews, that the NJPPA encourages their company P2 programs.

Table 7.36. P2 Program Barriers and Influence Factors Associations

P2 Program Barrier	P2 Influence Factor	Factor Rank: More Important (+) Less Important (-)	Mann-Whitney U Test Significance
Cost	Technical Feasibility	(+)	.019
	Potential FWP	(+)	.019
	NJPPA Planning Req.'s	(+)	.006
Technical Feasibility	Potential FWP	(-)	.0004
Regulatory Disincentives	Potential Cost Savings	(+)	.014
	Potential FWP	(-)	.015
	NJPPA Planning Req.'s	(-)	.020
Product Quality Problems	P2 Technologies Mkt Entry	(-)	.043
	Technical Feasibility	(+)	.024
No Barriers	Env'l Conduct Code	(+)	.008
	Public Toxics Reports	(+)	.006
	Company Image	(+)	.001
	Potential Reduced Liability	(+)	.039
	Reduced Recordkeeping	(+)	.019
	P2 Technologies Mkt Entry	(+)	.021
	Potential FWP	(+)	.018

7.7 P2 Commitment Index: Distribution and Correlations

P2 Commitment Index scores are calculated for each respondent per the equation developed in Section 5.3.2.:

$$\text{P2 Index} = z(\Sigma A) + z(\Sigma P) + z(\Sigma M) + z(\Sigma G) + z(\Sigma D) \qquad \textbf{(Equation 7.1)}$$

where:

$z(x)$ is the z-score of x;

A is Facility P2 Organizational Attributes (0-13);

P is Past Facility Reductions Achievements (0-5);

M is P2 Methods Implementation (0-7);

G is P2 5-Year Reduction Goals (0-26);

D is Special Facility Environmental Initiatives (0-3).

The resultant z-scores for each index component cluster around means of zero, as illustrated in Table 7.37. P2 Index z-scores have a mean of 0.18, and range in value from -5.0 to 5.75.

Table 7.37. P2 Commitment Index Z-Scores

Z-Scores	Mean	Minimum	Maximum	Valid N
Z(Organizational Attributes)	.00	-2.38	1.57	106
Z(Past Achievements)	.00	-1.93	1.52	93
Z(Methods Implementation)	.00	-1.77	1.51	106
Z(Goals)	.00	-1.67	2.00	93
Z(Environmental Initiatives)	.00	-1.22	2.10	106
Z(P2 Index) Maximum Range		-8.97	8.70	
Z(P2 Index) Observed	.18	-5.00	5.75	80

Grouping the overall P2 Index z-scores, allows for a general assignment of commitment categories, as follows:

z(P2 Index) ≤ -1.50   -1.50 < z(P2 Index) < 1.50   z(P2 Index) ≥ 1.50;

corrected for the actual mean of 0.18:

z(P2 Index) ≤ -1.32	-1.32 < z(P2 Index) < 1.68	z(P2 Index) ≥ 1.68
Below Average (22 Cases)	Average (32 Cases)	Above Average (26 Cases)

7.7.1 P2 Commitment Index Distribution

Using the preceding scheme (adjusted for maximum range), each index component category can also be assigned below average to above average rankings. Based upon these rankings for mean P2 Index and Index component z-scores, SIC product groups are evaluated over each commitment area, as illustrated in Table 7.38. For clarity, "above average" is denoted as "high," "below average," as "low." Actual computed z-scores appear in Table 7.39.

Table 7.38. P2 Commitment Index and Components by SIC Group

SIC Product Group	P2 Organization. Attributes	Past Reduction Achievemt.	P2 Methods Implement.	P2 5-Year Goals	Special Env'l Initiatives	P2 Commitment Index
Med/Ph/Bio	Low	Avg	Avg	Avg	Avg	Avg
Ink/Dye/P	Avg	Avg	Low	Avg	Low	Avg
Soap/Deterg	Avg	Avg	Avg	Avg	Avg	Avg
InorgC	Avg	Avg	High	High	Avg	High
Paints	Avg	Avg	High	High	Avg	Avg
OrgC	High	High	Avg	Avg	Avg	Avg
Plastics	High	Avg	Avg	Low	High	Avg
Adh/S	Low	Avg	High	High	Avg	Avg
IndusGas	Low	Avg	Low	Avg	High	Low
Frag/Cos	Avg	Low	Low	Low	Low	Low
NitrF	Low	Low	Low	Low	High	Low

Table 7.39. Mean P2 Commitment Index and Component Z-Scores by SIC Group

SIC Product Group	P2 Organization. Attributes	Past Reduction Achievemt.	P2 Methods Implement.	P2 5-Year Goals	Special Env'l Initiatives	P2 Commitment Index
Med/Ph/Bio	-.31	-.03	-.29	.12	-.18	-.56
Ink/Dye/P	-.21	-.18	-.48	.03	-.35	-1.16
Soap/Deterg	-.06	-.17	.10	-.10	.20	.82
InorgC	.25	.03	.76	.40	.25	1.79
Paints	-.25	.03	.44	.42	-.03	1.09
OrgC	.35	.54	-.19	-.17	-.27	.54
Plastics	.77	.07	-.06	-.50	.49	.39
Adh/S	-.37	-.03	.69	.31	.11	.24
IndusGas	-.66	-.09	-.95	-.19	.62	-1.67
Frag/Cos	.05	-1.24	-.40	-.45	-.85	-3.44
NitrF	-.86	-.55	-.95	-1.67	.99	-3.03

Finally, SIC product groups are ordered by decreasing P2 commitment index scores, as shown in Table 7.40. It is important to note that the adhesive/sealants category as well as the last two groups, lowest on the P2 scale, are comprised of far too few cases to be considered representative of these product categories. (The industrial gas group, however, is representative of two thirds of all such facilities covered under the NJPPA in New Jersey.)

Table 7.40. SIC Product Groups Ordered by P2 Index Score

SIC Product Group	P2 Commitment Index	P2 Commitment Index	Valid Cases (N) (Total: 80)
InorgC	1.79	High	11
Paints	1.09	Avg - High	10
Soap/Deterg	.82	Avg	9
OrgC	.54	Avg	11
Plastics	.39	Avg	9
Adh/S	.24	Avg	3
Med/Ph/Bio	-.56	Avg	9
Ink/Dye/P	-1.16	Low - Avg	13
IndusGas	-1.67	Low	2
NitrF	-3.03	Low	1
Frag/Cos	-3.44	Low	2

P2 Index scores are not substantially different over varying facility size categories, however, differences are apparent between those owned by larger companies, and those not ($P = .029$). Chi-Square testing, using three P2 Index category rankings (below average, average, above average), indicates that where facilities are owned, only 17.6% have below average index scores. Another 47% of facilities have average scores, while the remaining 35% have above average scores. For independent facilities, on the other hand, scores are below average in 44.8% of cases, average in 27.6% of cases, and above average in 27.6% of cases.

7.7.2 P2 Commitment Index and the Influence Factors

A number of clear differences exist in the rankings of influence factors, between respondents in the above average commitment group and those in the below average group. Mann-Whitney test statistics highlight the following significant differences of opinion:

- Customer demand for "green" products is much more important to facilities in the above average commitment group (P = .045);
- Company drive for quality is of much greater concern to firms with above average commitment (P = .004), and further, the importance of quality increases with increasing commitment levels (Kruskal-Wallis P = .009);
- Employee safety is a paramount objective of highly P2-committed manufacturers (P = .006), and the rank importance of safety increases with commitment (K-W P = .018);
- Reducing environmental impact through P2 implementation is significantly more important to firms in the higher commitment category (P = .0005), and further, its importance increases with increasing commitments (K-W P = .001);
- At below average commitment levels, voluntary environmental conduct codes rank much less important (P = .047); and
- Financial factors overall, are considered most important by those with lower P2 commitments (P = .048).

Comparing the above and below average commitment groups each individually, to the remainder of the study group (including the average category), points to several additional influence factor observations. Although these items are not significant to the preferred levels, they serve to further define the P2 perspectives at opposing ends of the commitment scale. At above average commitment levels, company flexibility is considered somewhat more important in facility P2 implementation (P = .062), while NJPPA planning requirements are less important (P = .092). At below average commitment levels, both representation in NJPPA formulation (P = .092), and publication of toxics reporting data (P = .113) are considered more important.

As to P2 benefits, improved market competitiveness is considered significantly more important by those of above average commitment than by others in the study group (P = .033). Interestingly, P2-enhanced company image is important at both ends of the commitment scale, but contrasts markedly with those of average commitment, who label it much less important (P = .012). As to P2 barriers, those citing a lack of resources to expand their P2 programs, are significantly more likely to come from the above average commitment category (P = .0007).

7.8 P2 Commitment Index: Key P2 Organizational Attributes

Which P2 organizational attributes are most important in contributing to high P2 Commitment scores? Was the panel of pollution prevention professionals correct in its evaluation of the attributes it did agree on? And how important are these organizational attributes, anyway?

To compare the strength of the associations between P2 attributes and each of the commitment components, eta coefficients are determined for each pairing. This coefficient is appropriate for cases in which the dependent variable is measured on an interval scale (i.e., component z-scores), while the independent variable is nominal (P2 attributes). The squared eta coefficient provides a measure of the proportion of variability in the dependent variable, that can be accounted for by knowing values of the independent variable (Norusis 1993). The strongest associations between attributes and commitment components appear with applicable eta coefficients, in Table 7.41.

Table 7.41. P2 Index Components: Strongest Attributes Associations

P2 Commitment Index Component	Organizational Attributes	Eta Coefficient	Cases (N)
Z(P2 Methods Impl.)	Prioritized P2 Goals	.319	102
Z(P2 Reduction Goals)	Measure P2 Progress	.314	91
	Assigned P2 Individuals	.232	93
	Prioritized P2 Goals	.228	90
Z(Past Reduction Ach.)	Assigned P2 Individuals	.282	93
	Prioritized P2 Goals	.267	90
	P2 Progress Reporting	.261	89
Z(Special Initiatives)	P2 in Budget Planning	.231	96
	P2 Communications	.224	104

Summing these component z-scores forms the overall commitment index *less* the organizational attributes. This portion of the commitment index could be interpreted as the "action" half of the P2 picture. Computation of the eta (η) coefficients for pairings of this index with each organizational attribute, indicate that this "action"-index associates most strongly with:

- Setting of Prioritized P2 Goals (η = .384, N = 78)
- Monitoring and Measurement of P2 Progress (η = .341, N = 78)
- Regular P2 Progress Reporting (η = .279, N = 77)

The next two attributes, decreasing in strength of association, are:

- Provision of P2 Training/Education (η = .226, N = 78)
- Use of Cross-Functional Teams (η = .223, N = 76)

For every P2 attribute but one (employee P2 incentives/recognition), the association is positive. That is, higher mean "action" index scores correspond to the presence (as opposed to absence) of each attribute. The highest mean "action" scores coincide with the above-listed attributes, although their numerical order does not correlate with the ordered strength of association.

From the previous inter-attribute analysis (Section 7.2.5.7), it is clear that the greatest number of strong associations between attributes in general, involve establishment of P2 philosophy into company policy and regular reporting on P2 progress. The same phi coefficient matrix indicates that the P2 "action"-related attributes (above-listed) associate strongly with both one another, and again, with the establishment of P2 philosophy into company policy. With the recurrence of the P2 in company policy attribute, it is important to recall that the very strongest relationship revealed by the phi coefficient matrix, is that between establishment of P2 into company policy and top management P2 support. Without top management P2 support, it is difficult to imagine that P2 philosophy could be embedded in company policy, at all. (Where the panel of experts agreed, it designated top management commitment as the number one most important attribute; formal measurement, second; regular reporting, third; cross-functional teams, fourth; and P2 achievement in employee evaluation, fifth.)

To determine whether above-average P2 commitments are associated more with facility characteristics such as SIC product group, company size, ownership, and P2 program assistance, or with P2 organizational attributes, eta coefficients are again the appropriate tool. Results indicate that associations between "action"-index scores and facility characteristics are weak and in half of all cases, negative. That is, mean scores are actually lower with these facility characteristics, than without. The strongest associations involve SIC product groups, as follows:

- Inorganic Chemicals ($\eta = .258$, N = 80) (+)
- Fragrances & Cosmetics ($\eta = .249$, N = 80) (-)
- Ink, Dyes, Pigments ($\eta = .220$, N = 80) (-)

While the association between the inorganic chemicals product group and the action-index is substantial, it is not as strong as the associations for the top P2 attributes, as listed above. Further, eta coefficients decrease sharply after these first three (the next highest: $\eta = .198$, followed by $\eta = .130$), and many of the remaining associations are negative.

As a final test of the strength of association between facility organizational attributes and above-average P2 commitments, the "action" index must be examined at facilities with varying degrees of P2 attribute support. Analysis of variance of the mean "action" index scores over a breakdown of attribute sums (0, 1-4, 5-7, 8-10, 11-13), indicates a significant difference, indeed (F probability = .009). Where facilities are supported by below average attribute sums (0-7), the mean action z-index is low, at just -.688 (33 cases). At average to above average attribute levels (8-13), however, the mean action z-index is +.605 (47 cases).

