HARVARD UNIVERSITY
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Corporate Responses to Climate Change: The Institutional Dynamics of the Automobile Industry and Climate Change

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Environment and Natural Resources Program

Belfer Center for Science
and International Affairs

E-99-19

DECEMBER 1999

CITATION, CONTEXT, AND REPRODUCTION PAGE

This paper may be cited as: Rothenberg, Sandra and David L. Levy. 1999. "Corporate Responses to Climate Change: The Institutional Dynamics of the Automobile Industry and Climate Change" ENRP Discussion Paper E-99-19, Kennedy School of Government, Harvard University. Available at http://environment.harvard.edu/gea. No further citation is allowed without permission of the author(s). Comments are welcome and may be directed to the authors at the Belfer Center for Science and International Affairs, John F. Kennedy School of Government, Harvard University, 79 John F. Kennedy Street, Cambridge, MA 02138, telephone (617) 495-8132, fax (617) 496-0606, email slrbbu@rit.edu or Levy@umbsky.cc.umb.edu

The Global Environmental Assessment project is a collaborative team study of global environmental assessment as a link between science and policy. The Team is based at Harvard University. The project has two principal objectives. The first is to develop a more realistic and synoptic model of the actual relationships among science, assessment, and management in social responses to global change, and to use that model to understand, critique, and improve current practice of assessment as a bridge between science and policy making. The second is to elucidate a strategy of adaptive assessment and policy for global environmental problems, along with the methods and institutions to implement such a strategy in the real world.

The Global Environmental Assessment (GEA) Project is supported by a core grant from the National Science Foundation (Award No. SBR-9521910) for the "Global Environmental Assessment Team." Supplemental support to the GEA Team is provided by the National Oceanic and Atmospheric Administration, the Department of Energy, the National Aeronautics and Space Administration, the National Science Foundation, and the National Institute for Global Environmental Change. Additional support has been provided by the Department of Energy (Award No. DE-FG02-95ER62122) for the project, "Assessment Strategies for Global Environmental Change," the National Institute for Global Environmental Change (Awards No. 901214-HAR, LWT 62-123-06518) for the project "Towards Useful Integrated Assessments," the Center for Integrated Study of the Human Dimensions of Global Integrated Assessment Center at Carnegie Mellon University (NSF Award No. SBR-9521914) for the project "The Use of Global Environmental Assessments," the Belfer Center for Science and International Affairs at Harvard University's Kennedy School of Government, the International Human Dimensions Programme on Global Environmental Change, Harvard's Weatherhead Center for International Affairs, Harvard's Environmental Information Center, the International Institute for Applied Systems Analysis, the German Academic Exchange Service, the Heinrich Boll Foundation in Germany, the Massachusetts Institute of Technology's Center for Environmental Initiatives, the Heinz Family Foundation, the Heinz Center for Science, Economics and the Environment, and the National Center for Environmental Decisionmaking Research. The views expressed in this paper are those of the author and do not imply endorsement by any of the supporting institutions.

Publication abstracts of the GEA Project can be found on the GEA Web Page at http://environment.harvard.edu/gea. Further information on the Global Environmental Assessment project can be obtained from the Project Associate Director, Nancy Dickson, Belfer Center for Science and International Affairs, Kennedy School of Government, Harvard University, 79 JFK Street, Cambridge, MA 02138, telephone (617) 496-9469, telefax (617) 495-8963, Email nancy_dickson@harvard.edu.

FOREWORD

This paper was written as part of the Global Environmental Assessment Project, a collaborative, interdisciplinary effort to explore how assessment activities can better link scientific understanding with effective action on issues arising in the context of global environmental change. The Project seeks to understand the special problems, challenges and opportunities that arise in efforts to develop common scientific assessments that are relevant and credible across multiple national circumstances and political cultures. It takes a long-term perspective focused on the interactions of science, assessment and management over periods of a decade or more, rather than concentrating on specific studies or negotiating sessions. Global environmental change is viewed broadly to include not only climate and other atmospheric issues, but also transboundary movements of organisms and chemical toxins. (To learn more about the GEA Project visit the web page at http://environment.harvard.edu/gea/.)

The Project seeks to achieve progress towards three goals: deepening the critical understanding of the relationships among research, assessment and management in the global environmental arena; enhancing the communication among scholars and practitioners of global environmental assessments; and illuminating the contemporary choices facing the designers of global environmental assessments. It pursues these goals through a three-pronged strategy of competitively awarded fellowships that bring advanced doctoral and post-doctoral students to Harvard; an interdisciplinary training and research program involving faculty and fellows; and annual meetings bringing together scholars and practitioners of assessment.

The core of the Project is its Research Fellows. Fellows spend the year working with one another and project faculty as a Research Group exploring histories, processes and effects of global environmental assessment. These papers look across a range of particular assessments to examine variation and changes in what has been assessed, explore assessment as a part of a broader pattern of communication, and focus on the dynamics of assessment. The contributions these papers provide has been fundamental to the development of the GEA venture. I look forward to seeing revised versions published in appropriate journals.

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ABSTRACT

Although there has been some growing recognition of the role of private actors in international environmental regimes, little attention has been paid to the role of the private sector at the science-policy interface. Because the automobile industry plays a crucial role in mitigation of greenhouse gases, successful policy requires not just the assent but the active cooperation of this sector. Such cooperation, however, requires some institutional acceptance that climate change is indeed a significant risk. The work of the GEA program and others suggests that formal assessments do not simply land on the desks of policy makers and drive policy; rather, a complex social and political process mediates science and policy. In a similar way, the private sector is not a simple consumer of formal assessments. In this paper, we outline the role of institutional pressures in the development of corporate perspectives of climate change. Although institutional theory generally predicts convergence, or isomorphism, among organizational actors, theoretical arguments will be developed here to account for both homogeneous and heterogeneous corporate perceptions of and responses to climate change science. We focus on two factors, multiple competitive discourses within institutional fields and the transformation of institutional pressures through organizational boundaries and lenses, to explain industry responses to climate science and scientific assessments. We then explore these theoretical arguments through the case of the response of the US automobile to the climate change issue.

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ACRONYM LIST

AAMA	American Automotive Manufacturers Association
AEP	American Electric Power
API	American Petroleum Institute
BCSE	Business council for Sustainable Development
CAFE	Corporate Average Fuel Economy
CARB	California Air Review Board
CFC	Chloro Flouro Carbons
DOE	Department of Energy
EPA	Environmental Protection Agency
EPRI	Electric Power Research Institute
GCC	Global Climate Coalition
GCM	General Circulation Models
GHG	Greenhouse Gas
GM	General Motors
ICE	Information Council for the Environment
IPCC	International Panel on Climate Change
NAM	National Association of Manufacturers
NGO	Non-governmental Organization
NOAA	National Oceanic and Atmospheric Administration
PCAST	President's Committee of Advisors for Science and Technology
SAR	Second Assessment Report
SUV	Sport Utility Vehicle
UAW	United Auto Workers

Introduction

Corporations are critical players in the worldwide effort to address greenhouse gas (GHG) and other emissions. The business sector directly or indirectly accounts for the vast majority of greenhouse gas emissions. At the same time, business controls substantial technological, financial and organizational resources, which, if applied appropriately, could play a major role in reducing GHG emissions. The automobile sector is responsible for substantial emissions, and is among the most prominent non-state actors in the emerging international regime to address climate change (Winter 1998). Securing the cooperation of automobile companies is thus a key public policy objective.

Most of the literature on science and technology studies examines the interface between science and policy and suggests that scientific knowledge and social structures of governance are co-produced, and that the boundaries between policy and science are inherently ambiguous and subject to continuous renegotiation. The private sector, however, has generally been neglected in this debate. Although there has been some growing recognition of the role of private actors in international environmental regimes (Clapp 1998; Haufler 1998), little attention has been paid to the role of the private sector at the science-policy interface. Because the automobile industry plays a crucial role in mitigation of greenhouse gases, successful policy requires not just the assent but the active cooperation of this sector. Such cooperation, however, requires some institutional acceptance that climate change is indeed a significant risk. The work of the GEA program and others suggests that formal assessments do not simply land on the desks of policy makers and drive policy; rather, a complex social and political process mediates science and policy. In a similar way, the private sector is not a simple consumer of formal assessments.

