ENVIRONMENTAL POLICY TOOLS & FIRM-LEVEL MANAGEMENT PRACTICES IN THE UNITED STATES

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in cooperation with
OECD Environment Directorate

EXECUTIVE SUMMARY

Purpose & Approach

This report provides practical policy advice concerning the effectiveness and efficiency of alternative environmental policy innovations that encourage greater environmental improvements, and especially those related to EMS adoption. The study is part of a larger OECD project involving the participation of researchers from seven different OECD countries (Canada, France, Germany, Hungary, Japan, Norway, and United States—see Annex 1). The goal of the broader research project is to understand how firms' environmental actions change in different regulatory and social settings. In total, approximately 4,200 facilities with more than 50 employees in all manufacturing sectors participated in the larger study, of which 489 operated in the U.S. (OECD, 2003).

During the first step of the OECD study, research teams from the seven participating countries collaborated to design a uniform survey. Mailed to manufacturing facilities in each country, the survey considered the internal factors, financial incentives, and external pressures that shape organizations' environmental behavior (see Annex 2). Once the data were collected, the research teams completed a preliminary analysis of their data. For consistency, each country used the same report structure to convey their results. This report summarizes the key findings from the U.S. data.

The purpose of this report is three-fold. First, it offers preliminary advice regarding different U.S. environmental policies and programs that encourage environmental innovation. Second, this report is intended to help the U.S. manufacturing facilities that participated in our study to benchmark their environmental management against similar companies. Finally, the U.S. study was created to contribute to the dialogue about the different types of environmental innovations and how they might vary across OECD countries. To fulfil its purpose, the report addresses three broad research questions:

1. Why do facilities introduce environmental management systems and tools?
2. Why do facilities undertake specific types of environmental investments and innovations?
3. What are the links between facilities' financial performance and their environmental management practices?

Preliminary Findings

Why do facilities introduce environmental management systems and tools?

The results of this research indicate that the traditional regulatory system was the most important motivator for facilities to introduce EMSs, suggesting that in the absence of regulatory pressures, facilities may make fewer attempts to reduce their environmental harms. Parent companies had the second strongest influence on all facility-level environmental management decisions. Other internal stakeholders, such as non-management employees, influenced EMS adopters' environmental activities to a greater degree than non-adopters. While pressures from societal stakeholders had less influence on facilities' environmental practices, market pressures from commercial buyers, suppliers, and shareholders influenced EMS adopters more than non-adopters. Similarly, EMS adopters were more frequently motivated to improve their public image, create new technologies and products, and remain in step with their competitors.

With respect to the complementary management practices that facilitate environmental management, EMS adopters *had greater experience* with quality management systems, health and safety management systems, and process/job control systems. They also more frequently had dedicated budgets for research and development in environmental matters and had a formal environmental department. Facilities with EMSs also integrated environmental activities into other management practices. More specifically, EMS adopters integrated environmental concerns more frequently into their health and safety management systems, full-cost/activity-based accounting, management accounting systems, process/job control systems, and inventory/materials requirement planning than non-adopters. With the exception of health and safety management systems, facilities that merely were in the process of EMS adoption also demonstrated greater expertise with these complementary management practices than non-adopters.

Taken together, these findings indicate that EMS adopters endured *greater pressures* from stakeholders within regulatory agencies and markets to consider their environmental practices and to reduce their impact to the natural environment. They also had *stronger complementary capabilities* that facilitated EMS adoption. Related to the latter, our results indicate that a company's strong investments in pollution prevention facilitate its decision to later develop an EMS or to encourage their suppliers to develop more environmentally friendly products. Similarly, we should expect that facilities having little pollution prevention experience would be less likely to adopt an EMS because they lack the basic organizational expertise to do so, and therefore incur significantly greater expenses during EMS adoption. As a result, regulators may be able to promote more widespread adoption of advanced environmental management strategies, such as EMS, by simply encouraging additional organizations to develop their basic pollution prevention practices, as doing so increases the probability for EMS adoption at a later time. In the absence of this expertise, EMS adoption therefore is expected to be more expensive, and may also have more varied environmental results.

Because parent companies had a significant influence on facilities' environmental activities, our results further suggest that regulators may also have greater success targeting their incentive-based environmental policies at the corporate level in addition to the facility level. Doing so may provide the additional managerial support within facilities to make operational investments that lead to environmental improvements. Such support is important given that many environmental innovations require significant staff time, capital investments, employee training, and commitments for continual improvement.

Why do facilities undertake specific types of environmental investments and innovations?

The results of this study indicate that facilities having implemented EMSs reaped *greater improvements in their environmental performance* over the last three years than non-EMS adopters. This relationship also existed for facilities that merely were *in the process* of adopting an EMS in that both types of facilities benefited from reduced natural resource use, wastewater effluent and solid waste generation. Facilities that fully implemented their EMS also reduced their solid waste, air pollution, and risk of severe accidents more than non-adopters. Facilities that chose to certify their EMSs had the benefit of further reducing their natural resource use and wastewater effluent, although these differences were modest when compared to facilities that implemented non-certified EMSs. Further, it appears that facilities did not use their EMS to reduce their non-regulated aesthetic impacts, including odor, landscape and noise, because in every instance EMS adopters did not differ from non-adopters.

Taken together, these findings provide important preliminary evidence about the merits of EMS adoption for U.S. facilities. They also add further support for prior research suggesting that the introduction of an EMS improves the environmental performance and management efficiencies of most facilities (Andrews et al., 2003). Moreover, *while certified EMSs are associated with only modestly greater performance improvements than non-certified EMSs, facilities that are in the process of EMS adoption are able to achieve significant gains over non-adopters*.

When considering the *importance of incentive-based environmental policies on facilities' production activities*, organizations that were in the process of adopting an EMS, already adopted an EMS, or implemented a certified EMS placed greater importance on them. In particular, demand and supply information policies (e.g. eco-labels and recognition programs), participation in voluntary environmental programs (VEP) and subsidies or tax preferences all had greater importance to EMS adopters' production activities than to non-adopters' production activities.

At the same time, enterprises with certified EMSs also indicated that liability for environmental damages were more important to them than was the case for non-EMS adopters. These results indicate that facilities with certified EMSs operated with a greater sensitivity to coercive external pressures than non-EMS adopters. Coupled with the fact that facilities with EMSs also placed greater importance on incentive-based policies, these findings suggest that organizations adopting EMSs were more conscious of the entire environmental regulatory regime and how their enterprise operates within it.

When confronted with making a production change, which might reduce an organization's environmental impacts, companies can either make changes in production processes (by addressing waste closer to its source) or incorporate end-of-pipe production technology. Comparing facilities that had adopted an EMS with non-EMS adopters, and whether either had employed these two production changes, *EMS adopters changed their production processes and end-of-pipe technology more frequently than non-adopters*. Similarly, EMS adopters that indicated the importance of input bans, performance standards, and liability for environmental damages in their organization's environmental activities also reported that they relied more on end-of-pipe technology changes than non-EMS adopters.

More than half of EMS adopters were informed about government programs or policies that encouraged EMS adoption, whereas about one quarter of non-EMS adopting facilities knew of government sponsored programs that encouraged enterprises to adopt an EMS. Of the EMS adopters, most reported that they were familiar with government-sponsored EMS programs offering preferences for public procurement, financial support, waivers of environmental regulations, and reductions in the stringency of regulatory thresholds, however, far fewer were aware of the existence of programs offering fewer regulatory inspections, special recognition, or technical assistance. This situation presents an opportunity to regulators in that additional facilities may consider adopting an EMS if they were more knowledgeable about the programs that encouraged them to do so. Moreover, because it appears that EMS adopters rely more on VEPs and other incentive-based environmental programs, voluntary programs might be successful vehicles for encouraging more widespread EMS adoption. Programs that incorporate technical and pollution prevention assistance may further encourage companies to consider EMS adoption, especially those lacking the complementary capabilities that would make adopting an EMS less expensive.

Very few differences existed among facilities with certified EMSs and companies with non-certified EMSs, especially as they related to whether facilities had integrated their environmental activities into other management practices, (e.g. quality management practices and supply chain management). Similarly, when comparing facilities' reductions in environmental impacts, and actions taken to reduce environmental impacts, there were only modest differences among facilities with certified EMSs and facilities with non-certified EMSs. Instead, significant organizational differences existed among adopters of uncertified EMSs and non-EMS adopters. These findings suggest that facilities certifying their EMSs to an international standard such as ISO 14001 or EMAS may not necessarily achieve benefits beyond the environmental improvements gained by facilities implementing non-certified EMSs. They also support current regulatory positions that endorse EMSs more broadly, rather than only encouraging standardized EMSs such as ISO 14001.

What are the Links between firms' financial performance and their environmental management practices?

Once in place, all EMSs appear to lead to greater environmental improvements in that adopters consistently reported higher environmental performance than non-adopters. However, the link between environmental performance and financial performance is weak, at least at this initial stage, and additional investigation is therefore needed.

To further explore the relationship between EMS adoption and environmental and financial performance, it would be particularly useful to incorporate data from secondary sources. For example, by evaluating facilities' compliance data, we will be able to explore the relationships between violations and organizations' subsequent environmental strategies. We will also be able to assess the effect of pollution emissions on firms' environmental strategies. Additionally, it would be useful to combine the survey data with facilities' financial data so that we can investigate the relationship between financial and environmental performance more thoroughly.

Exploring the U.S. Data Further

This analysis relied on bivariate analyses, which are limited in their ability to simultaneously consider other influential variables and to predict outcomes. Therefore, more rigorous empirical analyses are needed to test these relationships further. Such an analysis would need to control for the selection bias associated firms' voluntary decisions to adopt different environmental practices because these biases may potentially affect subsequent financial and environmental performance estimates. However, prior to undertaking a multivariate analysis, we will need to create indices for most of our constructs in order to reduce the number of variables included in a multiple regression model.

While this report largely evaluated EMSs, there are many other types of environmental innovations that can be studied using the U.S. survey data, including a facility's decision to "green" its supply chain, to participate in government-sponsored and industry-sponsored VEPs, to rely on process changes rather than end-of-pipe pollution technology, among others. A broader exploration of these actions may provide a more comprehensive view of the types of environmental innovations utilized by U.S. companies and the effects they have on environmental performance.

Future research using the U.S. survey data also would benefit by including more objective measures for firms' financial and environmental data. For example, data related to firms' environmental violations and fines, toxic environmental releases, and publicly available financial data would offer a more complete perspective of how and to what extent companies that adopt advanced environmental strategies perform better than organizations that select not to do so. However, it is important to note that the focus of the broader OECD research study is to compare environmental performance across seven countries. As such, secondary environmental data are not as useful because environmental laws are inconsistent among the different countries and environmental compliance therefore is difficult to compare. Regardless, additional financial and environmental data will be critical to expanding the applicability of a U.S. study.

Finally, it is also important to understand how firms that responded to this survey differ from non-responding firms. To assess these differences, basic demographic data need to be collected for the facilities that received the U.S. survey. Such information will help us to generalize the results of this research to the broader population of U.S. manufacturing facilities, thereby increasing the applicability and robustness of the research findings.

Cross-country Comparisons

In the months ahead, this project will move away from a single country-based analysis and towards an analysis that compares similarities and differences across the participating countries. As a result, a more detailed analysis of the U.S. data will not occur as part of this research project. Instead, the U.S. survey data will be combined with data collected from the six other research teams in Canada, France, Germany, Hungary, Japan and Norway. The research teams will then address four research questions, paying particular attention to differences among the various countries:

1. What factors influence a facility's decisions to introduce an EMS and other environmental management tools?
2. What are the reasons why a facility undertakes specific types of environmental investments?
3. What determines the degree of a company's environmental innovation and integration?
4. What are the links between the aforementioned factors and the facility's financial performance?

The results of these cross-country analyses will be available in winter 2005 in a series of public reports. These reports will also be the topic of a multi-stakeholder workshop, which will be sponsored by the OECD and will be held in early 2005.

ACKNOWLEDGEMENTS

This report summarizes key findings from the OECD/NCSU survey, "U.S. Environmental Policy Tools and Firm-level Management Practices in the U.S." The following pages summarize the responses of hundreds of environmental managers who generously took the time to participate in this research. The authors thank the facility managers for their assistance.

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INTRODUCTION

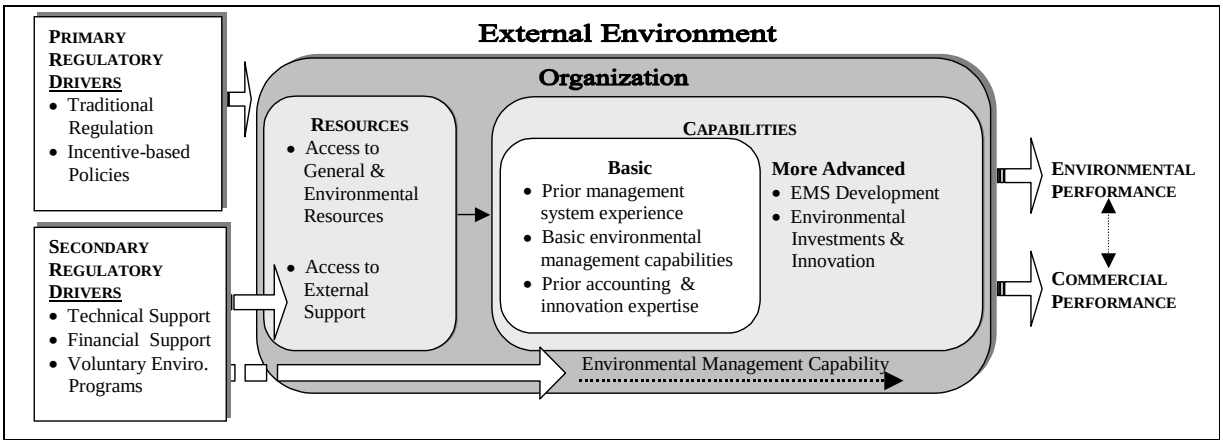
One of the main conclusions of recent environmental policy research by the Organisation for Economic Co-operation and Development (OECD) was the importance of understanding firms' financial motivations, decision-making procedures, and organizational structure, in addition to their relationship with different policies (OECD, 2001). The reasons for this conclusion stem, in part, from the differences in organizational responses to environmental policy. For example, the regulated community may respond very differently to tradable permit policies than to emission taxes. Similarly, traditional environmental regulatory approaches may result in different environmental outcomes than voluntary approaches. These diverse responses among the regulated community are hypothesized to result from differences within organizations. Some organizations, for example, may employ different management tools, accounting procedures, and other pollution prevention activities, and are therefore more likely to make investments in advanced voluntary environmental management (such as environmental management systems or environmental innovation). Each of these management tools may also lead to greater environmental management success.

The likelihood for organizations to adopt advanced environmental management activities is also interrelated with the expected financial benefits associated with these activities. However, public policy researchers rarely discuss organizational differences in conversations of the relative merit of different policies and programs. More often than not, policy research treats the internal workings of the organization as a "black box." For these reasons, an understanding of the relationship between environmental policy design and industrial organization is important to understanding the implementation of effective and efficient environmental policy tools.

While prior evaluations of organizational responses to various environmental innovations have attempted to go "inside the organization" (e.g. Jennings and Zandbergen (1995), Jaffe and Palmer (1997), Rugman and Verbeke (1998)), these studies largely assume that external incentives, such as environmental regulation, will result in *similar* responses from all firms. However, it is important to acknowledge that firms are not passive entities responding to external expectations. Many scholars have argued that organizations are evolving and dynamic (Perrow, 1986). They respond to external pressures in numerous ways based on their access to resources and the complementary capabilities that have developed over time (Perrow, 1986; Oliver, 1997). While researchers of organizational behavior recognize that firms respond heterogeneously to external pressures, scholars within the policy arena have generally not considered these issues and how the internal capabilities of the firm can produce a variety of different policy responses. For example, organizations with fewer internal capabilities may not be able to respond as quickly or as effectively to different types of environmental policies, whereas firms with strong internal competencies may be able to respond to diverse policies and programs, therefore minimizing their impact to the natural environment and their response costs.

It is for these reasons that regulators are becoming increasingly sensitive to the fact that environmental policies need to be developed such that incentives are combined with secondary "support" programs that increase their efficacy. These secondary support programs include technical or financial assistance programs for the implementation of environmental management systems (EMS), pollution prevention, and other environmental management practices, and involve helping the regulated community identify opportunities for improved environmental performance. Each of these measures may also yield financial benefits to the organization, as illustrated in Figure 1.

Figure 1: Relationships between Regulatory Drivers, Organizations' Environmental Management Capabilities & Performance



While firms generally encourage policy makers to develop secondary support programs, their encouragement is often tempered. The caution stems from firms' concerns that support programs may begin to resemble some aspects of traditional regulation, with its complex mix of public (environmental protection) and private (financial) interests. While EPA is quick to point out that its goal is not to subsidize firms by increasing their profitability, but to encourage the use of secondary support programs to achieve outcomes aligned with the nation's environmental policy goals (USEPA, 2002), should industry perceive that these support programs begin to resemble regulation some firms would likely curb their use of and enthusiasm for some such programs. For these reasons, before policy makers design incentive-based environmental policies and support programs that facilitate widespread policy implementation, they would benefit from a better understanding of the relationship between these policies and programs, and the environmental management and performance of the facilities that they regulate.

This study provides practical policy advice concerning the effectiveness and efficiency of alternative environmental policies and programs that encourage environmental innovation. It is part of a larger OECD research project in which seven different OECD countries (Canada, France, Germany, Hungary, Japan, Norway, and United States—see Annex 1) are participating. The goal of the broader research study is to understand how firms' environmental actions change in different regulatory and social settings. In total, approximately 4,200 facilities with more than 50 employees in all manufacturing sectors participated in the larger study, of which 489 operated in the U.S. (OECD, 2003).

During the first step of the OECD study, research teams from the seven participating countries collaborated to design a uniform survey. The survey considered the internal factors, financial incentives, and external pressures that shape organizations' environmental behavior (see Annex 2), and was mailed to manufacturing facilities within each country. Once the data were collected, the research teams completed a preliminary analysis of their data. For consistency, each country used the same report structure to convey their results. This report represents a summary of the U.S. data.

The purpose of this U.S. report is three-fold. First, it offers preliminary advice regarding different U.S. environmental policies and programs that encourage environmental innovation. Second, this report will help the U.S. manufacturing facilities that participated in our study to benchmark their environmental management against similar companies. Finally, the U.S. study was created to contribute to the dialogue of the different types of environmental innovation policies and how they might vary across OECD countries. This report addresses three broad research questions:

1. Why do facilities introduce environmental management tools and systems?
2. Why do facilities undertake specific types of environmental investments and innovations?
3. What are the links between facilities' financial performance and their environmental management practices?

To answer these questions, the U.S. study evaluated the internal factors, financial incentives, and external pressures that shape organizations' environmental behavior in a mail survey of 3,746 U.S. manufacturing facilities. A summary of the results is provided in the following sections.

METHODS & SAMPLE

Description of Methods

To answer our three research questions, a twelve-page survey was developed in conjunction with the OECD and researchers from the other countries who participated in the broader study. The survey consisted of five sections exploring which management systems and tools each facility used, perceptions of environmental impacts and how facilities addressed them, the influence of stakeholders in facility-level environmental practices, and the affect of environmental policies on facilities' behavior. The survey also elicited basic demographic information regarding the facility's structure and the structure of its parent company. Most questions requested discrete choice responses (e.g. "Yes" or "No"), while others requested Likert scale responses with four options (i.e. "Not at all," "Partially," "Fully," or "Not applicable"). In a small number of instances, six point Likert scales (i.e. "Significant decrease," "Decrease," "No Change," "Increase," "Significant Increase," "Not applicable") were used. Prior to its dissemination, the survey was pre-tested in Europe and Japan, and then revised.

The survey was mailed to environmental managers of all U.S. manufacturing facilities that had 50 employees or more, and that reported data to EPA's Toxic Release Inventory (TRI). The TRI contains data on facilities' toxic releases into the air, water and land for over 650 chemicals (USEPA, 2001).[1] Facilities with ten or more full-time employees that manufacture or process quantities above 25,000 pounds, or use more than 10,000 pounds of any of the 650 listed toxic substances during a calendar year, must file a separate form for each TRI chemical (USEPA, 2001). Nearly all manufacturing firms with more than 50 employees are required to submit data to the TRI (USEPA, 2003).

We surveyed the population of 3,746 facilities meeting our criteria because we required at least 300 responses to perform the necessary empirical analyses. Prior studies of U.S. manufacturing organizations suggested that response rates were likely to be low, especially for a survey of twelve pages in length. For example, a 16-page mail survey of facility managers' environmental practices yielded a response rate of 10.35 percent (Melnyk et. al, 1999). Shorter surveys on similar topics have demonstrated somewhat better response rates. For instance, a three-page mail survey of why manufacturing firms adopted various management practices yielded a response rate of 23 percent (Darnall, 2001). Also, within the U.S., smaller sized manufacturing facilities are less likely to respond to surveys, which affected our overall response rate. Given that the OECD survey was 12 pages and since we surveyed smaller facilities in addition to larger ones, we anticipated a response rate of between 10-15 percent.

The data were collected using a modified Dillman (1978) method. Each of the facility managers received a flat manila envelope that included a cover letter, survey and prepaid return envelope. To ensure the survey was more appealing visually, thereby helping to increase the response rates, the cover letter was printed on ivory-colored cotton paper with multi-color letterhead containing the OECD and North Carolina State University logos (per Dillman's (1978) recommendations). Space was provided for additional comments at the end of the survey.

Three media were used to administer the survey. Facility managers had the option of completing the hard-copy mail survey and returning it in the self-addressed return postage envelope. Second, facility

[1] The TRI includes toxic chemical quantities released to the environment both at the firm's facilities and sent off-site for release (including disposal), treated at the facility or sent off-site for treatment, combusted for energy recovery at the facility or sent off-site for energy recovery, and recycled at the facility or sent off-site for recycling (USEPA, 2001a).

managers could complete the survey on-line using a website developed for this study. These responses were automatically saved in a database. The website also contained a downloadable survey in MS Word, providing respondents with a third option of completing the survey on their computer and returning it to us by email. Alternatively, facility managers could print the MS Word, complete it by hand, and mail us the hard copy. To access the website, facility managers were provided a unique password in their cover letter and in all subsequent correspondence.

Offering respondents the option to complete the on-line survey was desirable for several reasons. First, since the on-line responses were complied directly into an electronic database, the Internet survey reduced the resources required for data entry and minimized data entry errors. Also, because facility managers were mailed only one survey, there was a higher probability that the questionnaire might be misplaced. Finally, we believed that the Internet survey would appeal to a portion of subjects who might prefer to respond to an on-line survey rather than a traditional mail-based survey.