Finally, a closer look at facilities characterized by high action index scores yet low P2 attribute support, and vice versa (low action index scores and high attribute support), seems to further confirm the importance of the key action-related P2 attributes. Only seven cases occur where facilities register high action index scores, yet slightly lower than average attribute sums (all have 5-7 attributes). Of these, one respondent reports the presence of each of the five *key* attributes among its total of seven. In five of the remaining cases, facilities each report having prioritized P2 goals (the most strongly associated action attribute), while lacking just one of the other top three action-related attributes. Of the 21 cases where action index scores are below average, seven indicate average to above average attribute sums. In two of these cases, P2 goals have not been established (the strongest action-related attribute), while in another, the other two of the top three key attributes are lacking. Two of the remaining lack combinations of the top three to five key attributes, while in only one case, every key attribute is present and further, the respondent indicates "no barriers" to expansion of the facility P2 program. Where facilities report average to above average attribute totals, *and* score above average on the action index, on the other hand (18 cases), all report having set prioritized P2 goals. Eight of these cite the presence of all the key attributes, six have all but one, and three have all but two (one case - missing information). In no case is more than one of the top three key attributes lacking.

CHAPTER 8

CONCLUSIONS AND RECOMMENDATIONS

The primary objectives of this study of the New Jersey Chemical and Allied Products Industry are to: a) develop a direct measure of company commitment to pollution prevention; b) use the measure to categorize study facilities by commitment levels; and c) differentiate the needs and interests of each commitment group in implementing its pollution prevention programs. Satisfaction of the first two objectives, which enable completion of the third, is made possible through the proposed P2 Commitment Index. The measure encompasses both P2 action elements, including methods implementation, reduction achievements, P2 goals, and special environmental initiatives; and P2 support elements, such as top management commitment and establishment of P2 philosophy into company policy. Application of the P2 Commitment Index creates clearly defined subgroups within the study population, each with its own distinctly different set of P2 interests and concerns.

The results of this study offer a starting point toward a better understanding of the barriers and motivations that lead to varying P2 commitment levels. Only with such knowledge, is it possible to devise policies or create incentives that will facilitate, rather than impede the pollution prevention commitment process.

8.1 Key Findings

8.1.1 Priority Factors in P2 Implementation

A. Study Group Overall

For the study group overall, the priority motivations to facility implementation of pollution prevention programs, in order from most important to least, are:

- Employee Safety
- Company Drive for Improved Quality
- Reduction in Liability
- Reduction in Environmental Impact
- Potential for Cost Savings

Although considered separately within the body of this study, it is clear that an important relationship exists in industry between employee safety and reduction in liability. The appearance of both of these on this list suggests that this area is one of particularly great concern.

B. Below Average Commitment Group

For respondents scoring at below average P2 commitment levels, the top priorities motivating P2 program implementation, ordered from most important to least, are:

- Regulations Other than P2 Laws
- Risk of Future Mandated P2 Laws
- NJPPA Planning Requirements
- Reduction in Environmental Impact
- Employee Safety

In addition, these respondents rate financial factors overall, much more important than others in the study group, while ranking voluntary environmental conduct codes, significantly less important than others.

C. Above Average Commitment Group

For respondents scoring above average on the P2 commitment scale, the top motivations, ordered from most important to least, are:

- Employee Safety
- Company Drive for Improved Quality
- Reduction in Environmental Impact
- Reduction in Liability
- Potential for Cost Savings

Additionally, above average commitment facility representatives rank both customer demand for "green" products, and improved market competitiveness, significantly more important than other respondents do. This group is also more likely to cite a lack of resources as the major barrier to P2 program expansion.

8.1.2 P2 Commitment Attributes

Pollution prevention commitments generally transcend facility characteristics such as SIC product type, or number of employees. Higher commitments occur more frequently at facilities owned by larger companies, but are distributed over all size categories and most product types. The most important facility characteristics involve P2 organizational support attributes. The key support attributes in facility P2 commitment are:

- Establishment of P2 Philosophy in Company Policy
- Top Management P2 Program Support
- Setting of Prioritized Facility P2 Goals
- Formal Monitoring and Measurement of P2 Progress
- Regular P2 Progress Reporting

Top management support for facility pollution prevention programs is associated with the P2 commitment index primarily in the area of establishment of P2 philosophy in company policy. Its role beyond this point in the facility P2 commitment, appears somewhat diminished. It is of interest to note, however, that 70% of the (16) facilities indicating uncertainty as to top management P2 support, have below average commitment index scores. (The remaining 30% score no higher than average.)

8.1.3 Cost Findings

P2-derived cost savings are cited by 60% of study facilities. Cost savings are significantly more frequent where:

- facilities report use or generation reductions achievements;
- facilities report high past generation reductions achievements;
- life-cycle analysis is integrated into product and/or process design;
- respondents cite involvement in voluntary environmental conduct codes.

8.1.4 P2 Implementation Methods

The average number of P2 methods implemented at study facilities is three, and this number is not affected by larger company ownership or parent company P2 program assistance. In addition:

- The highest achieved use reductions occur where facilities use raw materials changes and/or product substitution.
- The highest projected use reductions occur at facilities implementing product modification, raw materials substitution, and/or product substitution.
- As the number of different P2 methods implemented at a facility increases, the number of P2 organizational attributes supporting the P2 program increases.

8.1.5 P2 Program Barriers

Although ten respondents indicate having no barriers to expansion of their facility P2 programs, another 88 do cite various problem areas. The top three most frequently noted P2 program barriers are:

- Cost (i.e., implementation cost, compliance cost, need for P2 pay-back/savings/profit)
- Technical Feasibility
- Lack of Resources (i.e., personnel, time, space)

8.1.6 P2 Program Benefits

For the overall study group, the three most important P2 program benefits (ordered from most important to least) are:

- Reduced Environmental Impact
- P2-Derived Cost Savings
- Reduced Liability

8.1.7 Other Noteworthy Findings

- NJ Chemical and Allied Products NJPPA 5-Year Facility Goals (210 Plans Filed):
  1. 76% of facilities have slated use or NPO reduction process goals;
  2. 33% of all covered processes (1559) are slated for use or NPO reductions;
  3. 59% of facilities project use reductions;
  4. Overall goals would reduce targeted use quantities by 21%;
  5. 75% of facilities project NPO reductions;
  6. Overall goals would reduce targeted NPO quantities by 44%.

- Telephone Interview (232 respondents) Responses on the NJPPA:
  1. NJPPA Encourages Facility P2 Program 46%
  2. NJPPA Discourages Facility P2 Program 15%
  3. NJPPA Has No Impact on P2 Program 29%
- Telephone Interview Most Frequent Comments (232 respondents):
  1. NJPPA Takes Good Approach (User-Friendly, Voluntary Implementation) 32%
  2. NJPPA Compliance is Overburdensome (Cost, Paperwork) 32%
  3. NJPPA Audit and/or Planning Triggered New/Expanded P2 Initiatives 16%
- Out-of-Process Recycling Opinion Poll (120 respondents):
  1. NJPPA Should Define Out-of-Process Recycling as a P2 Method 75%
  2. NJPPA Should Not Include Out-of-Process Recycling 14%
- Most Frequent Suggestions for Improving NJPPA:
  1. Provide More Recognition for P2 Efforts/Achievements 39%
  2. Simplify NJPPA Reporting 28%
  3. Provide Technical Assistance 27%
  4. Provide Financial Incentives/Assistance 22%

8.2 Facility P2 Perspectives

Taking a closer look at the priority motivations and concerns of each P2 commitment group provides insights which help to define the differences in P2 perspectives. Each of the twenty-five different factors listed for ranking in the survey questionnaire, can be categorized quite differently from the assigned headings: regulatory/technical, financial, organizational/social. A more perceptive outlook would assign labels that classify factors into commitment-associated elements. That is, factors should cluster into groups that define whether facilities are either prodded into P2 activities through the regulatory enforcement "shuffle," or proactively involved as part of a sound business strategy. The P2 Commitment Index takes into account pollution prevention action elements - what facilities actually do and accomplish; and P2 support elements - organizational attributes that provide the backing for what facilities accomplish. The P2 influence factors, on the other hand give an indication of what P2 participants care about. These are the priorities that drive P2 commitments and explain why some companies go all out in their P2 efforts, while others lag behind.

Factors such as those ranked highest by the above-average commitment group, primarily come from a category representing proactive, self-motivated, ideals. These are factors such as: company drive for superior quality, concern about employee safety, reduction of environmental impact, P2 potential for cost savings, participation in a voluntary conduct code, satisfying customer demand for "green" products, seeking early entry into P2 technologies markets, and using P2 to gain a competitive edge. Businesses in this group are driven in their P2 efforts by a determination to stay on the "cutting edge." They seek the industry forefront and are anxious for recognition of their accomplishments. Factors such as reducing liability, reducing monitoring and recordkeeping, or seeking facility-wide permitting suggest a practical regulatory avoidance stance. Other items such as public toxics reporting data, potential P2 investment risk, concern about possible P2 mandates, and NJPPA planning requirements, however, are priorities that infer candidates for the regulatory shuffle.

The outlook from the latter category, which in fact represents the below average commitment group, is far different from that of the above average respondents. It suggests a less optimistic viewpoint wherein P2 activities are not aggressively pursued with the aim of continuous company improvement. Rather, maximum effort is required to simply maintain the status quo. These are firms driven in any P2 efforts, by regulatory requirements or serious concerns about company image. It seems that these businesses are either unaware of P2 opportunities, are unconvinced as to the strong association between P2 implementation and cost savings, or are simply unable to invest the start-up capital needed to get the first foot in the door.

8.3 Facility Needs and Concerns

The overriding concerns and barriers to P2 expansion or initiation, whether facilities are strongly P2-committed or not, are cost and technical feasibility. In cases of above-average commitment, the needed technology for P2 advancement beyond already optimized levels, is frequently not yet available. Facility representatives often mention internal company research and development initiatives, which are relied upon extensively for new P2 innovations. It seems that little is available to such firms, in the way of a P2 technology resource "store." In cases of below-average commitment, technology problems are of a much different variety. In these instances, the needed technology is not yet available to the *facility*. Plant managers are unaware of P2 implementation strategies and often indicate a desire for plant-specific technical review and recommendations from an outside agency (such as NJDEP).

As to P2 cost matters, while the specific issues may vary significantly, it seems that financial frustration is spread indiscriminately over all commitment lines. One of the most frequently cited statements, in both written commentary and telephone interviews, is the succinctly put: "pollution prevention must save money." Second most frequent, and always following the first: "pollution prevention will not happen unless it is mandated by law, or it provides a substantial benefit to the company." Even the most ingenious of scientists and engineers, and the most ambitious of P2 program managers, are limited in the final analysis, by the company bottom line. This situation makes long-term pollution prevention investments a rare find. P2 compliance managers and engineers must not only identify clever P2 opportunities, but to find even a glimmer of hope for implementation, projects must quickly prove cost-effective -- preferably in time for the next quarterly report.

8.4 Recommendations

Addressing these issues fully will require additional research and analysis. To begin the discussion, the following suggestions are offered as a New Jersey pollution prevention wish list:

- Initiation of a pollution prevention investment credit system, to encourage both start-up, and long-term P2 projects of far-reaching potential, and to ease the lengthy time for payback on investment. Credits could be traded toward items such as reduced permit fees, facility-wide permitting, or tax deductions.

- Development of a New Jersey P2 technologies clearinghouse, through which facilities of any size or product type could seek, trade, or provide P2 technological information. Through such a vehicle, facilities with little P2 exposure could obtain basic start-up information, with concrete examples of P2 opportunities and techniques implemented at like facilities. High achievers involved with P2 development could take advantage of (non-proprietary) information-sharing to avoid expenditures that in essence, re-invent the P2 wheel.

- Expansion of the New Jersey Technical Assistance Program, to enlarge upon P2 technological research, to make hands-on technical assistance available to more facilities, and to make such assistance available to facilities of a broader range of types and sizes.

- Evaluation of New Jersey facilities based upon the level of achievement of plant-specific P2 programs, and provision of merit awards for continuous improvement.

- Initiation of a "P2 exchange program" to propel overall NJ P2 participation. This would involve facility classification based upon P2 advancement, wherein:

    1. Upper-tier P2 firms educate lower-tier firms in P2 technologies with plant-specific review and recommendations, in exchange for P2 investment credits or grant monies toward their own further research; or

2. Upper-tier P2 firms work directly with lower-tier firms to install P2 technologies, and gain P2 credits or research funding for reductions achievements at the lower-tier facilities; or
3. Upper-tier P2 firms are otherwise recompensed and encouraged to share P2 research findings and innovations that can bring lower-tier firms up to at least a minimum standard level;
4. Upper-tier firms are rewarded for P2 achievements and given incentives, perhaps in the form of eased regulatory reporting requirements, for every year of documented exceptional P2 performance; and last
5. Incentives are established to encourage continued investment in P2 research and development within the industrial and academic communities, and to support joint research efforts involving both.

8.5 Conclusions

Based upon industry's reception of NJPPA planning requirements to date, and in light of the already sizable investment in this program, there appears little reason to institute any *major* NJPPA reforms. Facilities demonstrating below average commitment levels, in fact, need laws like the NJPPA to provoke their participation in pollution prevention activities. Slated reduction goals are substantial, particularly when aggregated for the industry as a whole, and in a number of cases (16%), NJPPA planning requirements have triggered new or expanded P2 initiatives.

