Climate Change Research: Evaluation and Policy Implications
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Communication Among Scientists, Decision Makers and Society: Developing Policy-Relevant Global Climate Change Research.

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Abstract

Defining the research most relevant to policy is not simply a technical task that can be answered by scientists. Decision makers need and value information differently than curiosity-driven scientists. In order to link science more effectively to policy, the two communities must gain a greater mutual understanding. Decision makers must define their needs so that scientists can determine how, and by when, research can address these needs. This vital dialogue between communities typically has been more ad hoc than systematic. The complexity and urgency of the global climate change issue necessitate ongoing communication between scientists and decision makers on the information needed for policy development and what research can provide. The results of relevant science policy dialogues are discussed herein.

1. INTRODUCTION

Effective communication between researchers and decision makers is a crucial ingredient for successfully addressing society's pressing environmental concerns. The increase in policy makers' demands for research that is relevant to solving societal issues highlights the communication gap between the technical and policy communities. The gap, largely caused by lack of mutual understanding, results in flawed and inadequate communication that hinders decision making and confuses the public.

This paper examines the cause of this communication gap and describes the significance of recent efforts to develop more fruitful science-policy dialogues on the issue of global climate change. First, the post-Cold War shift in government priorities for research funding is described; then the underlying relationship between science and policy is explored to identify key sources of ongoing miscommunication.

The paper then explains the importance of defining policy-relevant science questions that research can address. Finally, three projects are described involving the elicitation of decision makers' information needs in The United States, The Netherlands, and internationally.

2. POLICY RELEVANT RESEARCH

Fifty years after World War II, the major political, social, and economic changes sweeping the globe are causing an historic shift in the emphasis of research funded by governments. In many nations, such as the United States, national security was a major societal justification for massive public funding of the natural sciences and engineering. The end of the Cold War military competition has caused a wide spread reevaluation of science funding priorities [1,2].

Furthermore, the public's faith in science as an unquestioned source of ever increasing material living standards has been shaken by the emergence of many technologically-induced environmental problems [3]. With economic constraints to growth and global competition rapidly increasing, there are greater demands to direct government-funded science and engineering toward solving pressing societal problems.

The emerging post-Cold War rationale for government funding of research has five priority factors:

- Emphasizing science that provides societal benefits;
- Linking research programs to the needs of decision makers;
- Providing economic development and competitive advantages;
- Developing partnerships with diverse stakeholders; and
- Leveraging international research activities and programs.

None of these factors are new, but the increased emphasis upon them in guiding research investments is a major development for science in the post-Cold War period. This greater attention to investment return and the societal relevance of research will require enhanced efforts to improve the communication between scientists, decision makers, and the public.

3. RELATIONSHIP OF SCIENCE TO POLICY

"Science has the first word about everything and the last word about nothing," Victor Hugo observed. The truth of this is inherent in the relative roles that both "objective" scientific information and "subjective" human values inevitably play in decision making. Environmental policies are developed by interpreting and applying technical information in light of the needs and human values of society (Figure 1). Viable policies must not only be technically sound but also socially, politically, and economically acceptable.

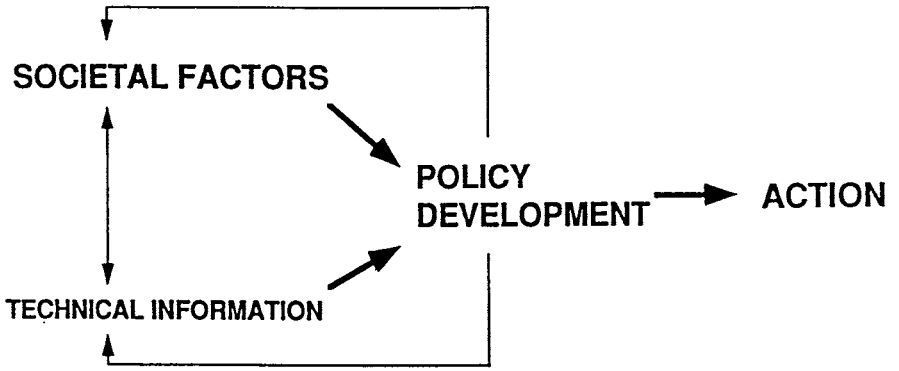

Figure 1. The relationship of science and human values in policy development, showing primary interactions and feedbacks.

