Standing, left to right:
J. Ausubel, O. Davidson, J.-H. Kim, E. Arrhenius
Seated, left to right:
S. Rayner, A.K. Jain, B. Schlomann, K. von Moltke

19

Group Report: Social and Institutional Barriers to Reducing CO_2 Emissions

J. AUSUBEL, Rapporteur
E. ARRHENIUS, R.E. BENEDICK, O. DAVIDSON,
A.K. JAIN, J.-H. KIM, S. RAYNER, B. SCHLOMANN,
R. UEBERHORST, K. VON MOLTKE

SUMMARY

Seven subjects warrant special attention to increase understanding of ways to reduce social and institutional barriers to reduction of CO_2 emissions. These are:

1. the diverse or plural rationalities for decision-making;
2. processes for consensus formation;
3. time horizons for social decision-making and action;
4. economic distortions of environmental and energy services;
5. design of organizations for research, assessment, and evaluation;
6. diffusion of environmentally relevant technology in developing countries and technological leapfrogging;
7. lifestyle trends and changes related to climate and energy.

INTRODUCTION

Discussion in our group moved from general issues of world views to how these views affect consensus formation, to the constraints from temporal

Limiting the Greenhouse Effect: Options for Controlling Atmospheric CO_2 Accumulation
Edited by G.I. Pearman

and economic factors in decision-making, to the issues of the relationship of science to policy, decision-making for development in the energy field, and consumer choices that maintain characteristic lifestyles (Figure 19.1). The point of departure for each subject was a question, as presented in this report. The common thread throughout was the emphasis on decision-making, including inputs, processes, and outcomes.

For most of the questions, it was found useful to explore the following dimensions:

1. *system levels*, i.e., international, national, subnational;
2. *organizational types*, i.e., intergovernmental, governmental, nongovernmental (including corporate);
3. *time horizons*, i.e., less than 15 years, 15–50 years, and beyond 50 years;

WHAT ARE THE LIMITATIONS OF DIFFERENT VIEWS OF NATURE, APPROACHES TO RATIONALITY, RISK MANAGEMENT, AND FRAMING OF INFORMATION, AND HOW CAN THESE BE TURNED TO ADVANTAGE?

The climate change issue provides ample evidence that there are abiding and sometimes contradictory views of nature and philosophies of risk

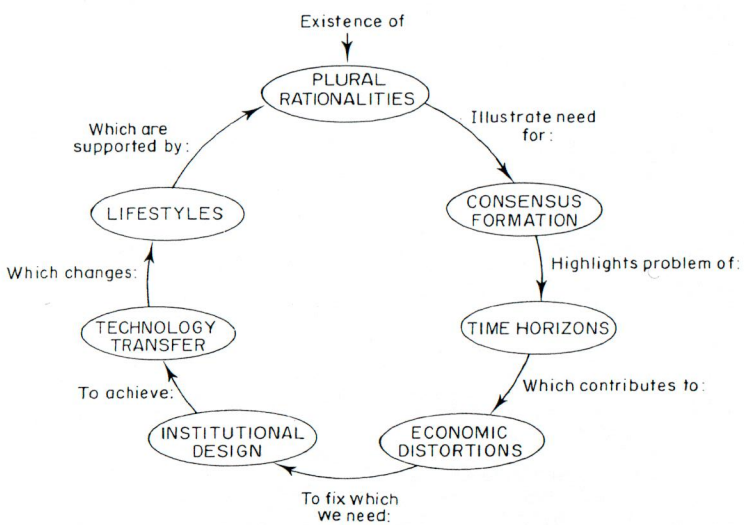

Figure 19.1 Schematic overview of social and institutional barriers to CO_2 reduction

management, in short *plural rationalities*. For some hazards, risk can be adequately defined by multiplying the probability of an event times its magnitude. For problems in which there is precision in measurement of the risk and for which the stakes are largely local, few difficulties arise. When risks become more difficult to quantify, when assessment relies on less-developed methods, and when the spatial extent of risk enlarges, understanding of underlying views of nature assumes greater significance.

One perspective on views of nature is provided by "cultural theory," as developed in anthropology (Douglas 1978; Douglas and Wildavsky 1982; Gross and Rayner 1985; James et al. 1986). Cultural theory suggests that there are primary "nature myths" (Holling 1986; Schwarz and Thompson 1990). These may be that nature is either fragile, robust, resilient, or capricious. As shown in Table 19.1, where nature is represented as a ball on a differently shaped surface, myths leads to a particular moral imperative, preference in response strategy, and type of social organization. This typology is a heuristic device, defining pure or ideal types that are rarely

Table 19.1 Nature myths. For a thorough discussion of such myths and a somewhat different categorization, see Schwarz and Thompson (1990)

FRAGILE	ROBUST	RESILIENT	CAPRICIOUS
			
DON'T MESS WITH NATURE	DON'T CURB GROWTH	PRESERVE CHOICE	DON'T TREAD ON ME
PREVENTION	ADAPTATION	SUSTAINABLE DEVELOPMENT	FATALISM/ DENIAL
"GREEN" ENVIRONMENTAL GROUPS	MARKETS	BUREAUCRACIES	NIMBYS* *Not In My Backyard

found in practice. Individuals and organizations are in fact likely to be hybrids of these views and characteristics.

The approach, nevertheless, does suggest the extent to which notions of trust, liability, and consent are integral to the definition of risk. As suggested in Table 19.2, each form of social organization is likely to have preferences in regard to how trust is established, how liability is characterized, and how consent is obtained. The existence of plural rationalities creates structural obstacles to social learning, because it is hard for individuals and groups, dwelling primarily in one or another paradigm, to interact.