Two areas do require attention, however: a) the out-of-process recycling issue must be re-visited and perhaps added to the program with some level of recognition; and b) regulatory compliance paperwork must somehow be streamlined. Integration of NJPPA standards, rules, and regulations with other New Jersey environmental laws would begin to address this issue.

Uniformity - even without relaxation of environmental laws - could ease the regulatory burden and the associated costs of compliance, substantially.

Finally, it is interesting to point out that NJPPA regulations actually require that businesses develop and demonstrate several of the key P2 attributes identified in this study. The NJPPA requires that facilities formally measure and monitor P2 progress, that facility reduction goals be established (and documented for public consumption through NJDEP-filed plan summaries), and that facilities regularly report on P2 progress (through the required 5-year plan summaries and annual reporting updates). These requirements comprise three of the top five organizational attributes associated with the very highest of P2 commitments. Perhaps they are related to the successes that the NJPPA can claim, to date. The larger question remains, however, as to whether regulations such as the NJPPA will provoke the lasting pollution prevention commitments that are needed to achieve significant results.

APPENDIX A.

TRANSCRIPT OF INTRODUCTORY TELEPHONE INTERVIEW

Telephone Interview Pre-Survey Mailing

This is __________, of the Environmental Policy Institute, at NJIT. We sent you a letter recently introducing our independent research study on New Jersey pollution prevention policies. We're contacting firms covered under the New Jersey Pollution Prevention Act, seeking commentary regarding the impacts of current regulations on company pollution prevention practices. We'd like to know what company officials think of current policies, how you feel they might be improved, and whether you find that they've encouraged, or in fact hindered, company pollution prevention efforts. The results of this study will contribute to current efforts toward reshaping New Jersey environmental regulations.

We'll be sending out questionnaires that deal with these issues within the week. I'm calling today to ask you three quick preliminary questions and to verify that I have the correct name and address to send this to. (ASK SURVEY Q.'s)

(NO: Is there a better time that I could call and speak with you later?)

<table>
<tr><td colspan="2">1. Is your company currently using pollution prevention techniques in any processes, and if so, what methods are you using? (Provide examples, if necessary: product modification, raw materials changes, product substitution, product redesign, process modification, improved operating procedures, in-process recycling.)</td></tr>
<tr><td>Yes</td><td>No</td></tr>
<tr><td>2. What are the biggest reasons for your company's implementing pollution prevention methods?</td><td>2. What are the biggest problems your company faces in implementing pollution prevention methods?</td></tr>
<tr><td colspan="2">3. The last question deals with current state pollution prevention policies. Are you familiar with the New Jersey Pollution Prevention Act?</td></tr>
<tr><td>Yes</td><td>No</td></tr>
<tr><td>3a. Do you think it encourages, discourages, or has no impact, on company implementation of pollution prevention? And why?</td><td>3a. Do you think existing state policies encourage, discourage, or have no impact, on company implementation of pollution prevention? And why?</td></tr>
<tr><td>Thank you for your time. We'll get this out to you right away and we'll look forward to hearing from you.</td><td>I enjoyed speaking with you and appreciate your time.</td></tr>
</table>

APPENDIX B.

SURVEY QUESTIONNAIRES

Survey Questionnaire No. 1 - For Businesses Using P2 Methods

A Survey for the New Jersey Chemical and Allied Products Industry

Facility Pollution Prevention Questionnaire

Part I. Facility Overview

A. Basis Information

Facility SIC Code(s): Primary______ Secondary______ Others______

Number of Employees at this Facility: ________________

B. Facility Processes

Please provide a brief description of the major processes that your facility currently operates, and the products and/or services which you provide. List in order of significance.

Product or Service	Brief Process Description

C. Facility Organizational Structure

1. Is this facility owned by a larger corporation? Y/N ______

2. If yes, is facility pollution prevention managed or assisted by the parent company? Y/N ______

D. Company Environmental Affairs (General)

1. Does your company use recycled materials in any production processes? Y/N ______

2. Does your company offer a product or packaging "take-back" program, wherein consumers may return items for company remanufacture/re-use? Y/N ______

3. Does your company use "life-cycle analysis" in product design? Y/N ______

4. Does your company manufacture "green" products? Y/N ______

5. Has company implementation of pollution prevention, resulted in cost savings? Y/N ______

6. Has your company achieved reductions in the use and/or generation of hazardous materials over the last 10 years (whether through "pollution prevention," or any other method)? Y/N ______

a. 1985-95 Estimate of Use Reduction for *this* Facility (%): ______

b. 1985-95 Estimate of Generation Reduction for *this* Facility (%): ______

Definitions

For purposes of this questionnaire, "pollution prevention" is defined as in the NJPPA of 1991. "NJPPA" means the currently effective version of the New Jersey Pollution Prevention Act, as passed in 1991. (Proposed amendments A-903/S-308 may be approved this year by the NJ Legislature.)

"Pollution Prevention" (NJPPA 1991):

Reduction of use and/or generation of hazardous substances via
1) Changes in production technologies;
2) Changes in raw materials or products;
3) Changes in on-site facility or production processes.

NJPPA Includes: Raw material substitution, product reformulation, production process redesign or modification, in-process recycling, improved operation and maintenance of production process equipment.

NJPPA Does Not Include: Treatment, increased pollution control, out-of-process recycling, incineration.

Part II. Facility Pollution Prevention Review

Instructions: Please indicate below - *for this facility* - which pollution prevention techniques you are currently engaged in, the approximate date of earliest implementation, the percentage of facility processes to which each method applies, and which techniques are planned for implementation in the future. Check all that apply.

A. **Pollution Prevention (PP) Methods**	Currently Implementing	Approximate Date of Earliest Implementation (Mo/Yr)	Percentage of Processes Applicable To (%)	Planned for Future Implementation
1. Product Modification (Change in product composition.)	•	—	—	•
2. Raw Materials Changes (Purification or substitution of input materials.)	•	—	—	•
3. Product Redesign (For increased lifespan, repairability, re-use, disassembly, etc.)	•	—	—	•
4. Product Substitution (Alteration of product line to eliminate problem product.)	•	—	—	•

5. *Process Modification* (Changes to improve efficiency or decrease generation of waste/by-products.)	•	—	—	•
6. Improved Operating Practices (Improvements in facility maintenance, inventory control, housekeeping, and overall management.)	•	—	—	•
7. In-Process Recycling	•	—	—	•

Part II. Facility Pollution Prevention Review

Instructions: Please answer each of the following questions by checking the appropriate box, to indicate "yes" or "no."

B. Organizational Elements	**Yes** (2)	**No** (1)	**Don't Know** (0)
1. Is pollution prevention established in your company policy through a written mission or vision statement?	•	•	•
2. Is top management committed to implementation of pollution prevention and achievement of measurable results?	•	•	•
3. Does your company incorporate pollution prevention into product design and/or production process planning?	•	•	•
4. Is pollution prevention incorporated into company budgeting processes?	•	•	•
5. Has your company created "cross-functional" teams, which are responsible for integrating pollution prevention throughout all company areas (technical, marketing, management, communications)?	•	•	•
6. Are specific individuals designated with responsibility for coordination of pollution prevention activities?	•	•	•
7. Does your company provide (or make outside provision for) training/education for pollution prevention planning and implementation?	•	•	•
8. Has your company set pollution prevention goals?	•	•	•
9. Does your company offer employees incentives and/or recognition for pollution prevention accomplishments?	•	•	•
10. Is pollution prevention achievement a factor in employee performance evaluations?	•	•	•
11. Are company representatives active in conferences/seminars, trade group networks, or other communications to improve understanding or gain new ideas about pollution prevention?	•	•	•
12. Are formal procedures in place to measure pollution prevention progress?	•	•	•
13. Is pollution prevention progress reported within the company on a regular basis?	•	•	•

Part III. Pollution Prevention Rationale

Instructions: Please indicate the *level of importance* of each of the following factors in your company's implementation of pollution prevention. Check the one box you feel is most appropriate for each item.

A. Regulatory/Technical Factors	Very Important (4)	Important (3)	Somewhat Important (2)	Not Important (1)	Does Not Apply (0)
1. NJ Pollution Prevention Act (NJPPA*) planning requirements for facility inventory and reductions targeting.	•	•	•	•	•
2. Potential for facility-wide permitting through NJ DEP, with a demonstrated commitment to pollution prevention.	•	•	•	•	•
3. NJPPA voluntary standards for use/generation reductions; implementation not required.	•	•	•	•	•
4. Concern that future state/national laws will make implementation of pollution prevention or source reduction mandatory.	•	•	•	•	•
5. NJPPA policy objectives.	•	•	•	•	•
6. Clarity & consistency of the NJPPA rules and regulations.	•	•	•	•	•
7. Company or trade group representation in the formation of the NJPPA.	•	•	•	•	•
8. NJ Department of Environmental Protection flexibility in administering the NJPPA.	•	•	•	•	•
9. State/federal regulations other than pollution prevention laws.	•	•	•	•	•
10. Technical feasibility: company technical knowledge, capability, support.	•	•	•	•	•
11. Availability of technical assistance through the NJ Technical Assistance Program (TAP) at NJIT.	•	•	•	•	•

*NJPPA means the current NJ Pollution Prevention Act, as passed in 1991 (see p.2).

Part III. Pollution Prevention Rationale (cont.)

Instructions: Please indicate the *level of importance* of each of the following considerations, in your company's implementation of pollution prevention. Check the one box you feel is most appropriate for each item.

B. Financial Considerations	Very Important (4)	Important (3)	Somewhat Important (2)	Not Important (1)	Does Not Apply (0)
1. Implementation/program costs including capital expenses for equipment and project engineering.	•	•	•	•	•
2. Potential for cost savings using pollution prevention techniques.	•	•	•	•	•
3. Consumer demand for "green" products and/or investment opportunities.	•	•	•	•	•
4. Competitive advantages of early entry into pollution prevention technologies market.	•	•	•	•	•
5. Potential reduction in monitoring, reporting, and/or recordkeeping, with pollution prevention.	•	•	•	•	•
6. Potential reduction in liability and/or fines for non-compliance, with pollution prevention.	•	•	•	•	•
7. Uncertainty about future regulations, which could place pollution prevention investments at risk.	•	•	•	•	•
C. Organizational/Social Factors					
1. Company flexibility to make organizational/technical changes for pollution prevention implementation.	•	•	•	•	•
2. Company drive for quality and efficiency in management and/or production operations.	•	•	•	•	•
3. Potential for improved employee safety, working conditions, and/or morale.	•	•	•	•	•
4. Potential for enhanced company image attractiveness to investors, consumers, and/or new recruits.	•	•	•	•	•

5. Publication of toxics use/generation reporting data.	•	•	•	•	•
6. Company participation in a voluntary code of environmental conduct (through trade group, state, national, and/or global organization).	•	•	•	•	•
7. Potential for cleaner production/less environmental impact, with pollution prevention.	•	•	•	•	•

Part IV. Pollution Prevention Commentary

1. Please rank the following general categories from Part III., in their importance to your company's implementation of pollution prevention. Number in order from 1-3; "1" most important, "3" least important:

_____Regulatory/Technical Factors _____Financial Factors _____Organizational/Social

2. What are the most important benefits of your company's pollution prevention program? Please rank the following by numbering from 1-6; "1" most important, "6" least important (or "N/A" if item does not apply):

_____Cost Savings _____Improved Market Competitiveness _____Enhanced Company Image

_____Reduced Liability _____Reduced Environmental Impact _____Facility-Wide Permit

_____Other(s): ____

3. Should out-of-process recycling be included in the NJPPA definition of pollution prevention? Y/N __________
Why/why not?

____

____

4. What are the negative impacts of your company's pollution prevention program?

____

____

5. What factors stand most in the way of expansion of the pollution prevention program at your facility?

____

____

6. How could the NJPPA be improved, if at all, to increase industry participation in pollution prevention programs? (i.e., Provision of more technical support, research funding, grants/loan programs, more/less stringency in planning requirements, credit for past PP accomplishments, etc.)

____

____

____

7. How could the NJPPA be improved, if at all, to inspire *your company* to expand its pollution prevention program? (i.e., Provision of more technical support, research funding, grants/loan programs, more/less stringency in planning requirements, credit for past PP accomplishments, etc.)

____

____

____

8. Please list items not covered by this questionnaire, which you feel are important in a company decision to either embrace, or reject pollution prevention philosophy.

____

____

THANK YOU FOR COMPLETING THIS QUESTIONNAIRE.
YOUR TIME AND INPUT ARE APPRECIATED.

Please return questionnaire using enclosed envelope, or direct to: Dr. Peter Lederman, PE, Director, NJIT Center for Environmental Engineering and Science, 138 Warren St., Newark, NJ 07102-1982, Attn: J. Thornton, EPI Project Mgr. (By FAX: 201-802-1946)

Survey Questionnaire No. 2 - For Businesses Implementing No P2 Methods

A Survey for the New Jersey Chemical and Allied Products Industry
Facility Pollution Prevention Questionnaire

Part I. Facility Overview

A. Basis Information

Facility SIC Code(s): Primary______ Secondary______ Others______

Number of Employees at this Facility: ________________

Is this facility owned by a larger corporation? Y/N ______________

B. Facility Processes

Please provide a brief description of the major processes that your facility currently operates, and the products and/or services which you provide. List in order of significance.

