



Annotated Bibliography

This bibliography contains annotations for selected Resource List materials. Books and articles were annotated by University of Minnesota Professor Alfie Marcus. Bracketed letters indicate the corresponding Resource List topic:

- A. What is Strategic Environmental Management?
- B. SEM and Competitiveness
- C. Implementing SEM
- D. Tools for SEM
- E. Cases Illustrating How to Create Value

For information on how to obtain any materials listed here that are not found in most campus libraries, see the Resource List.

Ahearn, James, Harry Fatkin, and William Schwalm. "Case Study: Polaroid Corporation's Systematic Approach to Waste Minimization." *Pollution Prevention Review* (Summer 1991) 257-271. [E]

The case discusses the impetus for the Toxic Use and Waste Reduction Program, the goals, the way materials were categorized in terms of their harm, the normalization of waste to rate of production, setting priorities, and implementation.

Allen, David, and Kirsten Sinclair Rosselot. "Pollution Prevention at the Macro Scale: Flows of Wastes, Industrial Ecology, and Life Cycle Analyses." *Waste Management* 14, no. 3-4 (1994): 317-328. [D]

This paper distinguishes three approaches to P2. The first is simply to inventory all wastes and emissions associated with a product or process, but two related approaches analyze the complex systems used to convert raw materials to products. "Industrial metabolism" starts with the raw material, such as lead, and follows it through processes into products; such studies have the promise of showing low cost/low toxicity options. "Life cycle analysis" starts with the product and identifies all the precursors necessary for its manufacture, use, and disposal. The authors list the various life cycle analyses done on containers, laundry detergents, diapers, and other products and assess the paper vs. plastic sack controversy, concluding that the results are ambiguous (plastic requires less energy and has less air pollution, but requires the use of petroleum, a non-renewable resource).

American Institute for Pollution Prevention. *A Primer for Financial Analysis of Pollution Prevention Projects*. EPA/600/R-93/059. Washington: U.S. Environmental Protection Agency, 1993. [D]

This is a guide for P2 investing. Justification may be needed internally in the competition for funds, but it can also be helpful in negotiating a bank loan or securing funding from other outside sources. The guide uses a concept of life-cycle costing wherein the costs of maintainability, reliability, disposal/salvage value, and training and education are given equal weight in making financial decisions. It defines terms like "payback period," "internal rate of return," "benefit-cost ratio," and "present value of net benefits." It establishes different cost categories: (1) direct labor, materials, and equipment; (2) monitoring, reporting, recordkeeping, and permitting; (3) future liabilities; and (4) consumer response, employee relations, and corporate image. It starts with computation of baseline costs based on material input and output, shows how to account for the effects of interest, examines revenues and expenses (including insurance and depreciation), looks at cash flow and opportunity costs, and provides example calculations.

Barrett, Scott. "Environmental Regulation for Competitive Advantage." *Business Strategy Review* 2, no. 1 (Spring 1991): 1–17. [A]

The author's main argument is that when regulations are imposed they are usually good for some businesses and bad for others; the businesses in a position to take advantage of regulatory change often do so. The author provides examples from air pollution control and CFC elimination.

Bierma, Thomas, and Francis Waterstraat. *Pollution Prevention and Business Management: Curricula for Schools of Business and Public Health*. Champaign: Illinois Hazardous Waste Research Information Center, 1995. [D]

Three modules on introducing P2 to business are in this package. The first focuses on competitiveness, costs of pollution and prevention, and P2 opportunities and barriers. The second focuses on improving processes, balancing materials, analyzing financial impacts, and identifying and monitoring P2 solutions. The third focuses on management policy, organizational structure, and the business plan. Modules include supplemental readings, references, and problems and activities.

Crown Cork & Seal Company, Inc. "Source Reduction Project in Plant #23." Faribault, MN: CCSC, 1993. [E]

The case describes how a manufacturer of aerosol and vegetable cans implemented a source reduction program. The new employee-led program focuses on the inks, coatings, and solvents in the production process as well as non-hazardous metal scrap and packaging. The case has a description of new processes and procedures, waste reduction figures, and cost savings.

Elkington, John. "Towards the Sustainable Corporation." *California Management Review* 36, no. 2 (Winter 1994): 90–100. [A]

The author maintains that rising public concern about the environment poses a competitive challenge to different businesses than in the early 1970s. They are in advanced sectors like computing as well as in old manufacturing businesses like steel. As mandatory environmental disclosure has increased, so too has voluntary corporate reporting. The new challenge to corporations can be met in a variety of ways including alliances with suppliers and turning stakeholders into customers.

