CONSENSUAL PROCEDURES AND THE ROLE OF SCIENCE IN PUBLIC DECISION MAKING

by

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Abstract

This dissertation compares the handling of scientific disagreement in consensus-based, supplementary procedures to conventional decision making. Consensual procedures alter the role of scientific analysis and, by doing so, modify the use of scientific argument by policy advocates. Consequently, the application of consensus-based procedures induces a subtle shift of political power within the decision making process.

The alternative roles for scientific analysis and argument I have reviewed can transform decision making in three ways. It can (1) open up decision making to groups not otherwise able to take advantage of scientific expertise, (2) increase the credibility of technical data and analysis submitted by all participating parties, and (3) empower technically untrained persons. Debates can be extended beyond the consideration of technical factors to address the political conflicts that motivate parties to become involved in public policy making. Decision makers are more likely to make decisions that reflect a broader understanding of both the interests at stake as well as the scientific and technical aspects of a decision.

Case studies illustrate three different ways in which consensus-based procedures address scientific disagreement. A facilitated policy dialogue concerning the health risks of a mass-burn, municipal incinerator proposed in New York City shows how consensus-based procedures can help to clarify the basis of scientific disagreement. A regulatory negotiation conducted by the Environmental Protection Agency to set federal emission standards for wood burning stoves demonstrates a procedure for building a consensus on the technical factors underlying a policy decision. Finally, a pre-trial mediated negotiation in a legal suit over the allocation of fishing rights in the Great Lakes shows how a consensus-based procedure can be used to help a group proceed in negotiations despite scientific uncertainty on pertinent technical issues.

My findings suggest that consensus-based supplements to conventional decision making processes offer distinct advantages and disadvantages to policy making participants. A decision about whether or not to utilize such procedures ought to be contingent on contextual factors such as the party's relative level of technical expertise, access to technical data, time constraints, political objectives, and perceptions of the outcome under conventional decision making.

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Preface

This dissertation is about the role of science in public decision making. I examine how scientific information is dealt with in public decision making institutions in the United States and the relationship between the management of scientific information and political power. Specifically, I compare the handling of scientific disagreement in supplementary, consensus-based procedures to that in conventional decision making situations.

In the 1970s and 1980s in the United States, controversies over public regulation concerning the environment, food and drugs, consumer products, public health, workers' safety, and new technologies generally frequently included disputes between experts on relevant scientific and technical points. Part of the reason why scientific and technical factors have become salient is due to requisites of public decision making (described in Chapter 1) that formally or informally ascribe importance to the scientific and technical premises of decisions.

Requirements for integrating science into public decision making written in legislation are intended by pace setting policy makers to serve at least two purposes. First, policy makers want to help ensure that decisions are consistent with existing scientific knowledge. In this case, the issue is simply one of preferring information over ignorance. They assume that decision makers who consider scientific and technical factors will be less likely to make decisions that result in undesired consequences. Secondly, requiring that decisions be consistent with existing scientific knowledge is also a means of guarding against choices made purely in response to pressure from groups best equipped by virtue of their economic resources to exert political influence over decision makers. Science is put up as a counterforce to balance economic power in a political system that holds up "one man, one vote" as one of its mottos.

As the 1990s approach, it is quite apparent that neither of these two purposes is particularly well-served by conventional decision making procedures. A number of public decisions are notorious for their blatant lack of consistency with current scientific knowledge. For example, although the artificial sweetener, cyclamates, is generally believed by scientists to pose a lower health risk than saccharin, the former is banned while the latter is allowed to be used extensively in the food and drug industry. As a second example, the Clean Air Act Amendments of 1970 were based on an assumption that there exists a threshold level below which air pollution does not endanger public health, although at the time, a number of leading congressional actors were aware that most of the scientific community no longer accepted the threshold view. These two instances show that a consideration of scientific information alone does not always produce scientifically sound decisions.

Neither does the consideration of scientific components in public decision making necessarily prevent domination by economically powerful groups. Often, the distribution of access to scientific information and expertise among policy actors in a given case replicates the distribution of economic strength. An industry actor, for example, may have a staff of scientists ready to assemble information and perform analysis in support of policy alternatives preferred by that party, while locally-based, public interest groups may have only a staff of volunteers and poorly paid generalists, and little access to individuals with appropriate scientific expertise. In these cases, industry actors holds an obvious advantage in the scramble to develop supportive scientific and technical arguments for preferred policy alternatives.

In some cases, especially in instances in which a government regulatory agency is confronted by an uncooperative industry, scientific arguments do, in fact, provide a counterforce to economic strength. As explained further in Chapter 2, in judicial challenges to agency decision making, the court will defer to the agency as long as the scientific rationale for its decision appears reasonable. In effect, the ability of the agency to avail of scientific knowledge increases its capacity to withstand challenges from groups economically more resourceful.

In either case, scientific knowledge is used to justify and defend a particular decision alternative. Consideration of scientific arguments by decision makers does not ensure, however, that the decision is consistent with a comprehensive understanding of the situation given the existing state of scientific knowledge. Something has gone awry in efforts to weave science into public decision making. Rather than a politically neutral authority, science is summoned forth by policy advocates looking out for their own interests. It is used as a weapon to win political ground.

While few would doubt the benefits of integrating scientific and technical advice into decision making, scientific disagreement brings to the surface serious concerns about precisely what purpose scientific advice serves in the context of intense competition in public decision making. If scientific arguments are used by contending stakeholders to further political objectives, decision makers and others searching for politically acceptable, socially just, and scientifically sound decisions must devise ways of eliciting comment on scientific and technical factors that will transform "advocacy science" into knowledge that can be used to assist decision makers to reach their own decision making objectives.

Current methods for handling scientific information and disagreement appear seriously deficient. The application of alternative methods for dealing with scientific disagreement in public disputes raises several critical questions, however. While scientific information and expertise put into service by advocates of policy alternatives battling in the adversarial context of conventional decision making procedures may not be the most appropriate and desired role for science, does altering decision making procedures change the uses of scientific analysis? If the role of science is changed, how will the distribution of political power in specific instances of public decision making be affected? Finally, will "neutralizing" the persuasive power of scientific arguments result in a reversion to prior distributions of decision making power, which are patterned on the distribution of economic resources?

This dissertation was undertaken to address these questions. This work is exploratory. I have chosen to examine three cases in which government decision making diverged from the conventional path. Initially, I hoped these cases would constitute "new and better" ways of integrating scientific knowledge into public decision making. On the basis of a "fit" between my conception of the nature of science and my understanding of the general dynamics of an increasingly popular group of procedures based on a consensual approach to decision making, I selected cases in which "consensus-based"[1] procedures, in particular, were used.

My three cases span a range of decision making situations. One involves decision making by a local elected body; another concerns federal rulemaking; and a third involves litigation. I purposely selected cases in three different decision making forums to highlight the general applicability of consensus-based procedures. Accounts of what transpired in these cases were constructed from agency records, legal documents, relevant scientific and technical reports, newspaper accounts, written accounts by observers, and interviews with both observers and major participants.

My presentation is organized into five chapters. Chapter One examines the political uses of science in public decision making, the purposes scientific analysis was intended to serve, and those which have become commonplace in the 1980s. I close Chapter One with brief introductions to the three cases, providing background information, descriptions of the major actors, and short summaries of the reasons each actor became involved in the decision process.

Chapter Two provides a description of conventional decision making procedures in the United States. I pay particular attention to the methods for handling scientific and technical information, especially when disagreements between experts arise. To illustrate conventional decision making procedures, I have tried to imagine how each of my three cases might have fared under conventional proceedings. The purpose of this chapter is to ask and answer the question, "How do conventional methods of public policy making deal with scientific and technical disagreement, and with what political result?" I used hypothetical scenarios in order to avoid the methodological difficulty of identifying and comparing "matched pairs"[2] and persuasively attributing causal links between process and outcome.

Chapter Three presents an alternative approach to handling these same disagreements. Actual consensual decision making procedures are examined in each of the three cases. The overriding question is, of course, "Do consensus-based methods alter the way science is used and, if so, to what end?"

The fourth chapter deals with the question of political power. If, as I have argued, science is used as a weapon to direct public decisions and if the use of science and the role of experts is transformed by consensus-based processes, then how is the distribution of political power among the stakeholders in a decision affected by consensus-based methods? Do prior patterns of political influence (as determined by the distribution of economic resources) dominate once again?

In Chapter Five, I reflect on my findings and attempt to summarize the prospects for using consensus-based procedures in public decision making. I offer prescriptive advice to decision makers and different categories of stakeholders regarding the benefits and costs of agreeing to participate in a consensual effort to incorporate scientific and technical information into public decisions.

Notes

1. "Consensus-based" is defined in Chapter Three.

2. "Matched pairs" are two cases that have been handled in two different ways, in which the issues, political contests, policy actors, distribution of political power, and other factors are sufficiently similar to enable one to draw compelling conclusions about the effect of different processes on differential outcomes.

Chapter One
POLITICAL USES OF SCIENCE IN PUBLIC DECISION MAKING

Introduction

Science in Public Debates

When public health advocates brought their indictment against cigarettes to the steps of Capitol Hill in the 1960s, they faced a formidable opponent. The economically wealthy, well-organized, and extensive tobacco defense network included paid representatives of tobacco growers, cigarette manufacturers, and marketing organizations; congresspersons from tobacco growing regions; prominent members of four congressional subcommittees that handle tobacco legislation and appropriations; and officials at the Department of Agriculture involved with tobacco programs. Although many health professionals believed that cigarette smoking causes ill-health as early as the turn of the century, it was not until the early 1950s that public health advocates had in hand results from large-scale epidemiological studies indicating a strong association between smoking and lung cancer. Recognizing the potential potency of research findings linking cigarette smoking and disease, the tobacco industry quickly responded by establishing the Tobacco Industry Research Committee (now called the Council for Tobacco Research--U.S.A.)

(Fritschler).

What ensued was a lengthy debate over the scientific evidence proving a causal link between cigarette smoking and disease. The tobacco industry continually attacked the use of statistical evidence by anti-smoking advocates. The epidemiological studies showed correlations between cigarette smoking and the incidence of ill-health, but could not prove causality. The industry argued, for example, that variables uncontrolled in the study, such as lifestyle patterns, genetic traits, and environmental factors might have a stronger causal relationship with disease than cigarette smoking. In fact, two contrasting theories to explain the association between cigarette smoking and lung cancer were promoted: one assumed a causal link and the other attributed both the behavior and disease to the genetic composition of individuals (in other words, that a genetic factor is responsible for an individual´s predisposition to smoking and susceptibility to develop cancer). The genetic theory proved to be less persuasive, and public officials elected to take regulatory action.

Congressional action requiring a health warning on each package of cigarettes was only one victory in a continuing war between public health advocates and pro-smoking interests. From 1954-1980, the Council for Tobacco Research awarded 744 grants totalling $64 million to 413 scientists at 258 hospitals, laboratories, research institutions, and medical schools. An additional $15 million was contributed by the six major cigarette producers to support research on tobacco and health between 1964-1973, to the American Medical Association Education and Research Foundation, which then did not actively support the anti-smoking campaign (Fritchler).[1]

The 1987 congressional debate over banning cigarette smoking on all air flights of 2 hours or less duration has revived familiar arguments about the scientific basis of public policy to curtail tobacco use. A spokesperson for the Tobacco Institute, Inc.,[2] argued on national television that the three existing studies conducted on airlines in-flight do not show that the level of exposure to cigarette smoke experienced by non-smokers is hazardous to their health (Merryman).

When the United States Environmental Protection Agency (EPA) proposed regulations in early 1972 to reduce the amount of lead additives in gasoline, the Ethyl Corporation began a vigorous and persistent attack on the factual basis of EPA's decision. The Ethyl Corporation challenged whether reducing the amount of lead in gasoline would eliminate the health hazard of airborne lead to the extent suggested by one of the major EPA source documents (Collingridge). Ethyl also contested EPA's assertion that the catalytic converter, a technology that required lead-free fuel, was the only automobile air pollution control system that would be operational by 1975. Later rounds of the debate focussed more precisely on specific claims made by EPA in regard to identifying susceptible populations, the relative contributions of other sources of lead in blood, assessment of "acceptable" blood lead levels, and the correlation between air lead concentrations and blood lead levels. Each claim made by EPA to substantiate a phased-down reduction of lead in gasoline was countered by the Ethyl Corporation.

The record of the lawsuit alone numbered more than 10,000 pages (Ethyl Corporation v. EPA). Much of the argumentation revolved on the scientific and technical premises of the Agency's decision to regulate lead additives in gasoline. As the presiding District Court noted, "[Scientific] evidence may be isolated that supports virtually any inference one might care to draw" (Ethyl Corporation v. EPA). Again, the scientific basis of the decision was an integral part of the public debate, and each side of the eventual lawsuit invested considerable resources in substantiating its position with appropriate scientific and technical evidence.

When the state of New York and the City of New York jointly proposed to reconstruct the West Side Highway in lower Manhattan in what proponents described as a "mechanism for stimulating jobs, investment; an innovative urban design that will revitalize Manhattan's West Side," project opponents quickly organized to block it (Wanderstock: 77).

Although opponents mobilized around a list of issues including the project's ability to address its primary objective, transportation, they pegged their first courtroom attack on the adequacy of the draft Environmental Impact Statement (EIS) rendered in 1974 in accordance with the National Environmental Policy Act (NEPA). Subsequent lawsuits contested the final EIS claim concerning an area of the Hudson River targeted for landfill. The EIS, issued in January 1977, stated that this "interpier area" was incapable of supporting significant aquatic life. After prodding by the United States Environmental Protection Agency (EPA), the Westway Project conducted a 13-month study that revealed this water area supported 22 species of fish. The eventual demise of the Westway Project can be attributed in large part to the project's delay, but the final death blow was struck by the evidence indicating the extent of the project's likely environmental impacts, particularly with regard to the aquatic ecosystem.

As these three examples show, public actions in the United States ranging from congressional law making and federal administrative rulemaking to local, site-specific construction projects frequently involve consideration of scientific and technical information. In the legislature, scientific evidence is often cited as a compelling reason for formulation of public policy. Indeed, congressional actions that ultimately resulted in the requirement for a health warning on cigarette packaging were a response, albeit indirect, to a 1964 report by the Surgeon General, that, in turn, was a reaction to surmounting evidence on both sides of the Atlantic linking cigarette smoking to ill-health (Fritschler.) The EPA's action to reduce airborne lead was directed by the 1970 Clean Air Act (CAA) Amendments that explicitly instructed a consideration of scientific information. Under Section 108, the EPA was required to prepare a criteria document for each pollutant that "endangers the public health" and, under Section 109, the Agency was required to establish ambient air quality standards for such pollutants necessary to protect the public health and welfare, while allowing for an "adequate margin of safety." In the Westside Highway controversy, the technical assessment of predicted environmental damage proved pivotal in the decision to abandon the project.

Science as a Mechanism of Accountability

Science explicitly contributed to public decision making in the United States only sporadically (and then mostly during wartime) prior to the Roosevelt Administration (Lakoff; Mullins; West). The creation of the New Deal agencies, however, signalled the beginning of an era of delegated decision making, with important consequences for the use of science and technical expertise in public decisions (Lowi; West). Indeed, part of the rationale for the establishment of independent government regulatory agencies was the more specialized knowledge in public decision making that agency personnel were expected to contribute.

Almost as soon as the agencies were established, Congress acted to ensure a method of accountability. The Administrative Procedures Act (APA) of 1946 was the congressional response to concern about discretionary decision making by administrative agencies and independent commissions, which were insulated from the electorate. Formal rulemaking procedures prescribed by the APA require that administrative decisions be based on the record (West). The "record" includes transcripts of testimony and exhibits, all papers and requests filed in the proceeding, proposed findings and conclusions, exceptions to the decision, and supporting reasons for the exceptions or proposed findings or conclusions (Barry and Whitcomb). On issues concerning the public health, new technology, and the environment, this prescription required decision makers to demonstrate that their actions were consistent with pertinent scientific and technical knowledge. In addition to formal rulemaking, "hybrid" rulemaking procedures, which are contained in more recent statutes, such as the Occupational Safety and Health Act (OSHA), the Toxic Substances Control Act (TSCA), and the Consumer Protection and Safety Act (CPSA), require "informal rulemaking" similarly to be based on the record. These procedural impositions on administrative decision making laid the groundwork for the development, popularization, and refinement of a host of technical methods of decision analysis including cost-benefit analysis and its more recent derivative, risk-benefit analysis. (These technical decision making aids often come under scrutiny in public disputes.)

In more recent regulatory legislation, especially in areas pertaining to the environment, health and safety, food and drugs, and new technologies, directives for scientific analysis is often explicitly mandated. The Clean Air Act, for example, instructs EPA to issue air quality criteria for air pollutants that "accurately reflect the latest scientific knowledge useful in indicating the kind and extent of all identifiable effects on public health or welfare" (Clean Air Act). The Occupational Safety and Health Act of 1970 and the Toxic Substances Control Act of 1976 similarly require in regulatory actions a consideration of scientific data and the best available scientific evidence on health risks (Crandall and Lave: vii).

Finally, legislation, such as the National Environmental Policy Act (NEPA) of 1969, has brought the importance of scientific and technical issues into the forefront of a wider array of issues. NEPA, which has been duplicated in modified form in many state governments, mandates that all decisions concerning actions requiring federal funds consider adverse environmental consequences of the proposed actions. Projects ranging from the construction of a backyard toolshed to off-shore oil leasing now may require an appraisal of possible environmental impact. In short, although administrators, unlike elected decision makers, are not answerable to a voting constituency, a requirement to base decisions on the record suggests a different sort of accountability, and one that entails extensive use of scientific and technical documentation and analysis.

Politically astute elected officials have taken the cues concerning the importance of scientific and technical analysis and have followed suit by establishing their own channels for receiving scientific and technical information. For example, as early as 1957, the President's Science Advisory Committee was established to counsel the Executive Officer on the technical merits and consequences of specific programs (Fischer). The U.S. Congress established the Office of Technology Assessment (OTA) in 1972 to provide legislators advice on technical and scientific aspects of important issues, as well as to study the social, economic, and political impacts of new technological developments. The institutional infrastructure encouraging the use of what is broadly referred to as "science," (technical as well as more theory-oriented scientific work) in public decision making is now in place.

Accountability, Authority and the Nature of Science

Efforts to ensure the accountability of decision makers, especially in the administrative branches of government, have yielded prescriptions for decision making. Importantly, these prescriptions have carved a special niche for scientific and technical analysis. They presuppose a particular ideal of science. Presumptions about the rationality of decision making are central. Decisions are expected to follow directly from the evidence submitted.

The scientific ideal presumed by the current institutional framework in the United States mistakenly confuses characteristics about the objectives of science as a process and the products we think of as scientific knowledge. This false ideal implies that scientific endeavors are objective and neutral, and yield a single, coherent understanding of reality.[3] This, however, is probably an impossible goal.

It is consistent, however, with the popularly accepted mission of science as the acquisition of knowledge, or truth (Hiskes and Hiskes). According to the dominant philosophy of science through the 1970s, known as logical empiricism, the primary test of truth is the replicability of experimental findings. Hiskes and Hiskes write that logical empiricism assumes that

> (1) Data obtained through careful experiment and observation are objective;

(2) there is one universally valid logic for science; and

(3) through rigorous application of logic to data, science gradually makes progress toward the ancient Greek ideal of _theoria_ (Hiskes and Hiskes: 10-11).

According to the logical empiricist view, data are incontrovertible and unchanging. Any rational person observing the same event would report identical observations. The recording of data eventually leads to the development of theory that integrates abstract concepts and generalizable principles to explain diverse phenomena. Logic is linear and one-directional. In short, this view implies, that the results of the scientific method are absolute and without ambiguity.

This characterization of science as a dispassionate activity, (that is, one that does not depend on the views of the individual scientist), has deep roots. Sir Francis Bacon was instrumental in crystallizing this view as far back as the 1500s (Lakoff). As the formal architect of the modern method of scientific inquiry, (which prescribes the setting and testing of hypotheses as the means of establishing fact), he sought to outline a way of accumulating knowledge about the physical world that was free of theologically-based distortion and founded on the observation of reality rather than imagination. Moreover, to depict science in a manner that would be palatable to the then powerful religious establishment, Bacon carefully delineated the territory of science and claimed that the science of nature "is studiously indifferent to good and evil" (Lakoff: 9).

Bacon (and others) advocated this image of science during a period in which intense disputes over critical theological and philosophical issues were disrupting English society as well as life on the European continent (Ben-David). The growing popularity of the Baconian view at that time is attributable to the widely shared belief that a consensus on procedures is neutral with respect to religion or politics. What later became known as "the scientific method" represented a way for intellectual thought to progress in England amidst the country's civil revolution. Most scientists concurred with this apolitical image of science. One historian writes,

> One of the often-mentioned features of the prehistory of the Royal Society [an organization of scientists in Britain] is that the participants at the informal meetings of the circle from which the society emerged agreed not to discuss matters of religion or politics but to restrict themselves dispassionately to the neutral field of science. (Ben-David: 72)

Science then competed with religion and the monarchy as a way of understanding the world and making decisions about future actions. Success was eventually achieved when "instead of needing justification from other more fundamental values, science became a source and a standard of legitimacy" (Greenfield: 122).

This image of science as politically neutral has endured. Scientists in more recent years have continued to reaffirm it. Proponents of financial support for scientific research by the federal government have argued that the scientific community is and ought to be allowed to remain autonomous. The scientific community has been called a "priesthood" (Lapp), an "estate" (Price), and a "republic" (Polanyi) and scientists, accordingly, have been described as "objective," "disinterested," "uncorruptible," and "impartial" (Wood). Uniform standards of validating fact and the self-imposed discipline of the scientific method are offered as guarantees of a depersonalized and selfless quest for truth on behalf of the "common good".

This portrayal of the scientist as neutral has been underscored in discussions about the role of science in government decision making. Scientists and others have frequently and openly defended the advisory role they believe scientists ought to play in policy making (Burger; Crandall and Lave). They lament that scientific advice is often ignored or sacrificed for the sake of "democratic decision making" and that the public is not interested in advice that is objective and analytical (Burger).

Contemporary scientists, wittingly or not, often reinforce this image when in testifying on specific public policy issues they claim to distinguish between their "professional" and their "personal" views. In the debate over the regulation of chlorofluoromethanes (CFMs), for example, one scientist appearing before a Senate committee in 1975 stated,

> I should point out that the measurements that I am involved in are crucial to the question [of banning aerosol sprays] and I would like to remain neutral on such a question as you ask until I satisfy myself of the results of those measurements. That is from a scientific point of view. From the personal point of view, I feel very strongly about the issue of protecting the very delicate ozone photochemistry, and from that point of view I would urge on the basis of the data and calculations already available that action be taken (Brooks: 207).

The presumption underlying a separation of a "scientific point of view" and a "personal point of view" is that one is devoid of values while the other is not.

Science as a Weapon: Legitimation and Persuasion

Widespread acceptance of the logical empiricist view of science and the institutional frameworks that require reference to scientific knowledge in public decision making combine to create a powerful context wherein the uses of science are prescribed. As many writers have observed, science is a source of authority for justifying decisions and persuading competing elements of the polity of the legitimacy of one alternative (Dickson; Majone; Nelkin and Pollack). Like religion and the rule of the monarchy prior to the Age of Enlightenment, science is invoked in twentieth century decision making as a primary source of legitimacy:

> By invoking the authoritative canons of scientific reasoning and method, public authorities and others having a stake in technical issues seek to demonstrate the rationality of their position and thereby gain political support and acceptance (Brickman: 108).

Decision makers fearful of the consequences of politically unpopular decisions seek refuge in scientific and technical arguments indicating the "soundness" of their decisions. As one writer has noted with regard to policies for protecting health and the environment, "turning the job of defining adequate standards over to `experts´ relieves congressmen of the burden of resolving difficult controversies" (Melnick: 251). Administrative agencies aware of the possibility of lawsuits challenging their decisions and the scope of judicial review fortify their decisions with appropriate scientific or technical support.

On the other hand, scientific or technical advice that is not compatible with preferred policy alternatives can be disregarded (Mullins). For example, Senator Edmund S. Muskie stated in 1977 that

> [s]cientists and doctors have told us that there is no threshold, that any air pollution is harmful. The Clean Air Act is based on the assumption, although we knew at the time it was inaccurate, that there is a threshold (Melnick: 239).

Such confessions reaffirm that decision makers consult scientists but ignore their advice when it is politically expedient to do so. Rather than relying on scientific knowledge to guide their decisions, in such cases it appears that science is integrated post facto.

The same laws that require decision makers to account for the scientific and technical legitimacy of their decisions, in many cases, also provide a foothold for groups to challenge those decisions. Although the NEPA environmental impact assessment requirement is loosely advisory (and a decision maker may still approve a proposal despite the probability of substantial environmental harm--presumably because positive gains are invaluable), other legislation is more restrictive. The 1958 Delaney amendment to the Pure Food, Drug, and Cosmetic Act Amendments, for instance, forbids the approval of food additives that have been shown to cause cancer in humans or animals (Rushefsky). The wording and judicial interpretation of such legislation or agency rules dictate whether specific groups have a legal basis for contesting decisions they do not like. In many cases, because of a deep-rooted belief in the authority of science, decision makers find it hard to ignore strong objections to proposals that include criticisms of their scientific or technical premises.

Thus, the power of scientific argument to legitimize decisions is also a means for challenging a decision. Nelkin has written that "access to knowledge and the resulting ability to question the data used to legitimize decisions is an essential basis of power and influence"

(Nelkin, 1980: 16). Groups unhappy with a decision amass scientific evidence in an attempt to undermine the legitimacy of a decision, as did the Ethyl Corporation in the airborne lead case. Groups anticipating decisions mobilize resources to produce contending scientific claims in support of a more favorable policy alternative. This is how the Tobacco Institute reacted to anti-smoking legislation. In short, decision makers and stakeholding groups on different sides of a public debate acknowledge and cite portions of all available scientific and technical evidence to bolster a preferred alternative or to discredit competing alternatives in a battle to win political support (Nelkin, 1975).

As a result, debates before legislators, administrators, judges, and the public at large focus on technical premises that underlie decision alternatives. Science has become a major weapon of persuasion in public debates about the environment, health and safety, and new technologies. Indeed, preoccupation with the scientific and technical underpinnings of decision making can skew policy debates in several important ways.

Factors Behind the Partisan Use of Science

Why has scientific and technical expertise been awarded such a prominent status in political and legal institutions and, consequently, in debates over public decisions? A number of speculations come to mind.[4] On one dimension, advances in technology have had the dual effect of enhancing the ability to detect smaller and smaller increments of change and at the same time creating new sources of potential offenders. That is, instruments and testing procedures now allow researchers to detect contamination of air or water at concentrations of "parts per billion," or even "parts per trillion," in some cases, whereas earlier, "parts per million" was the limit. On the other hand, one writer argued that

> pollution is a direct consequence of the anti-ecological nature of a laissez-faire technology not properly assessed and controlled, and designed only to reinforce existing political and economic structures (Knelman: 48).

Finally, it can be argued that the cumulative nature of environmental and health impacts required the passage of a certain period of time before change could be observed. Commoner has argued that pollution first widely observed in the 1970s was the result of technological changes that had been occurring since the 1940s (Commoner, 1972). In short, the subject of public decisions is now more technical and scientific in nature than in previous times.

More compelling than the shaping of public issues by technological change, however, are factors that concern the individuals and groups behind contests over the shaping of public policy and decision making. The liberal social and political climate of the 1960s planted an expectation of "rights" among proliferating organized interest groups in the United States (Cigler and Loomis; O'Connor). The population and its elected leaders felt entitled to a certain standard of living. "Clean air" and "navigable, swimmable, and drinkable waters" were viewed as a right, not a privilege. This attitude was reflected in federal legislation that conferred legal standing on the general citizenry to enable "any person" to file a "citizen suit" against pollution sources to enforce emission standards or against the EPA administrator for failure to carry out provisions of federal environmental legislation (Stewart and Krier: 642).[5] Moreover, the notion of public decision making changed. Participatory decision making, "maximum feasible participation" of those affected by decisions, has become the norm since the 1960s (Freedman: 47).

Along with an expanded enfranchisement, environmental, community, and consumer groups have also gained in sophistication. The organization of environmental, community, and consumer groups in the 1960s provided an alternative ideological home for scientists, engineers, lawyers, and other highly trained professionals. Up until then, professionals either aligned with industry or government for research funding. The degree to which university researchers were independent of industry or government agenda is debatable, but certainly the development of environmental, community, and consumer groups provided an outlet for university researchers to enter public debates in a new way (Primack and Von Hippel). While the potential for general societal conflict increased on several fronts (additional sources of infractions of rights, enhanced means for measuring infractions of rights, a broadening definition of defensible rights, growing opportunities for individuals to express perceptions of violations, and others), scientific and technical expertise in service to ideologically organized interests expanded.

"The battle of the print-out" has become more common, then, not merely because of the growth in legal and institutional structures that encourage it, but because of an increasing ability of contending groups to avail themselves of the persuasive power of scientific and technical argumentation. This raises a fundamental point. Disputes over scientific or technical elements of public decisions emerge not from computer print-outs or purely scholarly disagreement, but from perceptions of the political, economic, and social consequences of those decisions. As Wilson's conflict model of policy making suggests, stakeholding groups perceive a peculiar distribution of costs and benefits resulting from a public decision (Wilson). These costs and benefits may be measured in individual, material or psychological gains or losses, the precedent-setting value of legal interpretations or interpretations of a particular agency's mandate and philosophy, or public statements on morality. For example, although an investigation would probably also show that even the earliest studies on the relationship of cigarette smoking to human disease arose from a concern for protecting public health, the motivation of the tobacco industry for funding research on smoking and cancer was clear. They acted out of a perception of a threat to their economic interest (should the health warning dissuade people from smoking) and, perhaps, to avert the moral condemnation of the tobacco industry conveyed by a public statement acknowledging the detrimental effect of smoking on public health. The Ethyl Corporation challenged EPA's scientific analyses for similar reasons. Challenges to the scientific and technical basis of public decisions and policy alternatives arise not from the spontaneous emergence of contradictory scientific evidence but from the mobilization of interests that have a stake in those decisions.

The capacity of a broader range of groups to utilize scientific and technical argumentation has caused a dispersion of access to the authoritative power of science. That scientific and technical analysis have become central pillars in challenges to the formulation and determination of controversial decisions in the legislatures and courts as well as in administrative agencies (at the federal, state, and municipal levels) signals a qualitative change in the distribution of influence over those decisions. How scientific and technical information, especially conflicting evidence, is managed in public forums holds tremendous implications for government decisions regarding public resource allocations and the prospects for social justice.

Three Case Studies: Background and Stakeholders

The following sections of this study are structured around three illustrative case studies. I turn now to an introduction of these three cases of public decision making, each of which appeared initially to turn on scientific and technical issues. I present brief histories about how the disputes arose, identify the major actors involved in the cases, and sketch the primary reasons for each group's involvement.

Solid Waste Disposal in New York City

An estimated 26,000 tons of municipal solid wastes (MSW) were generated daily by New York City's 10 million residents in 1984 (New York City Department of Sanitation, 1984b). As the first step of a comprehensive waste management plan for the City, the Department of Sanitation (DOS) put before the governing Board of Estimate a proposal to build one of eight mass-burn incinerators at the site of the former Brooklyn Navy Yard. The DOS proposal touted the mass burn technology as "one of the most successful and highly used [designs] in the world" (NYC DOS, 1984b: 1-1).

Predictably, opposition to the project emerged from many corners of the City. Paramount among the concerns raised was the fact that, unfortunately, this technology is also known to emit a class of highly toxic chemicals known as dioxins.[6] Dioxin gained popular attention in the United States as a result of controversy over the Vietnam war sprayings of "Agent Orange," (a defoliant containing dioxins as a contaminant), and the Times Beach tragedy, (in which soil contaminated with dioxins resulted in the relocation of an entire Missouri town). The Environmental Protection Agency (EPA) once called dioxins "one of the most perplexing and potentially dangerous chemicals ever to pollute the environment" (Raloff: 26).[7] Dioxins have been associated with cancer, birth defects, immune system disorders, and a host of other abnormalities in laboratory animals.