The diversity of views is also a resource. It provides society at large with sources of warning and with explorers, as well as with more stable organizations that can take a longer view. It also creates some ambiguity about the role of expertise. From the viewpoint of cultural theory, every social group has its own experts and its own characteristic demands for information. Because experts may hold fundamentally different views of nature, their views may remain in conflict, both about what the facts are and whether the facts make an argument. There are also structural reasons for the subversion of "rationality" (Elster 1983).

Understanding more about plural rationalities could have several benefits with regard to CO_2 reduction. It could help in design of more viable

Table 19.2 Characterization of trust, liability, and consent by various social organizations

	"GREEN" ENVIRON-MENTAL GROUPS	MARKETS	BUREAUCRACIES	NIMBYS
TRUST	PARTICI-PATION	SUCCESSFUL INDIVIDUALS	INSTITUTIONS	DUMB LUCK
LIABILITY	STRICT	INSURANCE	DEEP POCKETS	AVOIDANCE
CONSENT	EXPLICIT	REVEALED PREFERENCES	HYPOTHETICAL (REPRESENT-ATIVE)	VETO

and customized implementation strategies. It could help to facilitate communication between groups and to recognize where communication or synthesis will never be achieved. It argues for the preservation of cultural diversity as a resource from which behavioral and technological solutions may arise. It helps define balanced institutional development and explain when and where it may be useful to catalyze the formation of new organizations (Carroll 1988). For example, some societies may be particularly deficient in market organizations, others in small, critical nongovernmental organizations, and others in stable and effective bureaucracies. Finally, study of human views of nature and culture reminds us of the limits of particular notions of reason, including efficiency, and to take into account fairness and justice, administrative feasibility, and beauty.

Among the salient research questions are:

1. Can we describe better and more fully world views and their configuration?
2. How do diverse world views constrain action at the global level?
3. At the national level, how do diverse world views influence choice of policy instruments?
4. At the subnational level, are there ways to invert the tragedy of the commons so that local or community goals favor the global good?
5. Where is there a need to stimulate the growth of "missing" institutions?
6. What organizations are best adapted for the range of functions required to respond to global change, for example, functions of monitoring and verification of international environmental agreements?
7. How do diverse world views influence the sense of urgency that different groups hold about global environmental change?
8. How does culture structure the use and perception of time?
9. What environmental goals are best pursued through *explicit* consensus?
10. What environmental goals are best pursued through *informal* agreement?
11. To what extent can environmental and energy technologies be designed around world views?

WHAT ARE THE BARRIERS TO COLLECTIVE ACTION ARISING FROM KNOWLEDGE AND IGNORANCE, TRUST, SELF-INTEREST, POLITICAL MOTIVATION AND CONSENT, AT THE LEVELS FROM LOCAL TO GLOBAL DECISION-MAKING?

The existence of competing and differing world views rises to great importance in the *process of consensus formation*. In facing challenges such

as reduction of carbon emissions, it becomes desirable not only for the views to interact but also in key situations to arrive at a common view, or at least a view that is sufficiently broad for widespread social action to take place. In this context, it also becomes necessary to ask which world views are politically feasible or best adapted to action.

Barriers to collective action may arise because of deficits in knowledge with regard to underlying scientific questions, or with regard to motivations, attitudes, and willingness to act in the larger society of which the scientific community forms one element. The traditional model of "science advising" addresses the production of knowledge by the scientific community for an external "receptor" (Plowden 1987). It is increasingly necessary to consider new roles of the scientific community as all fields of human action become pervaded with technical questions and the more embracing question of the interaction of the scientific community with other groups (Burns and Ueberhorst 1988).

In many instances, work from the scientific community has been judged too narrow to be of use in politics. In politics it is often a mistake to isolate certain aspects of a question (for example, to consider only alternatives to gasoline without considering other changes in transport systems). Scenarios developed internally to science often have heuristic power but do not represent sufficient or socially urgent viewpoints. A key in politics is provision of alternatives, particularly in terms of what can be accepted by the public. There is a need to develop institutions that can engage in cooperative conceptualization of complex processes in such a way that social learning by all groups participating is enhanced. As long as there is a lack of a "common problematique" between the political system and the scientific community, proposals worked out in the scientific community will be of little use.

The essence of the stiuation is that many contemporary problems can only be defined with the help of scientists but cannot be solved by them. Solutions rest with intercommunitarian processes and, in some cases, with normative consensus formation. This requires a willingness to participate in political processes by scientists, changing roles for experts, and recognition that qualities of work by scientists can themselves be barriers to action. It also implies that sometimes consensus is more important than selection of a particular strategy, that the greatest need can be to create an action coalition to implement at least one of several reasonable strategies.

The situation is further complicated by the differing orientations of science and politics. Politics remains oriented primarily to decisions and concerns within the nation-state, although notions and limits of national sovereignty and security are changing, largely because of technology (Shultz 1990) and environment (Goldemberg and Durham 1989). The values of science tend

to be "universalistic." Many nongovernmental environmental organizations share this universalist viewpoint, sometimes irking governments, as in Brazil.

The challenge in the situation is to preserve the rights of science and the rules of democratic decision-making while recognizing that traditional argumentation rules used by society are not sufficient. It is necessary to develop processes that encourage the ability to work out views in detail, especially minority views, for those who may lack certain argumentative skills. It is desirable to work out alternative policies in a high quality way that does not rely on bringing every issue to a vote or a court trial. It is important to have a process that represents fairly both the middle and the tails of the distribution of opinion, or whatever shape the distribution may have.