We mailed surveys in May 2003, and we ensured facility managers that their individual responses would be kept confidential. Non-responding facility managers were sent up to two postcards at three-week intervals requesting them to complete the survey. Each postcard contained a web address and a unique password to access the on-line survey. Consistent with response rates in prior studies, a total of 489 managers who met our selection criteria (13 percent) completed our survey. Approximately three-quarters of respondents completed the mail survey and about one-quarter completed the on-line survey.

Survey Summary

- Mailed survey to 3,746 facility managers
- 489 VEP managers responded
- Response rate = 13%
- About thee-quarters of facility managers returned the mail survey and one-quarter completed the on-line survey

Description of Sample

Data Concerns

After administering the survey we discovered several concerns related to the quality of the data. First, a significant portion of the U.S. facilities (72) had difficulties indicating their main production activity using our list of international industrial codes. These facility managers either selected "other" and then described their operations qualitatively in the provided text box or simply left the question blank. However, upon further analysis it was clear that most of these facilities' industrial activities could be classified using the international codes. In a number of cases, the facility managers provided an industry code along with a qualitative response (we assume because of their uncertainty with designating a specific sector code). In several other instances, the qualitative responses were not congruent with their designated industrial sector. To address these issues, we researched each of the "other" responses and non-responses and coded 59 of them. The remaining nine industry codes were not categorized because we could not determine the industrial sector without additional information.

Second, in reviewing managers' responses, some may have exaggerated their environmental management practices. Similarly, we believe that respondents were more likely to leave an item blank rather than report that they did not monitor or did not utilize a particular management practice. Facilities responding to the survey therefore may have environmental practices that appear *better* than non-responding facilities. The expected influence of this bias is that our findings should show fewer differences among the facilities that responded to this survey. However, our results suggest that, the facility managers were not reluctant to discuss diverse attributes of their environmental activities, and numerous differences emerged among the various groups of respondents, indicating that response bias may be less significant.

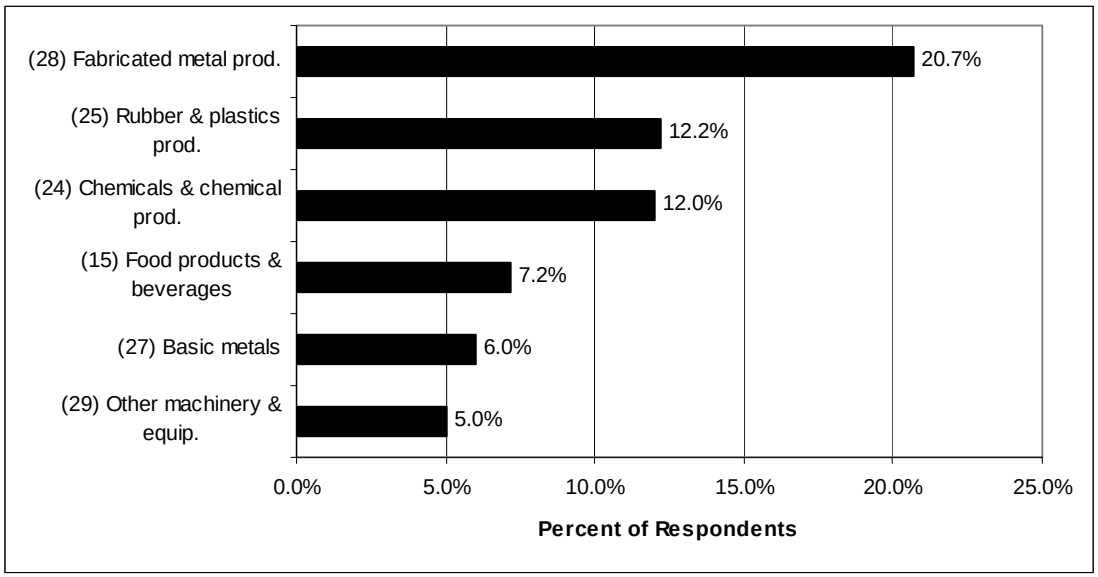
Finally, for some questions, facility managers indicated "not applicable." These questions were related to the extent to which environmental activities were integrated into facilities' management practices, the influence of certain organizations on facility's decisions to consider introducing an EMS and other environmental practices, the importance of various negative environmental impacts on the facility's products and production processes, monitoring of various environmental impacts, actions to reduce environmental impacts, etc. In each case, it was unclear why a facility manager might report that an item was not applicable. For some facility managers, low applicability might have been due to low overall importance to the facility manager, while other managers might not have believed the item was relevant to the industry in which the facility operates. In still other instances, a "not applicable" response might have been due to the fact that other divisions within the facility's corporation address the matter. Because we could not distinguish among these responses, they were omitted from the analyses.

The following section describes the basic characteristics of the facilities that responded to the survey.

Descriptive Statistics

The initial descriptive statistics illustrate that respondents represented facilities of different sizes and a wide variety of industrial sectors. The most represented industries are shown in Figure 2. The facilities in fabricated metal products industry, rubber and plastics producers, and chemical manufacturers responded to the survey more frequently than facilities representing other industrial sectors.

Figure 2: Most represented Industrial Sectors (n=478)



Within the U.S., the fabricated metal products, industrial machinery, electronics, transportation equipment, instrumentation and textile sectors are known as the cleanest manufacturing sectors in the U.S. (Gallagher & Ackerman, 2000). In contrast, the pulp and paper, chemical, petroleum refining and primary metals industries are cited as the five most polluting industries in the U.S. (Mani & Wheeler, 1997; World Bank, 1998). In this study, respondents represented all of the U.S. manufacturing sectors. Table 1 describes the represented sectors and number of respondents in greater detail.

Table 1: Summary of Industry Sectors by Respondents (n=478)

NACE Code	Manufacturing Industry	Total Reporting*	% Respondents w/ ≥50 workers
15	Food products & beverages	34	7.1%
16	Tobacco products	2	0.4%
17	Textiles	11	2.3%
18	Wearing apparel, dressing & dyeing of fur	0	0.0%
19	Tanning & dressing of leather; luggage, handbags, footwear	1	0.2%
20	Wood & products of wood & cork, except furniture	12	2.5%
21	Paper & paper products	22	4.6%
22	Publishing, printing & reproduction of recorded media	2	0.4%
23	Coke, refined petroleum products & nuclear fuel	7	1.5%
24	Chemicals & chemical products	50	10.5%
25	Rubber & plastics products	56	11.7%
26	Other non-metallic mineral products	19	4.0%
27	Basic metals	28	5.9%
28	Fabricated metal products, except machinery & equipment	95	19.9%
29	Other machinery & equipment	23	4.8%
30	Office, accounting & computing machinery	1	0.2%
31	Electrical machinery & apparatus	20	4.2%
32	Radio, television & communication equipment	7	1.5%
33	Medical, precision, & optical instruments, watches & clocks	5	1.0%
34	Motor vehicles, trailers & semi-trailers	10	2.1%
35	Other transport equipment	27	5.6%
36	Furniture	20	4.2%
37	Recycling	1	0.2%

* Ten facilities reported their manufacturing industry as “other” or did not respond to the question.

Figure 3 describes the sizes of facilities that responded to our survey. Facilities were distributed fairly evenly among the different size categories with 22 percent of the sample having 100-249 employees, 26 percent having 250-499 employees, and 30 percent having 500 employees or more. As expected at onset of this study, smaller facilities responded to the survey with less frequency. Twenty-two percent of the sample had fewer than 100 employees, and 44 percent of the respondents were small and medium-sized enterprises (SME) in that they employed fewer than 250 employees.

Figure 4 provides a summary of the scope of the market of the responding facilities. Over one-half (55 percent) of respondents indicated that their facilities operated in global markets and about one-third (32 percent) reported that they operated in the U.S. only. Only 4 percent of the respondents reported that they operated at the local level only. The facilities in this study were therefore more likely to consider environmental regulation from a national and international perspective rather than at a state or local level.

Figure 3: Distribution of Facility Size (n=479)

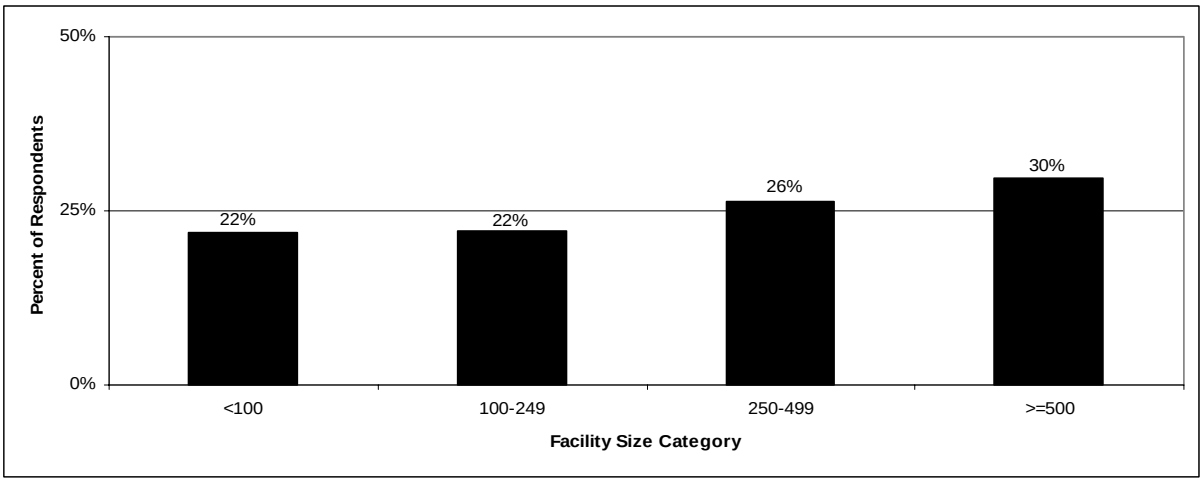
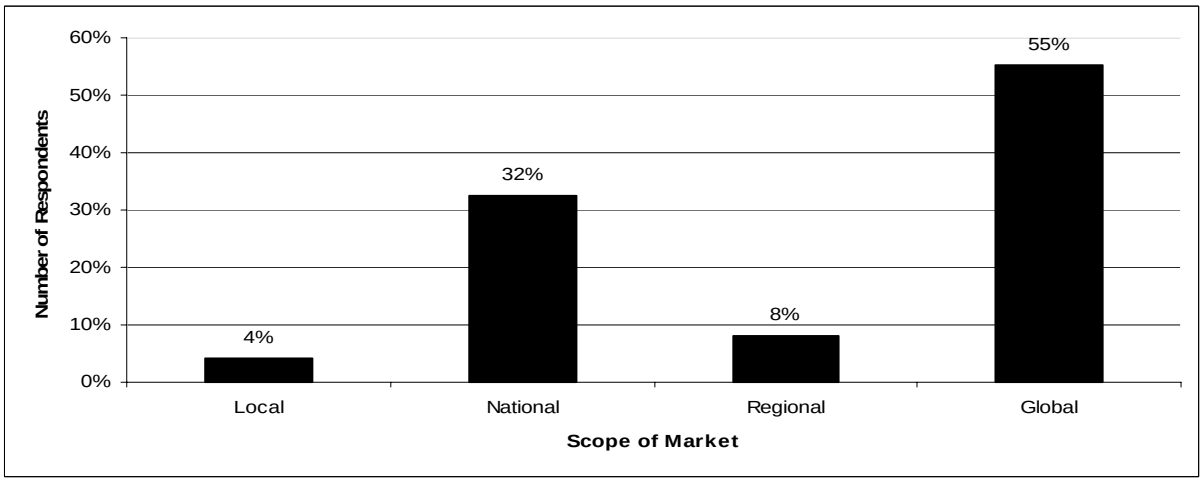
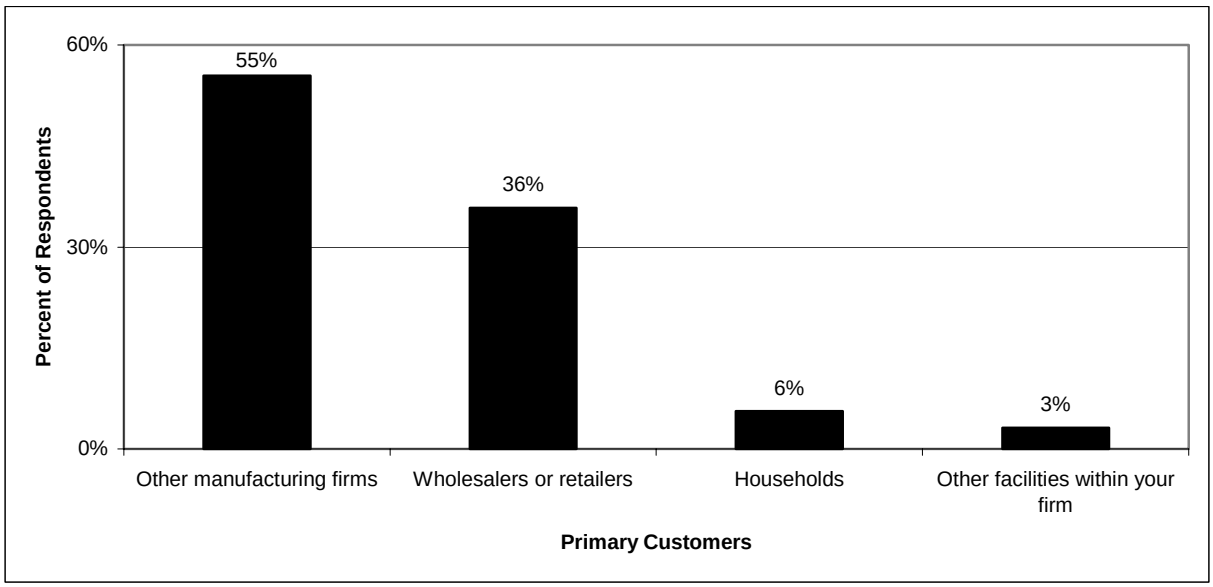


Figure 4: Scope of Facilities' Market (n=484)



While 44 percent of the respondents consisted of SMEs, about half of SMEs also operated in global markets. These results are interesting since we generally do not associate SMEs with international trade. There are at least three explanations for these results. First, over one-half (64 percent) of the SMEs indicated that they had parent companies and therefore were more likely to operate within larger, multinational organizations. Second, many smaller U.S. facilities within the metal products, machinery and equipment sectors are suppliers to international enterprises. As a result, these facilities were also more likely to market their products to other manufacturing enterprises. Indeed, over half of the facilities identified their primary customers as firms in other manufacturing sectors, as shown in Figure 5. Finally, international corporations may be relying on SMEs to outsource aspects of their manufacturing operations.

Figure 5: Facility Customers (n=480)



In contrast, about one-third (36 percent) of the facility managers indicated that either wholesalers or retailers were their primary customers. Only 6 percent of the facility managers indicated that household consumers were the primary consumers of their products. These findings also suggest that most facilities responding to our survey operated in the middle of the supply chain nearest wholesalers or retailers.

On average, the facilities responding to our survey had been in business for 46 years and their median facility age was 40 years (see Table 2). Only 13 percent had parent companies in foreign countries and 11 percent of the facilities had an R&D budget related specifically to environmental matters. Almost three-quarters of facilities (72 percent) reported that they had parent companies, and about one-quarter of the facilities (39 percent) reported that they competed with less than 5 other companies in marketing their produced goods. Finally, almost half (45 percent) of the facility managers indicated that their parent company was listed on a stock exchange.

Table 2: Summary of Facility Characteristics

Sample Characteristic	Value
Response rate, n=489	12.97%
Average (mean):	
• Facility age, n=478	46 yrs
• Annual value of shipment (over the last 3 years), n=286	$198.8M
• Number of facility employees (in the last 3 years), n=479	475
Percent of facilities:	
• With specialized environmental departments, n=463	82%
• With parent companies (multiple facility enterprises), n=473	72%
• Operating in global markets, n=484	55%
• With firms listed on the stock exchange, n=480	45%
• With between 5-10 competitors, n=477	39%
• With greater than 10 competitors, n=477	34%
• Operating in U.S. markets at the national level, n=484	32%
• With foreign located head offices, n=482	13%
• With R&D budgets allocated to environmental matters, n=470	11%
• Percent of R&D budgets allocated to environmental matters, n=36	16%

The following section provides a brief overview of the U.S. environmental regulatory system and recent trends that within it. The introduction is intended to provide a context for later sections of this report and for our research findings.

U.S. ENVIRONMENTAL POLICY TRENDS

Background

The U.S. Environmental Protection Agency (EPA) was created in the 1970s and with it came the development and reorganization of multiple environmental laws that were distributed under various government agencies. In general, EPA sets environmental standards and prescribes ways in which the regulated community must achieve those standards. The agency imposes mandates to obtain operating permits, to adopt specific control technology, to monitor and report on media-specific environmental activities, to allow regulators to audit the organization's environmental activities, and to address any emissions violations or legal implications of non-compliance. EPA also inspects firms and their facilities to ensure that they are in compliance with its standards.

Despite its name, EPA does not have lead authority for all U.S. environmental regulations. However, it does have responsibility for the major environmental programs including clean air, clean water, hazardous waste, toxics, and drinking water. The Department of Agriculture and Department of Interior have responsibility for most aspects of landuse, conservation and natural resource issues, and the Department of Energy regulates nuclear waste.

In addition to federal legislation, individual States set their own standards for many environmental issues specific to their jurisdictions. States are also responsible for ensuring compliance with federal or local standards. The enthusiasm with which States enforce environmental compliance varies.

"Current" State of Environmental Affairs

This section describes some of the U.S. environmental concerns and how environmental policy has attempted to address these problems. At the onset, it is important to note that many U.S. environmental data are old or simply are not collected. For example, the U.S. environmental agencies do not track greenhouse gas (GHG) emissions. In other cases, data collection is not consistent over time. Despite these shortcomings, the description below provides a brief overview of the environmental issues facing the U.S.

Air Quality

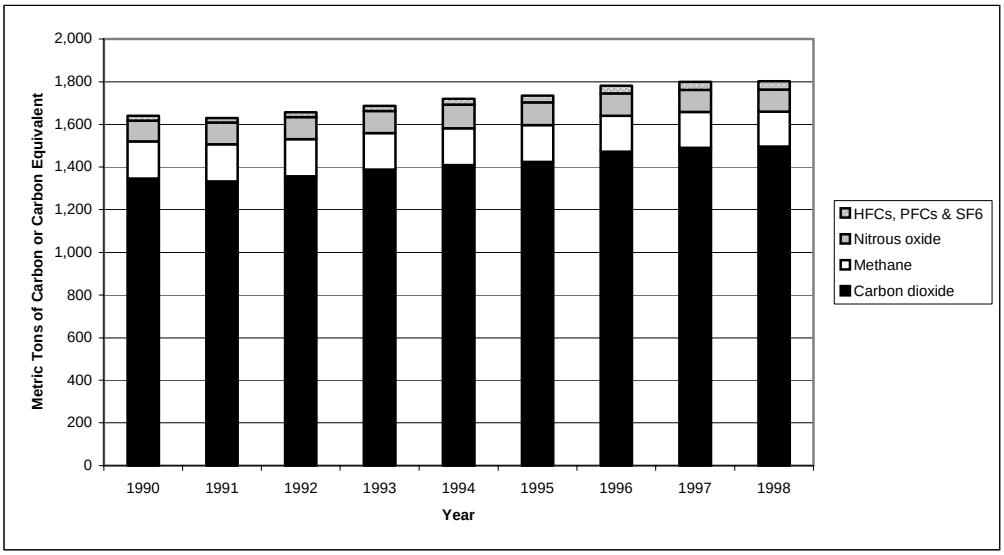
As in most OECD countries, levels of air and water pollution in the U.S. have reduced continually since the 1970s and are continuing to decline as revisions to the Clean Air and Clean Water Acts or periodic re-evaluation of regulations have resulted in progressively higher standards (O'Brien, 2001). Nevertheless, air quality is still a major issue, with relatively more attention now being paid to ozone concentrations and fine particulate matter. EPA has therefore established air quality standards in the form of limits on concentrations for six criteria air pollutants: sulfur dioxide (SO_2), nitrogen dioxide, lead, particulate matter, ozone, and carbon monoxide. Between 1986 and 1995, average airborne concentrations of lead dropped 78 percent, while those of carbon monoxide and SO_2 dropped 37 percent (USEPA, 1996). Concentrations of particulate matter also have improved, although not as much. Only recently, in 1997, did the EPA promulgate tighter standards for ozone and particulate matter (Davies & Mazurek, 1998). Nitrogen dioxide and ozone have not shown as much improvement over time (USEPA, 1995; USEPA, 1996). Both pollutants are related to urban smog.

The general improvement in air quality still has left some areas of the U.S. experiencing days when air pollution exceeds national health-based standards (Davies & Mazurek, 1998). Ozone, an indicator of smog, accounts for most of the failures to attain air quality standards. In 1996, approximately 127 million

people lived in counties classified as non-attainment areas for one or more criteria pollutants (Davies & Mazurek, 1998).

Global warming is caused by the same pollution emission sources that lead to poor air quality. The U.S., along with most other countries, has not met the 1992 UN Framework Convention on Climate Change (UNFCCC) commitment that GHG emissions be no higher in the year 2000 than in 1990 (O'Brien, 2001). Also, while the U.S. is a signatory to the Kyoto Protocol of the UNFCCC, it has not ratified UNFCCC. Doing so would commit the U.S. to substantial reductions in GHG emissions between 2008-2012 (O'Brien, 2001). Figure 6 shows U.S. production of GHGs. The U.S., with much higher emissions, both per capita and in absolute terms, than other countries, is a major contributor to increases in global concentrations of GHGs (O'Brien, 2001).

Figure 6: U.S. Emissions of Greenhouse Gases by Gas*



* Based on global warming potential; Source: USDOE, 1999.

Municipal Waste & Toxics

Since the 1960s, household and municipal waste management have improved in that the number of people receiving secondary or advanced levels of treatment increased from 4 million in 1960 to 143.7 million in 1988 (U.S. CEQ, 1990). Given low population density, the disposal of non-hazardous waste appears to be less of a problem generally in the U.S. than in many other OECD countries (at least as far as the federal authorities are concerned), even though per capita municipal waste generation is the highest in the world, and the waste recycling rate is relatively low (Davies & Mazurek, 1998). Toxic waste, with its more obvious impact on health and well-being, has a higher profile. Dealing with existing contaminated sites raises somewhat different problems from preventing or cleaning up after new releases of toxic substances, even if the environmental impacts are similar. In both cases the U.S. is becoming "cleaner" after two decades of action under "Superfund" and other legislation (Davies & Mazurek, 1998).

Water Quality

It is more difficult to understand the U.S. trends in water quality. Overall, it appears likely that the quality of the nation's rivers and lakes has improved significantly in a few places, but improved more

modestly or stayed the same in others (Davies & Mazurek, 1998). Water quality in estuaries and coastal waters has probably declined (Davies & Mazurek, 1998).