Science alone cannot provide answers to policy makers' ultimate questions because science necessarily is silent on the human values that underlie the decisions societies make. The scientific method itself is designed to screen out the value preferences and biases of the subjective human beings who conduct research. Technical information is useful in identifying issues, developing options, providing understanding and evaluating consequences for policy actions. But in the end, human values must be applied to determine what is "good" policy for a given society on a specific issue.

Take the example of nuclear energy: is promoting it a good or bad policy? On the surface this appears to be a scientifically answerable question yet nations with access to the same technical information have made different choices about the best policy for their societies. Indeed, there are Nobel Laureates that staunchly argue opposite sides of the case because the question ultimately involves human values. Science can only approximate the risks and benefits, but a subjective value judgement must be applied to decide what ratio between the two is acceptable to a given individual or society [4].

Many of the difficulties scientists and policy makers face in communicating and working together arise from differences in their professional cultures (Table 1). Both the scientific and decision making communities experience frustration over the paradoxical relationship between information development and policy development. The public and policy makers often perceive that science is more effective at identifying uncertain problems than it is at providing certain solutions. On the other hand, the technical community becomes frustrated by the perceived inability of policy makers to grasp the facts and take what they personally judge is the "logical" action.

Table 1
Contrasting Professional Cultures of Scientists and Policy Makers

Science	Policy
Objective Facts	Subjective Values
Proof	Beliefs
Rational	Emotional
Measurements	Perceptions
Incremental Progress	Deadlines and Crises

Applying technical information to decision making is a fundamentally different type of activity than discovering new knowledge. Alvin Weinberg coined the term "trans-science" to describe the process of using technical information in making decisions that inherently transcend the bounds of science [5]. He points out that facts alone are not sufficient even for weighing the benefits and costs in policy issues, because subjective values must be applied in choosing what facts to use and how. Harvey Brooks concludes that, "the facts that are selected and the way they are presented to the public may have a greater political impact than the facts themselves" [6].

4. SCIENTIFIC UNCERTAINTY AND POLICY DECISIONS

Environmental policy debates typically involve discussion of uncertainties and how much certainty is "enough" to justify a proposed action. The question of how much information is adequate for a given policy always involves a value judgement and cannot be answered by scientific research alone. There is no objective point in science that defines enough certainty for policy.

Research can only quantify the uncertainty in the science, and even that with great difficulty, but policy involves many other types of inherent uncertainties. Policy decisions must consider uncertainties about matters such as the significance of facts, the perceptions of the issue (opinion polls), the economic and social viability of the proposed solutions, and the actual versus intended consequences of the action.

The degree of scientific consensus is just one part of the information needed for decision making. Brooks cautions that we "should be careful not to expect that scientific consensus should be a necessary condition for policy consensus, an expectation to which scientists tend to be too prone" [7]. For instance, we might have no fiscal policies if action required consensus on economic predictions. The policy makers' roles include making subjective judgements about which information should be acted on and how much certainty is enough for decision making.

The degree of certainty that is adequate for policy can be viewed as an equation balancing scientific uncertainty and political uncertainty. Two general principles apply to environmental issues:

I. The greater the societal consensus on an issue, the less scientific certainty required for action.

II. The higher the societal costs of a policy, the greater the scientific certainty required for action.

The inverse of these principles also is true. They imply that enough certainty in the science is always defined relative to the political certainty in the issue. Therefore, enough scientific certainty in the policy process is a dynamic factor, not a static end point from research.

Two examples illustrate these principles. The United States and Canada fully shared scientific information on acid deposition; they had joint monitoring programs and the same degree of technical certainty on the issue. Nonetheless, lower scientific certainty was required to justify policy action by Canada because there was much higher political certainty than in the United States. Over 90% of Canadians believed that acid rain was a serious problem, while there was no such consensus in the United States. Canadians saw a threat to their major industries—timber, fisheries, and tourism—from the potential damages. In the United States, pollution control costs were instead perceived to be a threat to industry and jobs. In essence, all details of politics aside, the reason for the national differences in the thresholds of scientific certainty required for action was simple and predictable.

In the United States, chlorofluorocarbons (CFCs) were banned as spray can propellants back in 1978. At that time no ozone hole had appeared and scientific certainty about the issue was lower than about acid rain in 1980 or global climate change in 1994. The threshold

of scientific certainty was low for the initial CFC ban because there was political consensus that the risks of skin cancer were not judged to be worth the benefits of protecting a few jobs. Further banning CFCs from all other uses awaited higher scientific certainty because of the greater societal costs involved.