Freeman, Harry, Teresa Harten, Johnny Springer, Paul Randall, Mary Ann Curran, and Kenneth Stone. "Industrial Pollution Prevention: A Critical Review." *Journal of the Air and Waste Management Association* 42, no. 5 (May 1992): 618–656. [D]

In this state-of-art review, pollution prevention (P2) is defined, in accord with the EPA definition, as source reduction. Benefits to companies include improving the "bottom line," making compliance easier, and demonstrating a proactive commitment. The U.S. government, however, long remained tied to end-of-pipe regulation. The authors give an overview of federal P2 legislation, U.S. EPA programs such as 33/50 and Green Lights, and the P2 programs of several U.S. companies; there is a long discussion of what such programs need to be successful. Measuring environmental gains is a difficult issue, say the authors, but so too is the question of whether P2 is cost-effective—costs range from capital/operational to compliance/permit and consumer responses/employee relations. The authors state that short-term benefits are greater if regulators effectively enforce the law. Enhanced government incentives would come from taxes, marketable pollution privileges, information disclosure, and subsidies. Also discussed are P2 barriers, life cycle assessments and design for the environment.

Geffen, Donald, and Alfred Marcus. "Pollution Prevention — Overcoming Barriers to Further Progress." Ann Arbor: NPPC, 1998. [C]

If P2 is profitable and some companies have made impressive efforts, why has it not been more widely adopted? The authors cite four reasons: (1) Managers who see P2 as an extension of regulation, (2) inadequate accounting systems, (3) the risk of production process changes, and (4) other capital demands that compete with P2.

Gladwin, Thomas. "The Meaning of Greening: A Plea for Organizational Theory." In *Environmental Strategies for Industry*, ed. J. Schot and K. Fischer, 37–61. Washington: Island Press, 1993. [D]

The author inventories trends in corporate "greening": (1) pollution prevention and toxic reduction programs; (2) full cost analysis, auditing, design for the environment, and product stewardship; (3) collaboration between environmental organizations and corporations; (4) policy formalization catalyzed by industry associations; (5) greater CEO and board involvement; and (6) pressure from employees, regulation, accidents, and liability. According to the author, research in this

area has been imprecise and segregated from broader streams of organizational research. He discusses various organizational theories, focusing on “strategic choice.” This theory states that, in the environmental area, managers can create competitive advantage through cost leadership (environmental efficiency); product differentiation for premium prices; leveraging core competencies with technology; standard setting and innovation; generic substitutions; and alliance creation. This theory is connected to a theory of transformational leadership. However, a theory of evolutionary change, suggests that such moments of frame-breaking transformation (“punctuated equilibrium”) are rare and may require shocks, jolts, and crises that threaten the organization’s survival.

Hart, Stuart. “A Natural-Resource-Based View of the Firm.” *Academy of Management Review* 20, no. 4 (October 1995): 986–1,014. [A]

This article summarizes the literature on corporate strategy, starting with the arguments that competitive advantage is achieved through cost leadership or differentiation and ending with the new resource-based view of the firm, which stresses distinctive (nonimitable, rare, and nonsubstitutable) competencies. The article shows how a natural-resource-based view of the firm would help managers build such competencies through (1) pollution prevention and continuous improvement as a means to lower costs, (2) product stewardship through life-cycle costing, and (3) stakeholder integration. Sustainable development — a shared vision of minimal environmental impact associated with growth — is a means to secure future position. The skills it involves (pollution prevention, life-cycle costing, and stakeholder integration) are tacit ones. They provide not only external social legitimacy but internal strengths to secure long-term competitive advantage.

Heaton, George, Robert Repetto, and Rodney Sobin. *Transforming Technology: An Agenda for Environmentally Sustainable Growth in the 21st Century*. Washington: World Resources Institute, 1991. [B]

The authors maintain that some technologies can reduce environmental harm even while enhancing productivity. They include opportunities for pollution prevention and energy efficiency, renewable energy, advanced materials, biotechnology, and information technologies. Rapid dissemination of such technologies requires changes in government regulation, economic incentives, technology policies, corporate leadership, and better education of managers and engineers.