One interesting example of a mechanism of this type has been the Enquête-Kommission of the German Parliament on protection of the atmosphere (Enquête-Kommission 1989). Parliaments can serve as a mediating link between scientists and the general public. Through public hearings and published results, parliaments can provide a means for translating scientific findings into policy-relevant concepts and policy options.

The Enquête-Kommission broke new ground in the scope of its hearings and the balance of membership involving both scientists and politicians as full participants. Although primarily aimed at an audience of German decision-makers, the Enquête-Kommission made considerable efforts to broaden its influence. It invited witnesses on an international scale and designed a comprehensive report not limited to the German perspective but adopted a global viewpoint. The international significance of the Enquête-Kommission's process and work was reflected in the decision to translate the report into foreign languages and its use and citation by German political leaders, not only as the basis for German national policy but explicitly to serve as an example to other industrialized nations.

A paradoxical question is that bargains may be more likely to occur in an information-poor setting. While we live behind a veil of ignorance about winners and losers (Rawls 1971), the dominant strategy may be cooperative and collectively oriented. Since no participant can guarantee that he or she will not receive a devastating blow, risk averse players will want to minimize such possibilities. Thus, ironically, ignorance as much as information, may motivate environmentally (and globally) desirable outcomes.

Specific research questions:

1. How can processes for consensus formation in the field of environment and technology field be enhanced at all levels?
2. What changes are required in the processes internal to the scientific

community to make its work in its roles with a normative orientation more useful?

3. Should there be more discussion of guidelines or norms of advocacy for scientists to facilitate communication with the political system?
4. How is communication between science and politics affected by the universalist orientation of science in contrast to orientation of politicians toward the sovereign state?
4. To what extent is it the case in environmental negotiation that stakeholders facing decisions with highly uncertain outcomes will emphasize a fair process of decision-making rather than gambling for advantage?

WHAT OPPORTUNITIES AND CONSTRAINTS ON COLLECTIVE ACTION ARISE FROM DIFFERING PLANNING AND DECISION CYCLES AMONG INSTITUTIONS, INCLUDING PARTS OF GOVERNMENT, PRIVATE FIRMS, NONGOVERNMENTAL ORGANIZATIONS, AND THE MEDIA?

The relevance of the issue of *time horizons* originates in the fact that many of the costs potentially associated with reducing carbon emissions may appear in the short term, while benefits emerge over the longer run. The high level of uncertainty about both costs and benefits further creates a preference in many organizations and groups for a myopic strategy and for a search for "no regrets" policies.

Various time horizons characterize parts of government, consumers and voters, and industry, as well as science itself. Some parts of government, especially elected officials, tend to have relatively short-term perspectives. Many politicians will avoid taking decisions on sensitive or volatile issues during their term of office. Factors that influence the time horizons of elected officials include the power of narrow special interests and the costs of campaigns. However, there are other quite different factors that also lead toward short-term horizons. One is the failure of effective central planning, which often seeks to have a longer-range character through 5-year plans and other programs. Another is competition among priorities. Many governments, especially in developing countries, face immediate issues of survival of such large dimensions that there is little or no room on the political agenda for the long term.

It is important to note that there are instances of far-sighted decisions of governments, for example the establishment of national systems of agricultural research and the building of an infrastructure for water supply, wastewater treatment, and transportation. Over the past 100 years almost all nations of the world have chosen to set aside areas as nature preserves and parks, and many of these decisions have not been based on economic assessments. There have also been long-range studies such as the "Global 2000" project of the U.S. government in the late 1970s (Barney 1980), which sought to encourage all departments of government to look forward to the issues that they would need to address more than 20 years in the future.

Consumers and voters also often opt for the near term. The tremendous expansion of consumer debt in all countries is one indicator of the desire for short-term gratification. The experience of the public with changes in scientific knowledge also leads to a certain skepticism about long-term commitments.

In industry, time horizons are determined in large part by the depreciation structure of capital stock, tax rules, and features of financial markets that favor optimizing for periods that are often less than two years and rarely extend for more than 7–10 years. Businesses face the very real risk of bankruptcy and thus must take decisions in the interest of survival.

At the same time, some sectors of industry demonstrate long-term horizons. Decisions to develop entirely new products in such sectors as pharmaceuticals, to build automobile factories and power stations, to develop a mine, or to plant timber resources imply horizons of a decade or more. At the highest levels of industry, there may often be more long-term vision about what is best for an enterprise, which involves not only short-term financial results but a long-term flow of products and a positive public image.

Nongovernmental organizations appear to span a range of time horizons. Some follow fads and fashions and can sustain themselves only by fund-raising strategies that require abandoning an issue if it will not attract contributions, dues, and membership. Others are explicitly oriented toward long-term considerations and may be insulated by endowments or stable memberships. There are also organizations like churches and universities that have displayed longevity measured in many centuries despite taking many short-run decisions that appear uneconomic.

At the international level, the United Nations system has sought to provide long-range perspectives and has designed many decadal programs. However, in practice, unreliable UN budgets have meant that many more programs are announced than carried through. Moreover, there is just as much mistrust of centralized management and planning at the global level as there is on the national level.

The scientific community is unusual in its comfort with long-term considerations. A period of one or two hundred years is short compared to the time horizons of disciplines such as cosmology, geology, or ecology, and

scientific agendas are routinely pursued over decades. However, science is always uncertain about what constitutes usable knowledge for today.

