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# **POLLUTION PREVENTION RESEARCH STRATEGIC PLAN**

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**Draft Report  
March 1991**



**U.S. Environmental Protection Agency  
Office of Research and Development**

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## CHAPTER 1 INTRODUCTION

### BACKGROUND

During the past two decades, the U.S. Environmental Protection Agency (EPA) has made considerable progress in improving environmental quality, but these efforts have focused largely on treating and controlling pollutants that have already been generated. EPA's "end-of-the-pipe" approaches have achieved significant reductions in the discharge of pollutants, but additional gains in treatment and control will, in most cases, be much more costly and difficult to achieve. The U.S. currently spends nearly \$115 billion each year (about 2 percent of the U.S. gross national product) on environmental protection. Although this amount has been increasing, national environmental pollution control expenditures are just one-third of the amount spent on national defense, one-third of the cost of medical care, and one-fifth of the cost for housing. Despite the increasing expenditures for pollution control, many environmental problems remain and complex new problems have arisen that pose serious environmental and health risks. Many of the problems we now face are not amenable to the end-of-the-pipe treatment approaches that we have used in the past. The old tools in the environmental toolkit are no longer adequate to address these problems. We need creative new strategies for reducing environmental risk. Further strides in protecting the environment will require preventing problems by reducing or eliminating the generation of pollutants in the first place. Pollution prevention holds the key to future gains in environmental protection.

### What is Pollution Prevention?

Pollution prevention is, very simply, any activity undertaken to reduce or eliminate pollution or waste or to reduce its toxicity. It involves the use of processes, practices, or products that reduce or eliminate the generation of pollutants and wastes, or that protect natural resources through conservation or more efficient utilization. The application of pollution prevention techniques varies depending on the economic sector in which they are used. For example, there are three basic approaches to preventing pollution in the manufacturing sector:

- Changing the inputs to processes to reduce reliance on toxic raw materials. A manufacturer may substitute non-toxic for toxic feedstocks in making a product.



- Changing processes to reduce the amount and toxicity of waste generated. The production process may be altered to reduce the volume of materials released to the environment and/or the toxicity of these materials; in addition to avoiding waste management costs, these changes often improve efficiency by reducing raw material losses and conserving water. Process changes may include equipment modifications or less expensive maintenance and housekeeping measures, as well as in-process, closed-loop recycling that returns waste materials directly to production as raw materials.
- Changing outputs to reduce reliance on toxic or environmentally harmful products. The manufacturers or users of products may switch to non-toxic (or less toxic) or less polluting substitutes.

In the agricultural sector, pollution may be prevented by developing and adopting low input sustainable agricultural practices that eliminate the wasteful use of inputs, such as water, fertilizers, and pesticides. In addition, soil conservation and land management practices that prevent sediment erosion and the runoff of pesticides and fertilizers also prevent pollution. In the energy and transportation sectors, pollution from energy consumption can be prevented by increasing efficiency to reduce the generation of pollutants associated with extraction, refining, and use of fuels; and by increasing reliance on clean, renewable energy sources or alternative, less polluting fuels.

While recycling (other than closed loop processes), reuse, and reclamation are not included in the Agency's definition of pollution prevention, EPA recognizes the important role they play in reducing the amount of waste generated that requires subsequent treatment and disposal. The Office of Solid Waste (OSW) in its *The Solid Waste Dilemma: An Agenda for Action*, published in February 1989, established a national goal of 25 percent source reduction and recycling by the end of 1992. The *Agenda for Action* also identified activities that EPA could undertake to facilitate achievement of this goal and the objectives outlined in the *Agenda*. OSW is currently updating the *Agenda* with a report entitled, *The Solid Waste Dilemma: Solutions for the 90's*, which addresses the progress that the Agency has made since setting the agenda and future plans for furthering this progress. The update focuses on the issues and needs concerning the solid waste problem and activities that can be undertaken by federal, state, and local governments, industry, manufacturers, distributors, retailers, citizens, and public interest groups to achieve the national goal for source reduction and recycling.

In a 1988 report to EPA entitled, *Future Risk: Research Strategies for the 1990s*, the Science Advisory Board (SAB) recommended that prevention or reduction of environmental risk should be a primary long-term goal for the Agency. The report advised EPA to shift the focus of its

environmental protection strategy from "end-of-pipe" treatment to preventing pollution. The SAB defined a hierarchy for risk reduction research to help in setting priorities and in achieving the Agency's overall goal of protecting human health and the environment. The hierarchy clearly indicates that pollution prevention should consistently be the first option for reducing risks. In addition, the SAB recommended that EPA plan, implement, and sustain a long-term research program to support the new strategy of preventing pollution.

Recognizing the importance of pollution prevention in furthering the Agency's progress in protecting human health and the environment, EPA established the Pollution Prevention Office (PPO) in the Office of Policy, Planning and Evaluation in 1988. The PPO is charged with promoting an integrated environmental ethic stressing the prevention of pollution. This office is the focal point for the Agency's pollution prevention activities and a major impetus behind an integrated, cross-media approach to pollution prevention.

On January 26, 1989, EPA published a proposed policy statement that established pollution prevention as the Agency's preferred approach for protecting human health and the environment. EPA has already begun to incorporate this policy into the Agency's decision processes. For example, the Agency has established a comprehensive four-year strategic planning process as a means of integrating important pollution prevention policy themes into how the Agency conducts its business. Strategic planning will allow EPA to give more deliberate attention to pollution prevention in key research and budgeting decisions.

### **The Pollution Prevention Act**

The American public has become increasingly aware of the potential health and environmental risks associated with pollution. The information reporting requirements of Title III of the Superfund Amendments and Reauthorization Act (SARA) have made the public more aware of the massive amounts of pollution that are released by industry each year. Congress, recognizing the public's growing concern and the importance of preventing further damage to the environment, drafted legislation that established a national pollution prevention policy in the U.S.

On October 27, 1990, Congress passed the Pollution Prevention Act. Enactment of this legislation will strengthen and accelerate efforts to promote pollution prevention throughout the

Nation. The Act declares the national policy of the United States to be that pollution should be prevented or reduced at the source whenever feasible; and it establishes source reduction as the first priority in the pollution prevention hierarchy, followed by recycling, treatment, and proper disposal. Source reduction, as defined in the Act, is any "practice which reduces the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or otherwise released into the environment prior to recycling, treatment, or disposal; and reduces the hazards to public health and the environment associated with the release of such substances, pollutants, or contaminants."

The Pollution Prevention Act of 1990 requires EPA to establish an office, independent of the media offices, to carry out its functions under this Act, and develop and implement a strategy to promote pollution prevention within the public and private sectors. As part of the strategy, the EPA Administrator will:

- Coordinate pollution prevention activities in each Agency office and promote similar practices in other federal agencies and industry.
- Establish standard methods for measuring source reduction; and develop, test, and disseminate model source reduction auditing procedures.
- Establish a training program on pollution prevention opportunities.
- Make recommendations to Congress to eliminate barriers to pollution prevention and identify opportunities to use federal procurement to encourage source reduction.
- Establish a source reduction clearinghouse containing information on management, technical, and operational approaches to source reduction; and develop improved methods for providing public access to data collected under federal environmental statutes.
- Establish an advisory panel of technical experts to advise the EPA Administrator on ways to improve the collection and dissemination of data.
- Provide grants to states for programs to promote pollution prevention by local businesses.
- Identify research needs relating to pollution prevention and set priorities for research to target the most promising opportunities for source reduction.

The Act also requires facilities reporting under the Toxics Release Inventory (TRI) provisions of Section 313 of SARA to provide information on pollution prevention and recycling activities with each annual filing.

## **EPA's Pollution Prevention Initiative**

Even before the Pollution Prevention Act was passed, EPA started work on establishing an Agencywide pollution prevention program and had initiated concurrent strategic planning efforts to assist the Agency in developing, implementing, and prioritizing various components of this program. As part of these planning efforts, EPA has recently prepared several reports that are intended to focus EPA's environmental protection efforts on reducing risk by targeting priority environmental problems and pollution prevention approaches to address these problems.

One of these reports, *Reducing Risk: Setting Priorities and Strategies for Environmental Protection*, was published in September 1990. It was prepared by the Science Advisory Board (SAB) at the request of EPA Administrator William Reilly. This report, together with its three appendices pertaining to ecological and welfare risks, human health risks, and strategic options for reducing risks, respectively, identifies steps that EPA could take to improve the Agency's efforts in reducing the risks associated with priority environmental problems. The SAB recommended that EPA take the necessary steps to ensure that the nation used all of the tools at its disposal in an integrated, targeted approach to protecting human health, welfare, and the ecosystem.

The *U.S. Environmental Protection Agency Pollution Prevention Strategy* prepared by PPO was released in January 1991. This document presents EPA's blueprint for an integrated, Agencywide, cross-media strategy for pollution prevention. The *Pollution Prevention Strategy* is designed to serve two purposes--(1) to provide guidance and direction for efforts to incorporate pollution prevention within EPA's existing regulatory and non-regulatory programs, and (2) to set forth a program that will achieve specific objectives in pollution prevention within a reasonable timeframe.

Both the *Reducing Risk: Setting Priorities and Strategies for Environmental Protection* and the *Pollution Prevention Strategy* helped shape and define the strategic plan for pollution prevention research presented in this report. ORD's *Pollution Prevention Research Strategic Plan* is congruous with the strategies and approaches recommended in these reports which are briefly described below.

### The SAB's Reducing Risk Report

Shortly after he took office in early 1989, EPA Administrator William Reilly asked the SAB to review EPA's 1987 report on relative environmental risk--*Unfinished Business: A Comparative Assessment of Environmental Problems*--to advise him broadly on new directions for reduction of environmental risks. The results of the SAB's review were published in *Reducing Risk: Setting Priorities and Strategies for Environmental Protection*. The purpose of the SAB review was to evaluate the relative risks posed by different environmental problems based on the best possible technical and scientific knowledge available. The SAB was also charged with identifying options to reduce those risks.

To accomplish this, the SAB established a special committee, the Relative Risk Reduction Strategies Committee. The charge to the Committee was to:

- Provide a critical review of the report, *Unfinished Business: A Comparative Assessment of Environmental Problems*, that reflects any significant new information that bears on the evaluation of the risks associated with specific environmental problems.
- Provide, to the extent possible, merged evaluations of cancer and non-cancer risks (i.e., health risks) and ecological and welfare risks (i.e., environmental risks).
- Provide optional strategies for reducing the major risks.
- Develop a long-term strategy for improving the methodology for assessing and ranking risks to human health and the environment and for assessing the alternative approaches for reducing risks.

The Committee generally agreed with the priority rankings of the 31 environmental problems included in *Unfinished Business*. In view of time and resource constraints, the Strategic Options Subcommittee of the Relative Risk Reduction Strategies Committee decided that it could not develop risk reduction options for all 31 problems. Initially, 10 problems--those posing the greatest health and ecological risk according to *Unfinished Business* rankings--were selected for analysis. One of these problems, worker exposure to toxic chemicals, was later dropped without the Subcommittee making judgments about risks and strategy options. Two additional problems were selected by the Subcommittee--hazardous waste and municipal solid waste--to include problems from another environmental medium and because of the large amounts of resources and the public interest devoted

to them. Two more problems--habitat alteration and wetlands--were added after it became apparent that the Ecological and Welfare Subcommittee of the Relative Risk Reduction Strategies Committee was likely to rank them as particularly important. The resulting list of 13 problems analyzed by the Subcommittee is presented in Exhibit 1 along with the top 10 priority problems from *Unfinished Business*.

The *Reducing Risk* report recommended that EPA target its environmental protection efforts on the basis of opportunities for the greatest risk reduction. It also recommended that EPA emphasize pollution prevention as the preferred option for reducing environmental risks over the long term:

*"A fundamental restructuring of the way the Agency approaches risk reduction is in order; the Agency's primary focus should be to prevent the creation of risks, as opposed to trying to control such risks once created."*

The SAB cited seven reasons for focusing on pollution prevention to reduce risk:

- For some environmental problems, such as stratospheric ozone depletion and global climate change, pollution prevention is the only solution.
- Pollution prevention is often the most effective solution. For instance, in the case of lead, asbestos, PCBs, and certain pesticides, the most effective solution has been to ban their use.
- There can be a tremendous cost benefit for pollution prevention in terms of avoiding costs of control, cleanup, and liability; and in terms of decreasing costs by increasing efficiency and productivity.
- Pollution prevention is the key to sustainable development. In many areas, the U.S. is approaching or even exceeding the capacity of the environment to absorb pollutants. It is clear that economic and industrial strategies for the future that minimize pollution and the consumption of resources are more likely to be sustainable.
- Pollution prevention often prevents the solution to one environmental problem from re-emerging as another kind of environmental problem in another medium, sometime in the future or in another place.
- Pollution prevention can help improve international relations in two ways--first, it can help developing countries avoid the environmental problems that we had in the U.S. by moving directly to low polluting, low waste technology; second, because it reduces the worldwide impact of U.S. generation of pollution and consumption of resources.

## **EXHIBIT 1**

### **PRIORITY ENVIRONMENTAL PROBLEMS**

#### **PROBLEMS TARGETED BY THE SAB RELATIVE RISK REDUCTION STRATEGIES COMMITTEE**

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- Criteria Air Pollutants
- Radon
- Ozone Depleting Substances
- Nonpoint Source Discharges
- Estuaries and Coastal Waters
- Hazardous Waste/Toxics
- Pesticides
- Toxic Air Pollutants
- Indoor Air Pollution
- CO<sub>2</sub> and Global Warming
- Wetlands
- Habitat Alteration
- Municipal Solid Waste

#### **TOP RANKED PROBLEMS IN *UNFINISHED BUSINESS***

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- Criteria Air Pollutants
- Radon
- Ozone Depleting Substances
- Nonpoint Source Discharges
- Estuaries and Coastal Waters
- Pesticides
- Toxic Air Pollutants
- Indoor Air Pollution
- CO<sub>2</sub> and Global Warming

### EPA's Pollution Prevention Strategy

EPA recognized that a clear and coordinated federal strategy for pollution prevention was needed to remove obstacles to preventing pollution and to foster preventive initiatives in the future. EPA believes that its environmental protection goals will be best served in the long run by a comprehensive pollution prevention strategy that proposes roles for industry, agriculture, the energy and transportation sectors, the American public, and the international community. The PPO has recently prepared such a strategy. The *U.S. Environmental Protection Agency Pollution Prevention Strategy* reflects EPA's belief that for pollution prevention to succeed, it must be a central part of the Agency's mission of protecting human health and the environment. One of the goals of the strategy is to incorporate prevention into every aspect of the Agency's operations in Program and Regional Offices.

The strategy focuses on cooperative efforts between EPA, industry, and state and local governments, as well as other departments and agencies such as the Departments of Energy, Transportation, and Agriculture to forge specific initiatives which address key environmental threats. For each sector, EPA will target projects which offer the potential to achieve specific reductions of emissions which pose a significant risk to human health or the environment. For example, the Industrial Toxics Project outlined in the strategy, targets high risk chemicals in the manufacturing sector that offer opportunities for prevention. This project focuses on reducing the environmental releases of 17 high-priority toxic pollutants (see Exhibit 2). Over a billion pounds of these chemicals are released into the environment each year. The Industrial Toxics Project involves the development of focused prevention strategies for each of the 17 chemicals and sets a voluntary goal of reducing total environmental releases of these chemicals by 33 percent by the end of 1992, and at least 50 percent by the end of 1995. EPA has developed this list of targeted chemicals, drawn from recommendations by Program Offices, based upon five criteria--(1) high levels of emissions, (2) technical or economic opportunities for pollution prevention, (3) potential for health and ecological risk, (4) potential for multiple exposures or cross-media contamination, and (5) limitations of treatment technologies. Most of the 17 pollutants targeted by the *Pollution Prevention Strategy* are slated for even greater regulatory controls under the Clean Air Act Amendments of 1990, but the controls would not go into effect until 1995.



- Pollution prevention protects the natural resources on the planet for future generations by reducing the amount of destruction caused by excessive pollution and slowing the depletion of resources.

From their study of the 13 priority environmental problems, the SAB Subcommittee identified a substantial number of strategy options which involve pollution prevention approaches. Upon reviewing these options the Subcommittee identified several cross-cutting themes:

- EPA's pollution prevention program should be directed broadly to address products and many productive sectors, not just industrial production processes. EPA should promote pollution prevention in all sectors, from manufacturing to agriculture to construction.
- EPA and other federal agencies should go beyond problem-by-problem pollution prevention to focus on comprehensive multiproblem solutions, such as toxics use reduction, energy efficiency and conservation, and on altering specific technologies of production or products which contribute to multiple problems, such as the automobile.
- Federal agencies should identify and eliminate standards, subsidies, activities or approvals that promote polluting or damaging activities or technologies, and instead promote non-polluting activities, technologies, and products, through incentives, research, technical assistance, procurement, and other means.
- EPA should actively work with representatives of many interests to promote better understanding of pollution prevention. Collaborative research, education, and technology development and transfer with industry, state agencies, organized labor, and public interest groups should be considered.
- Community right-to-know and other related programs should be given special attention and possibly expanded. These possibilities include having more producers and users of toxic chemicals and pesticides report publicly on such production and usage.
- In the long run, economic incentives and disincentives need to promote pollution prevention. Energy policy should encourage conservation, tax policy should encourage recycling and reuse, etc.

The environmental problems identified in the Subcommittee's report were used as input for selection of the environmental problems on which to focus the pollution prevention research strategy. Nine of the 10 environmental problems targeted in this strategic plan were included in the Subcommittee's report. The pollution prevention strategic options proposed by the Subcommittee provided background material for identifying research and information needs that must be addressed to implement some of the options. In addition, the cross-cutting themes for pollution prevention identified in the SAB report were used to help shape the research program outlined in Chapter 4 of this strategic plan.

## **EXHIBIT 2**

# **PRIORITY CHEMICALS TARGETED IN THE INDUSTRIAL TOXICS PROJECT OF THE POLLUTION PREVENTION STRATEGY**

### **HIGH-PRIORITY CHEMICALS TARGETED IN THE INDUSTRIAL TOXICS PROJECT**

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- Benzene
- Cadmium
- Carbon Tetrachloride
- Chloroform
- Chromium
- Cyanide
- Dichloromethane
- Lead
- Mercury
- Methyl Ethyl Ketone
- Methyl Isobutyl Ketone
- Nickel
- Tetrachloroethylene
- Toluene
- Trichloroethane
- Trichloroethylene
- Xylene

EPA is seeking voluntary, measurable commitments from major industrial sources of these contaminants to reduce environmental releases through prevention. Beginning in early 1991, EPA sent letters to 600 corporate polluters asking them to help achieve the Agency's goal of substantially reducing releases of the 17 chemicals over the next four years. EPA asked these companies to make commitments to the project and to develop prevention plans to carry them out. EPA will rely on data from the TRI to track reductions in releases of targeted contaminants from industrial facilities, and will develop more appropriate indicators for sources not covered by the TRI.

The Industrial Toxics Project is only the first step. EPA recognizes that there are abundant opportunities to promote pollution prevention in other sectors, such as agriculture, energy, transportation, municipal water and wastewater, and EPA is working with other federal agencies to develop specific strategies for these sectors.

Specific targets will be modified if subsequent detailed analyses suggest economic or technical obstacles to prevention, or point to more promising alternative opportunities. Where applicable, the TRI data will be used to identify industrial sources of targeted contaminants from manufacturing facilities, and geographic regions where releases are particularly high. Specific projects in the agricultural sector will be directed to regions experiencing groundwater, surface water, or ecosystem impacts due to farming practices; and projects in the energy sector will focus on efficiency and conservation.

The targeting exercise offers the benefit of focusing scarce federal dollars on key problems with a significant potential for payoff. At the same time, it will provide EPA with a solid base of practical experience from which pollution prevention can be expanded throughout the Agency. The strategy also addresses the institutional biases resulting from the single-media focus of EPA's programs by forming cross-media work groups organized around specific contaminants or their sources. These work groups will be charged with developing multimedia strategies that reduce the release of targeted contaminants to the total ecosystem, rather than arrange for their temporary transfer from one part to another. The Pollution Prevention Office will be charged with providing analyses and supporting data to assist in the development of these work group strategies.

In the long run, EPA hopes to promote a "cultural change" both within the Agency and throughout society, in which pollution prevention will be woven into the fabric of public programs and private activities. In the short term, the strategy provides a methodology for selecting targets of opportunity based on one or more criteria, including: (1) risk to human health and the environment, (2) technical or economic potential for prevention, (3) lack of adequate treatment capacity, (4) threats to attainment of environmental standards for air or water, and (5) problems that persist across more than one media or economic sector.

The *Pollution Prevention Research Strategic Plan* presented in this report utilizes an approach similar to that of the *Pollution Prevention Strategy* by focusing the pollution prevention research program on targeted priority environmental problems. Similar to the *Pollution Prevention Strategy*, the *Pollution Prevention Research Strategic Plan* focuses on eliminating or reducing the sources of environmental problems. For example, the hazardous waste and toxic air pollutants problems targeted by the *Pollution Prevention Research Strategic Plan* will address issues that affect the manufacturing sector in a manner analogous to the Industrial Toxics Project. Research on pesticides and non-point source pollution problems will address issues affecting pollution prevention opportunities in the agricultural sector; and research focused on criteria air pollutants, greenhouse gases, ozone depleting substances, and non-point source pollution address important pollution prevention issues in the energy and transportation sectors.

## **POLLUTION PREVENTION RESEARCH**

In 1987, ORD initiated the Waste Minimization Research program designed to encourage the identification, development, and demonstration of processes and techniques that result in a reduction or prevention of pollution. In 1989, ORD significantly expanded its pollution prevention research efforts to support the Agency's pollution prevention policy and in response to recommendations by the SAB. ORD's overall plan for expanding the Agency's pollution prevention research program was described in a Report to Congress published in March 1990.

### **Pollution Prevention Research Plan: Report to Congress**

The *Pollution Prevention Research Plan: Report to Congress* is a three-year plan that addresses the critical research elements needed to support an Agencywide multimedia pollution prevention initiative. This plan described a comprehensive program that includes both technological and non-technological research to address a broad range of pollution prevention issues. Preparation of the *Pollution Prevention Research Plan* was the first step in developing the research component of EPA's pollution prevention initiative.

The report to Congress was founded on the premise that pollution prevention should be a guiding principle for all environmental protection efforts and general human activities. We have learned that it can be enormously costly to clean up and dispose of pollutants after they have been generated. End-of-pipe controls and waste disposal should be the last line of defense, rather than the front line. Preventing pollution at the source offers great environmental and health benefits, and is almost certain to be the most economical approach in the long run.

The report to Congress identified six fundamental goals for the pollution prevention research program:

- **Stimulate the development and use of products that result in reduced pollution**--research is needed on methods for conducting product assessments and identifying pollution prevention opportunities, development and use of less polluting products, and the impacts of products on the environment at each stage of their life cycle.
- **Stimulate the development and implementation of technologies and processes that result in reduced pollution**--research is needed to identify and evaluate those aspects of production, use, maintenance, repair, and disposal processes that generate pollutants and waste. Research is also needed to assess pollution prevention opportunities, to develop less polluting processes, and to transfer these techniques to other industries.
- **Expand the reusability and recyclability of wastes and products and the demand for recycled materials**--research is needed on ways to improve the reusability and recyclability of wastes and products and to increase the capacity and demand for recycled materials in production processes.
- **Identify and promote the implementation of effective socioeconomic and institutional approaches to pollution prevention**--research is needed to understand the socioeconomic

and institutional factors that motivate behavior and foster changes in behavior, as they relate to incentives for adopting pollution prevention techniques; and the impact of these factors on the effectiveness of pollution prevention programs.

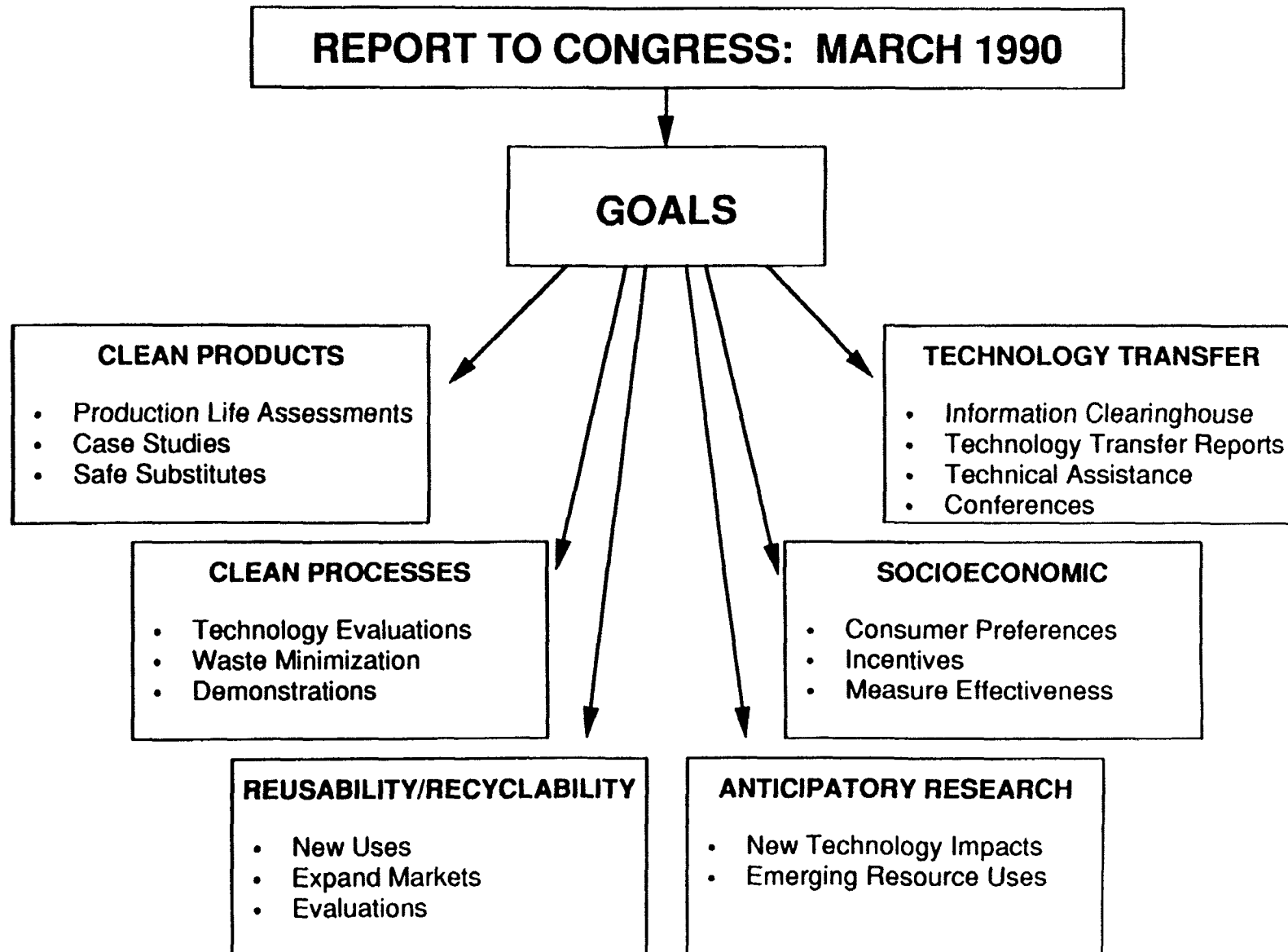
- Establish a program of research that will anticipate and address future environmental problems and pollution prevention opportunities--research is needed to assist EPA in anticipating and responding to emerging environmental issues and in evaluating new technologies that may significantly alter the status of pollution prevention programs in the future.
- Conduct a vigorous technology transfer and technical assistance program that facilitates pollution prevention strategies and technologies--it is imperative that the results of research investigations conducted under this program or by industry and academia are communicated expeditiously to appropriate audiences.

Each of these six goals corresponds to a research area that ORD needed to address in its comprehensive pollution prevention research program. These areas are summarized in Exhibit 3. Although recycling (other than closed loop) is not included in the Agency's definition of pollution prevention, ORD included recycling and reuse in the Pollution Prevention Research Program because of its importance in minimizing waste that requires subsequent treatment and disposal. The six research program areas defined in the report to Congress formed the framework of the pollution prevention component of the Agency's *Risk Reduction Core Research Strategy*. The *Core Research Strategy* focused on research projects designed to generate knowledge essential to all areas of environmental decision-making, as well as for the immediate regulatory needs of EPA's program offices.

The report to Congress formed the foundation of EPA's pollution prevention research efforts, but it did not delineate specific themes for future research efforts and did not define the projects to be undertaken. The report to Congress provided representative examples of the types of research projects that EPA expected to conduct, but an implementation strategy was necessary to clearly delineate themes for future research efforts and projects that could be conducted to achieve the goals and objectives of the program.

# EXHIBIT 3

## POLLUTION PREVENTION RESEARCH PLAN



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## **Pollution Prevention Research Strategic Plan**

Although the *Pollution Prevention Research Plan: Report to Congress* identified six research goals and the six major research programs corresponding to each of the goals, it did not specify the high priority environmental problems that should be addressed by the pollution prevention research program, nor the specific research projects to be undertaken. The report to Congress only provided descriptions of sample projects that were representative of the type of research projects that EPA expected to conduct. Now that the foundation of the pollution prevention research program has been laid, the Agency is ready to begin building the framework of the program. The next step in implementing the pollution prevention research initiative is to prepare a planning document that clearly delineates specific themes for future pollution prevention research efforts. The *Pollution Prevention Research Strategic Plan* is intended to serve as this planning document. It builds on the foundation laid by the Report to Congress and is intended to serve as the framework for the Agency's pollution prevention research initiative.

The strategic plan provides the "blue print" for the pollution prevention research program by focusing the Agency's research efforts on high priority environmental problems and the pollution prevention research projects that address these problems. By identifying and selecting priority environmental problems on which to focus the strategic plan, EPA is optimizing the use of limited resources and increasing the potential for significant impact in reducing the risks associated with these priority problems. In addition, the *Pollution Prevention Research Strategic Plan* bridges the economic sector approach utilized in the *Pollution Prevention Strategy* and the source reduction/recycling approach in OSW's *Agenda for Action* and the *Solutions for the 90's*.

In addition to providing a focus for future pollution prevention research efforts, the research strategy enables the Agency to investigate a variety of tools that could potentially impact more than one environmental problem, and priority can be given to the research projects that impact multiple problems. For example, socioeconomic tools such as market incentives could be effective for several problems including criteria air pollutants, municipal solid waste, and consumer products. In addition, pollution prevention approaches in one sector can impact a variety of environmental problems. For example, the manufacturing and use of paints containing toxic solvents can contribute to multiple



environmental problems such as criteria and toxic air pollutants, indoor air pollution, nonpoint source pollution, hazardous waste, municipal solid waste, and worker/consumer exposure. Therefore, a project investigating alternate formulations eliminating the toxic solvents could beneficially impact all of these environmental problems.

### **Overview of the Research Strategic Plan**

This *Pollution Prevention Research Strategic Plan* identifies 10 high priority environmental problems that will be used to focus ORD's pollution prevention research efforts over the next five years (FY 91-95). It describes the various research approaches that will be employed to meet the research needs associated with the 10 high priority problems. Chapter 2 of the strategic plan identifies the 10 priority environmental problems targeted in this strategic plan. Chapter 2 also discusses the process used to identify and prioritize the problems based on the relative risk posed by those problems and the potential success of reducing the risk through pollution prevention. The criteria that was used by the work group to select and prioritize the environmental problems are also outlined in Chapter 2.

Chapter 3 of the strategic plan presents the overall structure of the pollution prevention research program and briefly describes each of the six research program areas. In addition, the research areas are prioritized for each targeted environmental problem to quickly identify the most important research areas to be pursued to address that problem. Chapter 3 also identifies the pollution prevention research approaches used in each of the research areas to address the priority environmental problems targeted in the plan.

Chapter 4 describes a proposed research project to address each of the 10 high priority environmental problem areas: criteria air pollutants, toxic air pollutants, indoor air pollution, ozone depleting substances, greenhouse gases/global climate change, nonpoint source water discharges, hazardous waste, municipal solid waste, pesticides application, and the production, use, and disposal of consumer products. Each research project to address one of the environmental problems includes a technological research component (product, process, and recycling/reuse), non-technological

component (socioeconomic/institutional), and technology transfer component. Some of the projects include an anticipatory research component.

Chapter 5 discusses current pollution prevention research initiatives that are being performed or funded by ORD. These project descriptions indicate the progress achieved to date in the pollution prevention research program; and some of the research projects proposed in this strategic plan are intended to build on these current research activities. The information reporting requirements of Title III of SARA have made the public more aware of the massive amounts of pollution that are released by industry each year. Congress, recognizing the public's growing concern and the importance of preventing further damage to the environment, passed legislation that established a national pollution prevention policy in the U.S.

Through the pollution prevention research program and the efforts of the Pollution Prevention Office and the Office of Solid Waste, EPA is attempting to establish pollution prevention as a cornerstone of national environmental protection strategies, to communicate the message to all members of the environmental protection community, and to assist that community in implementing pollution prevention programs. The Agency recognizes the significant role that pollution prevention can play in preserving and protecting human health and the environment since it is applicable to a broad array of environmental problems and can be implemented through a variety of approaches and tools. Preparation of the *Pollution Prevention Research Strategic Plan*, the *Pollution Prevention Strategy*, the *Agenda for Action*, and *Solutions for the 90's* are important steps in institutionalizing pollution prevention at EPA and throughout society.

## **CHAPTER 2 PRIORITY RESEARCH ISSUES**

In a world of limited resources and multiple environmental problems, EPA must make the best possible choices about where and how to invest its R&D resources. Good choices require sound scientific and technical information and a capability to sift through the options and select those that offer the most promise in terms of long-term protection of health and the environment. In selecting high priority environmental problems for research, careful consideration of the degree of risk associated with the problem and the potential effectiveness of pollution prevention strategies is essential. By identifying and targeting priority environmental problems, the Agency will have a sound basis for focusing future pollution prevention research efforts and maximizing beneficial results.

### **RISK-BASED EVALUATION OF ENVIRONMENTAL PROBLEMS**

EPA has established a general policy that decision-makers should focus on actions that will be effective in reducing environmental risks. Just as successful businesses seek to garner the greatest financial returns over an appropriate timeframe, protectors of the environment must identify sources of environmental risk and make sound decisions about which actions will provide high payoff in reducing current and long-term risks. While any problem may merit attention, some problems pose greater risk and thus demand immediate attention. Therefore, EPA research programs should assist decisionmakers in understanding the risks associated with these problems, and the most effective actions to be undertaken to prevent, reduce, or eliminate these risks.

#### **Comparative Assessment of Environmental Problems**

Identifying and ranking environmental problems in an effort to focus EPA resources and maximize beneficial results is not a new concept to the Agency. Several years ago, the EPA Administrator organized a task force of about 75 senior managers and staff to compare the relative risks of a number of environmental problems and to rank these problems in order of priority of concern. In early 1987, the task force released a report entitled *Unfinished Business: A Comparative Assessment of Environmental Problems*. The report ranked 31 environmental problems within four broad categories of types of risk: (1) cancer risk, (2) non-cancer health risk, (3) ecological risk, and

(4) welfare risk. *Unfinished Business* provided some important insights for EPA management and others interested in environmental problems. For the first time, the many environmental problems addressed by EPA were systematically compared to one another using common denominators of risk. The report noted that some environmental problems which posed significant risks were not receiving a commensurate level of attention, while other problems were receiving a seemingly disproportionate level of public attention and resources. While highlighting the difficulty of evaluating the different categories of risks posed by environmental problems, the report also suggested the value of pursuing further efforts to evaluate and compare risks.

The Relative Risk Reduction Strategies Committee of the SAB reviewed the *Unfinished Business* report to develop strategic options for reducing the risks associated with high priority problems. In conducting its review, the Committee noted that the 31 environmental problems ranked in the report were based on statutory mandates and EPA's program structure. The Committee recommended that EPA take a broader approach to identifying and defining priority problems. They stressed the importance of considering health, ecological, and welfare effects, as well as those activities and pollutants that contribute to or cause the effects. There are a variety of ways to identify and define environmental problems, including:

- Human activities which cause stress or insults to the environment (e.g., pesticides application and other activities which cause nonpoint source discharges).
- Agents or pollutants which cause stress or insults to the environment (e.g., lead, radon, ozone depleting substances).
- Media which represent routes of exposure to sources of environmental risk (e.g., drinking water, indoor air).
- Targets or receptors which are affected by stresses (e.g., wetland ecosystems).
- Effects of stresses (e.g., specific health or environmental effects such as cancer and global warming).
- Legislative and program definitions, which usually combine two or more of the above.

The importance of viewing the universe of environmental problems from all of these different perspectives was recognized in preparation of the *Pollution Prevention Research Strategic Plan*. This research strategy targets priority issues that cut across the definitions cited above. For example, the

priorities include pesticides application (human activities causing environmental stress), toxic air pollutants and ozone depleting substances (agents which cause environmental stress), and global climate change (the effects of stresses). This approach was used to ensure selection of a variety of problems that are not focused on a single media or EPA program which pose the highest health and environmental risks.