Hunt, Robert, Jere Sellers, and William Franklin. “Resource and Environmental Profile Analysis: A Life Cycle Environmental Assessment for Products and Procedures.” *Environmental Impact Assessment Review* 12 (1992): 245–269. [D]

Life-cycle analysis starts with extraction of raw materials and includes processing, transportation, manufacturing of all intermediate and primary materials, fabrication, final use, disposal and recycling. It documents all measurable resource uses and environmental discharges. The procedures to carry out this type of analysis are very complex, as the authors show.

Jaffe, Adam, Steven Peterson, and Paul Portney. “Environmental Regulation and the Competitiveness of U.S. Manufacturing: What Does the Evidence Tell Us?” *Journal of Economic Literature* 33 (March 1995): 132–163. [B]

The authors cite EPA figures that U.S. spending on environmental regulation is about \$125 billion annually (2.1% of GDP) and will grow to \$190 billion (2.6% of GDP) by the end of the decade. They assemble the evidence on the effects of this spending. The conventional view is that it imposes costs, slows productivity growth, and hinders global competitiveness. The revisionist sees it as a driving force for competitiveness. The authors focus mainly on net exports of pollution-intensive manufacturing (paper, chemical, coal and petroleum, and primary metal industries), where abatement costs are highest. Few direct studies have examined the connection between regulatory spending and competitiveness, but indirect results of about 100 studies have bearing on the problem. The authors create a taxonomy of regulatory costs from the most direct (government administration and private sector compliance) to the least (unemployment and obsolete capital). They conclude that there is little evidence to support the proposition that regulations either hinder or help business competitiveness.

Jankus, Mark. “ARCO Solar, Inc.” In *Business and Society: Strategy, Ethics, and the Global Economy*, by Alfred Marcus, 390–403. Chicago: Irwin Press, 1995. [E]

This case is about what ARCO should do about its solar division in light of the fact that it has never been profitable and government subsidies are waning.

Keoleian, Gregory, and Dan Menerey. "Sustainable Development by Design: Review of Life Cycle Design and Related Approaches." *Air and Waste* 44 (May 1994): 645–667. [D]

Life cycle design covers all activities in the life of a product: from raw-material extraction through manufacturing to final use and disposal. It involves analyzing needs, making baseline assessments and benchmarks, and forming checklists based on legal, cultural, cost, performance, and environmental factors. Product and material life extension should be considered. The authors conclude that many factors limit the applicability of such analysis including lack of data and evaluation tools.

Klafter, Brenda, Barry Dambach, et al. "Environmental Benchmarking: AT&T and Intel's Project to Determine the Best-in-Class Corporate Pollution Prevention Programs." *Corporate Quality/Environmental Management* III (Spring 1993): 37–44. [D]

Detailed interviews were conducted at companies whose programs were selected as "best in class": 3M, Dow, DuPont, Xerox, and H. B. Fuller. Among the elements considered critical for a best-in-class program were: strategic objectives in business plans, top-level commitment, empowerment, dedicated staff, policies and procedures, institutionalized goals, R&D support, cross-functional teams, integration into product and process design, internal technology transfer, recognition and reward, and internal public relations involvement.

Klannen, Robert, and Noel Greis. "Managing Environmental Improvement Through Product and Process Innovation: Implications of Environmental Life Cycle Assessment." *Industrial Crisis Quarterly* 7, no. 4 (1993). [D]

The paper reviews alternative frameworks for product life cycle assessment that are being developed in the U.S., Canada, and Europe. It then presents a simple decision chart for making investments trade-offs between product redesign or process improvement based on the length of product use and the magnitude of environmental impacts associated with the product.

Koppell, Carla. "Pioneer Hi-Bred International: Developing an Environmental Statement and Strategy" (1992). Harvard Case 9-593-045. [E]

In this case, the challenge for the company, the world's largest seed business, is to integrate environmental stewardship with its strategic mission.

Management Institute for Environment and Business. *Competitive Implications of Environmental Regulation: A Study of Six Industries*. 1994. [B]

The studies show innovation in response to environmental regulation, from new means of production to innovative product characteristics. In many cases, it is regulated industries' suppliers who recognize the opportunity and develop these innovations; often the benefits involve better cost and quality products or services. Innovation depends on the type of regulation and the structure of the industry, with smaller or more fragmented industries more likely to innovate than larger, more concentrated ones. The studies are modeled after Michael Porter's approach to industry analysis in *Competitive Strategy* (New York: Free Press, 1980) and global competition in *The Competitive Advantage of Nations* (New York: Free Press, 1990). They cover pulp and paper, computer and electronic components, paint and coatings, refrigerators, printing ink, and dry cell battery industries.