5. POLICY-RELEVANT SCIENCE QUESTIONS

For scientists to assist effectively in the development of policy, their research needs to be focused on the questions of greatest value to decision makers. Examining past experiences in applying science to address environmental issues helps illustrate the importance of defining the policy-relevant science questions to guide research.

Policy relevancy is determined by the specific needs of the information user (policy maker) not the interests of the information producer (researcher). Unfortunately, the questions investigated by curiosity-driven science are often different than those required to provide the most policy-relevant information. This occurs because decision makers only require the information that can materially assist their specific deliberations, whereas scientists seek greater fundamental understanding of their subjects. Other mismatches exist because of the different values attached to information in the research and decision-making realms, and because policy makers need information that cuts across fields of research.

There are three general ways to define policy-relevant research questions:

- Educated guesses: This has been the traditional means whereby scientists who study an issue presume to formulate what questions they deem relevant to decision makers. Although quick, this investigator-driven approach fails to examine the real needs of the policy users. Curiosity-driven questions tend to dominate these agendas without the benefit of decision makers' input.
- Multi-stakeholder dialogues: This approach involves systematically eliciting the information needs of decision makers in the various stakeholder groups for the issue. Interviews and meetings are utilized to determine what the information users' need. Then scientists are involved in examining and responding to these needs in a facilitated process that ensures results reflecting the best input from both communities. This process can be accomplished over several months and builds direct dialogue between the participants, helping bridge the science-policy communication gap. A limitation of this method is that it does not allow distinguishing what information participants say they need from what they may use in practice.
- Social science research: This is the most intensive approach and goes beyond eliciting the expressed needs of decision makers to study their actual behavior in applying information. It involves carefully designed research and field studies observing the behavior of subjects involved in decision making. This approach provides valuable insights into the use of technical information in policy development. This scholarly approach requires extended periods, usually years, during which the policy relevant questions may shift. Moreover, it does not necessarily build ongoing dialogue between the science and policy communities.

Whereas the educated guess approach has typically been used, a combination of the multi-stakeholder dialogues and social science research is most effective. The dialogues facilitate timely development of broad policy-relevant science questions and build mutual understanding as a basis for consensus between the participants. This approach directly

enhances the effectiveness of linking science and policy. The longer-range and more intensive social studies of decision makers' and scientists' behaviors help provide deeper understanding for designing more effective communication. Interactions between these two types of approaches is valuable in assisting each to reach its goal.

The remaining sections of this paper describe three projects that represent multi-stakeholder dialogues aimed at defining policy-relevant research questions for global climate change. The general significance of the results of a pioneering study done in the United States in 1992 are reported. The second study was done in 1994 for The Netherlands, and it improved on the methods in the initial project. The third study is being conducted in 1995 by a joint team of the investigators from the U.S. and Dutch projects and applies the previously developed approaches to an international context.

6. U.S. DECISION MAKERS' CLIMATE INFORMATION NEEDS

In 1990, a number of U.S. research organizations became concerned that the government-sponsored U.S. Global Change Research Program (USGCRP) may not provide an adequate basis for the inevitable information demands of future policy development. They decided that a first step in moving toward a policy-relevant research agenda was to determine generally what information decision makers needed, and they launched the "Joint Climate Project to Address Decision Makers' Uncertainties" [8]. This unique private-federal partnership was sponsored by the Electric Power Research Institute (EPRI), U.S. Environmental Protection Agency (EPA), the U.S. Forest Service (USFS), and the U.S. Departments of Energy (DOE), Agriculture (USDA), and Interior (DOI). The project was designed and conducted by Science & Policy Associates, Inc. The Joint Climate Project established a multi-stakeholder dialogue to help identify some major questions U.S. decision makers had about global climate change and then had scientists determine what research and time frames would be required to address those questions.

6.1. Focusing on the Needs of Decision Makers

The Joint Climate Project identified policy-relevant research using two interactive phases: U.S. decision makers first defined their information needs, then scientists gave feedback on these needs and determined the research required to address the policy-relevant questions.

During the first phase of the project, the needs of the users of climate information were identified through interviews, workshops, and focus groups involving national-level decision makers. These individuals included dozens of U.S. government and private sector officials, ranging from working-level experts to members of Congress, Administration officials, and industry CEOs. They were invited to participate in the project on the basis of their active roles in climate change policy and their diverse perspectives, from federal regulators and resource managers, to industrial representatives and environmental groups. The interactive process lasted six months and resulted in a consensus set of policy-relevant general questions for researchers to address.