The efforts of the fossil fuel industry to cast doubt on claims that greenhouse gases are causing dangerous changes to the climate system are by now well documented (Gelbspan 1997; Franz 1998; Levy and Egan 1998). These efforts are generally interpreted to be strategic manipulation of scientific uncertainties and standards of proof; companies recognize that their economic interests are imperiled by potential measures to address climate change, and challenging the science is a time honored strategy for delaying or averting regulation (Jasanoff 1990). In this paper, we argue that corporate perspectives on climate science are not purely strategic; these perspectives are shaped by particular organizational structures, processes, and institutional pressures, and are internalized into the value and meaning structures of an organization. In addition, perceptions of economic interests and climate science mutually constitute each other; the perception of economic peril generates skepticism about the science, which in turn leads companies to defer investments in low emission technologies.

How, then, are perceptions of economic interest and environmental science created? Given the high level of uncertainty concerning environmental science, technological and market developments, and policy responses, auto firms cannot calculate their economic interests and appropriate strategic responses in any objective manner. In the absence of a rational economic calculus for assessing the returns of different response strategies to the climate issue, there is substantial scope for managerial discretion. Institutional theorists argue that institutional pressures will exert a relatively strong influence on organizational practices when market discipline is relatively weak, or when uncertainty is high. Uncertainty increases the influence of the institutional environment and reduces the impact of economic and competitive factors, or what is termed the task environment (Oliver 1997).

The sharp distinction between institutional and economic explanations, however, breaks down under closer examination. A more useful theoretical approach avoids this dualism and recognizes that economic calculations of interests always embody assumptions which may be more or less certain and subject to some degree of discursive construction. If scientific knowledge is increasingly recognized to be constructed through social, political, and institutional processes, economic knowledge is much more clearly so (Callon 1998). The problem is not that investment decisions are taken under conditions of uncertainty, for which many techniques exist. The issue is that planning scenarios contain predictions about research and development costs, consumer behavior, competitors' reactions, and regulatory practices that are shaped by structures of meaning which vary across organizational fields and are not stable over time. This economic knowledge, which guides corporate decisions, is a representation of the economy just as scientific knowledge is a representation of the physical world. Companies will engage with, absorb, and re-articulate cognitive and normative structures that have become relatively stabilized in their institutional environments. Moreover, corporate interests cannot be reduced to a single objective function such as profit maximization (Cyert and March 1965). Given the presence of multiple competing goals within a firm, corporate perspectives and decisions should be understood as emanating from a negotiated consensus among the dominant actors and coalitions within a firm. This internal process of discursive contestation and negotiation over representations of interests interacts with external institutional pressures. Economic knowledge is thus constructed among actor-networks at the firm and the industry levels. Agents, whether at the individual, departmental, corporate, or industry level, are embedded within and constituted within these networks (Granovetter 1985).

In this paper, we outline the role of institutional pressures in the development of corporate perspectives of climate change. Although institutional theory generally predicts convergence, or isomorphism, among organizational actors, theoretical arguments will be developed here to account for both homogeneous and heterogeneous corporate perceptions of and responses to climate change science. We then explore these theoretical arguments through the case of the response of the US automobile to the climate change issue.

Institutional Theory and Corporate Responses

Corporate perspectives on climate science and the market potential for mitigation technologies are likely to be influenced by a number of institutional actors. In addition to formal assessments conducted by national and international agencies, these agents might include competitors, industry associations, consumers, NGOs, regulatory agencies, the media and scholarly journals. These actors provide, in different degrees, information, legitimacy, resources, normative influence, and coercive pressures.

These actors constitute an organizational field, in the language of institutional theory, which, over a period of time, establishes norms, policies, and standards of accepted behavior that shape a particular company's discourse and practices (Powell 1991; Scott 1994). The core insight of the institutional perspective is that organizations are embedded within institutional fields with important cultural, symbolic, and regulatory dimensions. Organizations derive legitimacy as well as resources through conformity with their environments, and this tendency toward convergence, or isomorphism, operates through coercive, mimetic, and normative pressures (DiMaggio and Powell 1983). The institutional approach accounts for the persistence through time of organizational practices and discourses even when they have little direct economic value. Organizational boundaries are not considered to be major hurdles to the free and undistorted diffusion of practices and discourses, as dominant institutional cognitive, normative, and operational structures are presumed to create strong pressures for convergence across the organizational field.

Although institutional theory has generally been used to explain isomorphism of management practice among organizations, it can also be used to explain heterogeneity. Three primary theoretical arguments could account for heterogeneous organizational responses and perceptions. In this paper we will be focusing on the later two, as they have been addressed least in existing research. First, organizations often operate within multiple institutional fields, for example, belonging to different industry associations or national cultural and regulatory contexts, creating divergent pressures (D'Aunno, Sutton et al. 1991; Kempton and Craig 1993; Alexander 1996; Hoffman 1997). The boundaries of such organizational fields are inherently unclear, and organizational fields may overlap or be nested in broader structures (Holm 1995).

A second explanation for differences among companies, less explored in existing research, is that institutional discourses and practices do not pass undisturbed across organizational boundaries. Each company interprets institutional discourses through its own unique lens, which is a product of its own institutional history and organizational culture. A history of conflictual relations with regulatory agencies or of unsuccessful ventures with low emission technologies will inform the manner in which external discourses and practices are imported and rearticulated. Critical in this process is the action of boundary spanners, individuals or units that serve to link organizational

structure to environmental elements, whether by buffering, moderating, or influencing the environment (Thompson 1967; Aldrich and Herker 1977; Leifer and Delbecq 1978; Fennell and Alexander 1987). DiMaggio (1988) and Fligstein (1997) both stress the role of boundary spanners, called "institutional entrepreneurs," who are actors with sufficient power and resources to realize interests and change institutions (DiMaggio, 1988).

Boundary spanners are central in institutional dynamics because, not only do they attend to and filter information about the organizational context, but they also maintain organizational legitimacy through their interactions with stakeholders (Aldrich and Herker 1977). As described by Aldrich and Herker (1997), the reaction of an organization to the environment depends "to a great extent on the ability of the boundary spanners to achieve a compromise between organizational policy and environmental constraints [and] to choose strategies to overcome these constraints."

Finally, an organizational field can sustain multiple competing discourses. Concerning the environment, many companies still adhere to the notion that environmental regulations are inherently costly and antithetical to their economic interests. A growing group of companies, however, are embracing the discourse and practices of environmental management (Levy 1997), termed "eco-modernism" by (Hajer 1995), which posits that incorporating environmental concerns into business strategy can reduce costs and build new markets. Within the automobile industry, the traditional discourse held sway until the mid-1990s, but the eco-modernist discourse is contesting these conceptions and provides an alternative vocabulary with which firms can engage. Similarly, skeptical approaches to climate science provided discursive competition for those trying to use science to justify aggressive policy measures.

Method

Case study methodology is most appropriate to this area of research because of the complex relations among the actors and variables. Case studies can provide the breadth and depth of information to allow descriptive, causative, and inductive analysis to be performed (Eisenhardt 1989; Miles and Huberman 1994; Yin 1994). Yin (1989, pp.13-14) argues that:

> case studies are the preferred strategy when 'how' or 'why' questions are being posed, when the investigator has little control over events, and when the focus is on a contemporary phenomenon within some real life context....the distinctive need for case studies arises out of the desire to understand complex social phenomena.

The rich data generated by the case method are uniquely valuable in inductive, exploratory work. Eisenhardt (1989, p. 541) argues that the close relationship between theory-building and data

collection in case studies is likely to reduce bias, generate measurable constructs and testable hypotheses, and enhance the empirical validity of the theory:

> The central idea is that researchers constantly compare theory and data - iterating toward a theory which closely fits the data. A close fit is important to building good theory because it takes advantage of the new insights possible from the data and yields an empirically valid theory.

