Intractable Debate:
Why Congressional hearings on climate fail to advance policy

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Abstract

In the study of science-led policy debates considerable attention has gone to the role of experts in constructing shared knowledge and defining policy options. This paper explores expert advice as it plays out in one particular political arena – live testimony in a public hearing before Congress – using global climate change as a lens for the discussion. I begin by reviewing literature relevant to expert advice, science as it exists in public arenas, and the management of uncertainty by scientists and politicians. I then use this to frame an analysis of testimony given before Congress on issues of climate change and associated uncertainty.

Using the transcripts of three Congressional hearings over the course of 15 years, I show how the use of scientific advice on a policy problem can be problematic when both politicians and experts manage uncertainty to maintain the status quo. In addition, the advancement of policy decisions is hindered due to conflicting notions of "good science" and a mutually enforced assumption of objectivity that narrows the scope of debate. Despite concurrent advances in climate science itself, discourse in this setting demonstrates both a lack of political progress and a striking similarity in the content of political debate about climate science and climate policy, suggesting that such venues are not useful in advancing solutions for, or understanding of, a policy issue.

Introduction

Studies of science and its relationship to society struggle with the social division implied by that topic and the reality that there is no clean separation between the two. Public science is seen as a one-way communication to a non-scientific audience, but in practice the audience is mixed, and the interaction goes both ways (Hilgartner 1990). A Congressional hearing is a microcosm of this reality. It is structured specifically to facilitate science's speaking truth (from the mouths of experts) to power (the politicians), yet all participants become involved in constructing scientific knowledge and in advancing political interests.

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In the study of science-led policy debates, considerable attention has gone to the role of experts in constructing shared knowledge and defining policy options. This paper explores expert advice as it plays out in one particular political arena – live testimony in a public hearing before Congress – using global climate change as a lens for the discussion. I begin by reviewing literature relevant to expertise, science as it exists in public arenas, and the management of uncertainty by scientists and politicians. I then use this to frame analysis of testimony given before Congress on issues of climate change and associated uncertainty.

Though each entails a debate about climate science, the hearings chosen for analysis differ greatly. I have somewhat haphazardly selected three hearings that differ in goals, impetus, Congressional committee and participating politicians and scientists. They represent a sample of public debate among experts over a period of 15 years (1991-2005), a time during which knowledge of climate science, through numerous government funding programs, advanced considerably.

Based on my analysis, I argue that, far from clarifying controversy and enabling policy, hearings involving testimony on the uncertain and controversial issue of climate change impede political progress for three reasons. First, they introduce an illusion of objectivity that reinforces the idiomatic perception of science (Rose 1987). The notion of objectivity narrows the scope of a debate, privileges the information offered by expert witnesses, and ignores biases and political motivations inherent in the proceedings.

Second, regardless of agreement or conflict among testimonies, a hearing brings forth a narrow set of knowledge (focused by particular disciplinary biases) from within a much broader scientific community. This knowledge is selective among interpretations of the specific problem at issue, but also among varying conceptions of what constitutes "good science" or policy relevant science.

Finally, conflicting statements by experts are not easily resolved in the setting of a Congressional hearing. It can be difficult, especially for non-experts, to distinguish among statements that represent broadly accepted science, personal scientific judgments, and value-based opinions that do not stem from any particular expertise.

As Stephen Zehr (1999, p. 8) notes, it is "important to understand that public science is simply another occasion for performing real scientific work. Scientific knowledge is essentially being constructed in these public settings." I emphasize two important concerns in assembling scientific advice on a complex, controversial issue. First, it is important that such advice be assembled by a neutral actor with sufficient knowledge of the issue and experience in assembling a balanced perspective. Constructing a neutral process is not a simple task in political arenas. Though far less glamorous than a public hearing, reports by the Office of Technology Assessment are a good example of a balanced, neutral representation of issues, which receive very broad input. Second, I argue that hearings on climate change may be useful tools for adding to the public record or in building support for a preconceived policy position, but they should not be seen as ways to reduce controversy (political or scientific), nor as opportunities to induce finality for debates that are ongoing among scientists.

Uncertainty Management

As a fairly nebulous concept that is rarely given more definition or explanation than a single word, the concept of uncertainty is quite common in public discourse, and can take on many forms (Table 1).