## SELECTION OF PRIORITY ENVIRONMENTAL PROBLEMS

In preparation of the *Pollution Prevention Research Strategic Plan*, ORD held several meetings with EPA staff from the OEETD laboratories, the Pollution Prevention Office, the Office of Regulatory Management and Evaluation (Science, Economics, and Statistics Division), and the Office of Technology Transfer and Regulatory Support to solicit ideas and comments for the strategic plan, as well as descriptions of specific research projects that could be initiated as early as next fiscal year. A planning meeting was held on June 4, 1990 at the University of Cincinnati to discuss the structure and content of the strategic plan.

The work group was charged with establishing criteria for identifying and prioritizing 10 to 12 environmental problems whose risks could be reduced or eliminated through a pollution prevention approach. To initiate the identification and selection process, the work group started by discussing the top 13 environmental problems identified by the Relative Risk Reduction Strategies Committee.

During the discussion, seven additional environmental problems were identified for consideration by the work group. By applying the following criteria, the work group narrowed the list down to 10 priority environmental problems on which to focus the *Pollution Prevention Research Strategic Plan*:

- **Risk to human health and the environment**--those problems that pose the greatest risk relative to other environmental problems when taking into account the risk of cancer, chronic non-cancer health effects, reproductive, developmental, and neurotoxic risks, and the potential for ecological damage as well as the risk for multiple exposures.
- **Amenability to pollution prevention solutions and limitations of other solutions**--the potential contribution of a pollution prevention approach to solution or elimination of the environmental problem, particularly when pollution controls, treatment, and disposal options are limited or relatively ineffective in reducing the associated risks.

- Probable benefits and costs of reducing risks--the expected benefits (economical and environmental) of preventing the generation of sources contributing to the environmental problem outweigh the costs associated with implementing a pollution prevention approach.
- Degree to which the problem is addressed and funded by programs other than pollution prevention--environmental problems which are already being effectively addressed through other programs should not be priority targets of the pollution prevention program.

Subsequent to the June meeting, the work group members were individually asked to rank the 10 problems in order of priority using the criteria listed above. This, of course, is a subjective ranking based on the knowledge and experience of those involved, as little data are available on which to base objective rankings. The 10 high priority problems selected by the work group are presented in *ranked order of priority* in Exhibit 4. The ranking is a reasonable consensus of the individual inputs. While these ranking results are simply a rational composite of the individual ratings, logical conclusions have emerged to support the rankings. For example, air related problems emerged as the highest priorities based on the rating criteria. The air issues are characterized by relatively wide exposure and a general lack of amenability to end-of-pipe controls due to very large numbers of sources or the nonpoint source nature of the problems.

## IDENTIFICATION OF PRIORITY RESEARCH ISSUES FOR THE STRATEGIC PLAN

Once the priority problems were selected, the work group "brainstormed" to identify possible pollution prevention approaches to address these problems. Similar to the approach used by the SAB Subcommittee in preparing the *Reducing Risk: Setting Priorities and Strategies for Environmental Protection*, the work group found it extremely useful to analyze the environmental problems from alternative perspectives--for example, as pollutants (e.g., criteria air pollutants, toxic air pollutants), sources of the problem (e.g., automobiles, power plants), the effects of the problem (e.g., increased respiratory diseases, global climate change), and the sectors affecting the problem (e.g., energy, transportation, and agriculture). Analysis of the environmental problems in each of these distinct ways suggests different pollution prevention approaches. Only after taking such a multifaceted, comprehensive look at problems and potential solutions is it appropriate to develop a strategic plan for research to be conducted to assist the Agency in achieving the pollution prevention solutions to these problems.

## **EXHIBIT 4**

# **PRIORITY ENVIRONMENTAL PROBLEMS TARGETED IN THE POLLUTION PREVENTION RESEARCH STRATEGIC PLAN**

### **PROBLEMS SELECTED BY POLLUTION PREVENTION RESEARCH STRATEGIC PLAN WORK GROUP**

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**(In Order of Priority Ranking)**

- |  |                                      |
|--|--------------------------------------|
| (1) Indoor Air Pollutants (includes Radon) | (6) Pesticides Application           |
| (2) Criteria Air Pollutants                | (7) Nonpoint Source Water Discharges |
| (3) Ozone Depleting Substances             | (8) Hazardous Waste/Toxics           |
| (4) Greenhouse Gases/Global Climate Change | (9) Consumer Products                |
| (5) Toxic Air Pollutants                   | (10) Municipal Solid Waste           |

The work group then identified the data gaps and research needs associated with each of the pollution prevention approaches. Research projects that could be conducted to bridge these data gaps and enable the Agency to address the priority environmental problems with a pollution prevention approach were designed by the work group members.

To aid in the identification of various approaches, the work group focused on the six research areas identified in the *Pollution Prevention Research Plan: Report to Congress*--products, processes, recycling/reuse, socioeconomic and institutional research, anticipatory research, and technology transfer/technical assistance. With this structure in mind, the work group identified pollution prevention approaches to address each of the 10 priority environmental problems, and the associated research needs. This cross-cutting perspective ensures that the Agency pursues both technological and non-technological pollution prevention approaches to each environmental problem. For example, to address indoor air pollution problems, we are proposing the following research efforts focusing on source (building materials, carpets, paints, consumer products, etc.) management as the most effective mechanism for reducing or eliminating indoor air pollutants:

- **Product Research**--Development of low cost source test methods to encourage wide application by manufacturers. Expansion of source emissions data base and evaluation of building materials to ensure selection consistent with good IAQ practices and minimum product life cycle environmental impacts.
- **Process Research**--Develop IAQ model and perform test house studies to investigate the use of aerosol products, the effect of application mass for waxes, polishes, etc., and the impact of air fresheners and room deodorizers.
- **Socioeconomic Research**--Analyze the effectiveness of mandatory radon disclosure requirements on remediation, and the usefulness of current risk communication techniques to homeowners for radon and other indoor air pollutants. Evaluate the influence of consumer product labelling regarding indoor air pollutants on buying habits.
- **Anticipatory Research**--Expansion of response-based testing to determine biological (microbial, animal, human) responses to emissions from indoor sources and to evaluate the feasibility of radon standards for new buildings.
- **Technology Transfer**--Perform cooperative/interlaboratory evaluations of test methods to develop EPA and/or ASTM "standard methods."

In identifying potential pollution prevention approaches and research needs, the work group members considered the nature and controllability of the risks associated with the priority problem



areas. For example, risks associated with individual lifestyle choices may be more effectively reduced through market incentives and risk communication than through conventional regulatory approaches. The work group gave the greatest emphasis to approaches which concurrently address multiple risks; for example, pollution prevention initiatives to reduce fossil fuel use in the energy sector would help to address human health risks posed by criteria and toxic air pollution from fossil energy powerplants, and ecological risks posed by the threat of global climate change resulting from the emission of greenhouse gases.

### **Prioritization of the Research Approaches**

The work group devoted considerable thought to methods for prioritizing the research approaches associated with the 10 priority environmental problems. The work group was attempting to determine, for example, whether or not the problem of pesticides application could best be addressed through technology transfer or product research. The work group established the following criteria for prioritizing the pollution prevention research projects:

- **Contribution of Pollution Prevention Research in Reducing Risks**--the potential contribution of the research project in preventing, reducing, or eliminating the risks associated with the environmental problem.
- **Value Added by EPA Research**--the necessity of EPA conducting the research because of information needs that others are not addressing, and the importance of this research in implementing pollution prevention approaches to the problem.
- **Impact on Multiple Environmental Problems**--the contribution of the research results to better understanding of and capability to implement pollution prevention approaches that address multiple priority environmental problems.
- **Cost Effectiveness**--the cost of the research relative to the absolute amount of expected environmental improvements.

The work group recommended that the research priorities be reviewed and updated periodically as new problem areas emerge and as new information leads to revised evaluations of the risks associated with existing and new problem areas.

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## EVALUATION OF THE EFFECTIVENESS OF POLLUTION PREVENTION EFFORTS

The work group discussions included ways to measure and evaluate the effectiveness of pollution prevention efforts as a means of measuring progress in impacting targeted environmental problems. As a public policy goal, pollution prevention requires definition and measurement not only at the level of the individual waste generator or manager (business firm or operation, household or institution, urban jurisdiction, etc.), but also across the aggregate of human processes of materials and energy extraction, conversion, transportation, use, and disposal. Without serious attention to this broader perspective, pollution prevention initiatives might simply rearrange existing environmental management problems, without ensuring that the overall result is a reduction in the pollution burden.

For certain chemicals or categories of chemicals, the Toxic Release Inventory (TRI) data annual reporting required by SARA Section 313 may be able to be used as a gross indicator of pollution prevention progress. Because releases can be reduced by a variety of activities (ranging from end-of-pipe controls to delisting), reporting by industry on pollution prevention activities is more useful in gauging pollution prevention progress in this sector. The Pollution Prevention Act of 1990 requires EPA to establish standard methods of measuring source reduction, as well as the means by which to measure progress in meeting source reduction goals. The Act also requires those facilities that are required to report toxic chemical releases annually under the TRI provisions of Section 313 of SARA, to provide information on pollution prevention and recycling activities with each annual filing. The facilities are required to provide data on: (1) the quantity of the chemical released into the environment prior to recycling, treatment, or disposal; (2) the amount of the chemical that is recycled, the percentage change from the previous year, and the recycling process used; (3) the source reduction practices used for the chemical during that year; (4) the percentage change in emissions and recycling activities expected in the next two years; (5) the techniques which were used to identify source reduction opportunities; and (6) the amount of the chemical treated and the percentage change from the previous year. This data will provide important information about the types of pollution prevention activities being utilized and their effectiveness over time.

ORD is currently conducting a research project to develop a single measurement methodology for hazardous and non-hazardous multimedia pollution prevention. Pollution prevention measurement research being developed under this strategy considers the availability and use of TRI data and proposed changes affecting that data base in the future.

### **Measuring Pollution Prevention Progress at the Organizational Level**

At the level of the individual organization, the measurements needed are those that will permit managers to incorporate pollution prevention effectively to pursue organizational goals as well as to meet government reporting requirements. These measurements include, in general, what materials and energy are generated, identified by amounts and by the process and product from which they arise; what their environmental and associated legal, regulatory, and business risks are; what could be done to reduce them, including options for substitute materials, processes, products, and other ways of reducing them, each with its own associated costs and risks; and what the relevant manufacturing standards are, including efficiency measures and the full costs (including disposal and liability) associated with each course of action.

Even at this level, however, measuring pollution prevention presents important challenges. One problem concerns how to define baselines and normalize measurements--for instance, waste generated (or reduced) on an absolute basis (in physical units), per unit of input materials or output products (by weight or volume), or in economic units such as dollar value of sales. A second problem concerns how to account for displacement--reducing wastes by sending them to an off-site recycler, or even by incorporating them more efficiently into products on site, might or might not reduce the health and environmental impacts over the material's life cycle. Similar issues are raised by transformation and substitution effects--reducing one waste stream by substituting an alternative chemical or process will produce different waste streams, which may or may not be preferable to, or even commensurate with, the old ones.

Additionally, much of the information on pollution prevention to date has addressed incremental changes in existing facilities or practices. Many important decisions affecting waste generation, however, take place in decisions about capital investment in new plants and processes. Such decisions involve additional, and in some cases, different measurement challenges, such as accounting for nonexistent wastes that would otherwise have been produced (i.e., wastes avoided rather than reduced), allocating joint costs and benefits involved in co-location of complementary facilities, and others. Given the influence of such investment decisions on waste streams far into the future, these measurement questions have considerable practical as well as theoretical importance.

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### **Measuring Pollution Prevention Progress at the National Level**

From the broader perspective of public policy, additional measurement challenges arise. If we limit our attention to the perspectives of particular firms--or particular industrial, commercial, or institutional activities--or to wastes as a preconceived category, we are likely to see faulty priorities and to miscount as pollution prevention actions those that merely displace potential pollutants from one location or process to another. Measurement research must also be directed to the aggregate waste effects of society's material- and energy-use patterns as a whole. For example, a large and growing proportion of the total waste stream is attributable to disposable or non-durable products as wastes rather than the wastes resulting from manufacturing processes, especially given the considerable economic incentives that already exist to incorporate materials efficiently into products.

In the absence of effective measurement and allocation of the costs of product waste disposal, market forces tend toward increasingly wasteful product characteristics--proliferation of more and more differentiated or specialized products, disposable rather than durable products, heterogeneous rather than pure materials, complex sealed and unrepairable component assemblies, smaller and smaller unit sizes of products (with associated increases in packaging wastes), and cosmetic specifications for product characteristics (e.g., paper brightness standards) that unnecessarily increase waste generation and disposal problems, as well as reduce recycle and reuse opportunities.

### **Research Needs for Measurement and Evaluation of Pollution Prevention Efforts**

Research is sorely needed on criteria and methods for measuring progress in achieving pollution prevention objectives because of the following:

- Most of the published work in the field has been anecdotal. While many of the available case examples demonstrate spectacular successes in reducing waste generation at the source, with excellent return on investment characteristics, the effect on reducing total waste generation has been too small to be measurable.
- Many of the State Capacity Assurance Plans assume very significant reductions in the quantities of hazardous waste seeking off-site treatment and disposal. Yet few states provide substantive data on the degree of reduction possible or how it is to be achieved.
- No tested and validated methodology exists to even begin to assemble information that could eventually lead to the establishment of measurable objectives.

Some of the questions concerning the measurement of pollution prevention progress that need to be addressed by research include:

- What are the most useful indicators and measurement units for measuring pollution prevention at the source? Answers are necessary in order to develop uniform strategies for pollution prevention across the full spectrum of materials and energy transformation activities.
- Can the same indicators and units be used across different industry types and sectors? What differences must be taken into account, and how do these differences affect attempts to measure net or aggregate pollution prevention?
- Similarly, how should we measure pollution prevention in sectors other than manufacturing, such as minerals extraction and processing, agriculture and forestry, energy and transportation, commercial and institutional use, and households?
- How may one measure the post-production waste implications of products as incipient wastes over their life cycles? Relevant considerations include increases or decreases in usable life span, recyclability, environmental impacts compared to their substitutes, and perhaps others.
- How can one measure the pollution prevention effects of complex capital investment decisions, such as future pollution that is avoided (as opposed to present wastes that are reduced), allocation of pollution prevention benefits among multiple products and processes, and commensurability across qualitative changes in types of waste streams?
- What are the full life cycle implications of major commodity chemicals? Studies could be undertaken on pollution prevention for five to ten priority chemicals throughout their useful life cycles, including industrial and nonindustrial uses. Such studies would serve to refine measurement approaches and, more important, to identify the most important waste sources and pathways for high-priority environmental contaminants. Important issues include such questions as how to select the most important chemicals and how to collect quantitative data on chemical uses and losses (especially dissipative uses).
- What products are environmentally friendly? Comparative studies would be useful to illustrate the environmental impacts of selected products and their alternatives throughout their life cycles, from fabrication through ultimate disposal (e.g., paper versus foam cups, paper versus plastic grocery bags), and to demonstrate methodologically the full range of factors that should be examined to make such determinations.
- What are the relationships between plant-level measurements of pollution prevention and the combined effects of pollution prevention by multiple sectors at regional and national scales?
- How can one estimate more accurately the quantities of waste that might prove reducible, as well as the time and risk implications associated with such reduction? Also, how do these estimates compare with the public's definitions and goals for acceptable progress in pollution prevention?

## CHAPTER 3 STRUCTURE OF THE RESEARCH STRATEGIC PLAN

The *Pollution Prevention Research Strategic Plan* focuses on 10 priority environmental problems that can and should be addressed with a pollution prevention approach, because it is often the most beneficial and cost effective method of reducing environmental risks. The work group identified pollution prevention approaches to address each of these 10 environmental problems, and the associated research needs. The research projects are organized into the six major pollution prevention research program areas identified in the report to Congress: products, processes, recycling/reuse, socioeconomic and institutional research, anticipatory research, and technology transfer/technical assistance. The priorities for pollution prevention research approaches for each targeted environmental problem identified by the work group are presented in Exhibit 5. The priority rankings are the result of aggregate scores assigned by work group members to the research areas for each problem. Each research area is, in effect, a program eligible for funding based on its priority and availability of funds on a year-to-year basis. The projects identified by the work group and described in Chapter 4 of this strategic plan are examples of the projects that could be pursued, but they would be reviewed annually to determine yearly program directions.

### POLLUTION PREVENTION RESEARCH AREAS

EPA's pollution prevention research strategy is to address each of the 10 priority environmental problems with research in the six research areas defined in the *Pollution Prevention Research Plan: Report to Congress*. Each of the six areas is described below.

#### Product Research

The product research area is oriented toward understanding the polluting characteristics and life-long pollution generating attributes of products. This component of the pollution prevention research program focuses on establishing standardized methods for assessing products and their use patterns, and using these standard methods to identify and evaluate the pollution burdens that are represented by various products. In addition, this research area involves stimulating private sector development and use of environmentally preferable products. Products assessed under this

# **EXHIBIT 5** **PRIORITIZATION OF POLLUTION PREVENTION APPROACHES** **FOR TARGETED ENVIRONMENTAL PROBLEMS**

<div> <div>APPROACH</div> <div>PROBLEM</div> </div>	Product Research	Process Research	Recycling/Reuse Research	Socioeconomic Research	Anticipatory Research	Technology Transfer/Technical Assistance
Indoor Air Pollutants	HIGH	LOW	LOW	HIGH	MEDIUM	MEDIUM
Criteria Air Pollutants	HIGH	HIGH	MEDIUM	LOW	MEDIUM	LOW
Ozone Depleting Substances	HIGH	HIGH	MEDIUM	LOW	LOW	MEDIUM
Greenhouse Gases/GC Change	HIGH	HIGH	LOW	MEDIUM	MEDIUM	LOW
Toxic Air Pollutants	HIGH	HIGH	LOW	LOW	MEDIUM	MEDIUM
Pesticides Application	HIGH	HIGH	LOW	MEDIUM	LOW	MEDIUM
Nonpoint Source Water Discharges	MEDIUM	LOW	MEDIUM	HIGH	LOW	HIGH
Hazardous Waste	HIGH	HIGH	MEDIUM	LOW	LOW	MEDIUM
Consumer Products	HIGH	LOW	HIGH	MEDIUM	LOW	MEDIUM
Municipal Solid Waste	HIGH	LOW	HIGH	HIGH	LOW	MEDIUM

component of the research program may range from simple chemical compounds to complex manufactured items comprising numerous potential sources of pollution.

There are a variety of approaches that can be employed in conducting product research efforts. Product research could involve investigating product modifications and product substitutes that would result in products that are environmentally preferable--less toxic and/or less polluting. This research could also include studying functional alternatives to the product. Further, product test methods need to be developed and employed to evaluate the environmental impacts of specific products. Two additional approaches for product research are life cycle analysis and utilization management. Life cycle analysis is a study of the pollution generation characteristics and the opportunities for pollution prevention associated with the entire life cycle of the product. A product's life cycle includes its design, manufacture, use, maintenance and repair, and final disposal, including potential reuse or recycling options. The research projects described in Chapter 4 of this strategic plan that utilize some of these various approaches are highlighted by a check mark in Exhibit 6. For example, halons are ozone depleting substances with 3 to 10 times the depletion potential of CFCs. Research is proposed to identify chemical substitutes for halons that pose less risk to the ozone layer.

### **Process Research**

The process research area is oriented toward identifying and evaluating those aspects of production, use, maintenance and repair, and disposal processes that generate pollutants and waste; and to facilitating and evaluating alternative, environmentally preferable processes. Process research focuses on establishing standardized methods to identify and assess pollution and waste generation associated with these processes. This research is intended to encourage private sector innovation in adopting "environmentally friendly" processes and technologies.

The general approaches employed in process research are process modification, alternative feedstocks, and alternative processes. Modifications can be implemented at specific points in the process to reduce or eliminate generated waste. Similarly, alternative feedstocks can be used to reduce the toxicity or volume of waste. Alternative processes, designed to reduce and prevent pollution, need to be developed, demonstrated, and evaluated to promote use of these alternatives in the private and public sectors. For example, surface coatings is a major contributor to



## EXHIBIT 6 POLLUTION PREVENTION PRODUCT RESEARCH APPROACHES

<b>Approach Problem</b>	<b>Modification</b>	<b>Substitution</b>	<b>Functional Alternatives</b>	<b>Product Test Methodology and Testing</b>	<b>Utilization Management</b>	<b>Life Cycle Analysis</b>
<b>Indoor Air Pollutants</b>			✓	✓	✓	
<b>Criteria Air Pollutants</b>	✓	✓	✓	✓	✓	
<b>Ozone Depleting Substances</b>		✓		✓	✓	✓
<b>Greenhouse Gases/ GC Change</b>	✓	✓		✓	✓	
<b>Toxic Air Pollutants</b>	✓	✓	✓		✓	
<b>Pesticides Application</b>			✓	✓		
<b>Nonpoint Source Water Discharges</b>						
<b>Hazardous Waste/ Toxics</b>						
<b>Consumer Products</b>						
<b>Municipal Solid Waste</b>						✓

uncontrolled volatile organic compound (VOC) emissions. A research project is proposed to identify and demonstrate alternative coatings materials and processes to reduce the emissions of VOCs. Another process research approach is to investigate methods of testing and evaluating processes and their environmental impacts. These different approaches are used to address seven of the 10 priority problems as depicted in Exhibit 7. The proposed projects utilizing these process approaches are described in Chapter 4.

### **Recycling/Reuse Research**

The recycling and reuse research area focuses on evaluating waste streams, production feedstocks, and capacities for inclusion of reclaimed materials in production processes and products. In addition, the effectiveness of recycling/reuse programs needs to be evaluated. Recovery, reuse, and recycling are important options within the overall integrated pollution prevention approach for reducing the volume of waste generated. Community recycling programs usually involve segregation of recyclable municipal waste products for delivery to local recycling centers. Within industry, recycling programs involve numerous methods for reclaiming feedstock and waste materials for direct reuse within production processes, for recycling, or for exchanging wastes as input stocks for other industries.

The approaches investigated in recycling and reuse research include capture and recovery techniques, reclamation processing options, utilization options, and specification requirements. These approaches are used in the recycling/reuse research projects to address four of the priority environmental problems targeted in the strategic plan (see Exhibit 8). For example, significant environmental problems can occur when unwanted or unused chemicals are simply discarded. Research is proposed which would study the collection and reuse potential of unwanted pesticides and containers.

### **Socioeconomic and Institutional Research**

The socioeconomic and institutional research area focuses on identifying and evaluating non-technological factors that affect pollution prevention implementation opportunities. This research area also involves research to understand and overcome institutional, social, and economic obstacles to pollution prevention. It includes research in sociology, economics, and human behavior, as well

# **EXHIBIT 7** **POLLUTION PREVENTION PROCESS RESEARCH APPROACHES**

<div> <div>Approach</div> <div>Problem</div> </div>	Process Modification	Emission and Efficiency Testing	Alternative Feedstocks	Alternative Processes
Indoor Air Pollutants				
Criteria Air Pollutants		✓		
Ozone Depleting Substances	✓			
Greenhouse Gases/ GC Change	✓			✓
Toxic Air Pollutants	✓	✓		✓
Pesticides Application	✓			
Nonpoint Source Water Discharges				✓
Hazardous Waste/Toxics	✓			✓
Consumer Products				
Municipal Solid Waste				

## EXHIBIT 8

### POLLUTION PREVENTION RECYCLING AND REUSE RESEARCH APPROACHES

<div> <div>Approach</div> <div>Problem</div> </div>	Capture and Recovery	Specification Requirements	Reclamation Processing Options	Utilization Options
Indoor Air Pollutants				
Criteria Air Pollutants				
Ozone Depleting Substances	✓	✓	✓	✓
Greenhouse Gases/ GC Change				
Toxic Air Pollutants	✓	✓	✓	✓
Pesticides Application				✓
Nonpoint Source Water Discharges				
Hazardous Waste/Toxics				
Consumer Products				
Municipal Solid Waste		✓		

as studies of institutional conditions that favor or inhibit implementation of effective pollution prevention programs.

There is a broad range of approaches that can be utilized in socioeconomic and institutional research. These approaches include information and communication, market incentives, regulations, enforcement, and other means of modifying human behavior. Within each of these approaches is a number of techniques that can be investigated to determine their potential impact on the targeted environmental problem. *For example, market incentives include such techniques as marketable permits, deposit/refund systems, fees and taxes for pollution, and subsidies and tax credits for preventing pollution.* Any one or several of these market incentive techniques can be applied to a myriad of environmental problems. The various approaches to socioeconomic and institutional research for each targeted environmental problem are identified in Exhibit 9. An example of the *proposed socioeconomic and institutional research involves investigating creative ways of incorporating prevention into settlements.* Historically, EPA has not emphasized pollution prevention practices in its regulations governing hazardous waste.

### **Anticipatory Research**

The anticipatory research area allows the Agency to detect and respond to changing environmental, industrial, and consumer conditions. This research area is intended to provide the ability to pursue long-term research on emerging technologies or topics of concern, to enable EPA to prevent future pollution problems. The anticipatory research area includes the analysis of environmental trends and acquisition of comprehensive databases for ambient concentrations. This element of the pollution prevention research program focuses on the need for improved methods for acquisition of environmental monitoring data, as well as improved methods for statistical analysis. The effective interpretation of environmental quality data requires a profound knowledge of underlying processes and mechanisms, to provide properly formulated hypotheses to be used in the design of environmental monitoring programs and the interpretation of their results. Accordingly, transport and fate research is critical to foreseeing future problems and must be built into the anticipatory research program area.

# **EXHIBIT 9** **POLLUTION PREVENTION SOCIOECONOMIC AND** **INSTITUTIONAL RESEARCH APPROACHES**

<div> <div>Approach</div> <div>Problem</div> </div>	Information / Communication	Market Incentives	Regulations	Enforcement	Other
Indoor Air Pollutants	✓		✓		
Criteria Air Pollutants	✓	✓			✓
Ozone Depleting Substances	✓	✓	✓		
Greenhouse Gases/ GC Change	✓	✓			
Toxic Air Pollutants		✓			
Pesticides Application	✓	✓	✓		
Nonpoint Source Water Discharges		✓	✓		
Hazardous Waste/ Toxics	✓	✓	✓	✓	✓
Consumer Products	✓	✓			
Municipal Solid Waste	✓	✓	✓		

There are several approaches to identifying future issues that can be applied to the priority environmental problems targeted in the research strategic plan. These include:

- Gathering and analyzing ambient/ecological/health data for evidence of nascent problems.
- Developing and testing standards for product testing and evaluation.
- Analyzing societal/economic/technological trends and developing models that would predict future problems and possible solutions.
- Investigating pollution prevention alternatives and their impacts on emerging problems.
- Using expert scientific judgment on a continuing basis to identify pollution prevention needs, new potential problems, and means to address them.

These approaches will be pursued in the anticipatory research area to address seven of the targeted environmental problems (see Exhibit 10). For example, a significant contributor to nonpoint source pollution is urban runoff. Runoff of products such as fertilizers, pesticides, oil, and gasoline all pose considerable threats to the environment. Research is proposed to identify and evaluate other existing urban nonpoint pollution sources, and predict new sources that pose future threats.

### **Technology Transfer/Technical Assistance**

The technology transfer/technical assistance research area supports each of the five research program areas by providing the mechanism for rapid dissemination of information to potential users. This component of the pollution prevention research program focuses on targeting research deliverables to the appropriate audiences, developing the products that will best reach the audience(s), and providing support services that facilitate the technology transfer process. This overall strategy to technology transfer can be applied to any environmental problem.

The various activities for technology transfer include:

- Targeting research and products to the appropriate audience(s).
- Developing the products that best transfer the information to the audience(s).
- Providing information through various dissemination techniques.

# EXHIBIT 10

## POLLUTION PREVENTION ANTICIPATORY RESEARCH APPROACHES

<div> <div>Approach</div> <div>Problem</div> </div>	Monitoring and Standards Development	Trends Analysis and Modeling	Alternative Utilization	Expert Judgment and Needs Identification
Indoor Air Pollutants	✓			
Criteria Air Pollutants				
Ozone Depleting Substances			✓	
Greenhouse Gases/ GC Change	✓			
Toxic Air Pollutants				
Pesticides Application				
Nonpoint Source Water Discharges	✓			
Hazardous Waste/ Toxics	✓	✓		
Consumer Products				✓
Municipal Solid Waste				✓



## **POLLUTION PREVENTION RESEARCH STRATEGIC PLAN**

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- Supporting education and training to facilitate technology transfer.
- Providing direct technical assistance.
- Evaluating the effectiveness of technology transfer techniques and various products.

These technology transfer activities are used to address each of the 10 priority environmental problems targeted in the strategic plan (see Exhibit 11). For example, as part of the hazardous waste technology transfer efforts, it is proposed that PPO, OEETD, and OTTRS/CERI jointly co-sponsor industrial pollution prevention trade shows, and/or conference exhibits, and provide pollution prevention information. Also, with the help of EPA's university centers, these offices should encourage educational institutions to incorporate pollution prevention assessment and evaluation procedures into engineering curriculum.

# **EXHIBIT 11** **POLLUTION PREVENTION TECHNOLOGY TRANSFER AND** **TECHNOLOGY ASSISTANCE RESEARCH**

<div> <div>Approach</div> <div>Problem</div> </div>	Research and Product Targeting	Information Dissemination	Direct Technical Assistance	Education/ Training	Evaluation
Indoor Air Pollutants	✓	✓	✓	✓	✓
Criteria Air Pollutants	✓	✓	✓	✓	
Ozone Depleting Substances	✓	✓			
Greenhouse Gases/ GC Change	✓	✓	✓	✓	✓
Toxic Air Pollutants	✓	✓	✓		
Pesticides Application	✓				✓
Nonpoint Source Water Discharges	✓	✓		✓	✓
Hazardous Waste/Toxics	✓	✓		✓	✓
Consumer Products	✓	✓	✓	✓	✓
Municipal Solid Waste	✓	✓	✓	✓	✓

## **CHAPTER 4 PROBLEM-SPECIFIC RESEARCH**

The work group selected 10 priority environmental problems on which to focus this *Strategic Plan*, given the need to develop a realistic and achievable plan and the resource constraints associated with a finite budget. The 10 environmental problems identified by the work group are those that, in the professional judgment of the work group and the SAB, pose the greatest health and ecological risks. These problems include:

- Indoor air pollutants
- Criteria air pollutants
- Ozone depleting substances
- Greenhouse gases/global climate change
- Toxic air pollutants
- Pesticides application
- Nonpoint source water discharges
- Hazardous waste
- Production, use, and disposal of consumer products
- Municipal solid waste.

An overview of the research projects proposed to address each of these 10 environmental problems is presented in Exhibit 12. More detailed descriptions of the environmental problems, along with the proposed research projects associated with the problems, are presented in the remainder of this chapter. The resource requirements included in this strategic plan are only estimates, including those for FY 1991 since the budgetary decisions were not completed at the time of publication of this report.

## EXHIBIT 12

### PROPOSED POLLUTION PREVENTION RESEARCH

Priority Environmental Problems	Product Research	Process Research	Recycling Reuse Research	Socioeconomic/ Institutional Research	Anticipatory Research	Technology Transfer/ Technical Assistance
Indoor Air Pollutants	<ul style="list-style-type: none"> <li>• Development of low-cost test methods</li> <li>• Perform cooperative/interlaboratory evaluations of test methods</li> <li>• Expansion of source emissions data base</li> <li>• Selection of building materials for new EPA buildings</li> </ul>	<ul style="list-style-type: none"> <li>• Expansion of IAQ model and test-house studies</li> </ul>		<ul style="list-style-type: none"> <li>• Improving communication of indoor air pollution risks</li> <li>• Communicating technical pollution prevention information</li> <li>• Evaluating impact of labeling products</li> <li>• Evaluating state requirements for radon testing</li> </ul>	<ul style="list-style-type: none"> <li>• Expansion of response-based testing</li> <li>• Research the feasibility of radon standards for new buildings</li> </ul>	<ul style="list-style-type: none"> <li>• Target research and product deliverables</li> <li>• Develop, publish, and disseminate ORD research results</li> <li>• Advertise availability of ORD research information and guidance documents</li> <li>• Conduct workshops/conferences to transfer research results and provide technical assistance/training</li> <li>• Evaluate the effectiveness of the indoor air pollutants research efforts</li> <li>• Transfer technical information to state and local government and professional groups</li> </ul>

# EXHIBIT 12

## PROPOSED POLLUTION PREVENTION RESEARCH (cont.)

Priority Environmental Problems	Product Research	Process Research	Recycling Reuse Research	Socioeconomic Institutional Research	Anticipatory Research	Technology Transfer Technical Assistance
Criteria Air Pollutants (Ozone non-attainment)	<ul style="list-style-type: none"> <li>• Demonstrate the reduction of VOC emissions through alternative coating processes</li> <li>• Identify and evaluate consumer product prevention options</li> <li>• Evaluate solvent usage and sources of VOC emissions</li> <li>• Identify methods of reducing emissions from sources</li> </ul>	<ul style="list-style-type: none"> <li>• Demonstrate the reduction of VOC emissions through alternative coating processes</li> <li>• Identify methods of reducing emissions from sources</li> </ul>		<ul style="list-style-type: none"> <li>• Assess incentive effect on behavior modification</li> <li>• Investigate effectiveness of presentation</li> <li>• Develop incentive approaches to remove high emission cars</li> <li>• Research energy conservation incentives</li> <li>• Conduct research on market incentives to reduce emissions</li> <li>• Study the link between capital turnover and air pollution</li> <li>• Determine effects of reducing fossil fuel use</li> </ul>		<ul style="list-style-type: none"> <li>• Target research and product deliverables</li> <li>• Provide technology transfer to state and local environmental officials, small businesses, and researchers</li> <li>• Develop, publish, and disseminate research results</li> <li>• Advertise availability of ORD research information and guidance documents</li> <li>• Evaluate the effectiveness of the criteria air pollutants research efforts</li> </ul>

## EXHIBIT 12

### PROPOSED POLLUTION PREVENTION RESEARCH (cont.)

Priority Environmental Problems	Product Research	Process Research	Recycling Reuse Research	Socioeconomic Institutional Research	Anticipatory Research	Technology Transfer Technical Assistance
<b>Ozone-Depleting Substances</b>	<ul style="list-style-type: none"> <li>• Assess properties of chemical replacements for halons</li> <li>• Investigate alternatives to CFCs and their properties</li> <li>• Evaluate properties of potential halon and CFCs substitutes</li> <li>• Perform small- and large-scale testing of flooding agents</li> </ul>	<ul style="list-style-type: none"> <li>• Evaluate the best means for ultimate destruction/conversion of unwanted halons</li> <li>• Evaluate technologies to eliminate use of CFCs</li> </ul>	<ul style="list-style-type: none"> <li>• Assess the status of halon recycling</li> <li>• Research incentives for recycling/reuse of CFCs</li> <li>• Collect non-essential reservoirs of halons and develop a plan to recycle or destroy them.</li> </ul>	<ul style="list-style-type: none"> <li>• Develop an acceptability testing for new agents</li> <li>• Assess effectiveness of consumer product labeling</li> </ul>	<ul style="list-style-type: none"> <li>• Develop a conceptual plan for reallocation of the existing bank of halons to essential uses</li> </ul>	<ul style="list-style-type: none"> <li>• Target research and product deliverables</li> <li>• Develop, publish, and disseminate ORD research results</li> <li>• Advertise availability of ORD research information and guidance documents</li> <li>• Conduct workshops/conferences to transfer research results and provide technical assistance/training as needed</li> <li>• Evaluate the effectiveness of the ozone depleting substances research efforts</li> </ul>

# EXHIBIT 12

## PROPOSED POLLUTION PREVENTION RESEARCH (cont.)

Priority Environmental Problems	Product Research	Process Research	Recycling Reuse Research	Socioeconomic Institutional Research	Anticipatory Research	Technology Transfer Technical Assistance
Greenhouse Gases/ Global Climate Change	<ul style="list-style-type: none"> <li>• Evaluate, develop, and conduct performance testing procedures</li> <li>• Perform costs/benefits analysis for efficient lighting technologies</li> <li>• Construct and develop solar hydrogen production systems</li> </ul>	<ul style="list-style-type: none"> <li>• Develop a detailed research plan for performance testing of innovative motor control methodology</li> </ul>		<ul style="list-style-type: none"> <li>• Research motivation of behavioral changes through messages</li> <li>• Study energy conservation incentives</li> <li>• Develop practical alternative approaches to correct for subsidies for and damages from fossil fuel use</li> <li>• Investigate relative effectiveness of communicating cumulative long-term risks</li> </ul>	<ul style="list-style-type: none"> <li>• Develop an operational infrastructure to support product testing and evaluation</li> </ul>	<ul style="list-style-type: none"> <li>• Prepare an application handbook for the light practitioners and decisionmakers</li> <li>• Develop an outreach program to provide a comprehensive organized up-to-date source of research-based technical information</li> <li>• Target research and product deliverables</li> <li>• Conduct workshops/ conferences to transfer research results and provide technical assistance/training</li> <li>• Evaluate the effectiveness of the global climate change research efforts</li> <li>• Advertise availability of ORD research information and guidance documents</li> </ul>