This paper draws primarily from the experiences of two US automobile manufacturers. Data acquisition was acquired in a number of manners. Personal interviews were conducted over the course of several visits to firms in the automobile industry. Interviews were conducted with a cross-section of firm employees, including environmental staff, strategy, product development, marketing, and R&D. Other interviews, particularly those that focused on the more historical data, were performed over the phone, using a pre-developed semi-structured telephone interview format. Additional material was gathered through an extensive review of secondary source material.

Case material were analyzed through coding and display of data. All articles and interviewed were coded using QRS nudist. Two primary display formats, both of which are suggested by both Miles and Huberman (1994) and Yin (1994), were used. The first format is a temporal ordering of the data, in which specific events were placed in time lines created in order to gain a sense of historical development. The second format is a comparative matrix, in which the coded segments were categorized and placed in a matrix in order to explore how cases, in this case companies, differ from one another. Secondary source material was also collected for a more macro level analysis. These data were used to develop a general picture of the institutional and scientific background of the climate change issue.

Background: A History of The U.S. Industry Response to Climate Science

The Response of an Industrial Field

The notion that human emission of greenhouse gases might warm the earth's climate dates back to the work of Baron Jean Baptiste Fourier in 1827, and Svante Arrhenius first published estimates of the amount of warming caused by greenhouse gas related radiative forcing in 1896. The development of the scientific, institutional, and political dimensions of the climate issue have been detailed in a number of studies (Bodansky 1994; Agrawala 1998; Alfsen and Skodvin 1998; Edwards and Lahsen 1999; Kruck, Borchers et al. 1999). Scientific resources devoted to the issue grew rapidly during the 1960s and 1970s, and policymakers began to turn significant attention to it during the 1980s. Industry only began to take serious note of climate as a concern with regulatory import in the latter 1980s. The American automobile industry has been among the most vocal opponents of mandatory controls on emissions of greenhouse gases, though it has

not, of course, been alone in this opposition. Their activity has existed within a larger context of opposition from industrial sectors related to fossil fuels.

The automobile industry's response has largely been channeled through industry associations, the most vocal of which has been the Global Climate Coalition (GCC). The GCC was formed in 1989, initially under the auspices of the National Association of Manufacturers (NAM), though it was reorganized as an independent entity in 1992. The GCC represented about 40 companies and industry associations, primarily major users of fossil fuels such as the oil, automobile, and electric utility sectors, but also including other energy intense sectors such as cement, aluminum, iron and steel, chemicals, and paper. GM, Ford, and Chrysler, along with the AAMA, were all members. A senior GCC staff member, discussing motivations for the creation of the GCC, expressed the view that industry had become involved late in the negotiations leading to the Montreal Protocol, and that there was also considerable dissatisfaction with the Clean Air Act process. As he expressed it, "Boy, if we didn't like the Montreal Protocol, we knew we really wouldn't like climate change! This is the mother of all issues!" Although the GCC was constituted as a U.S.-based organization and was focused on domestic lobbying, a number of US subsidiaries of European multinationals also joined, and the GCC quickly rose to be the most prominent voice of industry, both in the US and in the international negotiations.

A key strategy of the GCC in its opposition to mandatory emission controls has been to challenge the science of climate change, pointing to a spectrum of opinion rather than consensus among scientists, and highlighting the uncertainties. Several scholars have noted that industry can attempt to protect itself from regulation with the authority and credibility of science, by invoking the high standards of proof required to accept a new scientific theory (Shackley 1999). Edwards and Lahsen (1999, pg. 12), for example, state that, "Economically powerful groups targeted by possible regulations, such as the fossil fuel industry, are well aware that closure of debate can be delayed by challenging key scientific results, or, sometimes even more effectively, by raising the level of certainty required of scientific knowledge". Industries' preference for "sound science" is also discussed by Jasanoff (1987) as part of the political negotiation of boundaries between science and policy. In fact, the GCC makes this explicit in its mission statement: "A bedrock principle for addressing global climate change issues is that science -- not emotional or political reactions -- must serve as the foundation for global climate policy decisions."

The GCC's efforts to challenge the science of climate change took a number of forms. It actively promoted the views of climate skeptics such as Patrick Michaels, Fred Singer, and Richard Lindzen in its literature, press releases, and congressional testimony, and would direct press inquiries to these people. It sponsored a number of reports, such as Accu-Weather (1994) and Davis (1996), and would also use reports from other sympathetic organizations, notably the Marshall Institute. The GCC regarded favorably the voluntary approach of the US Climate Action Plan, and in December 1994 asserted that "the state of the science does not justify adopting any additional commitments or actions at this time. Key aspects of the science,

particularly climate and regional weather effects, remain highly uncertain " (Global Climate Coalition 1994, pg. 30). The extent of uncertainty is, however, overstated. In an undated *Backgrounder* from the mid-1990s, it is acknowledged that greenhouse gases trap the sun's warmth and that their atmospheric concentrations are rising, but it is asserted that "scientists differ on whether the increase in the concentrations of these gases *will* cause an 'enhanced greenhouse effect', or warming of the planet." (emphasis added - note the future tense). This statement, with which even science skeptics would disagree, is, in a rhetorical sleight of hand, "supported" by a Gallup poll of American climate scientists, in which, when asked whether there *has* been any identifiable, human induced global warming to date, 49 percent of respondents replied no, and only 18 percent replied positively (emphasis added). The theme of uncertainty is developed in another *Backgrounder* that presents a more detailed critique of general circulation models (GCMs), pointing to their well-known limitations in modeling complex phenomena such as cloud cover, regional processes, and ocean circulation (Shackley 1999). They even cite Dr. Stephen Schneider from a 1990 Greenpeace report on the need for high resolution, coupled atmospheric models. This skeptical approach to GCMs stands in ironic contrast to the credibility the GCC has bestowed on general equilibrium economic models such as that used by the WEFA Group (WEFA Group and H. Zinder & Associates 1996), which predict a high cost for GHG mitigation, even though these models are even more complex and rest on less secure theoretical foundations than GCMs.

In addition to emphasizing uncertainties and the need for more scientific research, a number of discursive themes recur throughout the industry literature. One is that the greenhouse effect is natural and life sustaining. A second theme is that human emissions of greenhouse gases are relatively small compared to the total carbon cycle and to the radiative forcing due to water vapor. A final theme is that higher CO2 concentrations might increase " plant productivity", which is perhaps an argument geared toward the agricultural and forestry industries. This notion was made a centerpiece of a film titled *The Greening of Planet Earth* by the Western Fuels Association, a utility association and former member of the GCC, and was also repeated in a series of 1993 advertisements titled Repeal Rio.

The GCC not only challenged the scientific basis of the negotiations to limit emissions of greenhouse gases, but also mounted a public attack on the review process of the IPCC. At a symposium in Rayburn House, Washington DC, in May 1996, Don Pearlman of the Climate Council and William O'Keefe of the GCC and the American Petroleum Institute accused IPCC lead authors Ben Santer and Tom Wigley of secretly altering the IPCC report to reduce the expression of uncertainties, particularly in chapter 8. This chapter was the source of the oft-quoted IPCC statement that "the balance of evidence suggests that there is a discernible human influence on global climate." The GCC placed advertisements in the Washington Times and Energy Daily, stating that "unless the management of the IPCC promptly undertakes to republish the printed versions...the IPCC's credibility will have been lost." (Gelbspan 1997, pg. 78). Fred Seitz of the Marshall Institute followed with an op-ed piece in the Wall Street Journal on June 12, which became the forum for a spirited exchange (Edwards and Schneider 1997).