Table 1: Multiple Types of Uncertainty

Risk	Know the odds.
Uncertainty	Don't know the odds: may know the main parameters. May reduce uncertainty but increase ignorance.
Ignorance	Don't know what we don't know. Ignorance increases with increased commitments based on given knowledge.
Indeterminacy	Causal chains or networks open.

Source: Wynne, 1992

In a broad discussion of public science (including but certainly not limited to settings like that of a Congressional hearing) Stephen Zehr (2000) has noted several roles for uncertainty discourse:

- Among scientists it can create a demand for more research and point to inadequacy of scientific statements;
- In the media it can be used to bring drama to a narrative;
- It could be seen as delegitimizing science and opening the doors for others (non-scientists) to do work; or
- In politics it can legitimate the status quo, or be a boundary-ordering device.

Given assumptions of the truth and objectivity of science, one might expect uncertainty to be detrimental to science when exposed to (or by) politics. On the contrary, the existence of uncertainty is sometimes "managed" by both scientists and politicians in ways that allow them to justify action (or inaction) and build authority through boundary work. Thus, uncertainty can reinforce the dominance of science in a debate such that both scientists and politicians benefit. Shackley and Wynne (1996) have expanded this idea in identifying several ways in which uncertainty is managed as a "boundary-ordering device." Such uncertainty discourse (categorized as transformation, displacement, condensation or scheduling – see Table 2) allows experts to maintain legitimacy, validity and relevance in their own social world and that with which they communicate.[1]

[1] Some work has been done on the more general concept of uncertainty in "public science." For a useful review of this, see Zehr (2000), and Friedman, Dunwoody and Rogers (1999).

Table 2: Uncertainty Management

Transformation	Consolidation of multiple types of uncertainty into a single representation that is often more tractable.
Condensation	Representation of multiple types of uncertainty within a single statement, often with unspecified types implicit for select audiences.
Scheduling	Predictions of future reduction in uncertainty often in terms of institutions and research programs.
Displacement	Deflection of responsibility for uncertainty. Does not directly threaten authority, but can reduce policy relevance.

Source: Shackley and Wynne, 1996

Research like that of Shackley and Wynne (1996) has revealed examples of scientists managing uncertainty along social boundaries in a variety of public venues. For example, a detailed retrospective look at the concept of climate sensitivity (van der Sluijs et al. 1998), in a particular estimate of climate change potential that has remained constant since the late 1970s, showed how such a concept can carry different and quite fluid meaning for scientists of different disciplines and politicians who must interact with them.

An interesting paradox revealed by this conception of scientific uncertainty in the political sphere is that, while rhetoric may emphasize the goal of reducing uncertainty to enable policy goals, its existence is quite welcome to those who favor the institutional, political or research funding status quo. In the end uncertainty does not seem to weaken the role of science; indeed, sometimes it even strengthens it. Uncertainty may be far more detrimental to the policy process than to any established priority research area from which an expert might be called upon to testify.

Objectivity and Other Notions of Science

The above-mentioned claim by Zehr (1999) that public representations of science are another form of scientific work, rather than merely interpretations, runs counter to the more broadly assumed "dominant view" of the popularization of science. Simply put, the dominant view holds that complex scientific knowledge can only be fully understood by scientists, and thus its effective communication requires simplification. Such simplification is deemed either as appropriate or as a distortion, and scientists can use these judgments to demarcate "good science" (Hilgartner 1990). Of course, as both Zehr and Hilgartner suggest, reality is far more complicated. It appears that both simplification and construction of knowledge may happen in either in the laboratory or in public forums (Zehr 1999; Hilgartner 1990).[2]

[2] Hilgartner finds the dominant view to be inadequate, in part because of obvious feedbacks between public and laboratory science and evidence that scientists themselves often learn from simplifications assumed to be directed at the lay public.

With this dominant view, if two claims by scientists do not agree, then one must be a distortion. Both scientists and politicians can be seen falling into this trap when they apply their own notions of science in an attempt to ascertain which account is a distortion. But distortion is not a necessary ingredient for dispute over scientific results. The mere fact that each discipline has a unique way of framing and investigating a problem virtually guarantees that competing claims will emerge in multidisciplinary debates such as that of climate change and climate policy.

