

EPA Environmental Economic Research Strategy  
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SAB REVIEW DRAFT

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The United States Environmental Protection Agency, through its program and regional offices, generated this environmental economic research strategy. It will be subject to the Agency's peer and administrative review, and will be published as an EPA document.

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## **Glossary of Terms and Acronyms**

EPA: The United States Environmental Protection Agency (the Agency)

EERS: Environmental Economics Research Strategy

EPA Offices

- Sub-offices listed under Office
  - Projects or Programs listed under sub-office with responsibility

OAR: Office of Air and Radiation

- OAP: Office of Atmospheric Programs
- OAQPS: Office of Air Quality Planning and Standards
- OIA: Office of Indoor Air

OEI: Office of Environmental Information

OPEI: Office of Policy, Economics and Innovation

- NCEE: National Center for Environmental Economics
  - EBSP: Ecological Benefits Strategic Plan
- Office of Regulatory Programs
- NCEI: National Center for Environmental Innovation

OPPTS: Office of Pollution Prevention and Toxic Substances

- OPPT: Office of Pollution Prevention and Toxics
- OPP: Office of Pesticide Programs

ORD: Office of Research and Development

- OSP: Office of Science Policy
- NCER: National Center for Environmental Research
  - STAR: Science to Achieve Results Grants
- NCEA: National Center for Environmental Assessment
- NRMRL: National Risk Management Research Laboratory
- NHEERL: National Health and Environmental Effects Research Laboratory
- NERL: National Exposure Research Laboratory

OSWER: Office of Solid Waste and Emergency Response

- OSW: Office of Solid Waste (RCRA)
- OERR: Office of Emergency Response and Remediation

OW: Office of Water

- OST: Office of Science and Technology
- OWOW: Office of Wetlands, Oceans and Watersheds
- OWM: Office of Wastewater Management
- OGWDW: Office of Ground Water and Drinking Water

SAB: EPA's Science Advisory Board

- EEAC: Environmental Economics Advisory Committee (of the SAB)

## Environment Economics Research Strategy

### **Abstract**

*Economics research is an essential component to developing efficient environmental policy. The Environmental Economics Research Strategy (EERS) was developed to guide environment economics research at EPA for the next few years. EPA staff and managers were interviewed to identify research priorities. These priorities were compared to existing research to establish strategic objectives where EPA resources could make a difference and help the Agency and its clients to achieve their missions. The strategic research objectives include: 1. Human Health Valuation; 2 Ecological Valuation; 3. Environmental Compliance Behavior and Effective Interventions; 4. Benefits of Environmental Information Disclosure; and 5. Market Mechanisms and Incentives. Several of these strategic objectives, particularly human health and ecological valuation, and market mechanisms and incentives require an interdisciplinary approach to develop sound research. EPA will devote internal and extramural resources to filling the most important research gaps in these areas, and will develop interdisciplinary teams where needed to address the objectives.*

## Executive Summary

### **Background**

EPA needs accurate environmental economics research on which to base and evaluate policies. This Environmental Economics Research Strategy (EERS) has been developed to guide future environmental economics research at EPA. The focus of the EERS is to develop a comprehensive list of research priorities that are of interest and importance to environmental management over the long term.

The EERS was developed by a team from the National Center for Environmental Economics (NCEE) and the National Center for Environmental Research (NCER), working with EPA program offices, the Office of Research and Development (ORD) labs and centers and EPA regions. NCEE provides research support and economic guidance to EPA programs, and NCER manages an economics and decision sciences research grants program. The findings of the EERS will guide research activities in both of these organizations and in ORD labs and centers, which provide multi-disciplinary research support to programs and regions.

The EERS identifies priorities and research gaps, evaluates research tools, sets out strategic research objectives and suggests responsibilities and sequences for conducting or sponsoring research. EPA programs, other federal agencies, academics, states, local governments and others can consult the EERS to understand what EPA (in particular, NCEE and NCER) has planned and the results the Agency expects. These parties can use the EERS to plan their own research or analyses to make the best use of EPA's efforts. The EERS will guide research for several years or until circumstances change and then be revised.

The EERS is based on research priority needs identified through in-person interviews with program economists, managers and other users of economic research results. The offices that were interviewed identified short and long-term research needs and anticipated potential changes in program structure and emphasis.

The priority research areas were then compared with existing research to determine what remained to be done. This comparison generated a short list of strategic research objectives. The research objectives were matched to available tools and resources to identify comparative advantages throughout EPA and to develop timelines for achieving the objectives.

### **Research Priorities**

The research team interviewed over 75 people from 21 separate offices. These groups each established a list of research priorities and gave strength of preference weights to each. The research team combined the results, giving equal weights to each AA-ship. The final results are presented in Table ES1.

Table ES1 shows the top ten short and long-term priorities, listed in long-term priority

order, with relative weights or areas of emphasis. As the table shows, the relative priority rankings change based on whether the research areas are ranked by short-term weights, long-term weights, or the number of offices requesting each research topic.

The priority research areas were selected for emphasis based on both the breadth (number of offices requesting research in a topical area) and depth (strength of preference score) of expressed need, as well as the opportunity to develop a coherent long-term program of research. The highest priority research topics are information valuation, compliance decision-making, morbidity valuation, ecological valuation, mortality valuation, and market mechanisms and incentives – including both trading and methods other than trading. The first five topics were the highest-ranked research needs in the short-term and long-term and the two market mechanism topics were the most highly ranked priorities based on the number of offices requesting the research.

**Table ES1. General Research Priorities**

<b>Research Topics</b>	<b>Rank Based on Long Term</b>	<b>Rank Based on Short Term</b>	<b>Rank based on Number of Offices</b>	<b>Number of Offices</b>
Valuation of Reduced Morbidity Benefits	1	3	2	5
Environmental (Compliance) Behavior & Decision-Making	2	2	2	5
Valuation of Ecological Benefits	3	5	2	5
Benefits of Environmental Information Disclosure	4	4	10	2
Valuation of Mortality Benefits	5	1	7	3
Market Mechanisms & Incentives, Other than Trading	5	7	1	7
Green Accounting/International Trade/Finance	7	9	6	4
Market Mechanisms and Incentives, Trading	8	6	2	5
Discounting/Intergenerational Equity	9	8	7	3
Risk & Uncertainty: Techniques, Integration with Valuation, etc	9	10	7	3

## **Identifying Research Gaps**

After identifying priority research areas of interest from EPA economists, EPA staff focused on turning the priorities into an implementable research strategy. The research strategy team focused on the highest priority research areas, reviewed existing literature reviews in each area, and identified major gaps where new high-quality research is feasible and relevant to EPA's mission. The team evaluated research priorities based on four criteria.

Research must:

- Be needed by EPA, state or other clients;
- Not have been conducted (i.e., there must be a gap in the existing knowledge base);
- Be scientifically feasible and potentially of high quality;
- Be likely to provide useful answers within 5-10 years, and
- Be related to EPA's mission in a policy-relevant context.

A December 10, 2002 workshop brought research clients together from many offices to further define research questions within the more general areas in Table ES1. The workshop succeeded in further defining strategic research questions in Market Mechanisms and Incentives, Ecological and Human Health Valuation, and Compliance Decision-Making. Because each of these areas is quite broad, EPA used the workshop to formulate more specific research questions in each area. (See Chapter 3).

## **Strategic Objectives**

Based on the above criteria and the results of the survey, workshop and investigation of the existing research, implementation of the research strategy will focus on four strategic research objectives where EPA has determined an allocation of its resources will make a difference:

1. Ecological and Health Benefits Valuation;
2. Environmental (Compliance) Behavior and Decision-making;
3. Market Mechanisms and Incentives.
4. Benefits of Environmental Information Disclosure;

These research objectives will be the focus of EPA research efforts in the next few years, following the conduct of detailed literature reviews in each area where none exist.

## **Implementation**

To ensure that the return from research in these areas is maximized, resources will be dedicated to the further refinement of research questions as more information is developed. In addition, resources will be devoted to development of the appropriate interdisciplinary research teams, provision of necessary infrastructure for information access and communication, periodic assessment of the state of existing research, and provision of specific analytic guidance when warranted.



EPA uses a variety of vehicles for funding research outside the Agency. These funding vehicles include cooperative agreements, grants, and contracts. Each varies in its ability to generate research results in the short versus long run, in the degree of EPA's participation in and influence on research outcomes, in the expected quality and generalizability of research results, and in their ability to supply basic versus applied research. These characteristics have to be matched to the type and timing of research results required by EPA for each strategic research objective.

EPA's in-house research centers, including the National Center for Environmental Economics (NCEE) and the Office of Research and Development (ORD), can be used as a substitute for, or a complement to externally funded research. NCEE has a number of environmental economists who are well suited to conduct research and analysis on crosscutting issues in support of program offices and regions. NCEE can also provide research-related guidance, workshops and seminars.

Effective achievement of several of the research objectives requires interdisciplinary research approaches. This is particularly true for ecological and human health valuation, and market mechanisms and incentives. ORD conducts research on integrated risk assessment research questions, regularly collaborates with NCEE, and administers EPA's primary extramural research grant program. ORD and NCEE will strengthen this collaboration by searching for opportunities for interdisciplinary approaches to the research projects needed to address the strategic objectives. A more detailed discussion of the types of long-term projects conducted at NCEE and ORD is available in Chapter 4.

Finally, EPA will endeavor to communicate and disseminate research results through existing venues such as EPA workshops, seminars, and document databases, and to develop new venues where appropriate.

## Chapter 1. Overview

### Background

There is increasing awareness throughout the federal government of the value of economic analysis in public policy decisions. Both Congress and a series of presidents have enacted legislation and executive orders that require Federal agencies to conduct economic analyses to support policy or regulatory decisions.<sup>1</sup> It is generally agreed that paying attention to economic principles and information can yield more efficient resource use.

Environmental issues and policies are among the many that benefit from high quality economic analysis. The Environmental Protection Agency (EPA) simultaneously faces increased pressure to remove or avoid economically burdensome environmental regulations and to do a better job of protecting ecosystems and human health, particularly among sensitive populations. The Office of Management and Budget (OMB) has increased the stakes for EPA and other federal agencies by demanding more and higher quality economic analyses and improved underlying data. Across EPA, practitioners need applied and theoretically sound economic information, especially to analyze new environmental problems and regulatory tools. EPA also must ensure that its economic estimates are based on the best possible and practical scientific methods. This document, EPA's Environmental Economics Research Strategy (EERS), describes how EPA will develop research that provides the information and tools needed to continue to conduct economic analyses at EPA.

The primary role of environmental economics research for EPA and others with environmental management responsibilities is to develop the data and analytical methods needed to analyze environmental issues. These data and methods are crucial to understanding regulated entities' behavior, predicting responses to government policy interventions, evaluating the efficiency and equity effects of environmental rules and policies, and predicting future environmental problems driven by economic forces. The environmental economics research described in this strategy will become a cornerstone of the economic analyses that EPA needs to develop environmental policy.

### Report Organization

This report consists of five chapters. This chapter explains the background for developing the EERS, including how EPA uses economic research, how this strategy may be used, and some related efforts and plans. Chapter 2 reports the main findings from the needs assessment survey and workshop. Chapter 3 describes how EPA evaluated the remaining gaps in the research literature in priority economic research areas and developed strategic research goals to implement. Chapter 4 describes the research tools or approaches available to implement the strategy and how EPA plans to utilize these tools to generate and communicate needed research results. Appendix 1 provides more detail on the survey process. Appendix 2 discusses requests for

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<sup>1</sup>Several administrative statutes and executive orders require evaluation of economic impacts. These are described in more detail in U.S. EPA, 2000.

economic analysis and research that are not discussed in Chapter 2. Appendix 3 discusses the relationship of this document to other research strategies and plans, and similar documents. Appendix 4 describes the suite of research tools available to EPA. Appendix 5 shows detailed results of the interviews that form the needs assessment.

### **EPA's Use of Economics Research**

EPA's most frequent use of economic research is as a basis for benefit-cost, cost-effectiveness, and economic impact analyses for environmental regulations and other policies. Economic principles are also playing an increasingly important role in the design of implementation strategies, such as marketable pollution permit trading as an alternative to traditional regulation. Analysts have begun to use economic research to explain and predict individual or corporate environmental behavior in response to voluntary programs, incentives, regulations or sanctions. Finally, EPA is using economic information to predict future environmental conditions, i.e., investigating the extent to which environmental problems are caused by economic activities or variables.

#### Benefit-Cost Analysis

Developing environmental regulations is a significant part of EPA's mission and is required by a number of federal laws. Many rules at EPA are subject to some degree of benefit-cost analysis. Generally, more detailed and sophisticated analyses are performed for rules with larger economic impacts. Benefit-cost analysis also supports the evaluation of existing and ongoing Agency initiatives or goals, through retrospective or prospective analyses of aggregate benefits and costs.

Over the past 25 years, there has been a steady increase in EPA's use of benefit-cost analysis in rulemaking, and a commensurate improvement in the analytical techniques and data sources available to the Agency. EPA recently has revised its guidance for practitioners of benefit-cost and related analysis in Guidelines for Preparing Economic Analyses, EPA 2000 (the *Guidelines*). The Guidelines provide a thorough overview of the current standards, practices and available data for conducting economic analyses of environmental policies. They also acknowledge the deficiencies in the tools and data available to analysts that are needed to accurately assess benefits and costs.

With sufficient time and resources, economic research can provide the theoretical and technical basis for conducting the environmental economic analyses that EPA and others need. While current economic analyses contribute valuable information to environmental policymakers, scientific limitations often prevent them from fully characterizing benefits and costs of environmental quality changes. For example, it is common in benefit-cost analyses to base social cost estimates on calculated engineering costs of pollution control technologies. However, these costs are not the only environmentally related inputs, or factors of production, that may have important costs for businesses. The actual decision processes of firms or individuals may include considerations of fines for non-compliance, legal costs, reputation or relationships with the communities surrounding them. Sound research will improve understanding of these decision-making processes, and help to achieve environmental quality goals in as cost-effective a manner as possible.

In most applied benefit-cost analyses, environmental benefits are even less well understood, or accepted, than costs, in large part due to the absence of markets for environmental goods and services. To the extent currently feasible, the *Guidelines* present an overview of the methods available and suggest best practices for estimating environmental benefits. However, EPA analysts recognize that additional environmental economics research is needed to fully evaluate the benefits of environmental improvement. These benefits include valuation of reductions in morbidity or mortality risk, and improvements in ecological conditions. Primarily, we need to understand better how people understand and value changes in health risks and ecological services.

### Efficient Environmental Policy

Economic research contributes to the development of economically efficient environmental policy.<sup>2</sup> An increasingly important economic research area is the development of market mechanisms or incentives for environmental management. These complements or supplements to traditional regulations use competitive forces to attain environmental objectives. Federal agencies are required to identify and assess market methods and incentives as alternatives to direct regulation under Executive Order 12866. EPA's experience, particularly with the cap and trade program established under Title IV of the 1990 Clean Air Act Amendments, is that sound theoretical, empirical and experimental economic research can contribute to the design of more efficient and effective environmental policy. Research has shown that, compared to regulatory approaches, the cap and trade program has saved the electric utility industry billions of dollars while achieving a higher rate of SO<sub>2</sub> reductions (Ellerman, et al, 2000). The use of market methods and incentives is also increasing at the state and federal levels (Hahn 2000). More research on economic incentives will contribute to making emerging markets in pollution more feasible or more efficient as the EPA and states apply these tools in new situations.