Although the IPCC maintained that the textual revisions to the SAR were well within the bounds of editorial discretion, a number of process changes were initiated. The IPCC, under the leadership of Bob Watson, increased its efforts to include industry authors and reviewers for the Third Assessment Report and introduced Review Editors to the process, whose role was to ensure that authors at least considered comments submitted by external experts, NGOs, and industry. Although industry interviewees considered this a successful effort to open up the IPCC process, in broader political terms the challenge to IPCC's credibility fell short. According to Edwards (Edwards and Schneider 1997) the Chapter 8 controversy represented the particularly legalistic character of climate politics in the US, and the concerns were largely ignored in Europe. Levy (1998) argues that the challenge had little impact on the international negotiations because of the relative autonomy and legitimacy of the IPCC institutions. Moreover, the US delegation, under pressure to respond, chose to distance itself from the fossil fuel lobby. Tim Wirth, the US Under-Secretary of State for Global Affairs and head of the US delegation at the Second Conference of the Parties (COP-2) in Geneva in 1996, declared:

> We are not swayed by and strongly object to the recent allegations about the integrity of the IPCC's conclusions. These concerns were raised not by the scientists involved in the IPCC, not by participating governments, but rather by naysayers and special interests bent on belittling, attacking and obfuscating climate change science".[1]

After the Chapter 8 affair, industry became much more circumspect about challenging the fundamental science of climate. In planning its campaign in the run-up to Kyoto in December 1997, the GCC decided to shift the focus from scientific uncertainties toward the high costs of mitigation and the lack of developing country commitments. This decision was based, in part, upon market research that suggested the public was not engaged with the scientific debates and did not find industry a particularly credible source. Rather than challenge the credibility of the IPCC, the GCC has begun to use the cautious language of the SAR to its own advantage; in a June 20, 1997 press release, it cited the SAR in repudiating claims made by the environmental group Ozone Action.

At a more general level, in the late 1990s, a shift in position was similarly occurring in some sectors of US industry. On June 8, 1997, the Business Roundtable sponsored full-page advertisements in the US press signed by 130 CEOs which argued against mandatory emissions limitations at the forthcoming Kyoto conference, citing scientific uncertainties and the high cost of action. It was no accident, however, that the other 80 Business Roundtable members did not endorse the advertisements. Two companies had led an unsuccessful effort to draft an alternative text, which acknowledged that sufficient scientific evidence had accumulated to warrant concern, and that industry should be constructively engaged in developing precautionary measures. According to one member of PCAST, this break in industry ranks was brought to President Clinton's attention at the June 1997 meeting of the President's Council of Advisers for Science

and Technology (PCAST), at which a report on energy R&D options was presented. The President's awareness of the minority industry faction had significant political ramifications. He mobilized an interagency task force, and started a process that eventually converged on a set of policy recommendations for Kyoto.

A much more public effort to coalesce an industry bloc supportive of emission reductions was led by Eileen Claussen, a former U.S. Assistant Secretary of State for Environmental Affairs and negotiator at the climate change negotiations, who formed the Pew Center on Global Climate Change in April 1998. Thirteen companies joined immediately, including BP, Toyota, Boeing, Lockheed, Enron, United Technologies, American Electric Power, Whirlpool, Maytag, and 3M. These companies signed on to a series of newspaper advertisements stating that they "accept the views of most scientists that enough is known about the science and environmental impacts of climate change for us to take actions to address its consequences" (Cushman 1998). The Pew Center aimed to replace the International Climate Change Partnership (ICCP), headed by Kevin Fay, as the voice of progressive industry, and Claussen was forthright in explaining the benefits of membership: "Joining Pew gives companies credibility, and credibility means political access and influence. Reputation is especially important for companies in consumer markets". This message was not wasted on Dale E. Heydlauff, environmental VP of American Electric Power, who announced on joining the Pew Center that his company had a better chance of avoiding disaster "if we acknowledge there is legitimacy to the issues and have a hand in writing the policies" (Carey 1998). The highest priority policy concern for the US automobile industry was to avoid a tightening of CAFE standards, and obtaining credit for early action was also on the (Financial Times 1998).

A purely rationalist explanation for the shift in industry position would point to the emerging scientific consensus since the Second Assessment Report of the IPCC in 1995 and the strategic benefits for companies to "board the train" once it was seen to be leaving the station. By 1997, the business press in the US and Europe was conveying the impression of consensus (Raeburn 1997; Stipp 1997; The Economist 1997). From the perspective of a leading expert in this area, advances in basic science were fundamental to this change: "the whole fingerprint argument has become much stronger since the SAR. You've got the empirical data of record warmth, and the arguments about satellite measurements and solar effects have been resolved in refereed scientific publications." The growing body of scholarship in the field of science, technology, and policy should make us wary, however, of any simple linear connection between knowledge generated in the institutions of the scientific establishment, and societal responses. While the evolving science has surely played an important role in shifting corporate perspectives on the climate issue, the impact of this knowledge is mediated by the institutional environments in which companies are embedded.

Response of the US Automobile Industry

The response of the United States automobile industry to climate change science closely mirrors that of the more general story just recounted. Despite the debate in the scientific arena on climate change for many years prior, and the participation of some internal scientists in this debate, corporate attention to the climate issue picked up speed only in the late eighties. Managers and scientists at both Ford and GM recalled James Hansen's testimony before the US House Energy Committee in June 1988 as the catalyst that catapulted climate change onto corporate radar screens. Climate change did not become a high-priority issue beyond GM's relatively autonomous research laboratories until 1988. In Ford, participation in IPCC activities and more formal scientific scanning also started in the late eighties. Hansen, from NASA, testified during an unusually hot spell in the eastern U. S. that he was "99 percent certain" that recent warmer temperatures were attributable to greenhouse gas induced climate change, a claim which generated considerable media attention (Edwards and Lahsen 1999). As a result of this testimony and the high level of attention to the issue in the popular press, one industry climate specialist described his shock at how quickly "climate went from zero to sixty".

This delayed and "surprised" response suggests that the automobile industry paid little attention to the development of scientific concern around greenhouse gases or to early interest in the policy community. The President's Science Advisory Committee had discussed greenhouse gases and climate as far back as 1965, and in the early 1970s, two major scientific studies, according to Edwards, put climate firmly on the US policy agenda. The White House proposed a US climate program in 1974, leading to the National Climate Program Act of 1978, which authorized $50 million annually in research funding. The US Department of Energy initiated a CO2 research and assessment program in 1977, and in 1979 the White House Office of Science and Technology Policy requested a study on climate from the National Research Council. The ensuing Charney report predicted global warming in the range 1.5 C to 4.5 C, a forecast which has remained remarkably stable over two decades. In 1983, the US EPA published a rather alarming report on climate based on Hansen's modeling work. Yet, management in the US automobile industry appears to have paid much closer attention to the mass media coverage of Hansen's congressional testimony than to scientific developments. One GM scientist, Ruth Reck, recalled "We lived by the Wall Street Journal and the New York Times."

Another reason cited by managers for the attention to climate in 1988 was the rapidity with which the ozone depletion issue had moved from scientific concern to the Montreal Protocol in 1987, mandating a 50 percent reduction in CFC production. Indeed, attention to CFCs in the mid 1980s might have diverted industry attention away from greenhouse gases. To the extent that corporate managers take their cues from the US media, with its rather parochial national focus, they would be less likely to hear about major international conferences on climate. Although Detroit is closer to Toronto than to Washington D.C., almost none of the managers recalled the June 1988 Toronto Conference on the Changing Atmosphere, which culminated in a call for a

20% cut in greenhouse gas emissions by 2005 from 1987 levels. Even less known was the earlier series of workshops in Villach, Austria, held from 1980 to 1985.

Although Toyota was the only car company to join the Pew Center, the US automobile companies have also toned down their criticism of climate science as Kyoto approached. According to the trade journal *Automotive Industries* when the three US auto CEOs and UAW president Steve Yokich met with President Clinton in the Oval Office in early October, "they never questioned whether global warming was a scientifically proven concept." (Sorge and McElroy 1997) Ford's Trotman recalled that "We did not argue the science with the President. We didn't think that was a good use of his time or ours. It's generally agreed that the CO2 in the air has increased in the last decades and that there's cause for concern, and that we should be doing something."