In 1996, between one-third and one-half of surveyed bodies of water did not meet their designated standards (OECD, 1996, p.75). There are at least two explanations for this widespread non-compliance. First, EPA takes the costs of compliance into account in an informal discretionary manner, therefore avoiding or delaying enforcement proceedings where compliance costs are clearly high. Second, because of the complications with the water systems or the limited number of instruments available, it is difficult to meet water quality (Davies & Mazurek, 1998). For example, there is a significant delay between the time a polluter makes a decision to reduce its environmental discharges and the time to implementing its decision and improve its water quality (Davies & Mazurek, 1998). Monitoring instruments are limited because the current regulatory system does not adequately address non-point sources of pollution from agriculture.

Summary of Traditional Approach

In summary, EPA's conventional command-and-control approaches to environmental regulation have seen some successes and some shortcomings. However, critics argue that this system is characterized by its inefficiency and that more flexible approaches may lead to faster environmental improvements at a lower cost. Moreover, the current regulatory system relies on courts to establish or enforce environmental standards, which is a more costly means of ensuring environmental protection. Collectively, these factors contribute to less efficient and potentially less effective outcomes for environmental protection.

EPA's Traditional Regulatory Approach

- EPA's conventional approach to environmental regulation has seen some successes and shortcomings.
- The traditional system is criticized for its inefficiencies and flexible approaches may lead to faster environmental improvements at a lower cost.
- Ensuring regulatory compliance has been difficult.

At the same time, other stakeholders argue that the existing command-and-control standards should be tightened, new standards should be promulgated, and associated compliance monitoring and enforcement efforts should be increased. In making their arguments, these individuals point to EPA's inability to ensure regulatory compliance with environmental laws (Nash & Ehrenfeld, 1996; Davies & Mazurek, 1998). Compliance has been difficult for EPA to achieve because Congress has continually under-funded regulatory inspections and audits (Davies, et al., 1996). At the same time, EPA's budget has continued to shrink, despite an increasing load of mandated responsibilities (Portney & Stavins, 2000). For these reasons, EPA has never inspected many regulated companies (Davies & Mazurek, 1998).

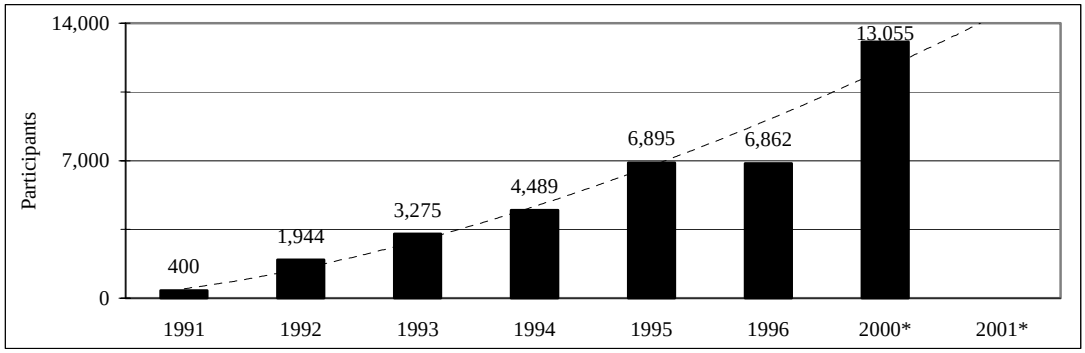
Shifting Focus

To address criticisms that the environmental regulatory system leads to inefficient environmental outcomes, over the past decade, EPA has given increasing attention to incentive-based policies and programs for environmental protection. This complementary approach to traditional regulation attempts to reward good behavior by utilizing incentives that encourage proactive environmental management. The new approach has roots in the Pollution Prevention Control Act of 1990, the Clean Air Act Amendments of 1990, and the Emergency Planning and Community Right-to-Know Act. These laws have allowed EPA to provide incentives to organizations that prevent pollution and have created opportunities for the agency to rely on environmental signals to ensure conformity with EPA's goals. In doing so, EPA has developed voluntary environmental programs (VEP), information-based environmental requirements, emissions trading, and pollution taxes. Each of these different policy tools is described further below.

Voluntary Environmental Programs

Since the passage of the Pollution Prevention Act and the Clean Air Act Amendments, EPA has initiated more than 40 VEPs (Mazurek, 1998) to encourage proactive environmental behavior among companies. A VEP is a program, code, agreement, or commitment that encourage organizations to voluntarily reduce their environmental impacts beyond the requirements established by the environmental regulatory system (Carmin, Darnall & Mil-Homens, 2003). Within EPA, VEPs are defined simply as programs designed to motivate people and organizations to take actions that benefit the environment beyond what is required by regulation. EPA's voluntary programs characteristically employ market forces to provide economic benefits to participants, use recognition, information, and other incentives, and encourage actions beyond compliance with environmental requirements and/or provide an alternative way to achieve a regulatory objective. By 1998, estimates suggested that there were 13,000 volunteers participating in EPA's VEPs alone (Mazurek, 1998), as illustrated in Figure 7. In each case, VEP participation signals information to regulators and other interested parties about an organization's latent environmental activities (Darnall and Carmin, 2003).

Figure 7: Participation in EPA's VEPs, 1991-2001†



†Adapted from Mazurek (1998). * Estimated.

VEPs are particularly attractive to regulators because of efficiency arguments. The rationale is that by creating these programs, or by encouraging industry groups or NGOs to do the same, government is able to spend fewer resources monitoring organizations that are ahead of the regulatory curve. Resources can instead be used for addressing organizations that fail to achieve their regulatory obligations. Similarly, organizations that participate in VEPs and therefore "signal" their "greenness" have the potential to make the environmental regulatory system less relevant to them, while at the same time improving their relationships with regulators and differentiating themselves from their competitors (Darnall and Carmin, 2003).

Organizations are choosing to participate in VEPs for a variety of reasons, many of which are related to the various external regulatory, market and social forces exerted on them. Other organizations participate in VEPs to draw on their existing internal capabilities in order to create competitive advantage. These internal motivators are important for regulators to understand since the effectiveness of their VEPs depend on how organizations respond to them. By appreciating the motivations of participating enterprises, regulators may create institutional structures that curb opportunism and thus increase the success of the programs themselves. Moreover, as regulators increasingly expand their use of incentive-based voluntary programs, it will be important for them to understand which organizations are more likely to participate in their VEPs so that they may better target specific industries and firms of interest.

Despite the attractiveness of VEPs, they also have problems. First, if VEPs are not monitored adequately, participating enterprises are more likely to free-ride and receive credit for their participation without improving their environmental performance (King & Lenox, 2001; Darnall et al., 2003). Second, EPA is challenged with creating credible monitoring standards while at the same time seeking to expand the number of participants in its VEPs (Darnall et al., 2003). As a result, many VEPs are developed with low overall requirements to encourage more widespread participation, but at the expense of potentially greater environmental gains (Darnall et al., 2003).

Information-based Environmental Policies

By providing information to interested parties about firms' environmental activities, and by assuming that participants adhere to program requirements, VEPs may indicate to regulators and the public which firms are environmental leaders (Darnall et al., 2003). Similarly, policies, such as Title III of EPA's Toxic Release Inventory, also rely on information to encourage good environmental behavior. An outgrowth of the Emergency Planning and Community Right-to-Know Act (EPCRA) of 1986, the TRI is the most comprehensive U.S. environmental database. The fact that these data are public has affected the regulated community in several ways. For example, the announcement of firms' toxic release quantities has been credited with short term reductions in firms' stock price (Konar & Cohen, 1997; Hamilton, 1995). Second, reporting firms' volumes of TRI chemicals also have been associated with significant changes in firms' environmental strategies that include participation in VEPs (Arora & Cason, 1996; King & Lenox, 2000).

Despite the obvious appeal of information-based regulations, like EPCRA, they have two important shortcomings. First, since TRI data are self-reported, it is difficult to know whether a firm's emissions reductions are a result of environmental performance improvements or modified chemical measurement schemes. Second, to retrieve federal environmental data, individuals must know how to access a particular firm's environmental information and be able to interpret complex data that often span multiple media (land, air, water, toxics).[2] An individual's investment in becoming informed is therefore a deadweight loss that is itself a manifestation of the inefficiency caused by the dearth of information (Miller, 1992) the policy is trying to address. To attend to these issues, a number of non-government organizations have attempted to digest TRI data so that it they are more meaningful for public consumption. However, because of its inherently technical nature, the general public is largely ignorant about TRI and the information it contains. As a result, the policy is limited in its ability to lead to more widespread changes in polluter behavior.

Tradable Emissions Permits

Other environmental policies and programs rely on market mechanisms. For example, EPA's emissions trading programs are the cornerstone of its market-based approach to environmental protection. Beginning in 1974, EPA began experimenting with emissions trading as part of the Clean Air Act's program for improving local air quality (Stavins, 2000). Firms that reduced emissions below the level required by law received "credits" usable against higher emissions elsewhere. Companies could use "netting" and "bubbles" to trade emissions reductions among sources within the firm, as long as total combined emissions did not exceed an aggregate limit (Stavins, 2000). Emissions from all the components of an industrial plant were combined and considered a single source for the purposes of regulation.

[2] EPA's Toxic Release Inventory is more user-friendly than most of EPA's environmental databases—if the user is seeking facility-level data. For users who seek firm-level data, the TRI is cumbersome and requires extensive research regarding facility-firm relationships, which discourages interested parties from becoming informed about firm-level environmental activities.

Then in 1990, the Clean Air Act Amendments were passed. The focal point of this legislation, Title IV, was a tradable permit system that regulated SO_2 emissions. The legislation was the outcome of numerous legislative initiatives during the 1980s aimed at reducing acid rain caused by electric utilities. The law sought to achieve a 10 million ton annual reduction in SO_2 emissions from 1980 levels by the year 2010. About 8.5 million tons of this reduction was to come from electric utilities (Davies, et al., 1996).

Title IV has two unique features. First, since 1995, it has granted utilities authorization to emit SO_2 in the form of emissions allowances. Second, the law imposed an 8.95 million ton aggregate emissions cap as a standard of performance that utilities must operate within; the regulation therefore created a performance standard that does not specify what actions the firm should take (Burtraw, 1996). The result was a greater flexibility in how the utility industry reduced its SO_2 emissions (Davies, et al., 1996). Utilities could reduce their emissions by switching to low-sulfur coal, installing flue-gas desulfurization equipment (scrubbers), closing inefficient plants, purchasing emissions allowances, increasing reliance on renewable energy, reducing electric power usage, or developing other alternative strategies (Davies et al., 1996). Companies that reduced their emissions below their number of allowances could then trade their surplus SO_2 allowances with other facilities, sell them, or bank them to cover emissions in future years (Davies et al., 1996).

The success of the SO_2 trading system has opened markets for cleaner low sulfur coal, expanded environmental technology markets and lead to environmental innovations that allow power generating facilities to operate more efficiently (Burtraw, 1996). Moreover, by deciding in advance how many permits would be issued in a given year, environmental regulators have been able to more efficiently control SO_2 pollution (Stavins, 2000).

The nitrogen oxide trading scheme was introduced on a smaller scale in twelve northeastern states, after a number of experiments in different areas (Stavins, 2000). In general, this program started successfully, and will be enlarged to a number of other states.

Despite their promise for environmental improvements, emissions trading has some complications. For example, it is difficult to determine the number of permits that should be issued (Blinder, 1987). However, setting the environmental target is a problem with all environmental policies, and in the case of ‘cap-and-trade’ tradable permit systems the issue is more transparent. Another complication with emissions trading programs is that political and administrative factors largely dictate the markets in which they can and should be used. For instance, if environmental impacts are highly differentiated spatially or temporally, it may be difficult to design an efficient scheme. Despite these concerns, the success of the tradable permits programs has won over many people who earlier had opposed them (Stavins, 2000).

Pollution Taxes

Regulators have also relied on taxes to curb pollution emissions. Taxes include effluent charges, deposit-refund systems, gasoline taxes, and user charges. In general, taxes are established at a level equal to the sum of the pollution costs to society. Also known as a Pigouvian tax, pollution taxes align polluters’ interests with the interests of society.

Most applications of pollution taxing systems in the U.S. have probably not achieved their anticipated environmental improvements, either because of their structure or because of the low levels at which charges have been set (Stavins, 2000). Moreover, while this type of policy is hailed as being more efficient than traditional regulation, it may not be as efficient as a pollution cap or emissions trading (Blinder, 1987). Nevertheless, it appears that some of these systems may have affected firm behavior (Stavins, 2000).

Summary

In summary, the EPA has made significant gains in environmental improvement by relying on its traditional environmental regulatory system. However, this system is criticized for its inefficiencies, which is why the agency is exploring incentive based policies and programs.

In developing our survey, we asked facilities about how they responded to both the traditional system and the incentive-based approaches. Our results are presented in the following sections.

Summary of Shifting EPA Focus

- EPA is now considering incentive-based policy instruments for environmental protection.
- Examples include:
  1. Voluntary environmental programs (VEP)
  2. Information-based environmental requirements
  3. Pollution trading
  4. Emissions taxes
- These environmental policy tools provide a backdrop for many of the questions asked in the OECD survey.

ENVIRONMENTAL MANAGEMENT & PERFORMANCE

This section describes the environmental management practices of the facilities that participated this study. It begins by describing which individual in each organization is generally responsible for the facility's environmental affairs. Additional context is then provided by evaluating the management practices facilities have implemented to support their environmental management practices. The section concludes by evaluating facilities' environmental performance over the last three years and by discussing how environmental performance varied for enterprises that chose to develop EMSs.

Environmental Management Systems & Tools

Some businesses have experimented with EMSs for many years. Companies such as 3M and IBM, for example, began implementing portions of their EMS over 25 years ago. Yet, prior to 1996, there was no major trend toward widespread adoption or standardization, perhaps due to a lack of international acceptance and understanding of the economic rationale (Darnall et al., 2000). However, publication of the ISO 14001 standard changed this trend, as it generated great interest in the business community (Darnall et al., 2000). ISO 14001-certified facilities are accredited by independent third-party registrars as adhering to the standard's provisions. Facilities that certify their EMSs to ISO 14001 must consider their environmental impacts and aspects systematically, and include five broad components: an environmental policy, an environmental plan, an implementation strategy, monitoring and corrective-action procedures, and management review.

Some business purchasers and government procurement officers already require their suppliers who have adopted an EMS receive greater preference than non-adopters in their purchasing decisions, as EMS adoption signals a company's commitment to systematic environmental management and to continuous improvement of their environmental performance (Darnall. et al., 2000). General Motors, for example, requires all its suppliers to adopt certified EMSs by December 31, 2002. Similarly, Ford Motor Company mandated that all its suppliers be ISO 14001 certified by July 1, 2003. Widespread company mandates such as these have the potential to profoundly impact supply chain relationships.

Because of its broad applicability, EMSs are particularly attractive to regulators, because they do not interfere with the EPA's regulatory objectives and may in fact help the federal and state regulators to achieve its environmental goals. This potential has motivated states and EPA to offer firms incentives to implement EMSs (Andrews et al., 2003). Since the late 1990s, state and federal environmental regulators have investigated the use of EMSs as a regulatory tool. Regulators' interest in EMSs is rooted in the belief that organizations having adopted EMSs may meet or exceed their regulatory commitments, therefore making the environmental regulatory system less relevant. For example, the Multi-state Working Group on EMSs (MSWG) together with EPA EMS sponsored pilot programs in ten states. The goal of these programs was twofold: to encourage EMS adoption in approximately 90 enterprises and to assess the potential EMSs may have for future regulation (Andrews et al., 2003). Following on the heals of this program, in 2000, EPA created its National Environmental Performance Track Program to recognize organizations that consistently meet their legal requirements and implement high-quality EMSs. If EMSs can be shown to increase environmental performance, then regulators may want to use them as a more widespread policy tool to help achieve their environmental protection goals.

In addition to potentially improving a facility's environmental management, the preliminary evidence shows that EMSs have the potential to influence other aspects of company operations, including consumer and public relations (Andrews et al., 2003). Over the last 10 years, consumers have increasingly demanded environmentally friendly products. For example, estimates of the sale of "green" products are

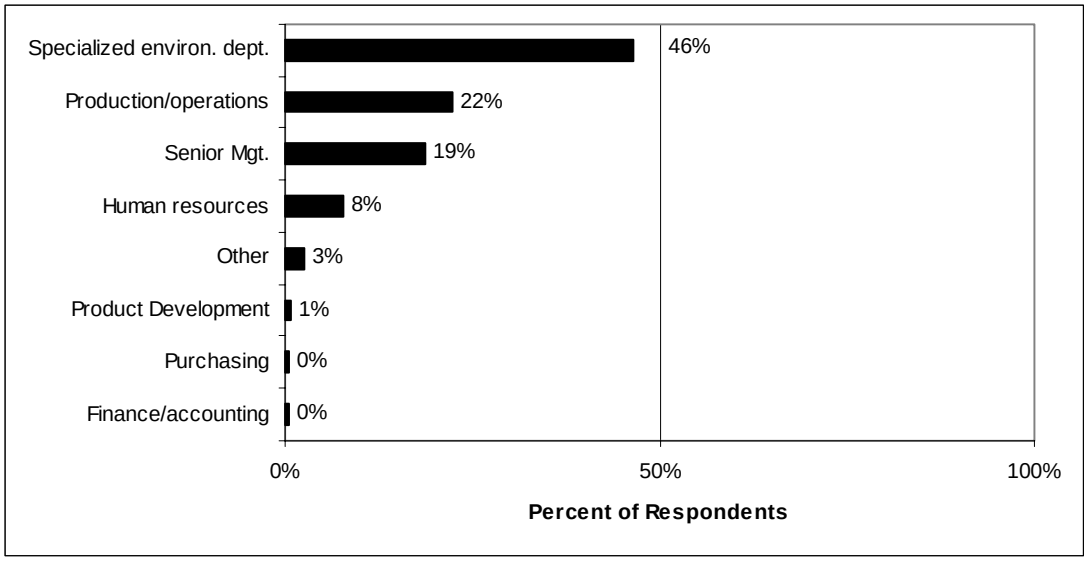
over $120 billion per year and expected to reach $200 billion per year by the end of the decade (U.S. EPA, 1990). Following this trend, more than 75 percent of U.S. consumers consider a company's environmental image in their shopping decisions (Kleiner, 1991). Consistently, consumers attest that the environment, broadly defined, is near the top of the list of public concerns (Portney, 1993). Facilities that adopt EMSs may better satisfy these consumer demands for environmentally conscious products (Darnall et al., 2000). Moreover, EMS adopting facilities may be better positioned to market their products as environmentally friendly and bolster their environmental reputation (Darnall et al., 2000). As a result, EMSs have the potential to reduce organizations' environmental impacts (as well as their related health and safety liabilities) and to enhance financial performance too.

However, not all businesses chose to adopt EMSs, and some consider EMS adoption but then elect to invest their resources in other areas. This occurrence is particularly interesting because it implies that adopters see greater value in EMSs than organizations that consider it but choose against adoption (Darnall, 2003a). However, little is known about firms' EMS adoption decisions, in large part because EMSs are a relatively recent development and we have not had enough time to research them.

The remainder of this section relates facilities' basic environmental practices with their decision to adopt an EMS. It begins by describing facilities' basic management practices and later associates these practices to their EMS adoption decisions.

In order to address their environmental activities over time, 95 percent of the facilities responding to the OECD survey had at least one person with explicit responsibility for environmental concerns. The location of this individual within the facility is shown in Figure 8. Almost half of these individuals (46 percent) were located in a specialized environmental department, such as a department of health, safety and the environment (HS&E), while about a quarter (22 percent) were located in the facilities' production or operations departments. Finally, 19 percent of respondents indicated that the person with explicit responsibility for environmental concerns occupied a position in senior management.

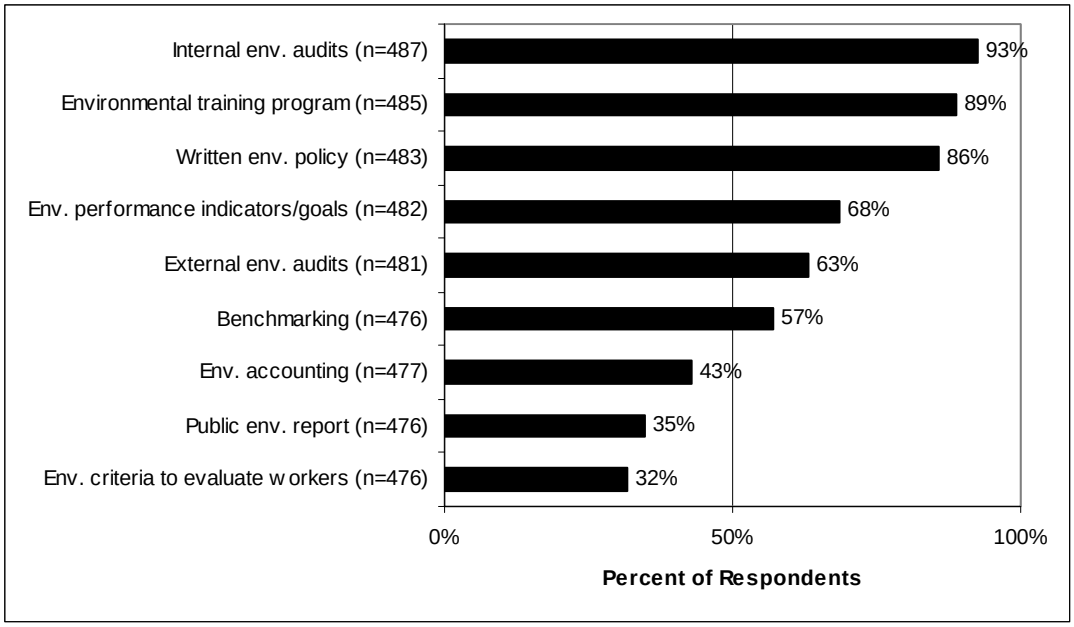
Figure 8: Location of Individuals Responsible for Environment (n=463)



While not all facilities had EMSs in place, almost all enterprises had implemented some EMS components. Figure 9 describes the practices that facilities had established in order to implement

environmental management. Almost all (93 percent) of the facilities carried out some type of internal environmental audit. And about two-thirds of them (63 percent) also had external audits of their environmental activities.