Product or Service	Brief Process Description

D. Company Environmental Affairs (General)

1. Does your company use recycled materials in any production processes? Y/N______

2. Does your company offer a product or packaging "take-back" program, wherein consumers may return items for company remanufacture/re-use? Y/N______

3. Does your company use "life-cycle analysis" in product design? Y/N______

4. Does your company manufacture "green" products? Y/N______

5. Has your company achieved reductions in the use and/or generation of hazardous materials over the last 10 years (whether through "pollution prevention," or any other method)? Y/N ______

   a. 1985-95 Estimate of Use Reduction for *this* Facility (%): ____________

   b. 1985-95 Estimate of Generation Reduction for *this* Facility (%): ____________

Definitions

For purposes of this questionnaire, "pollution prevention" is defined as in the NJPPA of 1991. "NJPPA" means the currently effective version of the New Jersey Pollution Prevention Act, as passed in 1991. (Proposed amendments A-903/S-308 may be approved this year by the NJ Legislature.)

"Pollution Prevention" (NJPPA 1991):

Reduction of use and/or generation of hazardous substances via

1) Changes in production technologies;
2) Changes in raw materials or products;
3) Changes in on-site facility or production processes.

NJPPA Includes: Raw material substitution, product reformulation, production process redesign or modification, in-process recycling, improved operation and maintenance of production process equipment.

NJPPA Does Not Include: Treatment, increased pollution control, out-of-process recycling, incineration.

Part II. Barriers to Facility Pollution Prevention

Instructions: Please indicate the *level of importance* of each of the following factors, in impeding implementation of pollution prevention techniques at this facility. Check the one box you feel is most appropriate for each item.

A. Regulatory/Technical Factors	Very Important (4)	Important (3)	Somewhat Important (2)	Not Important (1)	Does Not Apply (0)
1. NJ Pollution Prevention Act (NJPPA*) planning requirements for facility inventory and reductions targeting.	•	•	•	•	•
2. Limited potential for facility-wide permitting through NJ DEP, even with a demonstrated commitment to pollution prevention.	•	•	•	•	•
3. NJPPA voluntary standards for use/generation reductions; implementation not required.	•	•	•	•	•
4. Little chance that future state/national laws will make implementation of pollution prevention or source reduction mandatory.	•	•	•	•	•
5. Facility not amenable to implementation of pollution prevention strategies.	•	•	•	•	•
6. NJPPA policy objectives.	•	•	•	•	•
7. NJPPA rules and regulations are unclear and/or inconsistent.	•	•	•	•	•
8. No company or trade group representation in the formation of the NJPPA.	•	•	•	•	•
9. Lack of flexibility in NJ Department of Environmental Protection administering of NJPPA.	•	•	•	•	•

10. State/federal regulations other than pollution prevention laws.	•	•	•	•	•
11. Technical feasibility: need for technical knowledge, capability, support.	•	•	•	•	•
12. Company not eligible for the NJ Technical Assistance Program (TAP).	•	•	•	•	•

*NJPPA means the current NJ Pollution Prevention Act, as passed in 1991 (see p.1).

Part II. Barriers to Facility Pollution Prevention (cont.)

Instructions: Please indicate the *level of importance* of each of the following considerations, in impeding implementation of prevention techniques at this facility. Check the one box you feel is most appropriate for each item.

B. Financial Considerations	Very Important (4)	Important (3)	Somewhat Important (2)	Not Important (1)	Does Not Apply (0)
1. Implementation/program costs including capital expenses for equipment and project engineering.	•	•	•	•	•
2. Little or no foreseeable cost savings using pollution prevention techniques.	•	•	•	•	•
3. Little or no consumer demand for "green" products and/or investment opportunities.	•	•	•	•	•
4. Little or no competitive advantage in early entry into pollution prevention technologies market.	•	•	•	•	•
5. Little or no potential for reduction in monitoring, reporting, and/or recordkeeping, with pollution prevention.	•	•	•	•	•
6. Little or no potential for reduction in liability and/or fines for non-compliance, with pollution prevention.	•	•	•	•	•
7. Uncertainty about future regulations, which could place pollution prevention investments at risk.	•	•	•	•	•

C. Organizational/Social Factors

1. Need for personnel to research, manage, and/or implement pollution prevention strategies.	•	•	•	•	•
2. Need for company flexibility to make organizational/technical changes for pollution prevention implementation.	•	•	•	•	•

3. Little/no potential for improvement in quality/efficiency of management and/or production operations, using pollution prevention.	•	•	•	•	•
4. Little/no potential for improvement in employee safety, working conditions, or morale, using pollution prevention.	•	•	•	•	•
5. Little/no potential for enhancement of company image or attractiveness to investors, consumers, new recruits, using pollution prevention.	•	•	•	•	•
6. Publication of toxics use/generation reporting data.	•	•	•	•	•
7. Little/no potential for cleaner production/less environmental impact, using pollution prevention.	•	•	•	•	•

Part III. Pollution Prevention Commentary

1. Please rank the three general categories for their significance as barriers to implementation of pollution prevention techniques at this facility. Number in order from 1-3; "1" most significant, "3" least significant:

Regulatory/Technical Factors _______ Financial Factors______ Organizational/Social______

2. Do you think a company pollution prevention program would have negative impacts? If so, please describe:

3. Should out-of-process recycling be included in the NJPPA definition of pollution prevention? Y/N ______
Why/why not?

4. What factors stand most in the way of initiation of a pollution prevention program at this facility?

5. Under what conditions do you think your company would implement pollution prevention methods?

6. How could the NJPPA be improved, if at all, to increase industry participation in pollution prevention programs? (i.e., Provision of more technical support, research funding, grants/loan programs, more/less stringency in planning requirements, credit for past PP accomplishments, etc.)

7. How could the NJPPA be improved, if at all, to interest *your company* in implementing a pollution prevention program for this facility? (i.e., Provision of more technical support, research funding, grants/loan programs, more/less stringency in planning requirements, credit for past PP accomplishments, etc.)

8. Please list items not covered by this questionnaire, which you feel are important in a company decision to either embrace, or reject pollution prevention philosophy.

THANK YOU FOR COMPLETING THIS QUESTIONNAIRE.
YOUR TIME AND INPUT ARE APPRECIATED.

Survey Questionnaire No. 3 - For Businesses Unaware of P2 Methods

A Survey for the New Jersey Chemical and Allied Products Industry
Facility Pollution Prevention Questionnaire

Part I. Facility Overview

A. Basis Information

Facility SIC Code(s): Primary______ Secondary______ Others______

Number of Employees at this Facility: ________________

Is this facility owned by a larger corporation? Y/N ______________

B. Facility Processes

Please provide a brief description of the major processes that your facility currently operates, and the products and/or services which you provide. List in order of significance.

Product or Service	Brief Process Description

D. Company Environmental Affairs (General)

1. Does your company use recycled materials in any production processes? Y/N______

2. Does your company offer a product or packaging "take-back" program, wherein consumers may return items for company remanufacture/re-use? Y/N______

3. Does your company use "life-cycle analysis" in product design? Y/N______

4. Does your company manufacture "green" products? Y/N______

5. Has your company achieved reductions in the use and/or generation of hazardous materials over the last 10 years (whether through "pollution prevention," or any other method)? Y/N______

   a. 1985-95 Estimate of Use Reduction for *this* Facility (%): ________________

   b. 1985-95 Estimate of Generation Reduction for *this* Facility (%): ________________

Definitions

For purposes of this questionnaire, "pollution prevention" is defined as in the NJPPA of 1991. "NJPPA" means the currently effective version of the New Jersey Pollution Prevention Act, as passed in 1991. (Proposed amendments A-903/S-308 may be approved this year by the NJ Legislature.)

"Pollution Prevention" (NJPPA 1991):

Reduction of use and/or generation of hazardous substances via

1) Changes in production technologies;
2) Changes in raw materials or products;
3) Changes in on-site facility or production processes.

NJPPA Includes: Raw material substitution, product reformulation, production process redesign or modification, in-process recycling, improved operation and maintenance of production process equipment.
NJPPA Does Not Include: Treatment, increased pollution control, out-of-process recycling, incineration.

Industrial Pollution Prevention

Instructions: Which of the following items do you feel would be most important in your company's deciding whether or not to implement pollution prevention? Please rank the *level of importance* you think would apply for each item by checking the one box you feel is most appropriate.

A. Regulatory/Technical Factors	Very Important (4)	Important (3)	Somewhat Important (2)	Not Important (1)	Don't Know (0)
1. NJ Pollution Prevention Act (NJPPA*) planning requirements for facility inventory and reductions targeting.	•	•	•	•	•
2. Potential for cost savings using pollution prevention techniques.	•	•	•	•	•
3. NJPPA voluntary standards for use/generation reductions; implementation not required.	•	•	•	•	•
4. Concern that future state/national laws will make implementation of pollution prevention or source reduction mandatory.	•	•	•	•	•
5. NJPPA policy objectives.	•	•	•	•	•
6. Clarity & consistency of the NJPPA rules and regulations.	•	•	•	•	•
7. Company or trade group representation in the formation of the NJPPA.	•	•	•	•	•
8. NJ Department of Environmental Protection flexibility in administering the NJPPA.	•	•	•	•	•
9. State/federal regulations other than pollution prevention laws.	•	•	•	•	•
10. Technical feasibility: need for technical knowledge, capability, support.	•	•	•	•	•
11. Availability of technical assistance through the NJ Technical Assistance Program (TAP) at NJIT.	•	•	•	•	•

*NJPPA means the current NJ Pollution Prevention Act, as passed in 1991 (see p.1).

Part II. Pollution Prevention Rationale (cont.)

Instructions: Which of the following items do you feel would be most important in your company's deciding whether or not to implement pollution prevention? Please indicate the *level of importance* you think would apply for each item by checking the one box you feel is most appropriate.

B. Financial Considerations	Very Important (4)	Important (3)	Somewhat Important (2)	Not Important (1)	Don't Know (0)
1. Implementation/program costs including capital expenses for equipment and project engineering.	•	•	•	•	•
2. Potential for cost savings using pollution prevention techniques.	•	•	•	•	•
3. Consumer demand for "green" products and/or investment opportunities.	•	•	•	•	•
4. Competitive advantage of early entry into pollution prevention technologies market.	•	•	•	•	•
5. Potential for reduction in monitoring, reporting, and/or recordkeeping, with pollution prevention.	•	•	•	•	•
6. Potential for reduction in liability and/or fines for non-compliance, with pollution prevention.	•	•	•	•	•
7. Uncertainty about future regulations, which could place pollution prevention investments at risk.	•	•	•	•	•

C. Organizational/Social Factors					
1. Need for personnel to research, manage, and/or implement pollution prevention strategies.	•	•	•	•	•
2. Need for company flexibility to make organizational/technical changes for pollution prevention implementation.	•	•	•	•	•

3. Potential for improvement in quality/efficiency of management and/or production operations, using pollution prevention.	•	•	•	•	•
4. Potential for improvement in employee safety, working conditions, or morale, using pollution prevention.	•	•	•	•	•
5. Potential for enhancement of company image or attractiveness to investors, consumers, new recruits, using pollution prevention.	•	•	•	•	•
6. Publication of toxics use/generation reporting data.	•	•	•	•	•
7. Potential for cleaner production/less environmental impact, using pollution prevention.	•	•	•	•	•

Part III. Pollution Prevention Commentary

1. Which of the three general categories do you feel would be most important in your company's deciding whether or not to implement pollution prevention. Please number from 1-3; "1" most important, "3" least important:

Regulatory/Technical Factors ______ Financial Factors ______ Organizational/Social ______

2. Do you think a company pollution prevention program would have negative impacts? If so, please describe:

____

____

3. Should out-of-process recycling be included in the NJPPA definition of pollution prevention? Y/N ______
Why/why not?

____

____

4. What factors would stand most in the way of initiation of a pollution prevention program at this facility?

____

____

5. Under what conditions do you think your company would implement pollution prevention methods?

____

____

6. How could the NJPPA be improved, if at all, to increase industry participation in pollution prevention programs? (i.e., Provision of more technical support, research funding, grants/loan programs, more/less stringency in planning requirements, credit for past PP accomplishments, etc.)

____

____

7. How could the NJPPA be improved, if at all, to interest *your company* in implementing a pollution prevention program for this facility? (i.e., Provision of more technical support, research funding, grants/loan programs, more/less stringency in planning requirements, credit for past PP accomplishments, etc.)

____

____

8. Please list items not covered by this questionnaire, which you feel are important in a company decision to either embrace, or reject pollution prevention philosophy.

____

____

THANK YOU FOR COMPLETING THIS QUESTIONNAIRE.
YOUR TIME AND INPUT ARE APPRECIATED.