### Understanding Environmental (Compliance) Behavior

Another area of economics research is identifying how firms react to a range of potential government interventions in different markets and under differing economic conditions. EPA, states and others can use this research to tailor technical assistance, enforcement and compliance activities to optimize the use of public resources, i.e., to achieve environmental quality most cost-effectively. Specific research can demonstrate the circumstances under which voluntary, incentive, technical assistance and enforcement programs are effective at achieving society's environmental objectives.

A specific area of economics research under this topic is understanding how firms and industries initiate voluntary pollution prevention actions, either for financial reasons or in cooperation with the government. EPA, states and others can use this research to identify situations and scenarios where government policy would be most effective, namely those where there is a possibility of financial as well as economic benefits. This

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<sup>2</sup> Economically efficient environmental policy maximizes net benefits to society or achieves a given policy goal at the least cost.

research could also identify the types of incentives that could be used by the government to encourage such business behavior. It could also delineate performance measures to assess the financial, social and environmental benefits of such business behavior. In addition, similar questions need to be addressed for consumers.

### **Purposes of this Document**

The principal purposes of this research strategy are to identify EPA's highest priority environmental economics research needs, set out corresponding research objectives for the short and long terms, describe resources and tools available for achieving these research objectives, and suggest a timeframe and tools for meeting the objectives. While prescriptive, the research strategy is intended to be flexible. The EERS provides an overall framework, so that, as circumstances and priorities change, EPA can respond without having to completely reconstruct this planning effort.

The audiences for this strategy include EPA personnel, other federal agencies, state and local environmental agencies, non-governmental organizations, academic researchers, elected officials, and anyone interested in environmental economics research. These audiences will use this strategy according to their needs. At minimum, the EERS will make EPA's economics research intentions transparent. Other interested parties can then use this to complement or take advantage of EPA's research. The EERS is not intended to constrain independent research or analysis efforts by EPA program offices or regions. Rather, it will help guide (and outline) the activities of the two offices primarily responsible for crafting this research strategy, ORD and OPEI's National Center for Environmental Economics (NCEE).

ORD and OPEI have a unique and multi-faceted cross-office working relationship. The two offices share responsibility for developing and implementing this EERS. OPEI/NCEE has the lead responsibility for developing guidance and providing advice and technical support to programs and regions on issues of economic analysis. Part of this responsibility is met through internally conducted research in support of programs, supplemented by contractual arrangements with vendors and cooperative research agreements with, and grants to, qualified external economic researchers.

ORD conducts internal research in support of program activities, principally in an integrated framework with engineers, economists and health scientists. ORD scientists from several labs and centers also cooperate with NCEE researchers on a number of inter-disciplinary projects integrating economics with health and ecological research.

ORD's NCER administers the Science to Achieve Results (STAR) grant program, of which Economics and Decision Science research is a significant and cross-cutting component. NCEE has participated extensively in the economics research elements of the STAR grant program since its inception in 1995. NCEE staff assist with writing research solicitations, co-hosting conferences, reviewing proposals and assisting NCER with annual and strategic planning. Staff economists from the programs and regions also contribute assistance with these tasks.

NCEE and ORD will plan future activities to achieve the research objectives identified here. NCER will schedule grant solicitations, or requests for assistance (RFAs) to support external research on priority topics for the next few years, to the extent funding and grant limitations allow. Each year, NCER plans three or four RFAs in areas related to benefit-cost analysis, market mechanisms and incentive program design and evaluation, regulated entities' environmental behavior and decision-making, and how economic information is used to predict future environmental problems. NCER will use the research strategy results to focus these RFAs on the research topics of interest where the need for additional research is most critical.

OPEI's NCEE will use the EERS to help prioritize its internal and extramural research. NCEE will also produce new and or improved economic guidance on research areas identified in the EERS as Agency priorities change.

The research strategy's objectives include both problem-driven (applied) and core research. These research types are described in more detail in ORD's strategic plan (EPA 2001a). Problem-driven environmental economics research addresses specific, identified problems such as valuation of water quality. Core environmental economics research provides theoretical bases and methodological improvements that can be used to improve the understanding of human behavior with respect to environmental issues and problems, as well as tools that can be generally applied to solve environmental problems. Core research can also be accompanied by environmental economics data that can be used by other researchers and analysts.

ORD will use the strategy to plan specific internal economic research projects for the next few years and to target research areas for extramural funding. The strategic research objectives developed here will be translated into Long Term Goals in ORD's Multi-Year Plan for Economics and Decision Sciences. This link demonstrates ORD's commitment to providing the economics research that EPA needs. The path for attaining the Long Term Goal will be mapped out using Annual Performance Goals, which are evaluated using Annual Performance Measures. The Government Performance and Results Act (GPRA) requires agencies to establish strategic goals, annual performance goals and annual performance measures; these goals and measures are also routinely used in ORD's annual budget process.

The EERS will briefly discuss, but not plan for, economic analyses of EPA program-specific issues. Here the EERS makes a distinction between economic analysis and economic research. Economic analysis applies the tools and data developed by economic research to evaluate a particular issue or environmental problem for a specific policy purpose.<sup>3</sup> Economic research, whether applied or basic, creates generalizable theory, hypotheses, methods and data that can be applied to other circumstances. In order for the EERS to consider a research topic, the requested research must pose some question of interest to one or more programs over the long term. The EERS will

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<sup>3</sup> Where program offices requested analytical assistance during the development of the EERS, specific requests were noted and are described in Appendix 2, and may provide direction for program assistance in the future.

focus on research that can serve the needs of several programs or regions, rather than analyses tailored to a short-term program-specific need. These analytical efforts are handled best by the programs and regions directly involved in specific environmental issues, although assistance from ORD or NCEE may be appropriate in specific circumstances.

### **Relationship to Other Strategies, Plans, and Documents**

The EERS follows on related efforts particularly an economic research needs assessment survey conducted in 1997. It also is related to and will inform the efforts and strategies of a number of organizations within EPA, notably the EPA Strategic Plan, the work of NCEE and ORD's labs and centers, the ORD strategic plan, and a number of other research strategies and program efforts. The relationship of the EERS to other Strategies, Plans and Documents is detailed in Appendix 3.

### **Environmental Economics Strategy Development Process**

#### Internal EPA Review

The NCEE/ORD research strategy team jointly determined that a new and formal research strategy would be timely. The team assembled a workgroup from offices, research labs and regions throughout EPA to draft this Strategy. Workgroup members are economists and users of economic information who represent the concerns and needs of their offices with respect to economic issues. Much of the writing in this report is based upon contributions and suggestions of these workgroup members, especially the emphasis on emerging issues and evaluation of strategic and administrative initiatives. This group is responsible for reviewing the document, disseminating it for review to economists and managers within their offices, and conducting an internal peer review. ORD's Science Council and NCEE administrators also reviewed the EERS.

#### Peer Review

The EERS [will be] peer-reviewed by the Environmental Economics Advisory Committee (EEAC), a sub-committee of EPA's Science Advisory Board (SAB), in conformance with the guidance in EPA's *Peer Review Handbook*. The SAB is a federally-chartered advisory committee comprised of experts in various environmental science topics. The EEAC is comprised of esteemed environmental economists with a wide variety of interests and experience with issues affecting EPA economic analysis. The EEAC was also the SAB's formal peer review panel for the *Guidelines for Economic Analysis*.

## Chapter 2. Identifying Research Needs

### Methods

This section presents a brief overview of the process used to identify research needs and to prioritize those needs. The following two sections describe the overall results in some detail. Detail on the survey process itself is presented in Appendix 1.

#### Interview Process and Scoring

The development of this research plan follows ORD's general approach to setting research priorities, described in the ORD Strategic Plan (U.S. EPA 2001). To select research topics, the team took the following steps:

1. Sought input from its customers as to the type of research that is of greatest importance to their programs;
2. Sought input from NCEE and ORD staff regarding the state-of-the-science and the best opportunities for reducing uncertainty in EPA's understanding of important environmental economic issues, i.e., focus on the gaps in the existing research base;
3. Examined research activities in terms of scientific feasibility, resource constraints, tools and capabilities, compatibility with existing expertise, and EPA's ability to make a significant contribution relative to other research institutions that may be doing work in the area; and
4. Consulted with external experts (peer review) to ensure that the research will be of high quality and address important and novel issues.

The initial steps in the development of this strategy focused on soliciting client input from economists and users of economic information. The next two steps were used to further refine the research needs and plan implementation (see Sections 3 and 4). The final step, peer review, shall be conducted after internal EPA review is complete.

### Results

Clients were asked for their research needs in both the short and long terms. The remainder of this section presents overall results using short- and long-term weighting. The next section provides additional detail on priority areas. If more than one interview took place in a given Office, the team aggregated results to the level of Assistant or Associate Administrator. Rankings were normalized within each of these organizations so that they sum to one for each Office. Results are weighted equally across Offices.

The following tables present the preferences for results of the research strategy interviews by general categories. Since interview subjects provided priority rankings for both short-term and long-term needs, results are presented for each time period in Tables 2.1 and 2.2. Table 2.3 presents the number of offices that requested a research need in each category. In certain cases, expressed needs were determined to be for economic analysis and not research. An example is cost estimates for specific rules, which neither NCEE nor NCER could provide. These categories are discussed in Appendix 2 rather than this chapter for ease of presentation.



**Table 2.1 General Research Priorities – Short Term**

<b>Research Category</b>	<b>Rank<sup>4</sup></b>
Valuation of Mortality Benefits	1
Environmental (Compliance) Decision-Making	2
Valuation of Morbidity Benefits	3
Benefits of Environmental Information Disclosure	4
Valuation of Ecological Benefits	5
Market Methods and Incentives, Trading	6
Market Methods and Incentives, Other than Trading	7
Discounting/Intergenerational Equity	8
Green Accounting/International Trade/Finance	9
Risk & Uncertainty: Techniques, Integration with Valuation	10
Environmental Justice	11
Cross-Regulation Interaction	12

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4 Based on a weighting across EPA offices.

**Table 2.2 General Research Priorities – Long Term**

<b>Research Category</b>	<b>Rank</b>
Valuation of Morbidity Benefits	1
Environmental (Compliance) Decision-Making	2
Valuation of Ecological Benefits	3
Benefits of Environmental Information Disclosure	4
Valuation of Mortality Benefits	5
Market Methods and Incentives, Other than Trading	6
Green Accounting/Trade/Finance	7
Market Methods and Incentives, Trading	8
Discounting/Intergenerational Equity	9
Risk and Uncertainty: Techniques, Integration with Valuation	10
Cross-Regulation Interaction	11
Environmental Justice	12

**Table 2.3 Number of Offices Requesting Research Priorities Topics**

<b>Research Category</b>	<b>Number of Offices</b>
Market Methods and Incentives, Other than Trading	7
Market Methods and Incentives, Trading	5
Environmental (Compliance) Behavior & Decision-Making	5
Valuation of Morbidity Benefits	5
Valuation of Ecological Benefits	5
Green Accounting/Trade/Finance	4
Environmental Justice	4
Risk and Uncertainty: Techniques, Integration with Valuation	3
Discounting/Intergenerational Equity	3
Valuation of Mortality Benefits	3
Cross-Regulation Interaction	2
Benefits of Environmental Information Disclosure	2

*Valuation of Morbidity Benefits*

Four media offices (OAR, OW, OSW, and OPPTS), ORD and OCHP requested

improved valuation of reducing morbidity risk from environmental causes. Although the strategy team further sub-categorized morbidity (into asthma, skin lesions, etc.), most of the requests were very general. Offices either requested a long list of endpoints or generic “non-cancer health endpoints.” Because the economic literature does not provide values for a large number of health endpoints, research could make significant contributions in this area. While EPA will need further clarification to set priorities for research to develop morbidity values, the implementation of this EERS will address this issue directly (see Chapters 3 and 4). Program economists mentioned some specific health endpoints, including earaches, headaches, cold-like illness, gastrointestinal upset, reproductive and developmental effects, asthma, developmental disorders (e.g. Attention Deficit-Hyperactivity Disorder, autism, mental retardation), and cancer-related morbidity effects. OAR and OW requested health endpoints caused by toxics exposure, while OSWER and OPPTS both mentioned lead-related illnesses as priority research topics. Several offices mentioned a need for values for special sub-populations, especially children, and two offices suggested research to evaluate Quality-Adjusted Life-Years (QALYs) or some other framework as a potential tool for estimating and transferring benefit values.

#### *Compliance Decision-Making and Behavior*

The general category of Compliance Decision-Making can be subdivided into three more detailed research topics:

- Why and how do facilities perform well environmentally, or comply or not comply with environmental rules or policies?
- What policies or approaches will effectively induce compliance or improved environmental performance?
- How effective are voluntary programs?

The first two questions are closely related. EPA needs to understand individual or corporate environmental behavior both with and without government intervention in order to adopt a cost-effective combination of approaches (for both the regulators and the regulated) that will improve environmental quality. Five offices requested research in this area: OAR, OW, OSW, OECA, and OPPTS. Of these, OECA put the highest weight on this research topic. These offices are trying to understand how corporations and other regulated entities view compliance and how they will react to regulations, enforcement actions, and other interventions. They also want to understand what organizational characteristics foster improved environmental performance and compliance.

While OECA’s interest was general, the four program offices that placed a priority on this research area had more specific interests:

- OAR wants to understand facility location decisions;
- OW wants research into how drinking water purveyors decide what technologies to select in order to comply,
- OPP is interested in how farmers and applicators select pesticides and application programs, i.e., which pesticide to use and how much;
- OSW wants to understand how on-site versus off-site hazardous waste disposal

decisions were made and how leaking underground storage tank and Potentially Responsible Party (under Superfund) owner-operators make decisions about mothballing or revitalizing sites.

Interest in research on the effectiveness of and participation in voluntary programs was also broad. OW, OSW, OECA, and OPPTS want to know what induces participation in voluntary programs and what changes in environmental outcomes result from participation. They would also like to understand the conditions under which a voluntary program might be superior to a regulatory program.

### *Valuation of Ecological Benefits*

Expressed needs for ecological benefits research tended to be both general and pervasive across programs. Research to improve the valuation of ecological benefits was requested by ORD and the four media offices: OAR, OW, OSW, and OPPTS. Moreover, the Assistant Administrator for Water made this topic his office's highest research priority.<sup>5</sup> There is a great degree of uncertainty associated with this topic, both because there are a large number of ecosystem or ecological services (or benefits) that are not valued, and because economists do not fully understand how people consider and make choices regarding (i.e., value) ecological services.