The project sponsor was the Department of Sanitation (DOS), the City agency charged with disposing of solid wastes. To generate support for the proposal to build the mass-burn incinerator (that was billed by the DOS as a "resource recovery facility" because it is designed to produce electricity from the steam produced during the combustion process), DOS staff invested considerable effort in building up a sense of crisis around the garbage disposal situation in New York City. In the introduction to the project´s Draft Environmental Impact Statement (DEIS) and cover letter to the city´s governing Board of Estimate, the impending closure of the City's second largest landfill site and the imminent loss of out-of-state options were juxtaposed to daily tonnage estimates of municipal solid wastes. Sanitation Commissioner Steisel predicted that the one remaining landfill would be exhausted in 13 years (New York Times, December 7, 1984), in a city in which publicly acceptable projects, such as schools and firehouses, commonly take six to eight years to implement.

The City's concern over the waste disposal issue can be traced to the first Lindsay administration, when the DOS began to anticipate the depletion of landfill sites. Proposals were drawn up, but no action was taken. Then, under the Beame administration in 1977, a "blue ribbon" task force produced a report entitled "Comprehensive Solid Waste Management Plan for Refuse Disposal and Recovery of Material and Energy Resources." Although this report was not itself considered a "master plan," its overview and evaluation of alternatives for waste disposal provided the basis for the City's comprehensive plan and facility site-selection. After being given the green light from the state legislature and approval by the City's Board of Estimate (BOE), the City had in hand by 1981 a proposal for the design, construction, and operation of the first of eight proposed so-called resource recovery plants, a 3,000 tons per day capacity facility at the Brooklyn Navy Yard. The City's investment in the mass-burn incinerator thus was not trivial and was performed with sanctions and support from state as well as city government.

A vocal supporter of the mass-burn incinerator was Mayor Koch. Having endorsed the recently defeated, monumental "Westway" project, the $3 billion waste disposal plan may have represented more than simply a way of removing garbage from the streets (New York Times, December 7, 1984). In any case, Mayor Koch had made public his support of the proposal, and he was reportedly energetically lobbying BOE members for their votes.[8]

The Brooklyn Navy Yard site covers 13 acres in the northeastern corner of the Brooklyn Navy Yard, bordering the East River (NYC DOS. 1984b). The site is industrial in character, used for the storage of road salt, sanitation trucks, and retired City vehicles. It is surrounded by other industrial lands and by active residential neighborhoods to the east (Williamsburg) and south (Fort Green). The MSW incinerator design proposed for the Brooklyn Navy Yard plant consists of four units, each capable of burning 750 tons per day and comprising an individual combustion chamber (furnace), boiler, air pollution control device (a fabric filter, or baghouse), and ash handling equipment. The four units would share one, 500-foot-high emission stack. Wastes would be loaded into the facility from barges, and fed onto a system of moving grates contained in the furnace. Steam generated from the combustion process would furnish energy to operate the plant and excess steam (77% if operated at full capacity) would be sold and exported off-site (to a nearby utility).

The DOS fully expected that construction and operation of the DOS high technology waste disposal proposal would arouse local protests. Accordingly, the comprehensive, long-term plan put forth by the DOS strategically dispersed the eight proposed facilities throughout the City's boroughs in order to promote a sense of fairness among the residents. Anticipating opposition specifically in regard to intensified traffic congestion caused by the movement of garbage overland to the Brooklyn Navy Yard site, the DOS proposal intentionally exploited the riverside location and made provisions for barge transport of wastes. The draft environmental impact statement prepared for the Brooklyn Navy Yard project consequently identified no significant, adverse environmental impacts.

In fact, traffic congestion, noise levels, unsightliness, and other conventional air and water pollution concerns caused little apprehension among the vocal public. The issue that did generate considerable controversy was the predicted level of toxic emissions and predictions of consequent increases in the City's cancer rates.

Standing against the proposal was an amalgamation of community and environmental groups. Foremost was an ethnic community adjacent to the Brooklyn Navy Yard. This community of Hassidic Jews had been relocated from another part of the city several years earlier and was sensitive about its minority status. The tight, religion-based organization of this community enabled leaders to respond quickly to the DOS action. Although these residents were concerned about aesthetic as well as other not-in-my-backyard factors (traffic, noise, odors, etc.), they focussed on the health threat posed by dioxin emissions after soliciting and receiving technical advice from the Center on the Biology of Natural Systems at Queens College.

The leading spokesperson for the Center for the Biology of Natural Systems in this dispute was Professor Barry Commoner, a scientist and political activist, whose extensive writing on technology and the environment promoted him to the status of a one-time, third party presidential candidate.[9] A group of biologists at the Center had been involved in research on the emissions of mass-burn incinerators. They promptly produced a harsh, written critique of the DOS's DEIS, faulting, in particular, its alleged underestimation of projected increases in cancers due to emissions of carcinogens. Dr. Commoner and his associates also presented their critique at public meetings.

Other groups that opposed the proposal included advocates of recycling, such as Environmental Action and the Environmental Defense Fund, and state-wide environmental groups, such as the New York Public Interest Research Group, whose representative was quoted in a news article as saying, "What the city is proposing to do is take 26,000 tons per day of recyclable garbage and convert it into toxic emissions." (New York Times, November 26, 1984) While the Natural Resources Defense Council, a national environmental group that has a New York City office, was also concerned with the issue of dioxin emissions from waste-to-energy plants, they typically avoid involvement in specific projects. (Interestingly, the NRDC was involved at that time in negotiating a settlement to a lawsuit against the Environmental Protection Agency that eventually would require the EPA to reexamine its regulatory activities in this area.)[10]

Wood burning Stove Emission Standards[11]

On August 2, 1985, the Environmental Protection Agency issued an "advanced notice of proposed rulemaking" for performance standards for new stationary sources of particulate emissions from residential wood combustion (RWC) units. EPA estimated that as of the end of 1983, 10.6 million RWC, defined as freestanding woodstoves and fireplace inserts, were putting out 2.7 million tons of particulate matter (PM), including 20,000 tons of polycyclic organic matter (POM), 7.4 million tons of carbon monoxide (CO), and 62,000 tons of hydrocarbon (HC) emissions annually

(Federal Register, 1985). The annual sales of new RWC units was projected to continue at 1 million units per year.

In addition to the deterioration of air quality noted in several locales where a high number of wood burning devices and geographic conditions were believed to aggravate air pollution, the EPA recognized the adverse health impact caused by particulate emissions. According to studies of ambient total suspended particulate (TSP) levels, RWC units were estimated to account for from 66 to 84 percent of the smaller respirable particulates. The catalyst for EPA action, however, was a legal suit filed by the State of New York and the Natural Resources Defense Council following the Agency's decision not to list POM as a hazardous air pollutant under Section 112 of the Clean Air Act. Since RWC is believed to account for nearly half of total nationwide POM, the litigants included the promulgation of new source performance standards (NSPS) for particulate matter for RWC units in an out-of-court settlement to the lawsuit. Under Section 111 of the Clean Air Act, the standard would be based on "best demonstrated technology" (BDT) for controlling particulate emissions from all new woodstoves and fireplace inserts.

Regulating emissions from RWC units posed a myriad of difficult policy issues for EPA that were complicated by a perceived lack of technical data (EPA, ca. July 3, 1985). Because of the Agency's perception of the inadequacy of available data, a shortage of resources to conduct additional research in order to generate necessary data, time constraints imposed by the Agency's desire to promulgate rules as an alternative to the lawsuit filed by the State of New York and the NRDC, and recent favorable Agency experimentation with negotiated rulemaking and the Agency's "desire for maximum involvement of the affected parties" (EPA, August 16, 1985), Agency personnel decided to explore the possibility of using a mediated negotiation to develop the emission standards for RWC units.

In early 1986, the Standards Development Branch of EPA sent letters to 20 or so prospective participants announcing the Agency's intention to undertake a regulatory negotiation process. The Agency also issued a notice in the February 7, 1986 Federal Register that it was considering establishing a new Advisory Committee, in accordance with the Federal Advisory Committee Act (FACA), whose purpose would be to negotiate issues leading to the development of proposed rules for NSPS for RWC units. Included in this public notice was a description of the procedure for identifying participants in the regulatory negotiation. EPA states,

> We do not believe that each potentially affected organizational [sic] or individual must necessarily have its own representative. However, we firmly believe that each interest must be adequately represented. Moreover, we must be satisfied that the group as a whole reflects a proper balance and mix of interests (Federal Register, 1986).

In addition, the EPA published a list of potential interests and parties.

The participants in the EPA regulatory negotiation to set emission standards for wood burning stoves largely replicated the EPA's original list of potential participants. Two additional members were accepted at the first organizational meeting and admitted by consensus of the original group. The fifteen negotiators plus the EPA negotiator included representatives from the industry organization, the Wood Heating Alliance (WHA), manufacturers of wood stoves (both member and non-members of the WHA), environmental groups such as the Natural Resources Defense (NRDC) Council and the Oregon Environmental Council, state air quality agencies, and independent testing laboratories. (See list in Appendix 2.)

The RWC case illustrates the wide variety of parties who may become active in a public debate, especially in the regulatory arena, and their varying interests, resources, and relative abilities to marshall credible technical arguments to their benefit. Setting particulate emission levels on RWC units would potentially affect consumers, manufacturers, government bodies responsible for enforcement, and the beneficiaries of cleaner air. Less visibly but also potentially affected are the manufacturers of pollution control technology, the independent testing laboratories, RWC unit importers, and the manufacturers of competing residential heating technologies. Probably a number of less directly affected groups also arguably could be included in a list of affected parties, such as resort developers who peddle woodstoves as a critical feature of the charm of their product.

The most conspicuous stakeholder in the wood stoves regulatory action is the soon-to-be regulated industry. The RWC industry is fairly small by the standards of American corporations. The majority of sales is dominated by five or six manufacturers; the market is filled out by a number of much smaller, regional firms. In addition, there are a handful of RWC unit importers. Part of the industry is politically organized under the umbrella trade organization called the Wood Heating Alliance. The more than 800-member WHA performs conventional lobbying activities for the industry in the nation's capital (and in state capitals as needed).

The RWC manufacturing community had an obvious interest in the development of regulations. Of course, the industry would prefer no regulations at all, since government standards implicitly mean some preemption of design and management control and frequently incur additional costs to the industry or the ultimate market price of the product, making it less competitive with alternative heating devices. In the spring of 1986, however, the RWC industry was facing enforceable state-level regulations on wood burning stoves in Oregon and Colorado, and legislative activity in several other states. Federal level regulations, if acceptable to the air quality community, would take the wind out of state-level activity and avert a potential nightmare of 50 different regulatory requirements. With the resources of its 800-member organization, propriety information on stove emissions, and the expertise of the industry, one would expect the WHA to make a considerable attempt to help shape the rules.

Not all RWC manufacturers belong to WHA. Certain RWC manufacturers believe WHA is too diverse to be adequately responsive to and representative of their interests. The WHA represents a broad spectrum of the wood heating industry, including the manufacturers of glass doors on fireplaces and fireplace tools. Among the RWC manufacturers, some were more accomplished than others in making design alterations to reduce particulate emission levels, at least during the initial testing of their stoves. Whereas the role of WHA in setting the federal regulations would be to fight to protect all RWC manufacturers, the interests of so-called "clean stove" manufacturers would be at odds with those of manufacturers currently unable to meet even Oregon standards. Consequently, in the RWC rulemaking, one non-WHA manufacturer perceiving separate and distinct interests from the trade organization sought and won independent representation.

Another segment of the RWC manufacturing industry with interests significantly different from WHA is the catalyst manufacturers. In 1986, two basic wood stove technologies were in competition: catalyst and non-catalyst designs. Manufacturers of catalysts believed that their technology significantly reduces particulate emission levels by increasing the completeness of the combustion process. Accordingly, they wanted regulations to acknowledge the superiority of catalyst stoves, which, they contended, would improve the environmental quality of the nation (and, coincidentally, their own sales). Also, catalysts manufacturers then had exclusive access to the limited data available on the durability and effectiveness of their catalyst technologies.

On the other side of the table were groups concerned generally with air quality. Even within the "environmental" coalition, however, significant political differences existed. Countering the strength of commitment of WHA in this debate was the National Resources Defense Council. NRDC has been called "the most effective lobbying and litigating group on U.S. environmental issues" and "some kind of shadow EPA" (The Wall Street Journal). In regard to the interests he believed the Council represents David Doniger, an attorney at the Natural Resources Defense Council stated, "We take the view that there are rights involved here, rights to be protected from threats to your health, regardless of the costs involved" (The Wall Street Journal).[12] Among environmental groups, the NRDC is the recognized leader on air quality issues (Doniger). It is networked with other national environmental groups through the National Clean Air Coalition.

As co-plaintiff in the legal suit spurring EPA action, the NRDC held a special place in ensuring that wood stove regulations would aim at achieving acceptable reductions in air pollution. The NRDC representative in the RWC case was David Doniger, who has been involved in Clean Air Act issues for many years and has developed a considerable amount of general technical knowledge about air quality issues and regulatory action as well as personal familiarity with many EPA staff. Although the NRDC is staffed both with persons trained in law and engineering sciences, the highly specialized nature of the wood stoves regulations and the heavy work load of NRDC scientists normally preclude ongoing consultation between attorneys and technical experts in non-litigated cases. The NRDC also does not have resources to undertake out-of-house technical research.

State governments also had an interest in setting emission standards for RWC units. The states of Oregon and Colorado, which already had working regulations on wood stoves, were looking for federal regulations that were compatible with their own rules, that would plug loopholes in their programs, and perhaps take over some of the administrative tasks of their programs (such as the certification of testing laboratories). These states were also concerned about "dirty stoves" operating just across their borders. States without wood stoves regulations were seeking standards to improve air quality in their "non-attainment" areas. In some cases, these states feared the threat of a cut-off of federal highway funds as a result of their failure to meet national ambient air quality standards.

The single consumers advocacy group represented, the Consumer Federation of America (CFA), and a state energy office shared a concern about the cost of regulatory actions that would be passed on to consumers and the cost-competitiveness of wood stoves compared with alternative heating sources. Air quality was not an area in which these groups specialized. Accordingly, neither negotiator from these groups possessed a high level of competency in pertinent scientific fields.

Finally, in addition to the interests of EPA described earlier, it appeared that EPA harbored concerns that were less explicit in its public statements. Several participants commented during interviews that EPA, perhaps under pressure from the Office of Management and Budget (OMB), seemed adamant throughout the proceedings about protecting the smallest stove manufacturers from instant extinction as a result of regulatory actions.

Fishing in the Great Lakes[13]

The highly emotional "Michigan fishing rights dispute" has a long history, formalized in 1973 when the first legal suit was filed. The United States government on behalf of the Bay Mills Indian Community[14] (and later joined as intervenors by the tribe itself and by the Sault St. Marie Tribe and the Grand Traverse Band of Ottawa-Chippewa Indians[15]) sued the State of Michigan over its jurisdictional authority to regulate tribal fishers in the Great Lakes of Michigan, Huron and Superior.

In response to grave concern over the lake ecology and the extermination of the indigenous lake trout first noted in the 1940s, the United States Fish and Wildlife Service (FWS) and the state of Michigan Department of Natural Resources (DNR) embarked on aggressive fishery management programs beginning in the 1960s. The primary objective of both agencies was the rehabilitation of the lake trout, and a cooperative arrangement was worked out in which the FWS provided DNR with fish for annual planting. Although lake trout were found to thrive in many parts of the lake, it was widely believed that reproduction was not occurring.

DNR's management approach grew increasingly aggressive. According to one legal counsel, DNR management practice was "regulating commercial fishing out of business." Among the most controversial and provocative restrictions imposed by the DNR was the banning of large mesh gill nets, which was intended to reduce the incidental catch of lake trout in areas fished commercially for white fish. Gill net gear was used by all small boat commercial fishers, but it was an integral part of tribal fishing culture. Moreover, the alternative trap net gear requiring large boats is beyond the reach of poorly capitalized tribal fishers. From the tribes´ perspective the ban constituted a direct threat on their lifestyle and livelihood. (In fact, many non-tribal small boat commercial fishers were put out of business by the gill net ban.) It was the enforcement of this ban against tribal fishers that triggered a 1973 lawsuit. The subsequent trial in 1978 resulted in a ruling, which was upheld at the appellate level, that decreed that an 1836 treaty protected the non-exclusive fishing rights of the tribes and that the tribes held the right to fish free of regulations imposed by the State of Michigan, unless the State could prove that tribal fishing was endangering the resource (United States v. Michigan, 1980).

About the time of the court ruling, an informal cooperative effort began among the biologists concerned about the status of the Great Lakes fishery. A team of biologists representing the DNR, the FWS, and the tribes began meeting annually to develop "total allowable catch" (TAC) figures by species in various zones (established on the basis of discrete fish stocks) of the lake. TAC is based on estimates of a number of factors including fish population size, age structure, growth rate, mortality rate, and others. Many of these estimates were based on data contributed by the members of this "tripartite technical working group" (TTWG). Catch data for past years were provided by FWS to whom both the state and tribal fishers reported. A relative dearth of resources had led to a coordination of research efforts and duplication of data rarely occurred. Thus, the biologists from the various agencies infrequently presented conflicting data. The annual status report represented a compilation of data from the various groups and a consensus opinion on the levels of catch any particular population could sustain. Implicit in the agreement on TAC was also an agreement on the desired growth rate of that population.

Subsequent to the 1979 court ruling, with a grant from the U.S. Bureau of Indian Affairs, the three tribal communities cooperatively set up their own fishery regulatory program called the Chippewa-Ottawa Fishery Management Authority. Subsumed under the Authority was a staff of biologists charged with monitoring tribal fishing activities and its impact on the fishery and advising the tribal leaders on management issues. The tribal management program served a dual purpose. It started the tribes on a path toward regulating tribal fishing activities consistent with the fishery resource and it brought the tribes closer to dealing with the federal and state governments on more equal footing by enabling them to speak in the "language" of fish biologists and resource managers.

During the early years of the 1980s fishing on the Great Lakes intensified. In response to an aggressive state tourism promotion effort, sports fishing flourished. The tribal fishing industry rebounded from past lows in part as a result of the favorable court ruling on treaty rights. Predictably, as fishing by all parties increased, fishery managers noted the approach and passing of TACs at earlier and earlier points in the season between 1980 and 1984.

The surpassing of TACs fixed by the Tripartite Working Group set off tensions between the DNR and the tribes and tribal and non-tribal fishers anew. On a few occasions the tribe closed their fisheries, forcing the migration of tribal fishers to more distant or less familiar waters. The presence of tribal fishers in areas popular among recreational fishers sparked personal hostilities and acts of violence. The predominantly small boat tribal fishers moved into direct competition with nontribal fishers, especially sports fishers who shared an affinity for sheltered bays and shore areas of the vast lakes. Although tribal fishers, like non-tribal commercial fishers, primarily sought whitefish, their large mesh gill nets indiscriminately killed the sports fishers' preferred lake trout. Gill nets also can snag the sports fishers' angler gear, undoubtedly contributing to the frustration that led to incidences of vandalism against gill nets set out in the waters. Tribal members on land suffered a backlash of hostile reactions.

On other occasions the tribes asked the court to order the closing of fishing waters to state-licensed, commercial fishers, agreeing to prohibit tribal fishing in those same waters concurrently with the court order. Such actions reportedly incited tribal and non-tribal fishers alike to fish as intensively as possible before the fishery was closed, creating what has been called a "racehorse fishery."

Why did the DNR not close the state fishery when TACs were reached? While acknowledging on one hand the value of setting TACs, the DNR did not believe that managing by TACs was effective, efficient, or desirable. DNR preferred to manage according to "total allowable effort," (TAE) meaning to regulate the number of fishing licenses, not the number of fish caught. The state argued that fishers routinely underreport their catch to officials. Therefore, catch reports are less accurate than expected. Since fishery personnel have a fairly clear idea of how many fish can be caught over a given period of time using a given type of gear, DNR resource managers argued that a more accurate approach is to divide TACs by the average catch by gear type and limit the number of licenses per zone accordingly.

Theoretically, TAE and TAC are equivalent measures.

From a management perspective, they differ substantially. Under the TAE management approach, licenses are assigned to specific zones. The closing of certain lake zones could put state-licensed fishers out of work for the season. Consequently, even if TACs are overshot before the end of the season, the state was reluctant to close the fishery. By choosing to manage by TAE, the state faced the possibility of trading-off an incremental depletion of the fishery resource for the economic stability of state-licensed fishers.

A second, more legalistic reason for the DNR's inaction was the state's interpretation of its administrative code, which would require a public hearing and a 90-day waiting period before a fishery could be closed. Under this interpretation, a federal court order was the only route sufficiently expedient to avert overfishing.

By 1984, it became apparent to the tribal fishers that additional court intervention was necessary in the management of the fishing resource.[16] The tribes filed a motion for the court to allocate the fish catch. Although the optimum division from the perspective of the tribes was humorously described as allowing "non-Indians to get the heads and the tails," when they filed for the motion, they were actually hoping for a 50-50 split across the board (all lake areas and all fish species). In contrast, the DNR was concerned that a 50-50 split of all fish ignored their own efforts at restoring fish populations, particularly in respect to the lake trout "put-grow-take" fishery. DNR staff also suspected serious underreporting of incidental lake trout catches by tribal gill net fishers.

Although the disputants were divided into two camps for the purposes of litigation, each of the parties had a unique set of concerns. The plaintiff group comprised the U.S. Department of Interior and three Indian tribes. According to Francis McGovern, who as the Special Master in the litigation proceedings had met privately with tribal members and other participants to ascertain their specific interests, the interests of the three tribes were distinct. The Bay Mills Indian Community, located along White Fish Bay in eastern Lake Superior in what one person described as a "classic fishing village," is by far the most traditional of the three tribal groups. McGovern described the approximately 750 members as "fiercely individualistic."[17] Decision making is by consensus. The community comprises 50-75 commercial, small boat fishers, but almost all families fish for their own consumption, and much of the community's economy is linked in some way to fishing. Moreover, fishing with traditional gear is a centerpiece of the culture: a young male symbolically becomes a "man" by fishing. In addition to the economic necessity of relying on traditional gill net gear for the fishers, for the Bay Mills Community, gill nets represented an integral component of their cultural make-up.

The Sault Ste. Marie Band of Chippewa Indians, the largest of the three tribes, is geographically dispersed over Michigan's upper and lower peninsulas. With a relatively powerful, centralized government system, the tribal leadership was concerned with maximizing the tribe's overall economic benefit, rather than with fishing per se (McGovern, 1986). The membership consisted of small boat gill net fishers, but was not wedded to traditional technology for its cultural value.

Finally, the Grand Traverse Band of Ottawa-Chippewa Indians is situated near Grand Traverse Bay along Michigan's famed "Gold Coast," a highly prized tourism and sports fishing area. Grand Traverse Band members had little to do with fishing, in contrast to the other two Indian groups, although they were interested in preserving their right to fish in waters close to home. Ironically, however, the members of this Band were the ones to bear the brunt of the hostile feelings directed from the non-tribal community against tribal fishers moving down from northern waters. Even the children of the Grand Traverse Band were taunted in the local schools. Consequently, the Grand Traverse Band leaders were interested in a settlement that emphasized accommodation consistent with limited tribal fishing in those parts of Lake Michigan close to their residences.

The U.S. Department of Interior represented both the

Bureau of Indian Affairs and the Fish and Wildlife Service. The Interior Department thus held the dual responsibility to ensure the preservation of treaty rights and to protect the natural resources of the Great Lakes. According to McGovern, the Fish and Wildlife Service held a more specific commitment of restoring the Great Lakes to their earlier economic prosperity. They were particularly intent on rehabilitation of the indigenous lake trout population.[18] Exactly how the Interior Department promotes these two competing, but not necessarily conflicting, interests at any given time is subject to changing political pressures from the particular political context (Doherty). The fact that the Department did file suit against the State of Michigan on behalf of the tribes suggests, however, that the Department would not ignore the treaty.

On the defendant's bench sat the State of Michigan's Department of Natural Resources. As a public agency, the DNR presumably represented a number of different stakeholding groups and different interests. Managing the conservation of the natural resource (the fishery) and maintaining the public peace were interests on behalf of all the state's residents. More specifically, the DNR was concerned with ensuring a viable fishing industry.

The fishing industry comprised both commercial and recreational fishers, however, and their individual interests were distinct. The DNR at least gave lip service to the non-tribal commercial fishers, but one observer has argued that the DNR gave priority to the sports fishing industry, citing statements by DNR personnel about the economic benefits to the state of a vibrant (sports fishing dependent) tourism industry (Doherty). While the commercial fishers competed with tribal commercial fishers primarily for whitefish, the better-capitalized large boat fishers with trap net gear were able to fish in deeper areas not safely navigable by small boats. The sports fishers, however, preferred coastal waters like the small boat tribal fishers. Primary sports fish were lake trout and salmon, two species that were planted annually by the DNR (comprising "put-grow-take" fisheries).

Thus even while acting as the sole defendant in the case, the Michigan Department of Natural Resources at least ostensibly represented a number of distinct and not always complementary interests. In addition to the litigants, the court recognized "litigating amici" (representing the sports and commercial fishers), and awarded two groups official status enabling them to participate in discovery and settlement negotiations.

The situation in 1984 was highly complex. Issues concerning interpretation of the 1836 treaty were intertwined with issues about individual and collective economic survival and development, racial violence, and lake ecology.

These introductory descriptions of my three cases will provide background information for the remainder of this study. We move on now to examine how conventional decision making institutions incorporate scientific information and deal with scientific disagreement. In the following chapter, I use these three cases to project hypothetical scenarios to depict the unfolding of conventional decision making under typical conditions. While each major case in public decision making may be unique, these scenarios are intended to capture the main features of conventional decision making procedures. The main question Chapter Two entertains is, "How do conventional procedures deal with scientific disagreement and with what result?"

Notes

1. The American Medical Association adopted a resolution acknowledging an association between the incidence of lung cancer and cigarette smoking on June 24, 1965.

2. The Tobacco Institute, Inc., is a lobbying, public relations organization formed in 1958 by 14 major tobacco producers. The company presidents of these firms sit on the Institute's board of directors.

3. In fact, while science as a process strives to develop an understanding of an objective reality, at any given point in time, the state of scientific knowledge is incomplete. As a result, multiple interpretations or "models" of reality are possible. Adherence or promotion of one interpretation over another is a social act conditioned partially by social context. This notion of "multiple representations of reality" will be expounded upon in Chapter Three.

4. For a discussion about the factors that have led to greater interest in the social control of technology, see Harvey Brooks, "Controlling Technology: Risks, Costs, and Benefits," unpublished manuscript, (November 7, 1986.)

5. See, for example, Section 304(a) of the Clean Air Act. Other Federal statutes with similar provisions include the Federal Water Pollution Control Act, the Noise Control Act of 1972, the Safe Drinking Water Act of 1974, and the Marine Protection Research and Sanctuaries Act of 1972.

6. The term "dioxin" is used to refer to two groups of closely related chemical compounds called polychlorinated dibenzo-p-dioxin (PCDD) and polychlorinated dibenzofuran (PCDF). The attack on mass-burn incinerators concerns the health risk posed by the two compounds combined.

7. The Environmental Protection Agency has since lowered its estimate of the toxicity of dioxin.

8. Suggested by Dr. Barry Commoner during a personal interview, Flushing, New York, October 1986.

9. Commoner ran as the "Citizen's Party" candidate in the 1980 U.S. presidential elections.

10. Explained during a telephone interview with David Doniger, attorney for the Natural Resources Defense Council, May 1987.

11. Unless specifically noted, descriptive information on the wood stoves case and opinions and perceptions of individual negotiators were obtained through telephone interviews listed in Appendix 1.

12. The "rights" approach to environmental quality is a fairly typical approach to environmental issues among lawyers.

13. Unless otherwise noted, descriptive information and information on the opinions and interests of the stakeholding parties were obtained through telephone interviews listed in Appendix A.

14. Hereforth referred to as the "Bays Mills tribe."

15. Hereforth referred to as "the Grand Traverse Band."

16. Stated by Special Master Francis McGovern during a telephone interview, August 1987.

17. Conveyed by Special Master McGovern during a telephone interview in August 1987.

18. Explained by McGovern during a telephone interview, August 1987.

Chapter Two
THE DYNAMICS OF ADVOCACY SCIENCE

Public Decision Making Institutions

In the United States, public decisions fall into three categories: decision making by elected officials (executives, legislatures, city councils, etc.); administrative decision making; and judicial decision making. Decision making in all three arenas at all levels of government (federal, regional, state, or local) commonly involve the consideration of scientific or technical information and analysis. Elected officials often refer to scientific and technical evidence when setting general policy on environmental, health, and safety issues (as in the cigarette smoking policy debates), deciding whether to appropriate funds for public projects (as in the New York City waste-to-energy controversy), and granting development permits for site-specific projects at the local level (as in the Westside Highway project). As the previous chapter noted, agencies with delegated authority to implement broad policy objectives are often legislatively required to demonstrate that their decisions are supported by appropriate technical documentation. The courts are the forum for determining liability in science-intensive "toxic tort" cases as well as providing the ultimate recourse for challenges to administrative decision making. In substantive judicial review, courts have inspected the record to determine whether or not decisions are substantiated by available evidence.

As described in Chapter One, when the perception of stakes is high among groups sufficiently organized, competent, and resourceful, the scientific information on which decisions ostensibly are based often becomes the focus of the public debate over a particular decision. That is, groups able to gain access to appropriate expertise and resources understand the strategic value of bolstering favored policy positions with supportive scientific arguments, and challenging the scientific or technical premises of competing decision alternatives. The strong sense of authority invested in scientific analysis through governing legislation and diffused more generally throughout the polity by its mythical formulation means that decisions that appear to lack scientific support lose political legitimacy. Undermining the technical basis of a decision alternative thus serves to delay, sometimes permanently, approval and implementation of the questioned alternative.

General recognition of the cost of delay in public decision making (economic as well as human costs incurred when decisions regarding protective actions are delayed or implementation postponed by challenges to the scientific premises of decisions) has spurred interest, investment, and experimentation in ways to integrate scientific and technical information into public decision making. In many cases, the costs of delaying a decision fall asymmetrically on different parties. Delaying a permit decision on a nuclear power plant, for example, imposes substantial financial expenses on a utility company, but little costs on project opponents. Conversely, postponing the enforcement of regulations to abate pollution saves polluters the monetary burden of pollution control while incrementally degrading air or water quality and public health. In such instances, one or more parties will benefit from postponing a decision, and has little incentive to bring the issue to a close. Occasionally, however, the costs of delaying a decision fall more symmetrically on several major parties, as in cases concerning a decision about a project in the very early stages of development. In these instances, both project proponents and opponents bear the costs of uncertainty, and may therefore see advantages in a speedy resolution of the dispute. Consequently, a number of procedures in various forums of public decision making now are directed specifically toward facilitating the collection of scientific or technical information or resolving scientific disagreement.

In the following sections, I present three hypothetical decision making scenarios built around my case studies. There are several purposes served by these scenarios. One purpose is to provide a common conception of the mechanics of legislative, administrative, and judicial decision making. Since actual public decision making varies considerably from case-to-case and according to the particular institution involved, it is helpful to root a discussion of the integration of scientific and technical information into public decision making in a common model, or set of models. Second, and more specifically, these scenarios are drawn here to depict how conventional methods and procedures are employed in attempts to fold scientific or technical information into public decisions, especially when that information is disputed. I find that the role of the scientist as arbiter and the procedures developed to handle scientific and technical disagreement that are based on a logical empiricist view of science give rise to a new set of dilemmas for public decision making without necessarily resolving disagreement on any components of a public dispute.