Consideration of time horizons suggests that we may need not only environmental laboratories and environmental ministries but also environmental churches. If "Green" is the new religion, it may be because "peace with nature" (Meyer-Abich 1986) can be maintained only by institutions and taboos with extraordinary durability and longevity.

Specific research questions:

1. What are the time horizons characteristic of the organizations most important to global environmental change and why?
2. What are the institutional factors and cultural beliefs that shape the spectrum of time horizons and enable them to change?
3. Why are some political systems more open to change and long-term perspectives?
4. What is the time required to reach various kinds of international agreements? Does it differ systematically for broad and specific agreements?
5. How can methods be improved for the conduct of studies that extend decades and generations ahead?
6. What establishes the calendar of science and are there ways to accelerate the production of usable knowledge from science important for global environment?

WHAT CHANGES IN PRICING RESOURCES AND DECISION-MAKING FOR RESEARCH AND DEVELOPMENT SHOULD BE GIVEN PRIORITY?

Important aspects of environmental protection and natural resource management are hindered by reliance on an antiquated and flawed economics (Baumol and Oates 1988; Pearce 1987; Solow 1973). At the same time, economic instruments can be powerful tools for environmental protection and for harmonizing goals for energy, environment, and growth (IEA 1989). Reducing *economic distortions* and shifting the economic system to reflect more accurately current, shared values about environment would be an important instrument for substantially reducing carbon emissions.

The problem for environment of the evaluation of time within the discipline of economics has been widely discussed for 20 years (Ausubel 1980). The practice of discounting, which correctly reflects that for many

economic decisions a dollar today is worth more than the same dollar held at a time in the future, systematically diminishes the value of environmental assets. To take the extreme case, a profitable activity today that would destroy the environment 100 years from now would still be assessed favorably in narrow economic terms, as any positive discount rate applied to an asset 100 years in the future would render it trivial.

Values of stocks of natural resources (as well as important social functions such as housework) are largely omitted from the systems of accounting generally used in national economic planning and in business decisions (Nordhaus and Tobin 1972). Partly the reason is that the systems were established for purposes quite distant from environmental protection. Partly the reason is that some environmental goods, which can be assessed in monetary terms with reasonable accuracy, have not been internalized into economic analyses. Partly it is because some environmental goods, such as genetic diversity or the assimilative capacity of the environment for wastes, are difficult to monetize at all.

The result is a set of energy prices that are particularly distorted from an environmental point of view. Prices have not reflected true *internal* costs, whether in central and eastern Europe, the Soviet Union, North America, western Europe, or less-developed countries. They have also not included *external* environmental costs and benefits. This is true not only for climate change but also for effects of energy sources on human health, materials and the built environment, and ecology. The unrealistically low monetary price of energy is associated with high levels of energy consumption.

The distortions affect not only overall consumption of energy but also the allocation within energy sources. Subsidies have tended to favor coal, oil, and nuclear energy over natural gas, solar energy, and energy efficiency, even though the latter are all more favorable from an environmental perspective. Pricing structures in energy are also strongly influenced by a tendency to use energy pricing for other goals of social welfare. The difficulty of separating social and economic criteria in practice in a single pricing structure has led to a dominance of social goals. It is important to note that subsidies to maintain employment in the coal industry or to insure against hazards of nuclear accidents were social choices of the same kind that are now needed to favor protection of the environment. It is also important to recognize that the structure of subsidies and incentives pervades not only energy use but also energy research and exploration. Thus, we may tend to develop the wrong fuels for the future, as well as use the wrong ones today.

The difficulty is that while there is agreement on the distorted pricing of the present system, there is much less agreement on how to improve it. There is general agreement on the need to internalize more environmental costs, and there is general agreement that changing prices can beneficially

effect both the sources of supply and the level of demand. However, it will be useful to provide much more insight into the potential for environmental management of various economic instruments and incentives.

The economic system must also be adapted to concerns for the resilience of ecosystems. The risk of sudden irreversible events in ecological systems places an increased value on early action. The absence of efficient economic evaluation systems considering abrupt human-induced changes and associated economic tools giving a bonus for early action, is a constraint in greenhouse-gas management. In adapting to greater instability and increased change in ecosystems under climate change, there is also a need for flexibility in future infrastructure establishment. Efficient economic tools for stimulating such flexibility must be developed.

Economics has been under pressure in recent years because it has neglected to look inside the "black box" of technology that is in fact responsible for much economic growth over the long run (Dosi et al. 1988). Now it is clear that the movement to achieve an economics that is more holistic, systemic, and evolutionary also requires that it operate intelligently inside "the green box."

Specific research needs:

1. To what extent will provision of better information about environmental costs of energy use change behavior?
2. How broad a definition of externalities can be functionally applied to current pricing structures?
3. What are long-run elasticities of energy demand, how high will taxes or charges need to be to exert a sustained influence on behavior, and are these best applied in gradual or abrupt price changes?
4. What are the strengths and weaknesses, by criteria including fairness and efficiency, of various economic regimes for limitation of carbon emissions (fixed reductions, per capita targets, carbon taxes, tradable permits, etc.)?
5. What are the relative benefits of approaches to the energy system as a whole versus approaches focusing only on carbon dioxide?
6. Why are more costly instruments for economic control often selected by society than the instruments judged superior by economists?
7. What is the shape of the "supply curve" for carbon reductions for different nations, regions, and the world as a whole?
8. To what extent will formal action at both the international and national level be needed in order to bring about changes in energy pricing sufficient to achieve major carbon emission reductions?