An Institutional Analysis of the Industry Response

Multiple Competitive Discourses

The now famous speech by British Petroleum's Group Chief Executive, John Browne at Stanford University on May 19, 1997 represented the first major fissure in the fossil fuel industry's position on the science of climate change. He stated that "there is now an effective consensus among the world's leading scientists and serious and well informed people outside the scientific community that there is a discernible human influence on the climate, and a link between the concentration of carbon dioxide and the increase in temperature." While acknowledging that considerable uncertainties still exist, Browne explicitly invoked the precautionary principle. This comment reflects a broader pattern of competing discourses within the institutional field marked by high industrial interaction.

These competing discourses emerged in a number of settings. Earlier, for example, we discussed the widening rift between firms within the Business Roundtable. Another example is the congressional hearings on climate change. On the surface, many hearings presented an example of what Hajer (1995) terms a "discourse coalition" among the fossil fuel industry, the climate skeptics, and key Republican congresspeople, in which coalition members appeared to share a concern that policy be guided by rigorous science, a broad distrust of governmental regulation, and a suspicion of the ideological roots of climate advocates. On closer inspection, however, a number of revealing discrepancies demonstrate the presence of fault lines and contradictions in this coalition. Statements by congressional committee leaders reveal a deep ideological antagonism toward environmentalism in general; Dana Rohrabacher termed the ozone depletion issue "another basically Chicken Little, a cry we've heard before when the American people were scared into the immediate removal of asbestos from their schools." Industry, by contrast, after fighting the good fight, demonstrated a more pragmatic, accommodationist approach (Levy 1997).

The common commitment to sound science is also questionable. While one or two of the skeptics, notably Lindzen, are widely acknowledged to adhere to the practices and norms that confer scientific legitimacy and credibility, others such as Patrick Michaels and Fred Singer do not publish on climate in the refereed literature. The politicians, who proclaim their desire for sound science, express distrust for the institutionalized procedures of the scientific community. Representative John Doolittle, when questioned about Fred Singer's credentials, responded that he was "not going to get involved in a mumbo jumbo of peer reviewed documents" (Gelbspan 1997, pg. 65). Both Doolittle and Rohrabacher claimed that the established community of climate scientists was exaggerating the problem in order to obtain greater funding. While many scholars would agree that scientific institutions do not, and cannot, deliver pure science untainted by politics (Jasanoff 1990; Boehmer-Christiansen 1994), the appeal to sound science in this case appears somewhat selective. Moreover, the fossil fuel lobby was on record for requesting more research, but the Republicans controlling congressional on the committees were interested in cutting government funding for climate research. At the May 1996 hearing, Rohrabacher called climate change research "money right down a rathole" (Gelbspan 1997, pg, 77). One insight to be gleaned from these hearings is that discursive coalitions are incomplete, unstable and contingent affairs.

As we discussed earlier, alliances can shift as some companies began to reconsider their economic interests and became more open to the scientific conclusions of the IPCC. The API apparently dissented from the 1997 decision to downplay the science, and began preparing a new campaign to enroll a group of climate skeptics who were not previously identified with the fossil fuel lobby. In internal documents leaked to the National Environmental Trust and the New York Times, API claimed that "those who oppose the treaty have done little to build a case against precipitous action on climate change based on the scientific uncertainty. As a result, the Clinton administration and environmental groups essentially have had the field to themselves." (National Environmental Trust 1998) The action plan expressed concern that the US media conveyed an impression of emerging scientific consensus while industry and its partners ceded the science and fought on the economic issues. The document argued that this stance was a strategic miscalculation because it put opponents of the Kyoto protocol in a weak position; a successful campaign to challenge the science "puts the United States in a stronger moral position and frees its negotiators from the need to make concessions as a defense against perceived selfish economic concerns."

Transformation of Institutional Pressures through Organizational Boundaries and Lenses

The Corporate Scientist as Monitor and Filter

Automobile companies construct perspectives on climate science based on multiple sources of information, both inside the company and in the external environment. Critical in the development of these perspectives are organizational boundary spanners, individuals who scan

the external environment for new information and translate it to the rest of the organization, as well as attempt to influence the constructions of this information in the external environment. Most climate science information in the automobile industry is formally filtered through such boundary spanners, often located in the R&D or environmental science department. For the climate issue, both Ford and GM use internal scientists to monitor the issue, filter and analyze the voluminous literature, and make presentations and recommendations to management. It is the job of the internal scientists to relay the state of the science to others in the organization. Therefore, scientists inside companies can play an important role in shaping corporate perspectives on particular issues.

With a large and independent research staff, GM appears to have been the first company to follow climate science in a serious manner. The VP of Environmental Activities at GM heard about a 1971 scientific article concerning the role of particulates and greenhouse gases in the global climate system, and he took an interest in their potential contribution to atmospheric cooling, the predominant climatic concern of the period. Ruth Reck, a scientist working in GM's research laboratories was assigned to examine the question. At Ford, prior to 1988, while Ford managers had held a number of discussions on the subject, they did not have anyone specifically assigned to tracking the climate issue. In 1988, however, Ford formally assigned an internal scientist to track climate science, and an engineer to monitor and participate in the negotiations over a climate regime and the IPCC process.

Environmental scientists are usually trained formally in the sciences, such as atmospheric chemistry, and are actively involved with the external scientific community. GM, for example, employs a small group of environmental scientists who publish in peer reviewed journals, attend conferences, and participate in governmental panels. It is through their interaction with the scientific community that these internal scientists became the first employees to be aware of the climate change as a potential concern for the firm.

Interestingly, early awareness of the climate issue often occurred through research involvement in other basic scientific issues, such as smog formation, tropospheric ozone, and CFCs, and particulates, in which GM and Ford labs were actively engaged. Remembered one VP of R&D at GM,

> Although most of the action had to do with tropospheric air pollution and emissions, there were several people who were real players in air mass movements and so on, so that there was a base of sophistication about atmospheric science systems. The first time it came onto my radar screen was in the 60s and 70s. I was certainly conscious of the worries that the world was about to freeze to death, so I thought I would follow it along. At GM it was around me as a developing issue, but that was more as a scientist than specifically as a manager.

Interaction with the scientific community, therefore, is an important mechanism for early and continued awareness of the climate issue. This interaction takes a number of forms. The most commonly cited activity was the regular scanning of journals such as *Nature* and *Science.* Membership in scientific associations and associated activities also brought scientists in contact with the climate issue. IPCC style assessments appear to be less important for the internal scientists in determining the state of the science. As stated by one environmental manager at Ford, "IPCC reports had little effect, and caused few surprises. [Our internal scientists] already let us know what was coming down the pike." An in-house scientist thought that her lack of attention to IPCC perhaps was due to its political nature. She commented, "The IPCC is the politics of science, not the science of science. I am inclined to stay out of the politics of it."

Instead, companies are more likely to obtain scientific "assessments" by interaction with outside academic experts. Both GM and Ford invited in a number of academic experts, though the list tended to be dominated by skeptics. Companies might also obtain information through interactions with government agencies, particularly in the US DOE and EPA, and through participation in programs such as Climate Wise or the voluntary EPA GHG reporting system.

The role of these formal boundary spanners varies. Some of the information transfer is done on a more passive level, where the scientists serve as a resource rather than an active proponent of certain scientific concepts. When the issue becomes hot in the popular press, for example, scientists are often turned to for advice. Similarly, an internal scientist might be called upon to review material if an executive was going to testify to congress or speak publicly about climate issues. At Ford, a member of the environmental engineering group was active in monitoring the IPCC process. This position was created when he advocated for his participation in major assessment processes, such as the UN negotiation sessions and the IPCC. As recalled by the VP of Environment, "[He] recommended that if we wanted to understand the human, political, and scientific dynamics of the issue, he really needed to be there." Interestingly, he performed this external monitoring function on behalf of the US auto industry and was funded and reported through the AAMA. As explained by the Ford's VP of Environment, "He was our window on the issues coming over the horizon."