Two offices, as part of their responses, identified a need for frameworks to understand and value ecological endpoints. There were some slightly more detailed requests for research, including estimation of the values of:

- Water quality changes (two offices requested estimates for changes caused by agricultural pollution and one requested a basis for national estimates);
- The sensitivity of water values based on stream size and uses;
- Ecological impacts from air pollutants;
- Introduced vs. native species;
- Avoided groundwater contamination;
- Ecosystems impacts from hazardous wastes;
- Avian species; and
- Ecological endpoints from reducing toxic pollutants.

### *Benefits of Environmental Information Disclosure*

High priority benefits related research area identified in the interview process included a generic category: *Benefits Valuation, Other Endpoints*, that is, environmental changes that are not direct ecological or human health endpoints. The programs' primary interest in this general category is for research to determine the value of environmental information disclosure. In fact, the reason this area ranked highest is that several offices placed a high priority on this area in both the short and long term. For example, OEI placed most of the weight of its preference on this single category, and OPPTS also requested value-of-information research.

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<sup>5</sup> This will be accounted for during implementation of the strategy, but the survey results were not altered in response the OW's Assistant Administrator's preferences.

There is currently no generally agreed upon method to estimate or monetize the benefits of information disclosure (e.g. Toxic Release Inventory, Consumer Confidence Reports). Anecdotal and other evidence exists that companies or facilities may change behavior after information announcements are made, and that the change in behavior affects exposure as well as the behavior of the potentially exposed population. This valuation research category is closely related to one on the effectiveness of information programs, see under Market Mechanisms and Incentives below. Other important research questions include:

- Are potential cost savings identified when disclosure is made?
- How is the value of information linked to the amount or toxicity of pollutant? (e.g., a corollary about food is that the value of information about fat content is not strictly correlated with the amount of fat); and
- How can benefits about the value of information in one situation be transferred to another?

#### *Valuation of Mortality Benefits*

The issue of mortality valuation has historically been of great interest to EPA economists. This interview exercise indicates that the topic is still important, in part due to OMB's interest in using QALYs or other alternatives to EPA's customary measure of the value or mortality risk reduction, the value of a statistical life (VSL). OW, OPPTS, and OCHP placed priority on this research topic. The survey results showed a strong interest in how mortality valuation varies by age. Many of the studies used to generate EPA's central estimate of the value of a "statistical life" are based on wage-risk studies and apply to working adults (U.S. EPA 2000), so there is a need for complementary values for children and the elderly. A related need is how individuals value remaining life (or a similar concept such as QALYs) and how these values vary by the age of the affected individual.

#### *Market Methods and Incentives, Other than Trading*

OEI, OAR, OW, OSW, OECA, OPPTS, and OPEI requested additional research in this category. Several offices suggested research on the Effectiveness of environmental information programs in achieving improved environmental outcomes and when these programs might be more cost-effective than regulatory programs.

#### *Market Methods and Incentives, Trading*

Six offices - OAR, OW, OSW, OPPTS, ORD, and OPEI - requested research on emission permit trading, primarily for "Trading in Practice" and "Trading in New Contexts." Some trading programs set up by EPA and other governments have been remarkably successful, saving billions of dollars in regulatory costs (EPA 2000; Ellerman, et al 2000). Other types of trading programs have not been as successful to date. Trading-related research should ultimately result in the implementation of efficient trading programs in areas where trading programs have not yet been established.

OW, as well as OAR and OPEI, requested empirical research on "*Trading in Practice.*" OW was particularly interested in exploring experience to date with Total Maximum Daily Load (TMDL) water quality discharge trades. The TMDL program sets maximum

pollutant loads for water bodies and would seem an ideal candidate for a trading program. However, existing attempts at TMDL trades have been difficult to establish and not always successful. TMDLs provide situations that are less clearly defined than the successful air pollution trades, both in terms of monitoring and with respect to pollutants. A TMDL trading program could involve multiple pollutants, a mixture of point and non-point sources, institutional constraints, monitoring difficulties, and spatial differentiation. These complications impose transaction costs and additional constraints on trades. Research could improve the prospects for successful trading programs in these situations by providing better understanding of the existing constraints, as well as information requirements for efficient markets.

*“Trading in New Contexts”* identifies research needs for the design of trading programs for sectors or pollutants where they do not currently exist. The four media offices (OAR, OW, OSW, and OPPTS) made requested research to explore trades in drinking water, pesticides, and hazardous waste, areas where little trading effort exists.

The next section will address how to compare the priority research needs with the existing body of research in order to identify those gaps where EPA research can be most beneficial.

## Chapter 3. Identifying the Research Gaps

### Approach

To make the transition from a needs assessment to an implementable research strategy, the research team identified existing research in the priority research areas and gaps between what was needed and what already existed. It was not possible to address all of the research needs, so the team focused on the highest priority research identified by the programs and regions.

The highest priority research fell into 4 major areas:

1. Valuation of the benefits of environmental improvement, specifically:
  - Human Health Benefits;
  - Ecological Benefits;
2. Environmental Behavior and Decisionmaking, including Voluntary Programs;
3. Market Mechanisms and Incentives, particularly Pollution Trading, and
4. Benefits of Environmental Information Disclosure.

Some research, and in some cases, a substantial amount of research, has been conducted in each of these areas. However, the perception among informed Agency economists who rely on this information is that existing research is insufficient to provide a thorough basis for environmental policy decisions. The EERS team supplemented these anecdotal assessments with assessments of recent literature reviews in several of the topical areas. Further consultation with experts and additional in-depth literature reviews in the remaining subject areas will help determine where EPA-sponsored research could have a notable payoff.

### Criteria for Identifying Priority Research

To assess priority research areas, the EERS team considered the criteria for selecting research topics (paraphrased from ORD's Strategic Plan, EPA 2001a, and augmented):

1. The research must be needed by EPA, state or other clients;
2. The research must not have been conducted already, i.e., there must be a gap in the relevant literature;
3. The research must be scientifically feasible and potentially of high quality;
4. The research must be related to EPA's mission in a policy-relevant context; and
5. EPA must be able to come to some conclusions within five to ten years to answer policy-relevant questions.

### Existing Literature in Priority Topics

Each of the four research areas will be discussed relative to these criteria, which will be used to determine implementation approaches in the next chapter. In several cases, the existing research base seems somewhat sparse, that is, the uncertainty or lack of knowledge in the topical area is pervasive.

#### Human Health Benefits

EPA has reasonably current assessments of the state of the science regarding valuation of morbidity (non-fatal) and mortality risk reductions. These assessments

come from recent cross-Agency reviews of the literature, largely in support of guidance development for applied benefit-cost analysis.

### *Morbidity Benefits*

To assess the current science on morbidity valuation, EPA's Science Policy Council, comprised of scientific administrators from across the Agency, sponsored a study in 2000 that provided guidance on how to estimate the value of reducing non-cancer (non-fatal) risk. This study resulted in the development of the Handbook for Non-Cancer Health Effects Valuation, EPA 2000 (see at: <http://www.epa.gov/osp/spc/Homeegs.htm>). This document contains an extensive literature review on existing valuation methods and morbidity endpoints for which values have been derived, including a large annotated bibliography. A key finding in this handbook is that WTP estimates of specific non-fatal endpoints are limited, especially for chronic or long-term health effects. Further, some potentially useful research results are difficult to use in applied analysis because they fail to control carefully for severity, duration and frequency. The value of the same non-fatal health effect may vary significantly with changes in severity and duration.

Another source assessing a subset of the literature is the Children's Health Valuation Handbook, a peer-reviewed reference to complement EPA's *Guidelines*. This handbook includes a bibliography of the empirical literature on valuing reduced health risks in children and comes to the general conclusion that there is very little information available to EPA analysts on this subject. However, this is changing as researchers respond to recent EPA RFAs in this area.

The research strategy team considered the endpoints and methods covered in both handbooks and determined that further research should focus on willingness to pay measures using empirically and theoretically sound methods rather than on more limited measures such as cost of illness. Willingness-to-pay measures are theoretically superior to alternative suggested measures that do not reflect how people actually would make choices. In the case of children's health risks, research should also consider the role of household composition on value.

As noted in Chapter 2, EPA program economists identified this area to be generally important but pinpointed few specific morbidity endpoints for conducting benefits research. As a result, the implementation process will identify specific health endpoints through further discussion with programs and regions, review of past analyses that were unable to value particular endpoints, as well as consideration of EPA's regulatory and policy agenda and the likely health endpoints that these will affect.

An initial conclusion of *this* review is that the large number of specific health endpoints that could be valued dwarfs the limited resources available to conduct valuation research. In response, a long-term strategy may be to develop methods that generate cost-effective and theoretically plausible values for multiple health endpoints, such as valuation of symptoms or health status indices, and improved methods for benefit transfer. Part of this strategy may be to develop a comprehensive study that would elicit



willingness-to-pay estimates for a large number of environmentally influenced health endpoints.

### Mortality Benefits

The issue of mortality benefits has received a great deal of attention from EPA, in no small part because environmental management measures often generate large reductions in mortality risks, estimated to be on the order of several billion dollars' worth annually (EPA, 1997; EPA, 1999). EPA recently completed a very current literature review of the benefits of reducing premature mortality as part of the *Guidelines* development process. The *Guidelines* themselves contain a brief summary of the state of the science in empirically characterizing the effect of population and risk on valuation, and the SAB's Environmental Economics Advisory Committee (EEAC) peer-reviewed the *Guidelines*.

In a related but separate exercise, the EEAC reviewed an EPA white paper assessing the literature on the subject of valuing reduced premature mortality from cancer (see: <http://yosemite.epa.gov/85256878006d971e.nsf/0/76b22907108eb6e4852569ee004541dd?OpenDocument>).

In short, these literature reviews, and the EEAC's comments regarding them, suggest that more research is needed on how the value of mortality risks vary with the age and health status of the individual, the co-morbidity associated with the mortality risk (e.g., illness from cancer), and risk characteristics such as the degree to which the risk is voluntarily taken.

EPA has also sponsored a significant amount of research in valuing mortality reductions, much of which was summarized in a recent EPA workshop (for proceedings of this workshop, see: [http://yosemite1.epa.gov/EE/epa/eerm.nsf/vwRepNumLookup/EE-0464?OpenDocument - Section5](http://yosemite1.epa.gov/EE/epa/eerm.nsf/vwRepNumLookup/EE-0464?OpenDocument-Section5)). Some recent EPA-sponsored research addresses EPA's priority mortality valuation issues, such as age- and debility-related valuation issues (see the following: <http://cfpub.epa.gov/ncer/abstracts/index.cfm/fuseaction/display.abstractDetail/abstract/24/report/F>, and <http://cfpub.epa.gov/ncer/abstracts/index.cfm/fuseaction/display.abstractDetail/abstract/1952/report/0>).

EPA continues to explore and develop research in this area, and is currently in the process of evaluating revisions to existing guidance on the topic of valuing reductions in premature mortality. Moreover, EPA and Resources for the Future, in cooperation with the National Institutes of Health, the Occupational Safety and Health Administration, the Food and Drug Administration, the Department of Transportation, the Department of Health and Human Services, and the U.S. Department of Agriculture sponsored a major conference on health evaluation in Washington February 2003 (<http://www.rff.org/valuinghealthoutcomes.htm>). The purpose of the conference was to bring together researchers and practitioners of various disciplines related to health and risk valuation. These include medical researchers engaged in health-related-quality of

life measures such as QALYs and disability-adjusted life years (DALYs), and economists, who primarily employ and develop willingness-to-pay measures. To date, these two broad disciplines have not interacted to a great extent to develop health valuation estimates. EPA and the other organizers expect this conference to lead to greater communication and cooperation across disciplines, which should be especially informative for identifying mutual research gaps.

EPA will use the results of this conference, the assessments developed with the Guidelines and current efforts to revise guidance, and the results of current research to further define the mortality research areas that should be pursued. At minimum, EPA expects to support further investigations into key areas of uncertainty already identified such as the role of age, physical condition and risk characteristics on willingness-to-pay for preventing premature mortality.

### Ecological Benefits

As with human health benefits, EPA has a recent appraisal of ecological benefits estimation. The Science Policy Council recently sponsored a study that summarized approaches for ecological benefits estimation. This study, A Framework for Economic Assessment of Ecological Benefits (EPA, 2002) can be found at <http://epa.gov/osp/spc/feueb3.pdf>. This document provides a thorough overview of the methods and issues involved in estimating the benefits of ecological improvement.

Ecological benefits estimation is problematic because ecosystems provide a wide range of essential services, but people frequently do not understand the services provided. Some of these services can be priced in markets and others are strictly non-market goods that require alternative valuation approaches. To value non-marketed ecological services, people must be familiar with them, which can require complex valuation approaches that combine education and value elicitation to obtain reliable willingness-to-pay measures. Not all of these approaches are universally accepted. Some non-economists have proposed alternative valuation measures based on energy balances or replacement costs<sup>6,7</sup>. To date, these approaches have met with little acceptance among economists as they violate the most basic and well-developed tenets of economic theory (see Bockstael, et al, 2000). EPA programs appear to want conventional willingness-to-pay measures for ecological services that would survive the rigor of the rule-making process.

As with morbidity valuation, programs were generally vague about the specific ecological endpoints for which they wanted values. EPA has conducted or sponsored a large number of ecological valuation studies through grants, cooperative agreements and internal research, at a cost of several million dollars. Moreover, the Environmental Valuation Resource Inventory, a benefits-transfer database developed by EPA and Environment Canada and maintained by Environment Canada, contains approximately

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6 Odum, H.T. 1996. Environmental Accounting, Emergy and Decision Making. John Wiley, NY  
7 Costanza, R; D'Arge, R.; de Groot, R.; Farber, S.; Grasso, M; Hannon, B.; Limburg, K; Naeem, S.; O'Neill, R; Paruaelo, J; Raskin, R; Sutton, P; ven den Belt, M. The Value of the World's Ecosystem Services and Natural Capital. Nature 387, 6230

500 water-related valuation studies, many of which estimate ecological values. It is critical to further focus the research in this topic in order to address only the highest needs where there is a deficiency in the research base.

NCEE, ORD and OW are currently developing the Ecological Benefits Strategic Plan (EBSP) as a collaborative effort between ecologists and economists to determine long-term critical research needs in this area. The results of this plan will be used to guide NCEE and ORD activities in this area. Furthermore, ORD-NCEA is conducting several pilot projects combining economic and ecological researchers to develop frameworks for future assessments. An initial conclusion of these efforts is that given the large number of specific ecological endpoints that could be valued in comparison to the limited resources that are likely to be available, a cost-effective strategy may be to investigate methods that generate theoretically sound values for multiple endpoints, such as the valuation of ecological indicators or indices and improved methods for benefit transfer.

#### Environmental (Compliance) Decision-Making & Behavior

Interest among both practitioners and academics has increased in this research area in recent years. However, even EPA staff's preference for compliance decision-making and behavior research is quite diverse. Each program desires research about the decision-making processes of its relevant regulated communities. These processes could be quite varied, as the regulated communities in question include different combinations of individuals, firms, government agencies and municipal corporations.