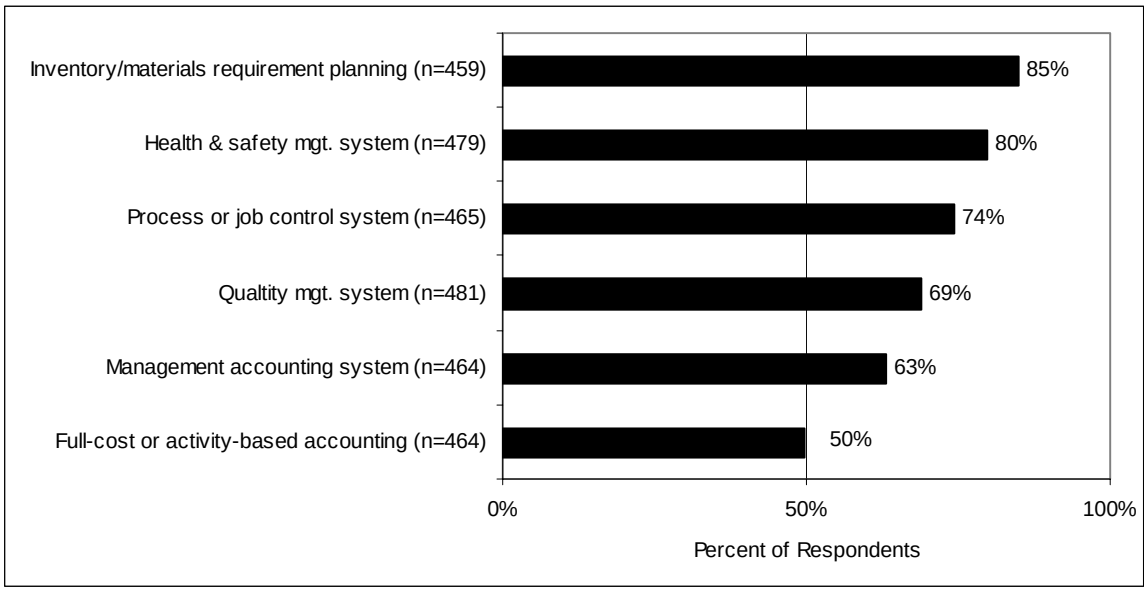
Figure 9: Facilities' Environmental Management Practices



Most facilities considered environmental training an important part of their environmental management strategy since 89 percent of the respondents reported that their enterprises utilized formal environmental training programs for their employees. Similarly, 86 percent reported that they had a written environmental policy and more than two-thirds (68 percent) had established environmental performance indicators or goals. Far fewer facilities went a step further to publish reports of their environmental activities. About one-third (35 percent) indicated that their organizations published environmental reports and about the same amount (32 percent) relied on environmental criteria to evaluate or compensate their employees.

Facility managers were also asked about the types of management practices that they implemented, such as quality management systems, health and safety management systems and inventory/materials requirement planning. Each of these management practices requires basic organizational capabilities that may also foster more systematic environmental management. These practices may also reduce the cost of EMS adoption (Darnall & Edwards, 2004). In general, more than three-quarters of the facilities indicated that they relied either on inventory/materials planning (85 percent), health and safety management systems (80 percent) or process/job control systems (74 percent), as shown in Figure 10. About 70 percent of environmental managers reported that their organizations had implemented quality management systems and about two-thirds (63 percent) had implemented management accounting systems. Finally, half of the facilities (50 percent) had implemented full-cost or activity-based accounting systems.

Figure 10: Practices Established to Facilitate Environmental Management



Since facilities have been introducing proactive environmental management practices at an increasing pace, we assessed the extent to which basic management practices were integrated into facilities' environmental strategies. For example, with the introduction of ISO 14001, we might expect a facility to integrate its quality management system into its EMS, because of the systematic links between the two management practices. Figure 11 shows that health and safety management systems were most frequently integrated into facilities' environmental activities. About 93 percent of environmental managers reported that their facilities' health and safety management systems were either partially or fully integrated into their environmental activities. Similarly, about 76 percent of environmental managers indicated that they had either fully or partially integrated environmental considerations into their process or job control systems. Full-cost accounting or activity-based accounting was least integrated into facilities' environmental management practices. Despite the lower rates of integration, almost two-thirds (63 percent) of facilities reported that these accounting systems were either fully or partially incorporated into their environmental activities.

The basic management practices, described in Figure 11, are considered complementary capabilities for environmental management. Organizations often use these capabilities as a basis upon which to adopt an EMS (Darnall, 2003b). At the same time, EMS adoption may encourage organizations to implement additional management system activities (such as those described in Figure 10) because of the complementary capabilities required to do both.

Overall about three-quarters (74 percent) of the facilities reported that they *considered* adopting an EMS. Of these facilities, about one-half (45 percent) followed through with implementing an EMS, as indicated in Figure 12. About one-fifth (22 percent) of respondents indicated they were ISO 14001-certified and only one percent had certified to EMAS. In each case, facilities that were certified to EMAS were also certified to ISO 14001.

Figure 11: Integration of other Management Practices with Environment

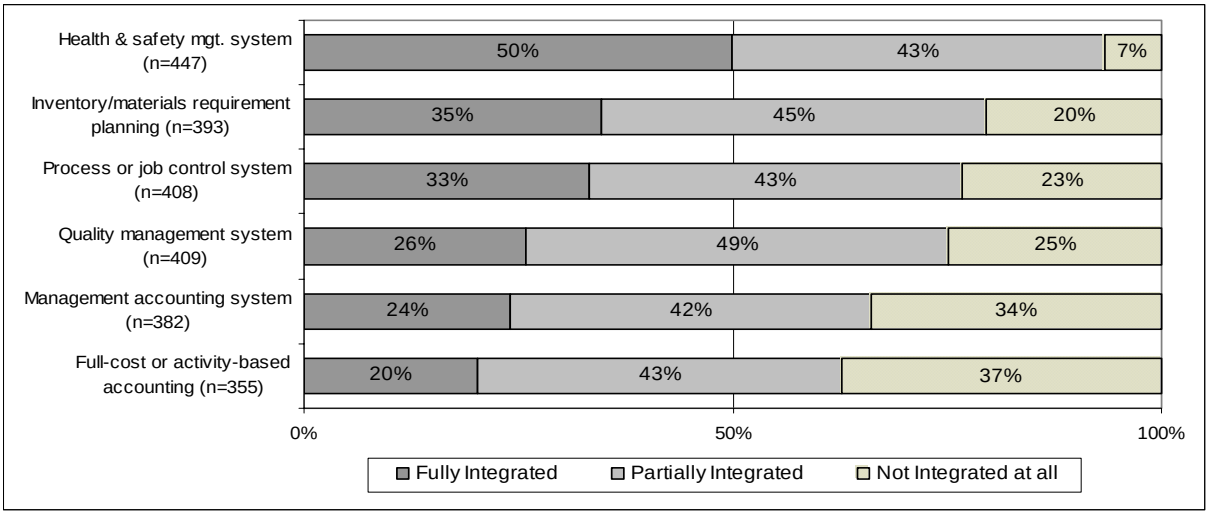
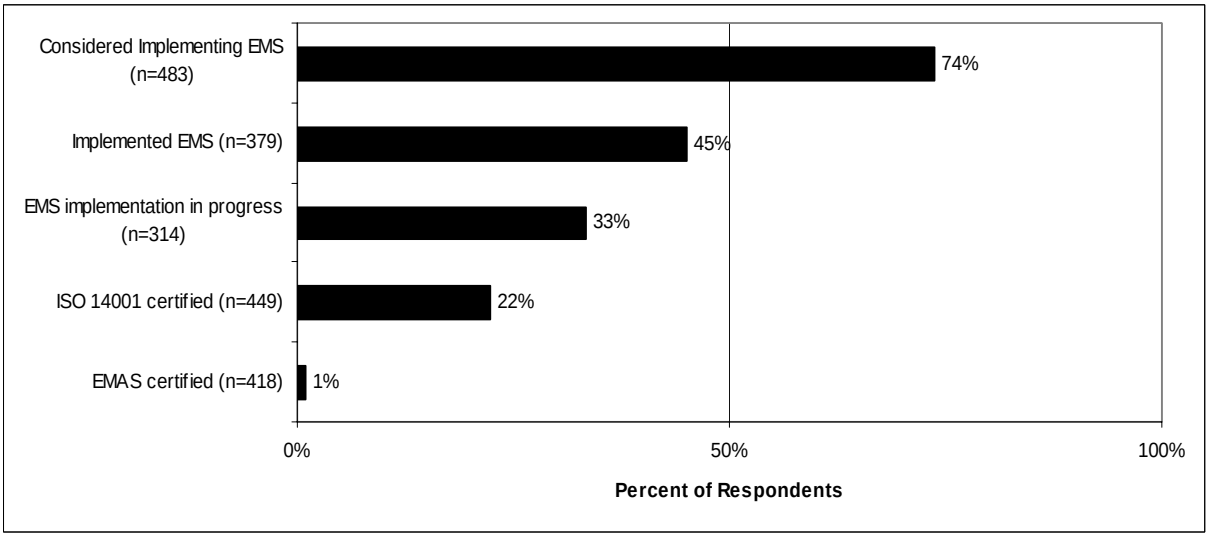


Figure 12: Diffusion of EMS Adoption



To evaluate the differences among EMS adopters and non-adopters, we used Chi-square tests, which led to several important results. First, EMS adopters more frequently had a parent company and more often were traded on the stock market (see Table 3). These facilities therefore had both parent corporations and shareholders for which they were accountable. Additional factors support these arguments in that EMS adopters were less frequently SMEs, but very large companies having more than 499 employees. Facilities that elected to adopt EMSs also more frequently operated in global markets than in national markets. Finally, EMS adopters more frequently implemented quality management systems, health and safety management systems and process/job control systems than non-adopters. These results support prior research on EMS adoption indicating that organizations implementing these systems also adopt quality management systems and health and safety management systems more

frequently (e.g. Darnall, 2003a; Darnall, 2003b). EMS adopters also allocate more of their budget to environmental matters and have dedicated departments to environmental affairs more often then non-adopters.

Table 3: Characteristics of EMS Adopters

Facility Characteristic	EMS	Non-EMS	p-value
Has parent company (n=368)	83%	58%	0.000***
Traded on stock market (n=371)	59%	33%	0.000***
Facility size			
< 100 employees (n=379)	15%	28%	0.002***
100-249 employees (n=379)	18%	24%	0.179
250-499 employees (n=379)	28%	27%	0.853
>499 employees (n=379)	39%	22%	0.000***
SME (n=379)	33%	52%	0.000***
Operates in national markets (n=379)	44%	21%	0.034**
Operates in global markets (n=379)	63%	50%	0.010***
Budgeted R&D for environmental matters (n=365)	15%	7%	0.010***
Implemented quality management system (n=376)	83%	57%	0.000***
Has environmental department (n=376)	82%	69%	0.000***
Adopted health & safety management systems (n=371)	89%	74%	0.000***
Implemented process/job control (n=361)	81%	67%	0.002***

* Statistically significant at $p \leq 0.10$; ** Statistically significant at $p \leq 0.05$; *** Statistically significant at $p \leq 0.01$

Besides evaluating the basic organizational differences between EMS adopters and non-adopters, we also considered how their management practices differed. More specifically, we evaluated how EMS adopters differed from non-adopters, and how facilities in the process of adopting an EMS differed from non-adopters. To test for these differences we used Chi-square tests to evaluate the extent that each group integrated environmental practices into their other management practices ("Fully," "Partially," or "Not at all").

The results showed that in every case, EMS adopters more frequently integrated environmental activities into other management systems, as shown in Table 4. These findings were also partially true for facilities that were *in the process* of EMS adoption. Interestingly, when testing the relationship between other management practices and whether facilities had implemented *certified* EMSs or not, only one difference emerged: facilities with certified EMSs integrated their environmental practices into quality management systems more than non-certified organizations.

These results suggest that there are fewer differences between facilities that certified their EMS and those that selected not to certify their EMS. Instead, organizational differences may largely exist between adopters of uncertified EMSs and non-EMS adopters, at least as they relate to other management practices that provide complementary capabilities for environmental management. With respect to facilities that were in the process of adopting an EMS, there were no statistically significant differences between them and non-EMS adopters, which is why they are not included in table 4.

Table 4: Integration of Environmental Activities with other Management Practices among EMS Adopters & Non-adopters

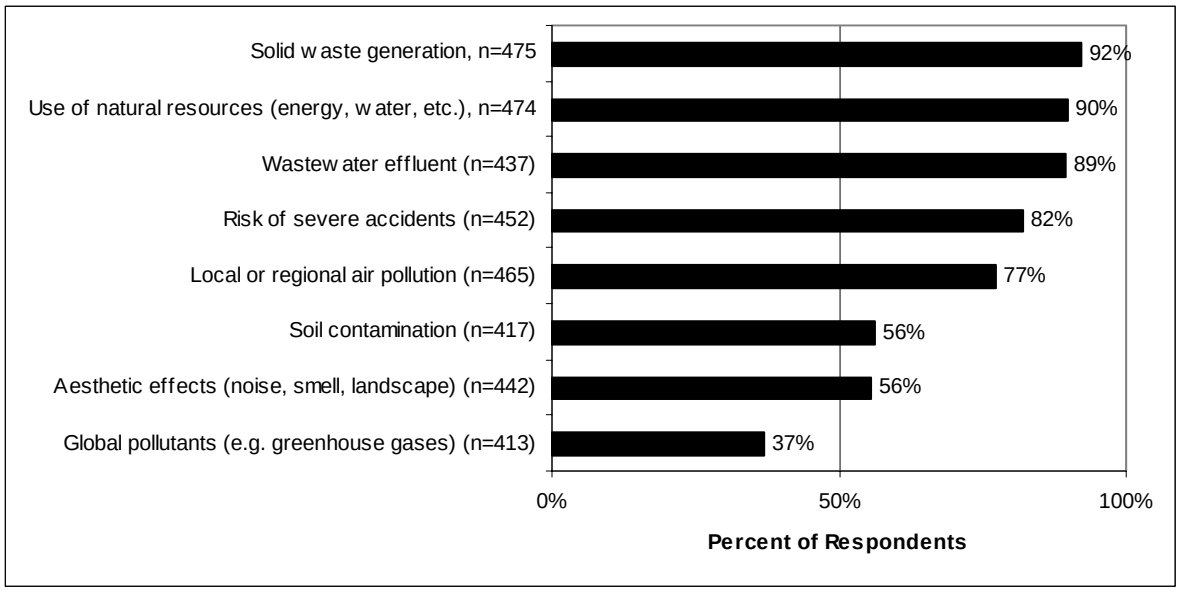
	Integration of Environmental Activities			
Other Management Practice	Not at all	Partially	Fully	p-value
Comparison of EMS Adopters to Non-adopters[†]				
Quality management system (n=317)	13%	44%	43%	0.000***
	42%	48%	10%	
Health and safety management system (n=348)	6%	29%	65%	0.000***
	8%	50%	42%	
Full-cost or activity-based accounting (n=277)	29%	40%	31%	0.000***
	48%	39%	13%	
Management accounting system (n=295)	27%	40%	34%	0.002***
	43%	39%	18%	
Process or job control system (n=317)	14%	43%	43%	0.000***
	33%	43%	24%	
Inventory/materials requirement planning (n=329)	25%	39%	36%	0.002***
	41%	37%	21%	
Comparison Facilities in the Process of EMS Adoption to Non-adopters[††]				
Quality management system (n=248)	16%	58%	26%	0.000***
	42%	48%	10%	
Health and safety management system (n=282)	5%	53%	42%	0.688
	8%	50%	42%	
Full-cost or activity-based accounting (n=226)	31%	54%	15%	0.047**
	48%	39%	13%	
Management accounting system (n=244)	28%	53%	19%	0.043**
	43%	39%	18%	
Process or job control system (n=258)	21%	43%	36%	0.050**
	33%	43%	24%	
Inventory/materials requirement planning (n=270)	23%	51%	26%	0.012**
	41%	37%	21%	

[†] Top values represent EMS adopters. Bottom values represent facilities that have neither fully adopted an EMS nor were in the process of EMS adoption.
[††] Top values represent facilities in the process of EMS adoption. Bottom values represent facilities that are non-EMS adopters.
* Statistically significant at $p \leq 0.10$; ** Statistically significant at $p \leq 0.05$; *** Statistically significant at $p \leq 0.01$

Environmental Measures, Innovation & Performance

To understand whether facilities monitored different types of environmental performance measures, we asked whether they regularly evaluated eight common environmental concerns. Figure 13 summarizes the responses of environmental managers and shows that most facilities regularly monitored their solid waste generation (92 percent), their use of natural resources (90 percent) and their wastewater effluent (89 percent). However, just over half regularly monitored their soil contamination (56 percent) and aesthetic effects (56 percent). Finally, far fewer regularly monitored their production of global pollutants such as GHGs (37 percent). The lower monitoring rate for GHG pollutants is most likely due to the fact that the U.S. has not implemented the Kyoto Protocol, and therefore reductions in GHG pollutants is largely on a voluntary basis. It is also important to note that a significant portion of facility managers failed to indicate whether they monitored their global pollutants. The non-response associated with this question is most likely due to the fact that facility managers did not monitor global pollutants and, rather than indicating their lack of monitoring, they left the question blank. As a result, the actual rate of monitoring for global pollutants among the population of manufacturing facilities is likely to be less than the reported 37 percent.

Figure 13: Environmental Performance Measures Regularly Monitored



Despite the fact that facility managers did not *regularly* monitor several environmental performance measures, some monitoring occurred, albeit irregular. This notion is supported by the actions facilities took to reduce their environmental impacts. For example, only 56 percent of the facility managers reported that they *regularly* monitored their soil contamination. However, 74 percent of facilities indicated that they took actions to reduce their soil contamination (see Figure 14). Similarly, while just over half (56 percent) of facility managers *regularly* monitored their aesthetic effects (such as noise, smell, landscape), about two-thirds (65 percent) reported that they took actions to minimize their aesthetic impacts.

To test for differences between EMS adopters and non-adopters and their discrete actions to reduce their environmental impacts, we used both Chi-square and Fisher's exact tests, depending on the number of cell counts in each frequency table. Fisher's exact is a nonparametric test that determines statistical differences between two categorical variables. For larger samples, Fisher's exact approximates Chi-square relationships.

The results indicated that EMS adopters more frequently took actions to reduce their natural resource use, solid waste, wastewater effluent, air pollution, global pollutants, and soil contamination, as shown in Table 5. Other significant differences were also found among facilities that were merely in the process of EMS adoption and those that had not considered EMS adoption at all. The findings indicate that facilities in the process of EMS adoption more frequently took actions to reduce their natural resource use, solid waste, global pollutants, and soil contamination.

Figure 14: Actions Taken to Reduce Environmental Impacts

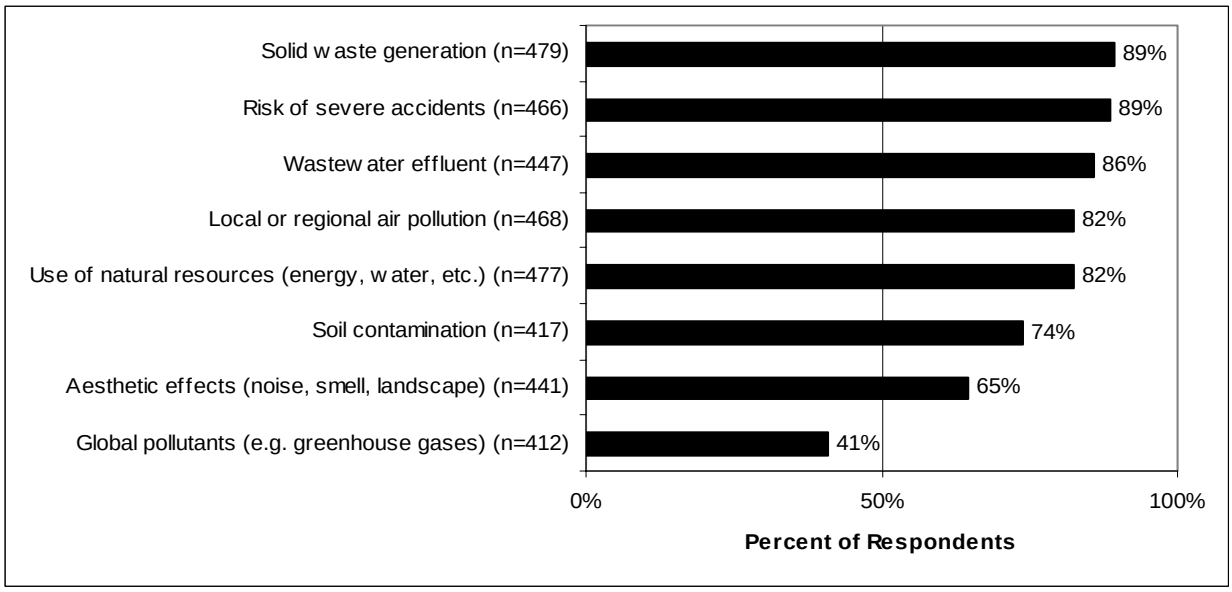


Table 5: Actions Taken to Reduce Environmental Impacts among EMS Adopters & Non-adopters

	Facility Comparisons[†]					
Facility Characteristic	In Progress/ Non-adopter	p-value	EMS Adopter/ Non-adopter	p-value	Certified EMS/ Non-certified EMS	p-value
Use of natural resources (energy, water, etc.)	87%	0.002***	93%	0.000***	94%	0.093*
(n=305, 368, 438)	71%		71%		82%	
Solid waste generation	90%	0.069*	97%	0.000***	100%	0.062*
(n=308, 370, 440)	83%		83%		89%	
Wastewater effluent	88%	0.172	90%	0.018**	94%	0.286
(n=281, 347, 413)	81%		81%		85%	
Local or regional air pollution	83%	0.334	88%	0.014**	94%	0.092*
(n=301, 361, 431)	78%		78%		81%	
Global pollutants (e.g. greenhouse gases)	47%	0.010***	48%	0.001***	41%	0.836
(n=261, 316, 379)	31%		31%		39%	
Aesthetic effects (noise, smell, landscape)	64%	0.858	66%	0.579	72%	0.333
(n=289, 336, 404)	63%		63%		63%	
Soil contamination	80%	0.031**	76%	0.096*	79%	0.461
(n=267, 323, 385)	68%		68%		73%	
Risk of severe accidents	89%	0.598	90%	0.318	97%	0.237
(n=298, 318, 428)	87%		87%		88%	

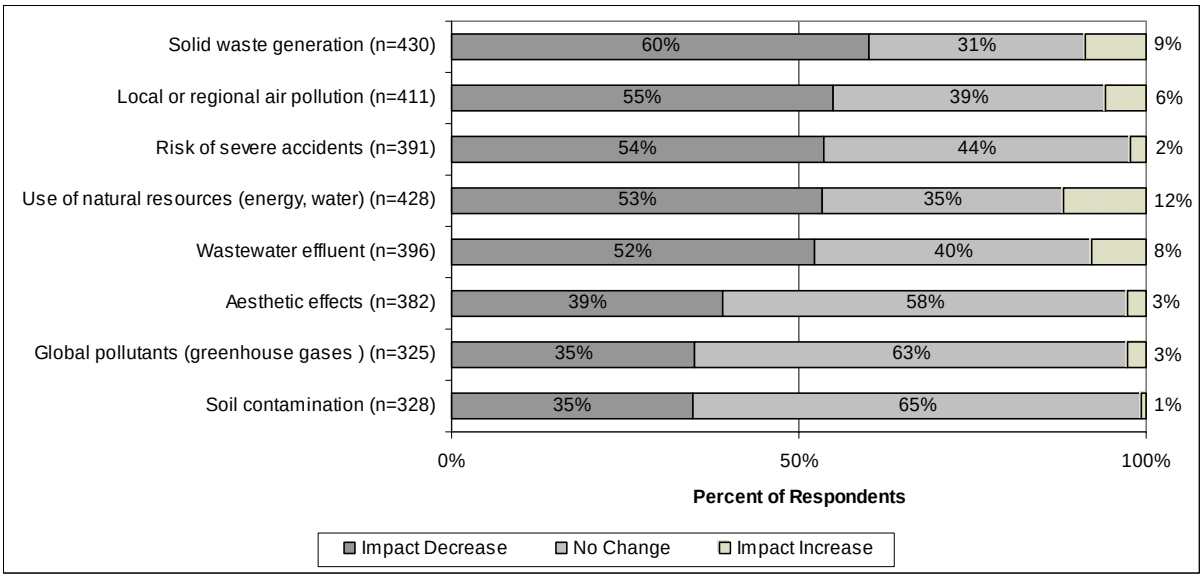
[†] Top values represent EMS adopting facilities, as denoted by the column title (EMS adoption in-progress, completed EMS adopter, and certified EMS). Bottom values represent comparison facilities (either non-EMS adopter or non-certified EMS adopter).
* Statistically significant at $p \leq 0.10$; ** Statistically significant at $p \leq 0.05$; *** Statistically significant at $p \leq 0.01$

In comparing facilities that had certified their EMSs to either ISO 14001 or EMAS and whether they took actions more frequently to reduce environmental impacts than non-certified organization, two

differences emerged. First, the results of the statistical analysis showed that facilities with certified EMSs more frequently acted to reduce their use of natural resources. Second, certified organizations acted more frequently to reduce their generation of solid waste than was the case for non-certified enterprises.