In the final section, I examine these dilemmas more closely. A discussion of an alternative philosophy of science that suggests a different approach for dealing with contested scientific and technical premises of public decisions is presented in Chapter Three.

Decision Making by Elected Officials: Local Decision Making on Appropriations for A Public Project

The first hypothetical decision making scenario describes decision making by elected officials. In this case, the body of elected officials is New York City´s Board of Estimate (BOE), which is a council consisting of the five elected borough presidents, the city comptroller, and the mayor. Other bodies of elected decision makers include the United States Congress, state legislatures, and city councils selected through citywide elections.

We might imagine that traditionally, local decision making by elected officials occurs much as it did in the New York City case up to the point of a "policy dialogue" that was sponsored by the New York Academy of Sciences (NYAS). The initial proposal for the Brooklyn Navy Yard waste-to-energy plant was put together by the New York City Department of Sanitation (New York City Department of Sanitation, 1984b). This proposal not only justified the project on technical grounds, (capacity of plant, site suitability, economic feasibility), but perhaps more importantly created a context and a climate for the Board of Estimate members to hear the request. The proposal, as presented to the BOE and the accompanying letter from the DOS director, prefaced the project description with dire projections of increasing daily tonnage of solid wastes, diminishing landfills, and vanishing waste disposal alternatives, painting the possibility of an impending crisis (New York City Department of Sanitation, 1984b). It is reasonable that an agency that has invested time, resources, and reputation in developing a proposal for public action will try to make the strongest case for the proposal before the decision makers. Creating a favorable drama around the issue is fair play.

Proposing agencies, especially at the local level, also now routinely attempt to generate public support and anticipate and, if possible, dissipate opposition before presenting proposals to decision makers. Public information meetings and citizen advisory committees are two common methods of attempting to achieve these aims. Through public and citizen advisory committee meetings, proposing agencies present their proposals and receive comments back from "the public." The degree to which these comments result in alterations of the original proposal varies. The key point is that "the public" (at least some part of it) speaks and the agency listens. The DOS both convened periodic public information meetings as well as assembled prominent community leaders to form a citizens advisory committee in 1981.

Public comments in local decision making for public projects are also solicited through the environmental impact review process. The federal National Environmental Policy Act (NEPA) requires the preparation of an environmental impact statement (EIS) for any "major" federal action "significantly affecting the quality of the human environment" (National Environmental Policy Act, Section 4331). Many states, including New York, followed the enactment of NEPA with state legislation that more broadly requires environmental impact assessments for a wider variety of project actions. A public works proposal would virtually always require an assessment. In many cases, the document that identifies and evaluates likely environmental impact, the environmental impact statement (EIS), becomes the basis of public debate.[1] Because impact statements largely consist of a collection of predictions about probable effects, and because predictions are, by nature, probabilistic and uncertain, they are wide open for dispute (Bacow).

The New York City case was no different. The DOS-commissioned draft environmental impact statement (DEIS) was promptly criticized sharply for failing to address adequately the human health risk posed by dioxin emissions from the proposed Brooklyn Navy Yard incinerator. Interestingly, the challenge did not come from the DOS-initiated Citizens Advisory Committee (CAC), which had been given $85,000 by the DOS to hire a technical consultant to review the document (Steisel). Up to this point, most of the CAC's concerns had centered on typical not-in-my-backyard ("NIMBY") concerns: bad odors, noise, traffic congestion, and so on. Instead, the objections to the DEIS stemmed largely from reports prepared by the Center for the Biology of Natural Systems (CBNS), Queens College, whose assistance had been requested by the Williamsburg community adjacent to the Brooklyn Navy Yard site.

The BOE's reaction to the strong criticism differed little from the conventional response of elected decision makers. They simply requested further examination of the issue. In this case, the proposal was sent back to the DOS (Commoner, 1985). Accordingly, the DOS contracted with an outside consultant to undertake a new study to address specifically the health risks.

The heat of the controversy encouraged BOE members to delay their decision for several months. Meanwhile, other minor policy actors entered the fray. The New York Times printed editorials urging BOE members to approve the project (New York Times, October 15, 1984; December 20, 1984; July 8, 1985; August 15, 1985). Environmental groups expressed reservations about the project at public forums and in letters and comments in local papers (New York Times, November 17, 1984; August 4, 1985; August 15, 1985). Opponents advocated greater investment by the City in alternatives such as recycling and source reduction approaches to waste management. The headline story on the proposal, however, from the issuance of the CBNS report, focussed on the health risks of dioxin emissions.

We can also assume during this interval that BOE members were approached by their constituency including special interest groups and the voters in their district. The Brooklyn Navy Yard waste-to-energy incinerator was one of eight similar facilities identified in the DOS's comprehensive solid waste management plan for sites strategically dispersed throughout the City in order to avert community opposition. As such, it represented the first leg of a huge capital expenditure project estimated to cost $3 billion (New York Times, December 7, 1984). The construction industry would be hungry for the lucrative project. Mayor Koch had also voiced solid support for the project, after having recently lost a long battle for the highly capital-intensive "Westway" project. It is fair to expect, as one participant claimed, that the Mayor's office was vigorously lobbying individual BOE members, especially political allies who courted the Mayor's endorsement in their reelection campaigns.[2]

In September 1984, the DOS-commissioned report, performed by Fred C. Hart & Associates (and hereinafter referred to as "the Hart report") was issued. Although projecting a higher risk than the original DEIS, the risk estimates of the Hart report were still much closer to those in the initial DEIS than to the CBNS predictions. Objections were not put to rest, however. Thus, after a series of conventionally convened public hearings, the formation of a citizen's advisory committee, and an effort to quell public controversy through an "authoritative" expert report, the elected decision makers continued to face an angry, confused, and suspicious public.

Administrative Decision Making: Traditional Rulemaking

Many state and federal agencies routinely engage in science-intensive decision making on issues inherently linked to science, such as health, safety, and environmental regulation. Although the details of decision making may vary according to an agency's internal operating procedures and specific legislative statutes, there are similarities in the ways they handle scientific or technical disagreement. To broadly illustrate this decision making pathway, consider how the Environmental Protection Agency (EPA) would have gone about setting New Source Performance emission standards for wood stoves.

EPA's traditional procedure for promulgating new source performance standards (NSPS) under the Clean Air Act relies heavily on staff in the technical branch of the Standards and Development Branch.[3] An imaginary scenario for developing emission standards for wood stoves under the traditional procedure would begin with Branch staff initiating a search of relevant technical information, beginning with a survey of the published literature, and reaching out to segments of the industry for opportunities to familiarize themselves with wood stoves production, sales, and use. On-site visits of production facilities nearby is also an option. The identification of firms solicited for input would be biased according to physical proximity and the personal familiarity of Branch staff with individual firm names or personnel.

EPA is required to publish its intention to promulgate new rules. Informal lobbying from many groups begins soon after the public announcement. Typically, as the soon-to-be regulated industry gets wind of EPA intentions, either individual companies or trade groups attempt to influence the shaping of the EPA document by (selectively) contributing information and otherwise volunteering opinions and ideas. Major environmental groups that specialize in clean air issues, like the Natural Resources Defence Council (NRDC), would also try to keep their finger on the pulse of EPA efforts. Compared with industry efforts, however, environmental group lobbying efforts could be expected to center on influencing the intention of the regulatory effort according to their interpretation of relevant legislation, rather than contributing additional technical information.

During the pre-proposal stage, lobbying activity is dominated disproportionately by certain groups. Interest groups with Washington D.C. offices and staff who personally interact with EPA on a regular basis appear to have greater access to EPA decision making than more distant, potentially affected interests. Also, public interest groups with organizational support and experience with air pollution issues are more likely to become involved at early stages than public interest groups with lesser resources or other specialties (like consumer's rights). In the wood stoves case, the NRDC had agreed in an out-of-court settlement with EPA to drop litigation proceedings if (among other conditions), EPA regulated particulate emissions from residential wood stoves. NRDC staff thus knew early on about the agency's rulemaking intentions and, presumably, could begin informal lobbying with EPA staff ahead of other interest groups. Also, representatives from the NRDC and the industry's Wood Heating Alliance (WHA), both with offices located within blocks of one another and not far from EPA headquarter offices in Washington, D.C., discussed the rulemaking procedures with one another and independently with EPA before the public announcement of the agency's intention to promulgate rules was issued.

On the other hand, groups that hold relevant technical information and expertise may be insufficiently motivated to lobby at the preproposal stage. In the wood stoves case, for example, the independent testing laboratories had unique experience and expertise in testing emissions from wood stoves as a result of business generated by the Oregon and Colorado state regulations. For the individual testing firms, however, the wood stoves tests probably produced only a small percentage of total revenues. There would exist little incentive for these firms to allocate staff time and resources toward developing EPA regulations. Thus, a potential gold mine of experience, expertise, and data would be left untapped. Similarly, the states of Oregon and Colorado had a wealth of knowledge gained through their regulatory actions. Representatives from both states, however, expressed doubt that (their own) agency budgets would have allowed involvement beyond simply sending in written comments to EPA's proposed rules.[4]

Before the proposed rules are published in the Federal Register, staff in various branches of the agency review the proposal for aspects of the rules which pertain especially to their branch. For example, staff in the Enforcement and Compliance Division would review the proposed rules for language clarity, consistency, and general enforceability. This circuitous review route undergoes at least three cycles. Syntheses of the various comments is largely the responsibility of the Standards and Development Branch.

Once the agency stamp of approval is given, the rules are made available for public review and comment. The public is given 60 days to read the proposed rules published in the Federal Register, to submit written comments, and to request a public hearing. At the end of the 60-day period, written comments are distributed to relevant branches in the agency for review and comment. A public hearing, if requested by a member of the public, allows individuals to express their concerns and argue their positions in person before EPA staff. Again, it is the responsibility and choice of the Standards and Development Branch to evaluate the significance of all public and in-house comments and to integrate them into the final rules. The promulgation of rules in this manner takes from three to five years. It is interesting to note that administrative rulemaking is subject to judicial challenge (after formal promulgation). In 1984, four out of five regulations proposed by EPA were contested in court (Susskind and McMahon).

Judicial Decision Making

Litigation in the fields of environmental protection, resource management, occupational health and safety, and consumer product safety often turns on particular scientific or technical assessments. In judicial decision making, the decision maker may be either a jury of citizens, one judge, or a panel of judges. For example, personal injury lawsuits are judged by juries, while "mass toxic torts" cases such as the suits against the Mansville Corporation by asbestos workers and lawsuits against the actions of administrative agencies are handled largely by courts without juries. Since a large proportion of the science-intensive lawsuits involve regulatory disputes, I will concentrate this discussion on administrative law.

In the United States, the courts may review challenged federal administrative, rulemaking decisions for three points: (1) to ensure that the agency acted within its mandated authority; (2) to ensure the agency's actions were procedurally consistent with relevant laws; and (3) to ascertain whether the agency's action was arbitrary and capricious. One legal scholar describes the role of the judiciary as follows:

> . . .the court has a supervisory function of review of agency decisions. This begins with enforcing the requirement of reasonable procedure, fair notice, and opportunity for the parties to present their case, and it includes examining the evidence and fact findings to see both that the evidentiary fact findings are supported by the record and that they provide a rational basis for inferences of ultimate fact (Levanthal: 511).

The precise basis for a court's review is dependent on the lawsuit itself. A judicial review on the basis of the first two points is clearly within the court's area of expertise; the third point is more problematic. Judges in the U.S. are largely trained as generalists. Their lack of specialized knowledge and training necessary for understanding complex technical arguments is aggravated by the time pressure on court decisions imposed by the long list of cases waiting to be heard, as well as the scarcity of resources allocated to the court for technical consultancy. As a result of the court's awareness of its limited technical capabilities, a court ruling on the "arbitrary and capricious" standard commonly restricts its examination only to determine whether the agency decision was based on "sufficient" scientific data and reasoning.[5] In one suit by chemical and gasoline manufacturers challenging EPA's regulations requiring the phased reduction of lead in gasoline, the opinion of the U.S. Court of Appeals, District of Columbia, expressed outright that the proper function of the court is to examine the technical evidence "solely to enable the court to determine whether the agency decision was rational and based on consideration of relevant factors" (Ethyl Corporation v. EPA); [emphasis in original]. In other words, that two or more equally "rational" technical arguments may justify contradictory policy prescriptions is inconsequential to the judicial reviewer. The court explained that

> evidence may be isolated that supports virtually any inference one might care to draw. Thus we might well have sustained a determination by the Administrator not to regulate lead additives on health grounds. That does not mean, however, that we cannot sustain his determination to so regulate (Ethyl v. EPA); [emphasis in original].

As long as the court can find no fault with the agency's line of reasoning, the court will affirm the agency's decision.

Similarly, in a suit against the EPA in which the plaintiff contested the scientific basis for EPA regulatory standards, the U.S. First Circuit Court concluded that

> petitioner's contention that contrary conclusions can be drawn from the data does not lead us to suspect that EPA committed clear error. To the extent [that] different conclusions could be drawn, the Agency was entitled to draw its own (South Terminal Corporation v. EPA).

The reluctance of the court to extend beyond its scope of expertise is understandable, but it does not promise scientifically sound resolutions to technically complex litigation.

In the Michigan fishing dispute, the three tribes and the federal government filed a motion asking the court to allocate fishing in portions of Lakes Michigan, Huron, and Superior falling under the jurisdiction of the State of Michigan. The presiding judge, Judge Enslen, ultimately ordered the parties to negotiate a settlement, hoping to avoid a resource allocation decision himself. If the parties had not been asked to negotiate an agreement, however, and the judge was required to rule on the issue, what would have been the basis of his ruling?

It is likely that Judge Enslen would have looked first to history for legal precedents. As reported in an article in Legal Times, "previous judicial resolutions of such disputes have generally divided the resource `down the middle,´ making no one happy and usually prolonging the battle."[6] If Judge Enslen had decided to resolve the case by ordering a percentage division of the resource, the critical issue would be how the judge defined the resource. Would he define it as the lakes´ fishing areas or as total fish stock? Discussions among the parties prior to the 1984 litigation had mentioned both a "zone concept" for assigning exclusive fishing areas according to "historically established, discrete fish populations," and a straight 50-50 split of fish according to species and zones. Would the judge's definition of the resource include only naturally reproducing fish populations, or would planted fish also be counted?

Whatever the principle Judge Enslen selected for deriving his allocation scheme and however he ultimately defined the resource, eventually he would need to rely on a set of data to describe the fishery (population sizes, age structures, migration patterns, mortality, etc.). Here again his decision process would grow murky, since his reliance on one set of data over another would have no objective basis. Each litigating party would have submitted data on the fishery. In many cases the data would be incomplete. In some cases the data would be conflicting.

For example, one sensitive issue was the extent to which large mesh gill net fishing depleted the lake trout populations. Assumptions about gill net-induced mortality affect the estimation of catch levels. The defendant, the Michigan Department of Natural Resources (DNR), claimed that the catch reports submitted by the tribal fishers seriously understated actual catches. Undoubtedly, the state's attorney would submit testimony by DNR fisheries division biologists attesting to the high probability that these reports were inaccurate, making various technical arguments why higher catch levels should be expected (including, perhaps, results from location specific assessment studies). Lacking the resources to go out and repeat similar assessment studies, or the time and resources to monitor the actual fish catch of tribal fishers, the judge would have no scientific basis for accepting one catch level figure over the other. Yet, in order for him to issue a finding and order, he would be forced to assume the accuracy of one set of data over the other, or to simply "split the difference" between the two catch level estimates.

Methods for Handling Scientific Information

As these brief decision making scenarios illustrate, conventional decision making patterns incorporate the use of several methods to facilitate the exchange of information on public policy. Methods for gathering information in public decision making and, more pointedly, for resolving disagreement on scientific components of public issues are highly similar across the three, different institutional settings. Moreover, these methods rest on the same, extremely narrow, theoretical basis. These methods, by technique, create barriers to a full airing and reconciliation of disputed scientific and technical points and contested political claims and, in fact, encourage a distortion of the issues and debate. In the following sections, I examine key similarities among methods commonly used to handle scientific disagreement in conventional decision making.

Limited Repertoire of Methods

The methods for handling scientific and technical information applied in various forums of public decision making can be divided roughly into two categories: those designed to elicit information and those designed to settle explicit disagreement. Public information meetings, public hearings (and court hearings), and written comments (and legal briefs, including those submitted by amici curiae), are common methods of eliciting comments on relevant scientific and technical components of public issues, as well as on more general aspects. Newspaper editorials and letters-to-the-editor are additional mechanisms by which interested parties can express their positions and concerns to the decision maker. These methods share a common model of dynamics and relationships. In this model, the decision maker receives comments from stakeholders. The comments consist of arguments in favor of or in opposition to a particular policy position or decision alternative. Often, these "position" comments will be accompanied by scientific or technical arguments that show that the advocated position is consistent with scientific knowledge (although sometimes the advocated position may be no more than a refutation of a proposed decision alternative without supportive technical arguments.) This model is schematically presented in

Figure 1.

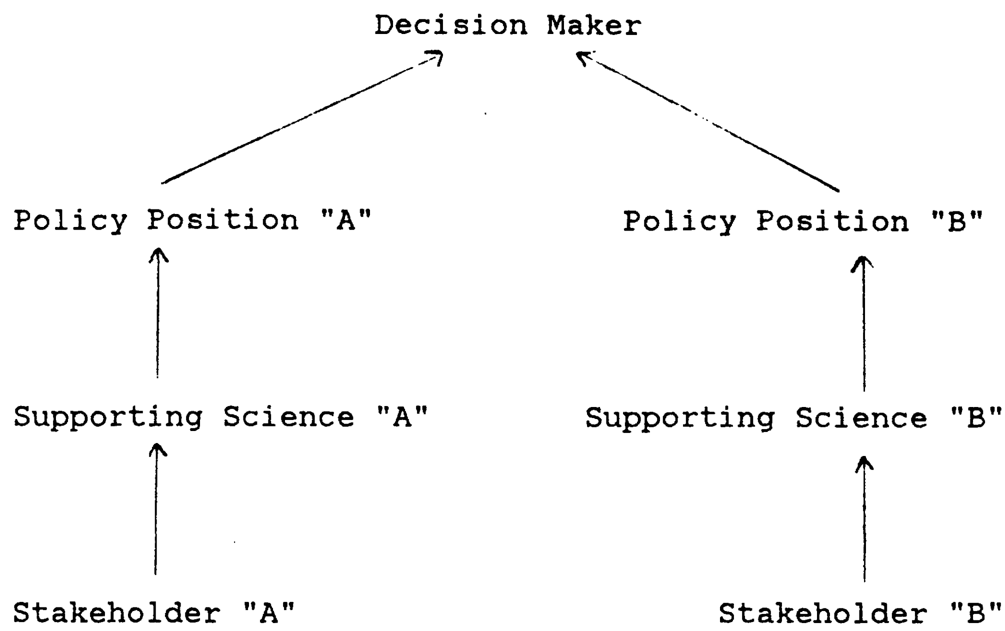

Figure 1

Communication Flows in Conventional Information-Eliciting Procedures

In the New York City case, the Board of Estimate is the decision maker who receives arguments supporting and opposing the Brooklyn Navy Yard plant. In this case, the DOS is considered a stakeholder, as are the CAC, the CBNS, and individuals and groups expressing their viewpoints through the media. In the wood stoves case, the EPA as a whole is the decision maker; WHA, the NRDC, and other groups who submit written comments or speak at public hearings are stakeholders. Finally, in litigation like the Michigan case, the judge is the decision maker, and the litigants and _amici curiae_ are the stakeholders.

Sometimes the scientific or technical support for an undesired decision or decision alternative is targeted for attack by competing stakeholders. In this case, the scientific disagreement becomes the major focus of the challenge. In the New York City case, for example, the risk posed by dioxin emissions became the primary issue. Questions pertaining to the level of expected dioxin emissions, (a "scientific" question), became salient.

When parties introduce scientific and technical analysis that is at odds with those that support competing decision alternatives, decision makers sometimes respond by employing a second tier of methods. This group of methods relies on consultation with experts, either individuals or panels, either verbally or through more formal, written reports, or some mixture of the two. This approach is presented schematically in Figure 2.

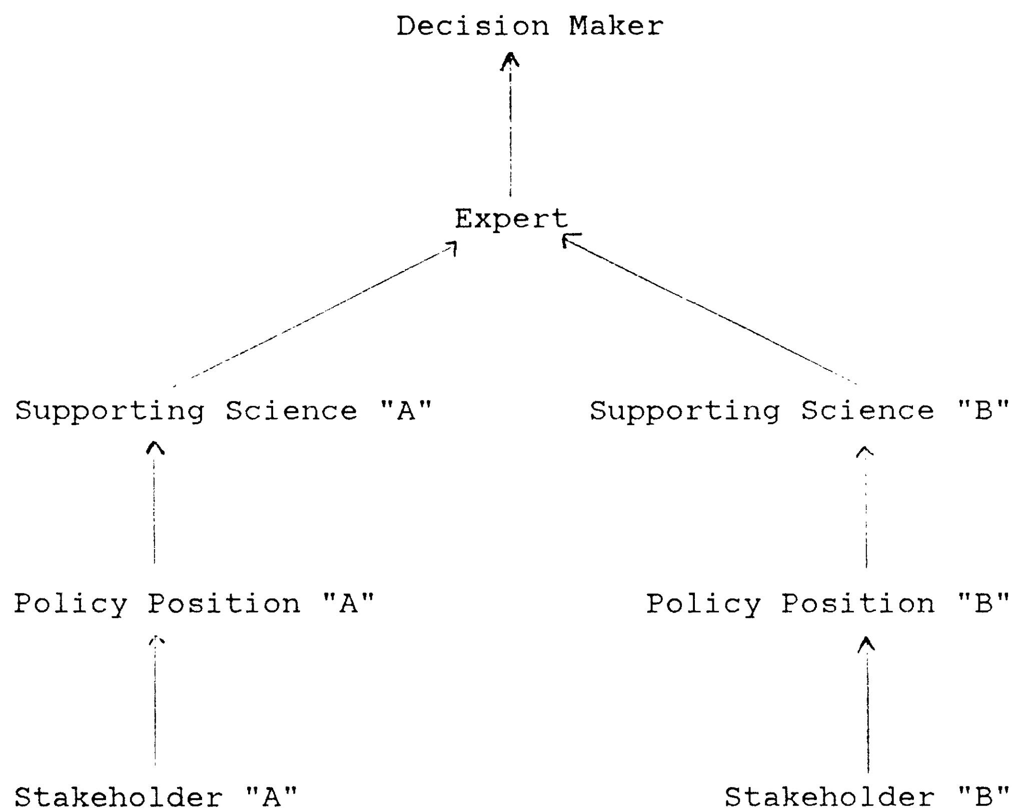

Figure 2

Communication Flows in Conventional
Dispute Resolution Procedures

In this case, the "expert" examines the scientific and technical evidence presented by the stakeholders, as well as additional information identified independently, and issues a report to the decision maker. Presumably, the report focusses primarily on disputed scientific and technical components of the policy issue. In the New York City case, the Hart report represented an attempt to consult an "expert" who would be authoritative. In a conventional EPA rulemaking process, a committee on the Science Advisory Board might serve as an internal "expert" review panel.

The popularity of this approach is indicated by the routinized character of expert review committees. Organizations such as the National Academy of Science (NAS) are ready to assemble special task forces to review existing scientific information on important issues of policy significance and to issue reports on their findings when asked. The NAS has convened task forces to arbitrate technical disagreements on issues relating to policy to reduce airborne lead, to protect the ozone layer, and the biological effects of low-level ionizing radiation, to name just a few. Administrative agencies, such as EPA and the Occupational Safety and Health Administration (OSHA), are permitted by law to create "permanent," "quasi-permanent," and "ad hoc" advisory committees to provide expert advice on general and specific policy issues.

In the courtroom, a parallel method is represented by the practice of appointing a "special master." Judges faced with technically complex litigation sometimes enlist the aid of a "special master" who has training in a pertinent technical field. In most cases, the special master is asked simply to review technical documents submitted by the litigants and amici curiae, although he is free to supplement the information with additional research of his own, thus broadening the scope of information that ultimately provides the basis for his opinion on important technical issues. The use of special masters also enhances the court's ability to deal with science-intensive disputes by bringing down conventional barriers such as limitations on ex parte communication (Little). In any case, the special master ultimately serves as yet another interpreter of disputed scientific and technical facts, advising the judge accordingly. His "break-the-tie" opinion, like the expert panel or neutral report, often then becomes the authority on which the court bases its broader, legal decision.

Finally, public agencies anticipating citizen opposition to an action or project commonly employ a third method which is procedurally more flexible than other methods and which, therefore, does not fall neatly into either of the two general approaches outlined above. This method is the formation of a citizen advisory committee. The citizen advisory committee differs from expert task forces or review panels because persons without particularly relevant technical expertise may participate. Rather than relevant technical expertise constituting the overriding criterion for appointment, political credentials guide the selection of the membership of citizen advisory committees.[7] The DOS exercised this strategy as the sponsor of the controversial waste disposal plan. The DOS's citizen advisory committee accordingly comprised two borough presidents and other respected community spokepersons.

In instances in which disagreement on scientific or technical components intensifies debate over a policy issue, the citizen advisory committee often conducts a review of the disputed points. In the New York City case, the citizen's advisory committee hired a consultant (with DOS funds) to review the DOS proposal, including the DEIS, and eventually concurred with the project proposal. The gamble taken by the decision maker or, in the New York City case, the sponsoring agency, is that the committee may end up opposing the preferred decision alternative. A skeptical view of the intent behind establishing citizen advisory committees suggests that such cases would be rare, however, because such citizen advisory committees often adopt the values and objectives of the sponsoring agency through the mechanism of "cooptation" (Selznick).

Common Roots: Implications of Logical Empiricism

These methods for managing scientific and technical information in public decision making, especially ones that attempt to "resolve" challenges to scientific premises, share a common theoretical lineage. The underlying assumption of these methods is a logical empiricist view of science. The politically neutral and objective status claimed for scientific knowledge by logical positivists has important implications for the design of methods for resolving disagreement on scientific issues.

The logical empiricist view suggests that any disagreement between scientists is due to error. For example, discrepancies between data are presumed attributable to error in experimental procedure. On a grander scale, the development of two contradictory or competing theories is presumed due to one theoretician's incomplete review of available data. And, disagreement on the meaning of research findings is attributed to faulty logic. Short of these sources of error, disagreement is explained by error due to the personal bias of one (or more) scientist who has allowed personal objectives to inappropriately enter and distort his analysis.

In this framework, disputed scientific points that arise in the context of public decision making can be resolved by uncovering error. Since error can be detected and corrected by a careful review of competing scientific arguments (to verify data and retrace the logic leading to the two [or more] incompatible conclusions) a reasonable approach to handling disagreement on scientific aspects of a decision is to conduct an additional review of the contradictory scientific arguments. In theory, the review should reveal error and determine which analysis is scientifically invalid, and which is not.

The practice of conducting additional research, the "expert panel," and the citizens committee's consultant's review are examples of procedures that can result from this line of thinking. The science court is another example. As initially proposed, a "science court" would consist of a judge or panel of judges to adjudicate scientific "right and wrong" after advocates of competing scientific views present their strongest arguments (Kantrowitz). Again, these procedures build on the fundamental presumption that properly undertaken scientific experimentation and analysis will yield a single, unambiguous set of data and findings.

Structuring the Use of Science and Its Consequences

As the New York City case shows, these methods for integrating public comment, including scientific and technical information, into politically acceptable and scientifically sound decisions can miss the mark. Despite the project sponsor's use of public hearings, public meetings, the EIS process to solicit written comments, and a citizen advisory committee, challenges to the project's scientific and technical premises were not dispelled. The decision making Board of Estimate's final attempt to quiet health risk concerns was to order the Department of Sanitation to commission a new study by independent consultants whose report they hoped the public would view as neutral. They were wrong, and the controversy continued.

These methods fail on two counts. First, they provide a context and structure neither for generating scientific and technical information in a comprehensive manner nor for settling disagreements on scientific or technical points that arise. Secondly, and more fundamentally, they do not address the political conflict that stands behind contentious political debates. At best, these methods fail to provide opportunities for clarifying either scientific or political views. At worst, these methods encourage an adversarial use of science that serves to obfuscate the political nature of public conflict.

The failure of these methods can be accounted for largely by three factors. First, the technical basis of scientific disagreement remain hidden, from both the decision maker and, possibly, the competing stakeholders. Second, by failing to integrate the consideration of scientific and political aspects of a policy issue, the political interests that drive participation by stakeholding groups are left unaddressed. Finally, the role cast for the scientist raises concerns about credibility that cannot be adequately put to rest. In the following sections, I elaborate these points more fully.

Basis of Scientific Disagreement Remains Hidden

Methods that are commonly used in conventional decision making institutions, namely public comment, public hearings, court hearings and the submission of legal briefs, provide opportunities for stakeholding groups to bring to the attention of decision makers scientific or technical evidence that might induce the decision maker (and others) to support or oppose a particular decision alternative. The anatomy of these methods, however, shows that incentives or mechanisms for uncovering the basis of contending scientific or technical evidence are lacking. The primary function of these methods is to provide opportunities for the stakeholders to present scientific arguments that appear to support policy alternatives they prefer, not to establish a common understanding of important elements of the decision (McCarthy). This narrow objective has a number of consequences.

In winner-takes-all situations, such as judicial rulings, it is to the advantage of the parties to disclose only supportive technical information (Abrams and Berry). When cross-examination of technical witnesses is allowed in the courtroom or at public hearings, the adversarial nature of the forum means that effort is directed toward discrediting opposing analyses or bolstering one's own analyses, rather than attempting to establish any kind of consensus. As Nyhart and Carrow have written, adversarial proceedings are characterized by, "one party with witnesses striving to prove facts essential to her or his case and the other party striving to disprove those facts" (Nyhart and Carrow: 3). Scientific studies whose findings may bridge the gap between disparate technical arguments remain excluded from the record, since neither party has a clear incentive to introduce them.

These methods also share serious constraints on communication that impede revelation of the technical basis for disagreement on scientific or technical components. To varying degrees, they offer only limited communications between the decision maker and stakeholders, and among stakeholders. Hearings and written comments submitted to decision makers are one-way channels of communication. Although a series of public hearings may be held on any given issue, normally the sequential arrangement is intended either to address geographically distinct constituencies or to consider different aspects of the controversy. Rarely are consecutive hearings held to accommodate give-and-take discussion, with intervals between meetings to allow, if necessary, for additional research or data collection aimed at narrowing or resolving scientific disagreements. In administrative decision making, legislation intended to prevent agency "capture" prescribes strict limitations on communications between the rulemaking agency and affected parties (Susskind and Cruikshank: 35).

From the perspective of stakeholders, such one-way communication breeds discontent. Participants in the wood stoves case consistently expressed considerable dismay with the traditional rulemaking procedure and some described the practice of submitting written comments to EPA on proposed rules as throwing their comments into EPA's "black hole" or "black box." There is a general frustration with a feeling of insignificance in public comment and public hearing formats: one may yell and scream and make a highly rational and well-documented case, but one may never know who, if anyone, is listening.

While the formal procedure suggests that two-way communication does not occur at all, in fairness to EPA staff, discussions with persons involved with federal agency rulemaking confirm that commenters are sometimes engaged informally in more in-depth, two-way communication after the public hearing or submission of written comment by agency staff committed to understanding the meaning and implications of comments.[8] The appointment of special masters endows the court with more flexibility with regard to communications with parties over submissions of a scientific or technical nature. Whether or not two-way communication occurs, however, in both instances, is idiosyncratic and depends largely on the personalities, work load, and other factors concerning the individuals and the agency or the court.

Privately initiated communication that occurs subsequent to the "one-shot" largely "one-way" public hearing is not witnessed by other stakeholders. Thus, in addition to concerns about collusion and "back room deal making," communication conducted outside of public forums forgoes the likelihood that supplementary data, interpretations, or objections held by other parties would be discovered. Opportunities for the cross-pollenization of information that might yield new insights is lost.