WHAT IS THE RELATION OF SCIENCE AND POLICY IN THE DESIGN AND EVALUATION OF INSTRUMENTS FOR REDUCING EMISSIONS?

The effectiveness of the relation between science and policy depends critically on *organizational design* for research, assessment, and evaluation regarding climatic change, its causes, and efforts for prevention and adaptation. The importance of design of organizations and decision-making processes has been highlighted by the creation of the Intergovernmental Panel on Climate Change (IPCC), whose results have been widely accepted as authoritative. Of course, structural aspects of decision-making processes cannot be separated from substantive aspects and performance. The relation between science and policy is determined not only by the vehicles for interaction but also by the quality, relevance, and timeliness of results, which along with the process employed contribute to credibility and legitimacy.

There are many functions requiring scientific or analytic skills that need to be fulfilled with regard to climatic change and carbon emission reduction. These include basic research, monitoring, assessment, policy design and implementation, verification and compliance, and policy evaluation. We highlight three gaps in an organizational landscape that merits careful study in its entirety (Tolba 1990). The three gaps are in the joint international conduct of basic environmental research, the joint international assessment of environment issues, and the evaluation of the effectiveness of programs intended to address environmental problems.

The probability of international agreement and action on climate change will likely be increased if scientists from many nations have the opportunity to participate in basic research related to global environment. However, most nations lack sufficient financial, technical, and human resources at the national level to develop autonomous research programs at the frontiers of environmental science. Equally important, it is necessary for the scientific community of nations and regions to be able to understand local and regional implications of global analyses. Ultimately, global issues are local problems, such as drought.

Already there are several useful programs, such as the World Climate Program, that coordinate national research efforts to achieve larger goals. A powerful means to achieve scientific advance and greater participation may be the establishment of a network of international environmental research centers. These centers would be governed internationally and have scientific staff members from many countries. In some ways, the network would be a "Green" version of the Consultative Group on International Agricultural Research. The centers would be responsible for both research and advanced training and would be located in both developing and developed countries. They should seek to strengthen national systems of

environmental research, as well as to perform regional and global analyses in order to fill gaps likely to remain from national systems. Recommendations for centers of this kind have been made as part of the International Geosphere-Biosphere Program (IGBP 1991) and by the Second World Climate Conference. However, as yet, little careful thought has been given to how the network might most usefully be designed, taking into account not only the goals of the scientific community but other communities as well.

While a network of centers might generate and diffuse new knowledge and strengthen the human resource base in environmental sciences for many regions, the question remains how to synthesize what is known at the international level. National efforts such as the Enquête-Kommission are unlikely to touch the full spectrum of issues and people concerned. Although the IPCC was a remarkable step forward in this regard, the IPCC reports leave many questions unanswered, especially with regard to impacts of climate and mitigation strategies for emissions. The IPCC analyses also say little at the regional level. The IPCC is likely to continue in some form. Nevertheless, to establish a more consistent and comprehensive capability, it might also be useful for several international scientific organizations to explore and develop their potential to perform similar assessments. Joint international assessments are integral to the process of consensus formation discussed earlier (see section on WHAT ARE THE BARRIERS. . .).

Among the organizations that might play a stronger role in international scientific assessments are the International Council of Scientific Unions, which embraces more than 40 national academies of sciences, the Council of Academies of Engineering and Technological Sciences, whose membership includes most national academies of technology; the Third World Academy of Sciences; and the African Academy of Sciences. Such organizations need to clarify the processes that they would use to assure high quality, credible, and independent results, as well as their relationships to governments and intergovernmental organizations in their role as conveners of experts to carry out assessments.

The third functional gap, evaluation, is one that is often neglected. Most organizations and sponsors prefer planning and making promises to evaluation. The need for evaluation is great for the larger society to accelerate social learning.

Historically there has been a rather weak connection between cause and effect in broadly defined formal social policy. This has been evident in areas such as urban policy, migration, and energy itself (Landsberg 1980). There have been many perverse and unexpected outcomes of policy interventions. It is important to have realistic expectations about our ability to create alternatives for human societies and move deliberately toward them. There has probably been a gradual increase in the ability to do so and there may

be a need for a great increase in this ability, not only because of climate change, but because of needs in development, population, health, and other areas. As we consider substantial escalation of policy interventions to achieve policy goals in environment, it is necessary concurrently to put in place mechanisms at the national and international levels to assess the efficacy of programs and policies and how it might be improved.

Specific research questions include:

1. How can progress in basic environmental research be accelerated to the benefit of many nations? Would a network of international environmental research centers be useful, and if so, how should it be designed?
2. How can the joint international conduct of scientific assessments be improved? Are there new roles for international nongovernmental scientific organizations in this regard?
3. How can evaluation of programs and policies designed to achieve reduction of carbon emissions be reliably assured? What combination of existing and new independent organizations might best carry out this function? How can institutional learning be accelerated?

HOW DO DIFFERENT LEVELS OF DEVELOPMENT, OUR UNDERSTANDING OF DEVELOPMENT PROCESSES, AND TRANSFER OF INFORMATION AND TECHNOLOGY CONSTRAIN CO_2 REDUCTION?

The ability of 80% of the global population to develop in a way that generates substantial income and employment, yet low levels of carbon emissions, will depend in large part on *diffusion of technology* and the possibility of *technological leapfrogging*. It is obvious that if the bulk of the developing world repeats the 20th century pattern of the advanced industrialized nations with their reliance on fossil fuels, and motorization and electrification based on these fuels, the atmospheric burden of CO_2 will grow substantially.