To assess facilities' environmental performance, environmental managers were asked about whether during the last three years their organizations experienced a decrease or increase in eight environmental impacts (per unit of output). In general, most of the facilities reported that at least one of eight environmental impacts decreased (see Figure 15). Greater gains were made in solid waste and air pollution reductions. About 12 percent of facilities reported increases in their impacts to natural resources such as energy and water consumption.

Figure 15: Changes in Environmental Impacts per Unit of Output in the Last Three Years



In considering how different types of facilities reduced their impacts at different levels, we evaluated whether facilities in the process of adopting an EMS performed compared to non-adopters, how EMS adopters performed compared to non-adopters, and how facilities with certified EMSs compared to facilities with an uncertified EMS. Facility managers were given five options to indicate the degree of change in their environmental impacts per unit of output as either "Significant decrease," "Decrease," "No change," "Increase" or "Significant increase". Fisher's exact test was used to compare the Likert scale responses. While statistical differences were based on all five Likert categories, for simplicity in conveying the results, we combined responses for managers reporting "Significant decrease" or "Decrease."

Similar to the patterns identified earlier, facilities that implemented EMSs reaped greater improvements in their environmental performance (see Table 6). This relationship also existed for facilities that were merely in the process of adopting an EMS. All types of EMS adopters appeared to have benefited from reduced natural resource use, wastewater effluent and solid waste generation. Facilities that fully implemented their EMS also reduced their solid waste, air pollution, and risk of severe accidents more than non-adopters. When comparing facilities with certified EMSs to those that elected not to certify their EMS, some differences emerged, although limited. Facilities with certified EMSs reduced their use of natural resources and their wastewater effluent more than facilities with non-certified

EMSs. Finally, it appears that facilities were not relying on their EMS to reduce aesthetic effects of their operations such as odor, landscape and noise because in every instance, EMS adopters did not differ from non-adopters.

Table 6: Environmental Impact Reductions Over the Last Three Years among EMS adopters & Non-adopters

	Facility Comparisons[†]					
Environmental Impact	In Progress/ Non-adopter	p-value	EMS Adopter/ Non-adopter	p-value	Certified EMS/ Non-certified EMS	p-value
Use of natural resources	60%	0.021**	65%	0.000***	76%	0.052*
(n=294, 359, 423)	40%		40%		51%	
Solid waste generation	63%	0.127	71%	0.001***	79%	0.184
(n=295, 361, 425)	50%		61%		59%	
Wastewater effluent	58%	0.015**	63%	0.000***	78%	0.052*
(n=266, 333, 393)	39%		39%		49%	
Local or regional air pollution	52%	0.210	66%	0.002***	64%	0.521
(n=286, 342, 407)	47%		47%		54%	
Global pollutants	44%	0.006***	43%	0.006***	16%	0.403
(n=224, 271, 319)	23%		23%		35%	
Aesthetic effects	40%	0.357	39%	0.966	40%	0.723
(n=268, 318, 380)	38%		38%		38%	
Soil contamination	44%	0.039**	37%	0.288	38%	0.735
(n=222, 276, 327)	27%		27%		33%	
Risk of severe accidents	52%	0.709	62%	0.044**	75%	0.158
(n=268, 331, 390)	47%		47%		52%	

[†] Top values represent EMS adopting facilities, as denoted by the column title (EMS adoption in-progress, completed EMS adopter, and certified EMS). Bottom values represent comparison facilities (either non-EMS adopter or non-certified EMS adopter).
* Statistically significant at $p \leq 0.10$; ** Statistically significant at $p \leq 0.05$; *** Statistically significant at $p \leq 0.01$

In summary, almost three quarters of all facilities considered adopting an EMS, although over one-half actually did so. EMS adopters differed from non-adopters along several dimensions. With respect to complementary management practices that facilitate environmental management, EMS adopters *had greater experience* with quality management systems, health and safety management systems, and process/job control systems. They also more frequently budgeted R&D for environmental matters and had a dedicated environmental department. Facilities with EMSs also integrated environmental activities into other management practices. More specifically, EMS adopters integrated environmental concerns more frequently into their health and safety management systems, full-cost/activity-based accounting, management accounting systems, process/job control systems, and inventory/materials requirement planning than non-adopters. With the exception of health and safety management systems, facilities that were merely in the process of EMS adoption also demonstrated greater expertise with these complementary management practices than non-adopters. These results add further support to prior research indicating that firms with stronger complementary capabilities are more likely to implement EMSs (Andrews et al., 2003; Darnall, 2003a, 2003b), probably because of the reduced cost of doing so (Darnall & Edwards, 2004).

These results further indicate that EMS adopters more frequently took actions to reduce their natural resource use, solid waste, wastewater effluent, air pollution, global pollutants, and soil contamination. Other significant differences were also found among facilities that were merely in the process of EMS adoption and those that had not considered EMS adoption at all. Such findings suggest that facilities in

the process of EMS adoption more frequently took actions to reduce their natural resource use, solid waste, global pollutants, and soil contamination.

Moreover, EMS adopters more frequently took actions to reduce their natural resource use, solid waste, wastewater effluent, air pollution, global pollutants, and soil contamination. Also, facilities that were merely in the process of EMS adoption more frequently took actions to reduce their natural resource use, solid waste, global pollutants, and soil contamination. Finally, EMS adopters reported that they had greater environmental impact reductions over the last three years than non-adopters in that they more frequently reduced their natural resource usage (e.g. energy and water), wastewater, local/regional air pollution, global air pollutants, risk of severe accidents than non-adopters. Facilities that took the extra step in certifying their EMSs had the benefit of further reducing their natural resource use and wastewater effluent, although these differences were modest when compared to facilities that implemented non-certified EMSs.

Taken together, these findings provide important preliminary evidence about the merits of EMS adoption for U.S. facilities. They also add further support for prior research suggesting that the introduction of an EMS can be expected to improve the environmental performance and management efficiencies of most facilities (Andrews et al., 2003). Finally, these findings illustrate that certified EMSs are associated with only modestly greater performance improvements than non-certified EMSs and facilities in the process of EMS adoption are able to achieve significant gains over non-adopters.

Summary of Environmental Management & Performance

- About three-quarters of facilities considered adopting an EMS and about 57 percent actually did so.
- EMS adopters implemented management practices and complementary capabilities for environmental management more frequently than non-adopters.
- EMS adopters integrated environmental activities into their other management systems more frequently.
- EMS adopters took greater *actions to reduce* their natural resource use, solid waste, wastewater effluent, air pollution, global pollutants, and soil contamination.
- EMS adopters had modestly greater *environmental impact reductions* than non-adopters in that they more frequently reduced their natural resource usage (e.g. energy and water), wastewater, local/regional air pollution, global air pollutants, risk of severe accidents.

MOTIVATIONS & STAKEHOLDER INFLUENCES

Institutional theory suggests that firms' external pressures shape their organizational actions. Three types of external pressures influence organizational change: coercive, mimetic and normative (DiMaggio & Powell, 1983). Institutions and their stakeholders exert coercive pressures. Normative pressures arise from professional relationships and are a result of networks including industry associations. Finally, mimicry is the attempt by organizations to model other enterprises.

Applications of DiMaggio and Powell's theory of institutional change have often focused on empirically evaluating the effects of coercion on organizations' environmental activity (e.g., Rugman & Verbeke, 1998; Henriques & Sadorsky, 1996; Arora & Cason, 1996; Welch, Mazur & Bretschneider, 2000). Henriques and Sadorsky (1996), for example, show that coercive external pressures exerted by legislators, lobbyists, the courts, activists and consumers all define the institutional boundaries of the firm though regulators, protests, lawsuits, political lobbying and direct negotiation also play a part. Similarly, Welch, Mazur and Bretschneider (2000) show that regulatory pressures shape firms' behaviors to participate in an industry-specific VEP.

These studies suggest that external influences lead to *homogeneity* among firms. However, this premise is criticized for both its lack of attention to the role of organizational self-interests, as well as for casting organizations as passive participants that respond to institutional pressures and expectations (Perrow, 1986; Oliver, 1997).

Hoffman (2000) recasts the institutional framework and addresses these criticisms by examining the motivators for organizations' environmental change. He suggests that regulatory, market, value chain[3] and social factors[4] influence firms' environmental actions. Within each of these categories firms endure coercive, normative and mimetic pressures. Hoffman explains that although these pressures constrain organizations' economic activities, they also create opportunities for strategic advantage. Such opportunities may expand as the regulatory system becomes more diverse and flexible (Jennings & Zandbergen, 1995). All of these pressures may also affect an organization's decision to implement various environmental practices.

Within the organization itself, pressure may also arise from internal stakeholders such as parent companies, management and non-management employees. Each of these different types of individuals are influenced by external institutions described above, and so the distinction between internal and external stakeholders is not as discrete as many would otherwise like to believe. In addressing the different types of stakeholders that shape facilities' environmental practices, we asked a series of questions that elicited information on the following types of individuals and groups:

External Stakeholders

- Government authorities
- Markets (shareholders, investors, banks, buyers, suppliers, household consumers)

[3] Value chain pressures may also fit within a more generalized view of a firm's market pressures.

[4] Social pressures are often related to firms' regulatory pressures in that societal expectations cause and shape the democratic process that produces environmental regulations. Similarly, when a firm violates environmental laws or pollutes more than its industry peers, NGOs, investors and other interested parties may publicly question its environmental management practices. As a result, while institutional theorists may suggest that social and regulatory pressures shape organizational change (Hoffman, 2000), these constructs are not necessarily distinct.

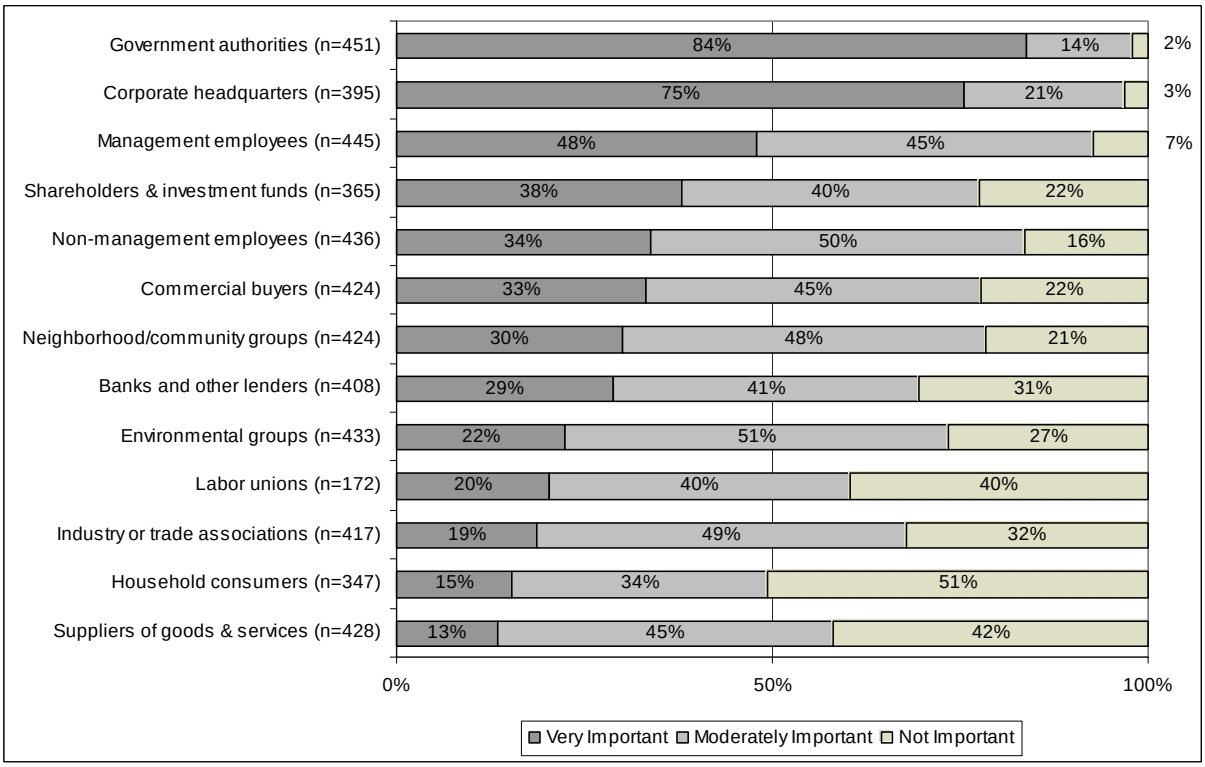
- Society (environmental groups, neighborhood groups, trade associations, unions)

Internal Stakeholders

- Corporate
- Management
- Non-management employees

We asked environmental managers about the types of external influences that shaped their facilities' environmental decisions. Their responses indicated that, pressures from regulatory authorities appeared to be the most important factor shaping their environmental behavior, as shown in Figure 16.

Figure 16: Factors Influencing Facilities' Environmental Practices

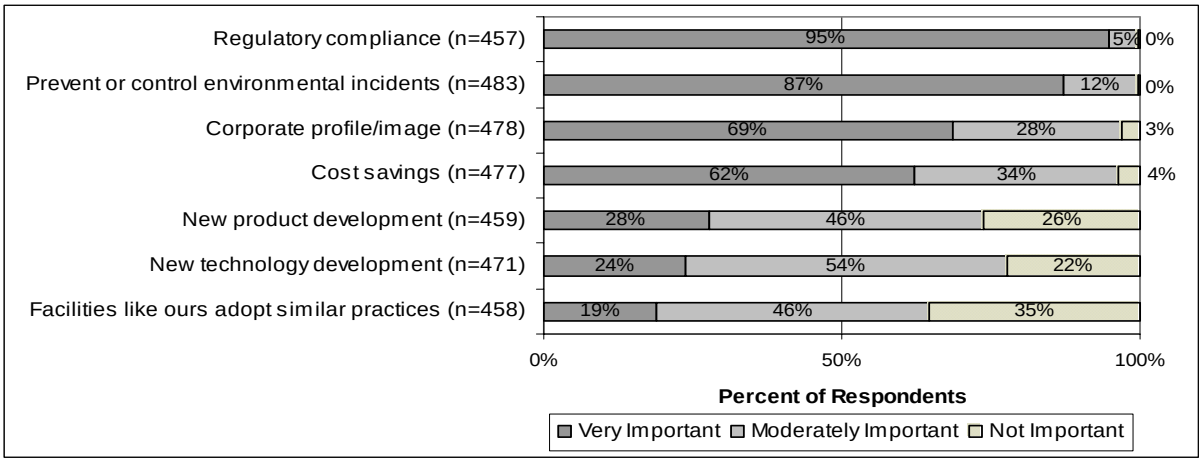


The results provide additional evidence of the importance of the traditional regulatory system in that the absence of the traditional system, the necessary external force may not exist to motivate rigorous attempts to reduce their environmental harms. Respondents also point to the importance of internal stakeholders. Corporate headquarters had a very important role for three-quarters of facilities' environmental practices and at least a moderate level of importance for 96 percent of facilities. These findings provide further evidence of the notion that regulators may have greater success encouraging parent companies rather than facilities to improve their environmental performance. Doing so may also lead to more widespread environmental benefits.

Societal stakeholders (environmental groups, neighborhood groups, trade associations, unions) had less influence on facilities' environmental practices. Between 19 – 30 percent of facility managers reported that they were very important factors shaping their enterprise's environmental behavior. While market influences from household buyers and suppliers had a relatively low influence on facilities' environmental practices, shareholders and buyers had a much greater role. About twice as many facility managers reported that shareholders and buyers were very important factors influencing their facilities' environmental practices as compared to household buyers and suppliers.

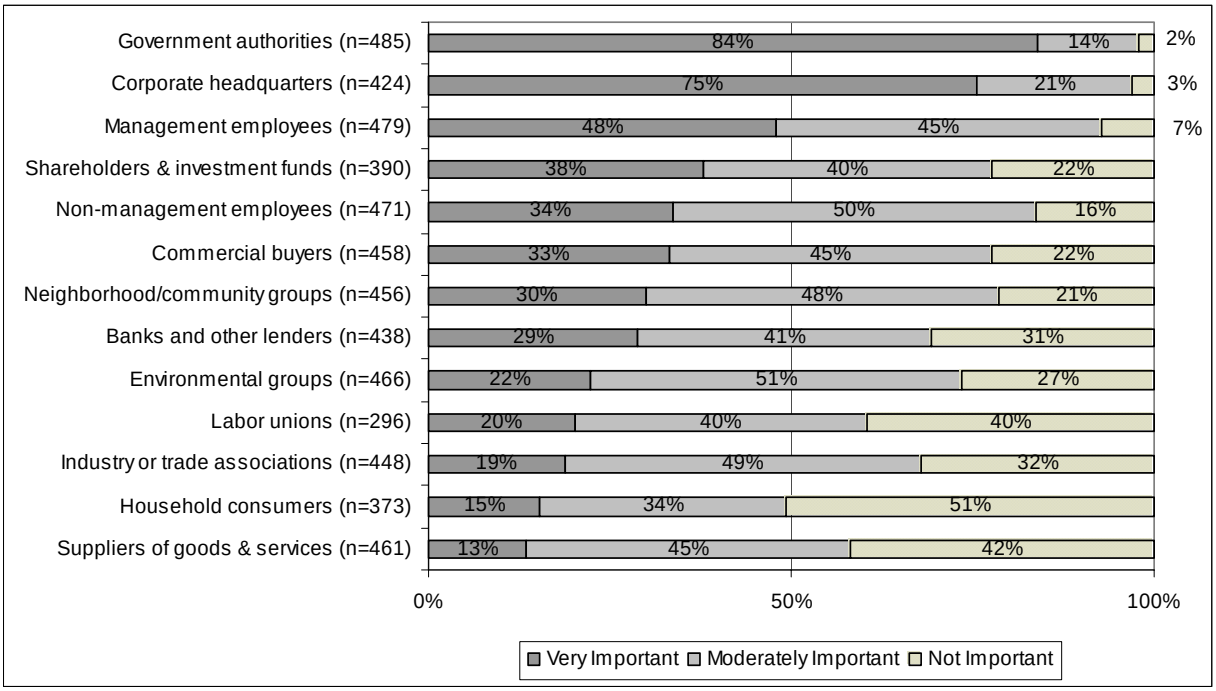
Environmental managers also reported that the desire to achieve regulatory compliance was very important or moderately important in all (100 percent) of their environmental practices, as illustrated in Figure 17. Similarly, the goal of preventing or controlling environmental incidents was very important or moderately important for 100 percent of the facility managers. However, both of these goals focus on end-of-pipe pollution control strategies rather than proactive pollution prevention. These findings therefore lend further support for the importance of the traditional regulatory system in motivating facility-level environmental actions. The desire to improve the facility's corporate image was very important or moderately important for 97 percent of facility managers responding to the survey. Finally, normative pressures from competitors had only a less important role in shaping facilities' environmental practices in that 65 percent of facility managers reported that the fact that other facilities like theirs were adopting similar practices motivated them to do the same.

Figure 17: Other Factors Influencing Facilities' Environmental Practices



Many of the reasons why facilities *considered* introducing an EMS were similar to the reasons why facilities implemented more general environmental practices. More specifically, external pressures from regulatory authorities appeared to be the most important motivator. About 84 percent of facilities reported that government authorities were a very important influence when considering whether to adopt an EMS, as shown in Figure 18. Additionally, relationships with corporate headquarters influenced facilities' decisions to consider EMS adoption. These findings provide additional evidence of the important role that corporate offices have in facility-level EMS adoption decisions (Darnall, 2003a; Darnall, 2001).

Figure 18: Factors Motivating Facilities to *Consider* Introducing an EMS



Using a combination of Chi-square tests and Fisher's exact tests, we evaluated how different external and internal stakeholders influenced facilities' environmental practices. In particular, we evaluated the relationship between EMS adopters and non-adopters and between ISO 14001-certified facilities and non-certified EMS adopters. The results are shown in Table 7, and indicate that along multiple dimensions EMS adopters differed from companies that elected not to adopt an EMS. In particular, EMS adopters more frequently reported that non-management employees influenced their environmental activities to a greater degree than non-adopters. External stakeholders also influenced EMS adopters to a greater degree.