Recognizing the inadequacy of the dominant view is important in scrutinizing public debate about science, but equally important is tracing how the dominant view (held dear by many who are involved in such discourse) shapes an argument. The problem is that each expert assumes his or her own rationality and objectivity, and that the audience assumes the rationality and objectivity of all experts. So, when supposedly rational claims compete, they rule each other out – it is intractable.

Hearings

1991: The policy cart and the science horse.

For the purposes of this discussion, I draw from testimony given in three hearings over the past 15 years (See Appendix A).[3] The first, which took place on October 8, 1991, was a review of "Priorities in Global Climate Change Research," organized by Representative Rick Boucher (D-VA), chair of the subcommittee on science of the House Committee on Science, Space and Technology. The hearing brought forth experts from academia and government agencies. Despite the explicit emphasis on the allocation of research funding in the U.S. Global Change Research Program, a main topic that emerged in this hearing was that of uncertainty in climate models and the question of whether model output was relevant to climate change policy.

Testimony by each witness in 1991 followed a fairly similar structure. Each witness gave an outline of his own area of expertise, assessed general understanding of the climate system from that perspective and pointed out areas where further research was needed. Though each arrived at a conclusion that more research was needed to achieve an understanding of climate that would better inform policy, each reached this conclusion in different ways. For example, Jerry Mahlman's testimony, which outlined a series of predictions about the next 50 years and associated a level of probability with each, ends with the prediction "that society's need for detailed climate change predictions will increase at a rate faster than the scientific community can provide them," necessitating a "sustained effort over many decades" by the global leaders and the scientific community (Priorities in Global Climate Change Research: Testimony of Jerry Mahlman 1991, p. 25). This assertion adds a social component to otherwise scientific predictions of how the physical environment will change, one that reinforces the need for scientific predictions. Mahlman expresses little doubt

[3] I cite individual testimony from each of the hearings in the References section below. All general information was taken from the public record of the relevant hearing unless otherwise noted. Page numbers are noted only for the 1991 hearing, as all others were read from internet resources.

about his own predictions, but emphasizes that increased research will reduce uncertainty and improve specificity.

Richard Lindzen, on the other hand, arrives at the same conclusion about a need for more funding, but from the opposite direction. Skeptical that global average temperatures can be expected to rise as much as predicted by current modeling efforts, he expresses confidence that improvements in basic theory along with better models will prove that climate change is not such a problem (Priorities in Global Climate Change Research: Testimony of Richard Lindzen 1991). Ralph Cicerone, on the other hand, similarly acknowledges the indeterminacy of current modeling efforts and the many areas where more understanding is needed, but is less skeptical. He takes a neutral approach to predictions of the significance of climate change, but reinforces the case for more research when he notes the danger of our lack of understanding in the face of such complexity and compares climate change research to the study of cancer (Priorities in Global Climate Change Research: Testimony of Ralph Cicerone 1991).

After the official testimony of each witness, the ensuing discussion led all three experts to agree that: 1. current climate modeling efforts were not useful in informing policy makers on what to do about climate change, and 2. that such policy relevant information would become available within about ten years. In other words, despite great uncertainty expressed in one way or another by all experts at this hearing, it is taken for granted by all that science in its current form can and will reduce these uncertainties, leading to a clear way forward in policy guiding how humans should interact with their environment.

In general, politicians in the room agreed with this assessment, not wanting to, as put by Don Ritter of Pennsylvania, “put the policy cart before the science horse.” (Priorities in Global Climate Change Research: Testimony of Don Ritter 1991, p. 8). The only alternative view was submitted in writing by George Brown, from California, who felt that “scientific uncertainty has become an operational synonym for inaction on global environmental issues, and the debate over global change has thus become an impediment to action on a wide range of issues critical to our survival" (Priorities in Global Climate Change Research: Testimony of George E. Brown 1991, p. 6). Unfortunately, Brown’s absence from the hearing itself meant that no one openly questioned whether the science horse was in any kind of position to be pulling a policy cart, regardless of uncertainty.

1995: Climate uncertainty or climate conspiracy?