Marcus, Alfred, and Donald Geffen. "Archer Daniels Midland (ADM) and Ethanol." In *Business and Society: Strategy, Ethics, and the Global Economy*, by Alfred Marcus, 463–473. Chicago: Irwin Press, 1995. [E]

This case is about the possible impacts on ADM's stock value from the ongoing controversy about ethanol's environmental benefits and economic costs.

Marcus, Alfred. "New Product Development at General Motors." In *Business and Society: Strategy, Ethics, and the Global Economy*, 421-431. Chicago: Irwin Press, 1995. [E]

This case is about the effects of California's zero-emission-vehicle requirements. What type of vehicle should General Motors develop? Should it apply political pressure to delay the imposition of the California standards?

Matheson, Andrew. "Renewable Energy in the United States" (1993, rev. May 4, 1995). Harvard Case 9-794-087. [E]

This case discusses renewable energy technologies such as hydro electric, geothermal, wind, biomass, solar, and energy. It also traces the public policies affecting these technologies and what incentives exist in the 1990s.

Murray, Fiona. "Xerox: Design for the Environment" (1993, rev. May 4, 1995). Harvard Case 9-794-022. [E]

This case describes the attempt by Xerox to seize competitive advantage from environmental efficacy through comprehensive changes in production concepts and design, manufacturing, product delivery, and relations with suppliers, distributors, and customers. It discusses Xerox programs in environmental management, quality, design-for-the-environment, recycling, and benchmarking.

"Pollution Prevention: A Guide to Program Implementation." Champaign: Illinois Hazardous Waste Research and Information Center, 1993. [D]

This guide defines P2, discusses incentives and obstacles, gives an overview of federal and state legislation, and then turns to elements in developing a P2 program: top management support, setting up teams, training, understanding processes and wastes, performing materials balance models, generating reduction options, cost considerations, and implementation and evaluation.

Porter, Michael, and Claas van der Linde. "Green and Competitive." *Harvard Business Review* 73 (September-October 1995): 120–134. [B]

The authors argue that, but that in a world of dynamic competition, companies can find innovative solutions to environmental problems. These problems can actually induce innovation that lowers total costs and increases product value. Pollution is a form of inefficiency: It indicates scrap, harmful substances, or incompletely used energy and creates no value for customers. Prevention of pollution is a step in the right direction, but ultimately companies must frame their environmental improvement efforts in terms of resource productivity. Just as the quality revolution showed that increased quality saved money, so too in the environmental area there is a need for a change in how the problem is viewed. Thus, pollution should be seen as being similar to defects in that it often shows flaws in product design or production. This understanding can be promoted by strict, outcome-based, comprehensive, predictable regulations that rely on market incentives.

Pratt, Gregory, Paul Gerbec, et. al. "An Indexing System for Comparing Toxic Air Pollutants Based Upon Their Potential Environmental Impacts." *Chemosphere* 27, no. 8 (1993): 1,359–1,379. [D]

The authors have developed a method for comparing toxic air emissions based on information about their environmental fate and toxicity to humans and other species. The system assigns numerical values to the substances based on their hazard potential.

President's Commission on Environmental Quality, Quality Management Subcommittee. *Total Quality Management: A Framework for Pollution Prevention*, President's Commission on Environmental Quality, Washington, January 1993. [D]

Describes the findings of PCEQ's Quality Management Subcommittee. From the basis of 12 company "quality environmental management" P2 case studies, the report describes the background for P2 and the steps for a business P2 program. Also includes tools and techniques, metrics, and a limited bibliography.

Prewitt, Edward. "Allied-Signal: Managing the Hazardous Waste Liability Risk" (1992). Harvard Case 9-793-044. [E]

The company wants to limit huge past liabilities and prevent such liabilities in the future. It has large operations in Europe and is considering harmonizing its environmental practices throughout the world. The case describes Allied-Signal's environmental risk management policies, including waste reduction, and its relationship to the chemical industry's "Responsible Care" program.

———. "Laidlaw Environmental Services" (1993; rev. August 16, 1994). Harvard Case 9-794-016. [E]

Laidlaw Environmental Services, the second largest hazardous waste management company in North America, has convened a task force to restructure and implement organizational changes after disappointing financial results.