Public and judicial hearings provide stakeholders a chance to argue their position (and favored policy alternatives) before the decision maker(s). The purpose of communication in such a context is explicitly to persuade, not to inform. Scientists and others citing scientific work adeptly manipulate language, including the language of science. The repertoire of tactics employed by stakeholders and their expert collaborators begins with the drama constructed around the presentation of scientific information and moves on to the selection of words spoken or written in testimony (Brooks; Gusfield; Mazur).

For example, the DOS´s preference for the term "resource recovery facility" to describe the proposed disposal option purposefully evokes a benign, even environmentally positive image, whereas "mass-burn incinerator," in contrast, does not. Stakeholders presenting expert witnesses recruit not simply persons with relevant technical training, but individuals with degrees (such as "Ph.D´s") and titles. The list of witnesses comprising the New York City DOS´s testimony before the BOE, for example, included the first Administrator of the New York City Environmental Protection Administration, a former chief engineer of the Sanitation Department, and others. These degrees and titles are intended as evidence of the witness's expertise and credibility. The implication is that scientific disagreement among witnesses should be judged on the basis of personal reputations, rather than the technical merits of contending arguments. Such a standard for evaluating competing technical arguments does little to advance the collective understanding of technical factors, or to ensure decisions are scientifically sound.

Other examples of manipulative communication tactics that are tolerated, if not encouraged, in existing decision making include the use of rhetorical devices, deceptive labelling, and the strategic "packaging" of technical information. One writer has suggested that rhetorical devices are the major source of public confusion on the technical merits of decision alternatives (Mazur). Hence, when Tobacco Institute, Inc. spokespersons allege that "no scientific evidence exists to prove that cigarette smoking causes lung cancer in humans," they are technically correct, since human epidemiological studies are impossible to conduct due to the difficulties of controlling for intervening variables. This statement does not address what is indicated from findings of other types of studies, such as laboratory animal experiments or statistical studies. Statements like these are intended to confuse decision makers and other non-expertly trained persons by appearing to refute contending scientific arguments without actually addressing their substance.

The "packaging" of technical information also sometimes has emotive significance. For example, the additional increase in the risk of developing cancer over a 70-year lifetime to an individual may appear small, and could be expected to stir little response among the public. The same increase applied to an entire population would yield an aggregate number of cancers that could appear quite worrisome. Stakeholders and experts can avail of different ways of expressing essentially the same risk estimates according to the response they desire.

The consequence of these communication constraints is a potentially critical flaw, namely that even a well-intentioned recipient of stakeholder comments has no mechanism for reconciling two contradictory sets of technical analyses outside of her own ability to dissect the arguments. Agency staff assigned the task of explaining discrepancies may spend days laboriously walking through the methodology and analysis of various submissions. Stakeholders may consciously obfuscate or misrepresent scientific documentation. Since the format of the scientific and technical information is fixed and largely the choosing of the contributor, the analyst may spend hours simply converting measurements presented in different units in competing analyses into comparable form. The quality and character of the scientific evidence presented by the disputants may be inconsistent. Stakeholders may focus on entirely different points in their technical argumentation. Yet, it is the responsibility of the reviewer to judge the relative merits of all submissions.

<u>Failure to Address Political Concerns</u>

Other serious concerns are also raised by approaches that focus narrowly on scientific disagreement. As a look back at Figure 2 will confirm, while contending groups wrap their preferred policy option with supportive scientific or technical documentation, the appeal to a "tie-breaking expert" presumes that contrary scientific and technical arguments can be extracted from these packages and examined in isolation. If the "expert" finds one or more arguments to be invalid, much of the persuasive power of the corresponding policy alternative is lost. In fact, it is unlikely that the decision maker will select that option. In a sense, disregarding a policy alternative because the scientific or technical argument is weak is like throwing the baby out with the bath water.

As noted earlier, public issues become disputes when two or more parties are dissatisfied with their assessments of expected changes in their respective well-being resulting from certain policy decisions. In other words, groups mobilize for or against public decisions in accordance with their political interests; the demands they view as rightfully theirs. The policy option that a group advocates represents a position considered to meet these political interests. Politically astute and resourceful groups are careful to develop options that are consistent with some body of scientific or technical information. Although a group may err in selecting a policy alternative that is based on inaccurate analysis, incomplete data, or some other flaw in the supportive scientific arguments, their political interests are nonetheless real. A decision making method that fails to acknowledge the political interests that lie beneath the policy alternatives advocated by different groups is shortchanging the political process.

Alternatively, groups may adhere to certain policy positions for strategic reasons. Their deeper political interest may be broader. For example, in the New York City case, it is conceivable that the CBNS researchers opposed the waste-to-energy plant not because of the health risk posed by plant emissions per se, but because of their opposition to a waste management program that accepts uncritically the dominant concept of "waste." While actually working toward a public program aimed at solid waste reduction at the source rather than through "disposal" technology, CBNS researchers might use the health risk argument to thwart the DOS proposal as a mobilizing strategy because the argument is more popularly embraced and has greater appeal to the general citizenry (Schattschneider). Thus, although their opposition to the plant is articulated as contesting the imposition of an additional health risk on the population, their underlying political interest is to force a reevaluation of what they consider to be ecologically arrogant assumptions of the current system of industrial technology by eliminating options for waste disposal.

Decision making methods that place an overemphasis on scientific and technical arguments further distort public debate by restricting consideration only to policy alternatives that can be substantiated by scientific and technical evidence. A preoccupation with identifying "scientific fact" blocks out arguments not couched in technical phraseology. Simply because a group is unable to formulate a scientific rationale for a preferred policy outcome does not signify that that policy alternative is technically unfeasible or based on an understanding that is scientifically invalid. Groups may simply lack resources for analysis or access to expertise to enable them to "fully package" their positions. Such an emphasis on scientific or technical arguments thus serves to restrict entry to public debates by imposing requirements for placing issues on the public agenda (Cobb and Elder).

In the anti-smoking campaign, for example, a group that might organize to oppose unlimited cigarette smoking may not be taken seriously because of the difficulties in quantifying physical discomfort experienced from secondary smoke. In debates concerning the regulation of artificial sweeteners, the value of artificial sweeteners in reducing the health risk of obesity is a benefit cited by some proponents of artificial sweeteners that is difficult to measure. Again, the interests of such groups may be legitimate, but a process that places a premium on "technical wrappings" can foster their neglect.

Even if decision makers succeed in uncovering the basis for discrepant scientific or technical arguments, methods that attempt to deal with scientific disagreement and political interests separately do not provide any means through which the decision maker can resynthesize political and scientific aspects into one policy. Various political interests of a group may not be explicit. In fashioning a policy position that would stand a chance of being accepted, they may have suppressed certain political interests over others. The policy position as presented to the decision maker does not necessarily include any sense of this ranking of different issues. Lacking this refinement, even a decision maker genuinely endeavoring to make a decision that meets the demands of various stakeholders would be unlikely to make a decision that stakeholders believe is fair.

Finally, these methods foster a hardening of policy positions. Through their investment of time, effort, and other resources in establishing a sound scientific and technical basis for a policy position, stakeholders become well-entrenched in the public debate and firmly attached to their position. An agency must carefully document why a proposed action is needed and why it is environmentally and socially acceptable before announcing a proposal publicly. After an agency like EPA spends 3 to 5 years developing a set of rules that it believes are scientifically defensible and acceptable within its own bureaucratic structure, its "sunk costs" may become too great to allow staff to consider modifications of any great magnitude. It would be difficult to imagine the Department of Sanitation deciding to forego its high technology waste disposal plans after more than 10 years of study. Through this time- and resource-consuming process, changes in policy alternatives become increasingly more difficult to justify in economic terms, and as the personal reputations of individuals involved are put on the line. For all parties, then, investment in supportive scientific or technical argumentation increases inflexibility on policy alternatives.

The Role of the Scientist

Methods commonly used to resolve challenges to the scientific or technical basis of decision alternatives attempt to isolate the disputed scientific or technical points from the broader policy issues. The operating assumption underlying this approach is that issues of "fact" and "value," or "scientific fact" and "policy," are distinguishable. Conceptually congruent with the logical empiricist view of science, expert committees are asked to rule on the "fact" portion of disputed public decisions. This division of "fact" and "values" creates a major dilemma for the demarcation of the role of the scientist and raises obstacles to decision making.

First, although the membership of all committees is not rigidly prescribed, committees formed specifically to address disputed scientific points that bear on policy decisions are usually dominated, if not comprised exclusively, by technical specialists. Membership of the three committees comprising EPA's Science Advisory Board (SAB), for example, is required by statute to be

> a body of independent scientists and engineers of sufficient size and diversity to provide a range of expertise required to assess the scientific and technical aspects of environmental issues (Ashford: 75).

The tendency to appoint technically trained persons to advisory committees to rule on the "latest and best" information reflects, again, the presumption that an appropriate qualification for determining "best" is technical training. While a "range of expertise" is considered important, the representation of a range of political interests apparently is not. This reflects a presumption that different disciplinary training is an expected and acceptable cause for differing opinions, but different political interests and values among scientists are not.

The logical empiricist view of science thus provides not only the theoretical basis for many conventional methods for managing scientific and technical information in public decision making, it also justifies a special place in decision making for the scientist. To the extent that determining the accuracy of contending scientific arguments contributes to the decision choice between two opposing policy alternatives, the role of the scientist is actually one of arbiter of public policy. If the political allegiances of scientists are not made explicit and scientists are not accountable to the public, then questions about democratic decision making arise (Dickson).

The appointment of expert technical review committees also presents difficulties in terms of public credibility. In the debate preceding regulatory action to reduce airborne lead, for example, the National Academy of Sciences (NAS) prepared a report to guide the Environmental Protection Agency in standard-setting. The committee's findings were criticized for its failure to make definitive statements about the lead issue in contrast to the findings, one year later, by another group whose report based on essentially identical data was considerably more alarming. One writer noted that the NAS committee did not include any of the scientists whose work had initially flagged concern about the adverse health effects of airborne lead, although industry scientists were included (Boffey). Public awareness of such differences in "expert" findings and suspicions about the sympathies of members of such expert committees diminish the credibility of such efforts and their success in settling scientific disagreements.

Summary

In this chapter, three hypothetical scenarios were presented in order to create a common reference point for a discussion of public decision making and to illustrate common methods for handling scientific and technical information and disputes. I argued that although these methods appear in slightly different form in the three institutional decision making contexts, they share many characteristics.

Conventional methods for resolving disagreement importantly share a theoretical foundation in logical empiricism that constrains their ability to fully air either scientific or political arguments. Specifically, they fail to undercover the basis of disagreement, to gain the trust and credibility of stakeholders, and to recognize political interests independently of positions substantiated by scientific arguments. As a result, administrative decisions and decisions by elected officials are taken to court, often at least partially on the basis of disputed scientific premises. EPA was sued twice, once by a pro-environmental group and once by industry, before finally promulgating regulations to reduce airborne lead that stood. In both cases, science was an integral part of the legal challenges (NRDC v. EPA; Ethyl v. EPA). Legal decisions do not necessarily end disputes, however, since judicial rulings that appear unfair and arbitrary to the losing party often are appealed in a higher court.

The value of destabilizing decisions should not be underestimated. Bouncing issues from one decision making forum to another serves a political purpose. Certain parties benefit by delaying action (Reisel; Susskind and Cruikshank). Preventing forward action on the Brooklyn Navy Yard mass-burn, waste-to-energy incinerator represented a positive gain to groups opposing the plant, such as the Williamsburg community, as long as their garbage continued to be collected by the City and taken away.

At some stage in many issues, however, changing circumstances may enhance the desirability for a more stable decision. If opposition groups perceived an impending waste disposal crisis in New York City, they might have a more favorable inclination toward a decision by the Board of Estimate, inasmuch as an outright rejection of the proposed facility would force the Department of Sanitation to more vigorously pursue other alternatives in order to clear the streets of a potential health hazard. In the wood stoves case, the traditional revulsion of industry to government regulation was assuaged by regulatory activity in several states. Throwing obstacles into EPA's rulemaking pathway might incite states that were already initiating regulatory action to move more quickly. Conversely, passage of federal regulations that appeared likely to be implemented would pacify state activity and prevent a multiplicity of state-level requirements on an industry doing interstate business. The party most likely to benefit by delaying an EPA rulemaking decision, in this case, was instead supportive.

The following chapter reconsiders the nature of scientific knowledge and presents an alternative approach for handling scientific and technical information in public decision making. These "consensus-based" methods are structurally more flexible than many conventional modes of soliciting public input. They appear more consistent with a revised concept of the nature of "science" and how it can contribute to public decision making.

Notes

1. In a survey by Wenner of 1900 environmental lawsuits in the 1970s, 855 cases used NEPA as the primary law or to supplement other arguments.

2. Stated by Barry Commoner during a personal interview, October 1986.

3. Telephone interview with Richard Colyer, May 1987.

4. King (Colorado) suggested during telephone interview that his input into EPA's rulemaking effort would have been severely limited to simply submitting written comments on the proposed rule. Kowalczyk (Oregon) believed Oregon's participation would have also taken a formal path of submitting written comments on the proposed rule, but he also believed EPA would have been especially receptive to Oregon's input prior to formal rule proposal because of the state's leadership on this issue.

5. The standard of judicial review of agency adjudications and formal rulemaking proceedings is the more stringent "substantial evidence."

6. Legal Times, April 22, 1985.

7. The selection of citizen advisory committees can vary substantially. In many cases, spokespersons for highly active environmental, residents, or business organizations are specially included. In other cases, appointment may be based on the official or unofficial status of community spokespersons, or simply the familiarity of agency personnel with such individuals. A primary concern of the sponsoring agency is that the committee appear credible (i.e., representative of the visible elements involved in the decision).

8. A record of such communications and their substantive content are added to the official, public record of the decision making procedure.

Chapter Three
CONSENSUAL APPROACHES TO HANDLING SCIENCE

An Analytic Alternative for Understanding Scientific Disagreement

Introduction

In this chapter, I describe three alternative procedures for handling scientific and technical components of a public decision. These procedures present ways of dealing with many of the inadequacies of conventional processes discussed in the previous chapter. Rather than on naive aspirations for establishing scientific "fact," these procedures are premised on an acceptance of the limits of science, both in terms of its inherent nature as a social process and its contribution to decision making. Consequently, they also alter the way in which political conflict is addressed.

These procedures are based on the experiences of three cases. In one case, disputed scientific and technical issues are dealt with by revealing the basis for disagreement and the different value orientations they reflected. The second procedure generated a sort of tacit accord on scientific and technical issues through active dialogue and adversarial reviews of pertinent information and analyses. This scientific accord provided a somewhat flexible but highly credible base from which stakeholders themselves fashioned policy that accommodated their political interests. In the third case, the procedure failed to dissipate disagreement over technical issues, but nonetheless succeeded in submerging such disputes. Again, the parties assented to burying the hatchet of scientific argumentation because of a common acknowledgement of the ambiguities of scientific knowledge at that particular point, which were revealed in part through the alternative procedure.

Each of these three procedures functioned as a supplementary step to a conventional decision making process. They entailed face-to-face interaction among stakeholders, their legal and scientific advisors, and, sometimes, the official decision makers or their representatives. And, each incorporated a consensus-based method that was directed toward actual or potential disagreement on scientific or technical aspects of the decision.

"Consensus" is an ambiguous term. It implies unanimity and a collective judgment. By "consensus-based method," I refer to a general class of decision making methods that are aimed to establish some kind of accord among all parties concerned. "Consensus," in this case, implies a shared disposition toward the objective of the procedure (i.e., to clarify disagreement, write a regulation, reach a settlement), but does not require an undifferentiated view of the issues. Consensus suggests acceptance, but not necessarily complete agreement.[1]

Further on, I will elaborate in greater depth on common features of these procedures. I turn now to a discussion intended to set a theoretical backdrop for the description of the three, consensus-based procedures. These points suggest the suitability of consensus-based approaches particularly for handling decisions that entail an extensive consideration of scientific or technical elements (what have been called "science-intensive" and "technically intensive" decisions).[2] First, the initial appeal of consensus-based procedures for decision making involving scientific and technical elements derives in part from its theoretical compatibility with an alternative to the logical empiricist view of science. This alternative philosophy of science, which is elaborated on in the following section, suggests a different conceptualization of the nature of scientific knowledge and the character of scientific disputes.

An Alternative Philosophy of Science

If the ideal of science, as depicted by the logical positivists could be met, public decision making would be simplified considerably. Debate would occur over the formulation and selection of policy alternatives (because of their unique distributive effects), but, as long as scientific endeavors were accepted as yielding one truth, a singular interpretation of reality, disputes over appropriate public actions would at least have a common starting point.

In fact, however, this ideal can not be met. Scientific efforts will fail to answer many questions, partly because of the inherent difficulties with what Weinberg has called, "trans-scientific issues", and also because, as recent social studies by Albury, Mulkay, and others have argued, science is not monolithic.[3] The scientific method (including data collection, experimentation, and theory building), is performed within a context of value-bound assumptions and choices. Consequently, scientific inquiry provides neither a singular way of knowing nor a solitary and absolute image of reality or truth.

In contrast to logical empiricism, I posit a philosophy of science that acknowledges the social nature of scientific efforts and far greater degrees of ambiguity in scientific work. This "new philosophy of science," began to develop during the mid- to late-1960s. Writers, such as Thomas Kuhn, pointed out the importance of paradigms, disciplinary lenses, and the "problem solving" nature of science. For example, Kuhn argued that scientists are trained, in a sense, indoctrinated, to accept a set of assumptions concerning models of theory and procedure. Even the determination of what constitutes a "fit" between plotted experimental data points and the curve suggested by a theoretical model is learned (Kuhn, 1982). Scientists work within this tightly constrained framework on "problems" until a given "paradigm" reaches a point of intellectual exhaustion and no longer provides a fruitful map for resolving unsettling questions (Ben-David). At such points, a "revolution" occurs, and a new theory of set of theories replaces the former (Kuhn, 1962). Scientific "truth" has a much more tentative ring in this context, being far more contingent on the conditions of observation and the theoretical framework within which the scientist works.

Science viewed this way, confers entirely new meaning to disagreements among scientists. Disagreement may represent a turning point in a single line of scientific thought, (a "revolution" in Kuhn´s language), or two alternative avenues for seeking truth, (different "paradigms" or "lenses" for viewing), rather than errors or faulty logic. Disagreements among scientists may represent differences in disciplinary training rather than incompetence. Importantly, scientific disagreement does not necessarily indicate that one analysis is "correct" and another "incorrect." Instead, disagreement represents two different, both incomplete, "slices" of reality. That is, investigators may be examining different elements of a "system" or observing the same elements from significantly different perspectives.

Kuhn´s seminal work coincided with a shift within the social studies of science. Other examinations of the activities of contemporary scientists suggest the influence of factors external to the laboratory on methodological choices made in the course of laboratory work (Latour; Knorr-Cetina). Such "external factors" affect the selection of research topics (Longino) and the communication of scientific work (Brooks; Mazur). These studies suggested that factors, such as personal experiential histories, employers and funding sources, and disciplinary tradition play a key role in shaping the products of scientific research, without contradicting the canons of the scientific method.

Technical Bases of Conflicting Scientific Advice

How exactly do the characteristics of the investigator and the objectives of an investigation shape the findings of scientific research? In the past twenty years, considerable attention has been devoted to understanding why scientists disagree and how divergent analysis can result from two equally "scientific" courses of investigation even within a single disciplinary tradition. A close examination of what scientists do (e.g., laboratory experiment, analysis based on statistical data, or a review of existing reports), suggests that researchers repeatedly confront decision choices that are not strictly prescribed by their disciplinary training. The choice is mostly a function of personal judgment. Different judgments made at these critical junctures can produce notably different research findings. The importance of personal judgment and discretionary decisions in various kinds of policy analysis (e.g., environmental impact assessment, risk assessment, cost-benefit analysis) has been noted by a number of authors (Bacow; Susskind and Dunlap), while others have performed similar analyses of laboratory conduct (Knorr-Cetina).

Their findings suggest five reasons why scientists often proffer very different advice. These factors have been described more fully elsewhere (Ozawa and Susskind). They are summarized below.

Differences in research design, include such steps as the framing of hypotheses, specification of assumptions (such as time frames, geographical boundaries, and functional definitions), and data selection (National Research Council; Mazur). The framing of hypotheses varies across different disciplines depending on the primary objectives and perspectives of the field. In predictive analysis, the specification of assumptions, especially the projection of future conditions, is critical. Even in laboratory science, the recording of data is dependent on functional definitions that may vary from one experiment to another, or from one laboratory to another. For example, the detection of "change" in a subject under study is dependent on the technology available for measuring change and the individuals performing the monitoring. Comparable types of experiments conducted over an interval of years in fields in which innovations in technological aids are profuse may result in data in forms that are not comparable.

Differences in the interpretation of data or findings can arise in cases in which scientists may agree on a given piece of evidence, but disagree about its significance. In the anti-smoking case, for example, some scientists may view statistics on the association of lung cancer and smoking habits as a strong indication of a causal relationship. Others may view the same statistics as supporting the hypothesis that lung cancer and smoking are both indications of a third condition, which is actually the causal factor inducing both disease and smoking in individuals. Interpretative differences arise from dissimilar choices of theory, or more directly, from contrary value orientations. Individuals who hold human health as the primary objective will often have a different calculus on interpretative issues from persons relatively more concerned with the stability of productive, economic activities, for example.

Confusing communication refers to the packaging of scientific information. Scientists, or the messengers who report scientific work, often employ rhetorical devices in their attempt to persuade decision makers and potential supporters of the policy implications of their scientific studies. For example, in the anti-smoking debate, one of the favorite phrases of tobacco supporters for many years was "there is no evidence to show that smoking causes lung cancer in humans." Technically speaking, this was true, since controlled experiments on humans were difficult to carry out because of ethical and other reasons, and the experiments on laboratory animals could be criticized for failing to accurately simulate human habits and living conditions.

Other confusing communication tactics include the representation of probabilities or statistical figures in ways which most favorably dramatize the numbers. For example, one writer noted that

> [Scientists] who favored [nuclear weapons] testing expressed health dangers in terms of the increased chance of cancer for an individual exposed to fallout. Expressed as a fraction, such increases were minuscule. The critics of testing, however, often expressed the identical facts in terms of actual deaths that would occur worldwide within a period of 50 years. . .as a result of current fallout. Some figures were very high (Brooks, 1980).

While it appeared as though one analysis suggested a low health risk and the other a high risk, in fact, the estimates of likely increases in the incidence of human cancers cited by the two groups and the interpretation of these figures, were identical. For dramatic purposes, however, the scientists quite intentionally chose to express the risk estimates with different reference points (i.e., the individual in one case, the population in the other). The "disagreement" was, hence, purely attributable to differences in communication tactics.

Policy prescriptions sometimes are made explicitly during the reporting of scientific information. Although a scientist may be asked solely to report on a particular "scientific" question concerning a given policy issue, the scientist may be unable to resist including statements about his "personal" opinion, as the quote in Chapter 1 illustrated. As argued in Chapter 1, this distinction between "personal opinion," or values, and "scientific advice," or fact, is somewhat illusionary. While statements about policy prescriptions, in fact, simply reflect value orientations that are inherent in the advice anyway, the explicit statement of policy preference further exacerbates the perception of disagreement among decision makers and others listening to the conflicting scientific testimony. Despite the fact that many decision alternatives may be consistent with a given identification of scientific and technical parameters, the expert voicing his own preference directs attention and, possibly, undue certification to that position.

Error remains a factor in the presentation of conflicting scientific information in public decision making (Wessel). While no studies have been conducted that display the degree to which error accounts for debate, concern about fraud in the scientific community is a related issue and one that has gained notice in recent years.

This revised formulation of the scientific enterprise and the nature of scientific disagreement has profound implications for the use of science in public decision making. If conflicting scientific evidence or analyses can be viewed legitimate from a scientific perspective, understanding the value choices that lead one investigator to one conclusion and another to a different conclusion from a similar starting point is important to a decision maker (and others) wishing to assess the compatibility of competing scientific arguments with her own values and policy choices. Rather than simply dismissing science as "not useful" in informing policy decisions when experts disagree, decision makers are obligated to explore the limits and possibilities of alternative scientific evidence or analysis. Also, if scientists are not politically neutral and dispassionate, then scientific analysis and the advice of scientists can not be held up as an authority in public decision making without an obfuscation of underlying political contests and the surrender of political power.

Public decision making procedures need adjustment to account for the biases of the scientist when scientific information, particularly contradictory analyses, is presented. If decision makers are able to decipher why scientists submit conflicting testimony, they will be better equipped to comprehend the value orientations embodied in each analysis or report. Doing so, presumably, might facilitate a more straightforward recognition and discussion of the interests and values at stake in the decision. Decision makers could gain a fuller understanding of technical factors and might then be better prepared to address the interests that motivate groups to act.

Consensus-Based Methods for Science-Intensive Public Decisions

Consensus-based supplements to conventional decision making are no longer unusual. They have been used in a variety of policy fields at local, state, and federal levels of government (Susskind and Cruikshank). A compilation of environmental disputes involving the application of consensus-based methods reported 160 cases between 1973 and 1986 (Bingham). In many instances, decisions were contingent on scientific or technical information that was ambiguous or disputed. Several federal agencies, including the Environmental Protection Agency and the Occupational Safety and Health Administration, have experimented with mediated negotiation in rulemaking on issues that frequently evoke challenges to scientific and technical components. State governments in Massachusetts, Virginia, Wisconsin, and Hawaii, among others, have institutionalized varying forms of alternative dispute resolution procedures to deal with a range of public policy issues.

The enthusiasm for consensus-based approaches stems from a number of favorable claims. In comparison to litigation, consensus-based methods are believed to be more economical for the parties (McGovern; Mernitz; Wall and Rude). Many proponents have suggested regulatory negotiation may be "less costly and more expeditious,"[4] as well as more "effective", and produce "better" regulations, and, as a process, garner greater political legitimacy compared to conventional procedures (Harter; Susskind and McCreary; Susskind and McMahon).

Several writers have speculated on the suitability of consensus-based procedures especially for science-intensive decision making (Abrams and Berry; Ozawa and Susskind; Rushefsky). A consensus-based method is believed to foster less adversarial uses of scientific information, greater opportunities for understanding the basis of disagreements, and higher probabilities of reaching an agreement on technical issues intimately linked to public decisions. The flexible structure of consensus-based methods and certain techniques, such as the assistance of an intervenor,[5] joint fact-finding, and collaborative model building, among others, have been proposed as tools for bringing a group to a common perception of scientific issues.[6] It has been suggested that constructing a common understanding of technical points creates a conducive environment in which participants can then debate more explicitly political decisions (Bacow and Wheeler; Cormick and Knaster; Susskind and McCreary).

Similarities Among Three Consensus-Based Procedures

The *ad hoc* nature of most consensus-based supplementary procedures has meant that particular designs and applications are highly varied. The three consensus-based procedures studied in this inquiry differ in many respects, but they also share certain, notable characteristics. I preface the description and analysis of these procedures with a summary of these similarities and brief notes about their relevance to science-intensive decisions. The case descriptions themselves will add color and texture to these points.

First, the procedures all included a "third-party" intervenor who assisted in the preparations leading to the consensus-based meetings as well as facilitated the meetings. An intervenor can be helpful simply to keep discussions moving along, but he can also perform a number of functions associated with complications specific to technically intensive decisions. For example, he can facilitate communications among individuals with varying levels of expertise in relevant technical areas, help the parties to avoid rhetorical devices in discussions of technical points, and serve generally to help coordinate the presentation of technical material.

Next, the meetings included face-to-face communications among contending parties and among their respective technical advisors. As the cases illustrate, interactive relations can provide a rich context for the presentation of scientific matters relevant to a decision. There are ramifications for the type, format, and quality of information submitted for review and consideration. Both contending stakeholders and decision makers benefit from the opportunity to raise questions and hear answers that may add precision and depth to their understanding of technical issues.

Most importantly, the very consensus-oriented character of these procedures has critical repercussions. The "consensus" in each case was directed at different elements. In one case, the group assembled in order to generate an accord on technical issues of agreement and disagreement and to elucidate the basis for disagreement. In another case, the "consensus" was aimed toward the common objective of developing regulations for controlling particulate emissions from residential heating devices. In the third case, the parties shared a desire to reach a legal settlement that would end public violence and enable the parties to pursue their separate uses of a public resource, the lakes' fishery. In all cases, the shared goal of the procedure provided sufficient impetus to maintain a cooperative and collaborative spirit, despite considerable underlying conflict.

Three Procedures for Science-Intensive Decision Making

In this section, I present descriptions of three cases in which a consensus-based method was inserted into a conventional decision making process to illustrate how consensus-based methods offer alternative ways of handling scientific and technical information and disputes. These cases suggest three distinct, alternative procedures. Indeed, one case shows how understanding the causes of scientific disagreement can move decision making forward. Another shows how building a consensus on technical aspects of a decision can lead to agreement on policy. The third case portrays a procedure for reaching a policy agreement in the presence of substantial technical uncertainty. Importantly, in all three cases, the procedures permitted a far greater degree of flexibility in dealing with technical and political uncertainty, as compared to the conventional "decide-announce-defend" approach.

Procedure 1: Understanding the Basis of Scientific Disagreement

The New York Academy of Sciences facilitated policy dialogue represents a rather narrow form of intervention. The objective, as described by Don Straus, chair of the Science and Society Committee of the Academy, was not "to solve or even suggest solutions to how to solve waste disposal" but to "help representatives of the BOE to walk through scientific issues concerned with how to solve solid waste disposal" (New York Academy of Sciences, 1984b). In fact, even this seemingly limited objective overstates the actual accomplishment of the 8-hour, one-day session. The achievement was modest: simply to trace the basis for the discrepant risk assessments performed in respect to one approach to the solid waste disposal issue, namely the proposed Brooklyn Navy Yard facility. Nonetheless, even this relatively minor accomplishment otherwise might not have occurred and the clarification of disputed technical points carried important implications for the politics of the overall decision making process.

A Close Look at the Scientific Disagreement

The New York Academy of Sciences policy dialogue was undertaken as a response to an urgent plea for assistance from the New York City Department of Sanitation (Konkel). One month after the Department of Sanitation (DOS) announced its plan to construct a resource recovery facility at the Brooklyn Navy Yard site, the Center for the Biology of Natural Systems (CBNS) issued the first of four reports condemning the project for exposing the City's residents to an increased risk of developing cancer. The city's governing Board of Estimate (BOE) instructed the DOS to conduct further study, which was embodied in a report by Fred C. Hart and Associates, Inc. Under what each called a "worst-case" scenario, the Hart report estimated an increase of 5.9 cancer cases per 1 million population exposed over a 70-year lifetime while the CBNS report predicted a range of 29 to 1,430 additional cases of cancer per million population (Commoner, 1984).

What accounted for this startling, 240-fold discrepancy? Briefly, the different figures can be traced to differing opinions on two main factors: (1) predicted dioxin emission levels, and (2) the effectiveness of proposed pollution control technologies. These two factors, in turn, are inextricably bound to a theory of the mechanisms of dioxin formation in municipal solid waste (MSW) incinerators.

Differing assumptions about the level of dioxin emissions is the singular risk assessment variable that goes the furthest in explaining why the two cancer risk assessments differed by more than a factor of 240. As is pointed out in one CBNS report, if the same expected emission level is factored into each analysis, the Hart and CBNS risk analyses respectively yield values of 5.9 and 29 additional cancer cases per 1 million population exposed over a 70-year lifetime. Given the high level of uncertainty in this type of risk assessment, a less than 5-fold difference between projections is not considered a significant variation (Commoner, 1984: IV-18).

Estimating expected levels of dioxin emissions is an imprecise task. Although reports on dioxin emissions from municipal incinerators appeared in the mid-1970s from the works of European researchers, existing data in 1984 was still spotty, idiosyncratic, and, as a result, inconclusive. The Hart report identified data on dioxin emissions from 19 incinerators located around the world. However, monitoring protocols, the specific identity of the dioxin isomers tested, the physical state of the dioxin compounds tested, and numerous other methodological details for each of these tests varied, making the comparability of performances among these existing facilities difficult to judge. Moreover, separating valid from invalid testing results was impossible.