Sometimes, however, internal scientists take a more active role in educating the organization regarding the state of climate science. In the case of ozone depletion, for example, Dupont finally reversed its stance only when its own scientists examined the theoretical and empirical evidence and concurred with external scientists about the gravity of the problem (Benedick 1991; Rothenberg and Maxwell 1995). This more active organizational role taken by environmental scientists (both internal and external to the organization) is reflective of what we discussed earlier as "institutional entrepreneurs."

The clearest example of this more active approach is seen in General Motors. As noted earlier, Ruth Reck, a scientist working in GM's research laboratories, was assigned to examine the climate issue. It is interesting to note that, at the time in GM, air quality was considered the more

important and prestigious topic on which to be working. Nevertheless, Reck quickly became a world leading authority on particulates and on cloud formations, and was accepted into the closely-knit climate scientific community. She published in refereed scientific journals, and presented at numerous conferences and workshops. As chair of the first symposium on atmospheric chemistry in 1973, she actually turned down a submission from Sherwood Rowland on CFCs, and later served as a reviewer for his landmark article in *Science*.

Reck, initially a climate skeptic, became an internal advocate for the issue by the mid 1970s, and also served as an important source of internal expertise, with regular access to top management. As remembered by Jimmy Johnston, GM's former VP of Government Relations, "[The environmental scientists] were very influential in putting the [climate] issues on the agenda. Ruth pushed what was really important, and was one of the more energetic people." In an effort to alert the company to the climate issue, and to find out what product divisions were already doing concerning GHG emissions reductions, she organized a large GM conference on the subject in 1985, which was attended by more than 700 company personnel. External climate scientists were invited to give presentations, notably excluding skeptics, whom she considered dishonest. Product managers were asked to speak about what they were already doing with respect to emissions and how this would be valuable in terms of reducing greenhouse gas emissions. Reck understood that she "absolutely had to sell this issue", and used this and other company forums to that end.

The differing role of corporate scientists in the "filtering" of climate science and assessments may help to explain differences in response between Ford and GM. At GM, where the corporate scientist was involved at an early stage with climate change research, the "surprise" at the response to the Hansen testimony was much less pronounced. Similarly, while all US companies were taking a more "wait and see" attitude to the science, GM, with an institutional entrepreneur that was an internal advocate of climate science, was the only company of the big three to refrain from strong direct attacks on the science.

Skepticism toward Climate Science

While to a differing degree, all three major US automobile companies, through their industry associations and independently, questioned mainstream climate change research and advocated a "wait and see" attitude. Ford's Trotman and Chrysler's Eaton were especially vociferous in the early '90s, through speeches and editorials, in castigating concerns about climate change and emphasizing the high cost of precipitate action in the face of uncertainty. The interviews revealed that these views were not just those of top management, but had permeated throughout various departments and management levels. One manager commented, "We have followed the science as a company and we would like to see more science and less hot air! What we'd like to see is good science driving good policy." In the mid to late 90s, the automobile industry followed the GCC in focusing on climate model uncertainties. In a 1998 paper, Ford environmental scientists stressed that the most significant oversight in current climate

assessments appears to have been inadequate study of the role that the Sun may have played in climate change. They state (Petrauskas and Shiller 1998, pg. 6):

> "Because of this, confirmation and quantification of the human capacity to influence climate beyond natural variability remains blurred. This fact alone does not completely eliminate all reason for concern, but it does loudly cry out for the scientific knowledge necessary to support far reaching global policy decisions... Real science needs to be verified first before such massive global changes in emissions ever could be justified in the future."

The predominant voice within the automobile companies was one of skepticism that the climate change was a major concern requiring significant private investment or government regulation. The corporate perspectives that we encountered across many interviewees at various *levels of* these organizations cannot all be attributed to interest based posturing. Managers in departments responsible for public and government relations might be more comfortable with putting a particular spin on the science, but there also appears to be a process of internalization of these perspectives. Even the differences across departments can be attributed to an internalization of the interest-based perspective. For example, one climate scientist in GM recalled that, "Jimmy Johnston [the former VP of government relations at GM] was a skeptic. He had to assume this position because he was the chief lobbyist. I understand where he was coming from." While even Johnston would admit that the adversarial political system in the US required some strategic exaggeration, it was clear that he was sincere in his skepticism about the science and the role of government regulation. After retiring from GM, Johnston joined the American Enterprise Institute where he wrote a book on his experiences (Johnston 1997).

Despite their adherence to the scientific norms of objectivity and rationality, we found that with the exception of one individual, the internal scientists tended toward the skeptical end of the spectrum of legitimate opinion among respected climate scientists (Morgan and Keith 1995). They all interpreted scientific uncertainties in a conservative manner, viewing them as a rationale for further research rather than seeing the potential for climate shocks from positive feedback or threshold affects. They pointed to the long time frame of atmospheric accumulation of GHGs a comfortable margin of time for reducing uncertainty rather than an urgent reason for early precautionary action.

The process by which these conservative viewpoints are institutionalized is not easy to document in concrete terms. As noted above, the managers and scientists work within an organization that feels threatened by the prospect of regulatory action to address climate change. There appears to be a subtle process of negotiation of identity between perceptions of corporate or departmental interest and an individual's own viewpoint. There is no clear boundary between them. As one ex-R&D manager expressed, "There is social pressure. For the [internal scientist], they are around people who don't pay attention to the climate issue and don't want to hear it.... People on the

operational side are more conservative." He also suggested that there might be some element of self-selection in terms of who is willing to be a corporate scientist. Another executive discussed the pressure to adopt a bottom-line perspective. She recalled that there was a need for credibility with the line guys. Lastly, one person who has worked closely with GM on these issues commented that it might have to do with where they get their information. If they are reading GCC literature and the Wall Street Journal, then they get a particular impression of the issue."

The Internal Scientist in Context

In order to understand the ways in which internal scientists interpret and communicate environmental science, and subsequently influence the rest of the organization, one must consider the context in which they operate. While companies attempt to speak with a single authoritative voice in public or to regulators, there are frequently significant internal tensions over controversial issues. Managers in different functional areas generally adopted perspectives consistent with their departmental interests. People responsible for advanced automotive technologies tended to see climate change as an opportunity. The spirit of the research labs tends to be "we will show top management we can do it – we can change things." While the R&D people had a vested interest in developing solutions to problems, and tended to view these solutions as technologically feasible, others in the organization were likely to take a more conservative approach. Managers in government relations and regulatory affairs departments, in particular, traditionally have seen their jobs as opposing governmental regulation and mandates. These managers were frequently concerned that the company might encourage more stringent regulation by demonstrating technological capabilities for reducing emissions, even if these technologies might be costly and unappealing to consumers. Managers responsible for product divisions and strategy were particularly concerned about the high cost of low emission technologies with little value to consumers. These tensions had bedeviled the development of GM's electric vehicle during the early 1990s (Shnayerson 1996).

Given these competing interests, the organizational location of the internal scientist becomes very important. The greater the level of accountability of the scientific staff to these other factions, the stronger these institutional pressures (DiMaggio and Powell 1983). Reck, who was the strongest proponent of climate change, operated in the GM labs for the most part as an independent researcher, evaluated as an academic rather than as a business manager, with promotion dependent on external publications.

One of the key factors for an institutional entrepreneur is that they have the power and resources to effect change. Reck's unique access to information, for example, put her in a strong position in this regard. She recalled, "I was only one working on climate. Everyone in corporation have to come to me, as I was the clearinghouse for information. This was a powerful position." The credibility and authority of internal climate scientists was also enhanced by the aura of scientific objectivity. This status, however, appeared to be a double-edged sword. The scientists were also

seen as remote from the core profit generating activities of the company, and their location in R&D labs or headquarters staff tended to isolate them somewhat from managers with line responsibility for product design and development. This was particularly true for the "research" arm of the R&D departments, whose research may or may not relate directly to near term product development. As explained by one R&D manager, "Most of the time the R was separate from the D. 97% of the R was in [the] laboratory. D was sort of a molecular film spread out over the company." This was particularly true in GM with its highly decentralized structure; the relative autonomy of GM's R&D and basic science led to an overall perception that the scientists were not contributing to the needs of the firm. Therefore, while decentralization of R&D enabled corporate scientists to pursue their interests in climate and maintain autonomy and credibility, it may have also reduced the ability of these scientists to influence corporate policy or product strategy.