One seemingly common factor among these regulated communities is the role of costs, and the need for cost minimization in the manufacturing, farming or service sectors. However, research has shown that perceptions of environmentally-related costs differ among different firms, organizations and individuals. For example, while some firms or individuals may base operating and capital investment decisions solely on accounting costs, others more strongly weigh the transaction costs of dealing with regulatory agencies, potential liability costs, the costs of adverse publicity, the potential cost savings of pollution prevention, costs associated with dealing with local communities, and even loss of sales (market share). Consideration of all of these types of costs, as well as the ability of firms to adapt through process changes and innovations, suggests the engineering cost approach used by many EPA programs may not fully reflect the costs that these entities consider regarding all environmentally-related factors of production.

EPA and others need research that is focused on how individuals, businesses, and facilities decide how to meet environmental obligations, how they determine their degree of compliance with environmental regulations or initiatives, and how they consider the range of potential costs. While traditional notions of costs have been researched extensively, relatively little research has been done on the actual role of complex environmental cost concepts in firm and individual decision-making.

EPA is in a unique position to make contributions to this research area because there are few other commensurate sources of research interest and funding. However the

beneficiaries of such research include many states and local governments, as well as other federal agencies. A question of increasing importance to EPA that is closely related to compliance decisions is how and why facilities or firms decide to participate in voluntary programs or standards. Such programs typically have costs and benefits for the firm that are not captured in traditional financial analyses.

### Market Mechanisms and Incentives

Commensurate with the interest from programs, regions, and elected officials, EPA is both conducting internal research and supporting extramural research in the Market Mechanisms and Incentives area. The most important focal areas are empirical research on the practical results of trading programs and research into the feasibility of new trading programs where none currently exist. For more ex-post empirical research to be feasible, additional trading programs have to be established and operated for several years. Where no trading markets exist, (ex ante) research must focus on theoretical and experimental design, as well as modeling using empirical values.

The STAR program has supported over 20 academic projects in this area over the past 3 years, including a number of experimental market studies, theoretical models that have identified the efficiency effects of alternative tradable permit allocation schemes, and the definitive empirical analysis of the CAA cap and trade program. Both NCEE and ORD-NRMRL have conducted incentive-related research and are planning more. NCEE recently published an assessment of the savings potential of incentive-based approaches in lieu of traditional regulations, identifying more than \$40 billion per year if all possible programs were implemented (see: <http://yosemite1.epa.gov/EE/Epa/eed.nsf/pages/incentives>).

ORD-NRMRL is designing and analyzing market approaches for environmental systems management, including a program of tradable credits for controlling urban storm water runoff, with a focus on stream quality and combined sewer overflows. Storm water is a significant source of water quality problems across the country, and market approaches have not been widely applied to stormwater (see <http://www.epa.gov/ORD/NRMRL/std/seb/tradeablecredits.htm>).

EPA hosted a symposium on research results and the state of the science in market mechanisms and incentives research in May 2003. The results of this workshop will further refine NCEE and ORD's MM&I research plans for 2004-2007. In general terms, EPA recognizes that, in order to realize the cost savings of MM&I programs, well-designed programs have to be developed and implemented for new pollutants, media and geographical areas. EPA will continue to conduct research to extend current validated results, and use lessons learned from existing programs and experimental and theoretical assessments to design and predict the outcomes of new MM&I programs.

As with other research areas, it is important to distinguish true MM&I research from analytical applications that are lower priorities. Research results should provide new theoretical developments or approaches that can be generalized to other circumstances or geographical areas. Unfortunately, the lack of existing theory and the complexity of market mechanisms and incentives applications to different media and situations offer a

wide range of potential extensions. For example, using tradable water quality permits to resolve non-point water problems is complicated by existing subsidies, lack of monitoring, cultural resistance to enforcement – all of which present the potential for new theoretical and empirical extensions. Similarly, some basic theoretical questions with significant policy implications, such as how marketable permits interact with existing taxes, still do not have satisfactory answers, and in fact, are not easily tested empirically. The disagreement among theorists must progress to empirical testing so that some questions can be answered and extended in fruitful directions, i.e., toward facilitating efficient trading program design. Other questions that affect market design, such as balancing demand and supply in a newly created market, and developing self-correcting markets, also need considerable further study. The applications are so diverse, the range of potential extensions so extensive, that the MM&I area is likely to be a source of useful behavioral research for some time.

### Benefits of Environmental Information Disclosure

As noted in Chapter 1, EPA operates under several statutes that require the disclosure of environmental information to consumers or communities. Most notable are the Community Right-to-Know Act requirements that facilities disclose releases of toxic substances through the Toxic Release Inventory (TRI), and the Safe Drinking Water Act requirement that water purveyors disclose chemicals contained in domestic water through annual Consumer Confidence reports.

While several studies have examined the effect of TRI disclosure on stock prices and firm behavior or have studied firms' participation in voluntary programs that include information disclosure or voluntary emissions reductions, none have directly estimated the economic benefit from using disclosure rules, compared to alternatives such as direct regulations (Hamilton, 1995; Khanna et al, 1998). The range of benefits could be considerable (see below), as could the number of methods for estimating them. Ultimately, the principal benefits to the public would be reductions in damages to ecosystems or human health that can be estimated. However, the reputed value of an information disclosure approach is that it can achieve these reductions at a lower cost or more equitably than other approaches such as regulation or market incentives.

How to calculate these benefits is unclear. However there are a number of pertinent questions, including:

- Are markets working more efficiently as a result of information disclosure, as economic theory would suggest?
- Are there health and ecosystem benefits that would be unrealized if not for the information disclosure requirements?
- Are there lower costs associated with firms acting on their own to avoid having to disclose seemingly adverse environmental results?
- Are there benefits to the firm to discovering pollution prevention cost savings?
- Are there implementation and enforcement savings for state and federal government agencies as a result of information disclosure?
- Are communities better informed and therefore more active in protecting their local environment through torts or negotiations with facilities? If so, what

damages are reduced or savings realized?

These and other questions have not been sufficiently addressed to date. There is a clear need for more empirical information, as well as development of improved theory about how environmental information affects choices. Furthermore, it is likely that EPA can make a significant contribution to this literature, as it has with the valuation for children's health risk reduction, simply because there is so little existing research.

### **Summary**

EPA understands that filling the research gaps in these four priority environmental economics research topics is a daunting task. Nonetheless, implementation of this research strategy will make headway and valuable advances to the state of knowledge given existing and expected resources. Already, EPA-conducted or -sponsored research has had a significant impact on valuation methods and market-oriented approaches to environmental policy, and addressing the remaining research gaps over the next 5 years will extend this successful track record.

## Chapter 4: Research Strategy Implementation

### Overview of Implementation Process

The Environmental Economics Research Strategy is a framework for producing research that clients within and outside of EPA can use to ultimately achieve cost-effective environmental protection. ORD, NCEE and their clients – programs, regions, states, local and tribal governments, academic researchers, non-profits and for-profit enterprises - need a number of different types of research-derived information. Some information, such as accurate data, and assessments of the state of existing research, are prerequisites to getting original, useful and high quality research results. This chapter discusses the different types of research that EPA and clients need, the tools available for developing these research topics, and the comparative advantages of various EPA organizations for providing them. It then articulates a flexible implementation approach that suggests a division of responsibilities, but allows for adaptation to changing circumstances.

Note: Neither this chapter nor the EERS in general is intended to proscribe research that programs, labs or regions believe they need. Rather, this chapter will describe what the organizations principally responsible for implementing this strategy, NCEE and ORD, plan to do to provide research identified as a priority across EPA.

The types of information needed to implement this strategy include

1. Research results in the four areas described:
  - a. Value of reducing environmental risks to:
    - i. health endpoints;
    - ii. ecological services;
  - b. Environmental (compliance) behavior and decision-making, particularly expanded considerations of costs;
  - c. Market mechanisms and incentives;
  - d. Benefits of environmental information disclosure;
2. Infrastructure for information access and communication, including databases of environmental values and firm and facility characteristics;
3. Periodic assessments of the state of existing research; and,
4. Specific analytical guidance as needed.

### Research Tools – Comparative Advantages

EPA's research vehicles or tools differ in their suitability for providing each information type. The available tools include: intramural EPA research, cooperative agreements between EPA researchers and research institutions, grants to research institutions, and contracts to economic consultants. The EERS team compared these tools on the basis of:

- their ability to generate results in the short vs. long-term;
- EPA's ability to influence research products and outcomes;
- typical quality of research results, with the "best" research defined as published in the most respected peer-reviewed academic journals;

- the specific nature of the research, that is, basic or applied;
- the relative generalizability of results, i.e., is it applicable to one media or program or generalizable to several programs, industries or locales; and
- the degree to which original research is needed, rather than program-specific applications of research results.

Table 4.1 shows, in general terms, how the research tools compare on each of these characteristics. Appendix 4 discusses these tools and criteria in more detail.

**Table 4.1 Characteristics of Research tools**

Research Tools	Research Characteristics				
	Time to produce results	Influence on research progress	Quality or Level of Peer Review	Basic v. Applied	Generalizability of Results
<b>Contracts</b>	Short, if contract vehicle in place	Maximum influence, directed by EPA	Generally not peer reviewed: Gray literature; not original research	Applied	Specific to Rule or Industry
<b>Intramural Research</b>	Short, if staff present; longer if hiring required	Highly flexible; EPA manages research; Research for direct EPA use	Low to high, depending on project and purpose.	Either: greater tendency toward applied	Mixed; some program specific, some broader applications
<b>Cooperative Agreements</b>	Up to several years; bidding and coordination issues	Less flexible; some research influence; tradeoffs and compromises; not for direct EPA use	Generally High Quality.	Mostly applied	Mixed; some program specific, some broader applications
<b>Grants</b>	Several years from initiation of award process to results	Little influence once award is made: not for EPA direct use	High quality; original research.	Basic or Applied research	Generally, broadly applicable methods or theory



## **Roles and Activities of EPA Programs, Centers, Labs and Regions**

The research capabilities of the actors involved with implementing the research strategy differ according to their respective missions and their relative access to the research tools described above. In general, *programs* perform analysis of media- or industry-specific issues, *regions* and *states* implement policies and regulations, and ORD and NCEE provide support to programs, regions and states and communicate research results. It is efficient for these offices to conduct in-house or extramural research that can be applied across programs, or to maintain expertise that can be used on a continuing basis by different programs, e.g., designing valuation surveys, integrated scientific research projects, or peer-review capabilities.

### EPA Programs and Regions

With some exceptions, EPA programs conduct analyses that utilize and apply existing research findings to specific issues. Most programs have economic staff on board to conduct economic analyses, and are supplemented by contractual support from economic consultants. In some instances, programs have had sufficient need for results that could be applied across rules or policies to justify maintaining true research capabilities. More often, than not however, the programs have turned to NCEE (for economics) or ORD (for other scientific disciplines or multi-disciplinary research) for basic or applied research support. Regions generally have used contracts for specific projects and have relied on the research offices or programs to provide research or analytical support. As noted in Chapter 2, regions frequently have different research and analytical needs than do the programs and are more involved in implementation issues.

### National Center for Environmental Economics (NCEE)

NCEE has the Agency's largest concentration of environmental economists on staff, making it uniquely qualified to conduct in-house analysis and research in support of programs or high-priority cross-program projects. NCEE also uses contracts, cooperative-agreements and grants in various ways to support program or cross-program research objectives. Generally, NCEE funds research and uses a significant part of its staff capacity for shorter-term projects, although it also conducts longer term (3-5 years) research projects that are of direct importance to EPA.

Over the years, NCEE has been receiving feedback on the Agency's economic research needs from its client offices via their requests for assistance with various economic topics. NCEE has produced research and published guidance on a wide variety of economic issues in response to these requests. The Center has also sponsored workshops and seminars that have served to disseminate economic research as well as identify holes in the existing body of economic research in specific subject areas pertinent to the Agency's mission.

The EERS will enable NCEE to direct its staff time toward economic issues that are likely to be in high demand in the coming years. NCEE will address key methodological issues, data needs and other gaps specified by the participants in this survey. By better understanding the gaps in the environmental economic research, NCEE will be able to

provide guidance and assistance with economic analyses, and promote consistency in the economic analysis being carried out throughout the Agency. In addition, NCEE will be better able to encourage outside researchers to focus on issues of interest to the Agency through its allocation of funding for extramural research, seminars and workshops directed at priority topic areas, support of visiting scholars, collaboration with outside researchers and communication of critical economic data.

NCEE is currently involved in a number of long-term projects related to specific research questions Program Offices mentioned as a priority in interviews for the EERS. Table 4.2 briefly describes these projects by subject area. A number of shorter-term projects are also under way that fall within these research subject areas, but they are not discussed here.

**Table 4.2. Research Priority-Related NCEE Projects**

<b>Research Priority Category</b>	<b>Related Long-Term NCEE Project</b>
Valuation of Morbidity Benefits	Drinking Water Arsenic Valuation Survey
	How households value risk reductions to children
	Estimation of willingness to pay to reduce asthma episodes for adults and children
Environmental Compliance and Decision-Making	Pollution Abatement and Cost Expenditures (PACE) Survey
	Chesapeake Bay Watershed Analysis
	Access and expertise in both the REMI and IMPLAN models
	Location decisions of TRI plants
	Development of the Trade and Environment Assessment Model (TEAM)
	Location decisions of electric utilities (future project)
Valuation of Ecological Benefits	Ecological Benefits Strategic Plan
Benefits of Information Disclosure	Short-term projects only at this time
Valuation of Mortality Benefits	Risk-risk survey for valuing cancer reductions
	Willingness-to-pay for mortality risk reduction: The case of bicycle safety helmets
	Preference calibration approach for mortality risk reduction
	Survey project eliciting values for mortality risk reductions to older individuals across countries
Market Methods and Incentives, Other than Trading	Methodology for evaluation of effectiveness of voluntary programs
Green Accounting/Trade/Finance	Retain access and expertise in GTAP CGE modeling
	Investment in USARM and AGSIM models of agriculture sector
	Development of the Trade and Environment Assessment Model (TEAM)

Research Priority Category	Related Long-Term NCEE Project
Market Methods and Incentives, Trading	Environmental justice in SO <sub>2</sub> emissions trading: evidence from the electric utilities industry
	An evaluation of productivity and costs under trading (future project)
	Groundwater trading (future project)
	Region 10 trading pilot project (future project)

NCEE has a number of projects underway related to valuation of reductions in morbidity. The Drinking Water Arsenic Valuation Survey collects data on the willingness-to-pay (WTP) for reduced exposure to arsenic in drinking water, and examines how these values are affected by the provision of information on arsenic risks, as well as the implied valuation measure for children’s health. NCEE also is involved in designing surveys for the State of Minnesota that can address how households value risk reductions to children, and in a study to examine the WTP to reduce asthma episodes for adults and children.

In the subject area of environmental compliance and decision-making, NCEE is involved in the design of the Pollution Abatement and Cost Expenditures Survey, and in conducting a Chesapeake Bay Watershed analysis to estimate the economic impacts of direct and indirect compliance. NCEE also has maintained access to and expertise in the Regional Economic Modeling Inc. (REMI) model and the Impact Analysis for Planning (IMPLAN) model for use in regulatory and impact analysis on a regional and/or industry level. In addition, research is ongoing related to the location and emission decisions of TRI plants. Future work related to the location decisions of electric utilities is also planned. Finally, NCEE is developing a highly disaggregated model of emission factors, referred to as the Trade and Environmental Assessment Model (TEAM), that can be used to translate changes in output resulting from trade liberalization or other exogenous regulatory decisions into environmental impacts.