The different research groups took different approaches to selecting an appropriate emission estimate for their risk analyses. From those 19 sets of emissions test data listed in the appendices of the Hart report, authors of the Hart report combined two sets of testing data, from the Chicago Northwest and the Zurich-Josefstrasse facilities for their risk assessment. They justified their selective use of data as follows.

> After examining all PCDF and PCDD emission data available in the literature, <u>the emission data selected as the most representative of the BNYRRF</u> [Brooklyn Navy Yard resource recovery facility] are the data from the Chicago, Northwest facility and Zurich-Josefstrasse facility. Both of these facilities use a furnace design similar to that proposed for the BNYRRF. The Chicago Northwest facility is located in an environment similar to that of the Brooklyn Navy Yard, i.e., a large U.S.

> metropolitan area; therefore, the waste is more likely to be similar to New York City waste than is the European. Furthermore, the sampling of the Chicago, Northwest facility was performed under sponsorship of the USEPA, using sampling methods designed to capture both gaseous and particulate forms of PCDFs and PCDDs. In addition, stringent quality assurance controls were used in order to assure representativeness. The Zurich-Josefstrasse facility was tested by the Swiss counterpart to the USEPA. The sampling method included both gaseous and particulate PCDFs and PCDDs in the sample, although the method is different from the USEPA method. Sampling of both gaseous and solid forms of PCDFs and PCDDs is important to ensure that the emission data are complete (Hart: 3-19, 3-20); [emphasis added].

Interestingly, as they note, emissions data from these two facilities were also among the lowest reported (Hart: 3-15).

The key words in the Hart report are "data selected as the most representative." In contrast, CBNS researchers looked at the available data comprehensively, rather than exclusively. They interpreted the wide range of test results as indicating the high variability and unpredictable nature of dioxin emissions, rather than as resulting from the varying reliability of measurement techniques in different cases. They asserted that too little is understood about the dynamics of dioxin emissions to confidently judge representativeness and comparability between plants. To safeguard against such gaps in knowledge, they utilized both the lowest and the highest tested emission levels in their risk assessment, (thereby yielding a range of expected increases in cancer rates, from

29 to 1,430 additional cases), without attempting to judge their relative validity (Commoner, 1984: I-9, 10).

In subsequent reports, the CBNS group continued to refute reasons offered by the Hart group for justifying their more narrow data selection. In particular, the CBNS group contested the relevance of design similarities cited by the Hart group as justification for their data selection. They argued that the Chicago, Northwest and Zurich-Josefstrasse facilities are more similar to the proposed BNY plant than the other facilities for which testing data were relatively complete, only in that they utilize a Martin grate (part of the furnace system). Other potentially important features such as the size of the facility were not similar. Moreover, they contested the role of the Martin grate and furnace operating conditions in affecting dioxin levels. They cited recent testing data from a Tsushima, Japan incinerator equipped with a Martin grate, which showed emission levels ten times higher than the Chicago, Northwest test data despite furnace temperatures of 800 degree centigrade (Commoner, 1984) and a Canadian study which indicated that emission rates were not significantly affected by temperature or other combustion factors (Commoner, 1984: IV-10).

At the core of the disagreement over the appropriate data set and the significance of the furnace system were assumptions about the formation and destruction of dioxin in

MSW incinerators. There was no challenge to the proposition that dioxins are destroyed at very high temperatures (800 degrees centigrade or higher). It was uncontested that under optimum conditions of air turbulence, oxygen concentration, residence time, and high temperatures, laboratory experiments have shown about 99% of dioxins present are destroyed. It was also more or less undisputed that the furnace design proposed for the BNY plant would be capable of destroying a significant proportion of the dioxin in the combustion chamber, although there certainly was room for disagreement on this issue.

What was contested was whether dioxin is actually present in the combustion chamber at all. The formation of dioxin in incinerators is not well understood. In their effort to knit together the pieces of information obtained by research thus far, researchers have developed three alternative hypotheses to explain dioxin formation. The first is that dioxin compounds are present in the raw refuse and are volatized during incineration. Since PCDDs and PCDFs are known to have formed as byproducts and contaminants of commercial chemical goods commonly found in municipal refuse (such as polychlorinated biphenyls [PCBs]), it is reasonable to assume that municipal wastes may contain traces of dioxin. In fact, one study did detect PCDFs and PCDDs in raw wastes, although not in sufficient quantities to explain tested dioxin emission levels (given the generally accepted fact that laboratory experiments have demonstrated that about 99% of the dioxins present are destroyed at high temperatures.)

The second hypothesis, one regarded as the conventional theory, posits that PCDDs and PCDFs are formed from precursors present in the waste stream. Precursors are products (such as PCBs and chlorophenols) that contain PCDF and PCDD materials as contaminants. It is hypothesized that PCDFs and PCDDs form at temperatures sufficient to decompose precursors but too low to destroy dioxin. PCDFs and PCDDs can also volatize directly from precursor materials. Laboratory experiments have provided data consistent with this theory, although no studies have yielded conclusive data (Hart: 3-4). In fact, one experiment indicated that adding precursor materials to the waste stream did not significantly increase the PCDF and PCDD concentrations found adsorbed onto fly ash (Hart: 3-5).

The third theory proposes that PCDDs and PCDFs are synthesized "de novo" from constituents of materials commonly present in the waste stream, such as wood products and plastics. The "de novo synthesis" theory of the formation of dioxin has been deduced from laboratory experiments that have shown that no dioxin is emitted when certain materials are burned separately but is detected when these and related products are incinerated together. According to this theory, PCDDs and PCDFs are formed in municipal solid waste (MSW) incinerator systems by chemical reactions between carbon-ring compounds produced by the incomplete combustion of lignin (a constituent of wood and, therefore, of paper), and chlorine in the form of hydrochloric acid. Hydrochloric acid is produced in incinerators by the combustion of chlorine-containing plastics (such as polyvinyl chloride, or "vinyl") that are present in MSW. Ordinary table salt in MSW makes an unknown, but apparently minor, contribution. Paper is the major source of lignin in MSW (CBNS: IV-8).

Distinct from the preceding two theories, the "de novo synthesis" theory further posits that syntheses of PCDDs and PCDFs do not occur in the incinerator, but at later points in the waste gas stream. The carbon-ring compounds and chlorine compounds are freed from their original state during the combustion process and adsorb onto particles of fly ash. These constituents of PCDDs and PCDFs then react under lower temperatures (in the smokestack or other points beyond the combustion chambers) to form PCDDs and PCDFs. As in the case of the conventional theory, the results of at least one experiment appear to contradict this theory (Hart: 3-5).

The authors of the Hart report acknowledged the ambiguity of existing empirical evidence by recognizing that dioxin formation may occur by more than one mechanism. They argued, however, that,

> Since there is a design temperature difference between the pollution control device and the stack of the BNYRRF of only ten degrees, it is unlikely that condensation occurs in the stack. Therefore, if PCDF and PCDD materials are adsorbed before entering the pollution control device, some portion of these materials will be trapped in the fabric filter because the fabric filter is more efficient at collecting fly ash than the electrostatic precipitator (Hart: 3-23).

Implicitly, they justified a narrow data set on the assumption that dioxin is present in the raw waste or is formed from precursors during the combustion step and can be destroyed under optimum heat conditions. They further assumed that any dioxin formed subsequent to the high temperature chambers is likely to form before, not in, the stack, and will therefore be contained by the fabric filter control system.

The CBNS team more adamantly subscribed to only one theory, the de novo synthesis theory. In their report they described tests from the Tsushima, Japan incinerator, which is similar to the proposed plant in furnace design and equipped with the same pollution control system. They wrote:

> The tests showed that this system failed to control PCDD/PCDF emissions. Indeed, they showed that PCDDs and PCDFs were actually synthesized in the control system; seven times as much PCDD/PCDF left the control system (and was emitted through the stack) as entered it (CBNS: IV-11).

The relevance of the process of dioxin formation to the BNY proposal is two-fold. First, if PCDDs and

PCDFs are indeed formed by precursors in the waste stream as the conventional theory holds, then they ought to be destroyed if appropriate incineration conditions are maintained. On the other hand, if the de novo synthesis theory is true, and synthesis occurs only after temperatures in the waste gas stream are sufficiently cooled, then PCDDs and PCDFs would not be present in the combustion process at all and high incineration temperatures and other combustion factors such as air turbulence and oxygen balance could be expected to have no effect on emission levels. Thus, if the conventional theory is true, the importance of the Martin grate in selecting emission level data is substantiated and a lower risk estimate may be more accurate. Conversely, if the de novo synthesis theory is correct, this design feature would be arguably less significant in relation to data selection, and a higher risk estimate is warranted.

Theories of dioxin formation also have implications for evaluating the effectiveness of pollution control technologies. If PCDD and PCDF precursors are present as contaminants in single products, waste separation before incineration would have no effect on dioxin emission levels. If formation occurs during combustion, then increasing the effectiveness of particulate emission control systems should reduce dioxin emissions. If dioxin is formed in accordance with the de novo synthesis theory, "add-on" air pollution control technologies would be useless unless a significant proportion of the dioxin formation occurred before or in the control technology system. In that case, waste separation prior to incineration would appear much more promising.

This account of the New York City dispute shows that discrepancies in the work of reputable scientists can occur when the scientists hold differing opinions about factors that cannot be ascertained given the present state of knowledge. These two groups of researchers reached different determinations on the appropriate data set largely because of a lack of conclusive information on the mechanism of dioxin formation in MSW incinerators. Without a definitive theory and armed with contradictory test results from dissimilar facilities taken under unquantifiably varying conditions and findings from laboratory studies whose extrapolation to real world experiences is questionable, each constructed plausible and persuasive scientific rationales for critically different data selections.

Without knowing the relative impact of various factors on dioxin emissions, some scientists are willing to make assumptions where others are not.

Without conclusive evidence to support one theory of dioxin formation over another, scientists may intuitively find one argument more compelling than another. The willingness to make assumptions, the "intuition" that attracts an individual to one theory over others, like personal "risk aversity" levels, are intermediate manifestations of the individual´s unique set of values. When disagreement surfaces, the debate may heat up to the degree that groups intentionally (or not) engage in communicative manipulations, such as using single terms like "worst case" to convey different meanings.

These kinds of disagreements arise again and again in science-intensive public disputes, in varied renditions, as the latter two cases illustrate. In what ways did the facilitated policy dialogue function to enlighten the decision makers (in this case, their staff advisors) on the issue of dioxin emissions and solid waste incinerators?

Decoding Scientific Disagreements

The "by-invitation-only" facilitated policy dialogue was set up as one, 8-hour day session to address three specific issues concerning the proposed mass-burn incinerator (New York Academy of Sciences, 1984a). Staff from the sponsoring New York Academy of

Sciences selected these topic areas on the basis of independent interviews with members of the BOE. The three issues were: (1) the types of emissions and their health effects, (2) the sources of emissions in resource recovery plants, and (3) the control of emissions. After 30-minute presentations on each topic from expert panelists, also selected by the Academy staff in consultation with BOE staff and representatives of major environmental groups, the floor was opened to questions from other panelists, BOE staff, and the general audience.

The isolated opportunity that the one-day session offered scientists to present their views made the occasion vulnerable to attempts at "grandstanding." In some cases, presenters used the forum to defend their opinions and interpretations of study results. For example, panelist Walter Shaub, a chemist whose work had been cited in CBNS reports, was asked to address the issue of the sources of PCDD and PCDF emissions from mass-burn plants. He spent much of his 15 minutes rendering a carefully prepared statement condemning the "CBNS theory" (the de novo theory) and clarifying what he believed was the proper interpretation of the results of his research. His reinterpretation of historical data cited by CBNS provoked a strong rebuttal by Commoner during the following question and answer period. This interval of the policy dialogue, which can be characterized as highly antagonistic, seemed to constitute little more than an opportunity for the speakers to present orally their own "adventures in applied probability."[7]

In contrast, the question and answer period in other instances helped to clarify exactly what the experts, in their cautious, scientific language rich with disclaimers, were actually saying. The dialogue allowed the audience an opportunity to gain an appreciation of the contingent nature of prescriptive advice (an estimate of the effectiveness of emission reduction technologies) and descriptive scientific theory (assumptions about the formation and destruction of dioxins). The mediator assisted in these interactions between decision maker representatives and experts by rephrasing questions and responses, and by reminding speakers of the focus of the discussion. In some cases, the mediator's attempt to rephrase a question helped the asker to express it more clearly himself. In other cases, the mediator's attempt to repeat a response was corrected by the respondent. All of these efforts resulted in clarification of the scientist's view for the non-scientist listener.

Perhaps most importantly, what was achieved was not only merely the disclosure of the technical basis for differing risk assessments, but the disengagement of two polar opposite policy positions--to build and not to build the plant--from the scientific issues. The lay-out of the issues, the question-and-answer format, and the mediator´s vigilance helped to keep clear the distinction between what is known about dioxin formation and destruction and pollution control technologies, and the desirability of different technologies. Rather than a "black and white" choice between a plant with high emissions and no plant and no emissions, a richer landscape of alternatives was drawn as individuals became inspired to suggest novel ways of dealing with uncertainty. One suggestion heard was to require the builders of the mass-burn incinerator to bear the costs incurred if a plant is shut down for failure to attain emission levels, for example. This is an intriguing way to force those most confident of their assertions to gamble the hardest.

It is also significant that Dr. Barry Commoner, the leading scientist-spokesperson opposing the proposed Brooklyn Navy Yard facility and a participant at the facilitated policy dialogue, sent a letter that was published in the New York Times three days after the meeting. Reasserting his belief that DOS estimates of dioxin emissions were inaccurately understated, he proposed that a "good way to cut through the controversy, which was suggested by a recent action by California in response to an incinerator issue" (and a suggestion that was raised at the NYAS policy dialogue) was to require "the builder to show, by tests on the completed incinerator, that it does, in fact, emit dioxin at the low rate that the builder predicts" (New York Times, January 5, 1985). This statement by Commoner seems to indicate that the two issues--the question of the cancer risk posed by dioxin emissions from the proposed facility and the question of whether to build the facility or not--were successfully severed by the discussions at the policy dialogue.

One Step Toward A Decision

The New York City Board of Estimate voted to approve the comprehensive waste disposal plan on December 20 1984, only two days after the policy dialogue (New York Times, December 21, 1984). Public opposition to the high-tech approach persisted, but in August 1985, the BOE approved the Brooklyn Navy Yard proposal as well (New York Times, August 16, 1985). Members of the Williamsburg community organized a mass protest march to City Hall and a spokesperson was quoted as saying, "We will be at the site every single day, a single bulldozer will not enter that site." (New York Times, September 6, 1985) Residents subsequently filed a legal suit and construction of the plant has been delayed.

Disengaging decision alternatives from disputes over scientific or technical issues is only the first step in developing a politically acceptable decision. The facilitated policy dialogue was not designed to take the discussion beyond the point of clarifying disagreements between experts. Consequently, although potentially it reopened the discussion to new alternatives and the expression of political interests, the policy dialogue was not directed toward facilitating either process. It presented opportunities, but without strong inducements.

The decision alternatives that were added to the discussion partly as a result of the information that surfaced at the policy dialogue consisted of add-on air pollution control technologies and more stringent monitoring provisions to ensure expected operating condition are not violated. One might argue also that advocates of alternatives to mass-burn incineration gained political ground since legitimization of the higher risk assessment and the *de novo* theory of dioxin formation would have made recycling and other approaches appear more appealing to decision makers hoping to allay public fears. While the actual benefits to advocates of alternative waste disposal methods and incinerator designs afforded by the policy dialogue are difficult to identify absolutely, it certainly is plausible that the policy dialogue broadened the consideration of decision alternatives to include ones more compatible with their political objectives.

On the other hand, the relatively limited scope of the policy dialogue, in terms of objectives and scheduling, did not allow for more revealing discussions of political interests. The meeting was focussed entirely on scientific issues. Although this was useful in disclosing some value choices behind divergent technical analyses, (e.g., how conservative a stance to assume in estimating variables), it did not flush out statements about the motivations of various groups involved.

For some groups, the political interests that spurred action were less clear than those of others. Although the CBNS researchers and the Williamsburg community sat on the same side in the scientific dispute, the political interests behind their involvement were probably quite distinct. The Williamsburg residents opposed the Brooklyn Navy Yard plant because it was slotted for a site adjacent to their neighborhood. Although general public health risks were certainly of concern to them, it is not clear that they would have spoken out against a similar plant had it been proposed for a location elsewhere in Brooklyn, in the Bronx, or in another state.

The motivation of the CBNS researchers can be surmised quite differently. Dr. Commoner has been part of public opposition to mass-burn incinerators in several communities outside his own. From his extensive writings, his involvement and those of his colleagues at CBNS might be understood as a manifestation of a commitment toward restructuring a "wasteful," environmentally assaultive society into a more ecologically balanced one.[8] The fact that Dr. Commoner advocated recycling, waste sorting, and source reduction in lieu of mass-burn incineration reinforces this interpretation of Dr. Commoner's motives. On the other hand, his involvement may simply be motivated by a belief in self-determination and a response to a request for assistance from a community struggling to gain control of its future.[9] In any case, his political motives were probably more ideologically oriented than those of the Williamsburg community.

The interests of other groups present at the policy dialogue can be expected to differ again from these two groups. However, the policy dialogue did not encourage a discussion of the concerns and interests behind the involvement of various groups.

Consequently, it provided little additional enlightenment to decision makers aiming to make a politically acceptable and technically reasonable decision.

Procedure 2: Building a Technical Consensus[10]

The woodburning stoves regulatory negotiation was a fairly comprehensive attempt to weave technical and scientific knowledge into the policy making trade-offs necessary in developing implementable technology-based pollution control regulations. In contrast to the facilitated policy dialogue and the Michigan fishing case, the regulatory negotiation preceded any well-publicized debate over the issue under consideration, emission standards for new residential wood combustion units. The participants held a wide range of concerns and were variously equipped to deal with scientific, legal, and regulatory aspects of rulemaking.

Putting the Process in Motion

The Environmental Protection Agency's objective was to develop rules that were politically palatable, enforceable, and technically feasible. EPA had previous experience with the use of negotiation in rulemaking. The agency, through its Office of Program Planning and Evaluation, had undertaken a pilot project in regulatory negotiation beginning in 1983. By mid-1985, three of the six demonstration "reg negs" were completed or underway (Harter, 1986). The EPA process designers, through consultation with the Standards Development Branch, were also familiar with the nature and type of issues that would require consideration, and the critical limitations of the technical and scientific knowledge needed to back up decisions. Although regulations agreed upon by the negotiating parties were preferable, even without signatures, EPA would be closer to promulgating appropriate rules at the end of the negotiation effort.

The agency identified potential and eventual negotiators and, through a published notice in the Federal Register, invited other members of the interested public to attend the first organizational meeting. An EPA staff person initially intended to serve as mediator, but the EPA-hired consultant, originally acting as "convener" eventually took over all facilitating as well as convening responsibilities. Meetings were open to the public and statements and questions from observers were encouraged after procedural recognition from the facilitator. Accordingly, the six meetings that took place over a period of six months were lengthy, but rich with the engineering, legal, and regulatory knowledge of many individuals as well as intense debate between parties with competing interests.

As in the New York City waste-to-energy plant dispute, the science and technology of wood stoves is not well understood. Emissions vary in accordance with a number of difficult-to-control factors. User habits, such as the way one stacks wood, wood type and age, burn rates, and other such factors, as well as stove design can cause variations in particulate emission levels. Although stoves equipped with catalysts are widely believed to burn more "cleanly," a lack of long-term data arouses doubt about the overall performance of catalysts in reducing emission levels. Moreover, it is suspected that catalysts degrade through use. But, how quickly degradation occurs and the effect of different catalyst materials and stove designs on degradation rates is not known. Finally, the difference between emission levels occurring during laboratory testing and actual home-use is also highly speculative.

The level of technical ambiguity surrounding wood stove emissions opened the door for analytical acrobatics and political posturing by the stakeholding parties. Instead, through the negotiations the parties apparently recognized the uncertain nature of the calculations over which they labored. Sometimes, through an iterative process, agreement would be reached on one number or one method of measurement or analysis. More often, a sort of "bounded" ambiguity prevailed. In these cases, the negotiations over "hard numbers," such as permissible emission levels, compliance dates, and so on, transpired in a climate in which negotiators had a common acceptance of the range of scientifically acceptable estimations. In determining the package of provisions that comprised the ultimate regulations, negotiators traded across issues ("logrolling," in Lewicki and Litterer's terminology), accepting higher estimates on one variable that justified one party's preferred policy choice, in exchange for lower estimates on another variable which justified another party's preference on a different provision. What resulted was a mosaic of rules and regulations which has not been seriously criticized after publication and which most parties believe are as scientifically and technically sound as possible to develop under the prevailing time constraints.

Reaching A Technical Consensus

This scientific and technical consensus was accomplished in a number of different ways. Although EPA staff persons had appropriate technical training which was supplemented by hired consultants, the accelerated rulemaking schedule resulting from the NRDC lawsuit meant that the agency would be hard pressed to generate independent scientific and technical data. By involving many parties in the rulemaking process, it in effect "externalized" some of the effort and cost of gathering data. The negotiating parties, notably the WHA, the independent testing laboratories, and the states of Oregon and Colorado, which have operational regulatory programs, volunteered data and technical analysis on issues of their particular concern as well as in response to requests by others during meetings. As a result, the regulatory negotiation format allowed the group to assemble a massive amount of existing information rapidly in usable form.

Data and analysis presented by parties with a strong interest in a particular decision are often looked upon skeptically by the receivers--be they decision makers, other interested parties, or observers. Such information is often viewed as biased, incomplete, or even inaccurate. In the regulatory negotiation setting, negotiators, their expert advisors, and observers were able to freely question the party presenting the information about assumptions of the methodology and others details of research design. When EPA presented an econometric model to predict the impact of exempting small manufacturers from the regulations, for example, skeptical negotiators were invited to submit alternative input values, or assumptions, to yield predictions under varying conditions.

Error in data or analysis could be detected as group members carefully scrutinized each item submitted. Even if no flaws or inconsistencies were uncovered in the cross-examination, the listeners, experts and non-experts alike, gained a sense of the data's validity, an understanding of the underlying assumptions of the analysis, and general significance of the information simply by the tenor of the discussion.[11] With the stakeholders physically together, technical arguments were "on trial" to be judged by the group as a whole, not only by EPA. The credibility of data, as well as alternative analyses and interpretations, benefitted immeasurably from the careful, open, and interactive viewing they received in the negotiation setting.[12]

The structure of the negotiation sessions also allowed for the presentation of contradictory, inconsistent, and complementary scientific and technical evidence and arguments in a way that maximized the opportunity for understanding how and why they differ. When technical disagreements and uncertainties seemed too unwieldy for the mixed group to handle, subcommittees were appointed (comprising representatives from each major coalition) to examine the issue more closely and to come to back to the larger group with some kind of clarification, if not a consensus. Because the negotiations were structured so that all issues were introduced in the earlier sessions and then "revisited" during the later meetings of final deliberations and bargaining, participants also had an opportunity to seek independent reviews and consultations during the interim (US EPA, 1984). Participants were encouraged to (and did) submit additional materials for consideration by the group at points between the two discussions. Thus, a considerable amount of debate over the technical aspects occurred, allowing a full airing of multiple sides of the issues (alternative interpretation, inconsistent data, competing theories, etc.).

Also, as in the NYAS policy dialogue, the presence of both "expert" and "non-experts" in both legal and regulatory aspects and combustion chemistry and physics aspects of the wood stoves issues translated into a language that was relatively clean of rhetoric and deceptive manipulations. In addition to the fact that many participants indicated that they were not shy about revealing ignorance, the facilitator also made deliberate efforts to pull in the reins on any speaker who rambled on in technical jargon or without clear explanations. It is interesting to note that despite conspicuous efforts to keep the discussions comprehensible to all participants, inevitably certain topics were overly complex for everyone to follow. Individuals who later admitted the discussions sometimes went over their heads, did not feel they had been "snowed," however. Again, it was the strength of bonding among members of coalitions that apparently assured such players of the integrity of the discussions.[13]

It seemed that the participants were satisfied at the end of the negotiations with the scientific validity and technical feasibility of the rules they collaborated in writing. Participants commented that political positions (policy options) were always grounded in what was technically possible. The inclusion of technically expert persons in each major coalition meant that individuals with a particular concern could thrash it out during a caucus and the coalition members together could develop a proposal to suggest to the larger negotiating group.

Although there seems to have been a considerable amount of give-and-take during this regulatory negotiation including a substantial amount of information sharing and debate over methodological assumptions and technical ambiguities, many participants also noted that they did not believe that EPA had relinquished any real control over the rulemaking procedure. A number of participants commented that, throughout the negotiations, EPA seemed to draw certain lines over which they would not cross, regardless of the technical or political arguments proffered.[14] One person interviewed described the EPA lead negotiator's attitude on particular issues as being one of "Don't confuse me with the facts." In other words, the respondents indicated a certain close-mindedness on the part of the EPA in regard to hearing scientific or technical arguments in support of positions the agency (apparently for political reasons) was not prepared to back. Negotiators seemed not seriously discouraged by EPA's behavior, however, and instead showed a sort of appreciation of the agency's own bureaucratic and political tightrope (such as OMB's oversight role in rulemaking, which is to assess the economic impact of proposed rules as required under Executive Order 12991).

Managing Science to Forge a Political Consensus

The consensus-based procedure employed in the EPA rulemaking negotiation was a comprehensive and deliberate attempt by EPA to orchestrate the submission of technical information and the expression of political interests. While the a gency retained a considerable degree of control over the process through its success at unilaterally invoking limits to discussions and, at times, refusing to entertain further technical arguments, negotiators nonetheless expressed a sense of participation in decision making unusual under conventional proceedings. Discussions on relevant scientific and technical points were adversarial and competitive, but not destructive or unproductive.

Three factors contributed to this treatment of scientific and technical components of the rule´s development. First, although negotiators freely submitted technical information and analysis in a way that might have explicitly supported or challenged certain policy alternatives, the discussion format of the negotiations provided opportunities for ample questioning and clarification. As in the NYAS policy dialogue, participants developed a more thorough understanding of the basis for differences in data and analyses. The group developed a mutual appreciation of the uncertain nature of both the scientific and technical premises and the actual effects of various regulatory actions. Importantly, both scientific and regulatory "uncertainty" were accepted as facts of life given the current state of knowledge. Both types of "best guess" estimates were accepted as the necessary basis for policy rather than as an opportunity for casting doubt on the desirability and suitability of a proposed action.

Second, the timing of the consensus-based intervention was significant. Since the negotiations occurred prior to a complete formulation of the rule by any party, participants did not begin the procedure reacting against certain options. That is, because more or less the entire rule was yet to be developed, participants recognized the contingent nature of their initial positions on various provisions of the rule. The negotiators refrained from explicitly ranking policy options and, rather, viewed the issues as a package. A stricter emission standard would be more reasonable from the manufacturers' perspective if the compliance date was delayed to coincide with production cycles, for example. In contrast, if manufacturers instead had been presented with a fully formulated rule proposed by EPA, they would have likely launched an attack on the scientific merits or technical feasibility of the numerical standards rather than suggest adjustments to other portions of the rule. The positions of both EPA and the manufacturers would have hardened around specific emission level figures and a full-blown technical dispute likely would have erupted.

Finally, the negotiators in the wood stove regulatory negotiation shared a common desire to generate rules. Each party had their own incentive to promulgate federal rules, and each negotiator, other than those from EPA, had a strong interest in the group developing the rules rather than the agency alone. This shared goal provided the focus and impetus necessary to move the group along and away from protracted, contentious uses of technical argumentation.

Because other negotiators apparently deferred to EPA negotiators in the proceedings, an alternative interpretation of the rulemaking effort might contend that the agency was, in fact, imposing its view of scientific and technical parameters on the other participants and using this dominance to guide the development of the rules along a relatively narrow course. After all, EPA led off discussions with technical reports written by their consultants according to EPA specifications and circulated written summaries of the meetings, in effect, etching their version of discussions into the group's collective memory. More alarmingly, participants commented on EPA's refusal to consider additional evidence and arguments on certain issues. There are features of the procedure that suggest that this interpretation is not likely to be true, however.

First, while EPA may have held a privileged position in regard to the initial presentation of technical information, other participants (and observers) were encouraged to present additional information or analysis. Participants, especially negotiators representing the manufacturers, the independent testing laboratories, and Oregon state, frequently did submit supplementary data and analysis on points relevant to their areas of experience and expertise.

Second, it might also be argued that the degree to which the agency tended to reject evidence counter to its own in the negotiation was no greater than its exercise of discretion in normal rulemaking. In fact, in the negotiation setting, failure to consider evidence was openly visible to participants and performed only at a potential loss of credibility for the process. Participants could rebel en masse, if necessary, by withdrawing from the negotiation. Since the parties soon organized themselves into coalitions, the displeasure of one party could result in many parties registering complaint by walking (out). Thus, the damage EPA would incur by openly refusing to consider scientific evidence that contradicted their own would be considerably greater in a consensual procedure than under conventional rulemaking procedures, and the agency might be less likely to blithely overrule or neglect contrary arguments.

In any case, all participants believed that their interests were better expressed and met through the negotiated rulemaking procedure in comparison to conventional proceedings. As two persons described it, "Each group got something" and "No one gave away something they really wanted."[15] Similarly, no negotiator interviewed criticized the scientific or technical soundness of the rule, although many noted gaps in information they believe might have helped to refine the rule. In fact, several participants described the resulting rules as highly creative and wise in ways that EPA would have been unable to duplicate on its own.[16]

Procedure Three: Proceeding Despite Uncertainty[17]

The mediation effort in the Michigan fishing rights dispute occurred as a result of a court order and came at a relatively late stage in the evolution of the dispute. Unlike the New York City case, it was unclear how prominent technical issues would become in the negotiations. Like the wood stoves case, however, key contenders in the legal battle had access to a sizable scientific and technical arsenal. Any settlement was likely to hinge critically on the perceptions of various parties with respect to major scientific points.

Building Communication Linkages

The principal parties, the Michigan Department of Natural Resources (DNR), representing commercial and sports fishers, the three tribes, and the federal Department of the Interior had been engaged in legal battle for more than a decade. Relations among the parties were strained. The tribes felt the DNR only dealt with them grudgingly, treating them with increasing respect only as a result of their victories in the courts (Doherty). A series of attempts had been made over the years to negotiate a settlement, including an effort in 1982 that produced an "agreement in principle" among the key parties. But, the agreement had fallen apart when attorneys began drafting and the parties began reviewing the document (Legal Times).

When the Special Master arrived on the scene, he was greeted with a number of parties with a long history of distrust and difficult relations. He was given instructions from the court to assist the parties to reach a negotiated settlement and to manage the discovery process leading to a court trial, which was set for April 22, 1985, in the event that negotiations failed.

Special Master McGovern's strategy was built upon three elements: (1) fostering a sense of urgency to settle the dispute, (2) cultivating among the litigants a desire to have a direct hand in shaping the settlement and, (3) de-escalating the hostile use of scientific arguments. Between the months of January to March 1985, the Special Master met with the attorneys representing the parties on an accelerated discovery schedule. At least one attorney recalled billing his client conservatively for 250 hours per month during that period, and spending three out of four weeks obtaining depositions from witnesses for the case.

During this interval, McGovern also called a meeting inviting all interested parties, the biologists, and the attorneys, to hear remarks by participants in a similar case of litigation concerning a state-tribal fishery dispute in Washington state. The message of this gathering as received by many of the listeners was that litigation was a horrendous affair that should be avoided at all costs.

Finally, McGovern brought together in several meetings biologists from the key parties (replicating almost to a person the TTWG) and a nonpartisan convener and a fish biologist with modelling expertise from the state-funded University of Michigan Institute for Fisheries Research. The purpose of convening the biologists was to develop a common model for predicting the impact on the fishery of varied allocation proposals.