In general, countries of the world can be analyzed in three groups: (a) developing countries, those countries using energy for survival; (b) newly industrialized countries, those using energy for development and industrialization; and (c) those using energy to sustain an industrialized lifestyle (Figure 19.2). Each type of country needs a new growth strategy in light of concern about carbon emissions and is likely to have a different response to the challenge to reduce emissions.

Countries differ in the extent to which their economies and administrations are oriented toward local matters, national concerns, and the international

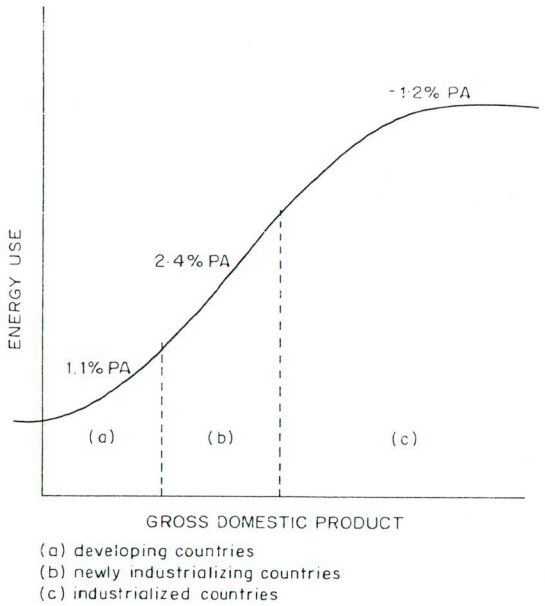

Figure 19.2 Generic energy/economy relationship

system. For many developing countries, subnational units are very important; for newly industrializing countries, there is often a very strong emphasis on national interest; the industrialized nations are most integrated into a global economy and participate most fully in regional blocs and international governance. The strength and abundance of organizational types also tend to vary with development. Government is often very weak in developing countries, and in many newly industrializing countries there are still few independent nongovernmental organizations. The time horizons of the poorest nations tend to be short, while the industrialized nations can usually afford to look further into the future. Moreover, informal links and decisions are often dominant in developing countries, while the industrialized nations tend to make the most explicit and formal decisions.

For countries of type (c), the challenge is to harvest the many technological opportunities that appear to exist. In many cases, the potential for efficiency has begun to be better utilized in the past 10–15 years. Countries of type (b) have tended to equate growth in energy use with economic growth. For these countries, it may be hard to change paths because of the recently installed capital infrastructure. Their carbon emission growth is likely to be steep but incremental.

In many ways countries of type (a) present the greatest challenge. They

need new energy sources the most and also need to make the clearest choices about paths to follow and organizational structures to foster them (Wilbanks 1990). There is often little political means to do much. The processes that can bring about more rapid growth are not well understood. In addition, there are many barriers to diffusion of technologies that might be most helpful to a more carbon-friendly pattern of development. Conversely, there is much transfer of inefficient and obsolete technology that looks inexpensive but can bring crippling infrastructure costs.

A significant barrier rests in the current status of intellectual property rights. Such rights are necessary to create and maintain incentives for innovation. However, the current system, or absence of system, may simultaneously harm industrialized countries and developing countries. The lack of rules in some less-developed countries discourages technology transfer and development of markets. However, simply expanding the present system of the developed nations may place excessive hurdles on less-developed countries and also undervalue some of their assets, for example, in biological resources and traditional knowledge. The London Ozone Convention, which includes a mechanism for financing replacement of chlorofluorocarbons in less-developed countries, is an illustration of an innovative approach to technology transfer in the environment field. Consideration needs to be given to appropriate mechanisms for joint ventures between countries of North and South in energy and environment. The role of international development organizations, which have only recently become concerned with global environment, also needs to be considered in this regard.

A further important barrier is the difficulty of interaction between science and government in many less-developed countries. The traditions and mechanisms of constructive relations between the communities are at an early stage. Establishment of national research councils, strengthening of the independence of universities, and strengthening of regional organizations such as the African Academy of Sciences can be valuable ways to lessen this barrier.

Specific research questions include:

1. Can we understand better the relative importance of various factors affecting response to carbon emission reduction at various levels of development?
2. Recognizing that in many countries there will be governments that lack leverage over the national economy, how can obstacles to action by developing countries to reduce carbon emission be overcome most effectively?
3. What are the possibilities for informal action to reduce carbon emissions in developing countries?
4. What is the possibility for developing countries to leapfrog in energy

and environmental technologies in order to avoid the pattern of development that has traditionally characterized industrialization?

5. How can international arrangements for transfer of technology and intellectual property rights be modified in a way that maintains incentives conducive to vigorous innovation globally and also equitably recognizes the assets and needs of less-developed countries?
6. What can be done to improve the weak performance of international organizations with regard to environmental protection in developing countries?
7. What can be done to strengthen indigenous environmental research capability in developing countries and to strengthen participation of scientists from developing countries in regional and global evaluations of environmental issues?

WHAT DO WE UNDERSTAND ABOUT THE POTENTIAL FOR CHANGES IN CONSUMPTION PATTERNS AND SOCIAL BEHAVIOR OVER DIFFERENT TIME HORIZONS?

Quantitative analysis (see Schipper, chapter 15, this volume) shows that differences in *lifestyle* account for differences in final energy consumption and patterns of energy use at least as large as those caused by the technologies employed. Because habits define energy demand to such a great extent, it is necessary to consider their flexibility. It is also not unreasonable for individuals to be concerned that efforts to reduce carbon emissions will have impacts on preferred behavior in such fundamental and sensitive areas as diet, movement, living area, and reproduction, and family size.