Survey Questionnaire No. 4 - For Pollution Prevention Professionals Panel

Industrial Pollution Prevention Questionnaire:
A Request for the Opinions of Pollution Prevention Professionals

Panelists asked to respond to this survey have been drawn from a cross-section of professionals representing industry, regulatory agencies, environmental groups, and academia. Results will assist in an on-going research study surrounding pollution prevention in the New Jersey Chemical and Allied Products Industry. All responses are strictly confidential and a summary of findings will be forwarded to all respondents. The definitions and references below are pertinent and may be helpful in completing this questionnaire.

THANK YOU FOR YOUR PARTICIPATION.
YOUR TIME AND INPUT ARE VERY MUCH APPRECIATED.

Definitions

For purposes of this questionnaire, "pollution prevention" is defined as in the currently effective version of the New Jersey Pollution Prevention Act (NJPPA) (as passed in 1991). (Proposed amendments to the NJPPA, A-903/S-308, may be approved in the near future by the NJ Legislature.)

"Pollution Prevention" (NJPPA 1991):

Reduction of use and/or generation of hazardous substances via
1) Changes in production technologies;
2) Changes in raw materials or products;
3) Changes in on-site facility or production processes.

NJPPA P2 Definition Includes: Raw material substitution, product reformulation, production process redesign or modification, in-process recycling, improved operation and maintenance of production process equipment.

NJPPA P2 Definition Specifically Excludes : Treatment, increased pollution control, out-of-process recycling, incineration.

a. "Covered" substances/processes are those for which NJPPA reporting is required. (That is, substances for which TRI Reports are required; processes involving hazardous (covered) substances.)

b. "NPO" is "Nonproduct Output," or material exiting a process as neither intermediate product, co-product, nor product.

c. "Targeted processes" are those responsible for 90% or more of facility use, generation, or release of hazardous substances.

d. "DEP" refers to the New Jersey Department of Environmental Protection (responsible for administration of the NJPPA).

e. "P2 Plan Summary" refers to the NJPPA-required Pollution Prevention Plan Summary covered facilities must submit to the NJDEP once every five years.

Notes

Elements listed for evaluation in Section A ("P2 Organizational Elements") of this questionnaire have been adapted from various sources, the foremost of which, follow:

AT&T Bell Laboratories QUEST Organization (1993). Facility Level Pollution Prevention Benchmarking Study._Washington, DC: The Business Roundtable.

Baas, Leo and Huisingh, Donald (1993). The Learning Process in the Implementation of Cleaner Production Within Companies. Graz, Austria: NATO/CCMS.

USEPA (1993). Life Cycle Design Guidance Manual: Environmental Requirements and the Product System. Washington, DC: USEPA.

Industrial Pollution Prevention Questionnaire

Which of the following organizational elements are most important in ensuring the success of a company pollution prevention program? Please rank the *importance* of each item below, by checking the one box you feel is most appropriate.

A. P2 Organizational Elements	Very Important	Important	Somewhat Important	Not Important	Don't Know
1. Establishment of P2 philosophy in company policy through a written mission or vision statement.	•	•	•	•	•
2. Top management commitment to implementation of P2 objectives and achievement of measurable results.	•	•	•	•	•
3. Incorporation of P2 principles into product design and/or process planning.	•	•	•	•	•
4. Provision for P2 initiatives in financial planning and budgeting processes.	•	•	•	•	•
5. Creation of "cross-functional" teams responsible to integrate P2 throughout all company areas.	•	•	•	•	•
6. Designation of specific individuals responsible for coordination of P2 activities.	•	•	•	•	•
7. Provision of employee P2 training/education (re concepts, methods, planning, implementation).	•	•	•	•	•
8. Establishment of specific P2 goals.	•	•	•	•	•
9. Employee incentives and/or recognition for P2 accomplishments.	•	•	•	•	•
10. Evaluation of P2 achievement in employee performance reviews.	•	•	•	•	•
11. Participation in conferences/seminars, trade group networks, and/or other communications to improve P2 knowledge/awareness.	•	•	•	•	•
12. Formal monitoring and measurement of pollution prevention progress.	•	•	•	•	•
13. Regular, in-company reporting on P2 progress.	•	•	•	•	•

Industrial Pollution Prevention Questionnaire

Which of the following factors are most indicative of a company's commitment to pollution prevention? Please rank the usefulness of *each* item in representing a company's P2 commitment, by checking the one box you feel is most appropriate. (For simplicity, assume a "company" is represented by just one facility, to which the various factors may apply.)

B. P2 Implementation Factors	**Very Indicative**	**Indicative**	**Somewhat Indicative**	**Not Indicative**	**Don't Know**
1. Implementation of at least one P2 technique.	•	•	•	•	•
2. Implementation of several different P2 techniques.	•	•	•	•	•
3. Implementation of P2 methods that are more aggressive than improved maintenance/housekeeping.	•	•	•	•	•
4. Implementation of raw materials modifications.	•	•	•	•	•
5. Use of life-cycle analysis in product design and planning.	•	•	•	•	•
6. Past achievement of reductions in use and/or generation of hazardous/toxic substances.	•	•	•	•	•
7. *Extent* of past achievement in *use* reductions (i.e., the greater the percentage reduction, the better).	•	•	•	•	•
8. *Extent* of past achievement in *generation* reductions (i.e., the greater the percentage reduction, the better).	•	•	•	•	•
9. Projection of 5-year use reduction goals for *any* covered* substances (in writing, submitted to DEP in P2 Plan Summary).	•	•	•	•	•
10. Projection of 5-year NPO* reduction goals for *any* covered substances (in writing, submitted to DEP in P2 Plan Summary).	•	•	•	•	•
11. Projection of 5-year use reduction goals for a *high percentage* of covered substances (i.e., the greater the percentage, the better).	•	•	•	•	•

12. Projection of 5-year NPO reduction goals for a *high percentage* of covered substances (i.e., the greater the percentage, the better).	•	•	•	•	•
13. *Extent* of 5-year use reduction goals for covered substances (i.e., the greater the % reduction, the better).	•	•	•	•	•
14. *Extent* of 5-year NPO reduction goals for covered substances (i.e., the greater the % reduction, the better).	•	•	•	•	•
15. Percentage of targeted processes* slated for use or NPO reductions (i.e., the greater the precentage, the better).	•	•	•	•	•
16. Percentage of all covered processes slated for use or NPO reductions (i.e., the greater the percentage, the better).	•	•	•	•	•

* See Definitions (p.1).

APPENDIX C.

SAMPLE 1993 POLLUTION PREVENTION PLAN SUMMARY FORM

Return to: NJDEPE/OPP, CN 423, 401 E. State St., Trenton, NJ 08625-0423

Pollution Prevention Plan Summary - 1993

(Based on Pollution Prevention Plan on Site)

PLEASE TYPE OR PRINT CLEARLY THE ENTIRE FORM (Sections A thru D)

Indicate any changes to above information.

Indicate any changes to above information.

Section A. Facility-Level Administrative Information

(This section needs to be filled out only ONCE)

1. a. TRI Facility ID No.:

   b. Phone Number: Area Code ( ) Number
   FAX Number: ( )

2. a. Highest Ranking Corporate Official at Facility: (Print) Last Name, First Name M.I.

   b. Position/Title

   c. Official's Address & Phone No. (if different from facility)

3. If your facility has an approved NJRTK Research & Development Laboratory exemption pursuant to N.J.A.C. 7:1G, enter the approval number here.

4. a. How many processes, including grouped processes, are there at this facility? a. [ ]

b. How many processes or grouped processes are targeted? b. [ ]

c. What was the facility's basis for targeting processes? (U)se/(N)PO/(R)eleases Enter U, N, or R. c. [ ]

5. Centroid coordinates of facility location in New Jersey State plane feet (NAD 89):

a. X _ _ _ _ _ _ _ . _

b. Y _ _ _ _ _ _ _ . _

6. Does your facility's Pollution Prevention Plan Summary contain information which you are claiming is confidential? (Y)es or (N)o a. [ ]

If "Yes", mark which type of copy this is: (C)onfidential Copy or Preliminary (P)ublic Copy b. [ ]

7. a. Non-management Employee Representative at Facility: (Print) Last Name, First Name M.I.

b. Business Phone No.: Area Code ( ) Number

8. Certification by owner/operator of this facility that plan has been prepared and is on site:
I certify under penalty of law that a Pollution Prevention Plan has been prepared for this industrial facility and that the Plan is available at the facility for inspection by the Department. I further certify that the information submitted in the Pollution Prevention Plan Summary is true, accurate, and complete to the best of my knowledge.

Date (MM/DD/YY)	Signature	Position/Title
/ /		
	Print or Type Name	Phone No.: (if different from facility) Area Code ( ) Number

NOTE: N.J.A.C. 7:1K-5.1(b) 3.iii. requires the submission of a list of permits issued by the Department as part of a Pollution Prevention Plan summary. Because the Department currently has such permit information on file, pursuant to specific permitting programs, it is not requiring separate submission of this list in an effort to streamline reporting. However, the Department reserves the right to require submission of this permit list by any facility.

DEPE-113
3/94

Pollution Prevention Plan Summary - 1993
(Based on Pollution Prevention Plan on Site)

Hazardous Substance: ____________

Chemical Abstract Services (CAS) Number: ____ -- ____ -- ____

Facility Name ____________

NJ-EIN:

Section B. Facility-Level Information (Photocopy and use a separate page for each hazardous substance.)

1. Five year reduction goals for USE and NPO: Fill in both pounds and percent.
   Use the worksheets in the instructions for assistance.

1	USE	NPO
a. Five year reduction goal (pounds, see (i) below):	a1 , , , lb.	a2 , , , lb.
b. Five year reduction goal (percentage, see (ii) below):	b1 . %	b2 . %

(i) USE goal will relate to total USE, which can be determined from quantities reported on 1993 Release & Pollution Prevention Report (R & PPR), using the following formula: TOTAL USE = B5 + B6 + B7 + B8 - B11. Nonproduct Output (NPO) goal will relate to TOTAL NPO, which is reported as item B12 on the 1993 R & PPR.

(ii) To calculate the USE Percentage (%) goal, divide 1a1. by the TOTAL USE and multiply the quotient by 100. To calculate the NPO (%) goal, divide 1a2. by TOTAL NPO (i.e., item B12 on R & PPR) and multiply the quotient by 100. See accompanying instructions.

2. Are you classifying any outputs as co-product? (Y)es or (N)o ☐

OPTIONAL INFORMATION

Items 3 through 6 may be answered if you would like to report on Pollution Prevention activities and the resulting reductions prior to preparing the Pollution Prevention Plan. You may answer any or all items in this optional section.

3. Reductions between 1987 or indicated year (*) and base year:

3	USE	NPO

3. Reductions between 1987 or indicated year (*) and base year:

a. Total Reduction (pounds):

Base reductions on data for 1987 or other indicated year.

b. Total Reduction (percentage):

Divide amount in 3a by 1987 (*) amount. Multiply quotient by 100.

3 USE	NPO
a1 , , , lb.	a2 , , , lb.
b1 . %	b2 . %
	RELEASES
	a3 , , , lb.
	b3 . %

(*) You may use 1987 data or any year afterwards. Indicate year in box if other than 1987.

4. Description of methods used to achieve reductions:

Describe pollution prevention techniques used and changes (technological or otherwise) to processes and operations (e.g., a solvent substitution, a new procedure). Use the codes from Appendix 2. In instructions. Add written descriptions and explain "Other" in Further Explanation, below.

4a. USE:

4b. NPO:

4c. RELEASES:

5. Further explanation:

6. Previous pollution prevention achievements: Describe reductions of use, NPO, or releases PRIOR to 1987. (Use codes as above, if applicable.)

(Attach additional pages if necessary.)

DEPE-113
3/94

Pollution Prevention Plan Summary - 1993
(Based on Pollution Prevention Plan on Site)

____
Facility Name
NJ-EIN:

Section C. Process Description

(Photocopy and use a separate page for each process or grouped process at your facility.)

1. Process ID: Process code chosen by facility. Up to twelve characters or digits may be used. _ _ _ _ _ _ _ _ _ _ _ _
   Must have same ID in Plan Summary and ALL future Release and Pollution Prevention Reports.

2. Product SIC Code: Use 4 digit codes - list provided in Appendix 3. of instructions. _ _ _ _

3. Process Description
   a. Process Category: ☐ (Fill with only one appropriate code.)
      1 = Chemical Manufacturing (Product of process is a chemical)
      2 = Article Manufacturing (Chemicals are used in process, but product is an article)
      3 = Storage and Handling (if separate)
      4 = Treatment Operations

   b. Mode of Operation: ☐ (B)atch, (C)ontinuous, or (N)ot Applicable
      Enter B, C, or N.

   c. **Specific Descriptions:**
      Most processes have one discrete step (for example, a "coating" process). Some may be defined to have more than one (e.g., "cleaning" and then "coating"). For a one-step process, use one descriptor (Appendix 4.). If there is a second step, use an additional descriptor for the second step. If your process category in 3a., above, is 4 (Treatment Operations), you may use the Waste Treatment Codes (Appendix 5.). Continue in this manner until all steps are described. See Instructions

until all steps are described. See Instructions.

___ , ___ , ___ , ___ , ___ , ___ , ___ , ___ , ___ , ___

If "Other" or "Similar to" is chosen, describe below.