As one of a set of hearings on “Scientific Integrity and Public Trust,” the Subcommittee on Energy and Environment of the House Committee on Science held a hearing entitled “Climate Models and Projections of Potential Impacts of Global Climate Change,” on November 16, 1995. The testimony in these proceedings makes for an interesting comparison with the 1991 hearing in light of the political atmosphere in which it was staged. Large cuts to the budget of the U.S. Global Change Research Program (USGCRP), which funds the majority of climate research in the U.S., had been proposed, and both the hearing and the proposed cuts came amid Republican suspicions of exaggeration and distortion of information related to climate change, and accusations that dissenting scientific views had been suppressed (Brown 1997). Thus, beyond questions of uncertainty, like “how to know when we know enough to act,” issues of scientific integrity were now at stake. As in

1991, the hearing drew testimony from government officials and academics, including Jerry Mahlman, who had testified in 1991.

Mahlman's testimony was almost identical to his earlier statement of 1991. In both he includes a statement indicating that it is not the place of scientists to give policy advice, but he *does* suggest that reports of the Intergovernmental Panel on Climate Change be used as a basis for such a decision. He then reinforces the idea of neutrality by assigning seemingly objective probabilities to predicted events, leaving policy makers to "place their bets." Finally, he ends with the same kind of "meta-prediction" that societal need for better predictions will increase.

An interesting departure from Mahlman's 1991 testimony, however, is in the list of events to which he assigns probabilities (or, to apply Wynne's (1992) framework, measures of risk). While the 1991 list included only climatological events, such as the radiative effect of increased greenhouse gases, the 1995 list added events in the progress of climate research, such as the ability to model regional climate. This adds two new dimensions to the statement that suggest increased skill in navigating the social boundary between climate science and policy. First, Mahlman anticipates policy makers' desire for uncertainty scheduling (Appendix A), and predicts scientific breakthroughs in that area. Second, Mahlman mixes two kinds of statements in his list of probabilities. He puts predictions of events in a natural system into the same uncertainty framework as predictions of the evolution of scientific knowledge. Thus, he simultaneously engages in three of the four types of uncertainty management noted by Shackley and Wynne (1996): transformation, condensation, and scheduling.[4]

The other testimony of note in this hearing was that of Patrick Michaels (Climate Models and Projections of Potential Impacts of Global Climate Change: Testimony of Patrick Michaels 1995), a climate researcher known for his vocal and highly visible skepticism of mainstream climate science.[5] Michaels presents a series of arguments that climate models and mainstream consensus on climate change estimates cannot be trusted, and that a group of scientists labeled "the minority" have been suppressed. These assertions raise questions about the difference between "bad" science and uncertain science, but do not offer satisfactory answers. For example, Michaels argues that his (minority) view, which is that climate change will be much smaller than was predicted in the early 90s, has been supported by recent changes in climate predictions. He uses this observation to claim that: 1. models used to project climate change as reported in consensus documents like the assessment reports of the Intergovernmental Panel on Climate Change (IPCC) are flawed and inaccurate, and 2. that scientific consensus reports (which did not incorporate his criticisms) in general are not to be trusted.

Michaels' testimony provides useful fodder for any climate skeptic, expert, politician or otherwise, but is unhelpful in understanding what is to be believed about climate. Two main contradictions illustrate this:

[4] Mahlman also does some uncertainty 'displacement' at the end of his testimony when he notes that as climate predictions progress, there may be surprises along the way. He does not indicate whether this expectation is included in his prior assessment of uncertainty.

[5] For example, both in 1995 (Zehr 2000) and more recently (Michaels 2001) Michaels can be found making public statements along these lines.

1. Michaels claims that climate models are flawed and inaccurate, but that recent developments have brought their results more into line with his own work. He does not offer an explanation of why the newer models are "better," nor in fact does he appear to believe that to be the case. Thus a lay person is left to wonder what it is that makes Michaels' work on climate any more valid than that represented by the IPCC.
2. Michaels describes global warming controversy as a "classic example of the normal and creative scientific tension that exists between those who formulate hypotheses (i.e. 'models') and those who evaluate such hypotheses with observed data." In light of this, were previous consensus estimates a conspiracy against the minority view, or simply an early step in evolving scientific knowledge?

It is difficult to see how the scientific information presented in this hearing can lead to a better informed decision. The real debate in this hearing, though not explicit, is about conflicting notions of valid and/or usable knowledge. As a subtext, however, this debate is confusing and unhelpful.