Then, leading experts in climate-related fields were convened at a workshop to discuss the specific questions developed by the decision makers. The scientists were chosen for their activities in research or in the synthesis of research results. They represented a broad range

of expertise, including climate system modeling and monitoring, managed and unmanaged ecosystems, energy and technology, as well as economics and social sciences. The workshop participants examined the research needed to address the questions and the expectations for providing better information over the next two, five, and ten years, and beyond.

6.2. Findings of the Joint Climate Project

The consensus-identifying approach of this project yielded several key findings that reflect the general concerns of decision makers and the responses of the research community. In discussions with these two communities, several common themes emerged for enhancing communication and increasing the value of research results.

6.3. The Concerns of Decision Makers

- *International Perspectives Drive Policy*: The participating decision makers identified several general principles that define policy-relevant questions for research. The project was conducted during the year before the United Nations Conference on Environment and Development (UNCED). Talks were well underway to craft a Framework Convention on Climate Change. Therefore, many government policy makers focused on these and other ongoing international negotiations and conferences. The officials specifically asked for information to support follow-up actions to UNCED and preparations for future events. For their part, non-government decision makers expressed concern with the possible regulatory implications of proposed actions.
- *Climate Change Impacts and Human Responses are Key to Decision Making*: Aside from pressing international policy issues, decision making is driven by concerns about the potential impacts of changing climate at the regional level, rather than predictions of changing global mean values of climate variables. Specifically, input is needed from the economic, social, and ecological sciences on the potential regional impacts of climate change and the consequences of possible response strategies. Any response to the threat of climate change must be measured against what is at stake. Therefore, more information is needed on the ecosystems, regions, and human populations that are most at risk from potential climate changes, even if atmospheric research is still unable to provide reliable predictions of the specific changes that will drive effects.
- *Implications of Uncertainties Need Clarification*: Researchers need to clarify the sources and implications of policy-relevant scientific uncertainties and estimate time frames for reducing them. Many uncertainties, although scientifically profound, may be relatively insignificant for developing policies. There is a need to define better which uncertainties are most important for policy development and resource management, and the practical implications of these uncertainties for decision makers.
- *Certainty is Not a Prerequisite for Action*: During the project, several decision makers stressed that the resolution of all scientific uncertainties is not a prerequisite for policy action. Decisions are regularly made in the face of some uncertainty. Decision makers will apply their constituents' values to determine how much certainty they judge is enough to take political action.

6.4. The Response of Researchers

In the next phase of the project, a diverse group of U.S. experts in climate-related fields were convened to examine how research could best address the questions posed by decision makers. Specifically, the scientists examined what types of research are needed to reduce the uncertainties in the policy-relevant questions and estimated the time frames for possible results.

- *Timely Results*: Some of the key questions decision makers have about climate change can be addressed within a short time frame on the basis of analysis and interpretation of currently available scientific information. Although more complete scientific understanding of climate change may be decades away, much of the information needed to begin addressing decision makers' questions can be provided within two to five years. This could include a comprehensive evaluation of indicators of global climate change, a preliminary vulnerability analysis for systems and regions most sensitive to climate change, and an assessment of the sources and levels of greenhouse gas emissions for use in identifying potential mitigation and adaptation options.
- *Parallel Approach to Climate and Human Responses Research*: Scientists need not wait for accurate climate predictions before beginning their research on potential impacts and response options. It is neither necessary nor practical for research to progress sequentially from the climate system, to the impacts, and then to the potential human responses in order to provide useful results for decision makers. Much can be done to improve the understanding of impacts without waiting for accurate regional climate predictions. For example, integrated regional and multi-sectoral models—using climate, ecological, demographic, economic, and social data collected at the regional level—can provide essential information on potential climate responses, the vulnerability and adaptability of key systems, the extreme ranges of change, and the impacts of climate change on the global marketplace.
- *Greater Emphasis on Impacts and Human Responses Research*: Information on climate change impacts and response strategies has the greatest potential for assisting decision makers, yet these fields are the least researched. Many of the key questions identified by decision makers involve a significant amount of new socioeconomic, behavioral, and ecological research. However, only modest increases in funding for these disciplines would be necessary to achieve useful information for policy within a few years. Social science and economic research, in particular, receive a small percentage of federal funding, but are critical for making decisions about climate change.
- *Integrated Assessments and Case Studies*: Integrated assessments of the causal linkages from emissions through impacts and human responses would help structure information for effective use in decision making. Such assessments would incorporate natural and physical sciences, economics, and social factors, including technological change and adaptation. In addition, a coordinated examination of case studies of regional climate variability is needed—based on historically documented events that show how societies have responded to past climatic variations. This information would provide valuable insights on how to treat future events.
- *Expect the Unexpected*: Multi-disciplinary research on potential surprises is also important, given their potentially serious implications for decision making (i.e., climate change could be much worse than anticipated, or it could be insignificant). Decision makers and scientists should frequently re-examine research on potential surprises, given that scientific progress is