# EXHIBIT 12

## PROPOSED POLLUTION PREVENTION RESEARCH (cont.)

Priority Environmental Problems	Product Research	Process Research	Recycling Reuse Research	Socioeconomic Institutional Research	Anticipatory Research	Technology Transfer/ Technical Assistance
<b>Toxic Air Pollutants</b>	<ul style="list-style-type: none"> <li>• Evaluate the use of products emitting air toxics</li> <li>• Develop reliable, low-emission wood stoves</li> </ul>	<ul style="list-style-type: none"> <li>• Demonstrate the viability of air toxic emissions reductions</li> <li>• Evaluate improved techniques that eliminate the use of toxic solvents</li> <li>• Identify methods of reducing emissions</li> <li>• Develop reliable low emission wood stoves</li> </ul>		<ul style="list-style-type: none"> <li>• Assess incentives for use of clean fuels</li> <li>• Subsidize R&amp;D on nontoxic substitutes</li> <li>• Evaluate pollution prevention measures</li> </ul>	<ul style="list-style-type: none"> <li>• Evaluate the impact of marketing alternative fuels</li> </ul>	<ul style="list-style-type: none"> <li>• Provide technology transfer to state and local environmental officials, small businesses, and researchers</li> <li>• Target research and product deliverables</li> <li>• Develop, publish, and disseminate ORD research results</li> <li>• Advertise availability of ORD research information and guidance documents</li> <li>• Conduct workshops/conferences to transfer research results and provide technical assistance/training</li> <li>• Evaluate the effectiveness of the toxic air pollutants research efforts</li> </ul>



## EXHIBIT 12

### PROPOSED POLLUTION PREVENTION RESEARCH (cont.)

Priority Environmental Problems	Product Research	Process Research	Recycling Reuse Research	Socioeconomic Institutional Research	Anticipatory Research	Technology Transfer Technical Assistance
<b>Pesticides Application</b>	<ul style="list-style-type: none"> <li>• Evaluate container design modifications</li> <li>• Perform transport and transformation studies on new or alternative pesticides</li> </ul>	<ul style="list-style-type: none"> <li>• Evaluate pesticide manufacturing process modifications</li> <li>• Demonstration of process modification</li> </ul>	<ul style="list-style-type: none"> <li>• Conduct a study and demonstrate rinsing practices</li> <li>• Investigate recycling methods for dry product containers</li> <li>• Study the collection and reuse of pesticide products and containers</li> </ul>	<ul style="list-style-type: none"> <li>• Provide R&amp;D on effectiveness of labeling</li> <li>• Evaluate a possible pesticides right-to-know program</li> <li>• Investigate incentives for integrated pest management</li> <li>• Evaluate other uses of USDA incentives</li> </ul>		<ul style="list-style-type: none"> <li>• Target research and product deliverables</li> <li>• Develop, publish, and disseminate ORD research results</li> <li>• Advertise availability of ORD research information and guidance documents</li> <li>• Conduct workshops/conferences to transfer research results and provide technical assistance/training</li> <li>• Evaluate the effectiveness of the pesticides application research efforts</li> <li>• Develop training for farmers on pesticide use, reuse, and disposal</li> </ul>

# EXHIBIT 12

## PROPOSED POLLUTION PREVENTION RESEARCH (cont.)

Priority Environmental Problems	Product Research	Process Research	Recycling Reuse Research	Socioeconomic Institutional Research	Anticipatory Research	Technology Transfer Technical Assistance
Nonpoint Source Water Discharges		<ul style="list-style-type: none"> <li>• Perform best management practices</li> </ul>		<ul style="list-style-type: none"> <li>• Provide guidance on institutional practices to control urban water quality</li> <li>• Evaluate USDA incentives for reducing non-point source runoff</li> <li>• Assess price effects on fertilizer use</li> <li>• Investigate regulation of land use</li> </ul>	<ul style="list-style-type: none"> <li>• Evaluate urban pollution sources</li> </ul>	<ul style="list-style-type: none"> <li>• Develop urban runoff best management practices guidance document</li> <li>• Target research and product deliverables</li> <li>• Develop, publish, and disseminate ORD research results</li> <li>• Advertise availability of ORD research information and guidance documents</li> <li>• Conduct workshops/conferences to transfer research results and provide technical assistance/training</li> <li>• Evaluate the effectiveness of the nonpoint source pollution research efforts</li> </ul>

## EXHIBIT 12

### PROPOSED POLLUTION PREVENTION RESEARCH (cont.)

Priority Environmental Problems	Product Research	Process Research	Recycling Reuse Research	Socioeconomic Institutional Research	Anticipatory Research	Technology Transfer Technical Assistance
<b>Hazardous Waste</b>		<ul style="list-style-type: none"> <li>• Develop methods for measuring pollution prevention</li> <li>• Assess waste minimization technologies</li> <li>• Develop surfaces cleaning methods</li> <li>• Develop models for new pollution prevention industrial processes</li> </ul>		<ul style="list-style-type: none"> <li>• Examine community reaction to hazardous waste facilities</li> <li>• Determine the role of insurance and indemnity bonds in safe disposal</li> <li>• Investigate regulations and RCRA regulatory flexibility to promote pollution prevention</li> <li>• Determine methods to conduct and promote hazardous waste audits</li> <li>• Research the feasibility of product stewardship</li> <li>• Perform R&amp;D on product liability</li> <li>• Identify market approaches for lead pollution prevention</li> </ul>	<ul style="list-style-type: none"> <li>• Prepare a research prioritization report</li> <li>• Perform risk modeling for prioritization of research</li> </ul>	<ul style="list-style-type: none"> <li>• Target research and product deliverables</li> <li>• Develop, publish, and disseminate ORD research results</li> <li>• Advertise availability of ORD research information and guidance documents</li> <li>• Conduct workshops/conferences to transfer research results and provide technical assistance/training</li> <li>• Evaluate the effectiveness of the hazardous waste research efforts</li> <li>• Publish results from demonstrations</li> </ul>

## EXHIBIT 12

### PROPOSED POLLUTION PREVENTION RESEARCH (cont.)

Priority Environmental Problems	Product Research	Process Research	Recycling Reuse Research	Socioeconomic Institutional Research	Anticipatory Research	Technology Transfer Technical Assistance
Production, Use, and Disposal of Consumer Products	<ul style="list-style-type: none"> <li>• Develop and establish the capability to study clean products</li> <li>• Prepare an alternative products/safe substitute document</li> </ul>	<ul style="list-style-type: none"> <li>• Prepare a product and process design guidance manual</li> </ul>		<ul style="list-style-type: none"> <li>• Evaluate programs to produce and market clean products</li> <li>• Provide R&amp;D on consumer product labeling</li> <li>• Research environmental education as a way to achieve pollution prevention</li> <li>• Research incentives to reduce toxics in consumer products</li> <li>• Study the economics of production stage incentives/regulations</li> </ul>	<ul style="list-style-type: none"> <li>• Conduct life cycle analysis workshops</li> <li>• Conduct product industry specific workshops</li> <li>• Assess clean products R&amp;D needs</li> </ul>	<ul style="list-style-type: none"> <li>• Prepare a document on clean products research and implementation</li> <li>• Develop a report for consumers and producers on comparative risks of consumer products for pollution prevention</li> <li>• Target research and product deliverables</li> <li>• Advertise availability of ORD research information and guidance documents</li> <li>• Conduct workshops/conferences to transfer research results and provide technical assistance/training</li> <li>• Evaluate the effectiveness of the consumer products/use/disposal research efforts</li> <li>• Provide on-site technical assistance</li> </ul>

# EXHIBIT 12

## PROPOSED POLLUTION PREVENTION RESEARCH (cont.)

Priority Environmental Problems	Product Research	Process Research	Recycling Reuse Research	Socioeconomic Institutional Research	Anticipatory Research	Technology Transfer Technical Assistance
<b>Municipal Solid Waste</b>	<ul style="list-style-type: none"> <li>• Prepare a document on life cycle cost analysis for consumer products</li> <li>• Prepare a manual for waste-reducing product designs</li> <li>• Publish clean product programs case studies</li> </ul>		<ul style="list-style-type: none"> <li>• Prepare a summary of innovative recycling technologies</li> </ul>	<ul style="list-style-type: none"> <li>• Examine how communication/information motivates pollution prevention</li> <li>• Evaluate incentives for reducing quantities of household waste</li> <li>• Provide R&amp;D on disincentives to waste reduction/recycling</li> <li>• Evaluate deposit/refund market incentives</li> <li>• Investigate market expansion for recovered materials</li> </ul>	<ul style="list-style-type: none"> <li>• Conduct six specialized workshops to identify research needs</li> </ul>	<ul style="list-style-type: none"> <li>• Prepare a guidance document for measuring pollution prevention</li> <li>• Conduct several regional source reduction/recycling seminars</li> <li>• Target research and product deliverables</li> <li>• Develop, publish, and disseminate ORD research results</li> <li>• Advertise availability of ORD research information and guidance documents</li> <li>• Evaluate the effectiveness of the municipal solid waste research efforts</li> <li>• Provide technical assistance</li> </ul>

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## INDOOR AIR POLLUTANTS

### Description

Recent studies (e.g., TEAM) have shown that exposure to indoor air pollution is the major contributor to human health risk for a wide variety of environmental contaminants. In addition, building occupant complaints (i.e., Sick Building Syndrome) resulting in lost productivity have risen dramatically in the past few years. Thus, poor indoor air quality has adverse health and economic impacts. With few exceptions (e.g., radon), indoor air pollutants arise from sources within the indoor environment. Thus, while ventilation and air cleaning can be used to improve indoor air quality, *managing the sources is the most effective mechanism for reducing or eliminating indoor air pollutants.*

### Rationale

Agency studies on relative risk (e.g., *Unfinished Business* and Regional assessments) consistently place indoor air pollution near the top of the list of environmental hazards. Congress also recognizes the importance of the problem and has called on EPA to conduct R&D under SARA, Title IV--The Radon Gas and Indoor Air Quality Research Act. A wide variety of indoor sources emit pollutants to the indoor environment, including: building materials, carpets, furnishings, paints, office machines, consumer products, etc. To date, the manufacturers, architects, builders, building managers, and homeowners have paid scant attention to how such products and materials impact indoor air quality. Data on the emissions from indoor sources is extremely limited, as is guidance on how to select and use products/materials to ensure adequate indoor air quality. The purpose of this project is to develop the technical information needed to provide guidance on how to effectively manage sources of indoor air pollutants. Proper use of this information will promote reduced exposures to a wide variety of indoor air pollutants that are known, or are potential health hazards, or contribute to Sick Building Syndrome.

This project will develop information on "clean" products and materials and encourage their design, production, and use in homes, offices, schools, and other public access buildings. Elimination or reduction of pollutants from indoor sources represents pollution prevention in its purest form. Such an information-based, marketplace-oriented approach to preventing pollution will also reduce the need for more traditional command-and-control regulatory strategies.

## Research Needs

To effectively prevent and manage indoor sources, answers to the following questions are needed: 1) What compounds are emitted? 2) What are their emission rates? 3) How does the emission rate change over time? 4) What is the occupant response to the emissions (e.g., chronic, acute toxicity, irritation)? 5) How should the product/material be used?

## Current Activities

Current research by the Indoor Air Branch of AEERL/RTP on sources of indoor air pollutants focuses on:

- Emission Test Methods--Small chamber test methods have been developed to identify and quantify the emissions of vapor phase organics from indoor sources. These methods are being incorporated into an ASTM standard guide and are being used, to a limited extent, by manufacturers of materials and products used indoors.
- Source Emission Models--Simple first order decay source emissions models have been developed based on small chamber testing. Work is underway to develop mass transfer models accounting for evaporation, diffusion, and adsorption/desorption. This work includes the evaluation of adsorption to and re-emission from indoor sinks.
- Methods to Determine Biological (Microbial, Animal, Human) Responses to Emissions from Indoor Sources--This research to develop source tests based on occupant responses is in the planning stage. Such methods will be used to evaluate emissions from actual sources rather than artificial mixtures. A cooperative project between EPA, Yale University, and the University of Aarhus (Denmark) will be initiated in FY91.
- Impact of Product Use on Indoor Air Quality (IAQ)--An IAQ model has been developed to predict pollutant concentrations and occupant exposures based on source emission characteristics, indoor environmental conditions, and occupant activities. The model has been validated for several sources based on IAQ test house studies. Limited evaluations of the impact of increased ventilation (e.g., open windows, bathroom fans) on indoor pollutant levels have been conducted.
- Catalog of Indoor Sources and Emissions--A system for classifying indoor sources is being developed, and data on source emissions are being collected. This information will be compiled in a catalog for publication in FY91.

(Note: The first four project areas above are funded out of the base program; the fifth project is being funded with FY90 Pollution Prevention resources.)

The existing research program on indoor sources is developing the tools needed to answer the questions expressed in the Research Needs section. Application of testing methods and source emissions models will provide information on compounds emitted, emission rates, and emission rate changes. The new project on response-based test methods will begin to answer questions on how occupants react to indoor sources, and will ultimately lead to better ways to evaluate materials and products. The IAQ model and test house studies will provide information on how product usage impacts indoor air quality. The catalog of sources and emissions will provide useful information to user communities such as the American Institute of Architects (AIA), homebuilders, and product manufacturers.

### **Relationship to Sectors Targeted in PPO's Pollution Prevention Strategy**

This research effort focuses primarily on the industrial and consumer sectors with emphasis on the problems associated with volatile organic compounds, and toxic air pollutants (such as halogenated organics) associated with the indoor air environment. The constituents found in consumer products and building materials (e.g., paints and coatings) also contribute to the ambient air ozone non-attainment and air toxics problems. Cataloging of products, test methodologies, emission data, and selection guidance is intended for many groups including industry manufacturers/users, architectural designers, consumers, and others.

### **Proposed Technological Research**

A substantial expansion of the existing research program on indoor sources is needed to fully develop the technical data necessary to provide guidance on selection and use of indoor materials and products to ensure good indoor air quality. The currently modest in-house chamber and test house facilities, which have been the core of our highly successful research on emissions from sources and development of testing methods, will continue to be expanded over the next several years. Development of response-based testing methods will complement and draw on research of response mechanisms by the Health Effects Research Laboratory. In addition to continuation of the present Pollution Prevention project, the following projects are proposed:

- **Development of Low-Cost Test Methods**--The existing emissions testing methods, while acceptable for many applications, require a substantial capital investment and have relatively high personnel costs. Simpler, low-cost methods are needed to encourage wide application by manufacturers of indoor materials and products (Product Research).



- Cooperative/Interlaboratory Evaluations of Test Methods--Since emissions testing of indoor sources is still in its infancy, data on comparability of test results among laboratories is limited. A project involving both public (government, universities) and private (testing labs, manufacturers) organizations involved in product testing is needed to develop the necessary information. Such information could be used in the development of EPA and/or ASTM "standard methods" and to develop "certified test methods" (Product Research).
- Expansion of Source Emissions Data Base--The existing data base on source emissions is weak. A substantial expansion is needed across all categories of indoor sources. A dual program involving manufacturer testing of their own products and EPA funded testing of selected products would be developed. An example of an immediate use for such data is inclusion in the American Institute of Architects' *Environmental Resource Guide* (Product Research).
- Selection of Materials for New EPA Buildings--Within the next few years, new EPA buildings are anticipated for Washington, DC and Research Triangle Park, NC. A project to ensure selection of building materials and furnishings consistent with good IAQ is proposed. This project would be conducted cooperatively with the American Institute of Architects and EPA's Facility Management staff. The project could also include a building operations manual to ensure continued good IAQ by specifying appropriate ventilation and maintenance practices (Product Research).
- Product Usage Vis-a-Vis IAQ--IAQ model and test house studies will be expanded to include evaluation of consumer actions that impact indoor air quality. Potential areas of investigation include: (a) use of aerosol products under various ventilation strategies; (b) the effect of application mass (e.g., g/m<sup>2</sup>) for products such as waxes and polishes; and (c) impacts of air fresheners and room deodorizers (Process Research).
- Expansion of Response-Based Testing--The development of response-based tests, starting in FY91, is expected to take several years. There are, however, existing techniques (e.g., Fanger's olf test, animal tests for irritancy) that should be evaluated more widely. This work would be done in conjunction with the base program project (Anticipatory Research).
- Radon Standards for New Buildings--Research the feasibility of establishing radon standards for new buildings (Anticipatory Research).

### Proposed Non-Technological Research

Socioeconomic research is needed to better understand methods for communicating risks and modifying human behavior. The following projects are proposed to address the indoor air pollutants problem:

- Improving Communication of Indoor Air Pollution Risks--Examine how to improve the communication to homeowners, landlords, and other building managers about the risks from radon and other indoor air pollutants. This research also investigates the effectiveness

of mandatory radon disclosure requirements on remediation. The goal would be to increase the prevention of exposure, often by reducing the pollutants in the indoor environments.

- Communicating Technical Pollution Prevention Information--Investigate how to most effectively communicate technical information about indoor air pollution prevention to state and local governments and to professional groups. This project also examines the effectiveness of risk communication to homeowners for reducing the effects of radon and other indoor air pollutants.
- Evaluating Impact of Product Labeling--Examine the potential pollution prevention impact from labeling consumer products that contribute to indoor pollution.
- Evaluating State Requirements for Radon Testing--Determine the effectiveness of alternative radon testing requirements.

### Proposed Technology Transfer/Technical Assistance

Working cooperatively with OAR, ORD will expand its existing research on the sources of indoor air pollution to develop guidance on the selection of indoor construction and surfacing materials. The technology transfer plan for indoor air involves coordinating the following activities:

- Research and Product (Deliverable) Targeting--OTTRS technology transfer liaison will monitor deliverable development, attend meetings, and assist the laboratories and the program offices, where necessary, to assure preparation of quality ORD deliverables. OTTRS will also advise the program offices, as needed, on the utilization of the research, information, and other support services.
- Product Development--OTTRS/CERI will support publication of the reports and a catalog of indoor air emissions sources, along with estimates of emissions from these sources based on AEERL's research results.
- Information Dissemination--OTTRS/CERI will advertise the availability of information through its *Technology Transfer Newsletter* and other vehicles reaching the target audiences. OTTRS/CERI will also work closely with PPO and OAR to assist in adding the research results to the Pollution Prevention Information Clearinghouse.
- Education and Training--OAR and ORD will conduct regional workshops to inform EPA, state, and local government staff of the availability of information.
- Technical Assistance--Where commercialization of technology is at issue, OTTRS will provide assistance.
- Evaluation--ORD and OAR will assess the effectiveness of the research in achieving its intended results, and initiate any necessary adjustments to the program, products, and their delivery. OTTRS will work with the program offices to support evaluation efforts.

### Proposed Outputs

Input of emissions data to <i>AIA Environmental Resource Guide</i>	10/90
<i>Initial Catalog of Indoor Materials and Products</i>	12/90
Selection of materials for new EPA buildings	As Needed
Research and Product Targeting	Ongoing
Advertisement of ORD pollution prevention information products	01/91-94
Update of ORD pollution prevention research results in PPIC	01/91-96
Dissemination of information and research results	Ongoing
Report on communicating risks from indoor air pollutants	12/91
Support for education/training workshops	As Needed
Report on low-cost source test method	09/92
Report on transfer of information on indoor air pollutants	12/92
Report on chamber intercomparison study	09/93
Report on the impact of labeling consumer products	12/93
Updated Source Catalog with additional data	09/95
Report on consumer impact on IAQ	09/96
Report on response-based testing	03/97
Evaluation of effectiveness of research project	Ongoing

### Participating Offices

Cooperation with the following offices/laboratories/institutions is anticipated:

- OAR (Indoor Air Division), OPTS, OA--Compilation and publication of data from expansion of source emissions data base project; OA selection of materials, with ORD, OAR, OPTS input, on selection of materials for new EPA buildings project; guidance on product usage, based on results from product usage vis-a-vis IAQ project.
- HERL, ECAO--Collaboration on expansion of response-based testing project.
- AIA, Other Private Sector Groups--Collaboration on the following projects: catalog of indoor sources and emissions, development of low-cost test methods, cooperative/interlaboratory evaluations of test methods, and expansion of source emissions data base, with potential for joint funding.
- OPPE--Collaboration on the socioeconomic research projects.
- OTTRS/CERI--Collaboration on all technology transfer and technical assistance activities.

**Resources**

	FY91	FY92	FY93 (\$ thousands)	FY94	FY95
FTEs	0	0.5	2	2	2
S&E	0	200	250	300	300
R&D	300	500	600	800	600
TOTAL	300	700	850	1100	900

(Note: Resources do not include those of participating offices. FY91 resource requirements include existing pollution prevention project--Catalog of Indoor Emissions Sources.)

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## CRITERIA AIR POLLUTANTS

### Description

Attainment of the National Ambient Air Quality Standard for ozone has been among the most unyielding problems with which the U.S. Environmental Protection Agency has had to deal. Reduction of volatile organic compound (VOC) emissions from anthropogenic sources is a key component of the strategy to reduce ambient ozone concentrations. The primary objective of this project is to better understand how to reduce these emissions. In particular, emissions from stationary area sources, such as the use of coatings and consumer products, will be reduced via demonstration of pollution prevention options. Since many VOCs are also air toxics, this points to stationary area sources as a major source of air toxic emissions. Furthermore, these same sources may be contributing to other global problems, such as global warming and stratospheric ozone depletion.

### Rationale

Efforts to achieve extensive reductions in VOC emissions have not been successful partly because of the difficulty of dealing with stationary area sources. This difficulty has left these emissions largely uncontrolled. Area sources may contribute as much as 50 percent of national VOC emissions, and the growth of emissions from such sources may be outpacing efforts to reduce the diminishing base of uncontrolled point source emissions.

Add-on control devices are generally not economical for small, widely-distributed sources such as consumer products and small coating operations. Hence, innovative pollution prevention options are needed to achieve significant emission reductions. The successful application of pollution prevention techniques to small area sources, for which controls are generally ineffective, will help to generate support for the use of pollution prevention techniques in larger coating operations, where the capture and control of emissions can be expensive, complex, and is, in some cases, ineffective.

### Research Needs

Surface coatings and consumer products are two area source categories which make up a significant portion of uncontrolled VOC emissions. Both are amenable to prevention via formulation, application/packaging, and consumer usage pattern changes. Research is needed to characterize and demonstrate the efficacy of these changes. There is also a need to reduce emissions on a compound-specific basis. Hence, a top-down analysis to identify end-uses of solvents is needed in order to identify those which are amenable to reduction via pollution prevention. Subsequent research is needed to identify techniques to reduce these emissions. Information and data need to be transferred in an efficient manner to potential users in the public and private sectors.

### Current Activities

Current activities include research in both organic emissions prevention and control, and a strong *technology transfer effort* through the Control Technology Center (CTC). AEERL has an impressive history of evaluating developing control technologies for VOC control. Significant research continues in this direction. However, planning for the FY91-92 2% Set-Aside Pollution Prevention project and its subsequent completion will permit flexibility in organic emissions reduction objectives, a research program balanced between prevention and control, and an enhanced ability to provide technical support in the prevention area.

The 2% Set-Aside project includes research in alternative surface coatings and in consumer products. Three efforts are proposed to prevent solvent emissions from coating operations. The first two--Evaluation of Potential Coating Technologies and Surface-Coating-Free Materials Workshop--will bring together information about prevention opportunities and will provide a basis for anticipated demonstration efforts. The third project area consists of several demonstrations of prevention options, including technology for wood furniture manufacturing and autobody refinishing.

Two research areas are included under consumer product research. The first directly addresses consumer products. This effort includes the development of test methods to evaluate the VOC content of products and the development of low-polluting product options. A scoping study for test method development research has been initiated during FY90. The second effort concerns pesticide inerts. The primary purpose of this effort is to extend the current four category inerts approach,

which focuses on health-based concerns, to include ambient ozone, stratospheric ozone depletion and greenhouse potential concerns.

AEERL has been active in the coatings and consumer products areas. Cooperative coatings research continues with the Department of Defense. During 1989, AEERL and OAQPS co-sponsored a symposium with extensive industry participation addressing the potential regulation of consumer products. AEERL is working to expand New York's emissions estimate for the New York City metropolitan area to the entire NESCAUM region. In addition, AEERL has completed studies of VOC emissions from aerosol products and charcoal lighter fluid.

Research in the development of innovative controls (e.g., corona destruction) and the enhancement of existing controls (i.e., carbon adsorption and catalytic incineration) continues. Of critical importance is the evaluation of the effectiveness of controls as operated in industry. If, as suspected, the controls are not operated effectively, resulting in poor control efficiency, then research will be undertaken to identify and recommend special permit conditions to regulators, to provide guidance to industry, and to improve the robustness of control technology design and operation.

### **Relationship to Sectors Targeted in PPO's Pollution Prevention Strategy**

This pollution prevention research will address all sectors with emphasis on industry and energy/transportation. Focus will be on dealing with volatile organics from a wide variety of area and point sources. Special emphasis will be given to such areas as alternatives, substitutes, and improved methodologies for consumer products, paints and coatings, and solvent usage. Prevention-oriented upgrading of control technology effectiveness for point sources of VOCs will also be addressed for these sectors. Reduction in ozone will provide benefits in the agricultural sector through increased plant growth productivity, resulting in a need for less intensive farming practices.

### **Proposed Technological Research**

The proposed technological research includes the following product and process research efforts:

- **Alternative Coatings Materials and Processes**--Demonstrating the viability of VOC emissions reduction through alternative coating materials and processes (Product and Process Research).

- Consumer Product Pollution Prevention Options--Identifying and evaluating consumer product prevention options, including development of in-house laboratory capability to evaluate the environmental claims (VOC content, reduced volume of product per application, etc.) and the efficacy of improved products developed by industry (Product Research).
- Sources of VOC Emissions--Evaluating solvent usage via a top-down analysis of the marketplace, thereby identifying possible unmitigated sources of VOC emissions (Product Research).
- Emissions Reduction from Sources--Performing research to identify methods of reducing emissions from those sources creating the greatest health and welfare risk (Product Research with potential Process components).

(Note: The first two efforts listed above have been funded during FY91 and FY92 as part of the Administrator's 2% Set-Aside Pollution Prevention Projects.)

Industrial partners will be sought for the demonstration of alternative coating materials. These partners are needed to supply alternative coating formulations and/or equipment and to allow testing of coatings under manufacturing conditions. AEERL will work with SCAQMD to identify industrial partners during the initial stages of the program. A potential partner is Southern California Edison which has established a research facility for coatings application in the Los Angeles area.

### Proposed Non-Technological Research

Since little is known about whether air pollution alerts lead to mitigating behavior by individuals in the community or by the polluters, research is needed to evaluate incentives for behavior modification. The following research projects are proposed:

- Incentive Effect on Behavior Modification--Examine the incentive effect of air pollution alerts on both the general public and polluters, especially in terms of prevention of exposure through reduced releases.
- Effectiveness of Message Presentation--Investigate the effectiveness of alternative ways of presenting messages about individual pollution prevention actions that emphasize: (a) the impact on personal risk, and (b) the impact on the general environment.
- Incentive Approaches to Remove High Emission Cars--Develop incentives designed to encourage the elimination or repair of high emission vehicles.
- Energy Conservation Incentives--Examine a variety of energy conservation incentives for mobile and stationary sources.



- Market Incentives to Reduce Emissions--Investigate the feasibility and determine the effectiveness of marketable permits, energy/carbon taxes, and state permit taxes.
- Alternatives for Reducing Fossil Fuel Use--Provide an economic rationale and alternative approaches for altering energy prices, indicating the effects on fossil fuel use, environmental quality, economic impacts, and other advantages and disadvantages.
- Analyze Air Pollutant Alerts--Assess whether air pollution alerts can be used as an effective pollution prevention tool, and if so, how.
- Examine Trade-off Between Coating Emissions and Product Life--Assess the utility of coatings in extending the useable life of a product and study the trade-off between coating emissions and product life.

### Proposed Technology Transfer/Technical Assistance

The technology transfer plan for addressing the criteria air pollutants problem involves the following activities:

- Research and Product (Deliverable) Targeting--OTTRS technology transfer liaison will monitor deliverable development, attend meetings, and assist the laboratories and the program offices, where necessary, to assure preparation of quality ORD deliverables. OTTRS will also advise the program offices, as needed, on the utilization of the research, information, and other support services.
- Product Development--OTTRS/CERI will support publication of ORD reports based on AEERL's research results.
- Information Dissemination--Providing technology transfer to state and local environmental officials, small businesses, and researchers through workshops and the use of the Control Technology Center (CTC), the small business clearinghouse as proposed in the Clean Air Act Amendments, and the Pollution Prevention Information Clearinghouse (PPIC). OTTRS/CERI will advertise the availability of information through its *Technology Transfer Newsletter* and other vehicles reaching the target audiences. OTTRS/CERI will also work closely with PPO and OAR to assist in adding the research results to PPIC.
- Evaluation--ORD and OAR will assess the effectiveness of the research in achieving its intended results, and initiate any necessary adjustments to the program, products, and their delivery.

### Proposed Outputs

#### 2% Set-Aside Projects

Surface-coating-free materials workshop

05/91

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Evaluation of potential coating technologies report		06/91
Coatings demonstration projects		
Autobody refinishing	- Final Report	09/91
Wood furniture manufacture	- Interim Report	03/92
	- Interim Report	03/93
Consumer product test method development		
	- Annual Report	09/91
	- Annual Report	09/92
Prevention options availability report		
	- Interim Report	06/91
Aerosol propellant/packaging changes		
	- Interim Report	09/91
	- Final Report	09/92
Develop an expanded technical basis for a pesticide inerts strategy		06/92
<u>2% Set-Aside Follow-ons</u>		
Annual report on coatings demonstrations		09/93, 94, 95
Annual report on consumer products prevention		09/93, 94, 95
In-house consumer products prevention options laboratory operational		03/94
<u>Other Projects</u>		
Top-down solvent reduction strategy	- Opportunity Analysis for VOC Reduction	09/93
	- Annual Report on VOC Reduction	09/94, 95
Research and product targeting		Ongoing
Products development, publication, and dissemination		Ongoing
Update of ORD pollution prevention research results in PPIC		01/91-96
Evaluation of effectiveness of research project		Ongoing

## Participating Offices

Cooperation with the following offices/laboratories/institutions is anticipated:

### Pollution Prevention Office Annual Funding

- OPTS (OPP and OTS)--Coordination on the technological and non-technological research projects.
- OAR/OAOPS--Collaboration on the technological research efforts.
- EPA Region IX--Cooperation on technological research project.
- OTTRS/CERI--Collaboration on all technology transfer and technical assistance activities.
- OPPE--Collaboration on socioeconomic and institutional research initiatives.
- Industrial Partners--Cooperation on and contribution of funds for technological research efforts.
- SCAQMD (South Coast Air Quality Management District)--Collaboration on and contribution of funds for specific research efforts.
- NESCAUM (Northeast States for Coordinated Air Use Management)--Collaboration on research efforts.
- NYSDEC (New York State Department of Environmental Conservation)--Collaboration on research efforts.
- CARB (California Air Resources Board)--Collaboration on research efforts.

## Resources

	FY91	FY92	FY93 (\$ thousands)	FY94	FY95
FTEs	0	2	2	2	2
S&E	0	200	300	250	250
R&D	680	700	750	750	900
TOTAL	680	900	1050	1000	1150

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## **OZONE DEPLETING SUBSTANCES--Halon**

### **Description**

Halons are bromine-containing compounds that have found increased utilization as fire and explosion suppressants in recent years. They also can be potent depleters of stratospheric ozone. There are a number of applications where halons have important advantages over other fire extinguishants. Such cases include protection of installations where electronic monitoring of activities is vital to the safety of personnel (chemical production plants, air traffic control towers, military surveillance and communication centers, etc.), and where explosive concentrations of combustible gases can occur in occupied areas (e.g., gas charging rooms of aerosol plants and enclosed oil production facilities such as exist on the Alaskan North Slope). Some uses, however, have developed solely through convenience. Halons have long atmospheric lifetimes. This fact coupled with their ultimate release of bromine atoms in the stratosphere makes the halons potent depleters of stratospheric ozone. For this reason, the halons are already being limited in production and are facing ultimate phaseout. Alternative fire protection agents or strategies must be found to take the place of the halons in essential uses.

### **Rationale**

The fully halogenated Halons-1211, -1301, and -2402 are currently regulated by the EPA (40 CFR Part 82; August 12, 1988) and are subjected to an escalating tax by the Omnibus Budget Reconciliation Act of 1989. The EPA regulation implements the terms of the Montreal Protocol of 1987, which at present, allows the halons to continue to be produced but with production capped at the 1986 level. Amendments to the protocol agreed to in June 1990, now call for the complete phaseout of the halons by the year 2000.

As effective as the halons are in extinguishing fires and suppressing explosions, the ozone-depleting capability of these chemicals is three to ten times the depleting potential of the CFCs. It is generally recognized that while fires and explosions are undesirable, global ozone depletion is catastrophic. Therefore, the risk posed by continued consumption and emissions of the halons is unacceptable.

Halons are stored in cylinders until needed. Emissions are, therefore, restricted to inadvertent releases or intentional discharge for training, system servicing, or system readiness testing purposes. Production emissions are negligible. The prevention approach is particularly pertinent to the emissions of halons since such emissions are amenable to such techniques as temporary holding and recycling halons during system servicing, use of alternative chemicals or methods to simulate halon firefighting in training exercises, and elimination of use by substituting alternative fire suppressant agents or fire protection strategies.

### **Research Needs**

Halon emissions may be reduced in the near term by a number of means including: (1) restricting halon use to essential applications, (2) improving servicing procedures to eliminate unnecessary emissions, (3) reducing unnecessary discharges such as in the discharge testing of Halon-1301 systems, (4) using alternative methods of acceptance testing in halon systems (e.g., door fan tests, puff tests, or alternative test gases), (5) reallocating the halon bank to essential uses, (6) developing a destruction technology for unusable halons, and (7) establishing a system for recycling halons. All of the above approaches require development for implementation by the fire protection community.

To enable a complete phaseout of these ozone-depleting substances, however, alternative methods or chemicals must be found and demonstrated to be acceptable in essential applications in order for the fire protection community to proceed with their adoption.

### **Current Activities**

AEERL is a participant in the Halon Alternatives Research Consortium (HARC). This is a joint government-industry effort to search for alternative fire suppressant agents which combine the desirable attributes of the halons (namely, rapid extinction of fire while personnel may still be in the affected area and protection of property from fire and smoke without leaving a residue or without damage from the extinguishant itself). Consortium members include in addition to AEERL: Department of Defense (Air Force, Army, and Navy), National Aeronautics and Space Administration, National Science Foundation, National Institute of Standards and Technology, Halon Research Institute, halon producers, fire protection system manufacturers and distributors, and fire insurers.

The HARC strategy is to conduct a program of closely-coordinated research, empirical testing and analysis that is performed by experts in the critical technical areas. The technical effort is guided and monitored by a Technical Committee in which AEERL is an active participant. Research is currently underway to:

- Select trial chemicals and quick, relatively inexpensive performance screening tests to be run on them.
- Identify fire types for which halons are currently deployed and the requirements of a "drop-in" replacement agent.
- Identify the chemical, physical, and fluid mechanical properties of chemicals that would be most effective, economical, and safe.
- Establish a systematic data base to aid analysis of all pertinent information in support of the above.

In addition to assisting in the formation of the research strategy and in the oversight of HARC research projects, EPA is sponsoring the synthesis and preliminary property determinations of a subset of new chemicals which have been identified as possible halon replacements. These new chemicals are brominated derivatives of dimethylfluoroethers. This work commenced in FY90 and is being conducted by fluorine chemistry experts at the University of Tennessee. Samples of these new chemicals are being submitted to the National Institute of Standards and Technology for preliminary screening tests. This work has acquired special importance in view of the current U.S. position that hydrogenated chlorofluorocarbons (HCFCs), which comprise some of the leading proposed halon alternatives, should be eliminated (probably within the time frame of 2020-2040).

#### **Relationship to Sectors Targeted in PPO's Pollution Prevention Strategy**

The ozone-depleting substances research effort will address the industrial, energy, transportation, consumer, and government/military sectors. This is true because halons are used as fire extinguishants in all sectors. Alternatives, substitutes, and recycling/reuse of these halogenated organics (halons) will be developed and evaluated as a means for eliminating these extremely harmful materials, which are active stratospheric ozone depletors and greenhouse gases.

### Proposed Technological Research

Technological research efforts will emphasize accelerating the commercialization of proposed alternative chemicals for the halons. Recently, both DuPont and Great Lakes Chemicals have announced candidate alternative chemicals. However, much work remains to be done to prove the acceptability of these candidates in the various end-use applications. AEERL will be working with the HARC Implementation Committee to determine the critical path and institutional and technical barriers to the commercialization of these potential new fire extinguishants. For example, a consensus plan needs to be developed which will allow demonstration of proposed new agents in a manner which will be both timely and which will satisfy the potential end-user that the new agents will be acceptable for his purposes. For example, the requirements for suppression of weaponry explosions for the military will be different than the requirements for preventive inertion of gas explosions in Alaskan North Slope oil production facilities, and these will be different than the requirements for extinguishment of fires in electronic installations.

The consensus plan will need to incorporate input from the users regarding what constitutes agent pass-fail criteria, and what tests are appropriate to measure agent performance against these criteria. Products of pyrolysis of the new agents must be examined to determine if the agent itself may add additional hazard to the fire scenario. The entire plan and test results should be published to enable ready international as well as domestic acceptance.

In addition to constructing a consensus test plan and carrying out the actual tests on industry-proposed new agents, work on potential fall-back agents needs to be continued. This will involve completion of the work on brominated dimethylfluoroethers already underway at the University of Tennessee plus investigation of the class of perfluorocarbons as total flooding agents. The latter compounds have shown excellent fire extinguishment performance and very low toxicities in preliminary tests to date. Further fire extinguishment tests at larger scale as well as explosion suppression tests need to be performed.