Rothenberg, Sandra, James Maxwell, and Alfred Marcus. "Issues in the Implementation of Proactive Environmental Strategies." *Business Strategy and the Environment*, Part 4 (Winter 1992-93; Bradford, England: European Research Press): 1-12. [C]

The article discusses some of the programmatic choices managers must make to implement strategic environmental management: structure; performance monitoring and review; incentives and controls; guidelines and tools for investment; methodologies for decision-making; and guidelines for communication with stakeholders. It illustrates these choices with reference to Volvo.

Sarkis, Joseph. "Manufacturing Strategy and Environmental Consciousness." *Technovation* 15, no. 2 (1995): 79-97. [D]

The author lists a number of environmentally sound business practices from forming alliances with environmentalists and regulators to P2, staying ahead of regulation, managing suppliers, making employees feel responsible, and measuring impact. He includes a table summarizing Japanese company's environmental strategies. He then describes "environmentally conscious manufacturing": life cycle analysis, reduction, remanufacturing, and recycling and reuse; these have to be integrated with project planning and management.

Schaltegger, Stefan, and Andreas Sturm. "Eco-Controlling: An Integrated Economic Ecological Management Tool." In *Green Business Opportunities*, ed. Dominik Koechlin and Kaspar Muller. London: Pitman Publishing, 1993. [D]

Companies can gain a competitive edge by convincing their customers that their products produce less environmental harm. To make such a claim, companies need to examine the product's life cycle — from supplier to production, distribution, consumption, and disposal — to record and assess the ecological impact of their economic activities. A difficulty in this type of analysis is the boundaries: e.g., how far back in the production cycle to go? Another difficulty is moving from a calculation of how many pounds or kilograms of pollution are emitted to the harm caused. The authors believe that "approximately right" is better than "exactly wrong." They feel that the life cycle methodology can be integrated with economic based portfolio approaches to help a company decide which businesses to enter and which to exit.

Schot, Johan, and Kurt Fischer. "Introduction: The Greening of the Industrial Firm." In *Environmental Strategies for Industry*, 3-33. Washington: Island Press, 1993. [A]

The authors hold that, somewhere in the mid-1980s, firms changed from resisting environmental pressures to embracing and incorporating them. The new stage involved written policy statements, promises to go beyond compliance, and expanded staffing of environmental departments, which innovated in ways that influenced companies' strategic policies. Environmental considerations started affecting capital investment decisions, product development, and production processes optimization. Excellence in protecting the environment made some companies more competitive. For example, a company could pursue environmental efficiency to achieve cost leadership or develop green products for specific markets to pursue differentiation. An aspect of the new strategies might be new relations among buyers and suppliers. However, the authors note that existing technological trends, such as shorter product life-cycles, are at odds with environmental goals. Moreover, cleaner technologies depend on government regulation and subsidies, and without strict government enforcement, little profit may be made from these endeavors.

Shanely, Agnes. "Pollution Prevention Has a Long Way to Go." *Chemical Engineering* 100, no. 11 (November 1993): 30-43. [C]

This paper is a critical look at pollution prevention based on a survey of environmental and plant managers in the U.S. and Europe, which shows that (1) compliance still dominates and (2) many companies do not have pollution prevention programs in place.

Shrivastava, Paul. "The Role of Corporations in Achieving Ecological Sustainability." *Academy of Management Review* 20, no. 4 (October 1995): 936-960. [A]

This author discusses some of the important components of an ecologically sustainable corporation. Like the zero defects goal, "total quality environmental management" attempts to eliminate emissions, effluents, and accidents; minimize life-cycle costs; and create integrated industrial eco-systems. Ecologically sustainable strategies for competition are "least-cost," "differentiation," and "niche." Each has different components, from price to operational improvements, technology transfer, and contractor/supplier relations.

Stark, Richard. "Polaroid: Managing Environmental Responsibilities and Their Costs" (1993, rev. April 21, 1994). Harvard Case 9-194-052. [E]

This case is written from the perspective of Polaroid's Controller, who has to consider whether all environmental costs are being accounted for in financial statements, accounting reports, and pricing in light of possible exposure to future regulations.

"The Challenge of Going Green." *Harvard Business Review* 72, no. 13-14 (July-August 1994): 3-14. [B]

This symposium consists of a variety of responses to Walley and Whitehead's article in the previous issue. Participants include Richard A. Clark, CEO of Pacific Gas & Electric; J. Ladd Greeno of A.D. Little; Frances Cairncross, environment editor for *The Economist*; Daniel Esty of Yale; Richard Wells of Abt Associates; Rob Gray of the University of Dundee; Kurt Fischer of Tufts; and Johan Schot of the University of Twente.