incremental and new information may become available. Based on this information, contingency plans could be developed to prepare for unforeseen events.

• *International Perspective*: Because of the global dimensions of the issue, an international perspective for research is essential. Although decision makers may be most concerned with regional and local consequences, developing world issues (such as population and economic development as well as the pace, quality, and sustainability of development) will be critical. Assessing the ability of the international community to implement mitigation and adaptation measures is important for evaluating the effectiveness of response strategies on the climate system.

The project asked researchers to identify the potential types of information that research could provide to address decision makers' concerns in two, five, and ten years. The participants provided educated estimates of the potentially available information for time frames of interest to decision makers. These estimates were developed without regard to financial or other resource constraints. Furthermore, the researchers suggested what research could do, and not what currently planned efforts will do.

6.5. Lessons in Communication

Discussions during the Joint Climate Project with representatives of both communities provided ample evidence that decision makers and researchers are uncomfortable with the present situation. Both are anxious to develop and sustain a productive dialogue. Both would like to increase the effectiveness of the research community in the decision-making process. Both agree that a two-way bridge must be developed to span the communications gap between the two communities.

But to truly close this gap, to construct a bridge between the two communities, will take more than wistful expressions and lofty pronouncements. There is no substitute for sustained effort and innovative institutional arrangements. The decision makers and researchers who participated in the project agreed that greater attention must be paid to the development of systemic communications processes. In particular, both sides need to recognize the following points.

• *Not an Either/Or Decision*: Decision makers' choices are not simply between pursuing research or implementing response strategies. Rather, the challenge is to define the appropriate levels of each over time. Researchers need to provide a broad array of information to address the complex and interacting decisions on global climate change. Decision makers, for their part, need to recognize the long time scales involved in research and, thus, the importance of continuity of funding and program goals.

• *Global Climate Change in a Relative Risk Context*: Prediction of changes in mean global temperatures does not give an adequate picture of the societal risk that can be related to every-day experiences. The risk of global climate change needs to be compared to the risks of other economic, social, and environmental issues. Because the public tends to respond to perceived crises, assigning relative risk would help decision makers distinguish between verifiable serious threats and possibly misplaced public concern. Given that risk is a function of both the probability and the magnitude of the expected consequences, better data on possible impacts are critical to better estimates of societal risk.

• *Urgent Need for Education*: A concerted effort is needed to educate decision makers on the facts and uncertainties of global climate change. Since public concern is often the

impetus for formulating policy, scientists need to communicate technical information to the public more effectively and more frequently. In addition, scientists need to learn more about the decision-making process and the types of information most useful for policy. Frequent, two-way communication between decision makers and researchers is essential if research is to play an effective role in the decision-making process.

- *Research Does Not Always Provide the Answer*: Decision makers should understand that additional research can increase the amount of uncertainty in some areas. Researchers should inquire about how much certainty decision makers require to take a specific action. To this end, uncertainties that are not relevant to decision making should be identified early in the process. Decision makers and researchers should also seek ways to manage continuing uncertainties. For example, building resilient institutions would provide a flexible response to any future changes in climate, albeit at potentially significant costs. Contingency plans allow decision makers to prepare for possible climate outcomes through R&D on response technologies, without needing to deploy them.
- *Develop an Ongoing Assessment Process for Research*: To improve communication and better inform decision makers, research efforts should include an iterative assessment process. These assessments not only help to identify the relevant questions, but also serve to structure the research results and, thus, facilitate clearer communication between the two communities. Furthermore, the assessment process provides valuable input to the planning of policy-relevant research.