NCEE, working with ORD and OW, is taking the lead on developing an Ecological Benefits Strategic Plan to establish a dialogue between economists and ecologists in the Agency to identify information gaps and establish a more detailed research agenda for the measurement of ecological benefits (See Appendix 3).

NCEE has several long-term projects associated with benefits valuation related to mortality. A risk-risk survey for valuing cancer risk reductions addresses issues related to age, latency, timing, and morbidity. Another NCEE study examines prices paid for bicycle helmets to estimate the WTP for mortality risk reduction across different age groups. NCEE also is funding research on the use of the preference calibration approach for mortality risk valuation, and participating in a survey project to elicit values for mortality risk reductions to older individuals across countries.

Currently, NCEE has one long-term project related to market methods and incentives other than trading. Researchers are conducting research to develop a methodology useful for evaluating the effectiveness of voluntary programs as a regulatory tool. NCEE has a more active research agenda in the area of trading. Research projects, both on-going and planned, include an examination of the environmental justice implications of SO<sub>2</sub> emissions trading; an evaluation of plant productivity and costs under trading; a project related to operationalizing groundwater trading; and research related to the Region 10 trading pilot project.

In the area of trade, NCEE is developing a highly disaggregated model of emission factors, referred to as the Trade and Environmental Assessment Model (TEAM). Two models, the U.S. Agricultural and Resource Model (USARM) and the Agricultural Simulation Model (AGSIM), also are being modified to examine regulatory impacts in agriculture, including those related to trade. NCEE will make these models and the expertise needed to use them to the programs for analytical projects as resources permit.

#### Office of Research and Development (ORD)

ORD-sponsored research attempts to provide methods or models that are broadly applicable and will facilitate or improve economic analysis. ORD conducts internal integrated economic research, collaborates with NCEE on integrated economic and risk assessment research and administers the Agency's extramural research grant program, the STAR grant program. Many of ORD's research projects are focused on single media or issues. Priorities for research are based on relative risk to human health and ecosystems (U.S. EPA-ORD 2001). However, the economic tools developed as a result of this Strategy typically will not be limited to single risks, but will be used by economists across EPA, in other Federal Agencies, and in state and local governments to address a broad spectrum of issues.

ORD's research planning process focuses on answering overarching research questions, or long-term goals, through a series of interrelated solicitations or multi-disciplinary research projects. Among the long-term goals that ORD will pursue are the priorities shown above. ORD will support this research through STAR grants and other multi-disciplinary lab and center research projects.

#### *STAR Grants (National Center for Environmental Research)*

NCER will use this Strategy to set long-term goals for research planning purposes. These long-term goals will then be used to target STAR RFAs and when evaluating specific applications for funding. The STAR grant program has four newly revised long-term economic research goals based on the priorities suggested by the Program offices at EPA in the EERS. Implementation of this Strategy will concentrate on the three standing solicitations – Valuation for Environmental Policy, Corporate Environmental Behavior and the Effectiveness of Government Interventions, and Market Mechanisms and Incentives. However, NCER also funds economic research under other occasional solicitations and in integrated RFAs and will use these when appropriate to address

issues of importance that do not fall under the umbrella of the standing solicitations. NCEE and program economists will continue to provide invaluable input to NCER writing RFAs and evaluating proposals to ensure that funded research continues to meet EPA's needs.

#### Valuation for Environmental Policy

NCER's current Valuation for Environmental Policy (VEP) RFA is an outgrowth of two previous RFA's: Decision-Making and Valuation for Environmental Policy and Valuation of Environmental Impacts to Children's Health. The 2003 VEP RFA has two parts: Human Health Valuation and Ecological Valuation, although the relative focus of specific RFAs will vary from year to year.

An initial goal of the VEP RFA will be to fund investigations into the use of benefit transfer for human health and ecological valuation. A preliminary step may be to undertake studies that are designed to understand the frameworks underlying valuation. The focus on benefit transfer is necessary given the large number of human health and ecological endpoints for which programs requested valuation research. The STAR program does not have the resources to provide grants for all of these endpoints, but the development of transfer methods may be a cost-effective approach to this problem. After funding research into methodological development, NCER expects to fund original studies that can be used to provide values for transfer.

#### Corporate Environmental Behavior and Performance

Programs exhibited a surprising amount of interest in a better understanding of how regulated entities made process, disposal, and location decisions that affect environmental quality. At least one solicitation will be focused on specific applications of this issue. A related focus will be to investigate what firms and facilities perceive as costs when estimating environmental management costs.

#### Market Mechanisms and Incentives for Environmental Management (MM&I)

The MM&I solicitation will focus on two priorities, trading in practice and trading in new markets. The objectives will be to learn from experience in previous emissions trading markets and apply these lessons either in new or redesigned markets. The purpose of focusing on past trades will be to understand, first, "Have emissions trading markets led to environmental quality that is equal or superior to traditional regulations?" and second, "What savings have been achieved, compared to regulations?" The second objective will be to use theory-based models and experimental economics to better predict the success of new markets, and the considerations that need to be incorporated into program design to make new markets both more efficient and more effective in accomplishing environmental objectives.

#### Benefits of Environmental Information Disclosure

NCER is proposing to develop an RFA to address this topical area. As of early 2003, funding was not available to support research in this area. However, ORD is evaluating this area within the context of its resources and demands for its research services, and hopes to make funds available to develop some research in this area.

### *ORD Labs and Centers*

Several ORD labs and centers (other than NCER) currently have the capacity to develop integrated economics and risk assessment research projects. Additionally, these offices are developing joint projects with NCEE. Labs and centers will continue existing inter-disciplinary projects and programs that focus on high priority economic research areas. For example, an NCEA research project is integrating ecological endpoints and economic valuation, and NRMRL is conducting original research on new trading markets (storm water runoff for non-point water pollution control). The EERS will indicate where future integrated research is needed as these projects are completed.

ORD recently completed a white paper assessing future economic research capabilities needed by the organization. The primary conclusion of this assessment was that ORD needs to increase its ability to integrate social science research and analysis into its existing strengths in human health and ecological research. To the extent ORD can develop the economic research capabilities outlined in the white paper, it will be able to address the needs outlined in this strategy. In keeping with the white paper, ORD will emphasize integrating economics either in labs and centers or in cooperation with NCEE, using its expertise in engineering, physical and biological sciences to address the EERS priorities.

### Integration of Social, Biological and Physical Sciences

Of particular importance for valuation activities, the Administrator recently charged ORD's management to work with NCEE economists to integrate economic with biological and physical science analysis and research, a tacit recognition of what many in ORD and NCEE (and elsewhere) have known for some time. There is a clear need to better integrate economics and other social sciences with health and ecological assessments. The traditional approach of having physical, biological and engineering scientists define the research questions and agendas without input from downstream scientists such as economists underutilizes scientific findings at best, and at worst, wastes resources because the research design does not take into account how the findings will be used in a decision context. Equally, economic research conducted without the direct input of the relevant scientific and engineering disciplines runs similar risks if scientific and engineering uncertainties are not explicitly incorporated into the economic modeling and analysis.

There has been a lot of discussion on the topic of integration, and ORD-NCEA and OPEI-NCEE have developed a working team to investigate some case studies involving health risk assessment and benefits analysis through the Risk Assessment-Benefits Analysis project. This represents a promising start. However, the focus of this group has been for risk and benefits analysis for regulatory purposes. The research coordination needed to build the underlying science has not been developed. For example, commonly useful data have not been collected and the required cooperation among different research specialties is not yet evident at the beginning of the hypothesis development and data-gathering phases of research. As a stepping-stone, EPA's portfolio of health, ecology, emissions and economic databases – whether GIS-based or otherwise – should be catalogued and made available for researchers to

cross-reference and share.

ORD has some comparative advantages over other parts of EPA for integrating social science and health and ecological research. For one thing, it has a large number of these other scientists available, although it has very few social scientists. One solution would be for ORD to establish a policy of using multidisciplinary teams of scientists, engineers and economists wherever possible to identify research questions, design research strategies and conduct the indicated research. A combined effort to identify both scientifically valid and economically cost-effective solutions to environmental problems is crucial to prevent environmental protection from being more expensive than necessary.

A scientist exchange program between ORD and NCEE so that EPA social, biological and physical scientists could collaborate on research projects could facilitate improvements in data collection and methods. A similar requirement that grant recipients develop multi-disciplinary approaches relevant projects would further advance this goal.

### **Communication of Research Results**

NCEE and ORD will continue to expand their existing communication efforts to improve communication of economic research results within and outside of EPA. The primary outlets available to EPA are conferences and workshops, seminars, summary reports and research publications. NCEE and NCER have jointly organized and conducted a series of economics research workshops beginning in 1998. So far, there have been 7 workshops presenting results of STAR grants and related research. These have been attended by EPA and other federal and state agency staff, academics, and others with interest in the subjects discussed.

Both NCEE and ORD independently hold seminars on economic and other scientific research topics on a regular basis. NCEE uses its position as host to the EPA economics forum to invite economists from the programs, labs and region to attend or listen in by conference call. NCER is currently improving its ability to conference with remote locations via Lotus Placeware or video-conferences.

NCER has begun to produce research capsules that summarize related STAR research results in a specific area of interest, e.g., stated preference value elicitation methods. NCER will continue to produce these in topical areas where related projects have generated a useful compilation of results.

NCER and NCEE also propose to hold an annual economics research workshop for EPA staff to summarize the current research conducted or supported by EPA and to plan research for the coming year, e.g., focusing RFAs on high priority issues.

NCEE maintains a database of economic reports and regulatory economic and benefit-cost analyses. NCEE is in the process of improving the accessibility and usefulness of these reports.



ORD and NCEE, working with other offices, are investigating the establishment of research databases that contain EPA facility-specific data for researchers. Additionally, EPA is attempting to improve access to the Environmental Reference Valuation Inventory (EVRI), a database maintained by Environment Canada to facilitate the transfer of health and economic values from original studies to policy situations.

### **Conclusions**

EPA, through NCEE and ORD, has evaluated its needs for economic research by interviewing practitioners, reviewing the existing research, and consulting external experts. The EERS sets forth a plan to conduct the research of the highest priority and payoff for the Agency and its customers. The EERS also allocates responsibilities for accomplishing this plan. Some of the activities to be carried out are immediate and clear, while others are less certain and therefore require more information and flexibility. When this plan is implemented, EPA and economics researchers should be able to provide the Agency and its clients with suggestions for improving the cost-effectiveness of environmental protection.

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## Appendix 1.

### Survey Process

#### Needs Assessment

Research team members interviewed economists, users of economics, managers and other scientists with an interest in economics in as many parts of the Agency as possible. These staff members represent some of the primary customers of research provided by ORD and NCEE. Prior to interviews, NCEE and NCER sent letters to all of the Office Directors and Deputy Regional Administrators to identify potential users of economics research results. The research strategy team also used internal EPA lists such as membership in EPA's Economics Forum and past programmatic reviewers for NCER economics and decision science grants.

For Offices (Assistant Administrator level) with economists in several sub-offices (Office Director level or lower), meetings were generally held with groups of economists and others at the Office Director-level. The team held face-to-face meetings when possible; when not, team members conducted interviews through conference calls and e-mail. Virtually all meetings had at least two strategy team members present—one from NCEE and one from NCER. Trained facilitators led meetings when there were large numbers of interview subjects.

The research strategy team held 21 interview meetings with 76 participants, including respondents participating via phone or e-mail. The AA-, RA-level Offices that participated in interviews included:

- The Office of Air and Radiation (OAR),
- The Office of the Chief Financial Officer (OCFO),
- The Office of Children's Health Protection (OCHP),
- The Office of Enforcement and Compliance Assurance (OECA),
- The Office of Environmental Information (OEI),
- The Office of International Activities (OIA),
- The Office of Policy, Economics, and Innovation (OPEI),
- The Office of Prevention, Pesticides, and Toxic Substances (OPPTS),
- The Office of Research and Development (ORD),
- The Office of Solid Waste and Emergency Response (OSWER), and
- The Office of Water (OW).<sup>1</sup>

Each interview session began with an open-ended period of brainstorming where participants described all relevant economic research needs for their offices. Participants then ranked these research needs and results were used to create the scores in Tables 2.1 to 2.4.

Larger groups voted for individual research priorities using a multi-vote approach,<sup>2</sup> while

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<sup>1</sup> As the leads for development of this strategy, no staff members in NCEE or NCER were subjects of the interviews reported in this chapter, although other representatives from OPEI and ORD were. Some NCEE staff members were the subjects of a pretest interview.

<sup>2</sup> Each participant received 3 short-term votes and 3 long-term votes, and could distribute these to the

groups of one or two simply assigned weights (percentages) to the different research needs. The research strategy team provided separate voting opportunities for both short-term (defined as having results in three to five years) and long-term (defined as having results in more than five years) research needs. The strategy team then prepared lists of research needs with the associated weights along with other information about the meeting.

The EERS team coded each research idea from EPA staff interviews into topical categories at two different levels of detail. The first level has the broadest categorization while the second is more detailed. Table A.1 shows the more general categorization scheme, while Appendix 2 contains the more detailed categories.

**Table A.1 General Research Needs (alphabetical)**

Benefits Valuation, Ecological
Benefits Valuation, Morbidity
Benefits Valuation, Mortality
Benefits Valuation, Other Endpoints
Compliance Decision-Making
Cost/Impact Analyses
Cross-Regulation Interaction
Discounting/Intergenerational Equity
Environmental Justice
GPRA/Strategic Planning
Green Accounting/Trade/Finance
Market Methods and Incentives, Other Than Trading
Market Methods and Incentives, Trading
Risk and Uncertainty, Techniques, Integrating with Valuation, Other

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priorities developed in the brainstorming session in any fashion, i.e., all on one research priority or across two or three priorities for both short and long terms.

## Appendix 2. Requests for Analytical Support

As noted in Chapter 2, although for the most part, participants in the needs assessment were able to focus on research priorities, some respondents requested analyses or other products that could be handled better through guidance or a group such as the Economics Forum (a forum of economists from around the Agency). Three categories of priorities were eliminated from the presentation in Chapter 2: *GPRA Analysis/Strategic Planning*, *Cost Analyses*, and *Impact Analyses*. These categories were determined to be more analytical than research in nature because the specific requests from the programs and regions were for short term or rule-specific analytical results. The tables presenting research priorities from Chapter 2 are reproduced here with those categories added. The tables are then followed by category descriptions.