The mediation effort culminated in an intense, three-and-a- half day negotiation set at a college in Sault St. Marie in late March 1985. More than 50 persons representing the litigants as well as interested individuals representing only themselves attended the negotiations. This sizable group was divided into two, and a smaller core comprising representatives of the litigants hammered out an agreement that eventually became an order of the court. At the end of a round-the-clock session that extended some 36-hours, this core group of negotiators posed for the press cameras standing behind the settlement draft that bore their signatures.

The benefits from the meetings of the biologists, the Special Master´s focussed attempt to resolve important technical issues, cannot be appraised in isolation from the other activities undertaken during the first three months of 1985. Through the discovery process, the litigants were gaining an understanding of their opponents' lines of argumentation, on both legal and technical issues having to do with the fisheries. Nonetheless, what was achieved by McGovern's attempt to separate and zero in on the biology of the Great Lakes fisheries was both a common recognition among the litigants of the uncertainties of the biologists' assessments and recommendations, and the concurrent construction of his own evaluation of the resource, which was not particularly "expert," but which had the potential to become authoritative if the negotiators failed to reach an agreement.

An Unstable Scientific Consensus

Despite the difficulties faced by the policy makers, biologists working for the major parties had been working cooperatively for several years. The Great Lakes Fishery Commission, an international organization founded in 1956, established lake committees comprising representatives of all government agencies holding resource management responsibilities on each of the Great Lakes. In 1980, the Tripartite Technical Working Group with biologists from the DNR, Fish and Wildlife Service (U.S. Department of Interior), and the tribes' Chippewa-Ottawa Fishery Management Authority began meeting to compile data and set annual total allowable catch (TAC) levels on certain fish species in portions of Lakes Huron, Superior, and Michigan within the boundaries of the state of Michigan. The TACs represented a published consensus on recommended levels of fish catch by zones.[18]

It would seem that the TACs published in the annual Status of the Fishery reports compiled by the TTWG signalled the end of any adversarial or combative uses of scientific information or advisors. The TACs determined the "size of the pie" and biologists had little to say about whose buckets the fish should fall into. In fact, however, the reports represented not a true collaborative scientific finding, but a fragile compromise that could easily shatter if placed too close to any discussion on resource allocation. The matter of who should catch the fish was only thinly disguised behind more technically drawn arguments involved in establishing TACs.

Like many so-called "technical issues," the determination of TACs requires a mix of explicitly policy decisions and less conspicuous, value-bound, professional judgments. To begin with, TAC is dependent on a prior policy decision about the desired condition of the population under consideration. If population growth (as opposed to a stable or declining population size) is desired, a rate of growth must be targeted. For example, the federal Fish and Wildlife Service placed high priority on lake trout rehabilitation. For this species, they would tend to favor policies that would foster high population growth rates, such as a low TAC level, on the presumption that lower catch levels will reduce overall mortality rates and increase the probability that the lake trout population will reproduce. On the other hand, a group less concerned about lake trout rejuvenation might favor a much higher TAC, since their concern is short-term gains associated with catching fish.

Selecting a targeted growth rate for specific fish populations is clearly a decision guided by values, interests, and policy objectives. It is only the first of a series of negotiated points the TTWG members faced along the path to determining TACs, however. The next tier of issues concerned assumptions about variables used to establish TACs given a particular growth rate target. These variables include such factors as current population size, population age structure, individual growth rates, and mortality rates. On these points, value-bound, professional judgment comes into play in a more subtle way. Although some of the factors necessary for determining TAC are less controversial than others, all are merely estimates, based on extrapolations from data from sample studies,

studies of comparable populations, or multi-purpose record keeping.

The link between these assumptions and the ultimate TAC determination is quickly apparent. For example, as mentioned earlier, TAC is dependent on overall mortality rates. Mortality is defined as two components, fish catch level and natural mortality. Fish catch levels are recorded by the Fish and Wildlife Service based on catch reports submitted by licensed fishers. The natural mortality factor is less easily assessed. By convention, biologists have relied on the observed mortality rates of pristine populations.

The determination of both components of fish mortality became the subject of debate among biologists whose "professional judgments" clearly reflected political values and interest considerations. The Michigan DNR staff biologists took issue with the fish catch level component in establishing the mortality rate of lake trout. While fishermen for centuries have been chided for telling "fish stories," DNR policy makers accused tribal fishers of seriously underreporting their incidental lake trout catches. The DNR biologists accordingly argued that the FWS figures should be inflated when determining TACs.

Increasing the catch level component of the mortality rate used to determine TACs served an obvious political purpose. In the lake trout population, the Michigan DNR argued that the incidental lake trout caught by gill nets increased overall mortality to levels that inhibited lake trout reproduction. The DNR argued that restricting gill nets would reduce lake trout mortality and foster rejuvenation, without requiring a lowering of TAC levels that would diminish recreational fishing opportunities. Since only tribal fishers use gill nets, and some tribal fishers use gill nets exclusively, this interpretation of the cause of high mortality among lake trout populations has obvious implications for the allocation contest.

The natural mortality rate was open for debate as well. In this case, the tribes' biologists argued that the proportion of overall mortality attributed to natural mortality was underestimated. They argued that the use of mortality rates of pristine populations was inappropriate to estimate natural mortality of populations in environments that have undergone significant change, such as increased chemical pollution. The political motive for this line of argumentation is also fairly obvious: tribal biologists were attempting to defend the use of gill nets by shifting some of the onus of high mortality off the incidental catch component.

Given the intensity of the allocation dispute, it is unlikely that the biologists were completely unaware of the distributional implications of setting high or low TACs for specific species in particular zones. Undoubtedly, even while discussing the issues in a professional manner, they were honing arguments to edge TACs upward in fishing areas favored by their respective sponsors. Nonetheless, despite such politically motivated manipulations, it seemed that as long as the issue of who is catching the fish was kept out of the discussion, the biologists were able to agree on discrete figures for the variables used to determine TACs.

Appropriating Science

Given the fragility of the apparent consensus, how did Special Master McGovern deal with the technical aspects of the dispute? The structure of the alternative dispute resolution effort put in place by Special Master McGovern differed distinctively from the previous two cases in that the fishery biologists were consciously and deliberately convened at different times and places from the attorneys or the principals. McGovern's reasoning for this was simple. First, although McGovern himself did not mention this, according to one participant, Judge Enslen believed that the biologists could talk to one another, whereas relations among the principals were overly strained. It is likely that Judge Enslen communicated his hunch to McGovern, but whether he did or not, McGovern could easily see that the biologists had been cooperating for several years on the TTWG. He thus wanted to take advantage and not jeopardize that communication link.

According to McGovern, he also ascertained through conversations with individual biologists that the biologists qua biologists were disagreeing for two reasons. First, once there was any significant uncertainty in the analysis, individuals would go off in different directions with their own estimates of the appropriate figure to assume. Secondly, and not unrelated to the first issue, the policy makers who hired them were pushing certain policies and looking to the biologists to provide supportive scientific rationales. Distancing the biologists from their employers was therefore critical in McGovern's opinion. He could not control, of course, communications that occurred outside of these meetings.

Although the hostilities among the principals were said to have been mirrored by the biologists to some degree, McGovern hoped that he could succeed at toning down the adversarialism and political posturing by the biologists if they met without their advisees. During the series of meetings that occurred over about a three-month period, McGovern and his assisting technical facilitator, Francine Rabinowitz, an urban planning professor and member of an Los Angeles law firm, continually tried to guide the group to a consensus on technical issues based on their common commitment to the fisheries as an ecological resource and their standards of professionalism. Not insignificantly, meetings and field trips were scheduled to encourage the group to lunch, dine, and travel together. Opportunities to emphasize areas of agreement were fully exploited, as well as thoughtfully worded questions intended to "shame the biologists into recognizing their areas of agreement."[19]

McGovern attempted to deal with the first issue, the disagreement among the biologists in estimating values for various variables, by encouraging the biologists from the three major parties to collaborate on building a computer-based population model of the fisheries of the Great Lakes. His strategy was to help the biologists identify all the factors they could most easily agree on, insert these figures into a mutually acceptable model, and leave the variables of greatest uncertainty (and hence the most difficult to reach agreement on) for the policy makers to deal with. Ultimately, he hoped the model could be used "hands on" by the parties during negotiation to try out different allocation proposals to see who would get how much of what kind of fish in which part of the lake. For example, negotiators would be able to compare a proposal for a straight 50 percent split of all fish stock to one based on zone assignments, or contrast two or more different zonal apportionment schemes.

The group failed to develop the model McGovern had envisioned. According to McGovern, the failure was due to two major deficiencies: a lack of resources and skepticism about models generally. His second insight was perhaps not far off the mark. At least one biologist representing a key player confided that he would never have recommended reliance on the model to his advisees because he disagreed with many of the model's assumptions.

Although the model fell short of McGovern's original expectations for it, the exercise served other important purposes. First, the exercise helped the biologists to see more clearly the points of strongest agreement and disagreement and their relative importance. For example, the degree to which gill nets increased fish mortality was a point that seemed to be beyond settlement. Suspecting the difficulty it presented and the emotional overtones of the debate, since gill nets were used exclusively by the tribal fishers, Rabinowitz encouraged the group to leave the issue unresolved. The model that was subsequently constructed was run with "high", "moderate", and "low" values for the gill net mortality variable. Ultimately the model proved insensitive to these different levels. Thus, a point that might have become a lightning rod for reopening old wounds among the biologists was adeptly circumvented.

Perhaps more importantly than creating among the biologists a common frame of reference, the collaboration of the biologists helped to develop a technical base of reference for the Special Master. Given the Special Master´s privileged position before the court, the biologists would be quick to recognize the influence that the collaborative product might eventually hold. They would thus be encouraged to fight strongly for so-called technical judgments embedded in the model that have clear implications for their principals. Because the model was correlated with zones, one might suspect that biologists would fight especially hard to "win" arguments that would set technical parameters in zones important to their principals. Although the modelling effort did not bring the biologists closer to agreement on technical and scientific issues, it created an alternative "authority," that, one might argue, was a sort of composite. The model tactically served to move the parties closer to agreement not by dissolving disagreement among the scientists, but by creating an alternative "authority" that would legitimate the Special Master´s allocation recommendation to the court, should the parties fail to settle.

Restructuring the Use of Science

The consensus-based methods utilized in these three cases differed from one another in many respects. The degree of interaction between experts and non-experts, the duration of the consensus-based procedure, and the nature and extent of the facilitator´s intervention are just three of many ways in which techniques differed. Nonetheless, the unifying theme for distinguishing these methods remains unmistakable. These procedures aimed to clarify, resolve, or avoid disputes on key scientific and technical aspects of a decision, while allowing for the expression of political conflict to become more salient. Scientific knowledge and expertise were used to inform decisions, but without lengthy debates that result from a greater focus on science. As such, these methods represent substantial advances over conventional approaches toward integrating scientific information and disagreement into politically stable decisions.

Addressing Criticisms of Conventional Methods

In contrast to the methods reviewed in Chapter 2, these consensus-based methods assumed that differing scientific and technical opinions and supporting evidence can be legitimate, given the existing state of knowledge. That is, rather than to dismiss all arguments but one, or attempt to gloss over differences in scientific or technical judgments, the decision makers and stakeholders attempted to ascertain the degree of confidence that could be placed in various scientific or technical arguments. In the New York City policy dialogue, this was achieved through intense periods of questions and answers in the presence of a formidable line of individuals highly trained in relevant areas of expertise. In the wood stoves regulatory negotiation, the basis of divergent views was revealed by encouraging those with competing views to explain their interpretations or present alternative analysis. The flexible format and the longer time frame in this case allowed parties to seek and generate additional information and analysis between sessions to enrich the common knowledge base for all discussants.

Importantly in these two cases, the disclosure of the basis of scientific disagreement was performed openly in the presence of contending stakeholders as well as before representatives of the decision makers.

Although expert advisors hired by a particular party might share value biases that would tend to produce scientific conclusions that advantage their sponsors, the "mixed" audience format apparently operates to filter out these biases to some degree, as individuals struggle to maintain a standard of "professionalism" among their peers as well as credibility among their own clients. Thus, although stakeholders´ expert advisors may concentrate on critiquing data or analysis presented by contending groups, the end result tends to be less a stand-off than a joint recognition of the limits of scientific certainty.

Largely because of similar concerns about professional standards and because consensual methods appear to generate a stronger concern about clearing the air of misdirected information among all parties, scientific disagreements that are founded in illusion rather than substance were easily decloaked. "Miscommunication" tactics, such as using the same term to describe different phenomena as in the use of "worst case scenario," were readily identified by stakeholders, expert advisors, decision maker representatives, or the facilitator.

The recognition of the legitimacy of contending scientific or technical arguments and the understanding that differences result from differing value judgments, force decision makers and stakeholders alike to acknowledge the inevitable intrusion of political influences into scientific disputes. Once it became clear through the policy dialogue that the CBNS risk assessments reflected, more than anything else, a far more conservative orientation toward risk, ignoring conservative attitudes could be seen as a political action. At that point, the decision makers could chose to lose political goodwill from a segment of the population or attempt to address their concerns. But, they no longer had the choice to ignore entirely the political interests behind the movement to stop the Brooklyn Navy Yard plant.

Recognizing the political nature of scientific disputes also, in a sense, appears to encourage participants to state their concerns more explicitly. A general increase in the understanding of competing and conflicting interests enriches the discussion. Groups who initially supported competing decision alternatives might discover that their interests are different, but not conflicting. In the wood stoves case, for example, the traditional rivals were the clean air advocates and the affected industry. Clean air advocates wanted a numerical standard that would result in improved air quality. The wood stove manufacturers, on the other hand, were most concerned about a compliance date that could be accommodated within existing production schedules. As long as the standard was attainable with available technology, any standard requiring modifications in stove design would require a minimum amount of time to redesign and retool production lines. Thus, although the interests of the clean air advocates and the industry were divergent, they were less in conflict than appeared at first sight. Without a climate that encourages the discussion of political interests on this level, decisions that attempt to integrate such concerns are far less probable.

Finally, perhaps one of the more salient changes evident from these examples of consensus-based methods is the consistent function assigned to scientists and technical experts. Whereas the degree of discretionary decision making authority implicitly conferred onto scientists is unclear in conventional processes that place undue weight on scientific and technical factors, the role of scientists is less ambiguous when scientific and technical components are treated as guides and aids, not determinants. Consensus-based methods that are aimed at obtaining approval from all participants appear simultaneously to bring all individuals up to a common plane of technical competency. When experts are aware that they must explain the logic of their arguments rather than simply ride on their reputations to win concurrence, they too make more serious efforts to educate the stakeholders. The division between experts and non-experts narrows.

A New Role for Science?

In all three cases examined, science had been, or potentially would have been, utilized strictly to support or discredit one policy alternative. Prior to the policy dialogue, the New York City dispute was a classic case of two polar opposite policy options standing head-to-head behind inconsistent technical analyses. Although the basis for the divergences could be gleaned from a careful reading of the competing reports, the facilitated policy dialogue opened communication between reputable technical specialists and members of the concerned public, especially staff from the decision making Board of Estimate offices, and allowed an opportunity for the experts to elaborate on the reasons why ambiguities exist. In the course of their comments, they made clear that much of the cause of the uncertainty was inherent in the scientific enterprise, and was not something that could be corrected or eliminated through additional investigation or further testing, at least not within a reasonable amount of time. Thus, the discussions ended any possibility of the decision makers deferring a decision for further study or seeking authoritative guidance from scientists. It became clear that the risk assessments represented little more than varying orientations toward risk. The decision "to build" or "not to build," similarly reflects differences in a willingness to accept (or impose) a health risk.

A somewhat different dynamic prevailed in the wood stoves regulatory negotiation. Parties entered the negotiations with a fairly strong sense of the relative scarcity of pertinent scientific data and information. The "win-win" euphoria that pervades many popular writings and workshops on negotiation did not lull stakeholders into assuming that technical arguments did not matter, however. Stakeholders with access to technical studies went fully equipped and prepared to state their arguments in a manner most flattering to their interests. Nonetheless, unless their evidence was incontrovertible, the cross-examination by adversaries reduced many studies to "good guesses" rather than definitive statements. As such, the fire power of their technical support systems was constrained and stakeholders acceded to bargaining over ranges (of estimates for technical factors) and across issues.

Finally, in the Michigan fishing case, the use of science was transformed in two, interesting and distinct ways. First, debate over scientific issues concerning the biology of the Great Lakes fishery was almost entirely absent from the final negotiations. Biologists were not present in the negotiations, except as consultants to be conferred with during caucusing. Negotiating representatives of the major stakeholders simply checked back with their biologists to assess the catch implications of different allocation proposals. Apparently, the estimations of catches in different zones were not sufficiently divergent to evoke debate.

What is meant by "sufficiently divergent?" This leads to the second point. The stakeholders were negotiating under intense pressure to settle. The fishing dispute had been ongoing for years. Communities were reeling under the animosity between tribal fishers and non-tribal fishers, with outbreaks of physical violence, verbal abuse, and overtly racist media commentaries. A court trial date was approaching. Each party was aware of serious defects in their legal arguments. The outcome of a trial was thus uncertain. Most importantly, the court´s appointment of a special master meant that the court most likely would rule in accordance with Special Master McGovern´s settlement recommendation.

The role that science came to play in the settlement was secondary compared to what might have occurred in the courtroom. It was not used as a weapon by the stakeholders. If a weapon in any sense, it was one in hands of Special Master McGovern who through the mediation process had gained sufficient understanding of the technical issues to provide Judge Enslen with a credible technical base for an allocation decision.

If science under conventional decision making is deployed as a weapon to persuade decision makers or the polity to accept a given decision alternative, then altering the role of science through consensual approaches will have implications for the ability of different groups to exert influence over public decisions. In the following chapter, I consider how the distribution of political power is affected by the use of supplementary, consensus-based methods in decisions presumed to be informed by scientific and technical information and expertise.

Notes

1. Susskind and Cruikshank add other important elements of a "consensus-based" method, which will be discussed in later analyses. They write:

> A consensual approach is achieved when everyone agrees to live with a particular formulation of a problem and its solution because everyone knows the settlement is the best available under the circumstances, and because it attends to each party's most important concerns (Susskind and Cruikshank: 77).

2. Ozawa and Susskind (1985) call disputes that involve scientific analysis "science-intensive." Brooks (1984) referred to public policy disagreements in which technical issues become significant as "technically intensive disputes". For the purposes of this dissertation, the terms are interchangeable.

3. These writers contribute to what is called the "constructivist" view of science. The constructivist view looks toward the external culture that furnishes "interpretive resources" that shape scientific knowledge for political purposes. For further elaboration, see Ditta Bartels, "Commentary: It's Good Enough for Science, but Is It Good Enough for Social Action?" Science, Technology, and Human Values, 10(4): 69-74, 1985.

4. "Efficiency" is methodologically very difficult to measure. Bingham has noted that the identification of sets of comparable cases that have been settled either through consensual or conventional processes is nearly impossible. Calculating the costs incurred through either process encounters the same methodological difficulty of cost-benefit analysis.

5. I will use the term "intervenor" to mean the range of roles called "convener," "facilitator," or "mediator" in the negotiation literature.

6. For a more detailed discussion, see Ozawa and Susskind.

7. This phrase was used by Walter Shaub to describe the events during the policy dialogue (New York Academy of Sciences, 1984b).

8. See, for example, Commoner's The Closing Circle.

9. This was a reason given by Dr. Commoner during a personal interview in October 1986, at the Center for the Biology of Natural Systems, Queens College, Flushing, New York.

10. Unless otherwise noted, the following description of the Wood Burning Stoves regulatory negotiation is based on interviews listed in Appendix 1.

11. Based on comments made by David Doniger during a telephone interview, May 1987.

12. Based on comments by R.D. Gros Jean during telephone interview, May 1987.

13. Based on comments by John Charles during telephone interview, May 1987.

14. William Becker, John Canaday, Donnis Corn, and David Doniger were among the participants who made comments along this vein during telephone interviews, May and June 1987.

15. Statements were given by David Doniger and David Swankin during interviews, May 1987.

16. Based on comments made by William Becker, John King, and Harold Garabedian during telephone interviews, May and June 1987.

17. The description of the Michigan fishing case is drawn largely from interviews listed in Appendix 1.

18. TACs are as much policy- as science-based, because their determination is dependent on a targeted level of population growth. In other words, a mortality rate of 60% or 70% may both protect a given population, but the lower rate will be more likely to result in a higher rate of reproduction and hence population rejuvenation. Since TAC is simply the catch level correlated with given mortality rates, a TAC determination is predicated on agreement on a targeted rehabilitation rate. Biologists favoring rejuvenation over human-oriented concerns, such as short-term economic stability, for example, may support an assumption of higher rehabilitation targets and lower catch levels. Conversely, DNR biologists familiar with the state's commitment to sports fishing may tend to endorse slower (though steady) population growth rates for popular sports species, such as lake trout in tourism-dependent locales.

19. Based on telephone interview with Francine Rabinowitz, July 1987.

Chapter Four
CONSENSUAL APPROACHES, SCIENCE, AND POWER

Introduction

Consensus-based procedures alter the role of science and technical expertise in decision making. Do the transformations of the roles of science depicted in the previous chapter affect the distribution of political power in decision making? If so, how? How far do the ripplings of change travel? Is the redistribution of power restricted only to groups involved in the technical debate? Are groups that do not participate in the consensus-based procedure affected?

To examine the relationships among consensus-based procedures, science, and power, first consider briefly what constitutes "power" in public decision making and how science is variously used in different phases of the decision making process.

A Definition of "Power"

Public decisions often are appropriately contentious. Public decisions invariably reallocate material and other societal resources, symbolically, if not actually. They set the rules for future distributions. The Michigan fishing case concerned both the allocation of actual fish to various groups and the recognition of the rights of each group to the fishery resource. The high stakes of public decisions can evoke considerable debate among various segments of the polity for numerous reasons.

The responsibility for public decisions rests on the shoulders of government. Elected officials, administrative bodies, and the judiciary are vested with formal decision making authority. The authority to make a decision is not equivalent to power in decision making, however. A public decision is the product of a battle among contending actors to shape the issue (problem) the decision maker faces, as well as the alternative (solution) he chooses. Thus, while official decision makers hold the responsibility and authority, other groups contend for decision making power.

"Power" in public decision making can be conceptualized broadly as the ability to affect a decision maker's choice. The decision maker's choice is affected by a number of factors, including which issues are put before her for action (agenda setting), how the issue is formulated (problem formulation), what alternatives are presented for consideration (identifying alternatives), and the decision choice itself. Other factors that affect the decision maker's choice include the political credibility of various decision alternatives, personalities associated with various policy positions, the relative political importance of appeasing groups involved in the debate, institutional linkages to various policy alternatives, and the decision maker's own set of values. One way to think about these two sets of factors is to consider the first set as ways of shaping the situation, context, and perception of the issue itself and the second set as factors external to the issue that sway the individual decision maker toward one alternative over others within a given set of choices. Two writers have made the following distinction between these two sets of factors:

> Power is the capacity of actors (person, groups or institutions) to fix or to change (completely or partly) a set of action or choice alternatives for other actors.
>
> Influence is the capacity of actors to determine partly the actions or choices of other actors within the set of action or choice alternatives available to those actors (R. J. Kokken and F.N. Stokman: 46).

In this inquiry, I will make no distinction between Kokken and Stokman´s "influence" and "power," but simply consider them different moments for exercising "political power" in public decision making.

This conceptualization of political power in decision making helps to clarify the usefulness of science as a means for affecting public decisions. Science is used to define the reality in which "problems" exist, to define the "problem" itself and its solutions, and to provide the legitimacy and credibility for decision choices.

In the section below, I examine more closely the use of science in four general stages of decision making: agenda-setting, problem formulation, identification of alternatives, and the decision choice. These stages do not represent rigidly separate and discrete steps in decision making. In fact, conceptually, they sometimes overlap. Rather, these stages are intended simply to provide an analytical structure for thinking about the use of science in different phases of the evolution of a public decision. These four stages are also not meant to comprehensively represent public decision making. Indeed, public decisions can be thought of as originating in the earliest stirrings of controversy and extending beyond the decision choice stage, since implementation and (programmatic) evaluation can change the ultimate effect of the decision on the actual allocations of resources.

Science in Four Stages of Decision Making

The Use of Science in Agenda-Setting

The first step in decision making is to place issues on the political "agenda." Borrowing from Cobb and Elder, there are two types of political agendas. The more abstract, more general, and broader "systemic agenda" refers to a set of political controversies that are viewed as "legitimate concerns meriting the attention of the polity" (Cobb and Elder: 14). Ensuring a clean and healthy environment is an example of an issue that has been placed on the systemic agenda in the United States. Environmental quality is not yet on the systemic agenda of many third world countries. As a result, in the U.S. considerable legislation is directed toward controlling activities deemed environmentally offensive, whereas the idea of inhibiting business behavior for the sake of environmental quality in some third world countries is still considered subversive to a healthy economy.

The second type of political agenda is the "institutional agenda." The institutional agenda is a set of "concrete, specific items scheduled for active and serious consideration of a particular institutional decision-making body" (Cobb and Elder: 14). A lawsuit, as in the Great Lakes fishing case, is an example of an issue on the latter type of agenda. In contrast to issues on the more general systemic agenda, items on an institutional agenda are usually tailored for a particular decision making forum.

An issue is placed on either type of public agenda when advocates for action succeed in directing sufficient public attention to the issue to pressure elected officials to respond. One significant reason for getting issues on the public agenda is obvious: issues that are not considered will not be directly addressed. Public decision making resources will not be invested in issues that do not reach the public agenda.

There are also more subtle consequences.

> The social and political significance of agenda-building arises in part from the fact that it serves to structure subsequent policy choices. However, the stakes involved do not reside solely in the prospects of future policies. There are more immediate payoffs involved. These take the

form of social recognition and the validation of certain values, interests, and beliefs to the exclusion of others (Cobb and Elder: 171).

Agenda-setting hence not only helps to direct the future course of public actions, it also conditions the polity into accepting certain types of actions as assigned appropriately to the public domain.

Scientific arguments play important parts in setting the two types of agendas. The New York City case presents a particularly revealing illustration of how science can be used in attempts to place issues on both types of agendas.

The Department of Sanitation relied on technical assessments and expertise to place the comprehensive waste disposal plan and the Brooklyn Navy Yard incinerator proposal before the Board of Estimate. The dire predictions made by DOS on diminishing disposal capacity and increasing disposal needs were based on technical analyses performed by DOS staff. The predictions were designed to create a sense of urgency around the City's solid waste disposal situation in order to attract public concern and incite the BOE to act favorably.

One group opposing the DOS plans similarly used technical analysis to support their challenge. They focussed their attack on a technical assessment of the adverse health impact of the proposed technology on the City's residents. While the immediate objective was to affect the BOE's action on the proposals, this line of argumentation also served to arouse public concern about the desirability of dioxin-emitting (or health-threatening) technology in general. In this sense, technical argumentation may be seen as serving an attempt to bring the question of "safe" technology onto the systemic agenda.

The wood stoves case presents another example of the use of scientific information to place an issue on the public (institutional) agenda. In this case, a legal suit by the Natural Resources Defense Council provided the political impetus for EPA to initiate federal rulemaking. In order to pressure EPA to act (and to garner support from the court), however, the NRDC cited studies indicating that residential wood stoves produced nearly half of total nationwide polycyclic organic matter (POM) and identifying possible adverse health effects of POMs.

Science and Problem Formulation

Issues that arrive on the public agenda do not develop spontaneously. Just as their placement on the agenda is usually the product of groups advocating action, so is the particular form in which they are constructed the result of conscious and deliberate efforts by stakeholding groups. From a potentially unlimited assortment of facts about a condition or situation, a specific set is selected and interpreted to identify, describe, and explain a "problem" (Wildavsky). The selection of some facts and the neglect of others is usually carefully undertaken with a particular objective in mind.

The formulation of a problem can be manicured to serve political purposes in several ways. First, the formulation of a problem can be undertaken with an explicit aim to generate sympathy and support from those not directly involved in policy making. The New York case provides an example of the politically strategic value of problem formulation and the use of scientific argument. While residents adjacent to the Brooklyn Navy Yard site were opposed to the waste-to-energy plant for a number of reasons including a sense of being unfairly subjected to a noxious land use, their alliance with scientists from the Center for the Biology of Natural Systems presented a new way of framing the "problem." Rather than simply a locally unwanted facility, the waste-to-energy plant was transformed into a cancer-causing health threat to the entire community. Thus, instead of standing alone in their opposition to the plant, the analysis of risk posed by dioxin emissions enabled Williamsburg residents to generate support from the wider public on the basis of health and environmental concerns, in part because it was the first move in a comprehensive plan which would pose similar threats elsewhere in the City.

On the other hand, initially the DOS astutely attempted to steer clear of the health issue as much as possible. The agency's formulation of the waste disposal issue was built around the need for technically feasible and efficient solid waste disposal, not on the need for environmentally benign technologies.

By keeping the "problem" focussed narrowly, the DOS was also trying to assert what Gusfield has called its "ownership" of the problem. Gusfield has packaged a set of concepts under the term, "ownership." He contends that "ownership" is attributed to or claimed by certain groups on the basis of their reputation of expertise in relevant fields. He states that

> At any time in a historical period there is a recognition that specific public issues are the legitimate province of specific persons, roles, and offices that can command public attention, trust, and influence. They have credibility while others who attempt to capture public attention do not. Owners can make claims and assertions. . . . They possess authority in the field (Gusfield: 8).

"Disownership" of a public policy issue, once it has been defined as a "problem" in a particular form, is also a strategic ploy. Gusfield cites the reluctance of the alcohol beverage industry to become involved in activities during the temperance movement as one example. Even today, he notes, the industry's slogan, "The fault is in the man, not the bottle," as a rejection of ownership of the alcohol problem. Similarly, the tobacco industry attempted to "disown" the smoking problem by trying to refute the claims that tobacco smoking causes disease and instead framing the issues in terms of private choice.

Gusfield also discusses two additional components of problem formulation: notions of causal responsibility and political responsibility. He writes that "causal responsibility--is a matter of belief or cognition, an assertion about the sequence that factually accounts for the existence of the problem" (p. 11). Political responsibility, by contrast, affixes an obligation for remedial action. For example, in the wood stoves case, the political responsibility for reducing particulate emissions from residential wood heating devices was set on the shoulders of government, namely EPA (as a result of the Clean Air Act). Causal responsibility was assigned to the stove manufacturers. Part of the justification for pursuing this approach to improving air quality was a belief, substantiated by technical data, that many wood stoves are designed so that they emit higher levels of pollutants than desired and, perhaps, than necessary. If scientific arguments could have been constructed to convince regulators and the public that emission levels are a direct result of wood selection (age, type, degree of wetness, etc.) and stacking rather than stove design, the regulatory approach might have been redirected.

Finally, the formulation of problems is critical because the construction of a problem contains implications for their solutions. As long as the Department of Sanitation could retain a formulation of the Brooklyn Navy

Yard dispute as a question of how to dispose of municipal solid wastes, they not only maintained a position of expertise but also constrained the consideration of solutions to waste disposal methods, as opposed to waste reduction approaches. In the Michigan fishing case, the disputants similarly struggled to promote their own formulation of the fishing "problem." To the Department of Natural Resources, the problem was tribal fishers using large mesh gill nets in lake trout habitats popular among sports fishers. The DNR tried to use assessment data and catch records to show that the tribal fishers' gill nets were causing high mortality among lake trout, which, in turn, was both retarding rejuvenation of the population and reducing the pleasure of recreational fishers. If they succeeded in portraying the problem this way to the court, the court would have been led to consider elimination or severe restrictions on the use of gill net technology as a reasonable approach to solving at least part of the "problem" concerning the fishery.