Although economic factors may heavily influence energy consumption, it is also important to recognize the limits of these factors. For most individuals, firms, and countries, expenditures on energy require less than 10% of income. Thus, in many circumstances, even large increases in energy costs can be absorbed without major disruption of overall consumption. For a few activities, such as production of aluminum, energy costs constitute such a large proportion of total budget that the conduct of the activity is highly sensitive to economic factors. There is evidence that over the past two decades lifestyle preference has overridden several major price shocks to the energy system.

Most lifestyle changes appear to be moving in the wrong direction from the point of view of carbon emissions. For example, people in many societies have been spending somewhat more time traveling, and often in ways that

demand more energy. On average, time spent in travel consumes about ten times as much energy as time spent in a stable location, whether in work or leisure. The increase in mobility during the past decades has roughly canceled gains from greater efficiency of vehicles. Moreover, trends are moving toward fewer passengers per vehicle, larger vehicles, and kinds of vehicles that consume more energy, such as aircraft and cars.

Changes in population profile are also tending to increase energy demand. Along with population increase itself, the shrinking of households and the aging of the population tend to raise energy demand. Two households with three persons each will consume considerably more energy than one household of six. In industrialized societies, a significant and growing fraction of the population may now live on pension for a period of 20 years or more. This older segment of the population has a historically unprecedented amount of time and income to travel and maintain residences. Moreover, the population that is aging now is the first population in which possession of driver's licenses is prevalent.

A central question is the extent to which leisure activities will prove to be energy-intensive. With people in the industrialized societies living longer and steadily spending fewer lifehours at work, the question of how non-work time is used throughout life may become a main determinant of trends in energy consumption.

For developing countries, the question must be asked whether the consumption pattern of the industrialized nations will be repeated. So far, the pattern of urbanization, motorization, and unbundling of families appears similar.

For all societies, transportation and communication have advanced in lockstep as complementary goods. Increases in communication increase demand for transport, and increases in transport increase demand for communication. If one wishes to travel less, a good strategy is to give up the telephone. There is no evidence yet that communication substitutes for travel (Grübler 1990).

Ultimately, the question is to what extent it is possible to have patterns of development genuinely alternative to those with which we are familiar in the industrialized countries. In the 1920s, Trotsky and Stalin parted ways over the question of whether there could be socialism in one country or whether a world revolution was needed for the alternative to flourish. The year 1989 seemed to suggest that there is only one economic system for the whole planet and that it is not possible to maintain a separate development. A traveler to Bangkok, Sydney, Honolulu, Lagos, Bombay, Warsaw, and Berlin might well agree that amidst the cultural diversity there is still only one system of large buildings, cars, and urbanization. From an environmental point of view, global economic integration is both risk and opportunity. If

the system becomes more homogeneous, if everyone must use the same standards, and if lifestyles all tend in the same direction, then the task of change is immense though also clear and well-defined.

Specific research questions include:

1. Where and how will we live? What will be the size and kind of homes and households?
2. Where and how will we work? Can the relationship between transportation and communication be changed?
3. Where and how will we play? Will leisure be energy-intensive or not?
4. What have been the most significant behavioral changes in recent decades that have been favorable for energy efficiency?
5. How can lifestyles and behavior be changed while respecting individual rights? What is the potential of education in this regard? How is it best to project notions of needs for lifestyle change so that acceptance may be encouraged?
6. Can market research and consumer psychology be employed more constructively from the perspective of global environment?
7. What are the implications for energy demand of a continuation of recent trends in lifestyle?
8. What are the implications for lifestyle of various goals for carbon emission reduction?
9. How is it possible to foster the differentiation of societies to explore different evolutionary paths that may be more benign with regard to environment sufficient to establish the viability of the paths?

CONCLUSION

We have identified seven major barriers to reduction of carbon emissions: plural rationalities, consensus formation, time horizons, economic distortions, organizational design, technology diffusion, and lifestyles. In each area it is evident that proposals for action and change could be made now. At the same time, it is evident that much more remains to be learned about the barriers to action, and that contributions can come from anthropology, philosophy, religion, sociology, political science, psychology, organizational behavior, market research, economics, history, statistics, demography, geography, and development studies, and from the integration of all these disciplines (Meyer-Abich 1988; NRC 1990). The task of addressing the social and institutional barriers to carbon emissions will be with us for decades and perhaps centuries. It is necessary to deepen our partial views of the

barriers, to study the actions to reduce them for efficiency, flexibility, fairness, affordability, administrative burden, and sustainability, and to try to come to collective views of how action should proceed.

REFERENCES

Ausubel, J.H. 1980. Economics in the air: an introduction to economic issues of the atmosphere and climate. In: Climatic Constraints and Human Activities, ed. J.H. Ausubel and K. Biswas, pp. 13–59. Oxford: Pergamon.

Barney, G.D., ed. 1980. The Global 2000 Report to the President of the U.S. New York: Pergamon.

Baumol, W.J., and W.E. Oates, 1988. The Theory of Environmental Policy, 2nd ed. New York: Cambridge Univ. Press.

Burns, T.R., and R. Ueberhorst. 1988. Creative Democracy: Systematic Conflict Resolution and Policymaking in a World of High Science and Technology. New York: Praeger.

Carroll, G.R., ed. 1988. Ecological Models of Organizations. Cambridge: Praeger.

Dosi, G., C. Freeman, R. Nelson, G. Silberberg, and L. Soete. 1988. Technical Change and Economic Theory. London, New York: Pinter.