____

d. Identify which hazardous substances are used, generated, or released in the process or grouped process: (Use additional pages if necessary.) Check below (in box) if additional hazardous substances are included. ☐

	Hazardous Substance	CAS Number
(1)		_ _ _ _ _ _ - _ _ - _
(2)		_ _ _ _ _ _ - _ _ - _
(3)		_ _ _ _ _ _ - _ _ - _
(4)		_ _ _ _ _ _ - _ _ - _
(5)		_ _ _ _ _ _ - _ _ - _
(6)		_ _ _ _ _ _ - _ _ - _

4. Is this a targeted process? (Y)es or (N)o ☐

If yes and sources have been targeted, please list:
(Describe source in own words, attaching additional sheets if necessary)

5. Is this a grouped process? (Y)es or (N)o ☐

DEPE-113
3/94

Pollution Prevention Plan
(Based on Pollution Preve

Process ID: _ _ _ _ _ _ _ _ _ _ _ _ _ _
(Must have same ID in Plan Summary and ALL Release and Pollution Prevention Reports)

☐ Check if additional sheets are includ

Section D. Process Level Information for Targeted Processes Only

(Photocopy and use a separate page for each targeted process or targeted grouped

1. 5-year Reduction Goals for Hazardous Substances Used in Process or Grouped Processes:

	Hazardous Substance / CAS - Number	Use Range *	Technique (Use codes from Append in Instructions-- If "Other," describe additional sheets. See Instr
(1)	— —		
(2)	— —		
(3)	— —		
(4)	— —		
(5)	— —		
(6)	— —		

* Use Range: A = 0 - 4,999 lb.; B = 5,000 - 9,999 lb.; C = 10,000-24,999 lb.; D = 25,000-49,999 lb.; E = 50,0

Optional: Do not fill out unless applicable under N.J.A.C. 7:1K-4.6

2. Raw Material Substitution Certification: See instructions for requirements. (note: a

a. Identify hazardous substance for which claim is being made:

b. Explain why substitution is not feasible:

c. Certfication: I certify that Parts I and II of the Pollution Prevention Plan have been completed processes for which this Raw Material Substitution Certification is being claimed and that thr has determined that it is not technically or economically feasible to reduce the input use of th with a different raw material in the specific production process.

Signature

Print or Type Name

ıtion Plan Summary - 1993
ion Prevention Plan on Site)

Page __ of __

Facility Name

ts are included NJ-EIN:

I grouped process at your facility).

ʾrocesses:

from Appendix 2. r," describe on s. See Instructions.)	5-Year Reduction Goal Per Unit of Product (Percent)		Estimated Date of Introduction (Month/Year)	Estimated Date of Completion (Month/Year)
	Use	NPO		
	___ . _ %	___ . _ %	__ / __	__ / __
	___ . _ %	___ . _ %	__ / __	__ / __
	___ . _ %	___ . _ %	__ / __	__ / __
	___ . _ %	___ . _ %	__ / __	__ / __
	___ . _ %	___ . _ %	__ / __	__ / __
	___ . _ %	___ . _ %	__ / __	__ / __

ı lb.; E = 50,000 lb. +

(note: all above information in D.1. is still required)

ı completed for the specific combination of hazardous substances and production
ɜnd that through completion of the Pollution Prevention Plan this industrial facility
ut use of the hazardous substance below current levels by replacing the substance

Position/Title

APPENDIX D.

SURVEY TRANSMITTAL LETTERS

D1. Sample Letter of Introduction

ENVIRONMENTAL
POLICY INSTITUTE

July 24, 1995

John Doe, Plant Manager
ABC Chemical Company
PO Box 123
Newark, NJ 07101

Dear Mr. Doe:

Do New Jersey pollution prevention policies adequately reflect the needs and concerns of ABC CHEMICAL COMPANY?

We need to know what you think. In the next week or so, we will be calling you as part of an independent research study designed to assess the impact of current regulations on company pollution prevention practices. This study is sponsored by the Environmental Policy Institute (EPI), a collaborative research organization under the direction of Dr. Peter Lederman, Ph.D., PE, which links the NJIT Environmental Policy Studies Department and the Center for Environmental Engineering and Science.

We're contacting every chemical industry firm covered under the NJ Pollution Prevention Act, seeking the input of those most intimately involved with environmental compliance. Study results will be presented to all respondents, to business and industry representatives, and to state policymakers toward current initiatives to reshape state environmental regulations. Your input is vital to the success of this research. Please participate by providing us with your commentary.

The telephone call will take just two to three minutes, to be followed by mailing of a survey questionnaire. All company names and responses will be held in strictest confidence, with results to be published in a statistical format, only. If an interviewer should call you at an inconvenient time, please let him/her know and the call will gladly be postponed.

Please do not hesitate to contact me at (908) 832-2402, should you have any questions or comments. Thank you in advance for your time and participation.

Very truly yours,

Judith A. Thornton
Research Project Manager
Environmental Policy Institute

D2. Sample Questionnaire Cover Letter

ENVIRONMENTAL
POLICY INSTITUTE

August 24, 1995

John Doe, Plant Manager
ABC Chemical Company
P.O. Box 123
Newark, NJ 07101

Dear Mr. Doe:

Thank you for your participation in our recent telephone discussion regarding New Jersey pollution prevention policies. Your time and commentary are very much appreciated. Enclosed please find your EPI Facility Pollution Prevention Questionnaire. Your responses are vital to forming a report that will influence future New Jersey environmental regulations.

As we discussed, the intent of this study is to assess the impacts of current regulatory policies on company pollution prevention practices. We're distributing questionnaires to every chemical industry firm covered under the NJ Pollution Prevention Act, seeking the input of those most intimately involved with environmental compliance. We'd like to know what you think of current policies, how you feel they might be improved, and whether you find that they've encouraged, or in fact, hindered, company pollution prevention efforts. Our study results will be presented to all respondents, to business and industry representatives, and to state policymakers toward current initiatives to rework New Jersey environmental regulations.

This project is sponsored by the Environmental Policy Institute (EPI), an independent research organization under the direction of Dr. Peter Lederman, Ph.D., PE, which links the NJIT Environmental Policy Studies Department and the Center for Environmental Engineering and Science. All company names and survey responses will be held in strictest confidence, with results to be published in a statistical format, only.

Please complete the questionnaire and return it using the enclosed envelope or FAX your responses to us at (201) 802-1946. Do not hesitate to contact me at (908) 832-2402, should you have any questions or comments.

Again, thank you for your time and participation.

Very truly yours,

Judith A. Thornton
Research Project Manager
Environmental Policy Institute

enclosure

D3. Sample Follow-Up Questionnaire Reminder Letter

ENVIRONMENTAL
POLICY INSTITUTE

September 22, 1995

John Doe, Plant Manager
ABC Chemical Company
P.O. Box 123
Newark, NJ 07101

Dear Mr. Doe:

Enclosed please find a replacement copy of your EPI Facility Pollution Prevention Questionnaire. Your input is very important to our research study and we're counting on your response in order that we attain truly representative results. We expect that our findings will provide a significant contribution to on-going initiatives toward reworking New Jersey environmental regulations. Please make every effort to complete and return your survey to our offices as soon as possible.

The aim of this study is to assess the impacts of current regulatory policies on company pollution prevention practices. We're distributing questionnaires to every chemical industry firm covered under the NJ Pollution Prevention Act, seeking the input of those most intimately involved with environmental compliance. We'd like to know what you think of current policies, how you feel they might be improved, and whether you find that they've encouraged, or in fact, hindered, company pollution prevention efforts.

This project is sponsored by the Environmental Policy Institute (EPI), an independent research organization under the direction of Dr. Peter Lederman, Ph.D., PE, which links the NJIT Environmental Policy Studies Department and the Center for Environmental Engineering and Science. A summary of findings will be forwarded to all respondents, to business and industry group representatives, and to state policymakers. Please be assured that all survey responses are strictly confidential, with study results to be published in a statistical format, only.

Please complete the questionnaire and return it using the enclosed envelope or FAX your responses to us at (201) 802-1946. Do not hesitate to contact me at (908) 832-2402, should you have any questions or comments.

Again, thank you in advance for your time and participation.

Very truly yours,

Judith A. Thornton
Research Project Manager
Environmental Policy Institute

enclosure

D4. Sample Final Reminder Letter

ENVIRONMENTAL
POLICY INSTITUTE

October 12, 1995

John Doe, Plant Manager
ABC Chemical Company
P.O. Box 123
Newark, NJ 07101

Dear Mr. Doe:

Enclosed please find a replacement copy of your EPI Facility Pollution Prevention Questionnaire. It is not too late to reply! Your input is very important to our research study and we're counting on your response in order that we attain truly representative results. We expect that our findings will provide a significant contribution to on-going initiatives toward reworking New Jersey environmental regulations. Please make every effort to complete and return your survey to our offices as soon as possible.

The aim of this study is to assess the impacts of current regulatory policies on company pollution prevention practices. We've distributed a questionnaire to every chemical industry firm covered under the NJ Pollution Prevention Act, seeking the input of those most intimately involved with environmental compliance. We'd like to know what you think of current policies, how you feel they might be improved, and whether you find that they've encouraged, or in fact, hindered, company pollution prevention efforts.

This project is sponsored by the Environmental Policy Institute (EPI), an independent research organization under the direction of Dr. Peter Lederman, Ph.D., PE, which links the NJIT Environmental Policy Studies Department and the Center for Environmental Engineering and Science. A summary of findings will be forwarded to all respondents, to business and industry group representatives, and to state policymakers. Please be assured that all survey responses are strictly confidential, with study results to be published in a statistical format, only.

Please complete the questionnaire and return it using the enclosed envelope or FAX your responses to us at (201) 802-1946. Do not hesitate to contact me at (908) 832-2402, should you have any questions or comments.

Again, thank you in advance for your time and participation.

Very truly yours,

Judith A. Thornton
Research Project Manager
Environmental Policy Institute

enclosure

D5. Sample Thank You Letter

ENVIRONMENTAL
POLICY INSTITUTE

January 29, 1996

John Doe, Plant Manager
ABC Chemical Company
P.O. Box 128
Newark, NJ 07101

Dear Mr. Doe:

Thank you for returning your EPI Facility Pollution Prevention Questionnaire. We appreciate the time and effort of your response very much.

We are in the initial stages of compilation of the survey data and anticipate sending you a summary of findings by April 1996. Our results will also be forwarded to business and industry group representatives, as well as state policymakers. We expect that our findings will provide a significant contribution to on-going initiatives toward reshaping New Jersey environmental regulations.

Please feel free to contact me at (908) 832-2402 with any questions or additional comments you may wish to bring to our attention. Again, our sincere thanks for your time and participation.

Very truly yours,

Judith A. Thornton
Research Project Manager
Environmental Policy Institute (EPI)

D6. Sample Professional Panel Cover Letter

December 19, 1995

Ms. Jane Doe, Director
Environmental Protection Agency
120 University Boulevard
Cincinnati, OH 45123

Dear Ms. Doe:

We are in need of some expert opinions! *Yours* would be highly valued, so I'm writing today to ask you to participate in a brief survey as a member of our panel of pollution prevention professionals. Your input will assist in an on-going study on pollution prevention (P2) in the New Jersey Chemical and Allied Products Industry. The overall aim of this research is to determine the significance of various financial, regulatory, organizational, and social factors, in leading a chemical manufacturing firm to embrace a pollution prevention philosophy.

We seek your advice in evaluating each of our study facilities, to arrive at some measure of the existing company P2 commitments. A limited set of factors are available to us to base such appraisals upon. While many additional elements would surely help to describe a company P2 commitment, our particular focus (surrounding the New Jersey Pollution Prevention Act) has led to many of the items you will see here. The difficulty lies in *weighting* each of the selected elements appropriately. With your professional input and the consensus results of the panel, we feel we can formulate a suitable measure to carry forward with our analysis. Please let us know what you think of the various factors by completing the enclosed questionnaire and getting it back to us as soon as you possibly can.

Please FAX your completed questionnaire, if possible, to the attention of Dr. Peter Lederman, PE, Director, NJIT Center for Environmental Engineering and Science, at 201-802-1946. Alternatively, a return envelope is enclosed for your convenience (addressed to my home address, to avoid loss or delay in the university mail system). Additional sheets with your further comments, critique, and/or suggestions are more than welcome.

Please feel free to contact Dr. Lederman (201-596-2457), or myself (908-832-2402), should any questions arise in completing the questionnaire. We'll be sure to provide you with a summary of our study results (including the results of this survey) as soon as possible. Our sincere thanks for your time and thoughtful review. We look forward to hearing from you.

Very truly yours,

Judith A. Thornton
Graduate Student
Environmental Policy Studies

enclosures
cc: Dr. P. Lederman, Director CEES

APPENDIX E.