As new agents are found to replace the existing bank of halons, the need will arise to dispose of the unused, unwanted, or waste halons in an environmentally acceptable manner. Therefore, safe, effective means of destroying the halons or of converting them to other safer materials must be found and made available.



Until such time as new agents or alternative approaches can be put in place to completely eliminate use of the halons, a mechanism needs to be established for the realignment recycling of the current bank of the chemicals from non-essential to essential uses. This is needed to reduce continued production of the halons to minimal levels. Investigation of purity acceptance requirements, on-site purity testing, and possible institutional impediments to the transfer of recycled halons will be needed.

The following technological research projects are proposed to address the halons problem:

- Chemical Replacements for Halons--Investigate properties of chemical replacements for halons (Product Research).
- Properties of Halon Substitutes--Evaluate the properties of potential halon substitutes such as brominated dimethylfluoroethers (Product Research).
- Flooding Agents--Perform small- and large-scale testing of perfluorocarbons and/or brominated dimethylfluoroethers as total flooding agents (Product Research).
- Destruction of Halons--Evaluate the best means for ultimate destruction/conversion of unwanted halons (Process Research).
- Halon Recycling--Assess the feasibility of and processes for recycling halons (Recycling and Reuse Research).
- Collection of Non-essential Halons--Develop a plan to collect non-essential reservoirs of halons (such as portable fire extinguishers in offices), and develop a plan to recycle or destroy halons (Recycling and Reuse Research).
- Reallocation of Existing Bank of Halons--Develop a conceptual plan for reallocation of the existing bank of halons to essential uses (Anticipatory Research).

### **Proposed Non-Technological Research**

The following socioeconomic research projects are proposed to address the problem of ozone depleting substances:

- Acceptability Testing Plan for New Agents--Develop a consensus plan for acceptability testing of announced new candidate agents.
- Consumer Product Labeling--Assess the effectiveness of labeling consumer products that contribute to ozone depletion. An emphasis of this project would be to allay any confusion created by what seem to be conflicting messages: ozone in the ambient environment is harmful, but in the stratosphere it is good.

### Proposed Technology Transfer/Technical Assistance

The technology transfer plan for addressing the ozone depleting substances problem involves the following activities:

- Research and Product (Deliverable) Targeting--OTTRS technology transfer liaison will monitor deliverable development, attend meetings, and assist the laboratories and the program offices, where necessary, to assure preparation of quality ORD deliverables. OTTRS will also advise the program offices, as needed, on the utilization of the research, information, and other support services.
- Product Development--OTTRS/CERI will support publication of ORD reports based on AEERL's research results.
- Information Dissemination--OTTRS/CERI will advertise the availability of information through its *Technology Transfer Newsletter* and other vehicles reaching the target audiences. OTTRS/CERI will assist in adding the research results to PPIC.
- Evaluation--ORD will assess the effectiveness of the research in achieving its intended results, and initiate any necessary adjustments to the program, products, and their delivery.

### Proposed Outputs

Progress report on properties of chemical replacements for halons	09/91
Publish consensus plan for acceptability testing of announced new candidate agents	09/91
Interim status report on halon recycling	10/91
Report on small-scale testing of perfluorocarbons as potential total flooding fire extinguishants and explosion suppressants	12/91
Advertisement of ORD pollution prevention information products	01/91-94
Update of ORD pollution prevention research results in PPIC	01/91-96
Development, publication, and dissemination of research results	Ongoing
Report on properties of potential halon substitutes such as brominated dimethylfluoroethers	09/92
Progress report on acceptability testing of industry's announced new agents	10/92
Conceptual plan for reallocation of existing bank of halons to essential uses	09/93

Report on large-scale testing of perfluorocarbons and/or brominated dimethylfluoroethers as total flooding agents	12/93
Report on best means for ultimate destruction/conversion of unwanted halons	12/94
Final report on acceptability of industry's announced new agents	04/95
Evaluation of effectiveness of research project	Ongoing

### Participating Offices

Cooperation with the following offices is anticipated:

- OAR/Global Change Division--Collaboration on the technological research efforts.
- OPPE--Collaboration on the socioeconomic research efforts.
- OTTRS--Collaboration on the technology transfer/technical assistance activities.

### Resources

	FY91	FY92	FY93 (\$ thousands)	FY94	FY95
FTEs	0	1	1	1	1
S&E	0	60	60	60	60
R&D	200	250	300	300	150
TOTAL	200	310	360	360	210

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## **OZONE DEPLETING SUBSTANCES—Chlorofluorocarbons (CFCs) and 1,1,1-Trichloroethane**

### **Description**

CFCs and methyl chloroform (MCF or 1,1,1-trichloroethane) are among the substances that are to be phased out as per the Montreal Protocol amendments and the Clean Air Act amendments. CFCs are used in food preservation, space cooling, insulation, and solvents applications. MCF is used primarily as a solvent. The base program in stratospheric ozone protection emphasizes food preservation aspects of refrigeration. A prevention program is needed both to find alternative technologies or chemicals as a long-term solution and to ensure availability of chemicals (e.g., recycling) to allow utilization of existing capital equipment for its useful life.

### **Rationale**

The Montreal Protocol amendments and the House and Senate versions of the Clean Air Act Amendments call for phaseout of the same ozone depleting chemicals. However, the time schedules are different. Further, the current CFCs and many of their replacements (e.g., HCFCs) are also greenhouse gases, and HCFCs could lead to energy penalties and, therefore, greater than necessary generation of carbon dioxide. The percentage of control that could be achieved by add-on controls is not adequate. Therefore, the only approach is one of prevention.

### **Research Needs**

Needs exist in all major areas of pollution prevention including product research, process research, recycling, socioeconomic research, anticipatory research, and technology transfer. Some specific research examples are evaluation of alternative chemicals or technologies that might be used in space cooling of buildings to replace the HCFCs that are intended for the next generation of equipment, assistance to developing countries in determining how they can use their production facilities of banned chemicals to produce chemicals which would be less harmful, evaluation of alternative to MCF, and determination of techniques for evaluating whether Protocol chemicals are contained in products that the U.S. imports or exports.

### **Current Activities**

EPA's Air and Energy Engineering Research Laboratory has developed expertise in refrigeration technology. To date, this has been applied in domestic home refrigeration/freezers. Preliminary work is being done in other refrigeration areas such as space cooling in order to better define the needs. Industry is working on commercializing the HCFCs and some HFCs for space cooling applications; however, HCFCs and some HFCs are generally detrimental to global climate change (e.g., use of HFC-134a in mobile air-conditioning). In the solvents' area, there are several MCF uses for which no current solutions are known. Since this chemical has just been added to the phaseout schedule, little specific work has been done on these applications. It may be possible to utilize a next generation solvent that is being presently evaluated for replacement of CFC-113.

### **Relationship to Sectors Targeted in PPO's Pollution Prevention Strategy**

The ozone-depleting substances research effort will address the industrial, energy, consumer, and government sectors. CFCs are used in refrigeration and air cooling systems, insulation, and solvents applications. Alternative technologies or chemicals are needed for CFCs and MCF to eliminate the use of these ozone-depleting chemicals.

### **Proposed Technological Research**

Space cooling exigencies exist in the areas of chillers, heat pumps, and mobile air-conditioning. Alternative chemicals need to be evaluated as well as alternative technologies and technologies which could be used to assist existing technologies to make them more effective. It is expected that the work would be done partly in-house and partly via extramural efforts. Much work is needed to assist developing countries in their efforts to avoid the problems which we have faced as a result of our prior decisions in the use of CFCs. This work will fall into several categories from process research to technology transfer. Even well-established technologies may have to be adapted to operate in the sphere of the developing country (e.g., climate, operating conditions, maintenance, expertise of operators, quality of manufacturing, support personnel). Developing countries use MCF and even carbon tetrachloride as solvents. They will need help in finding and utilizing alternatives applicable to their situations.

The following technological research projects are proposed to address the chlorofluorocarbons and MCF problem:

- Alternatives to CFCs--Investigate chemicals that can be used as alternatives to CFCs and MCF and evaluate their effectiveness and potential health and environmental impacts (Product Research).
- Technologies to Eliminate Use of CFCs and MCF--Evaluate technologies that could eliminate the use of CFCs and MCF or technologies that could be used to assist existing technologies to make them more effective (Process Research).
- Recycling/Reuse of CFCs and MCF--Research the effectiveness of various incentives for recycling/reuse of CFCs and MCF (Recycling and Reuse Research).

### **Proposed Non-Technological Research**

The following socioeconomic research projects are proposed to address the problem of ozone depleting substances:

- Acceptability Testing Plan for New Agents--Develop a consensus plan for acceptability testing of announced new candidate agents, and prepare a report on acceptability testing of industry's announced new agents.
- Consumer Product Labeling--Assess the effectiveness of labeling consumer products that contribute to ozone depletion. An emphasis of this project would be to allay any confusion created by what seem to be conflicting messages: ozone in the ambient environment is harmful, but in the stratosphere it is good.
- Define Essential Uses--The Clean Air Act amendments require that non-essential uses be learned. These must be defined.

### **Proposed Technology Transfer/Technical Assistance**

The technology transfer plan for addressing the ozone depleting substances problem involves the following activities:

- Research and Product (Deliverable) Targeting--OTTRS technology transfer liaison will monitor deliverable development, attend meetings, and assist the laboratories and the program offices, where necessary, to assure preparation of quality ORD deliverables. OTTRS will also advise the program offices, as needed, on the utilization of the research, information, and other support services.

- Product Development--OTTRS/CERI will support publication of ORD reports based on AEERL's research results.
- Information Dissemination--OTTRS/CERI will advertise the availability of information through its *Technology Transfer Newsletter* and other vehicles reaching the target audiences. OTTRS/CERI will assist in adding the research results to PPIC.
- Evaluation--ORD will assess the effectiveness of the research in achieving its intended results, and initiate any necessary adjustments to the program, products, and their delivery.

### Proposed Outputs

Advertisement of ORD pollution prevention information products	01/91-94
Update of ORD pollution prevention research results in PPIC	01/91-96
Preparation, publication, and dissemination of reports on research results	Ongoing
Evaluation of effectiveness of research project	Ongoing

Additional outputs would be specifically determined after it is known when funds would be made available. Generally, there would be at least one output per work area each year. The outputs would range from research reports on evaluations of alternative concepts to testing of full-scale replacement equipment.

### Participating Offices

Cooperation with the following offices is anticipated:

- OAR/Global Change Division--Collaboration on the technological research efforts.
- OPPE--Collaboration on the socioeconomic research efforts.
- OTTRS/CERI--Collaboration on the technology transfer/technical assistance activities.

Resources

	FY91	FY92	FY93 (\$ thousands)	FY94	FY95
FTEs	0	2	3	3	3
S&E	0	150	300	250	250
R&D	0	500	1000	2000	2000
TOTAL	0	650	1300	2250	2250

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## GREENHOUSE GASES/GLOBAL CLIMATE CHANGE

### Description

The root causes of global warming are anthropogenic emissions of greenhouse gases resulting from the activities of a rapidly expanding global population. Among this set of activities, fossil fuel combustion will account for 50 percent of the problem in the form of CO<sub>2</sub> emissions by the year 2030. Deforestation and biomass combustion will account for approximately 25 percent more of the problem. Methane releases from landfills, pipelines, coal mines, and agricultural/animal husbandry activities will account for 15 percent.

Each of these problem areas is amenable to a partial engineering solution in the form of process and product modification, or material/fuel substitution; biomass fuels can replace fossil fuels while providing an incentive for reforestation; renewable sources of energy such as photovoltaic cells for hydrogen or electricity production can replace fossil fuels; conservation can reduce energy demand; and methane from landfills and coal mines can be recovered and used as a source of energy.

### Rationale

Conservation has been selected using several criteria. The first is that it addresses one of the principle sources of greenhouse gases, and the research benefits are therefore potentially very large. An equally important reason is that there is substantial uncertainty concerning the effects of global warming and a prudent course of action should address areas which have other benefits. If, a decade hence, it is found that the magnitude of the global warming phenomena will not significantly affect human health or the environment, nothing will have been lost if the policies and technologies pursued conserve finite fossil fuel resources or reduce emissions of conventional pollutants. This is the basis for the Administration's "no regrets" policy regarding climate change.

The final consideration is that this area is not being addressed in any substantive fashion by other groups, particularly DOE. DOE does have a substantial program in the area of conservation, but it is focused on the research and development of specific system components. Some important system research for industry has been overlooked. Insufficient attention has been devoted to component/system integration for advanced high efficiency lighting and to outreach programs for lighting practitioners and the user population. Electric motors use two-thirds of all electric power

generated, and each one percent improvement in their efficiency could save 17 billion kWh per year of electric energy. The application of fuzzy logic control for adjustable speed drive motors has not been extensively investigated in this country but is expected to yield large energy savings. Modifications to specific processes and operations in the industrial sector have the potential for large energy savings as do improvements in generic technologies.

Perhaps the overriding impetus for adopting a pollution prevention approach to the above area is that it is the only one which makes economic sense. DOE established some time ago that CO<sub>2</sub> control technologies are unaffordable and will remain so for the foreseeable future. Pollution prevention/conservation is the nearest term and most cost effective approach to reduce energy utilization. In the longer run, the necessary energy can be produced from non-fossil technologies, to the extent practicable.

The growing use of fossil fuels worldwide will not be ultimately sustainable, either from a standpoint of energy availability or environmental acceptability. Solar technology is already making some modest inroads throughout the world in displacing fossil fuel usage. However, the potential environmental benefits of solar technologies warrant a more proactive EPA research emphasis. Within the solar area, the specific area of solar photovoltaic is of substantial import as it relates to the environment. This technology holds the promise of providing two very clean forms of transportable energy, namely electricity and hydrogen. Two key requirements exist for accelerating the progress in application of such technology. One requirement is that an environmental engineering technology transfer program be established that will start to factor the solar choices into everyday pollution control/permitting decisions on new and modified construction. The second requirement is that the research, development, and demonstration of such technology be expanded with a definite joint, proactive involvement from the environmental engineering research community. A responsible prevention research position does not include standing on the sidelines during painfully slow evolution of this highly prevention-oriented technology.

### Research Needs

Three major areas in conservation need to be addressed--commercial and residential lighting, industrial processes, and motors. Although DOE has researched lighting components extensively, research on systems evaluation and testing methods is required, as is the transfer of this information to practical application. Industry-specific research in the areas of membrane separation technology

(a lower cost method than distillation for segregating liquids), recycling, electrification, and construction technology will be pursued, as will the use of fuzzy logic programming to control adjustable speed drive motors for enhanced energy efficiency. Fuzzy logic control applies a set theory and measurement theory which allows control of dynamic systems which are non-linear, too complex, ill-defined, or have data uncertainties which preclude conventional modern binary control.

Since the growing world demand for fossil fuels is known to be unsustainable in the long term, it would be prudent to begin developing viable alternatives. Solar photovoltaic cells have found modest applications, but additional research could allow them to become economic, non-polluting sources of both hydrogen fuel and electricity.

### **Current Activities**

A project to develop methods for testing and evaluating lighting systems using pollution prevention funds has been initiated. The approach includes the identification of those products and technologies that will be the most important in quickly improving lighting efficiency, the evaluation and development of a consistent set of standards to be used to test and evaluate the identified products, and the identification and certification of laboratories which can perform the testing. Generic studies on industrial boilers, process heaters, cogeneration, adjustable speed drive motors, lighting, and recycling have been completed. Application and cost/benefit studies have shown room for significant improvements in these areas. Motors, for example, operate most efficiently at full load, but are usually not required to do so. As a result, average energy losses of 20-25 percent occur. Intelligent control will significantly reduce these losses, but hardware and software development is necessary. In the solar photovoltaic area, the current rate of advance in the crystalline silicon and thin film allow predictions of electricity prices of \$0.020 to \$0.035 per kWh by the turn of the century.

### **Relationship to Sectors Targeted in PPO's Pollution Prevention Strategy**

The pollution prevention research addressing the greenhouse gases/global climate change problem will deal with all sectors with emphasis on the industry, consumer, and energy/transportation sectors. Reduction in fossil energy use is the primary objective. Reduction of carbon dioxide from fossil energy usage is the primary focus, but reductions in use of coal and petroleum result in many other benefits including reduction of volatile organics (ozone non

attainment, air toxics) and PM-10. Conservation-related aspects will focus on the top priority energy use areas (such as electric motors and lighting) where substantial progress can be made in both advancing technology and technology transfer into the environmental regulatory sector. Renewable energy aspects focus on getting use of solar photovoltaic alternatives built into the environmental regulatory structure through technology transfer. This will then allow consideration of offsets or tradeoffs on criteria-pollutant fossil fuel sources. Where solar options can be used, both criteria pollutants and global climate benefits will be achieved.

### **Proposed Technological Research**

The primary emphasis in lighting will be to identify and test systems to determine optimal energy efficiency. The information must then be effectively transferred to the design and construction industry to achieve market penetration. Industrial process research will focus initially on improved membrane separation technology, recycling, and approaches to electrification. Cost effectiveness of each of the improvements will be documented. In developing adjustable speed drive motors the emphasis will focus on fuzzy logic rather than the usual binary system. The energy efficiency of these systems will then be demonstrated.

There are four topics of interest in the solar area. The first is the construction and testing of a high efficiency photovoltaic module (1 to 5 kWh) to determine long-term reliability and performance. The second project would couple the best available commercial photovoltaic module to an electrolyzer for hydrogen production. Thirdly, the potential of a semiconductor septum electrochemical photovoltaic cell for direct production of hydrogen would be investigated. Finally, the potential for encouraging the use of solar technology through various environmental permitting/allowance procedures and technology transfer will be expanded.

Effort needs to be applied to the engineering analysis of a multitude of applications where the solar alternative can be made a preferred or acceptable alternative. Preliminary steps have been taken by DOE's Solar Energy Research Institute to inform potential users of the availability and applications of certain types of photovoltaic products. The basis for a much expanded parallel effort needs to be developed by environmental engineering applications research relevant to many of the permitting and regulatory options the Agency has direct or indirect control of or at least influences. Guidelines and demonstrations need to be developed which will get the information and visibility

down to a regional, state, and local level. Solar choices will not be available as an alternative unless this quantification and familiarization process is given adequate emphasis.

The following technological research projects are proposed to address the greenhouse gases/global climate change problem:

- Performance Testing Procedures--Evaluate, develop, and conduct performance testing procedures for selected efficient lighting components and systems (Product Research).
- Costs and Benefits Analysis for Efficient Lighting Technologies--Determine life cycle costs and evaluate energy and environmental impacts of efficiency lighting technologies (Product Research).
- Solar Hydrogen Production Systems--Construct and develop two solar hydrogen production systems, and evaluate their effectiveness (Product Research).
- Performance Testing of Innovative Motor Control Methodology--Develop a detailed research plan, design and develop a prototype, and conduct laboratory- and full-scale testing of an innovative motor control methodology (Process Research).
- Infrastructure to Support Product Testing and Evaluation--Develop an operational infrastructure to support continued product testing and evaluation of energy efficient technologies (Anticipatory Research).

### **Proposed Non-Technological Research**

The following socioeconomic and institutional research projects are proposed to address the greenhouse gases/global climate change problem:

- Communication of Cumulative Long-Term Risks--Investigate the relative effectiveness of traditional factual messages compared with affective (i.e., emotional) messages containing the same factual content. Two formats will be developed: one to stress health risk and the other to stress ecological risk.
- Motivation of Behavioral Changes Through Messages--Examine how to tailor messages about the effects of global warming to different groups. A particular focus of the research would be how to motivate changes in individual behavior to prevent the generation of greenhouse gases.
- Incentives for Energy Conservation--Examine various incentives to promote energy conservation in both the public and private sectors, as well as the general public.

- Correction of Subsidies for and Damages from Fossil Fuel Use--Develop practical alternative approaches for reducing fossil use by correcting for subsidies for and damages from fossil fuel use.

### Proposed Technology Transfer/Technical Assistance

The technology transfer plan for addressing the greenhouse gases/global climate change problem involves the following activities:

- Research and Product (Deliverable) Targeting--OTTRS will work closely with OEETD to transfer research conservation/pollution prevention information to the energy industry. ORD's technology transfer staff will monitor deliverable development, attend meetings, and advise and assist the laboratories, where necessary, to assure delivery of high quality products.
- Product Development--OTTRS/CERI will assist OEETD in preparing reports and fact sheets relating energy research findings and program direction. OTTRS/CERI will support publication of reports and handbooks resulting from AEERL's research. OEETD will develop an application handbook for the light practitioners and decisionmakers to support continued product testing and evaluation of lighting technology assessment.
- Information Dissemination--OTTRS/CERI will assist OEETD with the preparation and distribution of technology transfer documents derived from ORD research. OTTRS/CERI will promote the availability of the products through its *Technology Transfer Newsletter* and other vehicles. OTTRS will also assist in building an effective outreach program. Working closely with OEETD, OTTRS/CERI will explore the development of a prototype *Energy Efficiency Newsletter* as a regular outreach vehicle and use PPIC to exchange information as it is developed.
- Education/Training--OEETD and OTTRS/CERI will co-sponsor an energy efficient products trade show and conference. In addition, a series of workshops for industrial process and product designers and manufacturers will be held prior to the trade show.
- Technical Assistance--Development of an outreach program to provide a comprehensive organized up-to-date source of research-based technical programs. In addition, OEETD will support development of an operational infrastructure to support continued product testing and evaluation of lighting technologies.
- Evaluation--ORD and PPO will assess the effectiveness of the research in achieving its intended results, and initiate any necessary adjustments to the research program, products, and their delivery. OTTRS will work with the program offices to support evaluation efforts.

### Proposed Outputs

Advertisement of ORD pollution prevention information products	01/91-94
Update of ORD pollution prevention research results in PPIC	01/91-96

## POLLUTION PREVENTION RESEARCH STRATEGIC PLAN

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Report on small-scale testing and development of recommended prototype designs for two solar hydrogen production processes	09/91
Report on the conceptual design, cost, and evaluation of a high efficiency photovoltaic module	09/91
Final report on performance and reliability of high efficiency photovoltaic module	09/93
Handbook for light practitioners and decisionmakers	09/94
Final report on cost, performance, and reliability of two solar hydrogen production systems	09/95
Evaluation of effectiveness of research project	Ongoing

### Participating Offices

Cooperation with the following offices is anticipated:

- QAR--Collaboration to support the utilization and application of high efficiency motors and adjustable speed drivers.
- OPPE--Collaboration to develop and evaluate policy strategies considering the potential impacts (costs and benefits) of utilizing energy-efficient lighting and motor drive technologies.
- OTTRS/CERI--Collaboration on all technology transfer and technical assistance activities.

### Resources

	FY91	FY92	FY93 (\$ thousands)	FY94	FY95
FTEs	0	2	2	2	2
S&E	0	150	150	150	150
R&D	0	500	1000	1000	1000
TOTAL	0	650	1150	1150	1150

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## **TOXIC AIR POLLUTANTS**

### **Description**

Hundreds of toxic air pollutants are emitted to the atmosphere in large quantities from thousands of sources throughout the United States. The Clean Air Act mandates the establishment of National Emissions Standards for hazardous air pollutants. The new Clean Air Act Amendments (CAAA) of 1989 specify 191 pollutants or pollutant categories whose emissions to the environment must be curtailed on a stringent schedule, and the Administrator of EPA has singled out 17 air toxics for accelerated research and regulatory attention. Reducing the emissions of toxic air pollutants is one of the most difficult problems with which the U.S. Environmental Protection Agency has had to deal because there is a large number of pollutants emitted from a myriad of sources, some of which are very small. However, when taken collectively, the many small sources contribute to a serious and worsening air toxics problem in the U.S. Reduction of emissions of toxic air pollutants through prevention and control approaches is a key component of the strategy to reduce human exposure and subsequently the adverse effects of these pollutants.

The primary objective of this project is to assess existing methods for reducing these emissions and to develop innovative techniques for preventing the formation and/or release of the pollutants to the atmosphere. Stationary sources are a major focus of prevention research since these sources are large emitters of toxic air pollutants. In particular, emissions from methyl chloroform usage, paint stripping, and woodstoves will be reduced via demonstration of pollution prevention options. The importance of this work is further emphasized by the fact that these same sources may be contributing to other global problems, such as global warming, stratospheric ozone depletion, rising tropospheric ozone concentrations, and multimedia effects.

### **Rationale**

According to the Agency's latest figures from the Toxics Release Inventory, more than 2.4 billion pounds of toxic chemicals were released into the air in 1988. The emissions to the air constituted more than 50 percent of total emissions to all environmental media. Emissions in 1989 and 1990 are expected to be at approximately the same levels. Reductions in toxic pollutant emissions have not been achieved because of the absence of regulatory incentives, the difficulty of dealing with the many and varied sources of air toxics, and the frequently failure of existing control

technologies on large point sources to achieve the degree of control required for each source. It is essential that a strategy combining the best efforts of a pollution prevention approach and the use of control techniques as necessary be implemented to achieve the necessary reductions of emissions. Add-on control devices are not likely to be effective nor economical small, widely-distributed sources such as woodstoves and paint stripping operations. Hence, innovative pollution prevention options are needed to achieve significant emission reductions. The successful application of pollution prevention techniques and control technology, as needed, will help to significantly reduce air toxic emissions.

### **Research Needs**

Research needs include the development and demonstration of innovative prevention approaches involving changes in the formulation, application, and commercial/consumer usage of products and materials containing or emitting air toxics. Research is needed to characterize and demonstrate the efficacy of these changes. There is a need to reduce emissions on a compound-specific basis as required by the CAAA of 1989. Hence, a top-down analysis to identify end-uses of air toxics, including inorganic materials and organic solvents, is needed in order to identify those which are amenable to reduction via pollution prevention. Subsequent research is needed to identify viable techniques to reduce these emissions. Existing and planned pollution prevention programs in AEERL will include a focus on the list of 17 Toxics Release Inventory (TRI) chemicals highlighted by the Administrator. To do so, AEERL will apply prevention R&D approaches which have proven successful in other programs and will actively seek new, innovative prevention approaches for reducing the emissions of these and other pollutants. Sources will be identified and ranked in priority order for assessment and for the application and demonstration of prevention approaches. Current prevention options being considered include: (1) the development of substitutes for chemical raw materials and products; (2) the modification of manufacturing, production, handling, and storage processes and procedures; (3) a capture and recycle/reuse; (4) automated solvent management; and (5) the elimination of the need for products which cause emissions in their manufacture, use, and disposal.

AEERL will also apply the prevention R&D know-how gained in the highly successful effort underway on CFCs to the problem of eliminating the top OAR-targeted chlorinated organic air toxics. Means for source reduction and recycle will be focused on these targeted compounds, including trichloroethylene, chloroform, and methylene chloride. All sources will be screened and

ranked for priority setting, including degreasing, dry cleaning, surface preparation, solvent applications, and consumer products. Some of the prevention options are: (1) eliminating the need, (2) chemical/product substitutes, (3) process modifications/control, (4) high-capture recycle, and (5) computerized solvent management. In the substitutes area, emphasis will be placed on alternative agents found naturally in the environment, e.g., supercritical CO<sub>2</sub>. As a starting point, the body of existing information on prevention related to these compounds (such as recent work by OAQPS, other Program Offices, and the Source Reduction Research Partnership) will be analyzed thoroughly, along with the latest information on developments in the AEERL CFC and VOC prevention programs. Information and data need to be transferred in an efficient manner to potential users in the public and private sectors.

### Current Activities

AEERL has an impressive history of evaluating and developing prevention options and technologies for controlling toxic air pollutants, VOCs, and other pollutants. Significant research in the areas continues. Current activities include research in both emissions prevention and control. In both areas, the research is focusing on the enhancement of existing approaches and the development of new, innovative approaches. The research program also includes a strong technology transfer component through the Control Technology Center (CTC). Current planning to aid Agency regulators in the implementation of the CAAA of 1989, Title III-Air Toxics, will permit flexibility in organic and inorganic emissions reduction objectives, a research program balanced between prevention and control, and an enhanced ability to provide technical support in the prevention area.

AEERL's current prevention activity for emissions of toxic air pollutants has focused on co-control of air toxics and VOCs from coatings and consumer products. Cooperative coatings research continues with the Department of Defense. During 1989, AEERL and OAQPS co-sponsored a symposium addressing the regulation of consumer products. Studies of emissions and emission reduction options for aerosol products, small engines, and charcoal lighter fluid are essentially complete. Research in alternative coatings and consumer products will be continued in the FY91-92 2% Set-Aside Pollution Prevention Project, "Demonstration of Emerging Area-Source Prevention Options for Volatile Organics," which is included in the 5-year research plan for Ozone Non-Attainment. The active relationship between this research project and the list of 17 chemicals designated by the Administrator is shown in Exhibit 13.

**EXHIBIT 13**  
**LIST OF 17 TRI CHEMICALS: COORDINATION WITH**  
**"DEMONSTRATION OF EMERGING AREA SOURCE**  
**PREVENTION OPTIONS FOR VOLATILE ORGANICS"**

TRI Chemical	Coatings	Evaluation of		Auto	Evaluation of			Inerts
		Coat-Free	Wood		Methods	Options	Aerosol	
Chromium	NF	L						
Trichloroethylene	S	+/-		S	S	S	NF	S
Tetrachloroethylene	S	+/-		S	S	S	NF	S
Chloroform	S	S		S	S	S	NF	S
1,1,1-Trichloroethane	S	S		S	S	S	NF	S
Cadmium	NF	L						
Methylene Chloride	S	+/-		S	S	S	NF	S
Cyanide		+/-						
Lead	NF	L						
Mercury	NF	L						
Nickel								
Carbon Tetrachloride	S	+/-		S	S	S		S
Methyl Isobutyl Ketone	L	L	L	L	L	L	L	L
Methyl Ethyl Ketone	L	+/-	L	L	L	L	L	L
Toluene	L	L	L	L	L	L	L	L
Benzene	S	S	S	S	S	S	S	S
Xylenes	L	L	L	L	L	L	L	L

**Key:**

- L** = Direct, significant impact on emissions
- S** = Direct, small impact on emissions
- NF** = Not a project focus, could decrease emissions
- +/-** = Could increase or decrease emissions

Research to complement the pollution prevention efforts is continuing through the development of innovative controls. For example, corona destruction, a promising technology for control of low concentration organic emission streams, is undergoing evaluation at the bench and semi-pilot scales. Research to reduce air toxic emissions from woodstoves continues. Innovative woodstove and woodstove catalyst designs are being investigated.

The enhancement of existing controls (e.g., carbon adsorption and catalytic incineration) is also an active area. Ongoing efforts at the University of Texas will enhance modeling techniques for carbon adsorption, providing a tool for improved adsorber design and operation. Xylene, one of the 190 CAAA air toxics, will be used as a surrogate material in this study. Cooperative research with the University of Akron and the U.S. Air Force has identified several potential catalyst systems for the destruction of halogenated hydrocarbons.

Of critical importance is the evaluation of the effectiveness of controls as operated in industry. If, as suspected, the controls are not operated effectively, resulting in poor control efficiency, then research will be undertaken to identify and recommend special permit conditions to regulators, to provide guidance to industry, and to improve the overall effectiveness of existing control technology designs.

### **Relationship to Sectors Targeted in PPO's Pollution Prevention Strategy**

The pollution prevention research addressing toxic air pollutants will focus primarily on the industry and consumer sectors; to a limited extent the agricultural sector is also addressed. Focus will be on dealing with reductions in organic and inorganic toxics. Special emphasis will be given to fugitive sources of air toxics such as chlorinated solvents usage in such applications as solvent degreasers, dry cleaning (methyl chloroform included as a stratospheric ozone depletor). Emphasis will also cover SOCMF facilities and transportation, fuel handling, and storage. Also included are toxic organic aerosols responsible for PM-10 problems. Novel biomass combustion technologies and other prevention means for dealing with biomass smoke will be addressed. Worldwide, biomass smoke increases tropospheric ozone, contributing to global warming.

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### **Proposed Technological Research**

The proposed technological research includes the following product and process research initiatives:

- **Evaluate Use of Products Emitting Air Toxics**--Evaluate the usage of potential air toxic emitting products via a top-down analysis of the marketplace as requested by OAQPS, thereby identifying possible unmitigated sources of inorganic and organic toxic emissions (Product Research).
- **Identify Methods of Reducing Emissions**--Perform research to identify methods of reducing emissions from those sources creating the greatest health and welfare risks (Process Research).
- **Evaluate Improved Techniques that Eliminate the Use of Toxic Solvents**--Perform research to identify methods of eliminating methyl chloroform usage and of improving paint stripping techniques without increasing the use of substitute solvents and other materials which are a potential hazard to the air and other media (Product and Process Research).
- **Develop Low-Emission Woodstoves**--Develop low-emission woodstoves whose emissions are intrinsically less toxic than current emissions and whose operation is more reliable than traditional woodstoves (Product and Process Research).
- **Coordinate Process Research with RREL**--Establish coordination with RREL to provide AEERL's expertise in air issues to enhance pollution prevention process research and to participate in future industry evaluations, as appropriate (Process Research).
- **Evaluate Air Emissions from Alternative Fuels**--Evaluate the impact on air toxic emissions resulting from alternative fuels marketing and provide research to identify methods to prevent emissions or to improve control devices and operating procedures, as appropriate (Anticipatory and Process Research).

### **Proposed Non-Technological Research**

The following socioeconomic and institutional research efforts are proposed to address the toxic air pollutants problem:

- **Incentives for Use of Clean Fuels**--Assess the effectiveness of various incentives for the use of clean fuel alternatives. Particular emphasis will be placed on the design of the message in reaching different audiences.
- **Non-Toxic Substitutes**--Provide subsidy incentives for R&D on non-toxic substitutes for products emitting toxic air pollutants. This study will also evaluate the effectiveness of these incentives.

- Evaluate Pollution Prevention Measures--Collect and analyze data on the degree to which firms have responded to their own TRI information by instituting their own pollution prevention measures.

### Proposed Technology Transfer/Technical Assistance

The technology transfer plan to address the toxic air pollutants problem includes the following activities:

- Research and Product (Deliverable) Targeting--OTTRS staff will monitor deliverable development, attend meetings, and assist the laboratories and the program offices, where necessary, to assure quality ORD deliverables. OTTRS will also advise program office staff on the utilization of research, information, and other support services.
- Product Development--OTTRS/CERI will assist with the preparation and publication of research results, guidebooks, etc.
- Information Dissemination--OTTRS/CERI will advertise the availability of ORD information through its *Technology Transfer Newsletter* and other vehicles reaching the target audiences.
- Education/Training--Workshops will be conducted to inform EPA, state, and local government staff, as well as industry, of the research results.
- Technical Assistance--Provide technology transfer to state and local environmental officials small businesses, and researchers through workshops and the use of the Control Technology Center (CTC), the small business clearinghouse as proposed in the Clean Air Act Amendments, and PPIC.
- Evaluation--OTTRS will assist OEETD in assessing the effectiveness of the research in achieving its intended goals and initiate any necessary adjustments to the program, products, and their delivery.

### Proposed Outputs

Top-down reduction of inorganic and organic air toxics

- Opportunity Analysis 09/91
- Annual Report on Toxics Reduction 09/92, 93, 94, 95

Methyl chloroform substitution

- Annual Report 09/92, 93, 94, 95

Improved paint stripping techniques report

09/95

Novel biomass technologies to substitute  
for woodstoves

09/95

Coordination with RREL to include air issues in pollution prevention analyses

- |   |                   |
|---|-------------------|
| - Air included in Methodology           | 09/91             |
| - Annual Report on Industry Evaluations | 09/92, 93, 94, 95 |

Prevention in alternative fuels marketing

- |                 |           |
|-----------------|-----------|
| - Annual Report | 09/93, 94 |
|-----------------|-----------|

Advertisement of ORD pollution prevention research information products

01/91-94

Update of ORD pollution prevention research results in PPIC

01/91-96

Conduct workshops for training and information dissemination

As Needed

Evaluation of effectiveness of research project

Ongoing

Complete preliminary analysis of the viability of the corona destruction process at semi-pilot scale

09/91

### **Participating Offices**

Cooperation with the following offices is anticipated:

- ORD/RREL--Maintenance of close communication to provide air expertise to support current and future RREL pollution prevention process research.
- OAR/OAOPS--Collaboration to obtain feedback on the direction of the top-down toxics reduction project.
- OPPE--Coordination of the socioeconomic research efforts.
- OTTRS/CERI--Collaboration on all of the technology transfer and technical assistance activities.



POLLUTION PREVENTION RESEARCH STRATEGIC PLAN

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**Resources**

	FY91	FY92	FY93 (\$ thousands)	FY94	FY95
FTEs	0	2	3	3	3
S&E	0	150	250	250	250
R&D	300	900	1000	1200	1300
TOTAL	300	1050	1250	1450	1550

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## PESTICIDES APPLICATION

### Description

About 1.1 billion pounds of conventional active pesticide ingredients are used in the United States per year. Active ingredients in production number 850. About 75 percent of pesticide usage is in the agricultural sector, 18 percent in the industrial, commercial, and government sectors, and 7 percent in homes and gardens. Pesticides present a health risk to applicators and farmworkers, and to the general public through the food supply, and contamination of surface and groundwater. A pesticide (herbicide, insecticide, fungicide, and rodenticide) by its very nature is toxic to some organisms and thus can cause significant adverse human health problems and/or ecological damage. EPA's *Unfinished Business* report ranks pesticide risks in the highest category as compared with other environmental issues.