Table 7: Factors Influencing Facilities' Environmental Practices among EMS Adopters & Non-adopters

	Facility Comparisons[†]			
	EMS Adopter/ Non-adopter	p-value	Certified EMS/Non-certified EMS	p-value
Importance of Groups on Environmental Practices				
Government authorities	98%	0.447	100%	0.535
(n=375, 445)	98%		98%	
Corporate headquarters	98%	0.108	100%	0.604
(n=326, 386)	96%		97%	
Household consumers	48%	0.668	48%	1.000
(n=283, 342)	53%		50%	
Commercial buyers	82%	0.122	97%	0.003***
(n=351, 419)	75%		76%	
Suppliers of goods & services	67%	0.014**	77%	0.020**
(n=356, 423)	52%		58%	
Shareholders & investment funds	84%	0.005***	100%	0.016**
(n=304, 358)	69%		77%	
Banks & other lenders	71%	0.340	79%	0.155
(n=335, 401)	67%		69%	
Management employees	96%	0.114	97%	0.494
(n=371, 440)	91%		93%	
Non-management employees	91%	0.016**	94%	0.059*
(n=365, 432)	80%		84%	
Labor unions	70%	0.025**	83%	0.055*
(n=227, 273)	53%		58%	
Industry/trade associations	61%	0.148	79%	0.350
(n=346, 412)	71%		67%	
Environmental groups	70%	0.796	68%	0.728
(n=358, 427)	73%		74%	
Neighborhood/community groups	73%	0.180	77%	0.632
(n=354, 419)	81%		78%	
Prevent/control environmental incidents	100%	0.588	100%	0.636
(n=375, 444)	99%		100%	
Importance of Following Motivations on Environmental Practices				
Achieving regulatory compliance	100%	1.000	100%	1.000
(n=374, 443)	100%		100%	
Improving corporate profile/image	98%	0.012**	97%	0.338
(n=370, 439)	96%		97%	
Creating cost savings	96%	0.390	100%	0.433
(n=369, 438)	96%		96%	
Creating new technology development	85%	0.010***	84%	0.543
(n=367, 432)	73%		79%	
Creating new product development	83%	0.002***	90%	0.081*
(n=357, 420)	67%		74%	
Facilities like ours adopt similar practices	70%	0.012**	81%	0.096*
(n=353, 420)	64%		65%	

[†] Top values represent EMS adopting facilities, as denoted by the column title (EMS adoption in-progress, completed EMS adopter, and certified EMS), responding that the pressure is very important or moderately important. Bottom values represent comparison facilities (either non-EMS adopter or non-certified EMS adopter).

* Statistically significant at $p \leq 0.10$; ** Statistically significant at $p \leq 0.05$; *** Statistically significant at $p \leq 0.01$

More specifically, commercial buyers, suppliers, shareholders, and labor unions influenced environmental management practices of EMS adopters to a greater extent. Finally, EMS adopters more frequently reported that they were motivated to improve their public image, create new technologies and products and remain in step with their competitors when they acted to modify their environmental practices. Interestingly, in comparing facilities with a certified EMS to facilities with no EMS or no certified EMS, enterprises that chose to certify endured many of the same stakeholder pressures as non-certified facilities. However, in general, ISO 14001-certified facilities endured *greater* stakeholder pressures, as institutional theory would suggest.

In summary, the most important factors shaping facilities' environmental behaviors were regulatory pressures: the desire to achieve regulatory compliance and the goal to prevent or control environmental accidents. However, these motivators emphasize end-of-pipe pollution control strategies rather than proactive pollution prevention. These findings therefore lend further support for the importance of the traditional regulatory system in influencing facility-level environmental actions.

Internal stakeholders also had an important role in facility-level environmental management activities. After regulatory pressures, facilities reported that corporate headquarters was the second most influential factor influencing their environmental practices. These findings point to the often overlooked relationship between parent companies and their facilities, in that regulators may have greater success in encouraging proactive environmental management if they targeted their efforts at the corporate level rather than at the facility-level. Pressures from societal stakeholders had less influence on facilities' environmental practices.

Summary of Motivations & Stakeholder Influences

- Regulatory pressures, the desire to achieve regulatory compliance, and the goal to prevent or control environmental accidents were the most important factors shaping facilities' environmental practices.
- Internal stakeholders also had significant influence on facilities' environmental practices, especially corporate headquarters.
- Societal stakeholders had less influence on facilities' environmental practices.
- Compared to non-EMS adopters, adopters were influenced more by internal stakeholders including non-management employees.
- Commercial buyers, suppliers, shareholders, and labor unions influenced EMS adopters' environmental practices more than non-adopters.
- EMS adopters motivated more to improve their public image, create new technologies & products and remain in step with their competitors.

In comparing EMS adopters to non-adopters, EMS adopters endured greater pressures from non-management employees and labor unions. Commercial buyers, suppliers, shareholders and labor unions also influenced EMS adopters more than non-adopters. Finally, EMS adopters were more frequently motivated to improve their public image, create new technologies and products, and remain in step with their competitors. Taken together, these findings indicate that EMS adopters endured greater pressures from market institutions and societal actors and endured greater internal pressures throughout their organization to consider their environmental practices and to reduce their impact to the natural environment.

ROLE OF ENVIRONMENTAL POLICY

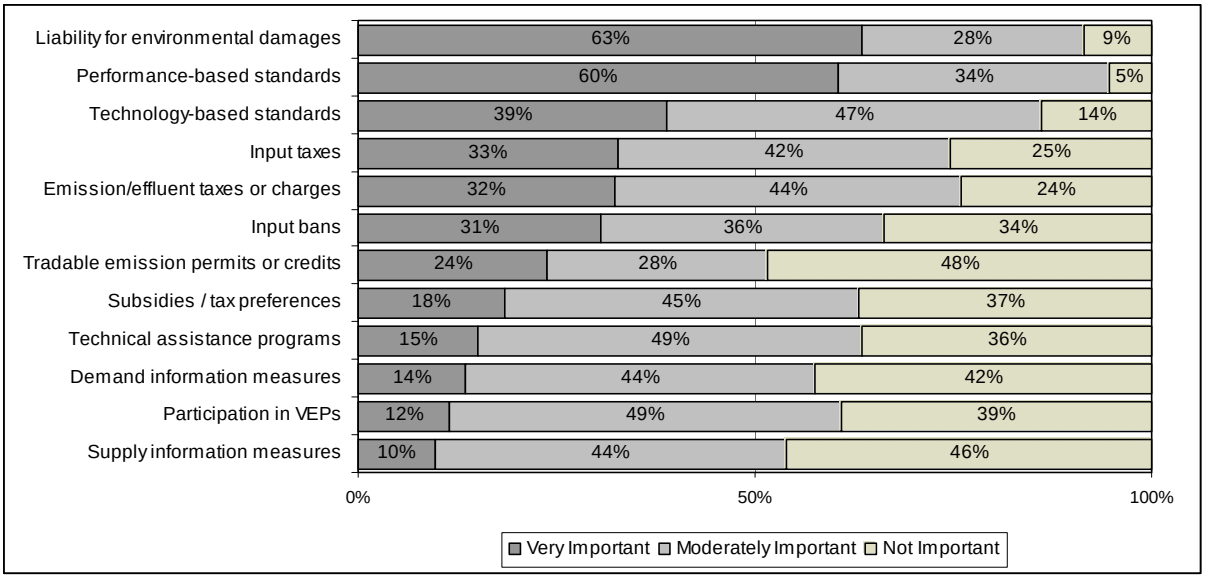
This section describes how environmental policy has shaped facilities' environmental behavior. It offers evidence that facility managers placed varying degrees of importance on different types of environmental policies and programs. The results further suggest that EMS adopters more frequently reported that some environmental policies and programs were more important than others. The section concludes with evaluation of the extent of coercive forces that the regulatory system exerts on facilities. In particular, we evaluated facility managers' self-reported stringency of the environmental regulatory system and the number of inspections they have had over the last three years.

Environmental Policy & EMS Adoption

As discussed earlier, direct regulation still dominates U.S. environmental policy. However, during the 1990s, the use of economic instruments and incentive-based policies and programs began to gain popularity in the U.S. and in some OECD countries. Despite the increasing prevalence of economic and incentive-based policies, little is known about how different types of organizations respond to them and which types of policy tools influence facility behavior more than others.

To address these issues, we asked environmental managers to assess the importance of twelve policies and programs in relation to their organizations' production activities (see Figure 19). Over one-half of the facility managers reported that the twelve policies were either very important or moderately important to their production activities. The most important policies were liability for environmental damages and performance-based standards. Approximately 91 percent of facility managers indicated that liability for environmental damages was either very important or moderately important, and 95 percent of facilities indicated that performance-based standards had the same degree of importance.

Figure 19: Impact of Policies to Facilities' Production Activities



Facility managers also reported with less frequency that technology-based standards were moderately or very important to their production activities. Only 39 percent of facilities indicated that technology-based standards had a high level of importance, whereas 60 percent indicated that performance-based standards or liability for environmental damages had the same degree of importance.

Finally, subsidies, technical assistance programs, supply and demand information measures and VEPs had less overall importance to facilities' production activities. Despite their reduced importance, more than half of the facility managers reported that these policies and programs were either very important or moderately important to their production activities.

Various types of organizations may respond to policies differently. For example, organizations that adopt an EMS may be better prepared to respond to pressures from direct regulation, therefore reducing the overall importance of the regulatory system. As a result, EMS adopters may believe that economic incentives are of greater independent influence on their production activities. This issue is being examined in the empirical analyses that follow.

To test for differences between EMS adopters and non-adopters, we used both Chi-square and Fisher's exact tests, depending on the number of cell counts in each frequency table. While statistical differences were based on all three Likert categories ("Not Important," "Moderately Important," and "Very Important"), for simplicity in conveying the results, we combined responses for managers reporting "Moderately Important" and "Very Important."

The results of the statistical tests indicate that facilities either in the process of adopting an EMS, already having adopted an EMS, or having implemented a certified EMS, placed greater importance on many incentive-based policies than non-EMS adopters. In particular, as evident in Table 8, demand and supply information policies (e.g. eco-labels and recognition programs), participation in VEPs and subsidies or tax preferences all had greater importance to EMS adopters' production activities than to non-adopters' production activities.

Enterprises with certified EMSs indicated that six of the twelve environmental policies were more important to their production activities, whereas uncertified facilities or facilities in the process of EMS adoption indicated that three of the twelve policies were more important (see Table 9). For example, facilities with certified EMSs stated that liability for environmental damages were more important to them than was the case for non-EMS adopters. These results indicate that contrary to prior expectations, facilities with certified EMSs operated with a greater sensitivity to coercive external pressures than non-EMS adopters. Coupled with the fact that facilities with EMSs also placed greater importance on incentive-based policies, these findings suggest that organizations adopting EMSs were more conscious of the entire environmental regulatory regime and how their enterprise operates within it.

Interestingly, EMS adopters and non-adopters also viewed some policies and programs with similar levels of importance. For example, facility managers indicated no differences in how they responded to technical assistance programs. The reason for these results is most likely due to the fact that government-sponsored technical assistance programs have less importance to larger facilities having parent companies and having greater access to resources. However, these same programs are more attractive to smaller facilities with less access to resources (Darnall, 2003b; Andrews et al., 2003). As we learn more about EMS adopters we will likely discover other important differences in how they operate and respond to different types of policy options, such as voluntary environmental programs that encourage EMS implementation.

Table 8: Importance of Policies and Production Technology Changes for EMS Adopters and Non-adopters

Policy or Program	Changes in Production Processes		Changes in End-of Pipe Technology	
	EMS Adopter/ Non-adopter	p-value	EMS Adopter/ Non-adopter	p-value
Input bans (n=190, 63)	70% 67%	0.819	70% 58%	0.074**
Technology-based standards (n=227, 78)	89% 84%	0.195	88% 87%	0.987
Performance-based standards (n=240, 80)	94% 94%	0.270	100% 89%	0.037**
Input taxes (n=227, 75)	73% 81%	0.418	77% 75%	0.921
Emission/effluent taxes or charges (n=227, 75)	76% 75%	0.954	76% 83%	0.629
Tradable emission permits or credits (n=194, 62)	60% 59%	0.972	48% 43%	0.934
Liability for environmental damages (n=233, 91)	95% 92%	0.148	97% 80%	0.033**
Demand information measures (n=204, 72)	69% 53%	0.029**	73% 35%	0.001**
Supply information measures (n=216, 75)	68% 48%	0.005**	76% 33%	0.000**
Participation in VEPs (n=223, 80)	73% 54%	0.019**	73% 53%	0.003**
Subsidies / tax preferences (n=219, 75)	71% 59%	0.151	67% 51%	0.252
Technical assistance programs (n=222, 79)	68% 69%	0.887	58% 52%	0.457

† Top values represent EMS adopting facilities that reported changes in their production technologies. Bottom values represent non-EMS adopters that reported no changes.

* Statistically significant at $p \leq 0.10$; ** Statistically significant at $p \leq 0.05$; *** Statistically significant at $p \leq 0.01$.

Table 9: Importance of Policies to Facilities' Production Activities among EMS Adopters & Non-adopters

Policy or Program	Facility Comparisons†					
	In Progress/ Non-adopter	p-value	EMS Adopter/ Non-adopter	p-value	Certified EMS/ Non-certified EMS	p-value
Input bans	61%	0.641	71%	0.395	83%	0.196
(n=212, 272, 317)	64%		64%		65%	
Technology-based standards	88%	0.600	89%	0.120	96%	0.206
(n=273, 329, 392)	83%		83%		85%	
Performance-based standards	98%	0.020**	95%	0.034**	100%	0.279
(n=295, 346, 415)	92%		92%		94%	
Input taxes	70%	0.462	74%	0.675	79%	0.685
(n=270, 324, 385)	77%		77%		75%	
Emission/effluent taxes or charges	74%	0.851	76%	0.848	77%	0.958
(n=277, 326, 391)	77%		76%		75%	
Tradable emission permits/credits	44%	0.587	58%	0.371	62%	0.551
(n=224, 274, 326)	50%		50%		51%	
Liability for env. damages	91%	0.387	96%	0.002***	93%	0.308
(n=293, 346, 416)	88%		88%		91%	
Demand information measures	61%	0.052*	71%	0.000***	78%	0.096*
(n=258, 297, 359)	45%		45%		55%	
Supply information measures	54%	0.073*	70%	0.000***	72%	0.194
(n=264, 314, 377)	41%		41%		53%	
Participation in VEPs	63%	0.158	72%	0.000***	73%	0.012**
(n=269, 327, 390)	51%		51%		62%	
Subsidies / tax preferences	67%	0.002***	71%	0.015**	79%	0.063*
(n=267, 317, 378)	55%		55%		62%	
Technical assistance programs	63%	0.840	67%	0.645	71%	0.826
(n=272, 325, 389)	62%		62%		65%	

† Top values represent EMS adopting facilities, as denoted by the column title (EMS adoption in-progress, completed EMS adopter, and certified EMS). Bottom values represent comparison facilities (either non-EMS adopter or non-certified EMS adopter).
* Statistically significant at $p \leq 0.10$; ** Statistically significant at $p \leq 0.05$; *** Statistically significant at $p \leq 0.01$

When confronted with making a production change which might reduce an organization's environmental impacts, companies have two options: they can either make changes in production processes (by addressing waste closer to its source) or incorporate end-of-pipe production technology. When comparing compared facilities that had adopted an EMS and whether they employed either of these two production changes EMS adopters changed their production processes and end-of-pipe technology more frequently than non-adopters. Similarly, EMS adopters that indicated the importance of input bans, performance standards, and liability for environmental damages in their organization's environmental activities also reported that they relied more on end-of-pipe technology changes than non-EMS adopters.

Not surprisingly, it appears that EMS adopters had a greater awareness of the existence of government-sponsored incentive programs that encourage EMS implementation. Regardless of whether facilities were implementing a certified or non-certified EMS, or were merely in the process of EMS adoption, adopters were more informed about EMS programs and policies, as shown in Table 10. Almost half of EMS adopters knew of government programs that encouraged EMS adoption, whereas only 28 percent of non-adopters knew of these programs. At the same time, over half of EMS adopters had no knowledge of government programs that encouraged EMS adoption. These results present an opportunity

for regulators in that additional organizations may consider implementing an EMS if they knew about the government assistance programs that encouraged them to do so.

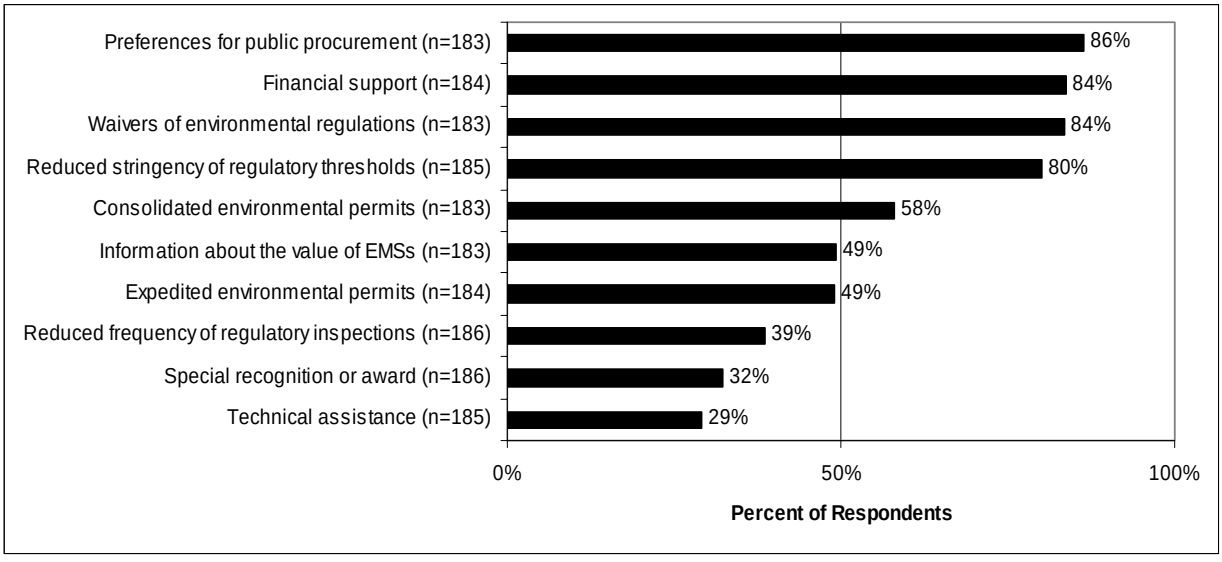
Table 10: Knowledge of Programs or Policies that Encourage EMS Adoption

Facility had Knowledge of Programs Encouraging EMS	Facility Characteristic			
	No EMS (n=205)	EMS Adoption in Progress (n=163)	EMS Adoption Completed (n=103)	Certified EMS (n=92)
Yes	28%	49%	48%	48%
No	72%	51%	52%	52%

For the facility managers who indicated they knew of regulator-sponsored EMS programs, we asked them about the types of programs for which they were most familiar. Most reported that they were familiar with EMS programs offering preferences for public procurement, providing financial support, offering waivers of environmental regulations, and reducing the stringency of regulatory thresholds, as shown in Figure 20. Between 80 – 86 percent of facility managers knew of these four incentive programs.

Far fewer facility managers were aware of the existence of programs offering either reduced frequencies of regulatory inspections, special recognition, or technical assistance. These results again may reflect opportunities for regulators who seek to promote their programs that encourage EMS adoption, in that additional facilities may consider EMS adoption, if such programs were put in place and facilities were better informed about different government-sponsored incentive programs.

Figure 20: Programs that Regulators Have to Encourage EMS Adoption

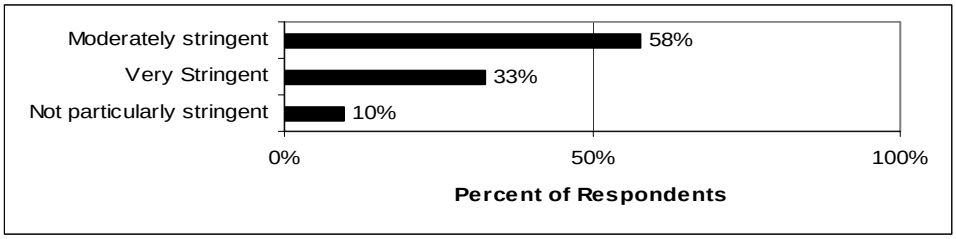


Description of Environmental Policy Regime

Despite the fact that it appears that most facilities' environmental actions were influenced significantly by the environmental policy regime, in general, facility managers reported that the regulatory system was only moderately stringent. Approximately 58 percent of the facility managers

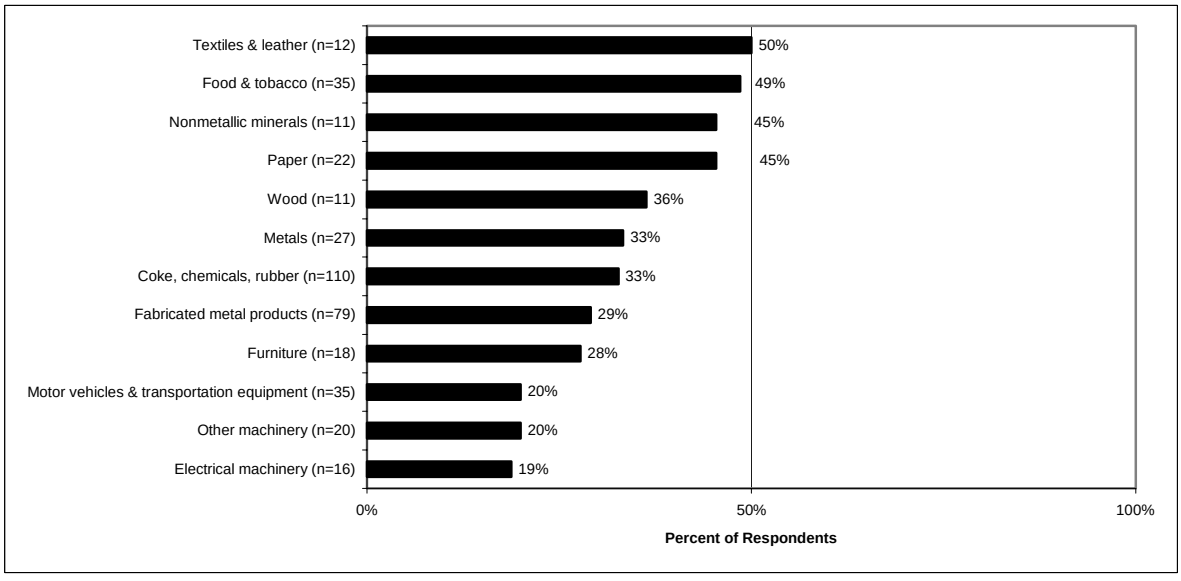
indicated that the environmental policy regime was moderately stringent and ten percent reported that the regime was not particularly stringent, as shown in Figure 21. At the same time, about a third (33 percent) of the facility managers reported that the regulatory system was very stringent.