P2 PROFESSIONAL PANEL STATISTICAL OUTPUT

- - - - - Kruskal-Wallis 1-Way Anova

A1 Co P2 Policy
by TYPE Respondent Type

Mean Rank	Cases		
10.00	4	TYPE = 1	Environmental Rep
8.00	4	TYPE = 2	Regulatory Rep
12.50	4	TYPE = 3	Industry Rep
3.50	4	TYPE = 4	Academia Rep
	--		
	16	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
7.6765	3	.0532	9.3214	3	.0253

- - - - - Kruskal-Wallis 1-Way Anova

A2 Top Mgmt P2 Commit
by TYPE Respondent Type

Mean Rank	Cases		
8.50	4	TYPE = 1	Environmental Rep
8.50	4	TYPE = 2	Regulatory Rep
8.50	4	TYPE = 3	Industry Rep
8.50	4	TYPE = 4	Academia Rep
	--		
	16	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
.0000	3	1.0000	.0000	3	1.0000

- - - - - Kruskal-Wallis 1-Way Anova

A3 P2 in Design Stage
by TYPE Respondent Type

Mean Rank	Cases		
13.50	4	TYPE = 1	Environmental Rep
5.50	4	TYPE = 2	Regulatory Rep
5.50	4	TYPE = 3	Industry Rep
9.50	4	TYPE = 4	Academia Rep
	--		
	16	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
7.7647	3	.0511	11.0000	3	.0117

- - - - - Kruskal-Wallis 1-Way Anova

A4 P2 in Budgeting
by TYPE Respondent Type

Mean Rank	Cases		
12.00	4	TYPE = 1	Environmental Rep
9.75	4	TYPE = 2	Regulatory Rep
2.50	4	TYPE = 3	Industry Rep
9.75	4	TYPE = 4	Academia Rep
	--		
	16	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
9.0662	3	.0284	10.2070	3	.0169

- - - - - Kruskal-Wallis 1-Way Anova

A5	X-Fn P2 Teams
by TYPE	Respondent Type

Mean Rank	Cases		
12.50	4	TYPE = 1	Environmental Rep
6.00	4	TYPE = 2	Regulatory Rep
9.50	4	TYPE = 3	Industry Rep
6.00	4	TYPE = 4	Academia Rep
	--		
	16	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
5.2059	3	.1573	7.0238	3	.0711

- - - - - Kruskal-Wallis 1-Way Anova

A6	Specific P2 Indiv
by TYPE	Respondent Type

Mean Rank	Cases		
11.25	4	TYPE = 1	Environmental Rep
12.25	4	TYPE = 2	Regulatory Rep
2.50	4	TYPE = 3	Industry Rep
8.00	4	TYPE = 4	Academia Rep
	--		
	16	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
10.2132	3	.0168	10.9198	3	.0122

- - - - - Kruskal-Wallis 1-Way Anova

A7	P2 Train/Education
by TYPE	Respondent Type

Mean Rank	Cases		
12.00	4	TYPE = 1	Environmental Rep
9.50	4	TYPE = 2	Regulatory Rep
2.50	4	TYPE = 3	Industry Rep
10.00	4	TYPE = 4	Academia Rep
	--		
	16	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
9.0882	3	.0281	9.9038	3	.0194

- - - - - Kruskal-Wallis 1-Way Anova

A8	Est P2 Goals
by TYPE	Respondent Type

Mean Rank	Cases		
10.00	4	TYPE = 1	Environmental Rep
4.00	4	TYPE = 2	Regulatory Rep
12.00	4	TYPE = 3	Industry Rep
8.00	4	TYPE = 4	Academia Rep
	--		
	16	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
6.1765	3	.1033	8.3333	3	.0396

- - - - - Kruskal-Wallis 1-Way Anova

A9 Empl Incent/Recog
by TYPE Respondent Type

Mean Rank	Cases		
11.50	4	TYPE = 1	Environmental Rep
4.75	4	TYPE = 2	Regulatory Rep
13.00	4	TYPE = 3	Industry Rep
4.75	4	TYPE = 4	Academia Rep
	--		
	16	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
10.1250	3	.0175	11.5909	3	.0089

- - - - - Kruskal-Wallis 1-Way Anova

A10 P2Ach in Empl Eval
by TYPE Respondent Type

Mean Rank	Cases		
12.25	4	TYPE = 1	Environmental Rep
9.00	4	TYPE = 2	Regulatory Rep
6.00	4	TYPE = 3	Industry Rep
6.75	4	TYPE = 4	Academia Rep
	--		
	16	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
4.1691	3	.2438	4.7093	3	.1944

- - - - - Kruskal-Wallis 1-Way Anova

A11	P2 Communications
by TYPE	Respondent Type

Mean Rank	Cases		
13.50	4	TYPE = 1	Environmental Rep
9.00	4	TYPE = 2	Regulatory Rep
2.50	4	TYPE = 3	Industry Rep
9.00	4	TYPE = 4	Academia Rep
	--		
	16	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
10.8529	3	.0125	13.5165	3	.0036

- - - - - Kruskal-Wallis 1-Way Anova

A12	Meas P2 Progress
by TYPE	Respondent Type

Mean Rank	Cases		
12.00	4	TYPE = 1	Environmental Rep
6.00	4	TYPE = 2	Regulatory Rep
6.00	4	TYPE = 3	Industry Rep
10.00	4	TYPE = 4	Academia Rep
	--		
	16	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
4.7647	3	.1899	7.3636	3	.0612

- - - - - Kruskal-Wallis 1-Way Anova

A13 Report P2 Progress
by TYPE Respondent Type

Mean Rank	Cases		
12.50	4	TYPE = 1	Environmental Rep
5.25	4	TYPE = 2	Regulatory Rep
8.00	4	TYPE = 3	Industry Rep
8.25	4	TYPE = 4	Academia Rep
	--		
	16	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
4.7426	3	.1916	5.4293	3	.1429

- - - - - Kruskal-Wallis 1-Way Anova

M@1 Use 1 P2Mthd
by TYPE Respondent Type

Mean Rank	Cases		
9.25	4	TYPE = 1	Environmental Rep
8.00	4	TYPE = 2	Regulatory Rep
8.00	4	TYPE = 3	Industry Rep
8.75	4	TYPE = 4	Academia Rep
	--		
	16	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
.1985	3	.9778	.2437	3	.9702

----- Kruskal-Wallis 1-Way Anova

M@# MSum>1
by TYPE Respondent Type

Mean Rank	Cases		
10.50	4	TYPE = 1	Environmental Rep
4.50	4	TYPE = 2	Regulatory Rep
10.50	4	TYPE = 3	Industry Rep
8.50	4	TYPE = 4	Academia Rep
	--		
	16	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
4.2353	3	.2372	4.9315	3	.1769

----- Kruskal-Wallis 1-Way Anova

M#M6 Mthds Used >M6
by TYPE Respondent Type

Mean Rank	Cases		
7.50	4	TYPE = 1	Environmental Rep
6.25	4	TYPE = 2	Regulatory Rep
13.00	4	TYPE = 3	Industry Rep
7.25	4	TYPE = 4	Academia Rep
	--		
	16	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
4.9191	3	.1778	5.4926	3	.1391

- - - - - Kruskal-Wallis 1-Way Anova

M2	Use M2 Raw Matls
by TYPE	Respondent Type

Mean Rank	Cases		
12.25	4	TYPE = 1	Environmental Rep
11.00	4	TYPE = 2	Regulatory Rep
4.00	4	TYPE = 3	Industry Rep
6.75	4	TYPE = 4	Academia Rep
	--		
	16	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
7.6985	3	.0527	8.5961	3	.0352

- - - - - Kruskal-Wallis 1-Way Anova

LCA	Use LifeCyc Anal
by TYPE	Respondent Type

Mean Rank	Cases		
12.75	4	TYPE = 1	Environmental Rep
10.00	4	TYPE = 2	Regulatory Rep
7.00	4	TYPE = 3	Industry Rep
4.25	4	TYPE = 4	Academia Rep
	--		
	16	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
7.1691	3	.0667	8.7996	3	.0321

- - - - - Kruskal-Wallis 1-Way Anova

PACH Past P2 Ach's
by TYPE Respondent Type

Mean Rank	Cases		
12.00	4	TYPE = 1	Environmental Rep
12.25	4	TYPE = 2	Regulatory Rep
3.50	4	TYPE = 3	Industry Rep
6.25	4	TYPE = 4	Academia Rep
	--		
	16	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
9.9485	3	.0190	10.9113	3	.0122

- - - - - Kruskal-Wallis 1-Way Anova

@PUR Extent Past UseRed
by TYPE Respondent Type

Mean Rank	Cases		
13.00	4	TYPE = 1	Environmental Rep
9.75	4	TYPE = 2	Regulatory Rep
3.50	4	TYPE = 3	Industry Rep
7.75	4	TYPE = 4	Academia Rep
	--		
	16	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
8.3603	3	.0391	9.6684	3	.0216

- - - - - Kruskal-Wallis 1-Way Anova

@PGR	Extent Past GenRed
by TYPE	Respondent Type

Mean Rank	Cases		
9.50	4	TYPE = 1	Environmental Rep
5.75	4	TYPE = 2	Regulatory Rep
14.00	4	TYPE = 3	Industry Rep
4.75	4	TYPE = 4	Academia Rep
	--		
	16	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
9.3309	3	.0252	10.5399	3	.0145

- - - - - Kruskal-Wallis 1-Way Anova

TURG	Any Subst TrgU Red
by TYPE	Respondent Type

Mean Rank	Cases		
9.00	3	TYPE = 1	Environmental Rep
9.00	2	TYPE = 2	Regulatory Rep
2.50	4	TYPE = 3	Industry Rep
9.00	4	TYPE = 4	Academia Rep
	--		
	13	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
7.7143	3	.0523	8.4578	3	.0374

- - - - - Kruskal-Wallis 1-Way Anova

TNRG	Any Subst TrgN Red
by TYPE	Respondent Type

Mean Rank	Cases		
10.00	3	TYPE = 1	Environmental Rep
9.25	4	TYPE = 2	Regulatory Rep
2.50	4	TYPE = 3	Industry Rep
10.75	4	TYPE = 4	Academia Rep
	--		
	15	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
8.4750	3	.0372	9.1445	3	.0274

- - - - - Kruskal-Wallis 1-Way Anova

@TU	% Subst TrgU Red
by TYPE	Respondent Type

Mean Rank	Cases		
10.00	3	TYPE = 1	Environmental Rep
10.00	4	TYPE = 2	Regulatory Rep
2.50	4	TYPE = 3	Industry Rep
10.00	4	TYPE = 4	Academia Rep
	--		
	15	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
8.2500	3	.0411	9.3902	3	.0245

- - - - - Kruskal-Wallis 1-Way Anova

@TN % Subst TrgN Red
by TYPE Respondent Type

Mean Rank	Cases		
11.00	3	TYPE = 1	Environmental Rep
8.75	4	TYPE = 2	Regulatory Rep
2.50	4	TYPE = 3	Industry Rep
10.50	4	TYPE = 4	Academia Rep
	--		
	15	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
8.7625	3	.0326	9.4547	3	.0238

- - - - - Kruskal-Wallis 1-Way Anova

@TU50 Extent URed Goals
by TYPE Respondent Type

Mean Rank	Cases		
9.75	4	TYPE = 1	Environmental Rep
11.00	4	TYPE = 2	Regulatory Rep
2.50	4	TYPE = 3	Industry Rep
10.75	4	TYPE = 4	Academia Rep
	--		
	16	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
8.6250	3	.0347	9.6305	3	.0220

- - - - - Kruskal-Wallis 1-Way Anova

@TN50 Extent NRed Goals
by TYPE Respondent Type

Mean Rank	Cases		
9.75	4	TYPE = 1	Environmental Rep
11.00	4	TYPE = 2	Regulatory Rep
2.50	4	TYPE = 3	Industry Rep
10.75	4	TYPE = 4	Academia Rep
	--		
	16	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
8.6250	3	.0347	9.6305	3	.0220

- - - - - Kruskal-Wallis 1-Way Anova

@TRG % TrgProc w/UReds
by TYPE Respondent Type

Mean Rank	Cases		
11.00	4	TYPE = 1	Environmental Rep
10.25	4	TYPE = 2	Regulatory Rep
2.50	4	TYPE = 3	Industry Rep
10.25	4	TYPE = 4	Academia Rep
	--		
	16	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
8.5368	3	.0361	9.4390	3	.0240

- - - - - Kruskal-Wallis 1-Way Anova

@PRG % Cov'dProc w/Reds
by TYPE Respondent Type

Mean Rank	Cases		
11.75	4	TYPE = 1	Environmental Rep
9.00	4	TYPE = 2	Regulatory Rep
2.50	4	TYPE = 3	Industry Rep
10.75	4	TYPE = 4	Academia Rep
	--		
	16	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
9.1544	3	.0273	9.7877	3	.0205

- - - - - Kendall Coefficient of Concordance

Mean Rank	Variable		
15.81	A1	Co P2 Policy	
25.69	A2	Top Mgmt P2 Commit	*AGREEMENT
22.15	A3	P2 in Design Stage	
17.15	A4	P2 in Budgeting	
17.65	A5	X-Fn P2 Teams	*AGREEMENT
12.27	A6	Specific P2 Indiv	
14.73	A7	P2 Train/Education	
22.92	A8	Est P2 Goals	
20.27	A9	Empl Incent/Recog	
13.27	A10	P2Ach in Empl Eval	*AGREEMENT
8.19	A11	P2 Communications	
21.23	A12	Meas P2 Progress	*AGREEMENT
19.65	A13	Report P2 Progress	*AGREEMENT
10.77	M@1	Use 1 P2Mthd	*AGREEMENT
13.77	M@#	MSum>1	*AGREEMENT
15.81	M#M6	Mthds Used >M6	*AGREEMENT
10.31	M2	Use M2 Raw Matls	
14.12	LCA	Use LifeCyc Anal	
7.23	PACH	Past P2 Ach's	
9.00	@PUR	Extent Past UseRed	
14.69	@PGR	Extent Past GenRed	
13.62	TURG	Any Subst TrgU Red	
12.85	TNRG	Any Subst TrgN Red	
13.62	@TU	% Subst TrgU Red	
13.62	@TN	% Subst TrgN Red	
13.62	@TU50	Extent URed Goals	
13.62	@TN50	Extent NRed Goals	
13.69	@TRG	% TrgProc w/UReds	
13.69	@PRG	% Cov'dProc w/Reds	

Cases	W	Chi-Square	D.F.	Significance
13	3.348E-01	121.8782	28	1.11E-13

REFERENCES

Aalders, Marius (1993). Regulation and in-company environmental management in the Netherlands. *Law & Policy* 15(2).