### Rationale

Pollution prevention offers a major opportunity to reduce the environmental risk of pesticides in three general areas: manufacturing of the raw product, formulation and packaging of the pesticide products, and application of the end-use products. At the manufacturing and formulation/packaging level, pollution prevention through reuse of liquids and solid streams would greatly minimize the amount of pesticide active ingredient, diluents, and carrier agents discharged to wastewater treatment plants. Wash-downs are critical for the formulators/packagers as a means of avoiding contaminating one product with residue from a previous batch. Reuse of these rinsates is one potential cost effective method to reduce discharges.

Reformulation of the pesticide to reduce its overall environmental risk, and to allow for more easily cleaned containers and equipment is a potential pollution prevention possibility. However, this approach is impeded by the cost and time a manufacturer encounters in having his product registered by EPA.

In the end-use applications industries (farmers, crop dusters, and lawn care professionals), pollution prevention can be accomplished through rinsate minimization and through the use of reusable and/or refillable and/or recyclable containers. At the home and garden use level, pollution prevention includes the proper disposal of unwanted pesticides and their containers.

### Research Needs

At the manufacturing level research and development is needed on new formulations that are less toxic and persistent, recycling/reuse in the manufacturing process, and waste reduction to minimize discharges.

In the pesticide formulation and packaging industries, research needs include investigating equipment rinsing practices to reuse as much water or solvents as possible and to minimize the volume of wastewater to be treated, and using reusable containers which could be returned to the manufacturer.

In the applications industry, research into container design to allow for closed applications systems, more efficient rinsing procedures to reduce the volume of rinsate, and using reusable and/or refillable and/or recyclable containers are necessary.

### Current Activities

In the pesticide manufacturing industry, research for the Office of Water Regulation and Support has focused on treatment of the final effluent. The ORD base program has not focused on pollution prevention to date because the primary purpose of this program is to collect data for regulatory support in the establishment of effluent guidelines for this industry.

In the pesticide formulating and packaging industry, an emphasis similar to the pesticide manufacturing industry has occurred. Current plans call for study of this industry during FY91, and pollution prevention strategies could be employed during these studies in addition to the collection of data for effluent guideline determinations.

Much work has been conducted in the applications industries by OPP as mandated by FIFRA 1988. The primary focus of OPP's work has been container design with a goal of reusable/refillable or recyclable containers. ORD has investigated rinsing procedures to minimize the volume of rinsates and maximize the effectiveness of the cleaning containers.

No ORD research has occurred in pollution prevention aimed at the small user (small farmers home, and garden). The base program does have a series of small projects aimed a

disposal/treatment of unwanted pesticide left in the container and rinsates resulting from cleaning those containers.

### **Proposed Technological Research**

The formulation of new pesticides should not be the function of EPA ORD. The Agency should encourage industry to do this. However, ORD should play an active role in working with industry to determine the toxicity, transport and transformation in the environment of new pesticides, and/or formulations to ensure that these products and possible degradation products are less toxic and less persistent than currently used products in natural waters, soils, and sediments. ORD should take an active role in working with industry to minimize the volume and toxicity of the wastewater. An evaluation of the current manufacturing processes should be made and opportunities for process design changes, and recycle/reuse of rinse waters to reduce wastewater volume should be identified.

In the formulation/packaging industries, ORD should work in the short term on better cleaning methods (e.g., high pressure and low volume rinsing, solvent rinsing with recycle) to reduce rinsates, and on reuse of off-specification formulations.

In the applications industries, ORD research should also be focused on reducing the volume of rinsates through better rinsing procedures, developing better methods of equipment washdown and reuse of these waters. ORD research should also assist OPP and the industry in container design. OPP and ORD should work closely with USDA in research on new methods of integrated pest management to minimize the volume and diversity of pesticides used in the agriculture.

For the small-scale farmer and home and garden end-users of pesticides, ORD pollution prevention research should focus on how to collect and reuse unwanted pesticides rather than the common practice of throwing the product and container away. Research with OPP on container design to encourage reusable and/or refillable and/or recyclable containers for the retail markets should also be conducted.

The following technological research initiatives are proposed to address the pesticides application problem:

- Container Design Modifications--Evaluate alternative container designs to assist in cleaning and/or reuse (Product Research).
- Transport and Transformation Studies--Perform transport and transformation studies of new or alternative pesticides and formulations in the aquatic and soil environments (Product Research).
- Pesticide Manufacturing Process Modifications--Evaluate pesticide manufacturing to determine opportunities to institute process modifications and reuse on in-plant waters to reduce discharges (Process Research).
- Demonstration of Process Modification--Demonstrate a process modification at a selected pesticide manufacturer (Process Research).
- Rinsing Practices--Conduct a study and demonstrate rinsing practices to minimize discharges (Recycling and Reuse Research).
- Recycling Methods for Dry Product Containers--Investigate recycling methods for dry product containers for pesticides (Recycling and Reuse Research).
- Reuse of Pesticide Products and Containers--Study the collection and reuse potential of unwanted pesticides and containers (Recycling and Reuse Research).

### **Proposed Non-Technological Research**

The following socioeconomic and institutional research initiatives are proposed to address the pesticides application problem:

- Effectiveness of Product Labeling--Investigate how to improve the pollution prevention effectiveness of pesticide labels, both for professional applicators and for household users. This research would include a component on training for farmers, and especially migrant workers who may lack English reading skills.
- Pesticides Right-to-Know Program--Evaluate the feasibility and potential effectiveness of a pesticides right-to-know program and whether or not it would result in more responsible use and disposal of pesticides or a reduction in use.
- Incentives for Integrated Pest Management--Investigate various incentives that could be effective in motivating the use of integrated pest management and low input sustainable agriculture. This study will also evaluate other USDA incentives.

### Technology Transfer/Technical Assistance

The technology transfer plan to address the pesticides application problem includes the following activities:

- Research and Product Targeting--Working closely with USDA and manufacturing association representatives, OEETD will use a work group structure to assist in the targeting of the research projects. Strong interaction will be necessary to assure the benefits of shared information. An informal activity assessment layer will be added to the work group. OTTRS/CERI will monitor product development and provide support to the laboratories and program offices, as needed, to assure delivery of quality ORD products.
- Product Development--OTTRS/CERI will be responsible for production of two capsule reports (manufacturer and end user) and several fact sheets transferring RREL's research results to the targeted audiences. Two demonstrations (process modification and rinsing practices) are planned for 1993. The reports and fact sheets will be presented to regional staff for their delivery to chemical and container manufacturers in their areas.
- Information Dissemination--OTTRS/CERI will distribute the reports. Questions that arise will be directed to PPIC. Technology articles will be sponsored in chemical manufacturing journals and other targeted newsletters. OEETD will prepare a data base for use on the PPIC bulletin board and develop promotional material to advertise its use.
- Education/Training--OTTRS/CERI will assist OEETD in exhibiting the methods and techniques identified through their research activities at selected industrial trade shows and conferences.
- Evaluation--ORD and PPO will assess whether or not the ORD research and its presentation achieved the desired results, and initiate any necessary adjustments to the research program.

### Proposed Outputs

Evaluation of pesticide manufacturing to determine opportunities to institute process modifications and reuse on in-plant waters to reduce discharges	02/92
Demonstration of a process modification at a pesticide manufacturer	05/93
Conduct of a study on rinsing practices to minimize discharges	09/92
Advertisement of ORD pollution presentation information products	01/91-94
Update of ORD pollution prevention research results in PPIC	01/91-96
Demonstration of rinsing practices	09/93

## POLLUTION PREVENTION RESEARCH STRATEGIC PLAN

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Evaluation of container design to assist in cleaning and/or reuse	06/92
Evaluation of ways to collect and reuse unwanted pesticides and containers	11/93
Investigation of recycling methods for dry product containers	09/92
Study of collection and reuse potential of unwanted pesticide products and containers	09/92
Training of farmers on pesticide use, reuse, and disposal	As Needed
Evaluation of effectiveness of the research projects	Ongoing
Transport and transformation studies of new or alternative pesticides and formulations in the aquatic and soil environment	06/93

### Participating Offices

Coordination with the following offices/agencies is anticipated:

- OPTS/OPP--Collaboration on certain technological research efforts.
- ERL-Athens--Collaboration on the transport and transformation project.
- OPPE/PPO--Collaboration on the socioeconomic research initiatives.
- OTTRS/CERI--Collaboration on all the technology transfer and technical assistance activities.
- USDA--Coordination of specific projects and possible co-funding.

### Resources

	FY91	FY92	FY93 (\$ thousands)	FY94	FY95
FTEs	0	3	4	5	5
S&E	0	200	300	350	350
R&D	0	750	1000	1200	1200
TOTAL*	0	950	1300	1550	1550

\*Approximately 25 percent of the effort would be through in-house research at RREL and ERL-Athens.

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## NONPOINT SOURCE WATER DISCHARGES

### Description

Nonpoint discharges are the largest contributing source type to pollution of surface waters. They are responsible for 96 percent of the sediment, 79 percent of the nitrogen, 74 percent of the phosphorus, 41 percent of the BOD and similarly high fraction of many toxic pollutants. Agriculture is the major nonpoint source. It is estimated between 68 and 83 percent of the nonpoint source loadings of the four conventional pollutants listed above come from agriculture. In some specific areas urban runoff, silviculture, mining, construction, etc. may also be major elements of the non-point source problem. Urban runoff is, for example, the only largely uncontrolled water pollution source from municipalities.

The United States Department of Agriculture (USDA) has had a long standing program on trying to reduce nonpoint discharges from agriculture. This includes programs on erosion control, pesticide and fertilizer management, and farming practices. USDA has developed many approaches and methods to achieve reductions, but has relied on voluntary participation by farmers and offered technical assistance, subsidies, cost sharing, and other inducements to implement their programs. EPA's role in this area is probably more in the line of national policy and regulations, and not research.

One area that ORD can play an important role is urban wet weather runoff. The importance of the pollution problems from urban discharges has been emphasized by Section 405 of the WQA of 1987 which requires permitting of runoff from large and medium-sized communities by 1992. Pollutants in urban runoff include particulates (including floatables), oxygen demanding materials, nutrients, toxic metals and organics, and pathogenic microorganisms.

### Rationale

The two approaches to controlling urban runoff have been collection of the runoff followed by treatment and the pollution prevention approach of best management practices (BMP) to prevent the contamination of the runoff. BMP encompass a wide range of low capital cost methods that reduce pollution at the source, which can be used in developed areas and incorporated into areas being developed. Because of the diffuse and stochastic nature of the rainfall causing urban runoff, use of

the low capital cost and easily implemented, regulated, and maintained pollution prevention methods has a strong potential for providing control at lower overall total cost than end-of-the-pipe treatment methods. Urban runoff may have a greater risk factor because of its association with greater sources of toxic material in and around urban areas and the higher population density.

### **Research Needs**

Urban runoff has not been thoroughly characterized, especially with respect to toxic materials. Although some urban watersheds were studied in the 1960s and 1970s, these studies concentrated on the conventional pollutants. Further data on the magnitude and source of toxic substances are needed. Based on this information, a pollution prevention approach to the most critical problems can be formulated.

Some research has been conducted on BMP for urban areas and some of the available information from agricultural areas is applicable to urban areas. The available information needs to be collected and made available in the form of a guidance document. This same information can be used to identify any research gaps.

Further development of BMP for specific urban settings are required. Major sources of toxic pollutants such as industrial sites, commercial areas, airports, maintenance areas, and spill prone areas need to be targeted for early BMP development.

### **Current Activities**

Although a number of management practices to pollution prevention were evaluated in the 1970s and early 1980s under the EPA Storm and Combined Sewer Program, none are being studied currently. Applicable BMP data from these earlier studies will serve as a foundation for any new research efforts. Some data are being collected on toxics in urban runoff.

### **Proposed Technological Research**

To guide the application of the best management practices, major sources of urban runoff pollution will be identified and quantified. These sources will include conventional urban areas, industrial sites, and environmental modifications, such as construction, which can create serious

temporary deleterious effects. The primary sources of this information will be literature produced by EPA and recent U.S. and foreign literature which will be collected and analyzed. Based on this review, data gaps will be identified and specific urban problem areas will be selected for further evaluation. A number of sites will be selected for urban runoff monitoring that will fill the data gaps.

The above literature review will also be used to establish the state-of-the-art of BMP for pollution prevention of urban runoff. With the available data a BMP guidance document will be prepared for EPA Regional, state, and local government use. In addition, the review will serve to identify problems that require further BMP development.

Evaluations and demonstrations of low capital cost BMP methods will be conducted for those methods with inadequate performance and cost data.

Appropriate rainfall runoff models will be modified to include toxic metals and organic compounds and results on the effectiveness of BMP. Using these models, calculations will be made of the pollution prevention effectiveness of BMP on a number of receiving waters in urban areas.

It should be realized that other pollution prevention programs within this strategy will have significant impacts on urban runoff. These include programs on lawn care products (fertilizer and pesticides), used oil recycle, gasoline spillage, and consumer trash.

The following technological research initiatives are proposed to address the nonpoint source water discharges problem:

- **Best Management Practices**--Identify, demonstrate, and evaluate best management practices to prevent or reduce nonpoint source water discharges (Process Research).
- **Urban Pollution Sources**--Identify and evaluate existing urban nonpoint pollution sources, and predict new sources that pose future threats (Anticipatory Research).

### **Proposed Non-Technological Research**

The following socioeconomic and institutional research initiatives are proposed to address the nonpoint source water discharges problem:

- **Institutional Practices to Control Urban Water Quality**--Provide guidance to regional, state, and local governments on institutional practices to control urban water quality.
- **Incentives for Reducing Nonpoint Source Runoff**--Evaluate the use of various incentives employed by USDA to reduce nonpoint source pollution.
- **Price Effects on Fertilizer Use**--Assess the impact of higher prices on the use of fertilizer by homeowners and farmers.
- **Regulation of Land Use**--Investigate the impact of supporting state and local efforts to regulate land use and the impact of these efforts on reducing nonpoint source water discharges.

### **Proposed Technology Transfer/Technical Assistance**

The technology transfer plan to address the nonpoint source water discharges problem includes the following activities:

- **Research and Product Targeting**--Strong interaction with OWEP and OWRS is planned. Representatives of these offices will be invited to a presentation of Best Management Practices (BMP) research and interim findings. An informal activity assessment layer will be added to the process. ORD headquarters technology transfer liaison will monitor product development and provide the laboratories and program offices advice and assistance, where necessary, to assure quality ORD deliverables. Assistance will also be provided to the program offices to further the use of ORD research, information, and support services.
- **Product Development**--OTTRS/CERI will be responsible for report and manual production of RREL's research results. A decisionmaker's guide format will be used for the BMP guidance document. Three of the four reports will be printed in large numbers to meet the client demand. Project summaries will also be prepared and distributed.
- **Information Dissemination**--OW, OEETD/RREL, and OTTRS/CERI will conduct workshops for state and regional staff, provide experts to respond to questions arising from the research program, promote the availability of products, and build an effective outreach program with ORD information. Working with OWEP and OWRS, OTTRS/CERI will prepare a BMP data base for use on an electronic bulletin board, and prepare an expert system software tool for the regions and states to distribute.
- **Education/Training**--A series of geographically targeted workshops with field demonstration sites will be conducted by OTTRS/CERI for regional and state staff.

- Technical Assistance/Demonstration--Technical assistance will be supplied through the program office staff. RREL will look at opportunities to use ongoing state and federal BMP sites to evaluate successes and set up other site demonstrations as needed. USDA, Soil Conservation Service, Water Resources Institutes, and selected municipalities would be looked at as cooperators in this part of the plan. Successes will be captured and packaged to stimulate the use of BMPs among the target audiences.
- Evaluation--ORD will assess whether or not the ORD research and its presentation achieved the intended goals, and initiate any necessary adjustments to the research program.

### Proposed Outputs

Report summarizing major urban pollution sources	06/92
Urban runoff BMP guidance document	11/92
BMP evaluation and demonstration reports	09/93-95
Guidance on institutional practices to control urban water quality	06/94
Advertisement of ORD pollution prevention research information products	01/91-94
Update of ORD pollution prevention research results in PPIC	01/91-96
Publication and dissemination of ORD reports	Ongoing
Evaluation of effectiveness of research projects	Ongoing

### Participating Offices

Coordination with the following offices is anticipated:

- OEPER/ERL-Athens--Collaboration on technological projects, particularly those involving risk assessment and modeling.
- QW--Collaboration on technological projects.
- Regions--Provide advice on specific urban runoff problems, evaluation in site selection, and technology transfer.
- OTTRS/CERI--Collaboration on all technology transfer and technical assistance activities.
- OPPE--Collaboration on the socioeconomic and institutional research initiatives.

**Resources**

	FY91	FY92	FY93 (\$ thousands)	FY94	FY95
FTEs	2	3	3	3	2
S&E	140	210	210	210	150
R&D	300	700	800	500	400
TOTAL	440	910	1010	710	550

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## **HAZARDOUS WASTE**

### **Description**

The mining, manufacturing, use, and disposal of materials and products produce a vast number of undesirable substances that are considered toxic and hazardous. These substances, consisting of both organic and inorganic material, which are associated with industrial processes are the subject of this project.

In 1985 the amount of hazardous liquid and solid waste totaled about 275 million metric tons. A 1987 Chemical Manufacturers Association hazardous waste survey of 552 plants gives some idea of the current disposal practices. The study revealed that 218 million tons of hazardous waste were generated, of which 96.7 percent was in the form of industrial wastewater. The wastewater was managed as follows: 90.5 percent was treated in a NPDES approved facility, POWT, or otherwise treated, and the remaining was injected. The solid waste was managed as follows: 77.2 percent was recycled (includes material reclamation/reuse/recovery and energy recovery); 8 percent was incinerated; 2.6 percent was treated; 0.3 percent was underground injected; 4.1 percent landfilled; 6.5 percent disposed in surface impoundments; and 0.5 percent placed in waste piles. Similar information on air releases was not collected.

Even through a significant volume of solid waste is recycled, opportunity to further reduce the volume and toxicity of hazardous waste as part of a pollution prevention program is large. An even greater opportunity is available in the wastewater area.

### **Rationale**

A number of analyses indicate that the amounts of waste currently generated could be substantially reduced through changes in raw materials, production processes, and products. The Office of Technology Assessment (OTA) concluded that a reasonable goal would be to reduce the generation of all types of hazardous waste entering all media by 10 percent each year for five years. The existing approach of end-of-the-pipeline treatment has many limitations in effectiveness and cost. As discharge limits are reduced to meet new health and environmental risk levels, costs increase at an accelerated rate and technology capabilities are pressed. It is becoming increasingly apparent that the approach to pollution control based on prevention is preferable to those based upon treatment.

and disposal, and that research and development can play a significant role in accomplishing this goal.

### Research Needs

Almost all industries could benefit in their pollution prevention activities by research. Because of EPA's limited research budget, its efforts must be focused on activities that can make significant inroads into accelerating the implementation of pollution prevention activities. Four approaches can be taken: 1) activities that can assist a wide variety of industries (e.g., guidance on waste audits and waste minimization opportunity assessments); 2) activities that are directed at the largest producers of hazardous waste; 3) activities that are directed at significant pollution problems (e.g., heavy metals or solvents); and 4) activities directed at small generators who do not have the resources to conduct their own research. One of the major research needs at this time is to identify and prioritize those areas where EPA should focus its activities. Although data exists on hazardous waste generation, no effort has been made to determine if it is sufficient to make programmatic research decisions.

Methods and procedures for accurate evaluation of pollution prevention need to be developed. Studies need to be conducted in a number of generic industries to determine what second and third order effects need to be considered in order to arrive at adequate data from which recommendations for process changes can be made. Parametric study data is also needed to determine relative sensitivity of pollution prevention effectiveness to various categories of activity, such as energy use. Studies are required to provide a tool for indexing or providing a basis of comparison among pollution prevention options that consist of sets of differing hazardous waste constituents with varying concentrations, and toxicities that are present in different media.

An informational network via regions, states, trade associations, international organizations, other government agencies, and industry is needed to provide information on the technologies planned or implemented on pollution prevention.

Research is needed in model integrated pollution prevention industrial systems that eliminate or greatly reduce hazardous waste from the acquisition of raw material through manufacture, product use, and final disposal.



Research is needed to evaluate and demonstrate pollution prevention methods, technologies, and systems. Industries should be selected on the basis that the results will be applicable throughout their industrial sector, attack a major hazardous/toxic material, and/or are a major source of pollutant.

### **Current Activities**

A program to encourage the development and adoption of new production and recycling technologies that result in the production of less hazardous waste was initiated in 1987. The program includes a broad spectrum of demonstrations and evaluation audit studies, technical assistance, and long-term research studies. A manual for conducting waste minimization assessments was developed as part of the Waste Reduction Assessments Program (WRAP). Cooperative agreements have been developed with engineering schools and the State of New Jersey to support demonstration assessments in many different types of facilities.

The Waste Reduction Innovative Technology Evaluation (WRITE) program was established to work with industry in the evaluation of innovative pollution prevention technologies. Agreements with several states are in place to assist in these demonstrations.

The Waste Reduction Evaluations at Federal Sites (WREAFS) was developed to facilitate cooperative waste minimization technology demonstrations with other federal agencies.

To facilitate the dissemination of information on pollution prevention the Pollution Prevention Information Clearinghouse (PPIC) has been established.

### **Proposed Technological Research**

The overall research direction is to establish an integrated program that provides a tool for evaluating existing pollution prevention technologies, testing new concepts that catalyze the development of new pollution prevention technologies, and transferring this information to the user community. Additionally, in concert with the combined resources of other government and private organizations, the project sponsors research to explore and demonstrate model production systems that integrate pollution prevention technologies from the ground up.

Efforts will continue to obtain baseline data to be used for establishing research priorities, and technology transfer. Data bases, such as the CMA and Toxic Release Inventory reports, and technology assessments will be used to identify target industries.

In order to measure the effectiveness of pollution prevention technologies, methods and procedures need to be developed. This effort has begun and as the procedures are developed they will be tested under actual industrial situations.

Pollution prevention technologies will be identified and evaluated at industries. The selection of those industries will be based on the data base and workshops directed at specific segments of the industry.

A core and anticipatory research program will be initiated in such areas as: generic technologies to minimize or eliminate wastewater; methods to clean surfaces that produce less hazardous waste; risk modeling for prioritization of pollution prevention activities; and models for new pollution prevention industrial processes.

The following technological research projects are proposed to address the hazardous waste problem:

- Measuring Pollution Prevention--Develop methods for measuring the impact of pollution prevention techniques on reducing hazardous wastes (Process Research).
- Waste Minimization Technologies--Assess generic technologies to minimize or eliminate hazardous components of wastewater (Process Research).
- Surface Cleaning Methods--Develop methods to clean surfaces that produce less hazardous waste (Process Research).
- Models for Pollution Prevention Industrial Processes--Develop models for new pollution prevention industrial processes (Process Research).
- Research Prioritization--Prepare a report identifying hazardous waste research priorities (Anticipatory Research).
- Risk Modelling for Prioritization of Research--Perform risk assessment modelling for prioritization of pollution prevention research projects to address hazardous waste (Anticipatory Research).

### **Proposed Non-Technological Research**

The following socioeconomic and institutional research initiatives are proposed to address the hazardous waste problem:

- **Community Reaction to Hazardous Waste Facilities**--Examine how industry, communities, and individuals can reach agreement on the permitting, construction, and operation of hazardous waste facilities. Risk communication potentially has an important role here, for helping the facility planners (industry and government) understand the concerns of the community and its members. Part of the solution is likely to involve sharing of power with respect to decisions about what sites to consider, what construction design and methods to be used, and what operating procedures are acceptable.
- **Role of Insurance and Indemnity Bonds in Safe Disposal**--Determine the role that could be played by insurance and indemnity bonds in encouraging the safe disposal of hazardous waste.
- **Regulations to Promote Pollution Prevention**--Investigate creative uses of EPA regulations to promote pollution prevention, such a trade offs between fines and installation of pollution prevention processes. Examine RCRA regulatory flexibility to promote pollution prevention.
- **Hazardous Waste Audits**--Determine the most effective method to conduct and promote hazardous waste audits.
- **Product Stewardship**--Investigate the feasibility of product stewardship in promoting responsible use and disposal of hazardous wastes and the impact on the hazardous waste problem.
- **Product Liability**--Investigate the impact of product liability on the reduction of hazardous waste in products.
- **Market Approaches**--Identify opportunities for economic incentives and perform a thorough characterization of the lead industry as required before any incentive can be installed.

### **Proposed Technology Transfer/Technical Assistance**

The technology transfer plan to address hazardous waste includes the following activities:

- **Research and Product Targeting**--The results of the field activities and ongoing research projects will be presented in technical reports. OTTRS/CERI will assist PPO and OEETD in designing and producing deliverables for the target audiences.
- **Product Development**--OTTRS/CERI will assist OEETD with publishing of approximately 30 technology assessment reports on industrial pollution prevention opportunities and 20 technology evaluation research briefs. These outputs will be delivered at periodic workshops and industrial conferences.

- **Information Dissemination**--OTTRS/CERI will assist PPO in the production and distribution of technology transfer documents, and other products derived from ORD research to the target organizations. Workshops will be held with state and regional staff to inform them of research findings and the availability of products which will support their activities. OTTRS/CERI will promote the availability of the products through its *Technology Transfer Newsletter* and other vehicles reaching the target audiences. OTTRS will also assist PPO in building an effective outreach program with ORD information. Working with PPO, OEETD and OTTRS will explore communication techniques that foster pollution prevention thinking in the following categories: in-plant programs for controlling material use and handling, inventory methods, recycling and management, and operation of facilities. These displays will contain relevant information for selected industries and incorporate information from PPIC.
- **Education/Training**--PPO, OEETD, and OTTRS/CERI will jointly cosponsor industrial pollution prevention trade shows and/or conference exhibits, and provide pollution prevention information. With the help of EPA's University Centers, encourage educational institutions to incorporate pollution prevention assessment and evaluation procedures into engineering curriculum.
- **Technical Assistance**--Publish results from demonstrations relating EPA activity and pollution prevention opportunities.
- **Evaluation**--ORD and PPO will assess whether or not the research achieved its intended goals, and initiate any necessary adjustments to the research program.

### **Proposed Outputs**

Research prioritization report	09/90
Wastewater workshop report	08/92
Assessments of approximately 30 technologies completed	09/91
Methods for measuring pollution prevention	09/91
Reports on 15 technology evaluations completed	09/92
Technology evaluations on high priority industries completed	09/94
Advertisement of ORD pollution prevention research information products	01/91-94
Update of ORD pollution prevention research results in PPIC	01/91-96
Industrial trade show exhibits/pollution prevention conferences	Ongoing
Publication and dissemination of ORD research reports	Ongoing
Evaluation of effectiveness of research projects	Ongoing

### Participating Offices

Coordination with the following offices/agencies is anticipated:

- OSW/QWRS--Collaboration on technological research efforts.
- QTS--Collaboration on technological research projects.
- OPPE/PPO--Collaboration on socioeconomic and institutional research initiatives.
- OTTRS--Collaboration on all technology transfer and technical assistance activities.

### Resources

	FY91	FY92	FY93 (\$ thousands)	FY94	FY95
FTEs	7	10	12	15	15
S&E	420	600	900	1200	1200
R&D	1500	3000	4000	5000	5000
TOTAL	1920	3600	4900	6200	6200

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## PRODUCTION, USE, AND DISPOSAL OF CONSUMER PRODUCTS

### Description

A worldwide concern regarding the concept of "clean" or "environmentally friendly" products exists in the marketplace for both producers and consumers. The production and use of products and packaging have negative impacts on the environment through the pollution of air, water, and land; resource and energy usage; and at any or all stages of a product's life cycle. Recent national surveys within the U.S. show that the majority of people favor reduction of environmental impacts even at the prospect of having to pay more for a product or service. This growing attitude has led to the general acceptance of the terms "environmentally-friendly products" or "clean products" referring to those products which are less damaging to human health and the environment. However, this clean products concept is based on the presumption that consumers are informed about the relative risks associated with the products they buy. Similarly, it presupposes that industry is aware of the risks associated with their own products they manufacture for consumption.

The problem is that most consumers and producers are unaware of all the steps involved in the life cycle of a product. Most products on store shelves are in the midst of a complex series of events, including the raw materials extracted to make the product, production, transportation, use/reuse, and final disposal. Each area has associated environmental impacts and health risks. Possibly even more harmful are consumer decisions which are based on only one or two highly visible aspects (such as CFC content) and ignore the total life cycle implications.

### Rationale

Several organizations in the U.S., as well as in foreign countries, have seized the clean products idea as an effective method for improving the environment. Public interest groups have published shoppers' guides for environmentally-conscious consumers while some grocery stores are labeling store shelves to identify clean products. Also, the EPA has recently drafted pollution prevention legislation which incorporates an environmental labeling provision. In addition, the governments of West Germany, Japan, Canada, as well as others, have enacted programs to label consumer goods based on environmental criteria.

While there is a definite interest by the general public in promoting and purchasing clean products, there is little information currently available to assist consumers in making sound buying decisions. The EPA can assist producers and consumers in filling this gap. There exists also the need to provide product and process designers with methodologies to develop new products and modify existing products to minimize cumulative life cycle risks and environmental impacts. The Clean Products Research Program will encourage actions that minimize environmental damage and encourage future RD&D of clean products and clean technology.

### **Research Needs**

The first research need is to develop the criteria and methodologies required to evaluate products. While various methodologies have been used to assess a product's overall environmental impact, it is generally agreed that a life cycle approach which analyzes a product's environmental impacts from design through disposal/reuse is the most valid. An accurate, valid methodology must be developed that is acceptable to both consumer and producer and can be implemented with ease.

Areas that require clean product research include: standardized definition and usage of environmental impact terminology; consumer survey to identify what types of information/education would be most helpful to consumers in making environmentally beneficial purchasing decisions; further development of methodologies to thoroughly and effectively evaluate products on a life cycle basis; RD&D on high environmental impact products for which acceptable, less damaging alternatives exist (safe substitutes) (e.g., aerosol deodorants could be replaced by existing solid and liquid deodorants which require less nonrecycling packaging and no chemical propellents); education on proper use and disposal of higher risk polluting products (e.g., concentrated products use less packaging, and the proper use of household pesticides encourage more efficiency); RD&D to explore greater and multiple uses for products including longer product life due to better care, maintenance, quality, technology, and/or improved use or product changes; and efforts to reshape today's convenience-oriented consumer perspective to a more environmentally responsible attitude.

### **Current Activities**

Several projects are in place to support research in the area of clean product research. A background document on clean products research and implementation by Franklin Associates, Ltd., has been prepared to provide background information on the current state of research activities and

implementation on the subject products, and to identify issues that must be resolved as programs are implemented. Through the University of Tennessee, a "safe substitutes" project will identify environmentally "safe" products based on product, packaging, and process for several product categories. A clean products case studies project conducted with INFORM is designed to produce several outputs to document the experiences of various companies involved in developing programs to produce and market products that might be categorized as "clean products."

A cooperative effort involving several EPA offices (OAQPS, OSW, OW, OPTS, ORD) as well as other groups representing industry and environmental interests proposes to prevent pollution at the pre-production stage by reducing market demand for consumer products entailing "risk" to human health and the environment. A final product of this project will be a guide for consumers and producers describing the product group, a scoring process, and risks associated with alternative products.

Research guidance and direction will result from a product life cycle analysis (PLA) workshop with producers of several well-known consumer products. In addition, a cooperative agreement with the University of Michigan is being developed to produce a guidance manual for industry on determining product design changes.

### **Proposed Technological Research**

The Clean Products Research Program gathers its foundation from several interconnected documents. The Product Research area of the *Pollution Prevention Research Plan: Report to Congress* provides a broad based plan to establish models, develop methodologies, identify opportunities, demonstrate techniques and technologies, and research various product design options. The *Background Document on Clean Products Research and Implementation* prepared through Franklin Associates, Ltd., focuses on consumer product methodologies and criteria development to evaluate products, and identifies specific issues/technical problems to be resolved. These two documents, with direction from the *MSW Research Agenda*, have led to our current activities. In response to growing worldwide concern of "clean products" and the dynamics of consumers, industry, and government, these documents may provide a sound basis for a changing technical research program due to legislative, socioeconomic, and institutional changes. Regardless of these changes, sound methodologies, enhanced source reduction technologies, and demonstration of safe substitutes will be required.



After the development of methodologies and criteria, products and categories of products will be selected to assess and demonstrate the effectiveness and ease of applying how to identify a clean product or identify a safe substitute alternative. This demonstration may take place through pilot-scale evaluation in-house, or through cooperation with industry associations. Extramural research will continue with the assessment of a guide for consumers and producers on various product groups. A necessary approach to future RD&D needs is to conduct workshops around a product or product group with consumer and producer representatives and determine the RD&D needs for pollution prevention from that product or product group. This approach is currently being piloted with the Diaper Industry Workshop and Dry-Cell Battery Recycling Workshop in FY90. This approach also opens the door for industry cooperation and information transfer of consumer needs for clean products. Workshop objectives are to better understand the current status of the industry, its level of activities, identify past research, and to identify clean product related research needs. Joint project RD&D will be established with other parts of the Pollution Prevention Research Program concerned with processes, municipal solid waste, household hazardous waste, socioeconomic and institutional studies, and technology transfer.

Using existing EPA research facilities and joint RD&D sites, an in-house clean products program will be developed utilizing clean products and safe substitutes within our facilities and demonstration sites. This in-house effort will provide EPA with an in-house capability to evaluate clean products during pilot- and full-scale operation and determine RD&D needs.

The following technological research projects are proposed to address the consumer products problem:

- Study of Clean Products--Develop and establish an in-house capability for the study of clean products using acceptable criteria and methodologies (Product Research).
- Alternative Products/Safe Substitutes-- Prepare a safe substitutes document which provides guidance on alternative products for particular uses (Product Research).
- Product and Process Design Guidance Manual--Prepare a product and process design guidance manual for producers to incorporate pollution prevention into product design and use (Product and Process Research).
- Life Cycle Analysis Workshop--Conduct product life cycle analysis workshop with representatives from industry, academia, government, and environmental organizations to determine RD&D direction (Anticipatory Research).

- Product-Industry Specific Workshops--Conduct product-industry specific workshops to pilot an RD&D needs approach and develop cooperative pollution prevention efforts (Anticipatory Research).
- Clean Products RD&D Needs--Assess ongoing clean products program and prepare RD&D needs document based on success stories and technology gaps (Anticipatory Research).

### **Proposed Non-Technological Research**

Research is needed on methods for communicating with users about the pollution aspects of products. Research is proposed to explore effective product labeling for a wide range of consumer products, in terms of product production, use, and disposal. The following socioeconomic and institutional research projects are proposed to address the consumer products problem:

- Programs to Produce and Market Clean Products--Evaluate the experiences of companies involved in developing innovative programs to produce and market clean products.
- Consumer Product Labeling--Investigate the feasibility and effectiveness of labeling consumer products on preventing the use of polluting consumer products.
- Environmental Education--Research environmental education as a way to achieve pollution prevention. This project includes a study of children's baseline attitudes and how they change in response to alternative educational approaches.
- Incentives to Reduce Toxics in Products--Investigate various incentives and their effectiveness in motivating the reduction of toxics in consumer products.
- Economics of Production Stage Incentives--Study the economics of production stage incentives/regulations to reduce household waste.

### **Proposed Technology Transfer/Technical Assistance**

ORD will assist PPO in transferring ORD's comparative risk information and research results. The technology transfer plan includes the following activities:

- Research and Product Targeting--Designing useful deliverables will require close cooperation between researchers and PPO. ORD's technology transfer liaison will monitor deliverable development, attend meetings, and provide assistance to the laboratory and to PPO as needed, and monitor the quality of products.
- Product Development--OTTRS/CERI will be responsible for disseminating RREL's research results. It is anticipated that a number of fact sheets, a manual for evaluating the risk of consumer products, and a clean products design manual will be generated.

- Information Dissemination--OTTRS/CERI will assist PPO in handling and distributing technology transfer documents derived from ORD research to consumer organizations and others, and will conduct five informational exchange meetings with state and regional staff to distribute reports and fact sheets. The exchange meetings will be sponsored by the research partners. OTTRS/CERI will promote the availability of the products through its *Technology Transfer Newsletter*, and other vehicles for reaching target groups. Working closely with PPO, OTTRS/CERI will explore development of prototype clean product information displays for relaying comparative product risk and cleaner product information to consumers in the marketplace. They will work with the Office of Public Affairs and Communication to develop a poster series on using clean products. They will use the Pollution Prevention Information Exchange System as the clearinghouse and bulletin board for this information.
- Education and Training--PPO, OEETD, and OTTRS/CERI will jointly co-sponsor a "clean products trade show and conference" in 1994. They will also develop information and hold at least four workshops for industrial process and product designers and manufacturers in 1994. In addition, four train-the-trainer workshops are planned for purveyors of environmental and consumer product information to present risk and clean product information.
- Technical Assistance--On-site technical assistance will be provided by RREL, working closely with PPO.
- Evaluation--ORD and PPO will jointly assess whether ORD research products achieved their intended goals.