In the 1991 hearing, experts differed over the gravity of climate change, but agreed that further funding of science would clarify this uncertainty and yield scientific information suitable for a policy decision. Sure enough, some testimony in the 1995 hearing did suggest that viable policy options were now available, but, as Robert Watson, representing the IPCC, noted, such decisions would still be made in the face of considerable uncertainty (Climate Models and Projections of Potential Impacts of Global Climate Change: Testimony of Robert Watson 1995). Other testimony like that of Michaels, which attempted to undermine the scientific integrity of the IPCC, suggested that such policy was unnecessary. In both cases, the testimony mixes conflicting interpretations of scientific knowledge with value-based conclusions about what should be done. In a sense, each argument invokes the precautionary principle from opposite perspectives forcing decision makers operating in such a landscape to base any conclusion on values, not science. So, while the views of scientists are logged on the public record, the information they provide does not add significant traction to any particular argument.

2005: Peer review or State of Fear?

The third hearing in this analysis, on "Science in Environmental Policy-Making," was organized by Senator James Inhofe (R-OK) before the Senate Committee on Environment and Public Works on September 28, 2005. This hearing included experts from academia, non-profit organizations, one government agency, and Michael Crichton, a famous novelist and author of the recently published environmental thriller, State of Fear.[6] Witnesses testified on a range of controversial environmental issues and larger questions of how science should or should not inform policy decisions. Despite the stated broader scope of this debate, climate change dominated the discussion, with particular focus on uncertainties in climate science and the relevance of climate science to policy.

From climate-related testimony in this hearing, it is clear that, in 10 years since the 1995 hearing, little has changed to bring any clarity to public debate over global warming or

[6] In this novel, Crichton draws extensively on climate science to inform a fictional story about a global environmental conspiracy.

the definition of good science.[7] In this discussion, opposing scientific views reach similar impasses with respect to the role of climate models and the definition of good or valid science. In particular, this debate featured an argument by Crichton and Gray that good science must be verifiable and replicable, and thus, that climate models are not and may never be useful to policy. The opposing side, represented by David Sandalow and Richard Benedick and echoed by Senators Boxer and Clinton, holds that good science should be determined on the basis of peer review. Each side, from its own normative perspective sees the other as lacking the credibility necessary to bring sound science to the table.

Discussion

Each of these three hearings is different in the ideological and experiential make-up of the expert panel, the impetus for the hearing itself, and the prescribed topic of discussion. Given these differences, the similarity of the discourse and the recurrence of (un)certain themes is striking. Climate science knowledge developed considerably between 1991 and 2005, and yet a comparison of the hearings from those years shows that many of the disagreements and misunderstandings that surfaced in the 1991 hearing remained unchanged 14 years later. This is particularly interesting given the assurances by experts in 1991 that climate science would make great advances of relevance to policy in a decade or less. Of course there is no crime in being wrong about such things, even for a scientist. But perhaps the crime is in the failure of all parties to recognize that consensus and policy are not automatic outcomes of scientific knowledge. Similarly, it should be noted that any problem discussed before Congress is arguably a societal problem by definition. The arguments about climate policy and knowledge of climate science, as described above, appear to take social concerns out of the equation, apparently placing the burdens of decision making on science itself.

In summarizing these debates, perhaps it is useful to take, as a starting point, some of the fall-out from the 1995 hearing on climate modeling. In a commentary piece in Environment Magazine, Representative George Brown (1997), who was the ranking Democrat on the House Science Committee at the time, reviews the events of the hearing and attempts to make sense of it all. His article begins by addressing the issue of misunderstandings and misrepresentations of science in these forums, lamenting that expertise is not subject to any particular standard of science that will assure the best information. In the end, he settles on peer review, claiming that without it:

> Such policy advice… constitutes nothing more than personal opinion. As such, it deserves no more deference than the opinions of other thoughtful citizens. But while most scientists generally try to limit their advice to scientific issues within their expertise or at least clearly distinguish between science and personal opinion, skeptic scientists frequently fail to abide by this standard in their publications (Brown, 1997).

[7] I do not deny that progress has been made outside of this sphere, but am merely pointing out that framing of the issue in public discourse yields equally intractable controversy that is policy-irrelevant.

One can see other Democrats taking up this charge in the 2005 hearing when Senator Clinton emphasizes the need for peer review and rejects the idea that Dr. Gray (who has published peer-reviewed material, but not on long-term climate change) or Crichton should be included as expert scientists (Science in Environmental Policy Making: Testimony of Hilary Clinton 2005).