Identifying Alternatives

As mentioned earlier, the identification of alternative solutions is largely dictated by the formulation of the "problem" (Gusfield). The way one poses a question often implies the appropriate answer, or set of answers. Posed as a "solid waste disposal problem," for example, the array of alternative actions available to the City of New York include remedies, such as building a new "waste disposal" facility, encouraging recycling efforts, etc. The presumption that solid wastes are a "given" tends to foreclose policy actions that might focus instead on discouraging the creation of "wastes," such as regulation to limit non-reusable packaging materials, for example.

Within the bounds set by the formulation of the "problem," however, usually a number of alternative actions are possible. The National Environmental Policy Act requires a consideration of alternative actions in environmental impact statements for projects proposed to meet specific objectives. Alternatives not identified, like issues not put on the public agenda, cannot be intentionally acted upon. The identification of alternatives is thus a highly political act, since it predetermines what decision outcomes are possible.

In public decisions on issues that concern the environment, health, and new technologies, scientific and technical expertise is often necessary for successfully identifying alternatives beyond the "no action" category. A basic concern of decision makers is that alternatives be technically feasible. The technical feasibility of reducing dioxin emissions was of paramount importance in the New York City case. If emissions could not be controlled, then the decision alternatives would be limited to constructing the

Brooklyn Navy Yard facility and accepting additional cancer risks approximated on the basis of the higher recorded emission levels from existing facilities, or abandoning the project altogether. On the other hand, if technical experts could argue (as they did) that emission reductions are possible by the installation of air pollution control technologies, then potentially a range of new decision alternatives would be identified--alternatives in technology as well as increments of cancer risks.

The Decision Choice

Among the array of problem formulations and corresponding alternative actions, for every issue on the institutional agenda the decision maker will make one choice. That choice is the outcome of the politics of the entire decision making process. Nonetheless, at a certain point in every decision making process that culminates in a decision, the articulated choices will be limited. At this point, different groups will attempt to persuade the decision maker to select Alternative "A" rather than Alternative "B," or "B" rather than "C."

The ways in which influence at this level is sought are multiple and complex. Often parties attempt to influence the decision maker´s behavior by linking unrelated contemporary issues--political horsetrading. This approach is not insignificant. In the New York City case, a disgruntled opponent to the Brooklyn Navy Yard project contended that certain BOE members voted to approve the project because they needed the endorsement of Mayor Koch, who vocally supported the proposal.[1] Similarly, one historian has suggested that the federal government's commitment to resolving the fishing dispute in the Great Lakes stemmed from President Reagan's 1980 presidential campaign promise to alleviate the "problem" of tribal fishers entering areas popular among sports fishers (Doherty).

Nonetheless, while scientific arguments may not be decisive factors, they often make decisions politically more attractive for decision makers who want to appease competing groups. Decision makers are strongly motivated to avoid decisions that are likely to offend a valued political constituency. Evidence that demonstrates the scientific reasonableness of a particular alternative may provide just the justification needed by a decision maker to defend that choice to his constituents. Science is thus put to work by policy advocates to persuade the decision maker of the political wisdom of opting for one alternative over another.

The wood stoves case provides another example. Wood stoves that incorporate a catalyst device are popularly believed to burn more "cleanly," (i.e., emit fewer particulates), and more efficiently than stoves not equipped with catalysts. Given the favorable reputation of catalyst stoves, and in the absence of contrary data, EPA might have opened itself to considerable criticism had it proposed wood stove regulations that did not single out catalyst-equipped stoves as "best demonstrated technology" (BDT).

There are several political reasons why EPA might have wanted to avoid regulations that restricted BDT to catalyst stove designs, however. Foremost, manufacturers of non-catalyst designs would have been severely disadvantaged vis-a-vis catalyst design stove manufacturers. Especially under a pro-business Administration, EPA probably would not want the regulations to seriously disrupt the industry in such a way. In addition, non-catalyst stove design manufacturers also argued that commitment to a single technology would eliminate an entire branch of innovation and would impair the development of more effective technology in the long run. Advocates of consumer rights and alternative energy technologies were also critical of a policy that would eliminate consumer choice or reduce intra-industry competition, that might eventually result in retail price increases.

Fortunately for EPA, a study in-progress reported data that appeared to confirm earlier hints that catalyst devices are often improperly used by owners, (resulting in higher emissions), and degrade through use over time. The availability of even only preliminary data was enough to discourage catalyst manufacturers, the manufacturers of catalyst-equipped wood stoves, and clean air advocates from lobbying against the "two-tracked" regulatory approach EPA ultimately proposed. Scientific data was hence instrumental in persuading EPA (and other negotiators) that a two-tracked regulatory approach was scientifically defensible and, hence, politically feasible.

The broad analytic framework laid out in the preceding section highlights the moments in public decision making when power can be exerted to affect a decision and how scientific arguments can be manipulated toward this end. I turn now to an examination of how scientific information and argument in the three consensus-based procedures described in the last chapter affected the possibilities for influencing decision making and for whom.

Effects on the Distribution of Power

Empowerment through Opportunity

In the New York City dispute over the proposal to construct a waste-to-energy MSW incinerator, the debate polarized around highly visible and vocal disagreement on the health risk posed by the project. The technical discourse focussed on the evaluation of the risk: both the estimate of its magnitude and its acceptability. The facilitated policy dialogue helped to clarify to representatives of stakeholding groups and the decision makers the basis for the disparate risk assessments as well as the limits of scientific knowledge concerning the creation and destruction of cancer-causing dioxins in MSW incinerators. How did this clarification of scientific disagreement potentially and actually alter the decision making process? Was the distribution of political power in this case significantly affected?

The agenda appears to have remained more or less as the DOS first framed the question to the BOE. That is, the issue considered by the BOE even after the policy dialogue was whether or not to approve the comprehensive waste disposal plan, which relied on waste-to-energy incineration, and the Brooklyn Navy Yard plant in particular. It appears, however, that clarifying the scientific disagreement diminished the preoccupation with disputed scientific elements and created windows of opportunity for the expression of additional viewpoints, which resulted in a somewhat modified formulation of the "problem" and additional decision alternatives.

Generally, this case suggests that groups unable to express their political interests through an agenda framed by a highly visible technical debate gain an opportunity to be heard by the decision makers when the technical debate fades out of the foreground. This is not to say that groups are suddenly magically empowered to draw the attention of the decision makers. Diminishing one avenue of influence simply means that the use of other tactics ascends. Thus, whether or not groups take advantage of the opportunity depends on their abilities to exploit other channels of influence. Nonetheless, clarifying the scientific disagreement that polarizes discussions around particular decision alternatives likely creates greater receptivity of the decision makers to other viewpoints and provides an opening that otherwise might not exist for less dominant, stakeholding groups.

In this case, the failure of scientists to invalidate the higher risk assessment potentially enlarged the list of decision alternatives considered by the decision makers and others. One might argue that without a clear field for approving the BNY facility, the decision makers grew more attentive to advocates of other solid waste disposal methods. Although proponents of alternatives, such as recycling and source reduction, were expressing their views publicly through the newspapers and, one may presume, privately with the decision makers, the BOE members had little incentive to listen or accommodate their interests as long as the DOS recommendations were perceived as feasible.[2] That is, why worry about small-scale waste management approaches if the massive, high-tech solution was approved? Moreover, the sophisticated technical debate held the public's attention to two simple alternatives: build or block.

However, when decision makers were made to feel sufficiently uncomfortable with the DOS proposal, in part as a result of the policy dialogue that affirmed the possibility of a high health risk, one could expect that the decision makers would have begun to think in terms of mitigation and ways to allay public fears of the high-tech solution. Supplementary disposal methods would reduce the tonnage of waste going into the incinerators, and the amount of dioxin coming out, and might thus newly appeal as an intermediate, "compromise" course.

Finally, the facilitated policy dialogue reduced the discretion of the decision makers to choose between Alternative "A" and Alternative "B". The discussions of key scientific issues precluded a dismissal of a either risk assessment as "erroneous." Importantly, the higher estimate developed by the CBNS team could not be ignored. Decision makers who may have been inclined to go along with the City agency's recommendation, on the basis of other factors, could no longer claim the waste-to-energy design represented safe, "proven technology." BOE members casting a vote in favor of the proposal thus became, in a sense, more accountable for their action and were forced to deal with the concerns of groups opposed to the imposition of possible, additional cancer risks on the city's residents. In a sense, once the opposing position was politically validated, (by the lack of invalidation of the supporting scientific evidence), the political costs to the decision makers of ignoring the interests behind them increased substantially.

The proposal for the BNY facility that was approved by the BOE in the summer of 1985 included stricter monitoring provisions (to avert human and mechanical failures) and was coupled with a commitment by the DOS to more vigorously pursue recycling as a method of reducing municipal solid waste.[3] The extent to which the policy dialogue itself contributed to this change can not be determined, but the decision choice evidently was broadened beyond the prior "build or block" framework. Interestingly, the state of New York issued a report in 1987 that recommends steps to reduce municipal solid wastes by 50% over the next decade (New York Times, January 7, 1987). The report also recommends continued reliance on incinerators.

Despite the modifications to the BNY proposal, opposition to the plant continued, which suggests the still incomplete accommodation of contesting political interests. State hearings for necessary permits were delayed more than a year by a lawsuit. As of November 1987, the project still needed permits from the state and federal EPA, and city officials doubted that the BNY plant will be operating before 1992 (New York Times, November 15, 1987).

Empowering the Underdogs

The wood stoves regulatory negotiation represented a rather extensive effort to generate new federal regulations. Technical aspects of multiple issues were extensively examined and debated, eventually evolving into a range of mutually acceptable approximations that then served as the basis for the rules. The institutional nature of rulemaking and the peculiar ascent of wood stove emissions onto EPA's agenda (through the NRDC lawsuit)[4] largely defined the problem before negotiations began. But, the consensual approach to the use of scientific information and analysis seemed to enhance the abilities of certain stakeholding groups to influence one another and EPA, especially during latter stages of the decision making process. There are several ways in which this occurred.

To begin with, the structure of the consensus-based procedure allowed entry to many resource-poor stakeholders who ordinarily might not have gained the attention of EPA. Rather than requiring technical competence or scientific information to be a ticket to effective participation in the rulemaking procedure (as is often true under conventional proceedings), the regulatory negotiation format based participation on the perception (of the agency initially and of the preliminary group of negotiators later) of which groups were likely to be most directly affected by the rules. This list of "stakeholders" is distinct from a list of those interested parties having technical competency. For example, the consumer's group and a state energy office were two groups included in the regulatory negotiation that did not possess training in relevant fields of engineering, combustion physics, or environmental regulation. Under conventional notice and comment proceedings, the technical naivete reflected in the comments of these groups might have led the agency to dismiss their concerns as incongruent with factors the agency believed were technically more feasible or necessary. Through participation in the consensus-based process, these two technically ill-prepared groups were able to put their imprint on the formulation of the emission rules and see to it that issues of direct concern to them were addressed.

Second, the regulatory negotiation enhanced the technical competency of many participants by providing an opportunity for coalitions of groups with common or non-conflicting interests to emerge and share technical expertise. A representative of a state-level environmental group stated that he depended heavily on the technical expertise of other members in a coalition of environmental and state air protection groups that he joined during the negotiation. Individuals aired specific interests during caucusing and coalition members together developed policy proposals that were grounded in what was technically possible and sound (Charles). Consequently, the interests of a group that was not independently well-equipped to handle technical aspects of the rulemaking were securely packaged with scientifically sound and, hence, politically persuasive arguments.

The opportunity to form coalitions for sharing resources is especially helpful for groups that traditionally lack resources, such as public interest groups. In the wood stoves case, the "environmental coalition" relied extensively on the technical expertise of the representative from the state of Oregon and the legal and regulatory expertise of the representative from the Natural Resources Defense Council. While neither of these groups has abundant resources, together they formed a strong knowledge base from which they and other members in the coalition could benefit.

The shared sense of "mission" among members of the coalitions allowed for a sharing of technical and legal expertise within a bubble of trust. Importantly, this same level of trust did not seem to extend beyond the coalitions into the full negotiating group. Negotiators, or technical advisors who accompanied them, volunteered relevant scientific or technical information either through writing or orally, but data and analyses were received skeptically. Experts were subject to intense cross-examination by competent persons from contending groups during plenary sessions in which technical components of the regulatory action were discussed. This high level of skepticism within the group as a whole, however, seemed to serve constructive purposes. The process of debate appeared to educate the non-experts in the group (and elevate their status in the discussions by improving their abilities to express political interests in technically acceptable formats). It also strengthened the conviction of the group overall that their ultimate, operating consensus on "facts" was sound.

When the technical presentations and subsequent debate failed to settle controversy to the satisfaction of the group as a whole, sometimes the issue would be tabled for further study by a smaller sub-group of the negotiators. These task forces usually included members from the two major coalitions and the EPA, thus keeping intact the web of trust, interdependence, and credibility. At other times, according to interviewees, the EPA representatives made a summary judgment on a given technical issue.

A summary judgment by any party is seriously contrary to the spirit of a consensual approach. The fact that the other negotiators deferred to the agency signifies the power held by EPA. One way to assess the implications of this event is to recall that under a conventional rulemaking procedure, the agency would have the same discretion to ignore certain technical arguments. The consensus-based procedure simply failed to offer any improvement. There is another way of looking at the situation, however. In a more adversarial context, a persuasive technical argument could also be used to generate public pressure to force a different response from the agency. When participants yield to EPA's refusal to further consider additional technical arguments in a consensus-based procedure, the agency effectively gains power.

Interestingly, in the wood stove case, while several parties expressed dismay and disappointment in EPA's behavior in those specific instances, no party was sufficiently disillusioned to pull out of the negotiation process altogether. Why this was so is difficult to determine on the basis of the information gathered. The reaction of these parties may signify a number of things. It could reflect a pragmatic acceptance of the bounds of the agency's own political constraints, the fact that no group recognized personal stakes in the implications of the particular technical issues at the time, or the fact that the negotiators were truly "coopted" by the process and believed the agency's actions were proper and just. In any case, this is an issue worth further analysis in future research.

Finally, one financially weak negotiator, the consumer's group representative, was granted funds from the regulatory negotiation resource pool to contract an economic analysis and to hire an engineering consultant. During an interview, the consumer's group negotiator said that he held the economic analysis "in his back pocket" in case he felt it necessary to present alternative arguments to EPA's economic analysis.[5] It was never shared with the rest of the negotiating group. The engineering consultant was available to all participants, but only the consumer´s group representative consulted with him. Although these actions sound close to the "hired gun" phenomena common under conventional procedures, in this case, the additional capability gained by this one group seemed to function more as a boost to the negotiator´s self-confidence than as an overt weapon to win "points" in the negotiations.

Empowerment for the Future

In the Michigan fishing dispute, the consensual method directed by Special Master McGovern differed importantly from the previous two examples. Unlike the facilitated policy dialogue and the negotiated rulemaking, McGovern´s strategy was to attain settlement by separating stakeholders (and their legal representatives) from their expert advisors (the biologists). The overall approach was also somewhat elitist, with regard to the groups granted participation status. McGovern "bifurcated" the final, three-and-a-half day negotiation session and divided the assembly of interested parties into two groups. The "inner circle" of negotiators that dealt with "more critical matters" was patterned closely after the list of formal litigants (McGovern). Similarly, the working group of biologists he earlier convened comprised expert advisors from only the three major groups.

The handling of the scientific components of the Michigan case did not appear to illuminate paths toward settlement. It did not empower groups that were not already influential in the case by virtue of their legal standing. It also did not visibly redistribute power within the "inner circle" of negotiators.

The separation of biologists from the stakeholders and their legal representatives was intended to "de-politicize" the scientific basis of the decisions. A common model predicting fish population in various zones of the lake, if constructed in a truly consensual manner, might have been a powerful asset for bargaining over "who gets what." Unfortunately, the model proved to be both overly complex and controversial. Despite the efforts of the facilitators,[6] the biologists did not reach sufficient agreement on critical factors, and the resulting model did not have either the technical capacity nor the political credibility to operate as McGovern had initially intended. The biologists returned to their respective advisees with little tangible evidence of a change in their understanding of the lakes´ fishery.

The collaborative modelling effort also failed to extend entry into decision making to outside groups or to bring in additional scientific or technical information. Notably absent were representatives from the sports fishers´

or the commercial fishers' organizations. The sports fishers believed, apparently correctly, that the state shared their interest in maintaining a healthy recreational fishery. Lack of participation in the technical discussions was not perceived by them to threaten their welfare. In fact, their interests were protected by the DNR during the negotiations.

In contrast, the commercial fishers did not fare as well. Indeed, if any one group ended up with the short straw in the deal, it was the commercial fishers. An attorney for the commercial fishers' organization expressed his doubt that scientific or technical arguments on behalf of his clients would have had any impact, however.[7] He also stated that, had he been asked, he would have advised his clients to save their money rather than to pay for an expert consultant or studies that might have supported their claims. He believed the combined political strength of the federal government and the state of Michigan were too overpowering for the commercial fishers to successfully challenge. Thus, even if McGovern had invited them, it is debatable whether the commercial fishers would have joined the technical collaboration, at least not without any financial assistance.

Finally, the treatment of the technical issues did not appear to significantly affect the relative abilities of members of the "inner circle" of negotiators to influence the decision. The three Native American Indian tribes had joined forces in the litigation. Their interests were distinct on several dimensions, however, and it appears that the tribes did not air out their different concerns and priorities before the negotiations. As a result, important concerns were forfeited. Of the three tribes, the numerically largest tribe appears to have been the most satisfied with the agreement. The members of the Bay Mills tribe were sufficiently dissatisfied with the agreement to instruct their attorney to file a suit against the negotiated agreement, which he did, and lost (McGovern). According to the attorney for the Grand Traverse Band, the southern tribe felt that their interests were sacrificed by the two tribes to the north. The attorney also said that he believed the biologist who ostensibly represented all three tribes as the head biologist of the joint Chippewa-Ottawa Fishery Management Council, was actually preferentially loyal to the Sault St. Marie tribe.[8] If this was true, the "lumping" of the three tribes' representation on the scientific issues may have been a critical oversight from the perspective of the two, numerically smaller tribes. Without access to alternative expertise, and without even the opportunity to hear the tribes' biologist in action amongst biologists from the rival groups, such suspicions could be neither confirmed nor laid to rest.

If "power" were measured by the ability of groups to win tangible gains through the decision, it would be especially difficult to deduce a change in the distribution of power among the various parties as a result of the treatment of scientific information and argumentation in this consensus-based procedure. The negotiated agreement, or the "decision outcome," is difficult to compare against an imaginary "what-the-judge-would-have-ruled" because several new items were added to the negotiation agenda.[9] Adding items to the negotiation agenda effectively reformulated the "problem" and expanded the list of alternative solutions. But, a direct relationship between the agenda revisions and the less contentious use of science is not clear.

On the other hand, if power is defined as the ability to influence future agendas for decision making, the negotiated outcome may have significant consequences for the distribution of power. One might argue that the negotiations succeeded in achieving an agreement mainly because the pie was enlarged. Issues concerning fish planting locations, fishing gear technology, technical assistance, and hard cash were added to the original allocation dispute. However, the pie was enlarged in a way that appears to strengthen the position of the tribes in future skirmishes over the fishery, which will undoubtedly arise during the 15-year life of the agreement, and in the renegotiation of the agreement scheduled for the year 2000.

In addition to the quantity of fish allocated implicitly through the assignment of fishing rights in certain zones, the tribes gained exclusive rights to fish in certain areas, technical assistance, and more than $1.5 million dollars from the federal government and the state of Michigan for use toward improving their fishery management and developing and implementing an economic development program (United States v. Michigan). In all cases, enhanced fishery management capabilities will certainly add to the tribes' ability to marshall technical data supporting their political claims in the future.

Conclusion

Consensus-based procedures move science-intensive debates toward resolution by playing down scientific and technical disagreement.

In the New York City case, initially the project sponsor and the major opposition group used risk assessments to attempt to persuade decision makers and the public of the reasonableness of their preferred policy decision. The policy dialogue clarified the basis of scientific disagreement, with neither contending sets of analysis declared "winner." The consequent understanding of the creation and destruction of dioxins in municipal solid waste incinerators that was impressed on the decision maker representatives and others was one that included both a sense of the uncertain nature of what is known, as well as the effect of different value orientations of the investigators on their advice. The use of scientific information was transformed. From a weapon to win political support, it became a tool to inform decision makers and the public of the implications of different political value orientations.

It is commonly feared that when "science" is deemphasized in discussions, brute force and political arm twisting by the more powerful actors take over and guide decision making. This analysis of three consensus-based procedures leads to contrary conclusions.

A less contentious use of science in public decision making can open the debate to voices and concerns of groups not commonly endowed with technical expertise or the financial resources to acquire it. When the dust settles around a feisty brawl over technical aspects of a decision, the resulting quiet may allow voices not speaking in technical dialects to be heard. Whether the decision maker or the public or other policy actors listen to these voices and whether these voices are even strong enough to speak is a separate matter. The opportunity is nonetheless evident.

Consensus-based procedures can also increase the access to information and expertise of all participating stakeholders through joint sessions with technical specialists and non-technical stakeholder representatives.

Opportunities to form coalitions also improve technical understanding and competency, which in turn enhance the ability of resource-poor groups to state their concerns in ways that appear congruent with technical parameters and that are hence more persuasive to decision makers and others.

Consensus-based procedures that result in educating participants about technical aspects also provide greater (knowledge) equity for the future. Sometimes, too, while the treatment of science in a negotiation may not directly or immediately redistribute decision making power by enhancing a group's technical competency at the moment, conditions in a settlement can be inserted to provide for a strengthening of technical resources for future decision making contests.

The underlying presumption in this discussion is that scientific information, knowledge, and expertise are a source of power in decision making by virtue of the authority popularly awarded to science. They are used to identify and define a problem and its solutions, and to persuade potential political allies and decision makers to support and choose among alternative actions.

The three cases studied here suggest different ways in which consensus-based procedures can result in a redistribution of power among the players in science-intensive public decision making. The degree and type of "power" that was affected ranged from mere "opportunity" to speak, to a shared grip on scientific information and technical tools. There were no consistent patterns in the use of science and its implications for decision making power except that, contrary to popular expectations, a consensual approach did not mean the monopoly of scientific information and analysis by one group. As a result, a less contentious role for science suggests a greater sharing of decision making influence.

Notes

1. Based on a personal interview with Barry Commoner at the Center for the Biology of Natural Systems, Flushing, New York in October 1986.

2. In an 80-page report, the Environmental Defense Fund claimed New York City could recycle 40% of its solid wastes by 1992 at far lower economic cost than incinerators (New York Times, August 4, 1985).

3. The DOS has implemented a program to recycle 15% of the City's municipal solid waste by 1990.

4. Their out-of-court agreement stipulated that EPA would address PM10 and POM emissions through regulating wood stoves under New Source Performance Standards of the Clean Air Act.

5. Personal interview with David Swankin, Consumer Federation of America, May 1987.

6. Special Master McGovern was assisted by Francine Rabinowitz in the facilitation of the modelling effort. Rabinowitz is a professor in urban planning at UCLA and has extensive experience with statistical modelling. A biologist from the State of Michigan funded Institute of Fisheries at the University of Michigan provided "non-partisan" expertise, particularly in fishery modelling.

7. Conveyed in a telephone interview with Nino Green, August 1987.

8. Telephone interview with William Rastetter, August 19, 1987.

9. Fish planting locations, technical assistance, hard cash, ongoing technical studies to reexamine the effectiveness of TACs as a management tool, and a time limit on the agreement are examples of issues that were added to the negotiation agenda.

Chapter Five
PROSPECTS FOR CHANGE

Miscast Roles for Science in Public Decision Making

From putting a man on the moon to beginning human life in a test tube, to the ultimate feat of rendering the planet uninhabitable to most life forms, the tremendous potential for human action made possible by the accumulation of scientific knowledge is staggering. Whether one agrees with the uses to which this knowledge has been applied or not, knowledge gained through "the scientific method" has tangible, material results. It is unquestionable that the body of scientific knowledge and the methods by which it has been obtained can make a substantial contribution toward understanding our world and the alternative futures before us. Few of us would welcome public (and private) decision making that ignores completely the advice of those with scientific expertise and knowledge.

As argued in Chapter 1, however, science currently is put to multiple uses. Lawmakers and other architects of public decision making procedures ostensibly have written references to the scientific basis of a decision into the criteria for decision making as a means of attempting to ensure the political accountability of decision makers. Requiring a "rational" basis is intended to counterbalance more overtly "political" pressures for a decision. In a period of American history in which the scientific community appeared to offer an alternative perspective to the self-interested preferences of private industry manipulating a "captured" agency, the "rational" approach seemed appropriate.

We have since found that disciplinary and other divisions of scientific knowledge can provide more than one "rational" interpretation of reality, however. One question can be answered in several ways, each equally valid from a scientific viewpoint, often as a result of our incomplete understanding of an objective reality. Moreover, scientific methodology represents a method for gathering information that is dependent on theory. Scientific theories guide the recognition, organization, and interpretation of events. Scientific knowledge, at any point in time, consists of a multitude of theories that give variable meaning to data. The selection of theory represents another of several, additional ways in which the paths for accumulating scientific knowledge can diverge. It is also one of many factors critical to the construction of scientific knowledge that is sensitive to the influence of political paradigms.

Scientific inquiry is a social activity. Knowledge so produced is not beyond "politics." The reasonableness of a decision from a scientific perspective is not acceptable as an indication of nonpartisanship. It is insufficient as a statement about accountability.

Multiple interpretations of facts, subscription to varying theories, and other differences of research design lead to divergent scientific conclusions about what is and what can be (under various assumptions about physical conditions). Groups advocating competing policy alternatives and decision makers defending their decisions preferentially cite supportive scientific arguments. As a result, "symbolic" uses of science, to legitimate decisions and decision alternatives in order to generate political support and acquiescence, have come to dominate the functions commonly served by scientific advising in public decision making.

Debate on scientific aspects of a decision divert attention from underlying political conflicts. Moreover, because the relative ability of different stakeholding groups and decision makers to take advantage of scientific arguments is unequal, the focus on scientific aspects serves to advantage groups with greater access to the scientific establishment. Contenders may attempt to focus attention on scientific aspects of an issue as a means of limiting participation and the agenda of issues subject to discussion.

Scientific knowledge has been mistakenly identified as a tool for ending dissent. As the New York City case demonstrated, resolving scientific disputes does not resolve political conflict. Settling the disagreement over risk levels by clarifying the basis of the uncertainty did not end the dispute over the mass-burn incinerator because it is political interest, not scientific disagreement, that fuel opposition in the first place. Whatever the risk from dioxin emissions, the Williamsburg community, for example, is one group that would likely continue to oppose the incinerator for a number of plausible reasons, ranging from the undesirability of an incinerator in the neighborhood, to concerns about the City's lack of respectfulness toward the community.

The tentative nature of scientific knowledge prevents its success as a means of insuring accountability or ending dissent in public decision making. These are false hopes that have been inappropriately attributed to the role of scientific knowledge. The resulting contentious uses of science by groups striving to dominate public decision making have imposed serious, though not easily quantified, costs on society. Protracted disputes, reversals of decisions, and inconsistent policies often result. Instead of decisions that represent a synthesis of political contests and scientific knowledge, the politics of decision making are obscured, certain stakeholders are excluded from participation, and decision makers are sometimes required to act without a reasonably sound understanding of pertinent scientific information.

Recasting Science Through Consensus-Based Procedures

Science is not limited to its former roles in public decision making. The examples of consensus-based procedures examined in this study suggest less contentious roles for science. Scientific information can inform stakeholders and decision makers of the feasibility and desirability of decision alternatives without being used explicitly as a tool to persuade others. It can be used to mark the bounds for discussions of political interests, but boundaries delineated through a consensual process that accommodate divergent viewpoints are less a means of controlling discourse than are those set by the imposition of one scientific interpretation.

As a result of less contentious uses of science, a narrowly framed technical debate can be opened to a discussion of political interests. Participation is not restricted by expertise. Decision making participants can devote their attention to a consideration of conflicting, competing, and compatible political interests rather than struggling to establish one representation of the technical premises of the decision. Resources can be directed more pointedly toward addressing the political competition and conflict that motivates controversy. Stakeholders and decision makers both gain a richer understanding of the issues and interests involved. And, stakeholders and decision makers recapture the subtle, unauthorized, decision making power technical experts wield through their mastery of technical argumentation.

These three cases illustrate three different procedures. The chart in Figure 3 on the following page summarizes the objectives, key features, primary techniques, degree of consensus, transformation of the role of science, and the impact on decision making of each consensus-based procedure as argued in the previous chapters. In all cases, science was transformed from a potentially destructive weapon into a more benign tool to guide decision making led by political considerations.

The wood stoves rulemaking case illustrates one example of a more constructive use of scientific knowledge. The group spent a considerable amount of time and resources on developing the technical basis of the rule. While groups undoubtedly submitted arguments they hoped would reinforce policy decisions they preferred, the overriding, collective objective of the technical discussions was to establish a reasonable estimate of the technical parameters of the problem. The explicit understanding among the group--that details of the regulations would not be finalized until the rule was considered in its entirety--enabled the parties to give up obstinate battling on technical points that were unresolvable within the existing time frame for developing regulations. The group was able to operate in this manner because they shared an acceptance of the uncertain nature of

	PROCEDURE 1	PROCEDURE 2	PROCEDURE 3
Objective	Understanding the basis of scientific disagreement	Building a technical consensus	Proceeding despite uncertainty
Key Features	Single all-day negotiating session Stakeholder representatives, technical experts, and decision maker representatives meet together No press invited, no press coverage	Multiple 2-3 day meetings over 6-month period Stakeholders, experts, and decision makers meet together Deadline imposed by regulatory protocol Minimal press coverage	One multiple-day negotiating session Separation of scientific experts and stakeholder representatives Deadline fixed by trial court Orchestrated press coverage
Techniques	Presentations by technical experts Question and answer period Facilitator attending to communications	Presentation by technical experts Question and answer period Facilitator attending to communications Additional data gathering and analysis Intervals between technical presentations and discussions	Data sharing among technical experts Collaborative model-building (attempted) Costs of non-settlement stressed by third-party intervenor
Degree of Consensus	Understanding effect of different value judgments on technical analysis Clarification of relationship between technical judgments and policy prescriptions	Agreement on uncertain nature of scientific analysis and regulatory actions Agreement on ranges of plausible estimates of technical factors	Tactical accord on scientific factors Agreement to continue research on disputed scientific factors
Transformation of Role of Science	Tool to generate public support into Expression of different orientations toward risk	Decision maker's rationale or basis of stakeholder's challenge into Information to define limits of possible decision alternatives	Instrument to persuade judge into Information to reassure each party that conditions of settlement minimally meet needs
Impact on Decision Making	Forces decision makers to be more accountable for actions Opens up debate to additional issues (decision alternatives) Opens participation to groups lacking technical capabilities	Resource-poor groups gain ability to promote political interests Participating stakeholders gain influence over decision maker	Stakeholders gain better understanding of competing party's interests Diminishes appeal of reverting to conventional decision making

Figure 3: DISTINCTIVE FEATURES OF THREE CONSENSUS-BASED PROCEDURES

air quality regulation (in terms of both the physics of wood stove combustion and the effect of regulatory controls) and a mutual respect for each group's political stake in the rule.

In the Michigan fishing case, far less consensus on technical aspects of the dispute was attained. Agreement on a comprehensive picture of the fishery, (the number of fish in a specific zone of the lake, the impact of large mesh gill nets, and so on), was shown to be unnecessary in order for the parties to reach an accord on dividing up the fishery resource. Instead, scientific knowledge was utilized by each party to reassure it that the conditions specified in the negotiated decision were sufficient to enable it to satisfy its own objectives. There were effectively three different maps of the existing fishery and three different visions of its future evolution. The negotiating group spent less time trying to persuade one another of the "correctness" of their model of the biology of the fishery or the technical merits of their positions, and concentrated instead on simply procuring an agreement that met their party's needs and desires. Such an approach toward using scientific knowledge and expertise is consistent with a conceptualization of scientific work as a politics-bound effort to define and understand reality.