### Proposed Outputs

Product life cycle analysis workshop	08/90
Product industry-specific workshops	08/90
Preparation of background document on clean products research and implementation	10/90
Advertisement of ORD pollution prevention research information products	01/91-94
Update of ORD pollution prevention research results in PPIC	01/91-96
Evaluation of companies' innovative programs to produce and market clean products	12/91
Development of a guidance report for consumers and producers on cooperative risk of consumer products for pollution prevention	02/92
Development and establishment of an in-house capability for the study of clean products	06/92

## **CHAPTER 5 ONGOING RESEARCH ACTIVITIES**

There are approximately 80 pollution prevention research projects being conducted or funded by EPA. These projects fall into two major categories--those funded by ORD and those funded by the 2% Set-Aside at the request of the EPA Administrator. Summary lists of most of the projects are presented in Exhibits 14 and 15, and brief descriptions of these projects follow. Those projects that are not included are primarily the social science pollution prevention projects conducted by EPA's Office of Policy, Planning and Evaluation.

# EXHIBIT 14

## SUMMARY OF ONGOING POLLUTION PREVENTION RESEARCH PROJECTS

5-2

RESEARCH PROJECTS	EPA PROJECT OFFICER	CONTACT PHONE NO.
1. Clean Products Background Information	Mary Ann Curran RREL	(513) 569-7837
2. Evaluating the Potential for Safe Substitutes	Mary Ann Curran RREL	(513) 569-7837
3. Clean Products Case Studies	Anne Robertson RREL	(513) 569-7658
4. Comparative Risk of Consumer Products for Pollution Prevention	Mary Ann Curran RREL	(513) 569-7837
5. Product and Process Design for Life Cycle Risk Reduction and Environmental Impact Mitigation	Mary Ann Curran RREL	(513) 569-7837
6. Research Strategy Background Development	Ivars J. Liciis RREL	(513) 569-7718
7. New Jersey/EPA Waste Minimization Assessment Program	Mary Ann Curran RREL	(513) 569-7837
8. Technical Support for the Waste Reduction Innovative Technologies Evaluation (WRITE) Program	Ivars J. Liciis RREL	(513) 569-7718
9. New Jersey/EPA WRITE Program	Johnny Springer, Jr. RREL	(513) 569-7542
10. California/EPA WRITE Program	Lisa M. Brown RREL	(513) 569-7634
11. Washington/EPA WRITE Program	Ivars J. Liciis RREL	(513) 569-7718
12. Connecticut/EPA WRITE Program	Lisa M. Brown RREL	(513) 569-7634
13. Illinois/EPA WRITE Program	Paul M. Randall RREL	(513) 569-7673
14. Minnesota/EPA WRITE Program	Teresa M. Harten RREL	(513) 569-7565
15. Erie County/EPA WRITE Program	Paul M. Randall RREL	(513) 569-7673

**EXHIBIT 4****SUMMARY OF ONGOING POLLUTION PREVENTION RESEARCH PROJECTS (Continued)**

RESEARCH PROJECTS	EPA PROJECT OFFICER	CONTACT PHONE NO.
16. Waste Reduction Evaluations at Federal Sites (WREAFS) Program	James S. Bridges RREL	(513) 569-7683
17. Chemical Substitutes for TCA and Methanol in Manufacturing Operations	Lisa M. Brown RREL	(513) 569-7634
	Johnny Springer, Jr. RREL	(513) 569-7542
18. Chromate Recovery by Adsorptive Filtration	Lisa M. Brown RREL	(513) 569-7634
19. Evaluation of Pollution Prevention Technologies in a New Jersey Vehicle Maintenance and Repair Facility	Paul M. Randall RREL	(513) 569-7673
20. Industry-Specific Waste Minimization Manuals	Teresa M. Harten RREL	(513) 569-7565
21. Small Generator Waste Minimization Assessments	Brain A. Westfall RREL	(513) 569-7755
22. Waste Reduction from Chlorinated and Petroleum-Based Degreasing Operations	Mary Ann Curran RREL	(513) 569-7837
23. Pollution Prevention by and for Small Business	Kenneth R. Stone RREL	(513) 569-7474
24. Ohio Waste Minimization Assessments	Mary Ann Curran RREL	(513) 569-7837
25. Fitzsimons Army Medical Center	Kenneth R. Stone RREL	(513) 569-7474
26. Waste Minimization Assessments and Reviews Within the Federal Community	Kenneth R. Stone RREL	(513) 569-7474
27. Wet to Dry System Evaluation in a Navy Paint Spray Booth	Paul M. Randall RREL	(513) 569-7673
28. American Institute for Pollution Prevention	David G. Stephan RREL	(513) 569-7896
29. International Conference on Pollution Prevention	Kenneth R. Stone RREL	(513) 569-7474

# EXHIBIT 14

## SUMMARY OF ONGOING POLLUTION PREVENTION RESEARCH PROJECTS (Continued)

RESEARCH PROJECTS	EPA PROJECT OFFICER	CONTACT PHONE NO.
30. EPA Research Project Case Studies	Johnny Springer, Jr. RREL	(513) 569-7542
31. Special Edition on Waste Minimization for Journal of Hazardous Materials	S. Garry Howell RREL	(513) 569-7756
32. Pollution Prevention Technical Support	Ivars J. Licis RREL	(513) 569-7718
33. Pollution Prevention Information Clearinghouse	Myles Morse RREL	(202) 382-5747
34. Product Life Cycle Assessments Workshop	Mary Ann Curran RREL	(513) 569-7837
35. USCGS Ketchikan Pollution Prevention Project	Kenneth R. Stone RREL	(513) 569-7474
36. Clean Products Workshop Series	Mary Ann Curran RREL	(513) 569-7837
37. Reclaiming Fiber from Newsprint	Teresa M. Harten RREL	(513) 569-7565
38. Determination of Legitimate Hazardous Waste Recycling	Brian A. Westfall RREL	(513) 569-7755
39. Composites from Recycled Plastics, Wood, and Recycled Wood Fiber	Teresa M. Harten RREL	(513) 569-7565
40. Oil Life Extension	Paul M. Randall RREL	(513) 569-7673
41. Pollution Prevention in Public Agencies	Brian A. Westfall RREL	(513) 569-7755
42. Model Community Pollution Prevention Case Study	Kenneth R. Stone RREL	(513) 569-7474
43. Methodology for Measuring Pollution Prevention	David G. Stephan RREL	(513) 569-789

**EXHIBIT 4****SUMMARY OF ONGOING POLLUTION PREVENTION RESEARCH PROJECTS (Continued)**

<b>RESEARCH PROJECTS</b>	<b>EPA PROJECT OFFICER</b>	<b>CONTACT PHONE NO.</b>
44. Consumer Product Emissions Prevention	Chester A. Vogel AEERL	(919) 541-2827
45. Minimizing Solvent Emissions from Pesticides	Geddes Ramsey AEERL	(919) 541-7963
46. Demonstration of Solvent-free Cleaning	Michael Kosusko AEERL	(919) 541-2734
47. Evaluation of Potential Coating Technologies	Michael Kosusko AEERL	(919) 541-2734
48. Alternative Coatings Demonstrations	Robert C. McCrillis AEERL	(919) 541-2733
49. Consumer Product Test Method Development	Chester Vogel AEERL	(919) 541-2827
50. Diagnosing and Preventing IAQ Problems: Sources of Emissions and Handbook	James White AEERL	(919) 541-1189
51. Industry Guidance/Assistance for Halon Replacements	N. Dean Smith AEERL	(919) 541-2708



## EXHIBIT 15

### SUMMARY OF ONGOING POLLUTION PREVENTION PROJECTS

2 % SET-ASIDE PROJECTS	LEAD OFFICE	TOTAL FUNDING (\$ In Thousands)
1. Pollution Prevention by and for Small Businesses	OSDBU	\$440
2. Sustainable Agriculture Initiative and Technology Transfer to Reduce Corn Herbicide	Region VIII, OPP	500
3. University Based Pollution Prevention	OTS	400
4. Pollution Prevention Education	Region VII, OA	660
5. Demonstration of Emerging Area-Source Prevention for Volatile Organics	ORD/HQ, AEERL/RTP	1,000
6. Promote and Institutionalize PP/Waste Min. in Water Permit Issuance Process	OW, OSW, OAR	1,000
7. Pollution Prevention Through EPA Procurement Guidelines	OSW, Regions VII, II	350
8. Pacific Northwest Pollution Prevention Research Foundation	Region X	200
9. Industrial PP Through Regulation and Outreach	OW, OTS	854
10. Chesapeake Bay Pesticide Index and Registry	Region III	350
11. Promoting PP in Enforcement Settlements	OECM	400
12. Environmentally Responsible Management of Agricultural Chemicals	Regions VII, X	965
13. Consumer Product Comparative Risk: Market Based Pollution Prevention	OAQPS, OSW	300
14. Lead Pollution Prevention	OTS	1,000
15. Preventing Groundwater Contamination from Pesticides	ORD	500
16. PP for Small and Medium Industrial Operations and Municipalities	ORD/OTTRS	500
17. Lead in Drinking Water	ODW	450
18. Community Planning and Implementation of Local PP Strategies	Region III	220
19. Reduction of Toxics in Emissions and Ash for MWCs	Region IV	400
20. Determining the Role for RCRA Inspectors in Assessment of PP Opportunities	OWPE	30
21. Reduced Mobile Source Emissions with Alternative Fuels	ORD	325
22. Reduction in Pesticide Application Through Bioregulation	ORD/OEPEP	350
23. State Level Conservation Projects	OAR	300
24. Projects to be Determined	PPO	346
TOTAL FUNDING FOR 2% SET-ASIDE PROJECTS		\$11.8 Million

# **POLLUTION PREVENTION PROJECT**

## **RREL Pollution Prevention Research Projects**



### **CLEAN PRODUCTS BACKGROUND INFORMATION**

#### **PROJECT OFFICER**

Mary Ann Curran (513) 569-7837

#### **PRINCIPAL INVESTIGATOR**

Marjorie Franklin (913) 649-2225  
Franklin Associates, Ltd.  
4121 W. 83rd St.  
Suite 108  
Prairie Village, Kansas 66208.

#### **DESCRIPTION**

The objective of this project is to identify, collect, and summarize available information on the subjects of clean products, methodologies for comparative evaluations of products to determine "environmental friendliness," environmental labeling programs and methodologies for life cycle analyses (both environmental impacts and costs related thereto) of products.

Published and unpublished information plus information from other appropriate sources will be gathered and succinctly summarized. Its relative quality is to be judged as may be possible. The result will be used to help in identifying research needs in the clean products area.

#### **PERIOD OF PERFORMANCE**

12/15/89 - 6/30/90

#### **MILESTONES**

Develop detailed work plan	12/31/90
Produce draft report	04/15/90
Provide final report	06/30/90

# **POLLUTION PREVENTION PROJECT**

## **RREL Pollution Prevention Research Projects**



### **EVALUATING THE POTENTIAL FOR SAFE SUBSTITUTES**

#### **PROJECT OFFICER**

Mary Ann Curran (513) 569-7837

#### **PRINCIPAL INVESTIGATOR**

Gary Davis (615) 974-4251  
University of Tennessee  
Knoxville, TN 37996

#### **DESCRIPTION**

EPA is working with the University of Tennessee (under a Cooperative Agreement) to evaluate the potential substitutes for products that are either toxic in and of themselves, or rely upon toxic chemicals in their production. The result will be a background document that identifies priority products for substitution and evaluates available substitutes.

The objectives for the project are as follows:

- Evaluate the potential for safe substitutes for toxic and polluting products.
  - Identify priority products, including consumer products, industrial chemicals, and pesticides.
  - Identify and evaluate existing substitutes for priority products.
  - Document case studies of successful substitutes for priority products.
  - Determine technical impediments to the use of safe substitutes for priority products.
- Transfer information about safe substitutes through background documents.
- Determine the future research needs for safe substitutes for priority products.

**PERIOD OF  
PERFORMANCE**

7/90 - 6/93

**MILESTONES**

Identification of priority products

1/90

Draft background document

01/92

Evaluate research needs

01/92

Perform product evaluations for  
safe substitutes

01/92 - 01/93

Final background document

06/93

# **POLLUTION PREVENTION PROJECT**

## **RREL Pollution Prevention Research Projects**



### **CLEAN PRODUCTS CASE STUDIES**

#### **PROJECT OFFICER**

Anne Robertson (513) 569-7658

#### **PRINCIPAL INVESTIGATOR**

Bette Fishbein (212) 689-4040  
INFORM  
381 Park Avenue South  
New York, NY 10016

#### **DESCRIPTION**

This cooperative agreement project is designed to produce several outputs to document the experiences of various companies involved in developing programs to produce and market products that might be categorized as "clean products." The first-year's studies will be devoted to products that are high profile products within the municipal solid waste stream. The study team will visit the sites of the companies selected and interview those involved with the subject programs. Products eligible for study will be chosen from those available in the United States, Canada, and Europe. The second-year projects will be devoted to more in-depth analysis of the potential environmental improvements possible through the greater use of environmentally-friendly products. Explorations of using environmental labeling plans will be included in the group of projects.

#### **PERIOD OF PERFORMANCE**

7/90 - 6/92

#### **MILESTONES**

Report, "Case Studies of Source Reduction in the Production of Products"	12/91
Report, "Case Studies of Reduction of Chemical Hazards in Products"	05/92

# **POLLUTION PREVENTION PROJECT**

## **RREL Pollution Prevention Research Projects**



### **COMPARATIVE RISK OF CONSUMER PRODUCTS FOR POLLUTION PREVENTION**

#### **PROJECT OFFICER**

Mary Ann Curran (513) 569-7837

#### **PRINCIPAL INVESTIGATOR**

Bruce Vigon (614) 424-4463  
Battelle  
505 King Avenue  
Columbus, OH 43201-2693

#### **DESCRIPTION**

This project proposes to prevent pollution at the pre-production stage by reducing market demand for consumer products entailing "risk" to human health and the environment. Every day, American consumers make purchasing decisions, such as between plastic and paper bags, or between cloth diapers or disposables. These decisions have direct and indirect impacts and vary in the cumulative risk they create through their production, transportation, use, maintenance, and disposal. Public awareness of the full cost of products can result in behavioral changes and new purchasing patterns. This phenomenon has been most obvious in recent public education campaigns on cancer and heart disease leading to modified diets to include high fiber and low cholesterol foods.

This project will be a cooperative effort involving several EPA offices (OAQPS, OSW, OW, OPTS, ORD), as well as other groups representing industry and environmental interests. The initial study will focus on a group of consumer goods selected by associated risks and effects on all media. Risks will be estimated from raw material processing to final disposal and culminate in a guide for consumers and producers describing the product group, resultant scores, and risks associated with alternative products.

#### **PERIOD OF PERFORMANCE**

8/90 - 1/92

#### **MILESTONES**

Risk Analysis Results	01/91
Final Guidance Report	12/91



## **PRODUCT AND PROCESS DESIGN FOR LIFE CYCLE RISK REDUCTION AND ENVIRONMENTAL IMPACT MITIGATION**

***PROJECT OFFICER***

Mary Ann Curran (513) 569-7837

***PRINCIPAL  
INVESTIGATOR***

Greg Keoleian (313) 764-1412  
School of Natural Resources  
University of Michigan  
2540 Dana Bldg.  
Ann Arbor, MI 48109-1115

***DESCRIPTION***

This project with the University of Michigan School of Natural Resources will provide product and process designers with a methodology to develop new products that minimize cumulative life cycle risks and environmental impacts, and modify existing products or processes to reduce cumulative risks and impacts. The purpose is to develop a systematic guide for product and process design that combines life cycle risk, environmental impact assessment, risk reduction and impact mitigation strategies.

***PERIOD OF  
PERFORMANCE***

10/90 - 10/92

***MILESTONES***

Draft risk reduction methodology	10/91
Select products for case studies	11/91
Final risk reduction methodology	11/92
Life cycle risk assessment	06/92
Draft case study report	06/92
Final case study report	10/92

# **POLLUTION PREVENTION PROJECT**

## **RREL Pollution Prevention Research Projects**



### **RESEARCH STRATEGY BACKGROUND DEVELOPMENT**

#### **PROJECT OFFICER**

Ivars J. Lics (513) 569-7718

#### **PRINCIPAL INVESTIGATOR**

Dr. Herbert Skovronek (201) 599-0100  
Science Applications International Corp.  
8400 Westpark Drive  
McLean, Virginia 22102

#### **DESCRIPTION**

This project is part of a technical support task funded in FY 89 with the objective of developing a basis for assigning research priorities to work performed within the Process Engineering Section of the Pollution Prevention Research Branch. The Process Engineering Section is partly responsible for defining, establishing, and carrying out a research program to enhance and accelerate the implementation of new pollution prevention technologies available at full- or pilot-scale and helping state and local government programs in this area. It is also charged with speeding the development of new technologies, and participation in the identification of future pollution problems, and designing anticipatory research programs to assist in the development of new technology that will help to avoid these problems.

In order to best prioritize research efforts within a limited budget, this project is designed to gather information on the pollution problems in existence, the new technologies available or being developed, and the perceived relative importance of both problems and opportunities in the area by a wide spectrum of people involved. To this end, a prioritization activity was performed using SIC as a basis and involving members of the EPA, industry, and academia. The resulting list of 10 to 20 SIC areas will be investigated further by consultation and workshops with the respective trade associations, technical associations and individual experts in the area. The result of this effort will be a table presenting high priority pollution problems and associated opportunities for research. The table will be used as background information to establish a research strategy and prioritize funding and research projects.



***PERIOD OF  
PERFORMANCE***

6/89 - 9/90

***MILESTONES***

Final Report

9/90

# **POLLUTION PREVENTION PROJECT**

*RREL Pollution Prevention Research Projects*



## **NEW JERSEY/EPA WASTE MINIMIZATION ASSESSMENT PROGRAM**

### **PROJECT OFFICER**

Mary Ann Curran (513) 569-7837

### **PRINCIPAL INVESTIGATOR**

Sanat Bhavsar (609) 292-8341  
State of New Jersey  
Department of Environmental Protection  
401 E. State Street  
5th Floor CN-028  
Trenton, NJ 08625

### **DESCRIPTION**

The project is designed to evaluate the use of waste minimization assessments in thirty hazardous waste generating facilities (across ten industries) in New Jersey. The assessments are being conducted by the New Jersey Institute of Technology (NJIT) personnel and will follow the EPA recommended procedure. NJDEP refers to the project as "Assessment of Recycling and Recovery Opportunities for Hazardous Waste (ARROW)."

Initial industries being studied include: 1) Nuclear Power Generation; 2) Graphics Control Manufacturing; 3) Paints and Coatings Manufacturing; 4) Printing; 5) Lubricant Production; 6) Transportation Vehicle Maintenance; and 7) Leather Finishing.

### **MILESTONES**

30 Project Summaries (assessments)	3/90 - 3/91
10 Research Briefs (industries)	3/91
Final Report	2/91

### **PERIOD OF PERFORMANCE**

9/1/88 - 3/1/91



## **NEW JERSEY/EPA WASTE MINIMIZATION ASSESSMENT PROGRAM**

**PROJECT OFFICER**

Mary Ann Curan (513) 569-7837

**PRINCIPAL  
INVESTIGATOR**

Sanat Bhavsar (609) 292-8341  
State of New Jersey  
Department of Environmental Protection  
401 E. State Street  
5th Floor CN-028  
Trenton, NJ 08625

**DESCRIPTION**

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Initial industries being studied include: 1) Nuclear Power Generation; 2) Graphics Control Manufacturing; 3) Paints and Coatings Manufacturing; 4) Printing; 5) Lubricant Production; 6) Transportation Vehicle Maintenance; and 7) Leather Finishing.

**PERIOD OF  
PERFORMANCE**

9/1/88 - 3/1/91

**MILESTONES**

30 Project Summaries (assessments)	3/90 - 3/91
10 Research Briefs (industries)	3/91
Final Report	2/91

# **POLLUTION PREVENTION PROJECT**

*RREL Pollution Prevention Research Projects*



## **TECHNICAL SUPPORT FOR THE WASTE REDUCTION INNOVATIVE TECHNOLOGIES EVALUATION (WRITE) PROGRAM**

### ***PROJECT OFFICER***

Ivars J. Licis (513) 569-7718

### ***PRINCIPAL INVESTIGATOR***

To be determined (201) 599-0100  
Science Applications International Corp.  
8400 Westpark Drive  
McLean, Virginia 22102

### ***DESCRIPTION***

This project consists of a collection of technical support tasks associated with the WRITE Program and with the research under the Process Engineering Section of the Pollution Prevention Research Branch. The major specific tasks include test plan design assistance, testing and analyses for waste reduction technologies to be evaluated under the WRITE Program (primary California), and providing expert technical reviews of proposals received by the Section.

### ***PERIOD OF PERFORMANCE***

FY 90-91

### ***MILESTONES***

A final report (Research Brief) is planned for each technology evaluated in California. Approximately four technologies are to be evaluated during the FY 90-91 period. The first of these is a research project with Hewlett Packard to evaluate reusable oil filters and extended oil use. There are no formal report requirements for the remaining technical support tasks.



## **NEW JERSEY/EPA WRITE PROGRAM**

### **PROJECT OFFICER**

Johnny Springer, Jr. (513) 569-7542

### **PRINCIPAL INVESTIGATOR**

Dr. Mohamed Elsaady (619) 292-8341  
New Jersey Department of Environmental Protection  
401 East State Street  
5th Floor West, CN-028  
Trenton, New Jersey 08625

### **DESCRIPTION**

Technical and economic evaluations will be conducted on manufacturing and processing operations in which waste minimization technologies reduce the volume and/or toxicity of wastes generated. The objectives of the project are to: establish reliable performance and cost information on pollution prevention techniques by conducting evaluations/demonstrations, encourage active participation of small and medium-sized companies in evaluating and adopting pollution prevention concepts, encourage transfer of knowledge and technology between large, medium, and small-sized firms and provide solutions to important chemical, waste stream and industry-specific pollution prevention research needs.

The first technology evaluation will examine the Zerpel "Zero Discharge" electroplating wastewater recovery system. Other technology evaluations will be performed in the areas of cleaning solvent substitution, acid/base recovery and reuse.

### **PERIOD OF PERFORMANCE**

8/14/89 - 8/13/92

### **MILESTONES**

Interim Technology Report	12/1/90
Interim Technology Report	04/1/92
Interim Technology Report	08/1/92
Interim Technology Report	12/1/91
Interim Technology Report	04/1/92
Final Report	08/1/92

# **POLLUTION PREVENTION PROJECT**

## **RREL Pollution Prevention Research Projects**



### **CALIFORNIA/EPA WRITE PROGRAM**

#### **PROJECT OFFICER**

Lisa M. Brown (513) 569-7634

#### **PRINCIPAL INVESTIGATOR**

Robert Ludwig (916) 324-2659  
California Dept. of Health Services  
Toxic Substances Control Program  
Alternative Technology Division  
400 P Street 20  
Sacramento, California 94234-7320

#### **DESCRIPTION**

The main objective of this project is to identify, develop, and evaluate innovative pollution prevention techniques through the cooperative efforts of California DHS and EPA. Through this program we are exploring methodologies that through engineering and economic assessments have the potential of reducing the quantity and/or the toxicity of waste produced at the source of generation, or to achieve practicable on-site reuse or recycling of these waste materials. California DHS under a Memorandum of Understanding with EPA will identify at least five techniques for evaluation during this three-year project.

#### **PERIOD OF PERFORMANCE**

6/30/89 - 6/30/92

#### **MILESTONES**

Interim Technology Report	04/01/90
Interim Technology Report	11/01/90
Interim Technology Report	05/01/91
Interim Technology Report	11/01/92
Interim Technology Report	05/01/92
Final Report	06/30/92



## **WASHINGTON/EPA WRITE PROGRAM**

### **PROJECT OFFICER**

Ivars J. Lics (513) 569-7718

### **PRINCIPAL INVESTIGATOR**

Robert Burmark (206) 438-7370  
Washington State Department of Ecology  
Office of Waste Reduction and Recycling MS PV-11  
Olympia, Washington 98504

### **DESCRIPTION**

This project will evaluate five waste minimization technologies that are either implemented at full-scale at the present time or have been developed through relatively large scale and are to be implemented within the time frame of the study. The five technologies will be evaluated during a three-year project period. At the present only one technology has been identified for which companies have been found willing to participate in evaluation. This technology involves the recycling of acetone still bottoms and the substitution of water-based cleaners for acetone with the objective of eliminating these RCRA wastes. Wastes of this type are generated by a large number of relatively small fiberglass fabrication shops in the State of Washington and also across the country. The State of Washington is in the process of implementing a regulation that includes the prohibition of landfilling these still bottoms.

The Washington Department of Ecology (WA-DOE) has arranged a technology evaluation that involves the participation of a builder of fiberglass boats and a company that makes bathtubs, spas and shower stalls to obtain data on the environmental and economic effects on recycling the still bottoms, drying, grinding and reformulating the product into a resin filler putty that was previously purchased and made from virgin material. The major benefit to companies is that they can eliminate the creation of RCRA waste. Q/A and test plans are being prepared at this time.

Specific plans for the other technologies have not been completed. Candidate technologies include: cement kiln uses for sand blasting grit; recycling/reuse of baghouse dust from electric arc furnaces; wastewater

elimination in auto engine rebuilding (engine bake out and ball-peening substituted for engine boilout); coating technology improvements such as dry powder applications vs. paint, paint curing, improvements in curing ovens; and reduction/recycling of pot liner waste in aluminum industry. Candidate participants are being sought via Pollution Prevention Workshops sponsored by the WA-DOE, DOE publications ("Ecology Today" and "Baseline") and site visits to state regional offices and their associated industry contacts.

***PERIOD OF  
PERFORMANCE***

6/16/89 - 6/15/92

***MILESTONES***

One report is being planned per technology evaluated. The first Research Brief is planned for 10/90.





## **CONNECTICUT/EPA WRITE PROGRAM**

**PROJECT OFFICER**

Lisa M. Brown (513) 569-7634

**PRINCIPAL  
INVESTIGATOR**

Frederick W. Kaeser (203) 244-2007  
Connecticut Hazardous Waste Management Service  
900 Asylum Avenue - Suite 360  
Hartford, Connecticut 06105-1904

**DESCRIPTION**

The main objective of this cooperative agreement is to identify, develop, and evaluate innovative pollution prevention techniques through the cooperative efforts of CHWMS and EPA. Specifically, this cooperative program will explore methodologies that through engineering and economic assessments have the potential of reducing the quantity and/or the toxicity of waste produced at the source generation, or to achieve practicable on-site reuse or recycling of these waste materials. CHWMS in coordination with its state grant program will identify at least five techniques for evaluation during this three-year project.

**PERIOD OF  
PERFORMANCE**

10/1/89 - 9/30/92

**MILESTONES**

Interim Technology Report	12/01/90
Interim Technology Report	05/01/91
Interim Technology Report	11/01/91
Interim Technology Report	03/01/92
Interim Technology Report	09/01/92
Final Report	09/30/92

# **POLLUTION PREVENTION PROJECT**

## **RREL Pollution Prevention Research Projects**



### **ILLINOIS/EPA WRITE PROGRAM**

#### **PROJECT OFFICER**

Paul M. Randall (513) 569-7673

#### **PRINCIPAL INVESTIGATOR**

Dr. Gary Miller (217) 333-8942  
Hazardous Waste Research and Information Center  
1 East Hazelwood Drive  
Champaign, Illinois 61820

#### **DESCRIPTION**

In June 1989, HWRIC/EPA began a three-year research program as part of the Waste Reduction Innovative Technology Evaluation (WRITE) Program. In the Program, HWRIC is working with industry in Illinois to demonstrate and evaluate at least five innovative source reduction and recycling options. The scope of the technology evaluations will include both engineering effectiveness and economic pay-back. The primary objective is to establish reliable performance and cost information on promising pollution prevention techniques and technologies.

During the first year, the major activities have been to identify candidate technologies, contact potential cooperating industries and technology developers, assess and select technologies for in-plant evaluation, and develop a degree of toxic hazard evaluation system. A worth assessment model, developed by the EPA, was applied to fourteen potential WRITE projects and after the review, five technology evaluation projects were selected. The selected projects for further evaluation are: 1) flexographic printing with water-based inks and alternative cleaners; 2) offset printing with soy-oil based inks and alternative cleaners; 3) non-cyanide zinc plating and reuse of recovered chemicals in electroplating; 4) vacuum evaporative batch recovery and reuse of metals in electroplating; 5) recovery and reuse of waste zircon molding sand in the investment casting industry.

#### **PERIOD OF PERFORMANCE**

6/19/89 - 6/18/92

***MILESTONES***

Research paper	12/90
Research paper	06/91
Research paper	12/91
Project final report and summary	06/92

# **POLLUTION PREVENTION PROJECT**

## **RREL Pollution Prevention Research Projects**



### **MINNESOTA/EPA WRITE PROGRAM**

#### **PROJECT OFFICER**

Teresa M. Harten (513) 569-7565

#### **PRINCIPAL INVESTIGATOR**

Cindy McComas (612) 625-4949  
Minnesota Technical Assistance Program  
420 Delaware St. S.E.  
University of Minnesota  
Minneapolis, MN 55455

#### **DESCRIPTION**

The objective of this project, which is funded by a cooperative agreement between EPA and the University of Minnesota, is to identify, implement, and evaluate innovative waste reduction technologies. The Minnesota Technical Assistance Program (MnTAP) is the state organization responsible for carrying out the evaluations for this project. MnTAP's WRITE Program focuses on evaluating innovative rinsing technologies in the plating, metal finishing, and circuit board manufacturing industries; both economic and engineering evaluations will be performed. Five or six technology evaluations at operating manufacturing facilities are planned for the three-year program project period. During the first year of the project, MnTAP publicized the WRITE Program within the target industrial community, performed site visits at candidate industries and selected one industrial community, performed site visits at candidate industries and selected one industry for conducting the first evaluation. MICOM, Inc., a printed circuit board manufacturer in the Minneapolis area, is the subject of the initial evaluation. Specifically, waste reducing modifications of rinsing equipment following an etchant bath and an electroless copper plating bath will be assessed. In addition, operational changes to the line will be implemented in an attempt to reduce process solution drag out.

The remaining technology evaluations will be performed cooperatively between EPA, MnTAP, and an external contractor; while EPA and MnTAP will select companies for these evaluations, the contractor will have primary responsibility for developing project test plans, data collection and analysis, and report writing.

***PERIOD OF  
PERFORMANCE***

7/1/89 - 6/30/92

***MILESTONES***

First technology report, Paper	12/31/90
Second technology report, Paper	04/15/90
Third technology report, Paper	08/15/91
Fourth technology report, Paper	01/15/92
Final project report	06/30/92

# **POLLUTION PREVENTION PROJECT**

## **RREL Pollution Prevention Research Projects**



### **ERIE COUNTY/EPA WRITE PROGRAM**

#### **PROJECT OFFICER**

Paul M. Randall (513) 569-7673

#### **PRINCIPAL INVESTIGATOR**

Mr. Paul B. Kranz, P.E. (716) 858-6370  
Erie County Department of Environment and Planning  
Division of Environmental Compliance  
95 Franklin Street  
Buffalo, New York 14202

#### **DESCRIPTION**

The Erie County Division of Environmental Compliance Services, Department of Environment and Planning, is proposing to develop and evaluate pollution prevention technologies for small to medium-sized businesses in western New York state. The program will be a cooperative effort utilizing the resources of the New York State Center for Hazardous Waste Management and RECRA Environmental, Inc., which is a private chemical analysis, prevention, and control firm located in Erie County.

In Erie County over 2500 companies are small- to medium-size businesses such as electroplating, motor vehicle servicing, dry cleaning, printing, and photography. The solicitation of proposals from industry will be facilitated by the New York Center for Hazardous Waste Management and RECRA Environmental. The New York State center has developed a roundtable on source reduction which consists of representatives from western New York industries and state and local government officials concerned with waste minimization. Approximately five technologies will be evaluated over a three year program period.

Currently, the Erie County grant has been awarded and a kick off meeting was held in June 1990. Identification and definition of projects has begun.

#### **PERIOD OF PERFORMANCE**

5/1/90 - 4/30/93

## ***MILESTONES***

Research paper	3/91
Research paper	9/91
Research paper	3/92
Research paper	9/92
Project final report and summary	3/93

# **POLLUTION PREVENTION PROJECT**

## **RREL Pollution Prevention Research Projects**



### **WASTE REDUCTION EVALUATIONS AT FEDERAL SITES (WREAFS) PROGRAM**

#### **PROJECT OFFICER**

James S. Bridges (513) 569-7683

#### **PRINCIPAL INVESTIGATOR**

Barry Langer (201) 599-0100  
SAIC  
1 Sears Drive  
Paramus, New Jersey 07652

#### **DESCRIPTION**

The WREAFS Program is a series of assessment and demonstration projects for pollution prevention and waste reduction conducted cooperatively by EPA and various parts of the DOD, DOE, and other federal agencies. The objectives of the WREAFS Program include: 1) performing waste minimization opportunity assessments, 2) demonstrating pollution prevention techniques or technologies at federal facilities, 3) conducting pollution prevention workshops within the federal sector, and 4) enhancing pollution prevention benefits within the Federal community.

Waste minimization opportunity assessments have been conducted at the following federal facilities:

- Philadelphia Navy Shipyard
- Ft. Riley (Kansas) Army Forces Command
- U.S. Coast Guard - Governor's Island, New York
- Naval Undersea Warfare Engineering Station - Keyport, Washington
- Veteran Medical Center - Cincinnati, Ohio
- USEPA - Andrew W. Breidenbach Environmental Research Center - Cincinnati, Ohio.

There are planned assessments and demonstrations with NASA, DOD, Department of Treasury, and others. A cooperative information transfer effort is being planned with EPA for Region X. In addition, a joint USAF RD&D project seeking to obtain information for its chlorinated solvents recycling program is underway with Auburn University. The DOD and DOE work is focused on a wide range of



industrial and military operations including: metal cleaning, solvent degreasing, spray painting, vehicle and battery repair, ship bilge cleaning, and equipment overhaul. The other federal activities more often concentrate on commercial services specific to their activity such as source reduction and recycling opportunities of hospital waste at a Veteran's hospital. The resultant pollution prevention recommendations are applicable to both the private and public sectors.

***PERIOD OF  
PERFORMANCE***

6/1/88 - 9/30/91

***MILESTONES***

WMOA Report and Project Summary	
- Keyport, Washington	09/01/90
AWBERC WMOA Report and	
Project Summary	09/03/90
Region X Federal Facilities	
Pollution Prevention Workshop	11/15/90
WMOA Report and Project Summary	
- Bureau of Printing	12/31/90
WMOA Report and Project Summary	
- Scott AFB, IL	01/01/91
WMOA Report and Project Summary	
- Fitzsimmons Army Hospital	02/01/91

# **POLLUTION PREVENTION PROJECT**

## **RREL Pollution Prevention Research Projects**



### **CHEMICAL SUBSTITUTES FOR TCA AND METHANOL IN MANUFACTURING OPERATIONS**

***PROJECT OFFICER***

Lisa M. Brown (513) 569-7634  
Johnny Springer, Jr. (513) 569-7542

***PRINCIPAL  
INVESTIGATOR***

In-house project in collaboration with:

Matthew Bower (513) 278-6547  
APS Materials, Inc.  
153 Walbrook  
Dayton, Ohio

Mike Szabo (513) 782-4829  
PEI Associates, Inc.  
11499 Chester Road  
Cincinnati, Ohio 45246

***DESCRIPTION***

A technical evaluation has been conducted at a small metal finishing company to determine the waste reduction/pollution prevention that can be achieved by substituting a dilute terpene-based cleaning solution for TCA and methanol in the cleaning of orthopedic implants. The final report is completed and the study found that the water-based solvent performs adequately as a substitute for TCA and methanol in degreasing operations.

***PERIOD OF  
PERFORMANCE***

3/1/89 - 9/30/89

***MILESTONES***

One paper - 4/89



## **CHROMATE RECOVERY BY ADSORPTIVE FILTRATION**

***PROJECT OFFICER***

Lisa M. Brown (513) 569-7634

***PRINCIPAL  
INVESTIGATOR***

Mark M. Benjamin (206) 543-7645  
University of Washington  
Department of Civil Engineering - FX-10  
Seattle, Washington 98195

***DESCRIPTION***

The objective of this project is to evaluate the performance of packed beds of granular media coated with iron oxide and other adsorbents for recovering chromate from industrial waste solutions. The initial testing will be conducted using synthetic wastes. Following that, tests will be conducted using batches of real waste. A small recovery unit will be installed on-site at an industry near the University at the culmination of the project for pilot-scale evaluation.

The experimental tasks have been divided into three phases:

- I. Optiminization of the process for coating the media with an adsorbent surface;
- II. Optimizing collection and recovery of chromate from relatively dilute synthetic waste solutions;
- III. Testing the process with real industrial wastes both at bench-scale and on-line at an industrial site.

***PERIOD OF  
PERFORMANCE***

10/1/89 - 4/30/92

***MILESTONES***

Final Report 4/30/92

# **POLLUTION PREVENTION PROJECT**

## **RREL Pollution Prevention Research Projects**



### **EVALUATION OF POLLUTION PREVENTION TECHNOLOGIES IN A NEW JERSEY VEHICLE MAINTENANCE AND REPAIR FACILITY**

#### **PROJECT OFFICER**

Paul M. Randall (513) 569-7673

#### **PRINCIPAL INVESTIGATOR**

Sanat Bhavsar (609) 292-8341  
State of New Jersey  
Department of Environmental Protection  
401 E. State Street  
5th Floor CN-028  
Trenton, New Jersey 08625-0402

#### **DESCRIPTION**

In September 1989, the USEPA and NJDEP entered into an agreement to investigate pollution prevention technologies. This cooperative agreement has a unique approach to evaluating source reduction and on-site reuse/recycling technologies to reduce waste generated. Main objectives of this study are: measurement of waste minimization efforts by New Jersey industries; develop and implement technologies in the vehicle maintenance and repair industry.