6.6. Project Significance

The Joint Climate Project represents a preliminary step in determining how researchers can assist U.S. decision makers over the coming years and decades, thereby helping to bridge the communication gap between these two communities. A more frequent and systematic two-way dialogue will be needed between decision makers and researchers in order for research to inform the decision-making process. Discussions with decision makers and researchers during the project revealed that both communities are very interested in developing and sustaining a productive dialogue. Both would like to increase the effectiveness of the research community in the decision-making process.

Following the successful dialogue established by the Joint Climate Project, other similar efforts were initiated for climate change in The Netherlands and for biodiversity in the United States [9]. These types of dialogues also need to be supplemented by more in-depth social science studies to elicit greater understanding of the behavior of decision makers in applying science. A better mutual understanding of the professional cultures of researchers and decision makers is required to enhance the effectiveness of linking science to policy.

7. NETHERLANDS POLICY OPTIONS STUDY

"Policy Options Addressing the Greenhouse Effect," a climate change project conducted in The Netherlands, had an approach and goals that were consistent with the Joint Climate Project. The Policy Options study was conducted for the Dutch National Research Programme on Global Air Pollution and Climate Change (NRP) by Prof. Pier Vellinga with his colleagues at the Institute for Environmental Studies (IVM) at the Free University of

Amsterdam and Prof. Jan Klabbers, with consultation by Dr. Chris Bernabo [10]. Within the project a dialogue has been initiated between policy makers, scientists, and other societal actors to look at how Dutch society can cope with the risks of climate change and the challenge of sustainable development.

The project produced two types of results. The first included various policy options and related actions. The second, and probably more important, results were related to the process itself. There was an improvement in the communication and discussions among all the stakeholders which, over the longer term, can lead to a more solid foundation for action.

7.1. Project Objectives

The Policy Options study was designed to bridge the gap between perceptions of policy makers, researchers, and public interest groups. The specific objectives were to:

- Reinforce communication between the three communities;
- Illustrate the perceptions of the communities;
- Examine policy development options; and
- Inject the options into the Dutch policy development process.

7.2. Project Approach

The first step in the process to develop climate policy options was to identify the issues through interviews and workshops with policy makers. Natural and social science researchers then assessed the issues in position papers and workshops. Next, round table discussions linked the science and policy perspectives. The outcomes of these discussions provided the basis for the development of a range of policy options and related actions.

7.3. Resulting Policy Options

The key policy options that emerged from the study were: no-regrets (actions which may be economical regardless of climate change considerations, although they may not be considered no-regrets by every country), least regrets (actions which adopt the precautionary principle), acceleration (encouraging reductions through subsidies or taxes), technological innovation, and institutional(ised) cultural change. The five options that have been generated effectively illustrate the complexity of the climate change issue with respect to causes, uncertainties, international relationships, and the values and norms that are at stake. They acknowledge the divergence of the views and interests of all players, and encourage working towards convergence of actions. Full details of the policy options may be found in the final report of the Dutch study [10].

7.4. Recommendations

Recommendations are based on the observation that within the natural sciences it was relatively easy to reach a shared view on climate change, but the bridge between the natural and social sciences was rather difficult to make. The project's recommendations include:

1. Enhance the Communication Between Scientists: Discussions in the science workshops revealed that economists, sociologists, philosophers still show large discrepancies in their

view of the problem and the paradigms used in their approach to the problem. As climate change and sustainable development require open, interdisciplinary minds, much work has to be done to improve the dialogue between the disciplines concerned.
2. *Improve the Science-Policy Interface*: The improvement of the science-policy interface will promote the assimilation of scientific results by policy actors and will also help in identifying the relevant research questions. This implies a broadening of the communication between the science community and policy actors from the private sector, the national and local government, and public interest groups. It is recommended that attention be paid to sector-specific constraints and opportunities of climate change and sustainable development.
3. *Integrate Climate Policy into Broadened Socio-Economic and Environmental Policies*: Various key societal groups do not perceive climate change as a problem that warrants stringent measures. All groups seem to agree, however, that environmental policies, including those relevant to climate change, should be integrated into broad socio-economic policy.
4. *Address Two Fields of Priorities*: The project revealed two fields of priorities, that necessarily need to be addressed: improving the dialogue between natural and social sciences; and improving the dialogue within the social sciences.