But, especially in a hearing like that of 2005, it is not clear that one conception of science is, by definition, better than another. Concerns raised by Michael Crichton about the validity and use of models are, by some views of science, perfectly defensible and relevant. Indeed, Crichton's skepticism of modeling has been voiced by other peer-reviewed scientists (Oreskes, Shrader-Frechette, and Belitz 1994). Furthermore, Crichton's adherence to the model of a double-blind, un-biased, replicable study as the best way to achieve good science may be unrealistic for climate modeling (indeed, even if feasible it would not address concerns of model indeterminacy), but as one view of science that has been highly successful in certain areas it may be a valuable thought exercise.

The point here is that, in this hearing, as in the others discussed herein, there was enough intellectual capital in the room to construct a very rich (though by no means comprehensive) narrative of a difficult problem involving expertise in many areas, including politics. The problem was not in anyone or everyone's wrongness about what is real or true; it was the wrongness of the situation – of a public hearing which simply highlights and exacerbates the exploitability of uncertainty and the "excess of objectivity" available to any politically motivated actor (Sarewitz 2004).

In a final commentary capping a string of responses to Brown's 1997 article,[8] Simon Shackley (1997, p.3) noted that "skeptical scientists are even more convinced than most that a robust scientific knowledge base is available to direct policy, even if their understanding of that knowledge base is very different from the orthodox view," and that both the mainstream scientists and skeptics think that "general political consensus on the environment is only feasible through the 'bottom line' of scientific knowledge and understanding." How can both sides of the argument believe so strongly in both the possibility and the power of objectivity?

Writing in "Risk and Culture," Douglas and Wildavsky (1982, p. 72) observe that "something has gone badly wrong with the idea of objectivity. It is taken out of context and turned into an absolute value for all discourse. The rules that produce objectivity rule out someone's subjectivity."[9] In defense of the value of métis, James Scott (1998) invokes a similar indictment of rationality: "As Pascal wrote, the great failure of rationalism is 'not its recognition of technical knowledge, but its failure to recognize any other.'"

What is to be done? Despite the numerous and apparently obligatory pleas by participants in all three of the hearings, it is unrealistic to think that politics can some how be silenced in the name of objectivity once a scientist begins speaking. Indeed, there is no reason to think that this would be desirable. If climate scientists truly have made an effort to provide policy relevant information to decision makers over the last 15 years, they seem to have failed, at least in the limited view of this case study. Rather than strangulation, it will take enlightened and informed use of politics to nurture this sort of interaction. And of

[8] See Michaels et al. (1997)

[9] They also point out that objectivity can often be wrongly equated with rightness.

course, politicians are the actors in this relationship that are best positioned to understand interests, values and decision making – not climate scientists. Especially on their home turf.

In a moment of incredulity during the 1991 Priorities in Global Change Research hearing, Jerry Mahlman pointed out that:

> It's important to recognize that from a scientist's perspective, looking at your extraordinarily difficult jobs, that I often look and wonder when I hear you being so concerned about uncertainty. Since I read the paper every day, it seems like every decision you make has equivalent or greater uncertainties. I don't see that there's any special status to this problem whatsoever in terms of uncertainty" (Priorities in Global Climate Change Research: Testimony of Jerry Mahlman 1991, p. 78)

In addition to what Shackley (1996) might consider to be gratuitous displacement of uncertainty, Mahlman's statement performs an interesting kind of boundary work – putting it to the politicians, not to make the tough decision, but to make the same sort of decision they are faced with day in and day out. Perhaps this is a glimmer of a way forward.

If neutrality in a Congressional hearing is impossible, then it should be acknowledged that every participant, "expert" or not, is a political actor with interests and values. Though perhaps distasteful to scientists preferring the "dominant view" of science, this recognition might make their jobs a bit easier. It would force the politicians to admit, as Mahlman pointed out in 1991, that their job is to operate under uncertainty, while experts simply provide information and protect their interests. Furthermore, it would encourage politicians to recognize that decisions informed by scientists or other experts are no different from any number of other difficult political decisions they face.