A detailed analysis of a waste minimization data base was compiled from the N.J. waste minimization reports for 1985, 1986, 1987. A report has been submitted summarizing the efforts of N.J. industries to minimize wastes.

At least five (5) target technologies have been identified for evaluation in the vehicle maintenance and repair industry. Phase I of the evaluation will investigate engine antifreeze recycling and reuse, and motor vehicle air conditioning refrigerant recovery and reuse. Phase II technologies are yet to be determined; however, they may consist of improved spray painting technology, parts cleaning technologies using aqueous cleaners and ultrasonic baths, or oil life extension studies.

The New Jersey Institute of Technology (NJIT) is preparing Quality Assurance Plans. Technologies will be tested at the New Jersey Department of Transportation (NJDOT) Facility. Results will be used as a model and guide for pollution prevention in the vehicle maintenance and repair industry.

***PERIOD OF  
PERFORMANCE***

9/1/89 - 8/31/91

***MILESTONES***

QAPP for Phase I technologies	07/90
Annual progress report	10/90
QAPP for Phase II technologies	11/90
Research paper	02/91
Project final report and summary	09/91

# **POLLUTION PREVENTION PROJECT**

## **RREL Pollution Prevention Research Projects**



### **INDUSTRY-SPECIFIC WASTE MINIMIZATION MANUALS**

#### **PROJECT OFFICER**

Teresa M. Harten (513) 569-7565

#### **PRINCIPAL INVESTIGATOR**

David Shoemaker (818) 449-2171  
Jacobs Engineering  
251 South Lake Avenue  
Pasadena, California 91101-3063

#### **DESCRIPTION**

Under this project, the Pollution Prevention Research Branch is publishing a series of industry-specific waste minimization guidance manuals. Existing manuals already developed by the State of California Department of Health Services for targeted industries are modified and augmented so that they are comprehensive, nationally applicable guidance documents. By June 1990, seven manuals had been published for the industrial categories designated in the titles provided below, making up the first set of manuals in the series. A second set of eleven manuals is scheduled for publication in late 1990 and early 1991; industrial categories that will be addressed and the publication schedule are listed below.

#### **PERIOD OF PERFORMANCE**

11/30/88 - 5/1/91

#### **MILESTONES**

*Guides to Pollution Prevention: The Paint Manufacturing Industry*  
EPA/625/7-90/005  
*Guides to Pollution Prevention: The Pesticide Formulating Industry*  
EPA/625/7-90/004  
*Guides to Pollution Prevention: The Commercial Printing Industry*  
EPA/625/7-90/008  
*Guides to Pollution Prevention: The Fabricated Metal Industry*  
EPA/625/7-90-006  
*Guides to Pollution Prevention: Selected Hospital Waste Streams*  
EPA/625/7-90/009  
*Guides to Pollution Prevention: Research and Educational Institutions*  
EPA/625/7-90/010



## **NEW JERSEY/EPA WASTE MINIMIZATION ASSESSMENT PROGRAM**

**PROJECT OFFICER**

Mary Ann Curan (513) 569-7837

**PRINCIPAL  
INVESTIGATOR**

Sanat Bhavsar (609) 292-8341  
State of New Jersey  
Department of Environmental Protection  
401 E. State Street  
5th Floor CN-028  
Trenton, NJ 08625

**DESCRIPTION**

This project is designed to evaluate the use of waste minimization assessments in thirty hazardous waste generating facilities (across ten industries) in New Jersey. The assessments are being conducted by the New Jersey Institute of Technology (NJIT) personnel and follow the EPA recommended procedure. NJDEP refers to the project as "Assessment of Recycling and Recovery Opportunities for Hazardous Waste (ARROW)."

Initial industries being studied include: 1) Nuclear Power Generation; 2) Graphics Control Manufacturing; 3) Paints and Coatings Manufacturing; 4) Printing; 5) Lubricant Production; 6) Transportation Vehicle Maintenance; and 7) Leather Finishing.

**PERIOD OF  
PERFORMANCE**

9/1/88 - 3/1/91

**MILESTONES**

30 Project Summaries (assessments)	3/90 - 3/91
10 Research Briefs (industries)	3/91
Final Report	2/91

# **POLLUTION PREVENTION PROJECT**

*RREL Pollution Prevention Research Projects*



## **SMALL GENERATOR WASTE MINIMIZATION ASSESSMENTS**

### **PROJECT OFFICER**

Brian A. Westfall (513) 569-7755

### **PRINCIPAL INVESTIGATOR**

Dr. F. William Kirsch (215) 387-2255  
Industrial Technology & Energy Management Division  
University City Science Center  
3624 Market Street  
Philadelphia, Pennsylvania 19104

### **DESCRIPTION**

Technical assistance to small- and medium-sized businesses which lack in-house capability for initiating waste minimization programs is provided through a cooperative agreement with the University City Science Center. Assessment teams composed of faculty and students have been established at the University of Tennessee (Knoxville), Colorado State University (Fort Collins), and the University of Louisville (Kentucky). The assessment teams apply and adapt the procedures in EPA's *Waste Minimization Opportunity Assessment Manual* to candidate facilities at no cost to the site owner. Waste minimization alternatives are identified and accompanied with estimated implementation costs and projected savings. All aspects of implementation are the responsibility of the host facility. A follow-up visit within one year documents the actual costs and savings generated by any of the recommendations which are implemented.

A broad spectrum of businesses have been included among the sites visited, as reflected in the following partial list:

- Metal Can Production
- Plastic Sign Manufacturing
- Automobile Bumper Refurbishing
- Glass Products
- Logging
- Railroad Car Refurbishing
- Printed Circuit Boards
- Paint Production



- Commercial Printing
- HVAC Equipment Production

***PERIOD OF  
PERFORMANCE***

6/20/88 - 3/19/91

***MILESTONES***

Twenty-four Case Study Summaries 8/90

***PERFORMANCE***

6/20/88 - 3/19/91

# **POLLUTION PREVENTION PROJECT**

## **RREL Pollution Prevention Research Projects**



### **WASTE REDUCTION FROM CHLORINATED AND PETROLEUM-BASED DEGREASING OPERATIONS**

#### **PROJECT OFFICER**

Mary Ann Curran (513) 569-7837

#### **PRINCIPAL INVESTIGATOR**

Dr. Ray Tarrer (205) 826-4827  
Auburn University  
Auburn, Alabama 36849

#### **DESCRIPTION**

In support of the Department of Defense waste minimization program, the Air Force is seeking to obtain the best available technology for its chlorinated solvents program. The major chlorinated degreasing solvent in use is 1,1,1,-trichloroethane (TCA). Concerns about the hazards associated with solvent recycling, as well as the handling of common chlorinated solvent inhibitors, have motivated the Air Force to investigate solvent use and recycling. In this joint effort with EPA, Auburn University will ascertain what is required to make state-of-the-art solvent recycling technology available, and minimize the risks to operators, liability, and damage to parts being cleaned. Under this charge, Auburn University has proposed a research effort in cooperation with a major solvent manufacturer. Initially, a risk assessment will be performed for the ongoing solvent recycling program at Tinker Air Force Base. The results will be used in formulating a model technology service program.

#### **PERIOD OF PERFORMANCE**

10/10/89 - 7/9/91

#### **MILESTONES**

Final Report

4/91



## **RREL Pollution Prevention Research Projects**

### **POLLUTION PREVENTION BY AND FOR SMALL BUSINESS**

**PROJECT OFFICER**

Kenneth R. Stone (513) 569-7474

Karen V. Brown (202) 557-1938  
Office of Small and Disadvantaged Business Utilization

**PRINCIPAL  
INVESTIGATOR**

To be determined

**DESCRIPTION**

This program will support the implementation and demonstration of promising pollution prevention techniques and technologies by small businesses and transmit the results of those demonstrations to others in the same, or similar industries. Small businesses will be solicited for demonstration proposals. A selection committee will choose the best proposals for award. Award selection will also involve relevant association to assist the awardee with the demonstration. Results of the demonstrations will be evaluated, published, and transferred throughout the relevant industries through a variety of methods.

This project will provide awards of \$25,000 each to small businesses that will demonstrate innovative approaches to pollution prevention. The demonstrations will be conducted on-site by the small business awardee. The EPA, along with supporting trade associations, will monitor the demonstration, analyze the results, and disseminate the conclusions among small businesses, relevant trade associations, and interested parties.

Fifteen trade associations have agreed to participate in this program and provide assistance to small businesses in the areas of technology and information transfer. Presentations of demonstration results will be sponsored at annual conferences and regional workshops as appropriate.

**PERIOD OF  
PERFORMANCE**

10/90 - 9/92

## ***MILESTONES***

Publish Demo Reports from 1990 Pilot Program	11/90
Publish Demo Reports from 1991 Active Program	09/91
Publish Demo Reports from 1992 Active Program	09/92



## **OHIO WASTE MINIMIZATION ASSESSMENTS**

**PROJECT OFFICER**

Mary Ann Curran (513) 569-7837

**PRINCIPAL  
INVESTIGATOR**

Barry Langer (201) 599-0100  
SAIC  
1 Sears Drive  
Paramus, New Jersey 07652

**DESCRIPTION**

This project carried out waste minimization assessments at various types of facilities in the immediate vicinity of the Risk Reduction Engineering Laboratory in Cincinnati. Assessments were carried out in accordance with the EPA Waste Minimization Opportunity Assessment Manual. To date, assessments have been carried out in a truck assembly facility, a mini photo lab, and a large church. of these assessments have produced draft reports outlining findings and recommendations for waste reduction.

**PERIOD OF  
PERFORMANCE**

4/89-9/91

**MILESTONES**

Assessment Report - Mini Photo Lab	2/91
Assessment Report - Church	4/91
Assessment Report - Truck Assembly	5/91

# **POLLUTION PREVENTION PROJECT**

## **RREL Pollution Prevention Research Projects**



### **FITZSIMONS ARMY MEDICAL CENTER**

**PROJECT OFFICER**

Kenneth R. Stone (513) 569-7474

**PRINCIPAL  
INVESTIGATOR**

To be determined

**DESCRIPTION**

Under the WREAFS program, RREL has taken the initiative to merge the experience and resources of the EPA with other federal agencies. Last year, a study of the Veterans Affairs Hospital Medical Center in Cincinnati (VA-Cin) was completed under WREAFS and a list of research needs was identified. This list recommends areas for future study by the EPA.

At the Fitzsimons Army Medical Center (FAMC) in Aurora, Colorado, the Army and the EPA will cooperate in an assessment that will emphasize application of these research needs. The FAMC is owned and managed by the Army's Health Services Command, and provides a full gamut of medical and health services to all U.S. military personnel, their dependents, and retirees.

An assessment team, made up of Army, EPA, and EPA contractor personnel will identify specific areas of the FAMC to be visited and evaluated. Individuals will be selected to perform the assessment, and then, in a draft report, review the observations and offer pollution prevention recommendations for the specific FAMC activities. This report will also evaluate the potential opportunities of future research.

**PERIOD OF  
PERFORMANCE**

8/90 - 1/91

**MILESTONES**

A final report (Research Brief) is planned for each technology evaluated in California.

Conduct On-site Assessment	08/90
Produce Draft Report for Review	10/90
Print Final Report	01/91



**WASTE MINIMIZATION ASSESSMENTS & REVIEWS  
WITHIN THE FEDERAL COMMUNITY**

**PROJECT OFFICER**

Kenneth R. Stone (513) 569-7474

**PRINCIPAL  
INVESTIGATOR**

To be determined

**DESCRIPTION**

Under this project, a Waste Minimization Opportunity Assessment (WMOA) will be conducted at a Department of the Treasury facility, such as an operation at the U.S. Mint, or Bureau of Engraving, where the principal waste generating activities result in metal and ink wastes. In addition, the principal investigator will review reports from two previous WMOAs of Federal facilities: the Veterans Affairs Hospital Medical Center in Cincinnati (VA-Cin); and Building 8100 (FORSCOM), Ft. Riley, Kansas (Ft. Riley). These reviews will evaluate the waste minimization options, findings, recommendations, and R&D needs identified in the earlier studies. The purpose is to take these findings one step further by providing assessment of costs, public opinion, in-house politics, available service marketing and promotion, and distribution.

**PERIOD OF  
PERFORMANCE**

4/90 - 2/91

**MILESTONES**

A final report (Research Brief) is planned for each technology evaluated in California.

Conduct On-site Assessment	08/90
Review Ft. Riley and Va-Cin Studies	09/90
Produce Draft Report for Review	11/90
Print Final Report	02/91

# **POLLUTION PREVENTION PROJECT**

## **RREL Pollution Prevention Research Projects**



### **WET TO DRY SYSTEM EVALUATION IN A NAVY PAINT SPRAY BOOTH**

#### **PROJECT OFFICER**

Paul M. Randall (513) 569-7673

#### **PRINCIPAL INVESTIGATOR**

Jacqueline Ayer (415) 961-5700 Ext. 3902  
Acurex Corporation  
485 Clyde Avenue  
P.O. Box 7044  
Mountain View, California 94039

#### **DESCRIPTION**

The Naval Energy and Environmental Support Activity (NEESA) has made a decision to convert one or more Navy paint spray booths equipped with water curtain particulate emission control systems to dry filtration operation. Conversion will result in the elimination of a hazardous wastewater stream caused by the removal of small amounts of volatile organic compounds (VOCs) from the air stream. Particulate matter is controlled using the cartridge filtration system.

The Pollution Prevention Research Branch (PPRB) of the Risk Reduction Engineering Laboratory (RREL) in Cincinnati, Ohio, has a research program called the Waste Reduction Evaluations at Federal Sites (WREAFS) program that supports research projects between the EPA and other federal agencies to demonstrate and evaluate products and processes that result in less waste being generated. This project will evaluate the conversion of a Navy paint spray booth from a water curtain particulate emission control technology to a dry filtration technology.

This project is awaiting award of the funding.

#### **PERIOD OF PERFORMANCE**

8/1/90 - 2/1/91

#### **MILESTONES**

A final report (Research Brief) is planned for each technology evaluated in California.

Final report and project summary	3/91
Research	4/91





## **AMERICAN INSTITUTE FOR POLLUTION PREVENTION**

***PROJECT OFFICER***

David G. Stephan (513) 569-7896

***PRINCIPAL  
INVESTIGATOR***

Thomas R. Hauser (513) 556-3693  
Dept. of Civil and Environmental Engineering  
University of Cincinnati  
Cincinnati, Ohio 45221

***DESCRIPTION***

The objective of this project is to establish and support an Institute that can: provide a new liaison channel between EPA and potential implementers of pollution prevention techniques, primarily in industry; assist the EPA in improving the quality and cost-effectiveness of its programs in the pollution prevention area; and help generate both private and public sector support for pollution prevention concepts.

Some 20 individuals with records of accomplishment in pollution prevention have been appointed to Institute membership. Dr. Joseph T. Ling has been elected Institute Chairman and Dr. Thomas L. Hurst has been elected as Vice-Chairman. The Institute's Executive Director is Dr. Thomas R. Hauser of the University of Cincinnati. Four Councils representing areas of special concern (Economics, Education, Implementation, and Technology) have been established and a set of specific 1- to 2-year objectives have been developed including: promoting/sponsoring several meetings on pollution prevention; assisting EPA on several of its "2% set-aside" projects; developing a plan for development/dissemination of pollution prevention curricula materials; examining pollution prevention economic models and other economic materials for effectiveness; defining various pollution prevention barriers/incentives; developing a measurement tool for pollution prevention progress; and participating in several pollution prevention demonstration projects.

***PERIOD OF  
PERFORMANCE***

10/1/88 -- Indefinite

## ***MILESTONES***

A final report (Research Brief) is planned for each technology evaluated in California.

Solicit member nominations	12/15/88
Appoint members	3/31/89
Hold inaugural meeting	6/30/89
Establish initial objectives	10/31/89
Produce annual progress report	6/30/90
Produce annual progress report	6/30/91



## **INTERNATIONAL CONFERENCE ON POLLUTION PREVENTION**

### **PROJECT OFFICER**

Kenneth R. Stone (513) 569-7474

### **PRINCIPAL INVESTIGATOR**

Mary Bourassa (703) 734-3198  
SAIC  
8400 Westpark Drive  
McLean, Virginia 22102

### **DESCRIPTION**

On June 10-13, 1990, a three-day international conference on pollution prevention was held at the Omni Shoreham Hotel in Washington, DC. With the support of the Department of Defense (DOD), the Department of Energy (DOE), and the International Association for Clean Technology (IACT), this conference explored the innovative technologies and socioeconomic issues arising in the field of pollution prevention. The conference attendance was 1,007, including participants from 43 countries.

This conference was also a demonstration project on how to run a large meeting as a clean product. Every effort was made to examine options that would minimize the volume of waste generated. Costs/savings from implementing these options were recorded and will be in a separate report.

### **PERIOD OF PERFORMANCE**

6/90 - 9/90

### **MILESTONES**

A final report (Research Brief) is planned for each technology evaluated in California.

First Announcement - Call for Papers

Second Announcement - Call for Papers

CEM Message: "EPA Plans Conference as a Clean Product"

Registration Brochure

Abstract Book

International Conference on Pollution Prevention

6/10-13/90

Conference Proceedings

8/90

Report on the Conference as a Clean Product

9/90

# **POLLUTION PREVENTION PROJECT**

## ***RREL Pollution Prevention Research Projects***



### **EPA RESEARCH PROJECT CASE STUDIES**

***PROJECT OFFICER***

Johnny Springer, Jr. (513) 569-7542

***PRINCIPAL  
INVESTIGATOR***

In-House Project

***DESCRIPTION***

The objective of this project is to prepare a compilation of summaries of waste minimization demonstrations, assessments, and research projects for publication as an EPA publication. This publication will contain all pollution prevention activities conducted in the Pollution Prevention Research Branch. The publication will contain an introduction and a subject index. All case studies will be represented according to a common format. A format for the publication has been developed, two reports have been prepared for inclusion in the book, and several other reports are currently being edited.

***PERIOD OF  
PERFORMANCE***

Annual

***MILESTONES***

A final report (Research Brief) is planned for each technology evaluated in California.

One volume to be produced annually



## **SPECIAL EDITION ON WASTE MINIMIZATION FOR JOURNAL OF HAZARDOUS MATERIALS**

**PROJECT OFFICER**

S. Garry Howell (513) 569-7756

**PRINCIPAL  
INVESTIGATOR**

In-House Project

**DESCRIPTION**

A special edition on waste minimization for the *Journal of Hazardous Materials* is being prepared. After consulting with the editor of the regular edition of the Journal, Gary Bennett of the University of Toledo, it was decided that authors with diverse viewpoints (EPA, academia, and industry) would be solicited for papers. If more than 10 or 12 acceptable papers are received, the excess would be considered for another special edition, or they might be submitted to another special edition, or they might be submitted to another journal. Since the *Journal of Hazardous Materials* is peer reviewed, most authors would prefer to publish in it.

To date, we have seven outside authors giving oral commitments, and one tentative commitment. The Pollution Prevention Research Branch will contribute another nine or ten, so even with a 50 percent rate of participation, there should be enough to fill one edition.

**PERIOD OF  
PERFORMANCE**

11/1/89 - 1/2/91

**MILESTONES**

A final report (Research Brief) is planned for each technology evaluated in California.

Submit Titles	12/01/89
Submit Abstracts	01/15/90
Submit Manuscripts	3/01/90
Finish Reviews and Corrections	01/25/91
Write Guest Editorial	01/2/91

# **POLLUTION PREVENTION PROJECT**

## **RREL Pollution Prevention Research Projects**



### **POLLUTION PREVENTION TECHNICAL SUPPORT**

#### **PROJECT OFFICER**

Ivars J. Lics (513) 569-7718

#### **PRINCIPAL INVESTIGATOR**

Jeffrey Means (614) 424-5442  
Battelle  
505 King Avenue  
Columbus, Ohio 43201-2693

#### **DESCRIPTION**

This project is comprised of two major parts, Pollution Prevention Technology Evaluations (such as those for WRITE), and Technical Assistance for Pollution Prevention. The first part provides contractor help in producing a test and QA plan; supplying the equipment and personnel to conduct, analyze and evaluate the test results; and preparing a draft report. To date, five (5) technology evaluation projects are being planned:

Connecticut WRITE  
Minnesota WRITE  
New Jersey WRITE  
New Jersey Prototype Evaluations  
Washington State WRITE

The specific technologies and test arrangements are in the process of being defined. A total of approximately 20 evaluations are planned at this time.

The second part of the project covers review of technical proposals, review of information for technical transfer purposes, and performance of assessments of pollution prevention technologies.

#### **PERIOD OF PERFORMANCE**

8/90 - 9/30/91

## ***MILESTONES***

A final report (Research Brief) is planned for each technology evaluated in California.

One report, paper, or research brief is planned for each technology evaluated. Summary, informal reports are to be prepared for the project two effort.

# **POLLUTION PREVENTION PROJECT**

## **RREL Pollution Prevention Research Projects**



### **POLLUTION PREVENTION INFORMATION CLEARINGHOUSE (PPIC)**

#### **PROJECT OFFICER**

Myles Morse (202) 382-5747

#### **PRINCIPAL INVESTIGATOR**

Chris Messner (703) 821-4800  
Science Applications International Corp.  
8400 Westpark Drive  
McLean, Virginia 22102

#### **DESCRIPTION**

The objective of this project is to establish and operate a national information clearinghouse on the subject of pollution prevention. The clearinghouse provides a wide range of information services related to pollution prevention and is meant to serve the needs of federal, state and local government agencies (including EPA), large and small businesses, trade associations, and others needing information on this subject.

PPIC contains abstracted and indexed technical information regarding pollution prevention techniques applicable to different industries, different manufacturing processes, and different types of wastes. It also contains information concerning federal and state assistance programs, legislative and policy matters, lists of knowledgeable contacts, a schedule of pertinent meetings, conferences and training sessions, and information on international activities on pollution prevention.

PPIC can be accessed by toll-free telephone "hotline" or by computer. Information packets containing general and industry-specific materials are available either by mail or through computer downloading. In addition, PPIC allows a user to order pertinent EPA reports directly from the National Technical Information Service or PPIC supplies the necessary ordering information for reports from other sources.

#### **PERIOD OF PERFORMANCE**

7/1/88 - ongoing



## ***MILESTONES***

Transfer Clearinghouse from OSW to ORD	7/1/88
Conduct planning workshop	12/31/88
Define Clearinghouse specifications	2/28/89
Initiate pilot test of computer system	3/31/89
Arrange for and train hotline staff	9/30/89
Complete pilot test of computer system	12/31/89
Place PPIC in full operation	1/15/90
Produce annual progress report	2/15/90
Produce annual progress report	2/15/91

**POLLUTION PREVENTION PROJECT**  
**RREL Pollution Prevention Research Projects**



**PRODUCT LIFE CYCLE ASSESSMENTS WORKSHOP**

**PROJECT OFFICER**

Mary Ann Curran (513) 569-7837

**PRINCIPAL  
INVESTIGATOR**

Dr. James A. Fava (202) 371-1090  
Society of Environmental Toxicology and Chemistry  
1101 14th Street, N.W.  
Suite 1100  
Washington, DC 20005

**DESCRIPTION**

The Society of Environmental Toxicology and Chemistry (SETAC) organized and conducted a workshop on August 18-23, 1990, to develop a technical framework for product life cycle assessments (PLAs). This workshop was conducted in a format which follows SETAC's successful Pellston Workshop Series. Since 1977, eight workshops of this type have been held. Participants invited to the workshop included over 50 representatives from industry, academia, trade associations, and state and federal governments.

The purpose of PLA Workshop was to reach consensus on the current questions about approaches to performing PLAs and develop recommendations about what additional information is necessary to provide a better understanding of the methodology. The objectives of the workshop were: 1) provide definitions, terms, and common vocabulary; 2) discuss state-of-the-art methodologies; 3) organize case histories and other consensus building thinking; and 4) identify research priorities.

**PERIOD OF  
PERFORMANCE**

7/90 - 12/90

**MILESTONES**

Draft Report	10/10/90
Final Report	12/30/90



## **USCGS KETCHAKAN POLLUTION PREVENTION PROJECT**

***PROJECT OFFICER***

Kenneth R. Stone (513) 569-7474

***PRINCIPAL  
INVESTIGATOR***

To be determined

***DESCRIPTION***

Under the WREAFS program, RREL and Region X are cooperating on providing support to the Alaska Department of Environmental Conservation (ADEC) and the United States Coast Guard Service (USCGS) to assess pollution prevention opportunities at the USCGS facilities at Ketchikan, Alaska. This project will provide technical assistance to facility operators, develop pollution prevention recommendations, and assist ADEC and USCGS in their implementation.

***PERIOD OF  
PERFORMANCE***

8/90 - 1/91

***MILESTONES***

Conduct Assessment	10/90
Draft Report on the Assessment	11/90
Final Pollution Prevention Plan	12/90

# **POLLUTION PREVENTION PROJECT**

## **RREL Pollution Prevention Research Projects**



### **CLEAN PRODUCTS WORKSHOP SERIES**

**PROJECT OFFICER**

Mary Ann Curran (513) 569-7837

**PRINCIPAL  
INVESTIGATOR**

Barry Langer (201) 599-0100  
SAIC  
1 Sears Drive  
Paramus, New Jersey 07652

**DESCRIPTION**

A series of workshops are being conducted to bring together representatives from industry, consumer groups, state and federal government, trade associations, academia, service industry, etc., involved in and knowledgeable of particular product areas where research needs can be identified. Workshops have been held in Cincinnati on tire recycling (August 2-3, 1989) and the diaper industry (July 31, 1990). Another workshop on dry cell batteries is being scheduled for Fall 1990. Three more are being planned for FY91. The product areas for future workshops are yet to be determined.

**PERIOD OF  
PERFORMANCE**

6/89 - 9/91

**MILESTONES**

Tire Recycling Workshop Unpublished Report	9/90
Diaper Industry Workshop Report	12/15/90
Dry Cell Battery Workshop Report	To be announced



## **RECLAIMING FIBER FROM NEWSPRINT**

**PROJECT OFFICER**

Teresa M. Harten (513) 569-7565

**PRINCIPAL  
INVESTIGATOR**

Dennis Gunderson (608) 231-9200  
Forest Products Laboratory  
One Gifford Pinchot Drive  
Madison, Wisconsin 53705-2398

**DESCRIPTION**

This project, which is funded under an Interagency Agreement with USDA's Forest Products Laboratory (FPL) in Madison, Wisconsin, is designed to investigate the potential for reclaiming newsprint by means of a dry fiberizing process. It is part of a larger research program at FPL that will explore dry and/or semi-dry paper-making processes; the American Newsprint Publishing Association (ANPA), FPL, and EPA are co-funding the total program. For the dry fiberizing portion of the program, FPL is looking at three methods for disintegrating newsprint that achieve the goals of fiberizing: effective separation of fibers with minimal damage to or shortening of these fibers. The three methods are hammermilling, ballmilling, and single disk refining.

During the first year of the project, FPL conducted familiarization and check-out trials with equipment, designed and constructed a laboratory device for separating the dry fiberized material, and began fiberizing and sampling in earnest. In best efforts to date, 97 percent of fiber length was retained (as compared to a wet slushed pulp) when old news was fiberized at 52 percent moisture content. Handsheets made from the semi-dry fiberized pulp did not perform as well as control handsheets, however. Wet-formed handsheets made from the semi-dry fiberized pulp delivered 93 percent of the tear strength and only 69 percent of the tensile strength of the control handsheets.

In an attempt to improve the strength properties of paper made from dry fiberized pulp, the remaining two years of the project will focus on ways of stimulating the bonding capabilities of the experimental pulp. Although wet technology exists to accomplish bonding enhancement, as with pulping and forming, the present research will investigate ways of doing this under dry or semi-dry conditions.

***PERIOD OF  
PERFORMANCE***

6/15/89 - 9/30/92

***MILESTONES***

Paper	6/1/90
Interim Report	9/1/90
Paper	5/15/91
Interim Report	9/1/91
Paper	6/15/92
Final Report	9/1/92



## **DETERMINATION OF LEGITIMATE HAZARDOUS WASTE RECYCLING**

### ***PROJECT OFFICER***

Brian A. Westfall (513) 569-7755

### ***PRINCIPAL INVESTIGATOR***

Barbara L. Cormier (513) 252-1222  
PEER Consultants  
4134 Linden Avenue, Suite 202  
Dayton, Ohio 45432

### ***DESCRIPTION***

The Resource Conservation and Recovery Act (RCRA), as well as EPA's waste management hierarchy, places a high priority on recycling waste rather than using conventional treatment and disposal methods. An incentive for recycling hazardous waste is the exemption of recycling operations from the RCRA permit requirements for hazardous waste treatment, storage, or disposal facilities. The regulatory requirements for treatment facilities are detailed and specific, but the requirements for recyclers are very general and little guidance has been developed to apply the requirements to a proposed recycling operation.

The Ohio EPA and U.S. EPA's Region V reviewed the claims of a company proposing to recycle hazardous electroplating sludges (RCRA Waste Code F006) by producing a material with uses in the abrasives industry or in ceramic building materials and fixtures. Technical assistance to determine whether or not the process meets the regulatory requirements as legitimate recycling was provided by the project officer and contracted consultants. Technical criteria for legitimate recycling include the following:

- The hazardous constituent(s) of the waste must be an essential ingredient of the end product.
- The product must be marketable.
- The recycler must have equipment capable of producing material which meets market specifications.

The proposed process was evaluated at bench-scale and in a test of a full-scale unit. The process was determined to meet the criteria for legitimate hazardous waste recycling and a letter confirming that finding was issued by Region V early in April 1990.

***PERIOD OF  
PERFORMANCE***

1/20/89 - 3/31/90

***MILESTONES***

Internal Report

3/90





## **COMPOSITES FROM RECYCLED PLASTICS, WOOD, AND RECYCLED WOOD FIBER**

### **PROJECT OFFICER**

Teresa Harten (513) 569-7565

### **PRINCIPAL INVESTIGATOR**

John Youngquist (608) 231-9398  
Forest Products Laboratory (FPL)  
One Gifford Pinchot Drive  
Madison, Wisconsin 53705-2398

### **DESCRIPTION**

A three-year interagency agreement has been made between the FPL and EPA to investigate and develop wood/plastic composites. The program is designed to examine the application of conventional equipment for thermomechanical production of wood fiber to the simultaneous formation of wood fibers and ground plastic from wood chips and plastic bottles. The program is also investigating forming operations such as extrusion, injection molding, and nonwoven web technology.

This research project involves lab and pilot-scale work to develop commercially viable thermoformable composite products using recycled high density polyethylene (HDPE), polyethylene terephthalate (PET) wood flour, recycled wood fiber, and reclaimed polyester fiber. Proof of concept research performed at USDA's Forest Products Laboratory (FPL) in Madison, Wisconsin has produced promising results.

### **PERIOD OF PERFORMANCE**

5/90 - 5/93

### **MILESTONES**

Paper	4/15/91
Interim Report	5/15/91
Paper	4/1/92
Interim Report	5/15/92
Paper, Final Report	5/93

# **POLLUTION PREVENTION PROJECT**

## **RREL Pollution Prevention Research Projects**



### **OIL LIFE EXTENSION**

#### **PROJECT OFFICER**

Paul M. Randall (513) 569-7673

#### **PRINCIPAL INVESTIGATOR**

Mr. David R. Kidd, P.E.  
Alaska Health Project  
431 W. 7th Avenue, Suite 101  
Anchorage, Alaska 99501

#### **DESCRIPTION**

This research cooperative agreement will be conducted by the Alaska Health Project (AHP) and the USEPA as part of the Pollution Prevention Research effort. AHP is a non-profit organization located in Anchorage, Alaska and provides technical support to small-medium sized businesses, rural communities, and the state to reduce wastes.

The principal thrust of this research project is to evaluate and demonstrate the effectiveness of by-pass ultra-filtration units with oil analysis to extend the useful life of lubricating oils in motor vehicles. The effectiveness of by-pass filters can be measured by installing them on engines and performing regular lab tests to measure the condition of the oil over time. Oil loses its ability to lubricate when contaminated by water, dirt, metal, or particles ranging from 20 to 40 microns. By-pass filters have the ability to filter contaminant particles down to <1 micron and can also absorb water. When sulfur particles combine with moisture in the crankcase oil, corrosive sulfuric acid is formed. By-pass manufacturers claim that the filter media will absorb water and minimize the sulfuric acid buildup in the crankcase oil. In the past three years, the Alaska Health Project has identified vendors and users of by-pass filtration units and oil analytical testing programs. Very little research has been done to date on the engineering impact of this technology and its application, especially in rural areas with limited support services.

This research is in the early stages. A cooperative agreement package has been submitted for funding.

***PERIOD OF  
PERFORMANCE***

9/1/90 - 8/31/93

***MILESTONES***

To be determined

# **POLLUTION PREVENTION PROJECT**

## **RREL Pollution Prevention Research Projects**



### **POLLUTION PREVENTION IN PUBLIC AGENCIES**

#### **PROJECT OFFICER**

Brian A. Westfall (513) 569-7755

#### **PRINCIPAL INVESTIGATOR**

Gordon R. Garner (502) 587-0591  
Louisville & Jefferson County Metropolitan Sewer District  
400 South Sixth Street  
Louisville, Kentucky 40202

#### **DESCRIPTION**

The Louisville and Jefferson County Metropolitan Sewer District (MSD) has proposed a project to develop and implement a comprehensive pollution prevention assessment process for public agencies and institutions located in the Louisville Metropolitan area. Under a cooperative agreement with EPA, the MSD will evaluate the current status of pollution prevention awareness and activities at a number of state, local and federal government organizations, including municipal governments, public schools, the water utility, the regional airport, state offices, the University of Louisville, and MSD itself. A pollution prevention assessment process specifically for public agencies will be developed and then tested at MSD and one or two additional agencies. The process will be modified as necessary and then used at all facilities which will participate. The widespread use of a uniform procedure will enhance the transfer of information among facilities having common waste management problems and similar waste reduction opportunities.

#### **PERIOD OF PERFORMANCE**

9/1/90 - 8/31/92

#### **MILESTONES**

Phase I - Evaluate current pollution prevention activities, Interim Report - 1990  
Phase II - Develop and test assessment process, Interim Report - 9/91  
Phase III - Assessments at remaining agencies, Final Report - 8/92



## **MODEL COMMUNITY POLLUTION PREVENTION CASE STUDY**

***PROJECT OFFICER***

Kenneth R. Stone (513) 569-7474

***PRINCIPAL  
INVESTIGATOR***

To be determined

***DESCRIPTION***

The purpose of this project is to establish a model environmental risk reduction program on a military base to demonstrate how pollution prevention techniques can be combined into a community through all the everyday community institutions, businesses and services. This model plan will address community organization, facilities and services, energy, transportation and education.

Currently, EPA is working with the Department of Defense selecting an appropriate military base for the study.

***PERIOD OF  
PERFORMANCE***

9/90 - 3/93

***MILESTONES***

Selection of Model Community Site 8/90

# **POLLUTION PREVENTION PROJECT**

## **RREL Pollution Prevention Research Projects**



### **METHODOLOGY FOR MEASURING POLLUTION PREVENTION**

**PROJECT OFFICER**

David G. Stephan (513) 569-7896

**PRINCIPAL  
INVESTIGATOR**

To be determined

**DESCRIPTION**

To adequately reflect the progress of waste reduction and determine the success of pollution prevention, it is necessary to utilize an appropriate measurement methodology that is acceptable to the private and public sectors. The objective of this initiative is to develop a single methodology which integrates mass-based pollution prevention. The final report will be a decisionmakers guide for calculating the progress of pollution prevention goals and present technical information on how to set reasonable pollution prevention goals. The report should include a series of worksheets that can be used to guide industry and government through the methodology.

In cooperation with the public and private sectors the project will develop a measurement methodology for hazardous and nonhazardous multimedia pollution prevention. Necessary input will be required through coordination with professional or trade associations, State governments, DOD, DOE, EPA and others who set pollution prevention goals. EPA will present a unified approach with the assistance of representatives of PPO, OSW and OEETD.

**PERIOD OF  
PERFORMANCE**

9/90 - 8/91

**MILESTONES**

Planning research and funds transfer	0-2 months
Approved work plan and coordination within EPA	2-4 months
Draft methodology	4-6 months
Consensus approval of methodology (public and private sectors)	6-8 months
Decisionmakers guide and methodology report	8-10 months
Demonstrate guide with methodology	10-12 months

# **POLLUTION PREVENTION PROJECT**

## **AEERL Pollution Prevention Research Projects**



### **CONSUMER PRODUCT EMISSIONS PREVENTION**

#### **PROJECT OFFICER**

Chester A. Vogel (919) 541-2827

#### **PRINCIPAL INVESTIGATOR**

Bruce Moore (919) 541-5460  
U.S. Environmental Protection Agency  
Office of Air Quality Planning & Standards  
MD-13  
Research Triangle Park, NC 27711

Doris Lo (415) 744-1187  
EPA Region IX (A-2-3)  
75 Hawthorne Street  
San Francisco, CA 94105

#### **DESCRIPTION**

Volatile organic compound (VOC) and air toxic emissions will be prevented by identifying and demonstrating low-polluting consumer products. Aerosols release approximately 650,000 tons per year of organics in the United States. Hence, aerosols are an area where a significant impact can be made. The initial activity, Aerosol Propellant/Packaging Changes, will identify alternatives to organics as propellants and carrier solvents and investigate packaging alternatives to aerosols. Region IX has the lead in this activity. Consumer products are a significant, uncontrolled source of VOC emissions (up to 10% of the stationary area source inventory). Viable substitutes for automotive products, which make up 15 to 20% of consumer product VOC emissions, will be identified in a Prevention Options Availability Report. Emphasis will be placed on those products that are the greatest contributors to VOC emissions. OAQPS has the lead role in this activity.