7.5. Project Significance

The Dutch project laid a solid basis for a continuation of the fruitful communication between the researchers attached to the NRP and the policy actors from all sectors of society. During the project it became clear that there is a vast body of knowledge available outside the scientific community. Different but valid perceptions exist about the various aspects of climate change and climate change policy outside the scientific community. Through the project, these have been initiated and can now serve as an important source of information both for policy actors and researchers.

8. INTERNATIONAL CLIMATE CHANGE PROJECT

The success of the U.S. and Netherlands studies encouraged the development of a project applying a similar process at the international scale. The project on "Enhancing the Effectiveness of Research to Assist International Climate Change Policy Development" (International Climate Change Project) is designed to determine the range of uncertainties and information needs of decision makers in relation to global climate change in an international context [11]. The project also assesses the research needed to help answer the associated questions and facilitates dialogue between scientists and policy makers at the international level. S&PA, IVM, Prof. Jan Klabbers, and Professor Bill Moomaw of the Tufts University Fletcher School of Law and Diplomacy in the United States have undertaken a project designed to address these issues at the international level. The initial phases of the project are funded jointly by the Dutch NRP and the U.S. EPA.

8.1. Project Goals

The goals of the International Climate Change Project are to:

- Identify and scope the range of policy options under consideration by representative countries, for which future research information is needed.
- Determine the research required to address the information needs relevant to the range of policy options identified and to help guide the planning of policy-relevant research.
- Enhance the dialogue between the decision making and research communities at the international level for the climate issue. The international dialogue fostered by this effort will promote a better understanding between decision makers and scientists both nationally and internationally.
- Facilitate the planning of research that is more relevant and usable by decision makers. Exercises such as this project make a lasting contribution to improving the utilization and linking of science with policy development.

8.2. Project Approach

The project compliments the current international activities relating to climate change and explores the long-term policy questions that require research-based information needs to support the range of policy options identified. The International Climate Change Project utilizes and updates the results obtained from the similar studies in the United States and Netherlands. The project will be undertaken in three phases:

- *Phase I - Project Design and Analysis:* Activities in Phase I covered project planning and design to formulate the scope and tasks of the project. A project Steering Committee provided guidance and recommendations on the scope of the project. Selection criteria for choosing participating countries were developed together with the procedures and approach for undertaking interviews and workshops in the subsequent phases. These selection criteria were designed to promote the selection of countries that would provide a wide range of policy options and the information and research needs to support these options. The Steering Committee considered five types of criteria identified by the project team: environmental, economic, political, cultural/geographical and feasibility. Initially four countries, in addition to the United States and The Netherlands were chosen to be included in this pilot project: Brazil, China, India, and Poland.
- *Phase II - Identification of Policy Options:* The objective of Phase II is to determine the range of policy options under consideration by policy stakeholders in the climate change issue. This will be undertaken through in-country interviews with representatives from the participating countries in February and March 1995, including an update of the information obtained during the national projects in The Netherlands and the United States. An international decision makers' workshop will be held in June 1995 to elaborate on the range, motivations, and substance of policy options. The output of Phase II will be a final report detailing the policy options identified and other results of the interviews and workshop.
- *Phase III - Identification of Research Needs to Address Policy Options Identified and Inter-Community Dialogue:* Phase III will present these options identified in Phase II to the research management community from the participating countries through the presentation of briefing papers and a workshop. A dialogue between the policy-making and research communities will be established through round tables or another workshop. The purpose of

this exercise is to identify research priorities and agendas and consider their implementation. Output from Phase III will be a report identifying key areas of research to address the policy questions identified as priorities in Phase II, synthesizing the dialogue between the policy-making and research communities, and summarizing the key areas for research and information needs identified during this dialogue.

8.3. Project Significance

The selection of Brazil, China, India, and Poland as pilot countries allows for an examination of climate change policy and research options in situations that are markedly different than those found in more developed countries. Integrating the findings of these efforts with those of the U.S. and Netherlands studies will provide a preliminary picture of how the decision-making and research communities can work together to address climate change at the global level. The process used in the project can be tailored to the needs of other countries to help them establish a dialogue between the science and policy communities.

9. CONCLUSIONS

Developing policy-relevant research requires the involvement of both scientists and decision makers in framing the appropriate questions. Policy users of the research results must articulate their information needs and consult scientists on the feasibility of research providing meaningful answers. Scientists can examine those initial requirements to determine the limitations and strengths of investigation and to meet them within available budgets and time frames. An iterative process between the users and producers of the information is desirable to refine and then periodically update the policy-relevant research questions as both the science and policy evolve.

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