In recognition of this problem, there have been efforts to further integrate environmental scientists with the rest of the organization at both companies. As the climate issue gained in prominence, for example, GM realized that it needed a direct bridge between their own climate scientist and their policy-making processes. Reck was directed to liaison closely with the executive VP for government and public affairs. This was a rather odd combination, given that the scientist had been the internal champion of the climate issue, and the VP's job was to convince the public and the government that mandatory emissions reductions were unnecessary and economically disastrous. While this move gave Reck a voice near the top of the company, the new home might also effectively have constrained her ability to promote the issue.

In the early 1990s, there was also an effort to increase the market relevance and accountability of research, and research projects were required to gain the sponsorship of a product division. In addition, both GM and Ford substantially eliminated basic scientific research during this period, reasoning that they should not waste their money generating non-proprietary knowledge to be disseminated in journals. Moreover, universities and government research labs were better positioned to conduct this research, and companies draw from this body of expertise when necessary. This integration shifted the balance for corporate scientists from an academic culture to a more traditional corporate setting. By the mid-1990s, neither Ford nor GM had internal scientists who were major players in the climate science community. This shift may also explain the relative skepticism of corporate scientists by the mid-1990s.

Not only must internal scientists negotiate inside a firm with multiple coalitions, but they also need to balance their business role with the one they play in the scientific arena. Therefore, corporate scientists adhere to the norms objectivity, rationality, and free investigation while being embedded in the business culture of bottom-line accountability and hierarchical subordination. This bridging of two cultures necessitates a subtle process of negotiation of identity for these scientists, who are not quite at home in either setting. The corporate scientists interviewed were particularly emphatic about their objectivity and independence, relating stories to demonstrate their refusal to be curtailed by narrow corporate interests. Ruth Reck was on an

EPA advisory committee, and in her words "GM desperately wanted to remove me from it. They thought I was not toeing the GM line. But I was an independent scientist and I have refused ever to be bought in my whole life. I was never on anything representing General Motors." Although not threatened with her job because of her independence, Reck knew there was dissatisfaction with this role. With their loyalty to the corporation in some doubt, corporate scientists needed to negotiate the border between these two cultures with some careful diplomacy. Reck recalled that "you had to speak strictly in terms of facts. Lots of people got into trouble for saying controversial things. I lived by the rule that anything you say might appear on the front page of the New York Times. Anything I said could always be backed by a reference."

Corporate scientists felt even less trusted in the public realm. Another industry climate specialist was chairman of EPA's Clean Air Advisory Committee, and became heavily involved in overseeing a review of air quality standards. This was the first time the EPA had used an industry person in this capacity, and for two years he spent most of his time on EPA work. This arrangement, however, was not wholly successful. From the perspective of the specialist, EPA had already made up its mind and didn't follow his advice in part because of his industry affiliation. Another industry specialist recounted an incident during an IPCC plenary session that was negotiating text of the Second Assessment Report, in .which he suggested a particular change, which was supported by one of the lead authors and then endorsed by a plenary vote. The IPCC chair, Bert Bolin later reportedly then took that lead author aside and warned him not to support other industry interventions.

While participation in EPA and IPCC panels might be considered prestigious professional activity for academic scientists, the corporate culture views it not just with suspicion but as a waste of valuable corporate resources. A number of scientists mentioned that external activity was viewed as unproductive, and that their corporate departments were reluctant to bear such a "tax". In this atmosphere, it is not surprising that the IPCC has had difficulty recruiting authors from industry, despite IPCC chair Robert Watson's re-doubled efforts to do so.

Institutional Histories and Leadership

The skeptical discourse concerning climate change is re-articulated within each company in the context of its particular institutional history, market position, and corporate culture. GM had invested an estimated $500 million in the EV, of which less than 1000 had been sold. Although a few GM managers thought that the company had gained valuable expertise in electric drive chains, the experience was widely perceived as a commercial mistake. Similarly, GM managers felt that they had rushed too quickly to downsize their vehicles, particularly luxury vehicles like the Cadillac. The industry perception was that the Ford was making more money in the late '90s because it had maintained its full-size vehicles and expanded production of trucks and SUVs faster than GM. One executive recalled an interaction that typifies this type of pressure. Ford had invested an estimated $500 million in sodium-sulfur batteries, only to abandon the project

because of safety concerns and because nickel metal hydride looked more promising. With this shared experience, being a first mover was not seen as an attractive proposition. Chrysler, for its part, had abandoned any significant R&D activity after the government bailout in 1986, helping to explain CEO Eaton's vociferous opposition to GHG emission controls.

The responses to climate change also needs to be placed in the context of the "siege" mentality prevalent in the US automobile industry. A senior executive at GM noted: "There is a broad agenda of efficiency, and against large vehicles as poor choices. Climate is only the most recent driver of fuel efficiency. Before that there was oil dependency, the energy crisis, urban sprawl, and smog." Johnston put it in more political terms: "there are people who have cast the automobile as a villain. It is a puritanical view, that we are having too much fun, that we have too much mobility and freedom, that suburban sprawl is bad. They think we should all live in beehives. So when scientists say that CO2 is a greenhouse gas, they jump on board." This mindset could induce contradictory effects. On the one hand, it tends to make managers skeptical of climate as a genuine concern, but on the other hand, managers see the continuing pressure and momentum toward fuel efficiency and feel compelled to accommodate even if they remain dubious about its necessity.

Corporate leadership also seems to play an important role in shaping corporate perspectives. Managers commented that while that this was not the kind of issue that Roger Smith would have paid the slightest attention to, (or he would have done whatever the rest of the industry wanted), Jack Smith had a different approach. As recalled by one VP, "My guess is that he took the view, 'look it is clear which way the world is going. We're going to have to go in that direction anyway for a lot of reasons so lets get on with it and not argue about the subject.'" Another described Rober Smith as a "bean counter", primarily interested in costs, while Stemple had more of a vision for the role of technology in sustaining the automobile industry. Yet another GM employee thought that the leadership of Harry Pearce has contributed to a greater acceptance of the climate issues within the company.

Discussion and Conclusions

Paradox: Companies Misleading Themselves

Despite dependency within both Ford and GM to institutionalize conservative and skeptical perspectives on climate change, at the very top levels in both companies there does appear to be a genuine concern to " know the truth". As one put it, "The trick from a management standpoint is how to get information through the layers of the organization and be able to make a judgement. We want to know what's really going on, not just what we want to hear." Managers acknowledged that if the more pessimistic forecasts were borne out, the Kyoto commitments would need to be substantially strengthened, with drastic implications for the industry. Another ex-VP commented on how top management prefers certainty, even if the news is unwelcome.

Recalling the story of DuPont and CFCs, he stated, "[There,] the head scientist came back and said – 'guys – I am convinced it is real.' Then DuPont could move. In a sense, if the scientists were able to say 'I saw yesterday's data and its certain.", the industry would breathe a sign of relief.... But as it stands, we are uncertain about the science and what the politicians are doing."

In an ironic twist, top management expresses a sincere desire to understand the true scope of the climate problem in order to make strategic plans, yet the automobile companies are constrained by institutional perspectives that reflect the perceived threat to their interests. Corporate scientists do not deliberately distort the scientific literature, but this research does suggest that, through their role as filters, monitors, and advisers, the companies are perhaps not receiving access to the full spectrum of opinion. We now move on to examine the institutional dynamics that have shifted the industry's position on climate change in the latter '90s.