#### **PERIOD OF PERFORMANCE**

10/1/90 - 9/30/92

## ***MILESTONES***

### **Automotive Products Prevention Options**

- Interim Report 9/15/91
- Final Report 9/30/92

### **Aerosol Propellant/Packaging Changes**

- Interim Report 9/30/91
- Final Report 9/30/92



**POLLUTION PREVENTION PROJECT**  
**AEERL Pollution Prevention Research Projects**



**MINIMIZING SOLVENT EMISSIONS FROM PESTICIDES**

**PROJECT OFFICER**

Geddes Ramsey (919) 541-7963

**PRINCIPAL  
INVESTIGATOR**

Kerry Leifer (703) 557-5108  
U.S. Environmental Protection Agency  
Office of Pesticide Programs (H-7505C)  
401 M Street, SW  
Washington, DC 20460

**DESCRIPTION**

Many pesticide inerts, the carriers and solvents used in pesticide formulations, are the source of substantial environmental problems. A strategy to reduce the volatile organic compounds (VOCs), stratospheric ozone depleters, and greenhouse gases used in, and thereby emitted from, pesticides will be established. VOC emission reduction projects will be enhanced by quantifying the type and amount of solvent inerts used in pesticides. AEERL will assemble and provide data on photochemical reactivity, stratospheric ozone depletion potential, and greenhouse factors to ensure full consideration of air issues in the resulting strategy.

OPP has address toxicity issues in its pesticide inerts strategy. However, inerts, many of which are VOCs, stratospheric ozone depleters, or greenhouse gases, continue to be released to the atmosphere during pesticide use. Research will provide information needed to reduce VOC and other organic emissions from pesticides.

**PERIOD OF  
PERFORMANCE**

10/1/90 - 12/30/92

**MILESTONES**

Characterization of Pesticide Inerts	9/15/91
Incorporation of VOC in the Pesticide Inert Strategy	12/15/92

# **POLLUTION PREVENTION PROJECT**

## **AEERL Pollution Prevention Research Projects**



### **DEMONSTRATION OF SOLVENT-FREE CLEANING**

#### **PROJECT OFFICER**

Michael Kosusko (919) 541-2734

#### **PRINCIPAL INVESTIGATOR**

Not yet identified

#### **DESCRIPTION**

The use of organic solvents for surface cleaning results in major air emissions of toxic organics and volatile organic compounds (VOCs). The use of, and thereby the air emissions from, these organic solvents will be reduced by replacing them with solvent-free cleaning methods which use relatively innocuous materials that are found in nature, such as CO<sub>2</sub>, N<sub>2</sub>, H<sub>2</sub>O, and air. Plasma cleaning would fall into this category. This solvents project is part of AEERL's integrated strategy to significantly reduce organic air emissions from all sectors of society and will impact multiple air pollution problems (tropospheric ozone, air toxics, and stratospheric ozone depletion). New solvent-free processes which reduce air emissions will be assessed using a life-cycle perspective because they will have impacts on other media.

It is recognized that surface cleaning is an active research area. During this project, contacts will be maintained with active researchers to avoid duplicative efforts and to identify the specific niches where research and demonstration efforts will have the maximum impact on organic air emissions. In the first phase, promising solvent-free technologies from the existing research of the Department of Defense (DOD), the National Aeronautics and Space Administration (NASA), the Department of Energy (DOE), and other sources will be identified. Simultaneously, a work group consisting of EPA Regions, states, OAQPS, OTS, and ORD participants will be established to provide guidance on technology requirements with respect to air regulations and to identify opportunities for the application of solvent-free cleaners in industrial facilities. In Phase II, solvent-free cleaning approaches will be demonstrated in two or three of these facilities, representing distant source categories.

***PERIOD OF  
PERFORMANCE***

4/1/91 - 6/30/92

***MILESTONES***

Priority List of Demonstrations  
Initiate Demonstrations  
Complete Demonstrations

7/15/91

9/30/91

6/30/92

# **POLLUTION PREVENTION PROJECT**

**AEERL Pollution Prevention Research Projects**



## **EVALUATION OF POTENTIAL COATING TECHNOLOGIES**

### **PROJECT OFFICER**

Michael Kosusko (919) 541-2734

### **PRINCIPAL INVESTIGATOR**

Coleen Northeim (919) 541-5816  
Research Triangle Institute  
P.O. Box 12194  
Research Triangle Park, NC 27709-2194

### **DESCRIPTION**

Opportunities for prevention of organic emissions from coating operations will be identified to provide a basis for demonstration projects and to facilitate technology transfer. Two activities are proposed: (1) The Evaluation of Potential Coating Technologies activity will identify and evaluate coatings which are more environmentally acceptable than those currently in use. Focus will be on small stationary area sources. (2) The Surface-Coating-Free Materials Workshop will explore approaches and techniques which offer potential to eliminate emissions both during the manufacture and the life of products by avoiding the coating process. A workshop will be held to ascertain the viability of new materials and opportunities for their demonstration. Industry, Department of Defense (DOD), and NASA will be solicited to help identify emerging technologies.

### **PERIOD OF PERFORMANCE**

12/1/90 - 12/15/91

### **MILESTONES**

Surface-Coating-Free Materials Workshop	6/91
Final Workshop Report	8/31/91
Evaluation of Technologies Report	12/15/91



## ALTERNATIVE COATING DEMONSTRATIONS

### **PROJECT OFFICER**

Robert C. McCrillis (919) 541-2733

### **PRINCIPAL INVESTIGATOR**

Not yet identified

### **DESCRIPTION**

The economics, ease of manufacture, quality, and durability of coated products manufactured using environmentally safe technologies will be demonstrated. New coating systems for wood furniture and autobody refinishing will be evaluated. Promising technologies are available in these areas. A third demonstration area will be selected based on discussions with potential industrial partners, the Department of Defense, or on results of the Evaluation of Potential Coating Technologies project. The demonstrations will focus on technologies for small, stationary area sources. However, demonstrations for large area sources will be considered should suitable opportunities for small area sources not be available. This task will demonstrate the next generation of technology for wood furniture, autobody refinishing, and at least one other coatings source category. State agencies could establish more stringent regulations once new technologies become available.

### **PERIOD OF PERFORMANCE**

12/1/90 - 9/30/93

### **MILESTONES**

Autobody Refinishing Demonstration	
- Final Report	6/30/92
Wood Furniture Demonstration	
- Interim Report	12/15/91
- Final Report	12/15/92
Other Demonstrations	
- Interim Report	6/30/92
- Final Report	9/30/93

# **POLLUTION PREVENTION PROJECT**

## **AEERL Pollution Prevention Research Projects**



### **CONSUMER PRODUCT TEST METHOD DEVELOPMENT**

#### **PROJECT OFFICER**

Chester Vogel (919) 541-2827

#### **PRINCIPAL INVESTIGATOR**

Joan Bursey (919) 481-0212  
Radian Corporation  
P.O. Box 13000  
Research Triangle Park, NC 27709

#### **DESCRIPTION**

Test methods for the VOC content of consumer products, such as organic liquids, aerosols, organic solids, and solids containing residual organics are being developed. These methods will be promoted as the standard measurement techniques. The development of a database of specific consumer product information is not anticipated. An opportunity exists for joint test method development with several California agencies. The Indoor Air Branch of AEERL, OAQPS, and NYSDEC (New York State) will act as technical advisors for this task.

This project will provide a key measurement tool to support the efforts of regulators and researchers to reduce VOCs, air toxics, and other environmentally adverse emissions from consumer products. As such, it has been identified by OAQPS and NESCAUM as one of the highest priority research activities for consumer products. Many states are considering rules to limit the VOC content of these products. These rules use criteria such as maximum VOC content by weight or percentage of VOCs removed from products via reformulation. There are presently no widely accepted methods for making these measurements. Hence, test method development is a key research component needed to support regulatory strategies. Similarly, industry needs these methods to evaluate their progress in reducing VOCs in their products.

#### **PERIOD OF PERFORMANCE**

4/23/90 - 9/30/92

#### **MILESTONES**

Present Preliminary Results (AWMA '91)  
Interim Technology Report  
Final Report

6/21/91  
12/15/91  
9/30/92

## *AEERL Pollution Prevention Research Projects*



### **DIAGNOSING AND PREVENTING IAQ PROBLEMS: SOURCES OF EMISSIONS AND HANDBOOK**

#### ***PROJECT OFFICER***

James White (919) 541-1189

#### ***PRINCIPAL INVESTIGATOR***

Margie Stockton  
Radian Corporation  
P.O. Box 13000  
Research Triangle Park, NC 27709

#### ***DESCRIPTION***

The need to control building systems and indoor sources is an essential component to improve indoor air quality. The information gathered in this project will enable building professionals and consumers to make informed choices about how to design and operate buildings and how to select products and materials to use in buildings. The proper use of this information will reduce exposure to a variety of IA pollutants known to be potential health hazards. The objectives of this project are the development of an information resource including a catalog, a handbook, and guidance documents which will enable the diagnosis and prevention of indoor air pollution from sources commonly found indoors. Information on low emitting materials will be combined with data on building investigations to provide recommendations for building design, operation, and product selection.

#### ***PERIOD OF PERFORMANCE***

2/27/91 - 9/30/94

#### ***MILESTONES***

Interim Catalog	09/91
Final Catalog	09/92
Interim Handbook	09/93
Final Handbook	09/94

# **POLLUTION PREVENTION PROJECT**

## **AEERL Pollution Prevention Research Projects**



### **INDUSTRY GUIDANCE/ASSISTANCE FOR HALON REPLACEMENTS**

#### **PROJECT OFFICER**

N. Dean Smith (919) 541-2708

#### **PRINCIPAL INVESTIGATOR**

Dr. Robert E. Tapscott (505) 768-7578  
New Mexico Engineering Research Institute  
University of New Mexico  
Albuquerque, NM 87131

#### **DESCRIPTION**

Alternative chemicals to Halon-1310 will be evaluated for total-flood application in fire protection for enclosed facilities such as those found on the Alaskan North Slope where leaks of flammable gaseous and liquid hydrocarbons can occur. This need includes fire suppression, explosion suppression, and explosion inerting. The assessment and comparison will include safety, health, environmental, availability, effectiveness, and other considerations needed to determine the applicability of the chemical alternatives evaluated. The alternatives will start with perfluorocarbons and will be extended to fluoroethers, hydrofluorocarbons, and others as results and funding allow.

This work is being done in cooperation with the Halon Alternatives Research Corporation and the North Slope pipeline and producing companies.

#### **PERIOD OF PERFORMANCE**

9/90 - 9/92

#### **MILESTONES**

Progress report on chemical properties	9/91
Interim report on alternative testing	12/91
Progress report: additional chemicals	9/92
Annual progress reports	10/92



## ***2% Set-Aside Project Description***



### **POLLUTION PREVENTION BY AND FOR SMALL BUSINESSES**

#### ***PARTICIPATING OFFICES***

OSDBU/Karen Brown (202) 557-7015

#### ***DESCRIPTION***

This program is designed to support the implementation and demonstration of promising pollution prevention techniques and technologies by small businesses and to transmit the results of these demonstrations to others in the same or similar industries. Small businesses will be solicited for demonstration proposals. Cooperating trade associations will strongly encourage their members to participate and assist the awardees with their demonstrations. Results of the demonstrations will be evaluated, published, and transferred throughout the relevant industry.

#### ***MILESTONES***

##### **FY 90**

- Determine criteria for selecting proposals and solicit proposals

##### **FY 91**

- Complete first selection of awardees and schedule deliverables
- Complete on-site demonstrations
- Publish final reports on selected projects

##### **FY 92**

- Complete second selection of Awardees
- Complete on-site demonstrations for second group of awards
- Publish final reports on selected projects for second group of awards

# **POLLUTION PREVENTION PROJECT**

## **2% Set-Aside Project Description**



### **SUSTAINABLE AGRICULTURE INITIATIVE AND TECHNOLOGY TRANSFER TO REDUCE CORN HERBICIDE**

#### ***PARTICIPATING OFFICES***

Region VIII/Doug Johnson (303) 293-1621  
OPP/Bernie Smale (202) 557-1443

PPD Contact: Deborah Hanlon (202) 382-4472

#### ***DESCRIPTION***

This initiative consists of on-farm applied research and demonstration of Sustainable Agriculture (SA) practices. EPA is combining its efforts with USDA to demonstrate a Weed Control Project to be applied to Colorado in 1991 and 1992. A national task force will be established to evaluate sustainable agriculture systems, perform economic analyses, and conduct workshops on agro-economic problems and solutions. The results of the project will be used to promote new agricultural and environmental policies.

#### ***MILESTONES***

##### **FY 90**

- Issue draft work plan to SA work groups and EPA participating offices for review/comment
- Establish management agency and project manager
- Make presentations to various organizations (ongoing)
- Plan implementation (ongoing)
- Perform weed control data search

##### **FY 91**

- Perform national survey analyses
- Train county extension agents

##### **FY 92**

- Conduct national symposia
- Perform regional workshop analyses
- Prepare and submit weed control report



## ***2% Set-Aside Project Description***

### **UNIVERSITY-BASED POLLUTION PREVENTION CENTERS**

#### ***PARTICIPATING OFFICES***

OTS/Anne Giesecke (202) 382-3801  
or David Kling (202) 382-3949  
ORD, ODW

PPD Contact: Brian Symmes (202) 245-3590

#### ***DESCRIPTION***

EPA will establish Pollution Prevention Centers at universities across the U.S. to disseminate state-of-the-art information on prevention strategies and techniques. The Centers will provide for cost-effective administration, allow for program specialization, address local environmental concerns, and maximize distribution of training, information, and materials. The Centers will be responsive to local and regional constituents in the areas that they serve, and will custom-tailor pollution prevention strategies in a way that a national program could not. The Coordinating Committee for the Centers will consolidate the valuable lessons learned at the local level and provide a forum for nationwide information exchange that will be easily accessible to national and multi-national industries, trade associations, environmental groups, and EPA.

#### ***MILESTONES***

##### **FY 90**

- Establish a minimum of three Centers

##### **FY 91**

- Develop three training courses
- Establish three additional Centers
- Establish the Coordinating Committee

##### **FY 92**

- Develop additional training courses, materials, and services
- Establish one additional Center

# **POLLUTION PREVENTION PROJECT**

## **2% Set-Aside Project Description**



### **POLLUTION PREVENTION CURRICULUM**

#### ***PARTICIPATING OFFICES***

Region VII/Rowena Michaels (913) 236-2803  
OA

PPD Contact: Priscilla Flattery (202) 382-4023

#### ***DESCRIPTION***

EPA, working in partnership with state and local governments, industry, educational institutions and other entities, is developing a pollution prevention educational curriculum for students in kindergarten through grade 12. This curriculum will be offered to all schools for their direct use or adoption, and will carry the full weight of EPA's endorsement. It will include appropriate videos, slides, films, computer software, and other teaching aids. The goal is to provide a rich, unified program on pollution prevention ethics and approaches to problems emphasizing source reduction or recycling.

#### ***MILESTONES***

##### **FY 90**

- Create task force and work groups

##### **FY 91 and FY 92**

- Initiate curriculum development and testing
- Initiate "leveraging" (i.e., development of public/private partnerships)
- Initiate production phase
- Initiate marketing and distribution phase
- Evaluate and update curriculum (ongoing)

## ***2% Set-Aside Project Description***



### **DEMONSTRATION OF EMERGING AREA-SOURCE PREVENTION OPTIONS FOR VOLATILE ORGANICS**

#### ***PARTICIPATING OFFICES***

Mike Kosusko (919) 541-2734  
ORD/AEERL

PPD Contact: Lynn Vendinello (202) 382-2602

#### ***DESCRIPTION***

This project involves cooperative work between EPA and industry to identify, develop, and demonstrate techniques that reduce VOC emissions from stationary area sources by developing, evaluating, and/or demonstrating pollution prevention options. This goal will be achieved by demonstrating the viability of VOC emissions reduction through alternative coating materials and processes, and identifying and evaluating consumer product prevention options.

#### ***MILESTONES***

##### **FY 90**

- Complete report on potential coating technologies
- Complete report on coating-free materials workshop
- Complete coating systems demonstration for auto refinishing
- Initiate consumer product test method
- Develop prevention options

##### **FY 92**

- Develop consumer product test method
- Develop the technical basis for a pesticide inert strategy

# **POLLUTION PREVENTION PROJECT**

## **2% Set-Aside Project Description**



### **PROMOTE AND INSTITUTIONALIZE POLLUTION PREVENTION IN THE WATER PERMIT ISSUANCE PROCESSES**

#### ***PARTICIPATING OFFICES***

OW/Martha Kirkpatrick (202) 475-9529  
OSWER, OAR, OPPE

PPD Contact: Deborah Hanlon (202) 382-4472

#### ***DESCRIPTION***

The EPA permitting programs are the key driving force behind controlling pollution across the country. These vehicles are also legal mechanisms for institutionalizing pollution prevention and forcing it to happen nationally. This project involves the development and implementation of training courses for NPDES and UIC permit writers to promote and institutionalize the "prevention ethic" in permits. In addition, multi-media training will be developed to increase permit writer's awareness of cross media impact, and the role of their decision on other media programs.

#### ***MILESTONES***

##### **FY 88**

- Complete feasibility study

##### **FY 90**

- Develop methodology for conducting pilot/demonstration studies

##### **FY 91**

- Conduct full-scale demonstration program

##### **FY 92**

- Begin implementation



## **2% Set-Aside Project Description**

### **POLLUTION PREVENTION THROUGH EPA PROCUREMENT GUIDELINES**

#### ***PARTICIPATING OFFICES***

OSW/Janette Hansen (202) 475-6690  
OARM, Regions II and VII

PPD Contact: David Fege (202) 382-6920

#### ***DESCRIPTION***

The goal of this project is to minimize the use of prime resources and optimize the implementation and impact of the EPA Guidelines for Procurement of Materials containing recycled or recovered goods. The project will focus upon enhancing federal implementation of the guidelines and also will promote state implementation. The products of this endeavor include workshops for federal and state government purchasing officials across the nation, and a final report on the impact and success of the efforts.

#### ***MILESTONES***

##### **FY 91**

- Conduct educational workshops on procurement guidelines

##### **FY 92**

- Develop measurements of success
- Conduct 11 follow-up workshops
- Complete a final report on the workshops, measurements of success, and recommendations for future activities

# **POLLUTION PREVENTION PROJECT**

## **2% Set-Aside Project Description**



### **PACIFIC NORTHWEST POLLUTION PREVENTION RESEARCH CENTER**

#### ***PARTICIPATING OFFICES***

Region X/David Teeter (202) 442-2871

PPD Contact: Jackie Krieger (202) 382-4418

#### ***DESCRIPTION***

The primary goal of the Pacific Northwest Pollution Prevention Research Center is to help prevent the generation of pollution by fostering research in relevant areas. The role of the Center is to sponsor pollution prevention for major industries in the Pacific Northwest, serve as a forum for public policy discussions, document progress, and aggregate pollution prevention opportunities. The Center will be governed by a board of directors, composed of one or more respected representatives from industry; academia; the environmental community; the states of Alaska, Idaho, Oregon, and Washington; and British Columbia.

#### ***MILESTONES***

##### **FY 90**

- Establish a work group
- Draft a charter for the center
- Establish a Board of Directors and hire Executive Director

##### **FY 91 and FY 92**

- Identify important pollution research gaps
- Set priorities based on the identification of research needs
- Support, sponsor, and/or conduct pollution prevention research



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## 2% Set-Aside Project Description



### **INDUSTRIAL POLLUTION PREVENTION: ATTACKING THE PROBLEM THROUGH REGULATION AND OUTREACH**

#### ***PARTICIPATING OFFICES***

OW/OWRS/Jim Lund (202) 382-7158

PPD Contact: Deborah Hanlon (202) 382-4472

#### ***DESCRIPTION***

An important key to significant gains in water quality and to preventing cross-media transfers is to stop pollution from occurring through programs to prevent and reduce sources, to recycle waste products, and to conserve water resources. This initiative involves a study to determine past industry compliance practices, a legal analysis of EPA's statutory authority to design and implement pollution prevention programs in the effluent guidelines development process, an examination of methods of influencing industry to implement pollution prevention measures voluntarily, and a study of international experiences with pollution prevention.

#### ***MILESTONES***

##### **FY 91**

- Prepare a revised Administrative Manual that describes the SOPs of the effluent guidelines process
- Complete a study on the efficacy of effluent guidelines in addressing cross-media transfers
- Prepare guidance and conduct pilot of the 301(k) waiver process
- Complete an options and proposals paper on industry incentives
- Complete a study of international efforts
- Complete several pilot projects
- Draft a paper on changes for the 1991 CWA reauthorization
- Prepare industry outreach materials (ongoing)

# **POLLUTION PREVENTION PROJECT**

## **2% Set-Aside Project Description**



### **CHESAPEAKE BAY PESTICIDE INDEX AND REGISTRY**

#### ***PARTICIPATING OFFICES***

Region III/Vicki Binetti (215) 597-6511

PPD Contact: Brian Symmes (202) 245-3590

#### ***DESCRIPTION***

The Chesapeake Bay has exhibited a long-term trend of declining water quality and aquatic life. With the signing of the Chesapeake Bay Agreement in 1987, EPA and the Bay States committed to reversing this trend through the development of a basin-wide toxics reduction strategy, covering both point and nonpoint sources.

The goal of this initiative is to reduce the environmental impact of pesticides in the Bay watershed. This project involves the development and testing of a Pesticide Hazard Index (PHI) which will be used to rank the potential environmental impacts of pesticides' active ingredients. The PHI results will be disseminated to the appropriate federal, state, and local agencies in order to encourage the use of those pesticides determined to be the "least environmentally harmful."

#### ***MILESTONES***

##### **FY 89 through 91**

- Develop and test pesticide hazard index

##### **FY 92**

- Apply pesticide hazard index
- Implement pesticide hazard index results



## **2% Set-Aside Project Description**

### **PROMOTING POLLUTION PREVENTION REQUIREMENTS IN ENFORCEMENT SETTLEMENTS**

#### ***PARTICIPATING OFFICES***

OECM/Peter Rosenberg (202) 382-7550  
OSWER, OW, OAR, OPTS, Region III, Region IV, and Region VIII

PPD Contact: Jim Edward (202) 382-3270

#### ***DESCRIPTION***

EPA's Office of Enforcement and Compliance Monitoring is currently chairing a work group comprised of most media compliance programs and Regions III, IV, and VIII, to develop proposed policy and guidance on the inclusion of pollution prevention requirements in enforcement settlements. The policy will be used by Agency negotiators to propose/accept appropriate pollution prevention conditions for consent orders and decrees. This project will expand the use of these settlements and evaluate their effectiveness so that enforcement tools and authorities can be used to enhance the Agency's overall commitment to pollution prevention.

#### ***MILESTONES***

##### **FY 89**

- Plan to issue draft policy

##### **FY 90**

- Oversee pilot testing of the policy in Regions III, IV, and VIII

##### **FY 91 and FY 92**

- Document and evaluate the effectiveness of the pollution prevention requirements contained in the settlements
- Technical support and assistance to identify cases where pollution prevention conditions are appropriate and to EPA settlement teams for case development/negotiations

# **POLLUTION PREVENTION PROJECT**

## **2% Set-Aside Project Description**



### **POLLUTION PREVENTION THROUGH ENVIRONMENTALLY RESPONSIBLE MANAGEMENT OF AGRICULTURAL CHEMICALS**

#### ***PARTICIPATING OFFICES***

Region VII/Bob Fenemore (913) 236-2970  
Region X/Gilbert Moore (206) 442-1200  
Region VI/Tom Davenport (214) 655-6444

PPD Contact: Jocelyn Woodman (202) 245-4164

#### ***DESCRIPTION***

The goals of this project are to prevent pollution by agricultural chemicals through education demonstration of best management practices, and integrated pest management; and to demonstrate that the goal can be achieved through multi-agency efforts of EPA, State environmental agencies, and the USDA. This will involve linking Agency resources with State agricultural chemical management programs and USDA resources.

#### ***MILESTONES***

##### FY 90

- Establish an interagency technical advisory committee
- Call for proposals from State Agricultural programs
- Review and select projects from proposals

##### FY 91

- Award grants to selected projects
- Conduct oversight and report progress

##### FY 92

- To be determined

## ***2% Set-Aside Project Description***



### **CONSUMER PRODUCT COMPARATIVE RISK: MARKET-BASED POLLUTION PREVENTION**

#### ***PARTICIPATING OFFICES***

OAQPS/Melissa McCullough (919) 541-5616  
OSW

PPD Contact: David Fege (202) 245-4164

#### ***DESCRIPTION***

The concept behind this project is that by providing information to consumers regarding the true environmental costs associated with consumer products, the demand side of the market will shift the manufacturing profile towards products that are less damaging to both the environment and public health. This project will design a methodology to assess the environmental and health consequences of products, test that methodology on sample product groups, and develop and implement a communication plan to transfer that information to the public, engineering and design schools, industry, the environmental community, and other interested audiences.

#### ***MILESTONES***

##### **FY 90**

- Develop preliminary life cycle methodology
- Select products for testing preliminary method

##### **FY 91**

- Select members of peer review team
- Convene initial peer review team meeting
- Draft method manual
- Analyze selected products and refine method
- Develop final manual

##### **FY 92**

- To be determined

# **POLLUTION PREVENTION PROJECT**

## **2% Set-Aside Project Description**



### **LEAD POLLUTION PREVENTION**

#### ***PARTICIPATING OFFICES***

OTS/Ed Brooks (202) 382-3749

PPD Contact: Lynn Vendinello (202) 382-2602

#### ***DESCRIPTION***

The objective of this project is to develop and carry out a concerted EPA-wide effort to reduce exposures to lead. This project explores the use of regulatory authorities to discourage the mining of lead and encourages lead recycling and the use of lead substitutes. OTS will initiate a regulatory investigation under TSCA to determine the most cost-beneficial way of using that authority to reduce human exposure to lead. The participating offices will collectively assess and agree upon the nature of the lead problem and possible solutions, and develop a regulation to be published in the *Federal Register*.

#### ***MILESTONES***

- Publish ANPRM in *Federal Register*
- Select regulatory objectives
- Analyze alternative regulatory approaches
- Identify lead product and use candidates for TSCA regulations
- Complete background document
- Publish NPRM in *Federal Register*



## ***2% Set-Aside Project Description***

### **PREVENTION OF GROUNDWATER CONTAMINATION FROM PESTICIDES INFORMATION SYSTEMS FOR STATE USE**

#### ***PARTICIPATING OFFICES***

ORD/Gail Robarge or Amy Mills (202) 382-7891

PPD Contact: Brian Symmes (202) 245-3590

#### ***DESCRIPTION***

The purpose of this initiative is to provide scientific tools for states to use in developing locally meaningful pesticide management plans. This effort will integrate existing technology and information such as: models for predicting the leaching of pesticides to groundwater; data that has been collected on soil properties and other relevant environmental factors; a geographic information system (GIS) to assist in analyzing data, and monitoring methods for detecting and tracking pesticide movement in the subsurface. Although this project will primarily address pesticides, use of other agricultural chemicals, such as fertilizers, could be assessed with the planned system.

#### ***MILESTONES***

##### **FY 91**

- Report on Design Criteria for the Pesticide Management Interagency Gateway
- Expand Pesticide Information Network

##### **FY 92**

- Develop guidance on the Development of a GIS Database for Pesticide Management
- Interim Guidance on Groundwater Monitoring Strategies for Pesticide Management
- Evaluate vulnerability assessment methodologies for pesticide management

# **POLLUTION PREVENTION PROJECT**

## **2% Set-Aside Project Description**



### **POLLUTION PREVENTION FOR SMALL AND MEDIUM SIZED INDUSTRIAL OPERATIONS AND MUNICIPALITIES**

#### ***PARTICIPATING OFFICES***

ORD/H. Douglas Williams (513) 569-7361  
Regions II, IV, VI, VII

PPD Contact: John Cross (202) 245-4164

#### ***DESCRIPTION***

Regional workshops will be established to provide pollution prevention information to specialists identified in state and local government and the private sector. Training modules will be produced specifically for selected small industrial operations, water treatment facilities, and POTWs. The workshops will be conducted by ORD's Center for Environmental Research Information (CERI) in cooperation with four EPA Regional offices. Technical support will be provided by the ORD Risk Reduction Engineering Laboratory (RREL) and state- or university-based regional training and waste reduction centers. Once this information has been developed, it will be available to other EPA Regional offices.

#### ***MILESTONES***

##### **FY 90**

- Identify Region-specific training needs

##### **FY 91**

- Develop Region-specific training modules
- Produce and test training modules specifically for water treatment facilities and POTWs
- Develop eight industry-specific pollution prevention reports

##### **FY 92**

- Finalize training modules for water treatment facilities and POTWs
- Finalize eight industry-specific pollution prevention reports
- Conduct four pollution prevention workshops for small industrial operations and four workshops for water and POTW facility operations



## ***2% Set-Aside Project Description***



### **REDUCING LEAD IN DRINKING WATER/ESTABLISHING UNIVERSITY-BASED POLLUTION PREVENTION CENTERS**

#### ***PARTICIPATING OFFICES***

ODW/Jeff Cohen (202) 382-5456  
OTS, ORD, EPA Regions I and IV

PPD Contact: Lynn Vendinello (202) 382-2602

#### ***DESCRIPTION***

This project focuses on reducing lead in drinking water by combining two projects:

- (1) OW's joint initiative with Regions I and IV and ORD to establish a network of university researchers, government, water suppliers, engineers, and environmentalists. This network will develop and share information on effective technologies to reduce drinking water lead levels attributable to corrosion by-products, and on complying with the various requirements of the forthcoming lead in drinking-water regulations.
- (2) OTS, ORD and ODW's joint initiative to establish university-based pollution prevention centers that will develop and disseminate technical information and provide technical assistance, especially to small water system operators and building managers.

#### ***MILESTONES***

##### **FY 90**

- Sign cooperative agreements with universities

##### **FY 91**

- Conduct two workshops to transfer information from corrosion control experts to specified university centers
- Implement university-based projects in research and training
- Conduct trial training seminars for water suppliers
- Complete four reports on the applied research and field studies in corrosion reduction

##### **FY 92**

- Revise the training materials and courses
- Complete a case-study video

# **POLLUTION PREVENTION PROJECT**

## **2% Set-Aside Project Description**



### **COMMUNITY PLANNING AND IMPLEMENTATION OF LOCAL POLLUTION PREVENTION STRATEGIES**

#### ***PARTICIPATING OFFICES***

Region III/James Hemby (215) 597-0765  
OPPE

PPD Contact: Julie Shannon (202) 382-2736

#### ***DESCRIPTION***

The results from Region III's Integrated Environmental Management Projects (IEMPs) and the Comparative Risk Project (CRP) will be used in conjunction with SARA Section 313 data to target a geographic area which would provide maximal risk reduction/resource conservation opportunities through pollution prevention. Assistance will be provided to community forums to establish and implement a plan for preventing pollution in their community. Materials and strategies will be developed which may be transferred to other communities.

#### ***MILESTONES***

##### **FY 90**

- Complete data analyses and document targeted "hot spots"

##### **FY 91**

- Complete OPA analysis of comparative risks and potential reduction within the targeted area
- Target a specific community
- Educate the community
- Develop benefit software and information brochures
- Develop Community Pollution Prevention Plan

##### **FY 92**

- Implement Community Pollution Prevention Plan
- Consult with facilities on use of software
- Set voluntary goals with industry and evaluate their progress
- Prepare final report on the planning process and progress to date

# **POLLUTION PREVENTION PROJECT**

## **2% Set-Aside Project Description**



### **DETERMINING THE PROPER ROLE FOR RCRA FACILITY INSPECTORS IN THE ASSESSMENT OF POLLUTION PREVENTION OPPORTUNITIES IN THE FIELD**

#### ***PARTICIPATING OFFICES***

OWPE/Peter Siebach (202) 475-9849

PPD Contact: Marty Snetzer (202) 245-4164

#### ***DESCRIPTION***

RCRA facility inspectors are responsible for conducting inspections, detecting violations, and recording evidence so that appropriate enforcement actions can be taken to ensure compliance. However, the inspector is not currently required to identify and advise facility owners and operators on potential waste minimization techniques that could be utilized at their facilities.

The RCRA Facility Inspector Program is being updated in FY90. EPA is considering an expansion of the program to include a session on waste minimization efforts. The emphasis would be on educating the inspector to provide basic waste minimization information and to act as a point of referral to the facility owner/operator.

#### ***MILESTONES***

##### **FY 91**

- Identify and evaluate existing state and regional programs that currently incorporate a "consultant" role into their basic RCRA inspector functions
- Develop recommendations for potential revisions to the national inspector training programs

##### **FY 92**

- Collect previously developed technical literature on pollution prevention for RCRA inspectors
- Streamline technical information on major industries outlining pollution prevention

## **2% Set-Aside Project Description**



### **REDUCED MOBILE SOURCE EMISSIONS THROUGH USE OF ALTERNATIVE FUELS**

#### ***PARTICIPATING OFFICES***

ORD/AREAL Lab/Larry Cupitt (919) 541-2107  
ORD, OPPE

PPD Contact: David Bassett (202) 245-4164

#### ***DESCRIPTION***

The largest single source category of pollutants in the urban atmosphere is motor vehicles. This initiative will reduce emissions of harmful pollutants from motor vehicles by encouraging the use of cleaner-burning alternative fuels and fuel pooling. In particular, this effort will quantify the benefits to be derived from switching to the use of alternative fuels and will demonstrate those benefits through a combination of field measurements, laboratory studies, and economic impact and analyses/risk assessments. The project also will provide a rational basis for the development of national policies to reduce mobile source emissions and their associated risks.

#### ***MILESTONES***

##### **FY 91**

- Publish report on protocols for field use of emissions measurement samplers

##### **FY 92**

- Publish report on tailpipe emissions and ambient concentrations before mandatory use of alternative fuel
- Develop internal reports on shed tests and production of ozone and toxic transformation products

# **POLLUTION PREVENTION PROJECT**

## **2% Set-Aside Project Description**



### **REDUCTION IN PESTICIDE APPLICATIONS THROUGH BIOREGULATION**

#### ***PARTICIPATING OFFICES***

ORD/OEPER/Jim Mueller (904) 932-9011  
OPTS

PPD Contact: Brian Symmes (202) 245-3590

#### ***DESCRIPTION***

Maintenance of current levels of agricultural productivity relies heavily on the use of large volumes of pesticides. Environmental contamination by pesticides is a significant problem because of the wide scale use, application, amounts and frequencies, and disposal relative to their degradation. If degradation is of sufficient magnitude, environmental contamination is reduced if not prevented.

The purpose of this effort is to use bioregulators to ensure accelerated degradation of persistent pesticides in or on surface soils, thereby preventing contamination of surface and subsurface soils and water. Through bioregulation, more persistent pesticides, which often contaminate groundwater and are usually more toxic, can be caused to biodegrade more quickly and thereby reduce their potential to contaminate non-target environments and organisms. Also, the effective field life of less persistent pesticides can be extended and environmental pollution reduced through reducing amounts and frequency of pesticide applications.

#### ***MILESTONES***

##### **FY 91**

- Conduct critical assessment of the potential of bioregulation to prevent agricultural pesticide pollution
- Develop research plan for use of agents accelerating degradation of persistent chemicals

##### **FY 92**

- Characterization of bacteria and fungi ability to degrade persistent pesticides
- Compilation of microbial strains established in pesticide-degrading organisms
- Screening of technologies for introduction of viable pesticide-degrading microorganisms

## **2% Set-Aside Project Description**



### **STATE-LEVEL CONSERVATION PROJECTS**

#### ***PARTICIPATING OFFICES***

OAR/Jim Mueller (904) 932-9011

PPD Contact: David Bassett (202) 475-9307

#### ***DESCRIPTION***

This project will use an existing network to promote increased use of energy conservation. This network includes EPA Headquarters and Regions, the states and several organizations including the State and Territorial Air Pollution Program Administrators/Association of Local Air Pollution Control Officials.

EPA Region I and the Air and Energy Engineering Research Laboratory will solicit and develop state-level projects that propose remedies, obstacles, and develop programs to encourage "least cost" utility planning with consideration of air, water, and solid waste impacts of alternative energy supplies.

#### ***MILESTONES***

- Assess emission, energy efficiency, and economic benefits of aggressive conservation program in states with acid rain legislation
- Apply methodology above to high emitting and high growth states that have not undertaken acid rain control programs
- Analyze the sulfur dioxide, oxides of nitrogen and carbon dioxide emission reduction potential of least cost utility planning, and assess mechanisms for coordinating State-level emission management programs and least cost utility planning