Douglas, M. 1978. Cultural Bias. Occasional paper 35, Royal Anthropological Institute. Reprinted in: In the Active Voice. London: Routledge and Kegan Paul.

Douglas, M., and A. Wildavsky. 1982. Risk and Culture: An Essay on the Selection of Technological and Environmental Dangers. Berkeley: Univ. of California Press.

Elster, J. 1983. Sour Grapes: Studies in the Subversion of Rationality: Cambridge: Cambridge Univ. Press.

Enquête-Kommission. 1989. Protecting the Earth's Atmosphere: An International Challenge. Interim report of the study commissions of the 11th German Bundestag. Bonn: Economica Verlag, Verlag C.F. Müller.

Goldemberg, J., and E.R. Durham. 1989. The Amazonia and national sovereignty. Workshop on: Our Changing Atmosphere: Sources of Stress and Challenges to Cooperation. Cambridge, MA: Am. Acad. Arts and Sciences.

Gross, J.L., and S. Rayner. 1985: Measuring Culture: A Paradigm for the Analysis of Social Organization. New York: Columbia.

Grübler, A. 1990. The Rise and Fall of Infrastructures. Heidelberg: Physica.

Holling, C.S. 1986. The resilience of terrestrial ecosystems: local surprise and global change. In: Sustainable Development of the Biosphere, ed. W.C. Clark and R. E. Munn, pp. 292–316. Cambridge: Cambridge Univ. Press.

IEA (International Energy Agency). 1989. Energy and the Environment: Policy Overview. Paris: Organization for Economic Cooperation and Development.

IGBP (International Geosphere-Biosphere Program). 1991. Global change system for analysis, research and training (START). Report of a meeting at Bellagio, Dec. 3–7, 1990. Report No. 15. Stockholm: IGBP.

James, P., P. Tayler, and M. Thompson. 1986. Plural Rationalities. Coventry: Institute for Management Research and Development, Univ. of Warwick.

Landsberg, H.H. 1980. Let's All Play Energy Policy! *Daedalus* **109(3)**:71–84.

Meyer-Abich, K.M. 1986. Peace with nature, or plants as indicators to the loss of humanity. *Experientia* **42**:115–120.

Meyer-Abich, K.M. 1988. Holism in science, technology, and society. In: Complexities of the Human Environment: A Cultural and Technological Perspective, ed. Karl Vak, pp. 41–48. Vienna: Europa Verlag.

Nordhaus, W., and J. Tobin. 1972. Is growth obsolete? Economic Growth Fiftieth Anniversary Colloquium V. New York: Natl. Bureau of Economic Research.
NRC (National Research Council). 1990. Research strategies for the U.S. global change research program. In: Human Sources of Global Change, pp. 108-130. Washington, D.C.: Natl. Academy Press.
Pearce, D.W. 1987. Foundations of an ecological economics. *Ecological Modelling* **38**:9–18.
Plowden, W., ed. 1987. Advising the Rulers. Oxford: Basil Blackwell.
Rawls, J. 1971. A Theory of Justice. Cambridge, MA: Harvard Univ. Press.
Rayner, S. 1987. Risk and relativism in science for policy. In: The Social and Cultural Construction of Risk, ed. B.B. Johnson and V.T. Covello. Boston: Riedel.
Schwarz, M., and M. Thompson. 1990. Divided We Stand. Philadelphia: University of Pennsylvania.
Shultz, G. 1990: On sovereignty. In: Engineering and Human Welfare, ed. H.E. Sladovich; pp. 31–35. Washington, D.C.: Natl. Acad. of Engineering.
Solow, R.M. 1973. The economics of resources or the resources of economics. *Am. Econ. Rev.* **64**:1–14.
Tolba, M.K. 1990: Building an environmental institutional framework for the future. *Env. Conservation* **17**:105–110.
Wilbanks, T.J. 1990. Implanting environmentally sound power sector strategies in developing countries. *Ann. Rev. Energy* **15**:255–276.

20

Implications for Greenhouse-Gas Emissions of Strategies Designed to Ameliorate Other Social and Environmental Problems

D.A. TIRPAK[1] and D.R. AHUJA[2]
[1] Office of Policy Analysis, PM-221 Environmental Protection Agency, Washington, D.C. 20460, U.S.A.
[2] The Bruce Company, 1100 6th Street, S.W., 215 Washington, D.C. 20024, U.S.A.

ABSTRACT

This chapter deals with repercussions of strategies designed to tackle primarily other social and environmental problems on greenhouse warming, which is caused by the emissions of several gases, each of which has other effects besides those on Earth's radiative balance. Because of the uncertainties on the timing, rate, and magnitude of anticipated climate change, the strategies being considered now by many countries are those that are justified because of their benefits for other social and environmental problems. Situations where benefits complement one another are, of course, the most attractive. Where instead of multiple benefits there are multiple trade-offs, there is little guidance for action. There are few strategies that will not involve some form of a trade-off, either with other social and environmental problems, between greenhouse gases themselves, or requiring some modifications in lifestyles. The U.S. has under considerations several commitments to environmental protection for reasons unrelated to climate change which could hold the emissions of greenhouse gases in 2000 to their levels in 1987, if chlorofluorocarbons are included in the total budget. Finally we point out that there are social and economic costs of both action and inaction.

Limiting the Greenhouse Effect: Options for Controlling Atmospheric CO_2 Accumulation
Edited by G.I. Pearman published 1992 John Wiley & Sons Ltd