The American Context

The debate over the strategic value of challenging climate science needs to be understood in the context of the particular nature of the science-policy interface in the United States. The congressional hearings on climate exemplify the adversarial, legalistic courtroom style through which the scientific basis for regulation is developed and contested. This contrasts sharply with the more integrated, consensual approach found in Europe (Jasanoff 1991; Edwards and Lahsen 1999; Kruck, Borchers et al. 1999). The institutional governance structures in the US causes companies engaged in contested policy arenas to make their case in a vociferous, public manner. As one auto executive put it, "The Hill works by compromise, so you need to go to the extreme. The more strident one side gets, the more the other side must. It ends up completely polarized." GM's Johnston made the case that the automobile industry ended up with CAFE in the first place because of a misplaced strategy of conciliation: "The Neville Chamberlain approach doesn't work. We offered voluntary fuel economy goals, with the usual rationalization that the train is leaving the station and we have to get on board. But the government turned around and made it mandatory. If we offer to do X, they will demand two X." Another auto executive compared the situation with Europe: "In the US, it doesn't help to have Al Gore getting up and saying that's people are dying in Chicago because of climate change. We are forced to be strident to counter that misinformation. In Europe, with some balance between the Commission and the Parliament, it's possible to have meaningful discourse."

The geographic structure of U.S.-based auto companies reflects a national basis to their organizational fields, which might also be a factor in their conservative response of the U.S. companies. Although these companies have been multinational for many years, the orientation of top management is primarily domestic. In numerous interviews, corporate managers, many with worldwide responsibilities, spoke about the difficulty of reducing emissions with gasoline at $1 a gallon, consumers who care little for fuel economy and are hungry for large SUVs, and a Senate unlikely to ratify Kyoto. These views are reinforced through membership in industry associations

dominated by U.S.-based companies. This situation only began to change for Ford and GM during the mid 1990s, as Ford implemented its Ford 2000 project which pushed toward the rationalization and integration of production and management worldwide, and GM began to move in a similar direction. By 1998, top management in both companies included a number of people with significant overseas experience.

Industry as Consumers of Climate Assessments: Implications for Policy and Management

One thing that emerged from this study was how relatively uninvolved industry was in the development and use of scientific assessments. Industry involvement in the development formal environmental assessments is sparse, and late in the process. Some reasons for this lack of involvement were the high time burden, potential legitimacy issues, and a concern regarding endorsing process of which they did not have total control. With regard to using formal assessments, throughout the attention cycle firms more likely to go straight to key scientists because assessments seen as not timely enough, not salient enough, and too political. This offers a challenge to policy makers if they are interested in increased industry participation. Interviews with key decision-makers in a number of assessment processes suggest that this is the case. One simple mechanism might be to offer more rapid feedback to industry participants so that they can better justify their participation to their firm. This could, for example, be in the form of executive summaries.

With respect to management, we saw that the influence of institutional context may hinder firms from viewing environmental science at a global level. As a result, companies may not be receiving full spectrum of scientific information. Some possible solutions to this might be increased global teaming, joint ventures, developing multiple channels for information, and maintaining high levels of communication among internal corporate scientists and external scientific community

Continued Institutional Pressures for Stability and Conformity

The reaction facing companies attempting to move ahead of their industries and become more proactive publicly on the climate issue demonstrates the significant institutional pressures that stabilize and reproduce an organizational field. GM, for example, had been invited to join the Pew Center at the outset, but was unwilling to break ranks with the GCC, whose goals were considered by Claussen to be incompatible with Pew. Those companies that did step out publicly, such as BP, were criticized and even found themselves somewhat isolated within their industry associations. When AEP joined the Pew Center, the reaction of fellow utility executives ranged "from shocked and confused to pretty vitriolic" (Carey 1998). Resistance to these moves is often expressed internally as well. According to Claussen, "these decisions have left a lot of blood all over the companies' meeting rooms". Corporate members of the PCAST that advocated

action on climate also reported facing flak in from their organizations. As an alternative to the Pew Center, GM joined an initiative of the World Resources Institute called Safe Climate, Sound Business in October 1998, and expressed the position that climate was an issue of sufficient concern that precautionary action needed to be taken. Reaction from the Detroit press, competitors, and congressional allies was hostile, and in a rhetorical dance, GM attempted to clarify that it was still firmly opposed to the Kyoto (Mastio 1998). This was not the first time that GM had faced institutional discipline for straying from the industry position. When a GM executive suggested that the company might support some form of energy tax, there was a backlash from irate American consumers, and radio talk-show host Rush Limbaugh devoted hours on the air to lambasting the company. When Louis Hughes, executive vice-president of GM's international operations, again voiced support for a gasoline tax increase of at least 50 cents per gallon in October 1997, an editorial in the Oil and Gas (1997) warned that "companies should not join politicians in steam-rolling opposing views on the issue."

The institutional environments in which companies are embedded can generate pressures for change as well as inertia. Membership in an association that is more proactive on climate, such as the Pew Center, or the Business Council for Sustainable Energy (BCSE), confers legitimacy on the voices of corporate managers and scientists who concur with the view that serious action is required to reduce greenhouse gas emissions. Even companies that are not members are exposed to this shifting discourse, through meetings, conferences and the media. Michael Marvin, director of the BCSE, organized a series of roundtable discussions in Washington D.C. in 1998 and 1999 on topics ranging from emissions trading, the Clean Development Mechanism, to liability issues. These meetings have been well attended by people from a wide range of companies and industry associations. According to Marvin, "Companies don't come expecting to change their positions, but they do move by a process of osmosis. At our meetings they talk about positive reasonable solutions. It makes a big splash when Enron, ARCO, and Shell come out ahead on the issue." Clearly, some voices have more power to shift the discourse than others. Even though climate science has not been a specific topic of discussion for Pew or the BCSE, participation in these organizations facilitates a process of convergence around the issue, and they serve to bring together views from disparate industries. According to Claussen, "Most of these people have not sat with each other before. There is a real mix of industries, and it is fascinating watching the dynamic develop. The companies give each other mutual credibility."

The 1997 PCAST panel on energy R&D can likewise be interpreted as a forum in which participants are not just educated as individuals on the subject of climate change, but are also subject to subtle social and institutional pressures. The PCAST panel was particularly potent because of the anticipation of a need to write a consensus report, and because of the technical nature of the subject material and the scientific background of most of the participants. Under these conditions, there was a strong expectation that participants would operate as experts rather than representatives of their industries. The constitution of the panel is deserving of some scrutiny in this context. About one-third of the members were brought from the permanent PCAST group, which does not have representatives from the automobile, coal, or oil industries,

but which does have members from companies more open to greenhouse gas control measures, such as Monsanto, a participant in WRI's Safe Climate, Sound Business Initiative. A further fifteen experts were drawn from external organizations, including the coal, oil, gas, and nuclear sectors, as well as from environmental NGOs and academia. People from fossil fuel sectors were therefore in a minority in a panel committed to scientific procedures and norms in a consensual process. The result was a consensus document that recognized the need for precautionary action and recommended a substantial increase in funds for energy R&D, particularly for renewables. Some industry participants mentioned they would probably get flak from their companies and industry associations for signing on, but they did so nevertheless. Holdren noted, for example, that one industry participant who held a Ph.D. from MIT in geophysics clearly shifted his thinking during the process. Similarly, the past president of EPRI, a chemical engineer who had spent much of his career working on coal technologies, became an effective advocate within the industry faction for the recommendation to put 80 percent of new money into renewals and efficiency.

The nature of the sea change in industry responses to climate change that occurred in the period 1996 to 1998 can be understood in terms of the fragility and temporality of institutionalized norms and meaning structures. Discursive formations arise from a process of contestation and negotiation, and their apparent stability may thus rest on contradictions and uneasy compromises. If stabilization of meaning are only tenuous and contingent upon a particular balance of material and organizational forces, a relatively small impetus or disruption can result in a substantial systemic change. As Bryan Wynne (1996, pg. 49) observed in his study of farmers' responses to a nuclear accident, "if, on the other hand, we recognize the tacit existing alienation and ambivalence often underlying surface quietude, we may see that what looks like a sudden shift of attitude, a betrayal, was nothing of the kind - it may have been only a very small shift in the complex balance of components of social identity which people are holding in tension with one another." This insight is pertinent at the level of an industry, a company, or even an individual.

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[1] Statement by Timothy E. Wirth, Under Secretary for Global Affairs, on behalf of the United States of America, at Convention on Climate Change, second Conference of the Parties, July 17.

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