**Table A2.1 General Research Priorities – Short Term**

Valuation of Mortality Benefits	1.19
Environmental (Compliance) Decision-Making	1.06
GPRA Analysis/Strategic Planning	1.00
Valuation of Morbidity Benefits	0.96
Benefits of Information Disclosure	0.89
Cost Analyses	0.83
Impact Analyses	0.71
Valuation of Ecological Benefits	0.64
Market Methods and Incentives, Trading	0.60
Market Methods and Incentives, Other than Trading	0.58
Discounting/Intergenerational Equity	0.38
Green Accounting/International Trade/Finance	0.32
Risk & Uncertainty: Techniques, Integration with Valuation, etc	0.11
Environmental Justice	0.06
Cross-Regulation Interaction	0.03

**Table A2.2 General Research Priorities – Long Term**

Valuation of Morbidity Benefits	1.27
Environmental (Compliance) Decision-Making	1.25
Valuation of Ecological Benefits	1.15
GPRA Analysis/Strategic Planning	1.00
Cost Analyses	0.89
Valuation of Information Disclosure	0.80
Valuation of Mortality Benefits	0.60
Market Methods and Incentives, Other than Trading	0.60
Green Accounting/Trade/Finance	0.51
Market Methods and Incentives, Trading	0.48
Discounting/Intergenerational Equity	0.22
Risk and Uncertainty, Risk Assessment Techniques, Integrating with	0.22
Impact Analyses	0.21
Cross-Regulation Interaction	0.13
Environmental Justice	0.09

**Table A2.3 Number of Offices Requesting Research Priorities Topics**

Topic	No. of Offices
Market Methods and Incentives, Other than Trading	7
Market Methods and Incentives, Trading	5
Environmental (Compliance) Decision-Making	5
Valuation of Morbidity Benefits	5
Valuation of Ecological Benefits	5
Impact Analyses	5
Green Accounting/Trade/Finance	4
Environmental Justice	4
Cost Analyses	4
Risk and Uncertainty, Risk Assessment Techniques,	3
Discounting/Intergenerational Equity	3
Valuation of Mortality Benefits	3
Cross-Regulation Interaction	2
Valuation of Information Disclosure	2
GPRA Analysis/Strategic Planning	1

### *GPRA/Strategic Planning*

As with environmental information, one office, OCFO, placed all of its research emphasis on one study objective, identifying the benefits and costs of achieving the objectives outlined in the Agency's new strategic plan. As noted above, a cross-agency workgroup is currently trying to address this issue in response to a request from OMB. The results of this workgroup will be used to help identify research areas later in the implementation of this strategy. The area does not seem to provide particularly fertile ground for high quality original research that would be generalizable to other situations. That is, it would benefit more from application of other research, e.g. valuation, cost, compliance behavior, than from original economic research. Implementation of the EERS will enhance the Agency's ability to estimate the costs and benefits of all of EPA strategic objectives, which reflects EPA's regulatory agenda to a significant degree.

### *Cost Analyses*

The primary request in this category was for cost estimates that could be used for specific rulemakings. Another request was for further guidance on translating private costs into social costs. This topic is considered in the *Guidelines* and discussions on this topic are appropriate for the Economics Forum. As discussed in the footnote to the Impact Analyses category, these are not appropriate for this document. One research topic is how learning over time affects cost estimates: that is, testing the hypothesis that compliance costs decrease over time as facilities adapt to new regulations.

### *Impact Analyses*

The category of Impact analyses reflects an aggregation of two sub-categories:

- Facility or firm-level impacts and
- Market, aggregate, or CGE impacts.

Respondents placed the major emphasis in this category on methods to calculate impacts (facility or firm-level and market, aggregate, or CGE) and the "Other" category, which they primarily used to request assistance for rule-specific cost estimates.<sup>8</sup>

Some requests could be either research or analysis. OAR, OW, OECA, OPPTS, and OPEI requested general research on the economic impacts of regulations to firms and markets, although specific ideas were quite varied across the offices. OW and OPEI requested guidance (see footnote) on the proper tools to analyze the impact of regulations on small businesses and non-traditional industries (such as agriculture). These two offices also requested retrospective analyses of the impacts of rules or government investments. Other offices requested a variety of analyses or improved models for use at large scales, including:

- Retrospective comparisons of economic growth in attainment vs. non-attainment areas;
- Incorporation of regulation-induced product quality changes into market

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<sup>8</sup> Requests for rule-specific costs or impacts are categorized more appropriately as analysis than research, and will not be addressed in this document, unless they have widespread generalizability. Similarly, while guidance is an important contribution to improving economic analysis, it is not research, but an application of research results.



analyses;

- Development of CGE models that can be used in regulatory decision-making;
- Measurement of the relationship between environmental and financial performance;
- Refinement/improvement of agricultural sector models to accommodate regulatory impacts;
- Updates of reports on cumulative impact of regulation on business; and
- Development of models that can be used to analyze the environmental effects of trade.

There is no apparent unifying theme to the research needs in this area, suggesting that more investigation into the highest priority impact area is needed to determine if original research can make the greatest contribution instead of guidance, literature reviews, or more specific applications. Several respondents requested guidance that could be updated through existing groups (the Economics Forum and a SBREFA review group) through NCEE.

## **Appendix 3. Relationships to Other Plans, Strategies and Documents**

### **Prior Environmental Economics Research Planning**

This effort follows directly from a five-year old needs assessment conducted by a predecessor group to NCEE (McClelland, et al, 1999). In that effort, EPA staff and external experts on the EPA Science Advisory Board's Environmental Economics Advisory Committee described and ranked the research areas that they considered to be most important. This prior research planning effort has been used for the last several years to focus STAR solicitations on valuation and market mechanisms and incentives, and as a source of ideas for in-house research conducted by NCEE economists. Given the passage of time, EPA believes the time is right to update and formalize the research planning process through this EERS.

### **Agency Strategic Plan**

In mid-fiscal year 2003, EPA is in the process of revising the Agency's Strategic Plan. While not complete, the structure of the plan has evolved from its previous version, moving from 10 strategic goals to 5. With the plan revision, OMB is requiring EPA to include the "social costs" of achieving EPA's strategic objectives. An Agency-wide group of economists and others are currently working to define and measure these "social" benefits and costs. EPA economists anticipate that it will take several years to develop methods and data that will allow the Agency to completely and accurately characterize the benefits and costs of achieving its strategic goals. The research developed in response to the EERS will provide some bases for estimating these benefits and costs, and make the EPA strategic plan more responsive to OMB requests.

### **ORD Strategic Plan**

The 2001 ORD Strategic plan sets out five strategic organizational goals. This research strategy should further achievement of all of these goals.

#### *1. Support the Agency's Mission.*

By proceeding from a basis of problem-driven research priorities derived by clients from across EPA and the outside, the EERS clearly supports the Agency across all programs and regions, where there is a well-recognized, critical need for additional economic information to accomplish its mission.

#### *2. Be a High-Performing Organization*

The EERS attempts to systematically incorporate all of ORD's economic research activities and integrate them with NCEE's and other EPA and external economic research, and with other scientific disciplines. This effort will maximize the exposure and effectiveness of ORD and EPA economics research.

#### *3. Be a Leader in the Environmental Research Community*

Research sponsored by the STAR grant program, and conducted or sponsored by NCEE and ORD labs is recognized as some of the most important environmental economics research developed anywhere. The EERS will further this reputation by supporting cutting edge and practical research that will affect the course of future environmental policy.

#### *4. Integrate Environmental Science and Technology to Solve Environmental Problems*

A sizable share of the research conducted by NCEE, ORD labs or externally through STAR grants is comprised of multi-disciplinary teams of economists and other scientists such as psychologists, ecologists, epidemiologists, engineers and health scientists. Sponsored environmental economics research uses a vast array of technological, financial, physical science and biological science information to analyze environmental policies. Several ORD labs and Centers are working closely with NCEE and the programs to integrate economic analysis with human health and ecological risk assessment. This EERS will improve and formalize support for this trend.

#### *5. Anticipate Future Environmental Issues*

This research strategy will help develop a capacity to predict how economic forces and trends will affect future environmental conditions.

### **Relationship of EERS to The National Center for Environmental Economics (NCEE)**

NCEE conducts and supervises research and development on economic analytic methods; leads production of cross-Agency economic reports; provides guidance for performing economic analysis; and promotes consistency in the preparation and presentation of economic information in the Agency. NCEE prepares economic analyses under its own direction, and functions as an internal resource for other Agency offices seeking information on benefit-cost research and techniques, economic impact models and measures, and economic incentive mechanisms. NCEE also performs a regulatory review function for the Agency by reviewing the economic analysis underlying significant regulatory actions.

The EERS will enhance NCEE's ability to perform its primary functions in several ways.

Putting Theory into Practice: NCEE is responsible for assisting EPA's offices in applying sound economic science in the preparation of economic analyses. The EERS will inform NCEE regarding the economic research needs of its client offices.

Improving EPA's Economic Tools: NCEE develops data and methods for benefit cost assessments through research aimed at filling priority needs common to many programs in the Agency. By better understanding the gaps in the existing economic research, and which research needs are most important given Agency priorities, NCEE's work in economic methods development can be better targeted at these identified needs.

Gateway for Academic Research: NCEE communicates EPA's research priorities to economics professionals across the nation. NCEE helps academicians identify topics pertinent to the Agency's needs and funds research in those areas through grants and cooperative agreements with universities. Through these efforts as well as seminars, workshops, and a website with online resources, NCEE serves as a gateway for academic research. The research needs identified in the EERS will allow NCEE to better engage the research community when seeking outside assistance with its research activities.

Linking Science and Policy: NCEE works to identify better ways to link the natural and social sciences to help improve risk assessments and benefit-cost analyses. NCEE

works to provide risk assessment information that can be fed easily into economic analyses. The goal is to improve EPA's ability to evaluate its progress in addressing risks to public health and the environment. Therefore, by understanding the Agency's economic research needs, NCEE is positioned to assess the underlying science, policy and data needs required to make the priority economic research as effective as possible in fulfilling the goals and mission of the Agency.

Exploring Emerging and Crosscutting Issues: The Center explores the changing nature of environmental problems that face EPA and the nation. This work includes identifying a wide range of emerging issues, trends, and challenges; assessing their potential impacts on the environment; and positioning the Agency to respond. The EERS will help NCEE prepare to meet these emerging challenges by focusing attention on the economic research that is most needed by the Agency to better evaluate future environmental issues and trends. Furthermore, as NCEE is not connected with any one media or program, the EERS will enhance NCEE's unique capability to address crosscutting issues.

### **Other ORD Strategies and Plans**

Because it focuses on behavior, environmental economics spans all of EPA's environmental protection activities. The ORD Strategic Plan (U.S. EPA 2001) notes that one of the trends likely to have the greatest impact on ORD research is the need to integrate "environmental research so that the findings of economics, sociology, psychology, and other social sciences can be incorporated into decision-making." Implementation of other ORD strategic plans will ultimately depend on better understanding of "individuals' behavior as consumers, commuters and property owners." Some particularly relevant strategies to the EERS include the ecological research strategy, the pollution prevention research strategy, the human health risk assessment research strategy, the asthma research strategy and the global change research strategy.

#### **NCEA - Global Change**

EPA's Global Change Research Program in the National Center for Environmental Assessment (NCEA) is an assessment-oriented program with primary emphasis on understanding the potential consequences of climate variability and change on human health, ecosystems, and socio-economic systems in the United States (see <http://www.epa.gov/globalresearch>). This includes assessing adaptation options to improve society's ability to effectively respond to the risks and opportunities presented by global change as they emerge. EPA's Global Program health assessments go beyond basic epidemiological research to develop integrated health assessment frameworks that consider the effects of multiple stresses, their interactions, and human adaptations, including economic responses. The global change program is also investigating the effects of global change on 1) aquatic ecosystems (which may include lakes, rivers, and streams; wetlands; and estuaries and coastal ecosystems); 2) invasive non-indigenous species; and 3) ecosystem services. These efforts are closely related to ecosystem valuation research.

#### **NCEA - Cincinnati**

To improve the utility of ecological risk assessment (ERA) in the decision making process, economists and ecologists in NCEA's Cincinnati lab are evaluating the application of models, landscape characterization methods, and economic analyses to formulate alternative approaches for protecting and restoring water quality and critical habitats, and to forecast the ecological, economic and human health outcomes of alternative solutions. The team of ecologists and economists is also exploring the relationship between indicators of ecosystem conditions and a selected set of high-priority environmental management problems in the Missouri, upper Mississippi or Ohio River basins. The products of this effort will be a set of problem-specific reports that will include conceptual models of sources, stressors, and both ecological and economic endpoints related to each problem.

#### NRMRL Cincinnati

Economists in NRMRL are working with engineers and ecologists to design and analyze market approaches for environmental systems management including a program of tradable credits for impervious surface for controlling urban storm water runoff, with a focus on stream quality and combined sewer overflows, a serious problem in many regions. This team is also working on construction of a basic theory of sustainable systems using principles from ecology, physics, law, and economics to uncover the underlying principles of sustainable systems and provide guidance on the viability different environmental systems management strategies.

#### ORD Capacity Needs White Paper

ORD recently developed an assessment of the social science capabilities that the organization will need in the future. All of the potential strategic directions involved integrating economics and other social sciences with engineering, physical and biological sciences. Among several suggestions for integrating social, life and "hard" sciences was that ORD should develop an integrated capacity where co-location of multiple disciplines would be essential to improved research. [NCEE has followed a similar strategy.]

#### **Other Plans and Activities**

##### *Ecological Benefits Strategic Plan*

Simultaneous with the development of the EERS, NCEE is working with the rest of the Agency, particularly ORD labs and centers and the Office of Water, to develop a strategic plan for estimating ecological benefits. This effort is patterned after a successful two-year collaboration between NCEE and NCEA to improve estimation of health benefits.

Development of the *Ecological Benefits Strategic Plan* (EBSP) involves both ecologists and economists from across EPA and will try to find common metrics for understanding ecological and economic processes, upon which sound estimates of values may be based. Interviews for the EBSP will involve both economists and ecologists and will focus solely on ecological valuations. As a result, they will provide different and more detailed results than the EERS surveys. The EBSP will identify research needs in ecology and related fields that are necessary to enhance the valuation of ecological

benefits. As noted below, EPA's programs perceive ecological valuation as a weakness in EPA's ability to estimate the benefits and costs of environmental protection, and have been consistently cited as a priority research area. NCEE and ORD will therefore use the results from the EBSP to focus research in the ecological benefits area.

*NRC Report on Air Pollution Benefits*

The National Research Council (NRC) recently issued a report (NRC 2002) on the estimation of the benefits of air pollution regulations. This report contained several recommendations including some that require further research to implement, including incorporating uncertainty in benefits estimation. ORD and NCEE are collaborating with OAR to provide whatever research support is necessary to respond to the NRC report.

*Program Office Research Plans*

Several program offices are developing and implementing research/analysis plans of their own, focusing on important program-specific issues. Both the Office of Air and the Office of Water have initiated research plans.

## **Appendix 4.**

### **Relative Advantages of Research Tools**

#### **Contracts**

Contracts are intended for the acquisition of services for EPA's direct use, rather than assistance to support more general purposes related to the Agency's mission. EPA programs use economic contracts for a range of specific tasks, often to estimate the costs and benefits of specific regulatory options. Contracts are generally more suitable for analysis than research. An economic analysis work assignment under a contract can be executed very quickly if a relevant contract is already in place, which makes contracts particularly suitable for analyses that are needed right away. Contractual analyses tend to be program or project specific, involve mostly secondary data sources, and rarely provide the original contributions needed to be published in peer-reviewed journals.