Figure 21: Facilities' Description of U.S. Environmental Policy Regime



Whether an organization considers the environmental regulatory regime to be stringent or not may be due in large part to the industrial sector in which a facility operates because different industrial sectors are constrained by environmental policies of varying stringency. For this reason, we explored which industries reported that the environmental policy regime was "Very Stringent." Our results indicated that the textiles and leather, food and tobacco, non-metallic minerals, and paper industries responded more frequently than other sectors that the environmental policy regime was very stringent, as shown in Figure 22. In contrast, the machinery sectors less frequently reported that the environmental policy regime was very stringent. The difference between these two perspectives is not a surprise since within the U.S., the fabricated metal products, industrial machinery, electronics, transportation equipment, instrumentation and textile sectors are known as the cleanest manufacturing sectors in the U.S. (Gallagher & Ackerman, 2000). These sectors also reported that the regulatory policy regime was less stringent.

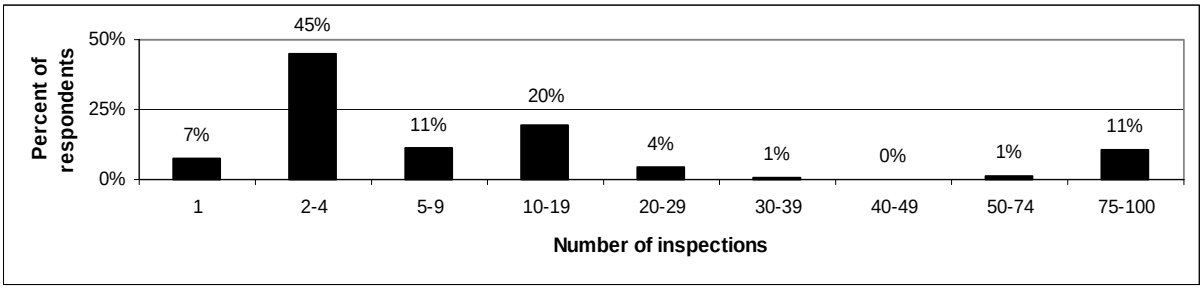
Figure 22: Facilities by Sector Indicating that the Environmental Policy Regime is "Very Stringent"



The final indicator of regulatory stringency that we evaluated was the number of inspections each facility received over the last three years. In general, organizations that are inspected more are believed to endure greater regulatory scrutiny than organizations that are inspected less. On average, the facility managers reported that they were inspected about 7 times over the last three years or about 2 times per year. However, some facilities reported far more inspections and others reported far fewer.

Figure 23 shows that almost half of the facility managers indicated that they received between 2 – 4 inspections over the last three years. Surprisingly, other facility managers reported that they were inspected up to 100 times, and in three cases, facility managers reported they received more than 3,000 inspections over the last three years. These results suggest that some facility managers probably aggregated their responses across all of their operating units rather than reporting the number of inspections for a single site.

Figure 23: Number of Environmental Inspections in the Last Three Years



In summary, facilities reported that the most important policies and programs influencing their environmental management activities were liability for environmental damages and performance-based environmental standards. EMS adopters reported that demand and supply information policies, participation in VEPs, subsidies/tax preferences, liability for environmental damages, and performance standards all had greater importance to them than was the case for non-adopters. Moreover, facilities with certified EMSs also operated with greater sensitivity to coercive external pressures from input bans and liability for environmental damages. Finally, EMS adopters were more informed about government programs or policies that encouraged EMS adoption. Far fewer facility managers knew about programs offering either reduced frequencies of regulatory inspections, special recognition, or technical assistance. These results present opportunities for regulators who seek to promote their programs that encourage EMS adoption, in that additional facilities may consider EMS adoption if they were more informed about different government-sponsored

Summary of the Role of Environmental Policy

- Liability for environmental damages and performance-based standards were the most important policy instruments for all facilities.
- EMS adopters were more conscious of the environmental regulatory regime and incentive-based environmental policies than non-adopters.
- Demand & supply information policies, participation in VEPs, subsidies/tax preferences, liability for environmental damages, and performance-based standards were more important to EMS adopters' production activities than was true for non-adopters.
- EMS adopters were more informed about government programs that encouraged EMS adoption.
- Significant opportunities exist to encourage additional EMS adoption.
- Most facilities believed the environmental policy regime is moderately stringent.
- Facilities in dirtier sectors believed the environmental policy regime was very stringent and facilities in cleaner industrial sectors believed it was less so.
- Almost half of the facilities were inspected by environmental regulators about one times per year.

incentive programs.

With respect to the environmental policy regime, most facilities considered it to be moderately stringent. As might be expected, facilities operating in dirtier industrial sectors reported that the environmental policy regime was more stringent than firms in cleaner sectors. These results are most likely due to the fact that enterprises operating in dirtier sectors have additional regulatory requirements. Finally, about half of the facilities were inspected between 2-4 times over the last three years, or about 1 time per year.

FINANCIAL & ENVIRONMENTAL PERFORMANCE

Only recently has much attention been placed on understanding what value an organization may accrue by improving its environmental performance. The lack of research on the topic may be attributed in part to conventional economic arguments suggesting that organizations should invest in environmental activities only to the extent that their marginal benefit of doing so equals their marginal cost. Interpreted more strictly, investment beyond the current regulatory requirements is detrimental to an organization's economic performance and constrains financial opportunities (Friedman, 1970; Christiansen & Haveman, 1981; Conrad & Morrison, 1989; Denison, 1979; Jaffe & Palmer, 1997; Lave, 1973; Norsworthy, Harper & Kunze, 1979). As a result, there is little incentive for an organization to be environmentally proactive.

Despite these arguments, by 1998 participation EPA's more than 40 voluntary environmental programs had attracted a projected 13,000 organizations (Mazurek, 1998). By participating, organizations are signaling to the market, to regulators and to the public that they are considering their impact to the natural environment perhaps more than their industry competitors (Darnall and Carmin, 2003). Still other firms have voluntarily reduced their TRI emissions significantly over time. In yet other instances, organizations are reducing their environmental impacts to qualify for eco-labels. Have these organizations acted against conventional economic wisdom? Not necessarily.

Traditional views of environmental investments are static in that they consider technology, products, processes and customer need to be fixed while only environmental regulation changes over time (Porter & van der Linde, 1995). In these situations the notion that regulation increases an organization's operating costs is inevitable (Porter & van der Linde, 1995). However, recent research in business strategy, management and economics is considering the innovative solutions that organizations discover in response to various external pressures. These studies indicate that organizations may benefit substantially by managing their environmental impacts better (Hart & Ahuja, 1996; Henderson & Mitchell, 1997; Klassen & McLaughlin, 1996). Benefits include creating greater internal efficiencies and competitive advantage.

Other studies have emphasized the market's ability to shape organizations' environmental actions (Konar and Cohen, 1997; Arora and Cason, 1996; Khanna and Damon, 1999). Market pressures for environmental consideration have increased as firms and customers have become increasingly aware of the environment. Information about an organization's environmental performance also affects its reputation (Arora and Gangopadhyay, 1995; Konar and Cohen, 1997; Marshall and Mayer, 1991). As consumers become more savvy of a firm's impact to the natural environment, organizations are responding by marketing themselves as environmentally friendly organizations (Russo & Fouts, 1997). In order to develop a pro-environmental reputation and to successfully differentiate their products based on "green" attributes, firms must provide credible information about their environmental efforts (Reinhardt, 1998). By providing information to markets about their relative "greenness," markets may reward companies that are environmentally friendly and punish those that are not (Klassen & McLaughlin, 1996). For example participants of VEPs can derive premium pricing and increase their sales (Rivera, 2002). In other instances, firms may be able to vigorously market their environmental certifications or eco-labels as selling points for its products, and as means to differentiate its products from its competitors (Darnall, Gallagher and Andrews, 2001). These labels enable companies to increase their recognition for being an environmental leader. Similarly, some firms give purchasing preference to factor suppliers with certified EMSs. Such preferences may help to ensure that a firm's product is more environmentally friendly, thus satisfying its market demands (Darnall, Gallagher and Andrews, 2001; Bowen et al., 2001). Finally, the

sheer announcement of firms' poor environmental performance has been credited with short term reductions in their stock price (see Konar & Cohen, 1997a; Hamilton, 1995).

Despite the burgeoning evidence, information asymmetries and other market imperfections have prevented the vast majority of U.S. firms from elevating their environmental strategy within their organizations. Firms that recognize the link between environmental and financial performance have exploited these market imperfections, thereby helping them gain competitive advantage. While some evidence linking environmental performance with economic performance is emerging, much is largely anecdotal or based on a single case. Far fewer studies compare the environmental-economic relationship cross-sectionally or among multiple countries.

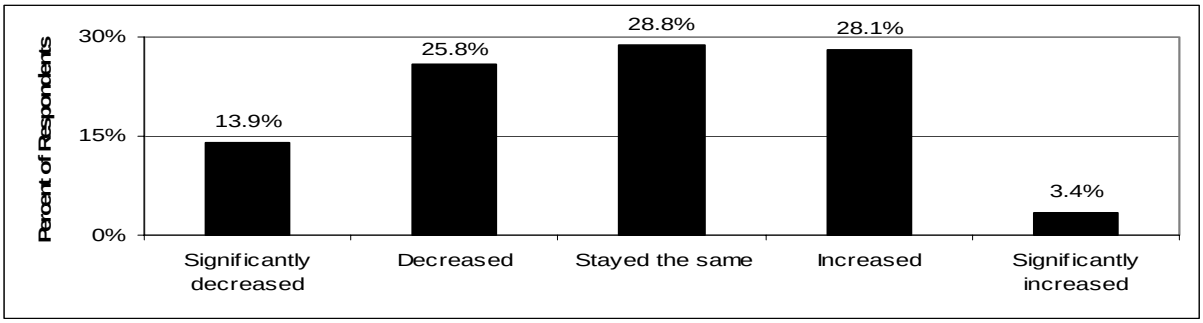
To evaluate the relationship between organizations' environmental and financial performance further, we asked facility managers to report their overall business performance and their value of shipments. In each instance, we asked facility managers to report their average performance over the last three years. In general, the results indicate that facilities have made small gains in their revenue performance over the last three years, as shown in Figure 24. Approximately 58 percent of facility managers reported that their facilities experienced small revenue gains and 13 percent reported large gains. Only about 16 percent of the facility managers indicated that their organization lost revenue over the past three years.

Figure 24: Facilities' Overall Business Performance over the Past Three Years*

* n=454

We also asked facilities how their overall business performance has changed over the last three years. Facility managers reported whether their shipments "Significantly Decreased," "Decreased," "Stayed the Same," "Increased," or "Significantly Increased." In general, the responses to this question followed a more normal distribution, with about 29 percent of the facilities reporting no change, as shown in Figure 25. About 31 percent of facility managers reported that their shipments either increased or significantly increased, and about 40 percent of the facilities indicated that their shipments either significantly decreased or decreased over the past three years.

Figure 25: Facilities' Average Annual Shipments over the Past Three Years*



* n=454

In comparing the financial performance of facilities that chose to adopt EMSs with those that chose not to adopt an EMS, EMS adopters reported that their average annual shipments over the past three years were *lower*, than non-adopters (see Table 11). About one-quarter of facilities (26 percent) of EMS adopters reported that their average annual shipments increased or significantly increased over the last three years compared to about one-third of non-adopters (34 percent). Facilities with certified EMSs also reported lower average annual shipments over the past three years. There were no statistical differences among EMS adopters and non-adopters and their overall business performance over the last three years.

Table 11: Financial Performance Over the Last Three Years among EMS Adopters & Non-adopters

	Facility Comparisons					
Financial Performance	In Progress/ Non-adopter	p-value	EMS Adopter/ Non-adopter	p-value	Certified EMS/ Non-certified EMS	p-value
Average annual shipments over the past three years (n=292, 347, 408)	35% 34%	0.466	26% 34%	0.064*	19% 31%	0.025 **
Overall business performance over the past three years (n=290, 353, 417)	71% 73%	0.745	70% 73%	0.456	72% 71%	0.876

† Top values represent EMS adopting facilities, as denoted by the column title (EMS adoption in-progress, completed EMS adopter, and certified EMS). Bottom values represent comparison facilities (either non-EMS adopter or non-certified EMS adopter).
* Statistically significant at $p \leq 0.10$; ** Statistically significant at $p \leq 0.05$; *** Statistically significant at $p \leq 0.01$

An organization's financial performance may also be related to other types of environmental behaviors. For example, facilities that establish environmental performance goals might reap additional economic benefits. Table 12 explores these issues further.

Table 12: Relationship between Financial Performance & Actions to Reduce Environmental Impacts

	Facility Comparisons[†]			
Environmental Impact	Business performance	p-value	Value of Shipments	p-value
Use of natural resources	73%	0.474	31%	0.162
(n=445, 437)	63%		35%	
Solid waste generation	72%	0.588	32%	0.856
(n=447, 439)	66%		30%	
Wastewater effluent	71%	0.679	30%	0.192
(n=418, 409)	76%		37%	
Local or regional air pollution	72%	0.788	31%	0.195
(n=436, 428)	65%		31%	
Global pollutants	70%	0.360	30%	0.581
(n=384, 375)	72%		32%	
Aesthetic effects	72%	0.880	30%	0.028**
(n=412, 403)	71%		34%	
Soil contamination	70%	0.814	31%	0.537
(n=390, 386)	71%		34%	
Risk of severe accidents	96%	0.850	31%	0.191
(n=435, 426)	79%		35%	

[†] Top values represent facilities that took actions to reduce environmental impacts. Bottom values represent facilities that did not take action.

* Statistically significant at $p \leq 0.10$; ** Statistically significant at $p \leq 0.05$; *** Statistically significant at $p \leq 0.01$

We evaluated nine environmental practices and then compared them to the value of facilities' shipments over the last three years and their business performance over the same period of time. A combination of Fisher's exact and Chi-square tests were used to evaluate the statistical differences among facilities, depending on the number of cell counts in each frequency table. In order to analyze the value of annual shipments over the last three years we asked facilities whether they "Significantly Decreased," "Decreased," "Stayed the Same," "Increased," or "Significantly Increased." Similarly, to assess facilities' overall business performance, we asked facilities whether they incurred "Large Losses," "Small Losses," "Broke Even," "Small Gains," or "Large Gains." While the statistical tests were based on the five-point Likert scales, for simplicity in conveying the results, the affirmative responses ("Increased" and "Significantly Increased" for value of shipments and "Improved" and "Significantly Improved" for business performance) are combined.

In general, facilities that implemented the nine environmental practices had no change in their business performance and value of shipments over the last three years. The only exception was for aesthetic effects in that facilities that reduced their aesthetic impacts experienced a *reduction* in the value of shipments over the last three years.

Finally, we considered whether organizations that either decreased or significantly decreased their impact to the natural environment also performed better financially than organizations that either had no change in their environmental performance or increased their impact to the natural environment (see Table 13). We considered both the relationship with facilities' value of shipments over the last three years in addition to their overall business performance using the same Likert scales discussed above.

Table 13: Relationship between Financial Performance & Decreases in Environmental Impacts

Significant Decrease or Decrease in the Following Environmental Impacts [†]	Value of Shipments		Business Performance	
	Improved	p-value	Increased	p-value
Use of natural resources (energy, water, etc.)	73%	0.578	38%	0.344
(n=433, 442)	71%		30%	
Solid waste generation	70%	0.892	33%	0.922
(n=432, 441)	71%		32%	
Wastewater effluent	76%	0.073*	31%	0.180
(n=402, 412)	68%		30%	
Local or regional air pollution	72%	0.921	29%	0.758
(n=433, 440)	71%		33%	
Global pollutants (e.g. greenhouse gases)	74%	0.268	34%	0.068*
(n=411, 419	68%		31%	
Aesthetic effects (noise, smell, landscape)	74%	0.288	29%	0.370
(n=423, 433)	70%		34%	
Soil contamination	76%	0.078*	34%	0.510
(n=414, 423)	66%		30%	
Risk of severe accidents	81%	0.025**	35%	0.603
(n=424,	68%		31%	

[†] Top values represent facilities decreased their environmental impacts. Bottom values represent facilities that did not decrease their impacts.

* Statistically significant at $p \leq 0.10$; ** Statistically significant at $p \leq 0.05$; *** Statistically significant at $p \leq 0.01$.

The results show that there was a weak relationship between facilities' value of shipments, business performance, and their reduced impact to the natural environment. That is, facilities that decreased their wastewater effluent, solid waste generation and their risk of severe accidents reported a *higher* shipment value over the last three years. Similarly, facilities that reduced their global pollutants reported stronger business performance over the last three years.

In summary, the relationship between environmental and financial performance is not as clear as we would hope. The results show that EMS adopters had *lower* overall value of shipments over the last three years than non-adopters. Also, facilities with greater overall value of shipments took fewer actions to improve aesthetic impacts. Finally, facilities' self-reported business performance had a weak relationship with environmental performance, in that facilities that reported a significant decrease or a moderate decrease in wastewater effluent, soil contamination, and severe risk of accidents also reported that they had improved their average value of shipments over the last three years. Similarly, facilities that reduced their global pollutants also improved their business performance over the last three years.

Summary of Environmental Practices & Financial Performance

- EMS adopters had shipments over the last three years had less value than non-adopters.
- Facilities with a *higher* value of their shipments over the last three years also less frequently took actions to reduce their impacts to aesthetics.
- Facilities that decreased their wastewater effluent, solid waste generation and their risk of severe accidents reported *higher* shipment values over the last three years.
- Facilities that reduced their global pollutants reported stronger business performance over the last three years.

The weak relationship between financial and environmental performance may be due to our aggregate measures. To understand these relationships better, more precise financial measures from external data sources should be collected to evaluate the association between environmental and financial performance with greater reliability.

CONCLUSIONS

Summary of Findings

Why do facilities introduce environmental management systems and tools?

The results of this research indicate that the traditional regulatory system was the most important motivator for facilities to introduce EMSs, suggesting that in the absence of regulatory pressures, facilities may make fewer attempts to reduce their environmental harms. Parent companies had the second strongest influence on all facility-level environmental management decisions. Other internal stakeholders, such as non-management employees, influenced EMS adopters' environmental activities to a greater degree than non-adopters. While pressures from societal stakeholders had less influence on facilities' environmental practices, market pressures from commercial buyers, suppliers, and shareholders influenced EMS adopters more than non-adopters. Similarly, EMS adopters were more frequently motivated to improve their public image, create new technologies and products, and remain in step with their competitors.

With respect to the complementary management practices that facilitate environmental management, EMS adopters *had greater experience* with quality management systems, health and safety management systems, and process/job control systems. They also more frequently had dedicated budgets for research and development in environmental matters and had a formal environmental department. Facilities with EMSs also integrated environmental activities into other management practices. More specifically, EMS adopters integrated environmental concerns more frequently into their health and safety management systems, full-cost/activity-based accounting, management accounting systems, process/job control systems, and inventory/materials requirement planning than non-adopters. With the exception of health and safety management systems, facilities that merely were in the process of EMS adoption also demonstrated greater expertise with these complementary management practices than non-adopters.

Taken together, these findings indicate that EMS adopters endured *greater pressures* from stakeholders within regulatory agencies and markets to consider their environmental practices and to reduce their impact to the natural environment. They also had *stronger complementary capabilities* that facilitated EMS adoption. Related to the latter, our results indicate that a company's strong investments in pollution prevention facilitate its decision to later develop an EMS or to encourage their suppliers to develop more environmentally friendly products. Similarly, we should expect that facilities having little pollution prevention experience would be less likely to adopt an EMS because they lack the basic organizational expertise to do so, and therefore incur significantly greater expenses during EMS adoption. As a result, regulators may be able to promote more widespread adoption of advanced environmental management strategies, such as EMS, by simply encouraging additional organizations to develop their basic pollution prevention practices, as doing so increases the probability for EMS adoption at a later time. In the absence of this expertise, EMS adoption therefore is expected to be more expensive, and may also have more varied environmental results.

Because parent companies had a significant influence on facilities' environmental activities, our results further suggest that regulators may also have greater success targeting their incentive-based environmental policies at the corporate level in addition to the facility level. Doing so may provide the additional managerial support within facilities to make operational investments that lead to environmental improvements. Such support is important given that many environmental innovations require significant staff time, capital investments, employee training, and commitments for continual improvement.

Why do facilities undertake specific types of environmental investments and innovations?

The results of this study indicate that facilities having implemented EMSs reaped *greater improvements in their environmental performance* over the last three years than non-EMS adopters. This relationship also existed for facilities that merely were *in the process* of adopting an EMS in that both types of facilities benefited from reduced natural resource use, wastewater effluent and solid waste generation. Facilities that fully implemented their EMS also reduced their solid waste, air pollution, and risk of severe accidents more than non-adopters. Facilities that chose to certify their EMSs had the benefit of further reducing their natural resource use and wastewater effluent, although these differences were modest when compared to facilities that implemented non-certified EMSs. Further, it appears that facilities did not use their EMS to reduce their non-regulated aesthetic impacts, including odor, landscape and noise, because in every instance EMS adopters did not differ from non-adopters.

Taken together, these findings provide important preliminary evidence about the merits of EMS adoption for U.S. facilities. They also add further support for prior research suggesting that the introduction of an EMS improves the environmental performance and management efficiencies of most facilities (Andrews et al., 2003). Moreover, *while certified EMSs are associated with only modestly greater performance improvements than non-certified EMSs, facilities that are in the process of EMS adoption are able to achieve significant gains over non-adopters.*

When considering the *importance of incentive-based environmental policies on facilities' production activities*, organizations that were in the process of adopting an EMS, already adopted an EMS, or implemented a certified EMS placed greater importance on them. In particular, demand and supply information policies (e.g. eco-labels and recognition programs), participation in voluntary environmental programs (VEP) and subsidies or tax preferences all had greater importance to EMS adopters' production activities than to non-adopters' production activities.

At the same time, enterprises with certified EMSs also indicated that liability for environmental damages were more important to them than was the case for non-EMS adopters. These results indicate that facilities with certified EMSs operated with a greater sensitivity to coercive external pressures than non-EMS adopters. Coupled with the fact that facilities with EMSs also placed greater importance on incentive-based policies, these findings suggest that organizations adopting EMSs were more conscious of the entire environmental regulatory regime and how their enterprise operates within it.

When confronted with making a production change, which might reduce an organization's environmental impacts, companies can either make changes in production processes (by addressing waste closer to its source) or incorporate end-of-pipe production technology. Comparing facilities that had adopted an EMS with non-EMS adopters, and whether either had employed these two production changes, *EMS adopters changed their production processes and end-of-pipe technology more frequently than non-adopters*. Similarly, EMS adopters that indicated the importance of input bans, performance standards, and liability for environmental damages in their organization's environmental activities also reported that they relied more on end-of-pipe technology changes than non-EMS adopters.