Conclusion

> I would like to say that those of us on this side of the panel are not experts. We're not scientists. I recognize that. But, you know, sometimes it might be healthy to sit back and kind of push back and look at it in an unscientific way and look at it in just a logical way. You've got to keep in mind that Washington, D.C., is the city of hysteria. Everyone has got to be hysterical about everything that happens up here. (Science in Environmental Policy Making: Testimony of James Inhofe 2005)

Although this paper has documented a lack of progress at the level of discourse in Congressional hearings, far more work is needed to place this modest case study in a broader context of political and scientific discourse, as well as a context of political outcomes. It would probably be extremely difficult to find tangible connections among hearings and eventual policy decisions (or lack thereof), but such an exercise may prove useful in performing a type of sensitivity analysis of the Congressional hearing landscape – looking for strengths in the process and finding ways for experts advice to gain traction.

An important element in assembling valuable public scientific discourse is an understanding of disciplinary norms. As discussed above, we can see many examples of how

such boundaries are managed, but it would be interesting to apply systematic study of how normative frameworks clash when applied to a problem like expert input to climate policy.

As for alternatives or improvements to Congressional hearings, a modest proposal is that of carefully exploring and applying the idea of neutrality. The obvious starting point for this is a retrospective look at the Office of Technology Assessment (OTA), which was famous for its ability to assemble politically neutral expertise to report on an issue. In addition to neutrality, the structure of OTA meant a certain degree of buy-in to the process by both Democrats and Republicans (Bimber 1996). Of course a major drawback of OTA work was the difficulty in assessing the depth of impact that its reports had on policy, but perhaps the idea of neutrally mediating expertise might be applied beyond the generation of written reports.

A brief glance at an OTA report on climate policy models (Congress, 1994) yields a discussion of climate modeling which lays bare many of the issues so bitterly fought over in each of these hearings, but in an uncontroversial and matter-of-fact way. The report recognizes the multiple types of uncertainty inherent in climate model results, and also briefly discusses the limitations of models in providing reliable information about the future. This is balanced with a straightforward account of the reasons for concern about climate change, and a discussion of both the uncertainty and potential danger of inaction.

There may be multiple models that better ensure neutrality and buy-in to the process of assembling panels and, more generally, expert input to the policy process. With this plan to move forward, perhaps progress can be made in finding an important and effective role for science in hysteria of political debate.

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Appendix A. List of witnesses who gave testimony for three hearings on climate science.

Witness	Position/Institution (as listed on public record)	Summary of Debate
"Priorities in Global Climate Change Research" - House Committee on Science, Space, and Technology, Subcommittee on Science, October 8, 1991		
Jerry D. Mahlman	Director, Geophysical Fluid Dynamics Laboratory for the National Oceanic and Atmospheric Administration (NOAA)	Disagreement on significance of climate change. Agreement that more research is needed to answer important policy questions.
Richard S. Lindzen	Alfred P. Sloan Professor of Meteorology at MIT	
Ralph J. Cicerone	Professor of geosciences and chemistry at UC Irvine	
"Climate Models and Projections of Potential Impacts of Global Climate Change" - House Science Committee, Subcommittee on Energy and Environment, November 16, 1995		
Peter F. Guerrero	Director, Environmental Protection Issues at Resources, Community, and Economic Development Division, U.S. General Accounting Office	Disagreement on significance of climate change, the validity of climate science and whether distortion or suppression of science has occurred. Agreement that more research is needed.
Jerry D. Mahlman	Director, Geophysical Fluid Dynamics Laboratory for the National Oceanic and Atmospheric Administration (NOAA)	
Patrick Michaels	Assistant Professor, Department of Environmental Science, University of Virginia	
Robert T. Watson	Associate Director of Environment, Office of Science and Technology Policy, Executive Office of the President	
William Neirenberg	Director Emeritus, Scripps Institution of Oceanography	
David Gardiner	Office of Policy, Planning, and Evaluation; Environmental Protection Agency	
Thomas Gale Moore	Senior Fellow, Hoover Institution; Stanford University	
"Science in Environmental Policy-Making" - Senate Committee on Environment and Public Works, September 28, 2005		
Michael Crichton	Author	Disagreement on significance of climate change, the validity of climate science, whether distortion or suppression of science has occurred, and the measure by which expertise should be judged (peer review or verifiability). Agreement that more research is needed.
Richard Benedick	President, National Council for Science and the Environment	
William Gray	Department of Atmospheric Science, Colorado State University	
Donald Roberts	Professor, Division of Tropical Public Health, Department of Preventive Medicine and Biometrics, Uniformed Services University of the Health Sciences	
David Sandalow	Director, Environment and Energy Project, The Brookings Institution	