#### **EPA Internal Research**

In-house research is arguably the fastest way to produce research results, if qualified staff is in place and no other barriers exist. However, if the Agency is missing the needed research capabilities, the time and resources required to initiate research can be considerable. EPA's personnel system requires considerable effort to hire new staff. To make new hires an efficient research approach, EPA would have to need the new personnel's skill set continually over the long-term.<sup>1</sup> Additionally, economic studies frequently use some form of survey or questioning of individuals or industry to gather information. Internal research that gathers information directly from individuals or firms is subject to Paperwork Reduction Act requirements, one of which is that OMB must review and approve any survey instrument. OMB's resources do not permit timely review of research survey instruments and OMB may take several years to approve economic research surveys.

Conversely, intramural research is particularly well suited to providing research results that are needed specifically by EPA programs. Also, conducting research internally gives EPA the greatest amount of influence regarding methods, hypotheses to test and the level of effort devoted to the research. Moreover, in-house research gives EPA the flexibility to adjust the level of rigor and peer review to which the research is subject to the needs of the clients. Some research conducted by EPA is original and other research is meta-analysis of other research results. Some economic analysis is appropriate for program-level consideration of options, while other research is published in the best peer-reviewed journals. EPA research can also range from theoretical to applied, although there is a greater tendency toward applied research for which EPA programs have a direct need.

#### **Cooperative Research Agreements**

Cooperative Agreements are joint research efforts between EPA scientists and researchers at other institutions. They are assistance agreements, which are intended

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<sup>1</sup>Visiting academics and research fellows may provide temporary or project-specific research skills.

to enable research of general interest related to EPA's mission. They may not be used to generate research results that primarily benefit EPA in its day-to-day activities. As a hybrid between grants and internal research, they share advantages and disadvantages of both. EPA staff has somewhat more control on the direction and timing of research efforts, but all facets of research results, resources and timing must be negotiated with co-investigators from outside of the Agency. Cooperative Agreements that use surveys or experiments are generally subject to PRA requirements and OMB review. Cooperative agreements often generate high quality publications that researchers submit to peer-reviewed journals. Results can be either program-specific or generalizable to a range of programs or circumstances.

### **Grants**

Like cooperative agreements, grants are assistance agreements, and are even more focused on research questions of broad academic or public interest. The grant-making process, from solicitation writing through peer review and award to final results can take up to 5 years. Grants give external researchers the greatest amount of discretion, and conversely give EPA the least amount of influence over research results. In the STAR program, research proposals are received in response to criteria set forth in published solicitations. The proposals are peer reviewed, and only the highest quality proposals are eligible for funding. As well focused as a solicitation may be, investigators have considerable flexibility in responding to it. EPA's influence over research topics, approaches or timetables is largely limited to deciding whether or not to fund a proposal. Grants typically produce the kind of high quality, peer-reviewed results for which academics are rewarded. They tend to be quite generalizable and benefit EPA programs only incidentally, although several programs may utilize adaptations of their results.



**Appendix 4.  
Detailed Interview Results**

OAR/OAQPS Meeting 4-29-02

ORD: Matt Clark

NCEE: Chris Dockins

OAQPS: Aaiysha Khursheed, Larry Sorrels, Bryan Hubbell, Virgis Brown, Tyler Fox, Ron Evans, Lillian Bradley, Lawrence Pope, Linda Chappell, Eric Crump, Lisa Conner, Nancy Mayer

Topic	Votes	
	ST	LT
how learning curve for technology affects future year compliance costs	3	
incorporating economic and behavioral responses (averting behavior) into epidemiological studies		6
how and when firm value (stocks) are affected by changes in environmental news		
linking water quality changes to economic endpoints (aquatic vegetation, nutrients, fish populations, economic endpoints)	3	3
ecological, economic, and health effects related to systems of agricultural production	2	
economic and health effect studies on sensitive subpopulations and EJ	1	1
spatial economic growth models for emissions projections, critical pollutants and toxics: dispersion of economic growth	2	3
quantification of emissions to provide basis for trading, better and more monitoring or equivalents; gross emissions within and across compounds and source categories (point and nonpoint)	3	2
value of non-cancer health endpoints of air toxics		3
linking environmental indicators with economic endpoints so indicators can be used in analyses	2	2
approach for determining appropriate air pollution control emissions fee and alternative payment/fee	4	1
in-depth analysis comparing economic growth in attainment and non-attainment areas; retrospective/prospective to find growth factors	2	1
emissions trading modeling for non-utility sectors; single/multiple	3	

pollutants, cross-industry, cross-pollutant, local/regional		
alternative (to QALYs) cost-effectiveness measures that capture acute and chronic health and ecological effects		
use Tiebout model to examine migration between attainment and non-attainment areas based on health and other environmental effects (who and why?)		
incorporate regulation-induced product quality changes into market (equilibrium) analyses and new products	4	1
estimating existence values for cultures (tribes)	1	5
new air or water quality models: need reduced-form surface models for off-the-shelf runs (practical policy-relevant versions, updatable)	1	2
tracking or banking systems that streamline transaction costs (environmental impact of trades)		1
residential visibility valuation	1	1
uncertainty characterization: generalize framework for addressing uncertainty for everything: integrated from dose-response to valuation to cost impacts	2	1
objective way to determine location of EJ communities with respect to sources	1	1
<b>Total Votes</b>	<b>35</b>	<b>34</b>

OAR/OPAR Meeting  
 ORD: Will Wheeler  
 NCEE: Brian Heninger  
 OAR: Jim DeMocker

6-10-02

Topic	Votes	
	ST	LT
value of any ecosystem services that are potentially relevant for air; paradigm to approach this valuation and define ecosystem service flows that satisfies ecologists and economists	33.3	33.3
morbidity risks: wider endpoint coverage, more subpopulations (e.g. childhood asthma), use of QALYs (or other methods) to transfer values	33.3	33.3
other welfare benefits, more endpoints, more population coverage ( household visibility; different agriculture crops; other species of timber)	33.3	33.3
mortality		
benefits transfer methods to get better coverage of endpoints		
indirect (productivity) benefits		
what are actual discount rates, rate or return on investment		
CGE models		
learning curve on compliance costs (costs go down over time), especially important for regulatory phase-ins		
<b>Total Votes</b>	100	100

OPAA/OCFO Meeting      DATE May 16, 2002  
 ORD: Matt Clark  
 NCEE:

Topic	Votes	
	ST	LT
Research that will improve the inclusion of social costs in EPA's strategic planning.		
Characterize benefits aligned with Government expenditure information from OCFO, so that relative values of expenditures can be determined. Estimates of both public and private costs.		
Prospective Benefit-cost analysis for each strategic objective.	100	100
Method: Desire rigorous peer-reviewed journal articles estimating the social costs of achieving EPA=s strategic goals. e.g, costs and benefits of climate change.		
<b>Total Votes</b>	100	100

OCHP Meeting 5-8-02  
 ORD: Will Wheeler  
 NCEE: Lanelle Wiggins  
 OCHP: Ed Chu

Topic	Votes	
	ST	LT
age-specific values for mortality valuation (children and elderly)	50	50
are QALYs theoretically appropriate for environmental policy use	10	
age-specific values for chronic health effects such as: asthma, developmental disorders (ADHD, autism, mental retardation), and health effects associated with cancer both during the disease and during remission (effects from cancer treatment)	40	50
economic indicators of the environment (what does pollution cost the economy?)		
<b>Total Votes</b>	100	100

OECA/OPPAC Meeting: May 9, 2002  
 ORD: Will Wheeler  
 NCEE: Ann Wolverton  
 OECA-OPPAC: Jon Silberman

Topic	Votes (%)	
	ST	LT
How and why do compliance and enforcement interventions B compliance assistance, compliance incentives, compliance monitoring (e.g., inspections, information collection requests), civil enforcement actions, and criminal enforcement actions, impact corporate behavior, decision-making, compliance, and performance? <u>1/</u>	45	45
What are the impacts and cost-effectiveness of Environmental Management Systems (EMSs) in achieving compliance and improving corporate efficiency, e.g. average or marginal costs of reducing units of pollution, energy savings, etc., improved competitiveness, compliance over the short and long term?	15	15
What organizational characteristics (e.g., centralized or decentralized, EMSs, performance appraisal, reward, and compensation policies; etc.) foster improved environmental performance and compliance?	15	15
What is the relationship between environmental and financial performance? How/why does compliance and environmental performance correlate with or affect financial performance (cost increases and reductions; value creation - tangible and intangible worth? How does public disclosure of compliance and performance information impact future environmental <i>and</i> financial performance (e.g., stock values; bond ratings; insurance rates; profitability)?	8	8
What compliance and enforcement interventions most effectively ensure accountability for the generation of credits and allowances in market-based effluent discharge and air emissions trading programs?	9	9
How does participation in voluntary incentive or recognition programs impact beyond-compliance behavior, corporate efficiency, and earnings/profitability?	8	8
<b>Total</b>	100	100

1/ This topic includes as sub-issues: -1- Increasingly, EPA and the States are employing integrated compliance strategies that rely multiple compliance and enforcement interventions (A tool that may be applied sequentially, simultaneously, or both - how can

we maximize and measure the synergistic impacts of such strategies?; -2- What motivates companies in their decision-making processes and how do compliance and enforcement interventions compare to other incentives companies may have to change their behavior?; -3- What are the effects/results of sector-based compliance and enforcement interventions?

OECA/ORE Meeting      5-28-02  
 ORD: Will Wheeler  
 NCEE: Brian Heninger  
 ORE: Jonathan Libber

Topic	Votes	
	ST	LT
understanding deterrence: what is the private discount rate for corporations; what kind of financing do they use (equity, WACC, other instruments).; defendants says after-tax, risk-free rate; how do firms make decisions with respect to discount rates	60	
how do responsible environmental officials view compliance and how do they react to regulations? If enforcement is not real, will they comply? (What do they day in business school?)	40	85
do the same things that motivate compliance in the U.S. apply elsewhere?		15
<b>Total Votes</b>	100	100



OEI Meeting 6-11-02  
 ORD: Will Wheeler  
 NCEE: Brian Heninger  
 OEI: Christine Augustyniak, Cody Rice

Topic	Votes	
	ST	LT
Value of information to corporations, labor, consumers: currently no way to monetize benefits of information provision (e.g. TRI) to compare against costs; anecdotal evidence exists;	80	80
how information is used in decision-making: companies change behavior, people choose where to live, work (include all subcategories)	20	20
specific: internal cost savings identified when report is prepared, value of information to companies		
specific: eco, health benefits from reduced pollution		
is emphasis on info programs (e.g. DfE) a good way to go, are they effective?		
Prioritize expansion of TRI (industries, chemicals, threshold quantities): what is highest value, what order, what is the marginal value of next aspect of program?		
how value of info is linked to lbs. of pollutant (e.g. fat content, value of info is not strictly correlated with amount of fat); lead is an example		
Use benefits transfer to get value from another situation		
<b>Total Votes</b>	100	100

OIA Meeting 4-28-02  
 ORD: Will Wheeler  
 NCEE: Brian Heninger  
 OIA: Paul Cough

Topic	Votes	
	ST	LT
tools for measuring environmental effects of trade agreements, including changes in terms of trade, location of production, or means of production if changes have environmental consequences); linking economic models with pollution intensity and effects	30	30
how different rules (e.g. banning MTBE) affect foreign investment, product movements/flows	2.5	2.5
finance: How do we pay to provide safe drinking water to developing countries? How should environmental improvement be paid for? (domestic vs. international finance, public vs. private, end-of-pipe vs. other methods)	2.5	2.5
environmentally preferable green products: how do you adjust incentives to promote their use/production in accordance with trade laws. E.g. shade-grown coffee, voluntary or mandatory labeling.	22.5	22.5
corporate environmental stewardship: people will appreciate trade more if companies are good citizens (e.g. private international agreements on P2)	22.5	22.5
	20	20
<b>Total Votes</b>	100	100

OPEI/OEPI Meeting 6-3-02  
 ORD: Will Wheeler  
 NCEE: Brian Heninger  
 OEPI: Katherine Dawes, Pamela Kogan

Topic	Votes	
	ST	LT
how trading actually works in practice (e.g. acid rain, smog, ozone, PM)	50	
how trading actually works in practice (water, NPS): flexible permitting, performance-based, across-media trades		40
water infrastructure, aging of POTWS; could cost a lot, so how to invest		40
Do innovative programs (e.g. flexible permitting) lead to disparities even if there is superior performance? EJ aspects (e.g. hotspots), how do you avoid this?	10	
incentives for beyond-compliance performance (is compliance assistance a good incentive?); e.g. Environmental Results Program in Massachusetts. Demonstrating cost-effectiveness and environmental soundness for other states.	20	
retrospective analyses of innovative programs: POTWs, bioreactors, P2 permitting pilots, more successful XL projects		
expanding markets for metals recycling/recovery (RCRA)	20	
P2 for small businesses		20
<b>Total Votes</b>	100	100

OPEI-Small Business Division Meeting DATE July 22, 2002

ORD: none

NCEE: Julie Hewitt, Ann Wolverton

Small Business Division: Tracy Mattson, Larry Tessier, Jim Malcolm, Tom Nakley, Daniel Eddinger, William Crosswhite, Elsa Bishop

Topic	Votes	
	ST	LT
Literature search for relevant small business economic research (not even sure what has been done); would help program offices to do better SBREFA analysis	25	
Cost to Implement Environmental Management Systems- to large vs. small businesses; what works what doesn't work? What motivates small businesses to implement (sometimes large firms require suppliers to have an EMS to stay on bidding list)?	25	
Measurement of true costs for small businesses (get a better idea of the economic impact; small businesses are a different animal from large businesses and are motivated by different factors; is the type of economic analysis we are doing appropriate in this context? (e.g. use of profit margin instead of revenues))	25	30
Incorporation of unique characteristics of small businesses into economic analysis (get a better idea of the economic impact; small businesses are a different animal from large businesses and are motivated by different factors; is the type of economic analysis we are doing appropriate in this context? (e.g. use of profit margin instead of revenues))	25	30
Update cumulative impact report completed in 1988		40
Data collection - building a database that accurately reflects revenues, costs, and profits of small businesses; geographical breakdown; labor differences, capital investment, etc.		
What motivates small business behavior?		
Evaluation of past rules to identify gaps /where we could have done better in our analysis (over or under estimation of universe affected, costs, etc.), and what we are missing. Title 5 of CAA cited as bad example.		
<b>Total Votes</b>	100	100

OPPTS/IO Meeting 5-6-02  
 ORD: Matt Clark  
 NCEE: Brian Heninger  
 OPPTS: Sandy Evalenko

Topic	Votes	
	ST	LT
Value of information to the public (e.g. inventory update rule); requiring companies to provide use and exposure information has costs but what are benefits?	30	
Human health valuation for non-monetized endpoints: how do you consider non-monetized benefits? Values for endocrine disruptors, values for special populations (e.g. farm workers). Lead a specific need.	30	25
Ecological valuation for non-monetized endpoints: endocrine disruptors and lead again	15	35
Expand literature on latency issue.	25	
Children's health valuation for specific endpoints		30
Market mechanisms/voluntary programs (e.g. technical assistance)	10	10
<b>Total Votes</b>	110	100

OPPTS/OPP Meeting 4-23-02

ORD: Becki Clark, Matt Clark, Will Wheeler

NCEE: Julie Hewitt

OPP: David Widawsky, John Faulkner, Jihad Alsadek, Carole Battle, Tim Kiely, Steve Smearmann, Alan Halvorson, Istanbul Yusuf, Arthur Grube, Philip Villanueva, T.J.