More than half of EMS adopters were informed about government programs or policies that encouraged EMS adoption, whereas about one quarter of non-EMS adopting facilities knew of government sponsored programs that encouraged enterprises to adopt an EMS. Of the EMS adopters, most reported that they were familiar with government-sponsored EMS programs offering preferences for public procurement, financial support, waivers of environmental regulations, and reductions in the stringency of regulatory thresholds, however, far fewer were aware of the existence of programs offering fewer regulatory inspections, special recognition, or technical assistance. This situation presents an opportunity to regulators in that additional facilities may consider adopting an EMS if they were more

knowledgeable about the programs that encouraged them to do so. Moreover, because it appears that EMS adopters rely more on VEPs and other incentive-based environmental programs, voluntary programs might be successful vehicles for encouraging more widespread EMS adoption. Programs that incorporate technical and pollution prevention assistance may further encourage companies to consider EMS adoption, especially those lacking the complementary capabilities that would make adopting an EMS less expensive.

Very few differences existed among facilities with certified EMSs and companies with non-certified EMSs, especially as they related to whether facilities had integrated their environmental activities into other management practices, (e.g. quality management practices and supply chain management). Similarly, when comparing facilities' reductions in environmental impacts, and actions taken to reduce environmental impacts, there were only modest differences among facilities with certified EMSs and facilities with non-certified EMSs. Instead, significant organizational differences existed among adopters of uncertified EMSs and non-EMS adopters. These findings suggest that facilities certifying their EMSs to an international standard such as ISO 14001 or EMAS may not necessarily achieve benefits beyond the environmental improvements gained by facilities implementing non-certified EMSs. They also support current regulatory positions that endorse EMSs more broadly, rather than only encouraging standardized EMSs such as ISO 14001.

What are the Links between firms' financial performance and their environmental management practices?

Once in place, all EMSs appear to lead to greater environmental improvements in that adopters consistently reported higher environmental performance than non-adopters. However, the link between environmental performance and financial performance is weak, at least at this initial stage, and additional investigation is therefore needed.

To further explore the relationship between EMS adoption and environmental and financial performance, it would be particularly useful to incorporate data from secondary sources. For example, by evaluating facilities' compliance data, we will be able to explore the relationships between violations and organizations' subsequent environmental strategies. We will also be able to assess the effect of pollution emissions on firms' environmental strategies. Additionally, it would be useful to combine the survey data with facilities' financial data so that we can investigate the relationship between financial and environmental performance more thoroughly.

Exploring the U.S. Data Further

Each of the relationships described in this report needs to be investigated further using multivariate analyses. While the bivariate relationships evaluated in this study are useful for understanding associations between two types of variables, they are limited in their ability to consider other influential variables at the same time. Bivariate analyses are also limited in their ability to predict different outcomes. For example, bivariate tests cannot determine whether environmental improvements lead to facilities considering EMS adoption or whether EMS adoption lead to facilities' environmental improvements. At this point, we only know that a positive association exists. Therefore, a more rigorous empirical analysis is needed to test these relationships further. Such an analysis would need to control for the selection bias associated firms' voluntary decisions to adopt different environmental practices because these biases may affect a facility's subsequent financial and environmental performance. However, prior to undertaking a multivariate analysis, we will need to create indices for most of our constructs in order to reduce the number of variables included in a multiple regression model.

While this report largely evaluated EMSs, there are many other types of environmental innovations that can be studied using the U.S. survey data, including a facility's decision to "green" its supply chain, to participate in government-sponsored and industry-sponsored VEPs, to rely on process changes rather than end-of-pipe pollution technology, among others. A broader exploration of these actions may provide a more comprehensive view of the types of environmental innovations utilized by U.S. companies and the effects they have on environmental performance.

Future research using the U.S. survey data also would benefit by including more objective measures for firms' financial and environmental data. For example, data related to firms' environmental violations and fines, toxic environmental releases, and publicly available financial data would offer a more complete perspective of how and to what extent companies that adopt advanced environmental strategies perform better than organizations that select not to do so. However, it is important to note that the focus of the broader OECD research study is to compare environmental performance across seven countries. As such, secondary environmental data are not as useful because environmental laws are inconsistent among the different countries and environmental compliance therefore is difficult to compare. Regardless, additional financial and environmental data will be critical to expanding the applicability of a U.S. study.

Finally, it is also important to understand how firms that responded to this survey differ from non-responding firms. To assess these differences, basic demographic data need to be collected for the facilities that received the U.S. survey. Such information will help us to generalize the results of this

research to the broader population of U.S. manufacturing facilities, thereby increasing the applicability and robustness of the research findings.

Next Steps: Cross-country Comparisons

In the months ahead, this project will move away from a single country-based analysis and towards an analysis that compares similarities and differences across the participating countries. As a result, a more detailed analysis of the U.S. data will not occur as part of this research project. Instead, the U.S. survey data will be combined with data collected from the six other research teams in Canada, France, Germany, Hungary, Japan and Norway. The research teams will then address four research questions, paying particular attention to differences among the various countries:

1. What factors influence a facility's decisions to introduce an EMS and other environmental management tools?
2. What are the reasons why a facility undertakes specific types of environmental investments?
3. What determines the degree of a company's environmental innovation and integration?
4. What are the links between the aforementioned factors and the facility's financial performance?

The results of these cross-country analyses will be available in winter 2005 in a series of public reports. These reports will also be the topic of a multi-stakeholder workshop, which will be sponsored by the OECD and will be held in early 2005.

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ANNEX 2: SUBSTANTIVE SURVEY QUESTIONS

SECTION 1: MANAGEMENT SYSTEMS AND TOOLS IN YOUR FACILITY

*This section contains questions related to your **facility**'s general management systems and tools, as well as those which relate to the environment. If your firm has many production facilities, please answer with reference to the facility at which you are located or with which you are most familiar. This is true of all subsequent sections, except the final section which is related to the firm as a whole.*

1.1. Does your facility have at least one person with **explicit responsibility** for environmental concerns?

Yes ❑ 1
No ❑ 0

If no, please proceed to question 1.3.

1.2. Which of the following **best describes the location** of this individual within your facility? (*Please tick only one box*.)

Senior management	❑ 1
Production/operations	❑ 2
Finance/accounting	❑ 3
Specialised environmental department (or equivalent)	❑ 4
External/media relations	❑ 5
Marketing/Sales	❑ 6
Purchasing	❑ 7
Human resources	❑ 8
Product development	❑ 9
Other department (please specify)_____	❑ 10

1.3. While **purchasing and/or marketing goods and services**, does your facility regularly consider the following measures? *(Please tick one box for each row.)*

	Yes 1	No 0
Assessing the environmental performance of our suppliers	❑	❑
Requiring suppliers to undertake environmental measures	❑	❑
Informing buyers of ways to reduce their environmental impacts	❑	❑

1.4. Which **practices** have been established in your facility in order to implement environmental management? *(Please tick one box for each row.)*

	Yes 1	No 0
Written environmental policy	❑	❑
Environmental criteria used in the evaluation and/or compensation of employees	❑	❑
Environmental training program in place for employees	❑	❑
Carry out external environmental audits	❑	❑
Carry out internal environmental audits	❑	❑
Benchmark environmental performance	❑	❑
Environmental accounting	❑	❑
Public environmental report	❑	❑
Environmental performance indicators / goals	❑	❑

Other practice (please specify) _____

1.5. Has your facility **considered introducing** an environmental management system?

Yes ❑ 1
No ❑ 0

If yes, please assess the importance of the following motivations. *(Please tick one box for each row.)*

	Not Important 1	Moderately Important 2	Very Important 3
It may help us to prevent or control our pollution	❑	❑	❑
It may improve our efforts to achieve regulatory compliance	❑	❑	❑
It may reduce the applicability of some regulations	❑	❑	❑
It may better identify future environmental liabilities	❑	❑	❑
It may improve our relations with regulatory authorities	❑	❑	❑
Regulators' incentives made it attractive	❑	❑	❑
It may allow for differentiation of our products	❑	❑	❑
It may improve our facility's profile/image	❑	❑	❑
It may create cost savings in terms of use of inputs	❑	❑	❑
It may create cost savings in terms of waste management	❑	❑	❑
It may improve information about our facility's operations	❑	❑	❑
Other facilities like ours are adopting similar systems	❑	❑	❑
Other reasons (please specify)_____	❑	❑	❑

1.6. Has your facility actually **implemented** an **environmental management system**?

Yes	❑	1	Year _ _ _ _
In progress	❑	2	
No	❑	0	

If no or in progress, please proceed to Question 1.8. **If yes**: Has your facility acquired any of the following **certifications in environmental management**?

	Yes 1	No 0	Year
EMAS	❑	❑	_ _ _ _
ISO 14001	❑	❑	_ _ _ _

1.7. Were the expected **benefits** of adopting an environmental management system as great as had been anticipated?

Yes ❑ 1
No ❑ 0

1.8. Has your facility implemented any of the following **other management practices**? *(Please tick one box for each row.)*

	Yes 1	No 0
Quality management system (e.g. ISO 9000)	❑	❑
Health and safety management system	❑	❑
Full-cost or activity-based accounting	❑	❑
Management accounting system	❑	❑
Process or job control system	❑	❑
Inventory or materials requirement planning	❑	❑
Other (please specify)_____		

1.9. To what extent are the **environmental activities** of your facility **integrated** with the following management practices? *(Please tick one box for each row.)*

	Not at all 1	Partially 2	Fully 3	Not applicable 4
Quality management system (e.g. ISO 9000)	❑	❑	❑	❑
Health and safety management system	❑	❑	❑	❑
Full-cost or activity-based accounting	❑	❑	❑	❑
Management accounting system	❑	❑	❑	❑
Process or job control system	❑	❑	❑	❑
Inventory or materials requirement planning	❑	❑	❑	❑
Other (please specify)_____	❑	❑	❑	❑

SECTION 2: ENVIRONMENTAL MEASURES, INNOVATION AND PERFORMANCE

*In this section, you are asked to provide an overall picture of how your **facility** has sought to address the environmental impacts of its production activities through technical measures and innovations.*

2.1. How important do you consider each of the following potential **negative environmental impacts** from your facility's products and production processes? *(Please tick one box for each row.)*

	No Negative Impacts 1	Moderately Negative Impacts 2	Very Negative Impacts 3	Not Applicable 4
Use of natural resources (energy, water, etc.)	❑	❑	❑	❑
Solid waste generation	❑	❑	❑	❑
Wastewater effluent	❑	❑	❑	❑
Local or regional air pollution	❑	❑	❑	❑
Global pollutants (e.g. greenhouse gases)	❑	❑	❑	❑
Aesthetic effects (noise, smell, landscape)	❑	❑	❑	❑
Soil contamination	❑	❑	❑	❑
Risk of severe accidents	❑	❑	❑	❑
Other impact (please specify)_____	❑	❑	❑	❑

2.2. Taking into consideration the negative environmental impacts stated above, which of the following **environmental performance measures** does your facility **regularly monitor**? *(Please tick one box for each row.)*

	Yes 1	No 0	Not Applicable 2
Use of natural resources (energy, water, etc.)	❑	❑	❑
Solid waste generation	❑	❑	❑
Wastewater effluent	❑	❑	❑
Local or regional air pollution	❑	❑	❑
Global pollutants (e.g. greenhouse gases)	❑	❑	❑
Aesthetic effects (noise, smell, landscape)	❑	❑	❑
Soil contamination	❑	❑	❑
Risk of severe accidents	❑	❑	❑
Other environmental perf. measure (please specify)_____	❑	❑	❑

2.3. Has your facility undertaken **concrete actions to reduce environmental impacts** associated with the following? *(Please tick one box for each row.)*

	Yes 1	No 0	Not Applicable 2
Use of natural resources (energy, water, etc.)	❑	❑	❑
Solid waste generation	❑	❑	❑
Wastewater effluent	❑	❑	❑
Local or regional air pollution	❑	❑	❑
Global pollutants (e.g. greenhouse gases)	❑	❑	❑
Aesthetic effects (noise, smell, landscape)	❑	❑	❑
Soil contamination	❑	❑	❑
Risk of severe accidents	❑	❑	❑
Other impacts (please specify)_____	❑	❑	❑

2.4. If your facility has undertaken significant **measures** specifically related to its **production technologies**, which of the following most closely characterises the nature of such measures? *(Please tick only one box.)*

Changes in production processes which reduce pollution emissions and/or resource use	❑	1
End-of-pipe technologies which reduce pollution emissions or allow for resource recovery	❑	0

2.5. If your facility has undertaken significant **technical measures** which reduce the environmental impacts associated with its activities, which of the following most closely characterises the nature of such measures? *(Please tick only one box.)*

Changes in production technologies	❑	1
Changes in product characteristics	❑	0

2.6. Has your facility experienced a **change in the environmental impacts per unit of output** of its products or production processes in the last three years with respect to the following? *(Please tick one box for each row.)*

	Significant Decrease	Decrease	No Change	Increase	Significant Increase	Not Applicable
	1	2	3	4	5	6
Use of natural resources (energy, water, etc.)	❑	❑	❑	❑	❑	❑
Solid waste generation	❑	❑	❑	❑	❑	❑
Wastewater effluent	❑	❑	❑	❑	❑	❑
Local or regional air pollution	❑	❑	❑	❑	❑	❑
Global pollutants (e.g. greenhouse gases)	❑	❑	❑	❑	❑	❑
Aesthetic effects (noise, smell, landscape)	❑	❑	❑	❑	❑	❑
Soil contamination	❑	❑	❑	❑	❑	❑
Risk of severe accidents	❑	❑	❑	❑	❑	❑
Other impact (please specify)_____	❑	❑	❑	❑	❑	❑

SECTION 3: THE INFLUENCE OF STAKEHOLDERS AND MOTIVATIONS ON ENVIRONMENTAL PRACTICES

*In this section, you are asked to provide information on the relative importance of different stakeholder groups and motivations on decisions regarding your **facility**'s environmental practices.*

3.1. How important do you consider the **influence** of the following **groups or organisations** on the environmental practices of your facility? *(Please tick one box for each row.)*

	Not Important 1	Moderately Important 2	Very Important 3	Not Applicable 4
Public authorities (government, state, municipal)	❑	❑	❑	❑
Corporate headquarters	❑	❑	❑	❑
Household consumers	❑	❑	❑	❑
Commercial buyers	❑	❑	❑	❑
Suppliers of goods and services	❑	❑	❑	❑
Shareholders and investment funds	❑	❑	❑	❑
Banks and other lenders	❑	❑	❑	❑
Management employees	❑	❑	❑	❑
Non-management employees	❑	❑	❑	❑
Labour unions	❑	❑	❑	❑
Industry or trade associations	❑	❑	❑	❑
Environmental groups or organisations	❑	❑	❑	❑
Neighbourhood/community groups & organisations	❑	❑	❑	❑
Other groups or organisations (please specify)_____	❑	❑	❑	❑

3.2. How **important** do you consider the following **motivations** to have been with respect to the environmental practices of your facility? *(Please tick one box for each row.)*

	Not Important 1	Moderately Important 2	Very Important 3	Not Applicable 4
Prevent or control environmental incidents	❑	❑	❑	❑
Regulatory compliance	❑	❑	❑	❑
Corporate profile/image	❑	❑	❑	❑
Cost savings	❑	❑	❑	❑
New technology development	❑	❑	❑	❑
New product development	❑	❑	❑	❑
Facilities similar to ours are adopting similar practices	❑	❑	❑	❑
Other reasons (please specify)_____	❑	❑	❑	❑

SECTION 4: PUBLIC ENVIRONMENTAL POLICY

*In this section you will be asked about the nature of public environmental policy, and how it affects your **facility**. Responses should reflect the role of all relevant public authorities (municipal, state, etc…).*

4.1. Please assess the following **environmental policy instruments** in terms of their impacts on your facility's production activities. *(Please tick one box for each row.)*

	Not Important 1	Moderately Important 2	Very Important 3	Not Applicable 4
Input bans	❑	❑	❑	❑
Technology-based standards (e.g. abatement equipment)	❑	❑	❑	❑
Performance-based standards (e.g. emission levels)	❑	❑	❑	❑
Input taxes (including energy)	❑	❑	❑	❑
Emission or effluent taxes or charges	❑	❑	❑	❑
Tradable emission permits or credits	❑	❑	❑	❑
Liability for environmental damages	❑	❑	❑	❑
Demand information measures (e.g. eco-labels)	❑	❑	❑	❑
Supply information measures (e.g. recognition programs)	❑	❑	❑	❑
Voluntary / negotiated agreements	❑	❑	❑	❑
Subsidies / tax preferences	❑	❑	❑	❑
Technical assistance programmes	❑	❑	❑	❑
Other policy instrument (please specify)_____	❑	❑	❑	❑

4.2. Do the **regulatory authorities** have programmes and policies in place to encourage your facility to use an environmental management system?

Yes ❑ 1
No ❑ 0

If yes, please indicate programmes which regulatory authorities have in place to encourage your facility to use an environmental management system. *(Please tick one box for each row.)*

	Yes 1	No 0
Reducing the frequency of their regulatory inspections	❑	❑
Expediting environmental permits	❑	❑
Consolidating environmental permits	❑	❑
Waiving environmental regulations	❑	❑
Reducing stringency of regulatory thresholds	❑	❑
Providing technical assistance	❑	❑
Providing financial support	❑	❑
Providing special recognition or award	❑	❑
Providing preferences for public procurement	❑	❑
Providing information about the value of such systems	❑	❑
Other incentive (please specify)_____	❑	❑

4.3. How would you describe the **environmental policy regime** to which your facility is subject? *(Please tick only one box.)*

Not particularly stringent, obligations can be met with relative ease	❑	1
Moderate stringency, requires some managerial and technological responses	❑	2
Very stringent, has a great deal of influence on decision-making within the facility	❑	3

4.4. How many times has your **facility** been **inspected** by public environmental authorities (central, state/province and municipal governments) in the last three years? _____

SECTION 5: FACILITY CHARACTERISTICS

*This section is intended to help us obtain a general picture of your **facility**'s market, ownership structure, size and sale, as well as the nature of its commercial market.*

5.1. How would you, in general, classify the **primary customers** for your facility's products? *(Please tick only one box.)*

Other manufacturing firms	❑	1
Wholesalers or retailers	❑	2
Households	❑	3
Other facilities within your firm	❑	4

5.2. What **best characterises the scope** of your facility's market? *(Please tick only one box.)*

Local	❑	1
National	❑	2
Regional (neighbouring countries)	❑	3
Global	❑	4

5.3. With how many other firms did your facility **compete on the market** for its most commercially important product within the past three years? *(Please tick only one box.)*

Less than 5	❑	1
5-10	❑	2
Greater than 10	❑	3

5.4. Please assess the following factors in your facility's **ability to compete** on the market for its most important product within the past three years. *(Please tick one box for each row.)*

	Not Important 1	Moderately Important 2	Very Important 3
Product price	❑	❑	❑
Product quality	❑	❑	❑
Firm image	❑	❑	❑
Established relationships with buyers	❑	❑	❑

5.5. What is the approximate **age of your facility** (in years)?_____

5.6. How many **people** were **employed full-time** by your facility on average over the last three years? _____

5.7. Please estimate your facility's average **annual expenditures on research and development** over the last three years? _____

5.8. Does your facility have a budget for **research and development** specifically related to **environmental matters**?

Yes ❑ 1
No ❑ 2

If yes, what percentage of your total budget for research and development has been allocated to environmental matters in the last three years? _____

5.9. Please estimate your facility's **average annual value of shipments** over the last three years._____

5.10. How has the value of shipments from your facility **changed** in the last three years? *(Please tick only one box.)*

They have significantly decreased	❑	1
They have decreased	❑	2
They have stayed about the same	❑	3
They have increased	❑	4
They have significantly increased	❑	5

If you are able to do so, please estimate your facility's **change in average annual value of shipments** over the last three years (in percentage per year)? _____

5.11. How would you assess your facility's **overall business performance** over the past three years? *(Please tick only one box.)*

Revenue has been so low as to produce large losses	❑	1
Revenue has been insufficient to cover costs	❑	2
Revenue has allowed us to break even	❑	3
Revenue has been sufficient to make a small profit	❑	4
Revenue has been well in excess of costs	❑	5

5.12. Please indicate the industrial sector in which you would place the **main production activity** of your facility. *(Please tick only one box.)*

Manufacture of food products and beverages	❑ 15
Manufacture of tobacco products	❑ 16
Manufacture of textiles	❑ 17
Manufacture of wearing apparel, dressing and dyeing of fur	❑ 18
Tanning and dressing of leather; manufacture of luggage, handbags, footwear, etc.	❑ 19
Manufacture of wood and products of wood and cork, except furniture	❑ 20
Manufacture of paper and paper products	❑ 21
Publishing, printing and reproduction of recorded media	❑ 22
Manufacture of coke, refined petroleum products and nuclear fuel	❑ 23
Manufacture of chemicals and chemical products	❑ 24
Manufacture of rubber and plastics products	❑ 25
Manufacture of other non-metallic mineral products	❑ 26
Manufacture of basic metals	❑ 27
Manufacture of fabricated metal products, except machinery and equipment	❑ 28
Manufacture of other machinery and equipment	❑ 29
Manufacture of office, accounting and computing machinery	❑ 30
Manufacture of electrical machinery and apparatus	❑ 31
Manufacture of radio, television and communication equipment	❑ 32
Manufacture of medical, precision, and optical instruments, watches and clocks	❑ 33
Manufacture of motor vehicles, trailers and semi-trailers	❑ 34
Manufacture of other transport equipment	❑ 35
Manufacture of furniture	❑ 36
Recycling	❑ 37
Other (please specify) _____	❑ 99

SECTION 6: FIRM CHARACTERISTICS

*This section is intended to help us obtain a general picture of your **firm** of which your facility is a part. The first four questions should be completed by all respondents. The last four should be completed by firms with more than one facility.*

6.1. Is your firm listed on a **stock exchange**?

Yes ❑ 1
No ❑ 0

6.2. Is your firm's **head office** located in a **foreign country**?

Yes ❑ 1
No ❑ 0

If yes, in which country? _____

6.3. Does your firm have **an environmental department** (or equivalent such as environmental, health and safety department)?

Yes ❑ 1
No ❑ 0

6.4. How many **different production facilities** does your firm have? _____

*Please answer the following questions if your firm has **more than one facility**.*

6.5. Please estimate your firm's average **annual expenditures on research and development** over the last three years? _____

6.6. Does your firm have a budget for **research and development** specifically related to **environmental matters**?

Yes ❑ 1
No ❑ 0

If yes, what percentage of your total budget for research and development has been allocated to environmental matters in the last three years? _____

6.7. How many **people** are presently **employed full-time** by your firm?_____

6.8. Please estimate your **firm's average annual value of shipments** over the last three years. _____

Thank you for taking the time to complete this questionnaire!