Trisoglio, Alex. "International Business and Sustainable Development." *Green Globe Yearbook*, ed. Helge Bergesen and Georg Parmann, 87-100. New York: Oxford University Press, 1993. [A]

The author holds that the movement from limited to growth to sustainable development holds promise not only for environmental industries, but for all companies. They will be affected by new technologies and approaches that will yield not only "green products" but less polluting and more resource-efficient products and services. The author emphasizes that developed economies had been dematerializing since the 1970s. He shows that many good business practices (e.g., quality) are also good for the environment; to speed the changes taking place, capital markets have to be harnessed and managers with strategic vision are needed.

U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics. *An Introduction to Environmental Accounting As A Business Management Tool*. EPA/742/R-95/001. Washington: U.S. EPA, 1995. [D]

The cost of pollution may be hidden in the category of "overhead," but many companies pay for it in the form of regulation, fines, contingencies, and bad image. The real costs of pollution can be computed for individual processes, an entire division, or the whole company: they can start with up-front pre-acquisition activities and end with disposal and decommissioning. Once such waste is discovered, it can be offset by generating

revenues from sales of waste; besides, more accurate costing can result in competitive advantage. It also should be used in capital budgeting where potential, less tangible benefits of P2 should not be ignored. These include increased sales due to image, better borrowing access and terms, equity more attractive to investors, and so on.

Upton, David. "McDonald's Corporation 1992 Operations, Flexibility and the Environment" (1992). Harvard Case 9-693-028. [E]

McDonalds has undertaken a unique environmental partnership with EDF. To what extent should environmental issues affect its product strategy and operating philosophy?

Vietor, Richard H. K., and Forest Reinhardt. *Business Management and the Natural Environment*. Cincinnati: South-Western Publishing, July 1995. [E]

At 700 pages, this book includes virtually all cases used in Harvard's environmental management courses, which the authors developed and now teach. The cases survey the many ways that environmental concerns affect the strategy and operations of business firms. Readers see executives formulating and implementing environmental strategy in a rapidly changing context, simultaneously managing scientific, legal, economic, and political problems. The book especially emphasizes business strategy and business-government relations, and thus draws heavily both on environmental economics and political science. The materials in the book are suitable for executives, graduate students, and advanced undergraduates. The teacher's manual (300 pp.) includes background information on the cases, detailed assignment questions and teaching plans, annotated exhibits, and suggestions for further reading.

Walley, Noah, and Bradley Whitehead. "It's Not Easy Being Green." *Harvard Business Review* 72, no. 11-12 (May-June, 1994): 46-52. [B]

The authors criticize the new vision of win-win environmental solutions. This vision is based on the idea that, in redesigning products to use fewer environmentally harmful substances, managers will be able to reduce costs and increase productivity. The authors claim that this vision is very unrealistic, as at many companies environmental costs are rising sharply with no chance of economic payback in sight.

Westley, Frances, and Harrie Vredenburg. "Strategic Bridging: The Collaboration Between Environmentalists and Business in the Marketing of Green Products." *Journal of Applied Behavioral Science* 27, no. 1 (March 1991) 65–90. [D]

The paper describes how, in Canada, an environmental group acted as bridge between a retail grocery and its consumers by endorsing a line of green products.

Willis, Vincent. "Archer Daniels Midland" (1992). Harvard Case 9-593-028. [E]

This case discusses the battle over ethanol in light of the passage of the 1990 Clean Air Act. What is the likely future of the ethanol industry, and what strategy should Archer Daniels Midland pursue?

Zosel, Thomas. "Case Study: How 3M Makes Pollution Prevention Pay Big Dividends." *Pollution Prevention Review* (Winter 1990-91): 67–73. [E]

This is a brief overview of the successful "Pollution Prevention Pays" (3P) program at 3M. It describes the program philosophy, implementation, and results. In 15 years, the program has saved the company \$500 million and reduced pollution rates per unit of production by 50 percent.



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The mission of the NPPC is to promote sustainable development by educating students, faculty, and professionals about pollution prevention; create educational materials; provide tools and strategies for addressing relevant environmental problems; and establish a national network of pollution prevention educators. In addition to developing educational materials and conducting research, the NPPC also offers an internship program, professional education and training, and conferences.

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