Wyatt, F. Hernandez

Topic	Votes	
	ST	LT
valuing aquatic impacts from pesticide use		9
Zilberman's work on tradeable permits for pesticides	2	
quantifying benefits		3
measuring FQPA impact to growers and consumers; refining and improving ag sector models (AGSIM, USARM) to accommodate pesticide regulatory models	9	
how do pesticide users decide which pesticide/product to use (including price, rate of return) and how much	4	3
pesticide usage on non-ag sites (residential, school)	1	
value of avian species		1
evolution of chemical industry; change to sustainable ag, biotech		1
valuation of human health impacts (by pesticide class)	5	3
effects of biotech on chemical use	1	
integrating risk assessments with valuation	1	
risk perception and valuation; how consumer risk perceptions (e.g. organics) affect behavior; how fear of remote risks (e.g. biotech) affects valuation; effects of green labels on consumer and farmer behavior		1
combine usage info into a user-friendly software	6	
Discounting; if to do, what rate to use (time stability)		
burden on health care system as a consequence of pesticide use		
how have regulatory decisions affected ag industry		
EPA role in communicating risks and benefits		1
comparative evaluation of pesticide regs; efficiency gains		2

tradeoff between intensity of use and extensive use (area); environmental burden		2
risk analyses (acre treatments vs. percentage of crop treated ration)	1	
improve major vendor=s pesticide data for usage data (targeting)	4	
regulatory impacts under market distortions		
how timing of regulatory decisions affects outcome	1	1
appropriate use of CBA		
institutional restrictions on pesticide use/usage (keeping a subsidy for a specific crop, lending requirements)		
economics of reducing expected risk vs. regulated risk (safety factors)	1	2
impacts of global warming on pesticide use;		4
managing global climate change on pesticide use		3
<b>Total Votes</b>	36	36

OPPTS/OPPT Meeting 5-08-02

ORD: Will Wheeler, Matt Clark

NCEE: Ann Wolverton

OPPT: Bob Lee, Gary Cole (summarizing rest of office)

Topic	Votes	
	ST	LT
incentives for voluntary programs (both business and consumer-related): what induces a firm's/consumer's decision to participate? how do these systems work? what change in behavior results from the provision of new information to consumers (e.g. labeling)? when is a voluntary program a good strategy in relation to a regulatory program?	50	50
Benefits from informational rules: do real improvements occur as a result of information provision? do we solve market failures with these kinds of rules?	30	30
discounting/intergenerational equity		20
VSLYs/QALYs	20	
<b>Total Votes</b>	100	100



ORD Meeting

DATE 6/06/02

ORD: Matt Clark, Will Wheeler

NCEE:

ORD: Anne Grambsch, Randy Bruins, Lynn Papa, Matt Heberling, Betsy Smith, Haynes Goddard, Hale Thurston, Beth Lemberg

Topic	Votes	
	ST	LT
how can non-market values be used to prioritize ecological restoration projects or inform other choices (as in ecological risk assessment)?	15	6.66
develop scenarios of technical and regional economic change and how these will affect environmental quality	16.67	
retrospective study of environmental restoration costs vs. prevention	8.33	
incorporating non-monetized values of ecosystems or other ways to value ecosystems		20
new or novel approaches to link quantified morbidity effects of air pollution with economic values		13.33
economic value of ecosystem services: how does this change by level of aggregation, spatial-temporal scales	16.67	16.67
important health metrics when valuing health risks and what types of information can risk assessors provide to economists	10	10
what behavioral modifications can individuals take to adapt to climate change and how can they be activated	6.67	6.67
investment strategies to manage non-point water quality problems and habitat restoration (inc. stormwater)	16.67	16.67
can market-based mechanisms guide these investments? what type of market structure/institutional arrangements would achieve efficiency within explicit ecological constraints?	10	10
<b>Total Votes</b>	100	100

OSWER/OERR Meeting

DATE: April 30, 2002

ORD: Will Wheeler

NCEE: Julie Hewitt

OERR: John Harris (Dave Slutsky, contractors)

Topic (SUPERFUND)	Votes	
	ST	LT
Identifying, quantifying, monetizing existence and use (including passive use recreation) values of open-space lands	50	
Understanding both landowner PRP and non-landowner PRP behavior (why do PRPs mothball sites? why do PRPs cooperate and why don't they? what leads to site reuse? compliance disincentives for cooperative behavior)	30	
What is the optimal solution when there are multiple sites in a geographic area?	20	
Appropriate discount rate for intergenerational flows		40
Identifying, quantifying, monetizing existence and use (including passive use recreation) values of open-space lands [see SR, too]		30
Monetizing ecosystem service values		20
How to value messes not made or voluntary cleanup (i.e., bigger picture benefits of Superfund program)? What's the appropriate methodology for capturing these as indirect benefits?		10
What portion of the health benefits of cleanup is capitalized into property values? Can we be certain there's no double-counting?		
Reusing a brownfield saves infrastructure investments (already there)		
How to compare re-use alternatives of contaminated sites and how to value?		
Why isn't there more of a market for environmental insurance? Are there adequate mechanisms to bottle risk for transfer?		
Why are states in a race to the bottom competing for business?		
How to measure cultural values?		
EJ questions in economics terms		
Is there a catalytic impact to resolving an NPL site? What does it trigger?		

Is there a value to permanent solutions over temporary (30 years) solutions: to clean it up and haul it away, or to contain it?		
Cleanup level is often tied to next use; are there intergenerational impacts to this? Are there financial tools to remedy this?		
Cross program interactions (SIP in air)		
Groundwater: clean up the aquifer or pump and treat; law says the former, but is latter more rational?		
Multicriteria analysis		
Value of EPA information being organized and presented differently to the market		
Stigma: is it attached to Agency action or to existence of contamination in the first place?		
How to meaningfully communicate C/B analysis to non-economists?		
<b>Total Votes</b>	100	100

OSWER/OSW Meeting 4-24-02

ORD: Becki Clark, Matt Clark, Will Wheeler

NCEE: Lanelle Wiggins

OSW: Lyn Luben, Mark Eads, Glenn Farber, Gary Ballard, Jan Young

Topic	Votes	
	ST	LT
cost issues related to a learning curve; technology becomes cheaper to operate (and to buy) every year	3	
price elasticity of demand for hazardous waste as a fuel	1	
Benefits, primarily lead exposure in children and adults; look at threshold effects (RA issue)	1	
how can economics stimulate and measure progress in solid waste recycling, solid waste energy recovery, and retail product stewardship (economic incentive approaches to waste reduction in the realm of corporate decision-making)		1
how can economics play a role in industrial ecology approaches to solid waste management		
what role/direction can economics provide to OSW's RCRA 2020 vision		
valuation of avoided contamination of groundwater (specifically address non-use values)	1	1
valuation of avoided acute events; explosions, toxic gas clouds, fires, major spills		1
effects of RCRA regs on private sector recycling decisions	1	
success of Extended Product Responsibility		1
tools and database to cross-walk cost/sales to economic impacts (firm closures, profit reductions)		
guidance or tools for translating engineering/out-of-pocket costs to social costs	1	1
how do sociological values effect corporate or individual economic decisions		1
intergenerational equity issues; What premium does society place on future generations?		1
valuation of ecological services: ecosystems, groundwater, biodiversity	3	2

(hazardous waste bioreceptors)		
tradeable permit program for hazardous waste		1
nonconstant or differential (between benefits and costs) discount rates	3	
additional benefits from P2 (versus remedial activities)		1
when is it cost effective to segregate waste by retrofitting a facility rather than ship commingled waste off-site		
liability thresholds for on-site waste management		
understand social cost of using virgin materials vs. reuse	1	1
sustainability analysis (renewables v. nonrenewables)		2
looking at ways to fortify existing hazardous waste markets; improve profitability, improve participation/coverage; achieve with incentives, regulatory and non-regulatory programs		
equity and environmental justice		1
<b>Total Votes</b>	15	15

OSWER/OUST Meeting 08/05/02  
 ORD: Will Wheeler  
 NCEE: Chris Dockins  
 OUST: Maricruz Magowan

Topic	Votes	
	ST	LT
average cost of an OUST cleanup (preferred by State or by Region)	40	
what is: the average cost of training one inspector, ideal number of inspectors, ideal frequency of inspection	20	
benefits of revitalization of sites/UST fields	10	15
database: age of tanks	5	
economic evaluation of leaks: frequency and causes	5	10
evaluation of LUST financial assurance formula	20	15
benefits of increased expenditures on cleanup		10
what economic factors drive owner and operator decisions; what opportunities would be more profitable and/or increase compliance?		15
database: location of tanks		35
<b>Total Votes</b>	100	100

OW/IO Meeting 4-25-02  
 ORD: Matt Clark, Will Wheeler  
 NCEE: Chris Dockins  
 OW: John Powers, Mahesh Podar, Ron McHugh

Topic	Votes	
	ST	LT
a framework for ecological service valuation to comprehensively estimate benefits	3	
water quality/quantity interactions; cause climate change on quantity (feeds into ecological valuation)		2
monetization of QALYs/DALYs		
monitoring technologies that make trading feasible; improve assessments	2	
institutional constraints (transaction costs) affecting transition from technology-based regulations to an incentive based regulatory system (e.g. ELGs to TMDLs); this transition is difficult because institutions support existing structures	2	
CGE models that can be used in regulatory decision-making		2
systematic framework for valuing mortality/morbidity	2	
integrated regional assessments of watersheds (e.g. hypoxia in Gulf)		
trading in context of TMDLs, multipollutant and multi-TMDL (scale); also between rivers		3
creating markets for multiple service flows between stakeholders		2
systematic strategy for environmental priority setting		
<b>Total Votes</b>	9	9

OW/OGWDW Meeting 2-28-02  
 ORD: Matt Clark, Will Wheeler  
 NCEE: Brian Heninger  
 OW: John Bennett, Tricia Hall, Becky Allen, Ephraim King

Topic	Votes	
	ST	LT
cost-effectiveness analysis, especially regarding life-years or QALYS as a subset (how to respond to a request for these analyses)how much dose-response info (by age) do you need for a life-years extended analysis	2	1
reproductive and developmental valuation (e.g. miscarriages and still births)	1	2
focus on treatments costs; need social costs of regs	1	2
OGWDW uses a decision tree to predict technology adoption and cost estimation; discovered tree was inaccurate (facilities adopt mgt. practices or get new sources in lieu of treatment; treat for taste and odor; install technologies at the same time)	3	
how to improve understanding of decision processes; retrospective studies one avenue		
integration of SDWA and CWA/interaction of treatment cost savings	2	4
valuation of leisure time		
value of GI incidents (USDA uses COI)	1	
data needs for QALYs		
application of qualitative endpoints where national incidence is not known		
characterization of uncertainty in benefits estimates		
valuation of health endpoints for children and elderly	1	1
variation in mortality value (WTP for cancer death vs. accident; age; voluntariness, dread, etc.)	1	1
alternative risk reduction measures (e.g. seat belts vs. drinking water contamination); if risk reductions come from different budgets, how do you compare them?		2
Costs to parents of a child's illness		



market mechanisms/incentives in a drinking water context	1	
LYE analysis for CE	2	2
<b>Total Votes</b>	15	15

OW/OST Meeting 5-7-02

ORD: Becki Clark, Matt Clark, Will Wheeler

NCEE: Lanelle Wiggins

OW: Chris Miller, Bill Anderson, Nick Bouwes, James Covington, Renee Johnson, Kristen Strellec

Topic	Votes	
	ST	LT
defining new water quality uses (guidance on widespread economic impacts for states, regions)		
valuation of non-cancer morbidity effects from toxic pollutants	1	1
WTP values that reflect latency period so they can be applied at time of exposure	2	1
environmental justice: how do our rules affect communities; benefits of improved EJ		2
how do you incorporate growth factors into impact analysis? Incentives for Smart Growth	3	
Tradeable permits; TMDLs vs. WQs vs. EGLs; how do you design them to work? Focus on market mechanism issue (add development credits)	1	2
intergenerational impacts; how discounting affects future generations: should it be done?	1	
A retrospective study: how ELGs affected industries/small businesses that have been regulated		2
cancer mortality risks (better link between risk and human health/mortality) with dose-response function;		1
WTP to avoid risk of various health endpoints from major pollutants		
guidance on assessing financial impacts to individual firms/facilities (e.g. consistency/what to use depending on kind of data/industry)	1	2
measuring impacts on nonpoint/ag sources, other non-traditional industries; little guidance available on impacts to non-corporate structures	2	2
ecological valuation; impacts from removal of nutrients/TSS	2	1
valuation of avoided pathogen exposure to humans, wildlife, agriculture	2	

QALYs	2	
environmental ethics (e.g. EJ, QALYs, impacts on non-humans, intergenerational)		1
benefits from reduction in ammonia and hydrogen sulfide air emissions		
environmental accounting/impacts linked to environmental accounts		1
effectiveness of voluntary programs (e.g. an EMS)	1	2
<b>Total Votes</b>	18	18

OW/OWM Meeting 4-29-02  
 ORD: Will Wheeler, Matt Clark  
 NCEE: Julie Hewitt  
 OWM: Laura Palmer, Ginny Kibler

Topic	Votes	
	ST	LT
documenting market failures based on a lack of information about the environment or about how their actions affect the environment		2
Ag impacts: value of impacts from ag pollution on groundwater and surface water health and eco effects of ag pollution on groundwater and surface water quality Impact of aquatic animal production (aquaculture) on surface water quality: is benefit transfer okay?	1	
Issues in water quality valuation: do people value water that is not new to them? valuation of small vs. large streams; small streams that feed into large streams are water quality values sensitive to recreational or other uses?	1	1
Impact of aquatic animal production (aquaculture) on surface water quality: is benefit transfer okay?		
value of produced species relative to natural species (invasive threat, substitution benefit)	1	1
Management practices: how to measure cost savings from improved management of collection system (i.e. sewer); tradeoff of O&M vs. future capital what are the costs and benefits of improved management practices	2	
WTP or COI values of avoiding specific illnesses (earaches, headaches, cold-like, non-GI, GI) with different durations		1
QALYs		
replacement for Mitchell-Carson for large national rules		1
how to account for baseline closures		
how to handle one year (or limited) data in a cyclical industry		
<b>Total Votes</b>	<b>6</b>	<b>6</b>