These cases demonstrate that scientific argumentation can be set aside and technical disputes need not be resolved before politically acceptable decisions can be made. In both cases, the urgency to make a decision and a common goal of participating fully in the decision making process were factors that encouraged stakeholders to cooperate and focus on dealing with political differences.

Of the three cases, the facilitated policy dialogue on the proposed mass-burn incinerator was designed most purposely to establish a consensus on a comprehensive view of scientific issues relevant to the proposal. In a sense, the NYAS sponsors were attempting to develop "one vision of reality." The consensus that was intended, however, was not one that rallied behind one risk assessment rather than another, but one which consisted of an understanding of the basis of variations in risk assessment, which are scientifically, equally plausible in the face of incomplete knowledge.

The facilitated policy dialogue clarified not only scientific aspects of the proposal, but also the sensitivity of scientific interpretations to political interests. Asking the question, "How do discrepant assessments arise?" leads to the question, "Why do discrepant assessments arise?" By confirming the legitimacy of a range of risk assessments, the process indirectly also elevated the status of corresponding political interests. In the New York case, the higher risk assessments reflected a more conservative approach to accepting (and imposing) risk. In effect, a consensual procedure can open the door for a discussion of political interests.

Variability in technical analysis is used by groups to strengthen their case against a particular policy alternative or decision. However, the level of political conflict is not only a function of the variability in technical analysis. On the contrary, political conflict is the source of the passion for technical disputes. If the variation in risk assessments by the CBNS researchers and the Hart team had been 24-fold and not 240-fold, it is likely that the dispute would not have escalated on the technical front, but the Williamsburg community, as argued previously, would undoubtedly have continued their vehement opposition to the Brooklyn Navy Yard project site.

Thus, while these cases show that politically acceptable decisions can be made without resolving disagreements on scientific or technical points, resolving disagreements on scientific elements will not settle political conflict.

Importantly, subordinating scientific aspects to political concerns in policy debates through the use of consensual procedures does not mean that the value of scientific knowledge is belittled. If any group assesses the implications of a decision alternative as seriously adverse, that group has the option of vetoing the choice. If their objections are ignored by others, they can withdraw from the process entirely. A consensus-based procedure cannot advance with dissent. Thus, in a sense, consensual procedures accommodate a full range of alternative interpretations of reality and the future. The consensual nature of decision making also will prevent decisions that have a chance of resulting in consequences to which any one group objects. Accordingly, decisions may tend to be conservative from a scientific perspective.

Procedures that give prominence to political elements are likely to raise objections by those concerned about opportunism on the part of participants. That is, how can we be sure that consensual procedures will not produce decisions that accommodate political needs at the expense of scientific soundness? As long as scientists and persons with relevant technical expertise are included in the consensual procedure, their advice is not likely to go unheeded. Even if non-technically trained stakeholder representatives favor a decision alternative on the basis of political criteria, strong dissent by technical experts will likely squelch it.

Moreover, a consensual procedure potentially offers greater insurance against scientifically unwise decisions than conventional, adversarial processes. In a consensual procedure, participating scientists have more incentive to act collegially. The consequent peer pressure to behave in accordance with the norms of the scientific community rather than in response to external pressures, (such as pressure from financial sponsors), can serve to embolden individual scientists to speak out even if doing so might invalidate a technical argument that supports their sponsor's preferred policy alternative. In effect, a consensus-based procedure can offer protection to "whistle blowers" and enhance the integrity of the technical basis of decisions.

Viability of Consensus-based Procedures

Indeed, the cases studied in this inquiry suggest that consensus-based methods of decision making can offer opportunities for a more thorough and less contentious, though not less skeptical, review of scientific and technical components of a decision. Clearly, however, certain groups will perceive a loss of decision making influence and power. If industry has the upper hand with regard to access to data, analysis, and expertise, why would industry agree to participate in a process in which they may lose some of their advantage? If government bodies have the authority to make decisions with only perfunctory requirements for public consultation, why would agencies and elected decision makers wish to complicate matters by involving other parties? If environmental advocacy groups make national headlines when they file a legal suit against a federal agency, why would they want to quietly expend their precious time and resources on relatively colorless negotiations? If scientists have a direct line to the decision maker, why would they want to join a process in which their voice becomes only one among many?

Each group clearly has something to lose by negotiating with competitors and agreeing to accept anything less than 100 per cent of their demands. Consensual approaches generally present a certain loss of control over decision making for all parties. The still largely ad hoc nature of the design and application of these methods means that each experience is unique. The peculiar mix of issues, interests, and individual negotiators may give rise to unexpected alliances and even reshape the agenda. Coalitions shift the balance of resources. Unpredictable factors, such as negotiator personalities and rapport among negotiators, the intervenor's style and range of services, and so on, exert differing pressures on individual negotiators that are still not well understood and not easily predicted. Facilitation techniques achieve intended objectives sometimes and fail at others. In short, decision making that is redirected by a consensus-based method remains a largely uncharted course. There is therefore considerable risk for all participants to engage in consensual approaches.

On the other hand, there are also definite gains for each of the various prospective participants, especially with regard to scientific and technical components. What are the incentives for various actors to promote and participate in consensual approaches? I speculate on benefits and incentives in the sections below. Figure 4, on the following page, summarizes the advantages and disadvantages of conventional and consensus-based methods for comparison. While scientists do not represent a separate category of actors in public disputes, (since their involvement is usually predicated on an alignment with a stakeholding group or decision makers), this discussion invites a consideration of their involvement in consensual procedures as well. Altering the role of science means the role of scientists will also change. Accordingly, below I include a discussion of the incentives for scientists to participate in consensual procedures.

POLICY ACTOR	CONVENTIONAL PROCEDURES: Potential Advantages	CONVENTIONAL PROCEDURES: Potential Disadvantages	CONSENSUS-BASED PROCEDURES: Potential Advantages	CONSENSUS-BASED PROCEDURES: Potential Disadvantages
Resource-Poor Stakeholders	Scientific disagreement can be used as aid for mobilizing political support	Lack technical expertise Lack resources to hire expertise Lack access to information (data, equipment, etc.) Lack entry into debate	Share expertise through coalitions Greater access to information Ticket to entry not scientific expertise Opportunity to express all concerns	Consensus not good for political mobilization Time-consuming Delay as tactic is forfeited Cannot exploit scientific uncertainty
Resource-Rich Stakeholders	Privileged access to data, analysis Can better absorb costs of drawn-out process Can launch expensive and and sometimes effective media campaign	Even if eventual court win, preferred policy not necessarily implemented Stereotyped image stirs public disfavor	Good public image Greatest concerns more likely to be addressed Higher certainty of outcome (can plan ahead)	Lose advantage of information and expertise Cannot exploit scientific uncer- Delay as tactic is forfeited
Decision Makers	Can cite scientific arguments to defend decision Decision making structure is in place	Information incomplete and presentations confusing Limited communications Unknown degree of power conferred upon experts Credibility poor among dissatisfied stakeholders Distorted reading of policy preferences of groups Apparent concessions to groups interpreted by others as favoriticism	Share information Share expertise Good public image Wider array of interests heard Richer understanding of various groups' interests Better working relationships with groups involved Scientifically unwise decisions avoided	Lose some discretionary decision making power Requires concentrated dedication of time
Scientists	Unique status awarded to scientists Consulting opportunies for scientists	Potential loss of public credibility for institution of science Advice can be disregarded by decision makers Pressure to reach "one answer"	Easier for individuals to change their mind if new evidence arises Greater credibility More likely to be listened to Brings together information from diverse sources	More "conservative" science

Figure 4. MAJOR ADVANTAGES AND DISADVANTAGES OF CONVENTIONAL AND CONSENSUS-BASED PROCEDURES FOR POLICY ACTORS BY MAJOR CATEGORY

Incentives to Decision Makers

For decision makers, consensus-based procedures offer several advantages with respect to the scientific and technical premises of decisions and the political legitimacy, control, and credibility of decision making. First consensual approaches offer an obvious advantage in regard to the consideration of scientific and technical information. The process sets up incentives, like conventional procedures, for various stakeholders to volunteer relevant data and analysis. Massive amounts of information and expertise can be assembled quickly and at relatively little direct cost to the decision maker. Unlike conventional procedures, however, the interactive and iterative process enable the decision maker to set and enforce a standard format for the presentation of information. Obfuscatory language can be eliminated. As a result, decision makers are more likely to receive technical information in a form they find intelligible. Subsequent decision choices are less likely to be based on faulty scientific or technical premises.

Second, by definition, when consensus-based methods yield products, they are products that are politically acceptable. Unless stakeholders are satisfied, no agreement will be reached. Importantly, consensual approaches are not based on completely fulfilling the demands of stakeholders, per se. In the best of cases, while perhaps no one is entirely satisfied with the all elements of the decision, a sufficient number of concerns is dealt with in an adequate manner so that the "threshold" for a group's approval is passed. However, approval from a particular group may result not from a minimal level of satisfaction with regard to the group's initial "wish list" of concerns, but from the group's assessment that the negotiated outcome is superior to the likely outcome under conventional decision making. In any case, however, the group's accord, although not a guarantee, increases the probability that the decision will not be challenged later.

Moreover, the decision maker's net can be cast more widely to catch a greater spectrum of issues and interests. In conventional procedures, issues and interests overshadowed by well-articulated disputes over scientific aspects of decisions are often neglected. As a result, substantial segments of the stakeholding community are effectively disenfranchised. The subsequent dissent and disillusionment of such groups is potentially destabilizing both in terms of implementation of the decision itself and the decision maker's own political base. Defining participation by the recognition of political interests rather than technical competence, consensus-based methods offer decision makers a means of receiving a broader array of viewpoints and an opportunity to accommodate these concerns in their decision choice. A consensual approach thus may be politically expedient for decision makers on a number of dimensions.

Third, amid the shifting foci of influence in consensus-based methods decision makers reap a clear gain vis-a-vis scientists and technical experts. Consensus-based methods that enable participants to better comprehend scientific and technical aspects of decisions recover a certain degree of control over the identification and choice of alternatives that has become the domain of those most fluent in the technical complexities. As decision makers develop a stronger understanding of technical arguments, they will be able to devise new alternatives that are consistent with technical knowledge, their perception and ranking of competing interests, and their personal concerns. Scientists and technical experts remain as "advisors" but are appropriately restrained.

Finally, consensual approaches that involve stakeholders and scientists yield decisions that are likely to be more credible to both participants in the process and outsiders. The interests of stakeholders are not subordinated to the declarations of scientists or technical experts, but neither are political concerns placated at the expense of scientific or technical soundness. By being a part of the decision maker's education regarding the interests of stakeholders and scientific arguments, stakeholders and scientists both gain a fuller appreciation of the decision maker's task and the ultimate decision. Again, credible decisions are critical to the political futures of decision makers, especially those wishing to cultivate a reputation for fair and wise decisions.

Incentives for Stakeholders

Consensus-based methods also offer attractive opportunities to stakeholders in public decisions, although the benefits may be less clear-cut than for decision makers. To begin with, the "voluntary" character of consensus-based processes is less consistent and more controversial. For example, a court order to negotiate a settlement is not truly a voluntary circumstance, given the potentially high cost of appearing uncooperative before the judge, who would otherwise render the decision. The decision maker's choice to pursue a consensual approach is also usually a carefully circumscribed event. As in the EPA wood stoves case, the decision maker can retain a large degree of discretion by setting the initial agenda and marking the boundaries of negotiable items. Nonetheless, a decision maker's invitation to engage in a consensus-based procedure should not be blithely declined.

Consensus-based methods offer a different set of advantages to stakeholders depending on their position in the public discussion. Stakeholders who are not part of the technical debate and who have concerns not entertained by the advocates of positions linked to the technical debates represent one subgroup. To the extent that their concerns and interests may be inadvertently overlooked (and not intentionally ignored) by decision makers, consensus-based methods may open up the range of issues and decision alternatives considered and addressed in the decision. Again, importantly, the ticket for entry into a consensus-based process is not technical expertise but the identification of political interests at stake.

At the same time, resource-poor stakeholders also gain access to information and expertise otherwise unavailable to them. Merely by attending sessions in which contending scientific and technical arguments or information are presented will elucidate points not otherwise comprehensible. Opportunities for direct questioning of technical presenters provide direct access to technical "tutors." Possibilities in consensual procedures for joining coalitions also enlarge the resource base of stakeholders. In many ways, resource-poor stakeholders can improve their understanding of technical points and thus enhance their ability to devise decision alternatives that meet their own political objectives and are consistent with technical knowledge.

Finally, the very act of participating in the deliberations that lead to a decision can be educational, especially to groups that are traditionally more distant from the decision making locus. The discussions that occur in a consensual procedure will convey not only technical information to negotiators, but also insights into the rank order of concerns of the decision maker and competing stakeholding groups. The knowledge gained can be used to shape proposals that are more likely to be accepted by others, as well as knowledge that can be constructively applied in future confrontations. The opportunities for gathering such information are more limited for groups with fewer resources and are thus especially valuable to such groups.

In light of the apparently clear gains for traditionally resource-poor groups to engage in consensus-based methods, what incentives exist for traditionally dominant groups, such as business and industry? Why should they share technical information and expertise that they might manipulate to their advantage under conventional procedures?

A popular image of business and industry is that they typically hold deep bank accounts that can be tapped to fund self-serving technical studies and expert testimonies. They often do, in fact, have direct and exclusive access to a vast vault of information and expertise. Even manufacturers in small industries, like the wood stove producers, have on the payroll persons with engineering expertise to assist in the research and development of their products. Bluntly, it is their business to gather technical data about their product. Leading manufacturers of large industries, like the petrochemical industry, have proprietary data concerning the chemical substances utilized in their production processes. They also keep health records on employees and, in many cases, have in their hands rare data on the health conditions of employees exposed to various chemicals. In terms of access to data and expertise, the ability of industry often exceeds even that of regulating agencies like EPA and OSHA.

In fact, not all firms are as resource-rich as those appearing on the "Fortune 500" list. Moreover, the concerns of different firms within an industry are usually not the same. Partly as a result of the stereotyped image of "big business" and "corporate giants," however, the scientific arguments of business and industry involved in contested public decisions are often taken lightly by others simply because they are presumed to purposely withhold and distort information to abet the firm or industry´s single-minded, avaricious mission to prosper. In true stereotypical fashion, the subtleties of the firm or industry´s multifaceted and diverse needs are often blurred, and lost to decision makers considering competing political claims.

Furthermore, under conventional decision making, corporations (and others) compete on an "all or nothing" basis. Accordingly, one´s scientific arguments are either "right" or "wrong." Winning on the scientific front, however, does not mean winning the battle. As the South Terminal v. EPA case cited in Chapter 1 illustrates, in judicial challenges to administrative decisions, a court will rule in favor of the plaintiff only if the analysis of the agency is found to be clearly in error. Even then, however, a ruling in favor of the plaintiff at most means only remanding the decision back to the agency for further review. Corporate stakeholders can expend considerable time and money on legal challenges for dubious gains.

In contrast, in consensus-based procedures industry spokespersons and representatives from individual firms gain an opportunity to differentiate their interests and concerns from stereotyped images. Consensus-based procedures enhance the credibility of scientific and technical information they contribute, if it is accepted by the negotiating group. Also through the process, they gain a sense of what the ultimate decision will look like. In the business world where "time is money," companies often assign high value to predictability in the regulatory environment. Put simply, corporate competitors may do well to trade lesser gains for greater certainty. It appears that consensus-based methods offer distinct advantages even to the "giants" in the public arena.

Finally, participating in a consensus-based procedure that aims to produce a technically sound decision that meets the interests of the decision maker as well as other participants will help to build a positive, public image for business and industry stakeholders. Rather than project images of self-interested bullies who attempt to "buy off" or manipulate decision makers, or who launch an expensive court challenge if an unfavored decision alternative is chosen, business and industry groups that participate in a consensual process will appear reasonable and public-spirited.

Incentives for Scientists

Scientists in public disputes are usually not independent stakeholders. More often, they are drawn into public debates as advisors to other stakeholders or the decision maker(s). When they enter on their own accord, and do not quickly ally with one of the contending groups, then one may presume they hold a separate interest in the decision in question. In such a case, they can be considered a "stakeholder," but one whose incentives to participate in a consensus-based supplement are distinct from those of other stakeholding groups. In any case, as a party to a dispute or as an advisor, scientists can either balk or buy into a proposal to undertake a consensual procedure, and it is important to consider the incentives to participate for scientists.

Scientists may initially feel reluctant to join a process in which they fear they will lose some control over the interpretation of their work. Consensus-based procedures that aim to involve all policy actors (stakeholders, decision makers, and scientists) in establishing the technical basis of public decisions may appear to force a "compromise" of scientific methodology by opening it to political bargaining among non-scientist stakeholders. The three cases examined in the previous chapters illustrate, however, that scientists are not pressured into supporting opinions with which they do not agree. In fact, in several ways scientists can more easily maintain their chosen roles as "seekers of truth" (rather than "advocates of policy") in consensus-based procedures.

First, consensus-based procedures encourage a thorough examination and, often, further analysis of scientific evidence. As discussed earlier, at any given point, scientific knowledge on a specific question is partial and incomplete. The evidence and arguments put forth by a particular scientist (or group of scientists) represent just one piece of a larger puzzle. In adversarial procedures, scientists are asked to defend their work. A consensual procedure, in contrast, asks scientists with different views to debate the relative validity and significance of their work toward a common objective, to determine what they can agree on. This shared goal potentially creates a rich opportunity for scientists to synthesize divergent data into a new theory or a composite understanding of the issue in question. Integrating new data into existing theories or modifying theories to account for new information is an important element of the ideal of how scientific inquiry advances the state of knowledge.

Moreover, under conventional, adversarial procedures scientists frequently feel bound (formally through payroll links or informally through their strong, public association with particular policy alternatives) to their original arguments. A consensual procedure that separates political stakes from scientific contests affords scientists greater flexibility to "change their minds," if new information persuades them to do so. In this sense, a consensual procedure frees individual scientists to act more as the "ideal scientist," especially those who are called into a public debate by their employer or research sponsor.

Third, consensus-based procedures educate non-expert policy actors to develop appropriate expectations about the capability of scientific expertise in public decision making. Observing scientists debate and defend conflicting viewpoints can be highly instructive to non-expert policy actors. Even while their understanding of substantive details may remain somewhat vague, they are able to gain a "feel" for the complexity of the issue, and the limits to current knowledge. When stakeholders and decision makers learn to appreciate the multiple perspectives possible in viewing a particular issue, and the value of each perspective, they are less likely to demand consistency or uniformity in opinion from scientific advisors. Non-expert policy actors (and the public in general) will be less inclined to demand single "answers" that scientists are not able to provide at the moment. At the same time, scientists will be able to demonstrate their conviction about what they do know. As a result, non-expert policy actors are less likely to believe the scientists are acting out of political self-interest, and the general credibility of science as an institution will be protected.

Finally, while credibility is important, alone it is insufficient to ensure that the advice of scientists will be heeded by the other policy actors. In consensual procedures, the participation of scientists in the formulation of policy alternatives gives scientists a direct hand in helping to shape the ultimate decision. In this way, they can help to make certain that the decision is consistent with the current state of scientific knowledge. Moreover, they can guide decision makers toward initiating actions that will help to fill gaps in the current state of knowledge (by including monitoring provisions, further data collection, or continuing analysis as part of decisions on controversial projects in which scientific uncertainty impedes a more precise understanding of the consequences of decision alternatives, for example).

Should Consensual Procedures Be Used?

Public decisions imply a redistribution of resources (be they material, economic, or political in nature). In a highly diversified society that is culturally pluralistic, economically stratified, and politically conflictual, such redistributions are inevitably contentious. Decision making that does not address political concerns will ultimately fail to endure. Inasmuch as public decisions represent even only a tactical truce among contending groups battling over resources, preserving the preeminence of political interests in public decision making is critical.

Under existing institutional structures, science is often used as a weapon to dominate public decisions. Scientific and technical resources are not distributed evenly throughout society. Highly educated individuals have greater access than those with fewer formal credentials. Much scientific activity is sponsored, directed, and held in private hands. This has implications for both who has current access to information and expertise, as well as how the agenda for scientific research has evolved, and how the base of scientific knowledge has developed. Even "public" science, funded by government, is heavily skewed toward fields and project areas with potential military applications. As a result, the scientific base for production-oriented technologies, for example, is far more sophisticated than our understanding of the coincidental, environmental effects of such technologies.

Public decision making procedures that foster adversarial uses of scientific argumentation can be suspected of systematically favoring certain groups. Decision making methods that deemphasize the persuasive power of scientific argumentation or lower the barriers to entry that scientific disputes sometimes constitute represent a step toward equalizing the opportunity for groups to compete for public resources. If equality of opportunity in public decision making is valued, defusing scientific "weapons" may be a second, critical element of public decision making procedures.

My findings suggest that consensus-based procedures can result in favorable transformations in the role of science in public decision making. Specifically, scientific knowledge can be used to help stakeholders and decision makers appraise the scientific soundness and political desirability of decision alternatives from their own perspective, rather than as a weapon that obfuscates the politics of decision making. This less adversarial role will move decision making toward scientifically sound decisions without sacrificing democratic goals.

In addition, consensual procedures not only facilitate an understanding of scientific factors and a clarification of technical disagreement, they also encourage discussion of the political interests behind public debates. A far more integrative discussion of science and politics, and the politics of scientific arguments, results.

A consensus-based procedure by definition must be voluntary. For groups contending in contests over public decisions, consensus-based procedures ought to be viewed as one of a package of tactical options available. The choice of political tactics in science-intensive decision making depends on a group's scientific and technical resources, as well as political and contextual factors. Before agreeing to participate in a consensus-based procedure, each prospective participant ought to consider three critical factors: (1) the advantages and disadvantages of a consensus-based approach given a group's resources, (2) a comparison of likely outcomes under all decision making path options, and (3) the compatibility of the objective of a consensus-based procedure with the political objectives of the stakeholder's involvement in the particular controversy.

First, a decision to engage in a consensus-based procedure ought to begin with an analysis of the advantages and disadvantages consensus-based approaches offer. Resource-poor groups fight an uphill battle regardless of the front on which confrontation occurs. Such groups, which frequently lack access to technical information and expertise, can be severely handicapped when a debate is focused on technical aspects. Conversely, resource-rich adversaries possess substantial advantage with regard to persuading decision makers and the public of the scientific soundness of their preferred policy positions. In these situations, consensus-based procedures that offer a sharing of technical information and expertise can constitute a tactical coup for resource-poor groups.

In comparison to resource-poor groups, resource-rich groups stand in relative advantage under both consensus-based and conventional decision making. The measure of whether such a group should participate in a consensus-based procedure is not only whether its preferred policy will prevail over those of resource-poor adversaries, but how the group will obtain its objectives and at what cost. A land developer who negotiates with abutting land owners and other community representatives is likely to encounter less resistance at later points in the processing of permit applications and construction than one who wins the first battle in a feisty courtroom. A developer who gains approval for a project after the concerns of the community have been aired and addressed by appropriate alterations to a project´s design is also likely to continue to reap valuable rewards in the future resulting from a positive community reputation.

Decision makers appear to have much to gain and little to lose by suggesting consensus-based supplements in decision making that involves complex scientific and technical issues. Enhancement of the political acceptability, credibility, scientific and technical soundness, and technical feasibility of consensually-derived decisions are not inconsequential benefits. The highest cost may actually boil down to the concentrated dedication of time required of decision makers themselves, or credible representatives.

The second factor that ought to be considered before agreeing to participate in a consensus-based procedure is an analysis of the likely outcomes under all decision making process options. In negotiation jargon, this amounts to assessing one´s BATNA, or "best alternative to a negotiated agreement."[1] The expected outcome of a conventional procedure is less predictable at some times than at others. Nonetheless, some contextual factors are sufficiently well-understood to send strong signals.

In a political climate led by a federal administration that believes the highest priority should be to protect the environment, for example, environmental advocates may believe their interests will be better promoted under conventional administrative and judicial patterns of decision making, where government retains considerable discretion. Under such conditions, there is little urgency to pursue alternative paths. On the other hand, under an anti-environmental leadership that has set out to castrate existing programs and dismember federal environmental policies, a strategy to pursue incremental, rather than radical gains, may be preferable to environmental advocates, and a consensus-based procedure may be one means of doing so.

Pursuing a procedure that is supplementary to conventional decision making also means that conventional decision making options may change as a result. The calculation of the expected outcome of a conventional decision making process that has been disrupted by a consensus-based procedure that did not produce an agreement is complicated and somewhat uncertain. It is still unclear how a court would look upon a legal challenge initiated by a party who withdraws from earlier negotiations, especially in a multi-party dispute in which other parties wish to continue negotiations. Part of the risk of agreeing to participate in a consensus-based procedure, then, is the impact a failed attempt may have on the outcome of the conventional decision making process. In the Michigan fishing case, the Bay Mills tribe subsequently withdrew their support of the negotiated agreement and a court trial was conducted on the merits of the negotiated agreement. The judge ruled against the tribe's legal challenge.

The final factor that each party ought to consider is an obvious one, but one that is easily overlooked. Whether or not a group ought to enter a consensus-based procedure is a function of the political objective of that group's involvement in a particular debate. That is, sometimes a group may deliberately exploit scientific uncertainty in order to draw public attention to a particular issue or decision. A consensual procedure that will clarify the basis of disagreement, even if it illuminates differences in political interests or values in the process, may not serve as effectively to capture the public's imagination, interest, support, and sympathy as other methods of political activism, such as street demonstrations or lengthy court battles that center on advocacy uses of science. As an aid for political mobilization, the symbolic usefulness of disputing sometimes outweighs the benefits of finding a resolution.

Also, consensus-based procedures presume a desire for forward movement. If delaying a decision is a primary objective of a group, then engaging in a consensus-based procedure only to draw out the decision making process is likely only to aggravate other participants who eventually realize the group's real motives. An uncooperative group, or one that ultimately sabotages a consensus-based effort by premeditatedly withdrawing, is likely to suffer some kind of backlash. If delaying a decision serves the best interest of a group, the group probably ought to avoid consensus-based procedures altogether.

If, however, a group wants a decision to be made, or believes one is imminent, an invitation to join a consensus-based procedure can represent an unequalled opportunity to shape that decision. In particular, a less contentious use of science developed through a consensual process enables groups not otherwise well-equipped to battle on the turf of experts to compete for control of public resources. For a technologically sophisticated society overall, consensus-based procedures may be just the key needed to open the door to scientifically-wise, participatory decision making.

Notes

1. See Roger Fisher and William Ury, Getting to Yes. (Boston: Houghton Miflin, 1981).

Appendix 1
INTERVIEWS

NEW YORK CITY MSW INCINERATOR CASE

Personal Interview

Barry Commoner, Director, Center for the Biology of Natural Systems, Queens College, Flushing, New York, October, 1986.

Telephone Interview

Marc David Block, New York Academy of Sciences, several during September 1986.

EPA WOOD STOVES REGULATORY NEGOTIATION

Telephone Interviews

Robert Ajax, Environmental Protection Agency, Chief of Standards Development Branch, Air Office, May 21, 1987.
William Becker, State and Territorial Air Pollution Program Administrators (STAPPA) and Association of Local Air Pollution Control Officials (ALAPCO), May 12, 1987.
Larry Canaday, Woodcutters Manufacturing, June 12, 1987.
John Charles, Oregon Environmental Council, May 1987.
Richard Colyer, Environmental Protection Agency, Standards Development Branch, May 7, 1987.
Donnis Corn, a-b Fabricators, Inc., May 18, 1987.
David Doniger, Natural Resources Defense Council, May 1987.
Harold Garabedian, State of Vermont, Air Pollution Control Program, Agency of Environmental Conservation, June 2, 1987.
R.D. Gros Jean, Corning Glass, May 12, 1987.
Brad Hollomon, New York State Energy Research and Development Authority, May 12, 1987.
Jim King, State of Colorado, Department of Health, May 13, 1987.
John Kowalczyk, State of Oregon, Department of Environmental Quality, May 11, 1987.
Neil Martin, Brugger Exports, Ltd., June 1, 1987.
David Menotti, Wood Heating Alliance, May 5, 1987.
Jay W. Shelton, Shelton Research, Inc., May 11, 1987.

Personal Interviews

Doreen Cantor, Environmental Protection Agency, Enforcement and Compliance Division, Washington, D.C., May 1, 1987.

Philip Harter, Washington, D.C., May 1, 1987.
David Swankin, Consumer's Federation of America, Washington, D.C., May 1, 1987.

MICHIGAN FISHING DISPUTE

Telephone Interviews

Richard Clark, Institute for Fisheries Research, August 27, 1987.
Robert Doherty, professor of history, University of Pittsburgh, September 1, 1987.
William Eger, biologist, Chippewa-Ottawa Fishery Management Authority, August 14, 1987.
Daniel Green, attorney for Sault St. Marie tribe of Chippewa Indians, August 12, 1987.
Nino Green, attorney for non-tribal commercial fishers, August 17, 1987.
Bruce Greene, attorney for Bay Mills Indian Community, August 13, 17, and 19, 1987.
Wilbur Hartman, biologist, U.S. Department of Interior, August 21, 1987.
Richard Hatch, Great Lakes Fishery Laboratory, Fish and Wildlife Service, U.S. Department of Interior, August 20, 1987.
Francis McGovern, professor, University of Alabama, July 1987.
Francine Rabinowitz, July 20, 1987.
William Rastetter, attorney for Grand Traverse Band of Chippewa-Ottawa Indians, August 19, 1987.
Stephen Schultz, attorney, Grand Traverse Area Sport Fishing Association, Michigan Charterboat Association, Michigan Steelhead and Salmon Fisherman's Association, August 13, 1987.
Mariana Shulstad, Department of Interior, August 17, 1987.
Ronald Skoog, former director of Michigan Department of Natural Resources, September 21, 1987.
Peter Stekettee, attorney, Michigan United Conservation Clubs, August 14, 1987.
Elizabeth Valentine, former Michigan Assitant Attorney General, August 14, 1987.
Asa Wright, biologist, Michigan Department of Natural Resources, Fisheries Division, August 20, 1987.

Appendix 2
PARTICIPANTS IN EPA WBS NEGOTIATED RULEMAKING

Negotiators/Affiliation

1. Robert Ajax, U.S. EPA
2. William Becker, STAPPA/ALAPCO*
3. Larry Canaday, Woodcutters Mfg.
4. John Charles, Oregon Environmental Council
5. Donnis Corn, a-b Fabricators, Inc.
6. David Doniger, Natural Resources Defense Council, Inc.
7. Harold Garabedian, Vermont Air Pollution Control Program
8. Robert Geiter, Applied Ceramics
9. R.D. Gros Jean, Corning Glass Works
10. Brad Holloman, New York State Energy Research and Development Authority and New York State Energy Office
11. Jim King, Colorado Department of Health
12. John Kowalczyk, Oregon Department of Environmental Quality
13. Neil Martin, Brugger Exports, Ltd.
14. David Menotti, Wood Heating Alliance
15. Jay W. Shelton, Shelton Research, Inc.
16. David Swankin, Consumer Federation of America

Facilitator

Phil Harter, Esq., Consultant to EPA

Executive Secretary

Chris Kirtz, U.S. EPA

Observers

Wayne Leiss, Office of Management and Budget
George J. Lippert, U.S. Forest Service
Jean Vernet, U.S. Department of Energy

*State and Territorial Air Pollution Program Administrators and Association of Local Air Pollution Control Officials

Source: Federal Register, Vol. 52, No. 32, February 18, 1987.

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Incinerators That Burn Unseparated Municipal Solid Waste, and an Assessment of Methods of Controlling Them (December 1); Vol. III: A Comparison of Different Estimates of the Risk Due to Emissions of Chlorinated Dioxins and Dibenzofurans from Proposed New York City Incinerators (Including a Critique of the Hart Report) (December 1); and Vol. IV: Summary (December 1). Flushing, NY: Center for the Biology of Natural Systems, Queens College, CUNY.

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