Ainsworth, Susan J. (1993). Responsible care program poses challenges for smaller firms. *Chemical & Engineering News* 71(32).

Allen, David T. and Rosselot, Kirsten S. (1994). Pollution prevention at the macro scale: Flows of wastes, industrial ecology and life cycle analyses. *Waste Management* 14(3/4), 317-328.

Altman, John A. and Petkus, Ed, Jr. (1994). Toward a Stakeholder-based policy process: An application of the social marketing perspective to environmental policy development. *Policy Sciences* 27, 37-51.

AT&T Bell Laboratories QUEST Organization (1993). *Facility Level Pollution Prevention Benchmarking Study.* Washington, DC: The Business Roundtable.

Azar, Jack (1993). Asset Recycling at Xerox. *EPA Journal* 15(4), 14-16.

Babbie, Earl (1994). *The Practice of Social Research.* 7th ed. Belmont, CA: Wadsworth Publishing Company.

Baas, Leo and Huisingh, Donald (1993). *The Learning Process in the Implementation of Cleaner Production Within Companies.* Graz, Austria: NATO/CCMS.

Barker, Emily (1992). Du Pont tries to clean up its act. *Business and Society Review* (80), 36-41.

Barnett, Harold C. (1990). Political environments and implementation failures: The case of Superfund enforcement. *Law & Policy* 12(3), 225-246.

Beaumont, John R., Pederson, Lene M. and Whitaker, Brian D. (1993). *Managing the Environment: Business Opportunity and Responsibility.* Oxford: Butterworth-Heinemann, Ltd.

Brown, Richard (1994). Theory and practice of regulatory enforcement: Occupational health and safety regulation in British Columbia. *Law & Policy* 16(1), 63-91.

Burby, Raymond J. and Paterson, Robert G. (1993). Improving compliance with State environmental regulations. *Journal of Policy Analysis and Management* 12(4), 753-772.

Cairncross, Frances (1990). A survey of industry and the environment: Cleaning up. *The Economist* 316(7671), 3-26.

Cebon, P. (1993). Corporate Obstacles to Pollution Prevention. *EPA Journal* 15(4), 20-22.

Davis, Charles and Feiock, Richard (1992). Testing theories of state hazardous waste regulation: A reassessment of the Williams and Matheny Study. *American Politics Quarterly* 20(4), 501-511.

Downing, Paul B. and Kimball, James N. (1982). Enforcing pollution control laws in the US *Policy Studies Journal* 11(1), 55-65.

Dyerson, Romano and Mueller, Frank (1993). Intervention by outsiders: A strategic management perspective on government industrial policy. *Journal of Public Policy* 13(1), 69-88.

Freeman, Harry (ed.) (1990). *Hazardous Waste Minimization.* New York, NY: McGraw-Hill Publishing Company.

Freeman, Harry (et al.) (1992). Industrial pollution prevention: A critical review. *Journal of the Air & Waste Management Association* 42(May), 618-650.

Gouchoe, Susan, et al. (1994). *Evaluation of the Effectiveness of Industry Pollution Prevention Planning Requirements & Guidance for Integrating Pollution Prevention Plans.* Medford, MA: Tufts University.

Graham, Ann B. (1993). The results of PPR's 1993 survey: Industry's pollution prevention practices. *Pollution Prevention Review* 3(4), 369-381.

Hawk, David L. (1994). *Environmental Management: Redefining and Redesigning Responsibility.* Newark: New Jersey Institute of Technology.

Hanson, Chris and Borkovic, Matthew (Undated). *ISO 14000 Overview.* SOCMA.

Hearne, Shelley A. and Aucott, Michael (1991). Source reduction versus release reduction: Why the TRI cannot measure pollution prevention. *Pollution Prevention Review* 2(1), 3-17.

Hemphill, Thomas A. (1993). Corporate environmentalism and self-regulation: Keeping enforcement agencies at bay. *Journal of Environmental Regulation* 3(2), 145-154.

Herzik, Eric B. (1992). The development of hazardous waste management as a state policy concern. Policy Studies Review 11(1), 141-148.

Hopper, J. R., et al. (1994). Pollution prevention by process modification: Reactions and separations. *Waste Management* 14(3/4), 187-202.

Hornstein, Donald T. (1993). Lessons from federal pesticide regulation on the paradigms and politics of environmental law reform. *Yale Journal on Regulation* 10, 369-446.

Huisingh, Donald (et al.) (1986). *Proven Profits from Pollution Prevention.* Washington, DC: Institute for Local Self-Reliance.

Ingram, Helen and Schneider, Anne (1990). Improving implementation through framing smarter statutes. *Journal of Public Policy* 10(1), 67-88.

Jones, Thomas L. (1994). An overlooked opportunity for pollution prevention case study: Union Carbide Taft plant, Hahnville, Louisiana. *Waste Management* 14(3/4), 203-213.

Keoleian, Gregory A. and Menerey, Dan (1993). *Life Cycle Design Guidance Manual: Environmental Requirements and the Product System.* Washington, DC: USEPA.

Khator, Renu (1993). Recycling: A policy dilemma for American States? *Policy Studies Journal* 21(2), 210-226.

Kling, David J. and Schaeffer, Eric (1993). EPA's flagship programs. *EPA Journal* 15(4), 26-30.

Langbein, Laura and Kerwin, Cornelius M. (1985). Implementation, negotiation and compliance in environmental and safety regulation. *Journal of Politics* 47 (Aug.), 854-880.

L'Etang, Jacquie (1994). Public relations and corporate social responsibility: Some issues arising. *Journal of Business Ethics* 13, 111-123.

Levin, Michael H. (1990). Implementing pollution prevention: incentives and irrationalities. *Journal of the Air and Waste Management Association* 40(9), 1227-1231.

Lynn, Frances M., Goldenberg, Abby G., and Roque, Julie (1992). *From Toxics Use Reduction to Materials Policy and Sustainable Development: Antecedents, Ideology, and Paradigm Shifts.* Chapel Hill: University of North Carolina.

Magat, Wesley A. and Viscusi, W. Kip (1990). Effectiveness of the EPA's regulatory enforcement: The case of industrial effluent standards. *Journal of Law & Economics* XXXIII (Oct.), 331-360.

Manley, Walter, H., II (1991). *Executive's Handbook of Model Business Conduct Codes.* Englewood Cliffs, NJ: Prentice Hall.

Mason, Robert D. (1982). *Statistical Techniques in Business and Economics, 5th Edition.* Homewood, IL: Richard D. Irwin, Inc.

McDonnell, Lorraine M. and Elmore, Richard F. (1987). Getting the job done: Alternative policy instruments. *Educational Evaluation and Policy Analysis* 9(2), 133-152.

Mounteer, Thomas R. (1994). The inherent worthiness of the struggle: The emergence of mandatory pollution prevention planning as an environmental regulatory ethic. *Columbia Journal of Environmental Law* 19, 251-325.

Mullin, Rick, et al. (1993). A global green standard: ISO-9000. *Chemical Week* 153(17), 39-74.

New Jersey Annotated Statutes 13:1D-35 et seq. (1991). *The Pollution Prevention Act.*

New Jersey Department of Environmental Protection (NJDEP) (1993). *Industrial Pollution Prevention Planning: Meeting Requirements Under the New Jersey Pollution Prevention Act.* Trenton, NJ: NJDEP.

New Jersey Department of Environmental Protection (NJDEP) (1994). *Current Status of Covered Universe.* Trenton, NJ: NJDEP.

New Jersey Department of Environmental Protection (NJDEP) (1995a). *Early Findings of the Pollution Prevention Program Part II: Preliminary Results of Industrial Reporting.* Trenton, NJ: NJDEP.

New Jersey Department of Environmental Protection (NJDEP) (1995b). *1993 Pollution Prevention Plan Summaries* (Computer Database - downloaded from NJ public information phone line: 11/1/95). Trenton, NJ: NJDEP.

New Jersey Department of Labor & Industry (1993). *Trends in Employment & Wages.* Newark, NJ: NJ Department of Labor.

Norusis, Marija J. (1993). *SPSS® for Windows™: Base System User's Guide, Release 6.0.* Chicago, IL: SPSS Inc.

Nowell, Clifford and Shogren, Jason (1994). Challenging the enforcement of environmental regulation. *Journal of Regulatory Economics* 6, 265-82.

Pizzolatto, Allayne B. and Zeringue, Cecil A., II (1993.) Facing society's demands for environmental protection: Management in practice. *Journal of Business Ethics* 12, 441-447.

Riley, Gwen J., Warren, John L., and Goidel, Eun-Sook (1994). Assessment of changes in reported TRI releases and transfers between 1989 and 1990. *Journal of the Air & Waste Management Association* 44(June), 769-772.

Ringquist, Evan J. (1993). Does regulation matter?: Evaluating the effects of state air pollution control programs. *The Journal of Politics* 55(4), 1022-1045.

Sabatier, Paul and Mazmanian (1980). The implementation of public policy: A framework of analysis. *Policy Studies Journal* 8, 538-560.

Sanyal, Rajib N. and Neves, Joao S. (1991a). Complying with voluntary codes of conduct: Corporate strategies for the Valdez Principles. *International Journal of Value Based Management* 4(1), 9-23.

Sanyal, Rajib N. and Neves, Joao S. (1991b). The Valdez Principles: Implications for corporate social responsibility. *Journal of Business Ethics* 10, 883-890.

Sarokin, David J. (et al.) (1985). *Cutting Chemical Wastes.* New York, NY: INFORM, Inc.

Scholz, John T. (1984). Voluntary compliance and regulatory enforcement. *Law & Policy* 6(4), 385-404.

Schmitt, Ronald E. and Podar, Mahesh K. (1994). Pollution prevention planning in refineries: Setting priorities based on risk. *Waste Management* 14(3/4), 289-298.

Sheridan, John H. (1992). Pollution prevention picks up steam. *Industry Week* (Feb.), 37-48.

Standard Industrial Classification Code Directory (1993). Omaha, NE: American Business Directories.

Smith, J. Andy, III (1993). The CERES principles: A voluntary code for corporate environmental responsibility. *Yale Journal of International Law* 18(297), 307-317.

Spriggs, H. Dennis (1994). Integration: The key to pollution prevention. *Waste Management* 14(3/4), 215-229.

SPSS® for Windows™. Computer Software. SPSS Inc., 1993. Release 6.1, disk.

US Code Annotated Title 42, Section 13101 et seq. (1990). *Pollution Prevention.*

United States Environmental Protection Agency (USEPA) (1991). *Toxics in the Community: National and Local Perspectives.* Washington, DC: USEPA.

United States Environmental Protection Agency (USEPA) (1992). *1989 Toxics Release Inventory: Public Data Release.* Washington, DC: USEPA.

United States Environmental Protection Agency (USEPA) (1993). *1991 Toxics Release Inventory: Public Data Release.* Washington, DC: USEPA.

United States Environmental Protection Agency (USEPA) (1994). *1992 Toxics Release Inventory: Public Data Release.* Washington, DC: USEPA.

United States Environmental Protection Agency (USEPA) (1995a). *1993 Toxics Release Inventory: Public Data Release.* Washington, DC: USEPA.

United States Environmental Protection Agency (USEPA) (1995b). *1993 Toxics Release Inventory: Public Data Release State Fact Sheets.* Washington, DC: USEPA.

United States General Accounting Office (GAO) (1994). *Pollution Prevention: EPA Should Reexamine the Objectives and Sustainability of State Programs.* Washington, DC: GAO.

Watts, Daniel J. (et al.) (1992). *Environmental Research Briefs.* Cincinnati, OH: USEPA.

Weimer, David L. (1992a). Claiming races, broiler contracts, heresthetics, and habits: ten concepts for policy design. *Policy Sciences* 25, 135-159.

Weimer, David L. (1992b). The craft of policy design: Can it be more than art? *Policy Studies Review* 11(3/4), 370-387.

White, Allen L., Becker, Monica and Goldstein, James (1991). *Alternative Approaches to the Financial Evaluation of Industrial Pollution Prevention Investments.* Boston, MA: Tellus Institute.

Zosel, Thomas W. (1990). How 3M makes pollution prevention pay by dividends. *Pollution Prevention Review* 1(1), 67-82.