

Climate research

As an old-timer in the climate policy arena, I applaud the article by Roger Pielke, Jr., and Daniel Sarewitz ("Wanted: Scientific Leadership on Climate," *Issues*, Winter 2002-03). For the past decade, I have maintained that climate change research must follow the guiding principle that we shall have to live with uncertainty. The details of the future of the climate system and its interaction with the global socioeconomic system are indeed unpredictable. Nevertheless, important messages can be extracted from current research findings. In trying to do so, more attention must be paid to issues such as decisionmaking under uncertainty, the economics of climate change, and the role of institutions and vested interests in the battles for control among the actors on the climate change scene. The key challenges will be to stimulate genuine interaction between decision-makers and social science researchers and to focus sharply on the most relevant social and political issues.

However, there is also a need for the climate system research community to give priority to analyses and summaries of present knowledge that are of more direct and immediate use for the development of a strategy to combat climate change. For example, how quickly are actions required, and what burden sharing between industrial and developing countries would be fair and most effective in efforts to increase mitigation during the next few decades?



The warming observed so far (about 0.6°C over the entire globe and 0.8°C over the continents) is probably only about half of what is in the making because of greenhouse gases already emitted to the atmosphere. The effect of human activity on climate is thus to a considerable degree hidden. The inertia of the climate system cannot be changed. Ironically, air pollution provides some protection against global warming, but preserving pollution is obviously not the answer to the problem. On the contrary, for health and other reasons, efforts are under way to reduce smoke and dust. Global warming of about 1.5°C is therefore unavoidable.

The global society has been slow to respond to the threat of climate change. Developing countries give top priority to their own sustainable development and argue that primary responsibility belongs with the industrial countries, which so far have produced about 75 percent of total CO₂ emissions with only 20 percent of the world's population. Past capital investments in

these countries mean, however, that the costs of rapid action are considerable. Human activities have already boosted greenhouse gas concentrations considerably. Unless forceful action is taken to limit emissions, it seems likely that greenhouse gas concentrations will reach a level that will result in an average global temperature increase of at least 2°C to 4°C. The climate change issue needs much more urgent attention, not least to clarify what the effects might be.

Considerably more than half of the emissions of greenhouse gases still come from industrial countries. Even if they would reduce their emissions by 50 percent during the next 50 years, in order to prevent a doubling of the CO₂ level in the atmosphere, the developing countries would have to restrict their per capita emissions to about 40 percent of what the industrial countries emit today. It is obvious that a global acceptance of the Kyoto Protocol would be only a small first step towards an aim of this kind. The antagonism between rich and poor countries will only become worse the longer the industrial countries delay in taking forceful action to reduce carbon emissions.

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We take strong issue with the claims of Pielke and Sarewitz, who state, "What happens when the sci-

entific community's responsibility to society conflicts with its professional self-interest? In the case of research related to climate change the answer is clear: Self interest trumps responsibility."

This outrageous and unsupported statement is egregiously wrong. It suggests that climate scientists pander to bureaucratic funding agencies, distorting or misrepresenting their results in order to attract research funds. The falseness of this is documented by the readily available publication records of the undersigned. These show that our scientific positions on important issues in the science of climate change have evolved over time. This evolution is both a response to and reflection of the community's developing understanding of a complex problem, not a self-interested response to the changing political or funding environment.

The basic driver in climate science, as in other areas of scientific research, is the pursuit of knowledge and understanding. Furthermore, the desire of climate scientists to reduce uncertainties does not, as Pielke and Sarewitz claim, arise primarily from the view that such reductions will be of direct benefit to policymakers. Rather, the quantification of uncertainties over time is important because it measures our level of understanding and the progress made in advancing that understanding.

Of course, it would be naïve to suppose that climate scientists live in ivory towers and are driven purely by intellectual curiosity. The needs of society raise interesting and stimulating questions that are amenable to scientific analysis. It is true, therefore, that some of the re-

sults that come from climate science are policy relevant. It is also true that scientists in the community are well aware of this. It is preposterous, however, to suggest that climate science is primarily policy driven.

The irony of Pielke and Sarewitz's article is that it criticizes climate scientists in order to promote research areas in which the authors themselves are engaged. One could easily interpret this as an example of self-interest trumping the responsibility that all scientists have of presenting a fair and balanced view of the issues. The positive points in their article, although not new, are sadly diluted by their confrontational approach. Their false dichotomies only divide the natural and social sciences further, whereas more cooperative interactions would benefit both.

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The state of California takes climate change seriously. Since 1988, when then-Assemblyman Byron Sher sponsored legislation focused on the potential risks of climate

change, California has pursued the full range of responses: inventory and assessment, scientific research, technological development, and regulations and incentives. Our interest in the relationship of science to policy led to extensive review of, and comments on, the draft strategic plan of the federal Climate Change Science Program. Many of our comments parallel the observations of Roger Pielke, Jr. and Daniel Sarewitz.

California starts with the premise that climate change is real and threatens costly potential impacts on water, energy, and other key economic and environmental systems in the state. The potential response to climate change includes both adaptations that are already underway and mitigation of greenhouse gas (GHG) emissions. The real policy issue before us, and therefore the target for scientific research, is the appropriate size and mix of investment in these two general categories of response.

We agree with Pielke and Sarewitz that regions and states are central to any adaptation strategy. The unique geography of California, a Mediterranean climate region within the United States, leads to impacts that may not manifest themselves elsewhere in the nation. The overwhelming dependence of California on the Sierra Nevada snow pack and long-distance transfers of water, much of which passes through the complex estuary of the San Francisco Bay-Delta area, is an example. We expect that effective adaptation will flow from policy decisions at the regional and state level rather than at the national level.

The policy context for adap-

tation within the state is found in major strategic planning efforts such as the State Water Plan; the State Transportation Plan; the newly authorized Integrated Energy Policy Report; the California Legacy Project, which focuses on land conservation priorities; the overarching Environmental Goals and Policy Report; and in the guidance that the state provides to local jurisdictions for land use planning. However, simply focusing attention on the issue is not sufficient. These plans will only be effective to the extent that climate science can provide these agencies with climate scenarios that describe a range of possible future climates that California may experience, at a scale useful for regional planning. Reducing uncertainty in projections of future climates is critical to progress, and we will actively pursue the help of the federal science agencies.

With respect to mitigation, the question is not if, but rather how. How do we lower our dependence on fossil fuels in a manner that stimulates rather than harms our economy? We do not find “decarbonization” of the economy to be inherently in conflict with economic growth and job creation—quite the opposite. To this end, we have aggressive programs researching emerging technology and the economics of its deployment, active incentive programs that will move our state toward more renewable energy and higher energy efficiencies, and regulatory programs that will lower GHG emissions from the transportation sector. Reducing uncertainty in the costs and benefits of these programs is central to our efforts, but

our commitment to reducing GHG emissions is clear.

Of course, we know that reducing California’s GHG emissions will not by itself stabilize the climate or reduce the amount we must spend on adaptation. But to argue against mitigation at the state or regional level on this basis is to misunderstand the larger historic role of California in providing environmental leadership, which is often adopted nationally and in some instances worldwide. The move away from a carbon-based economy is not a project to be understood solely through marginal economic analysis but rather as a historic transition from the long chapter of dependence on industrial fossil fuel and its associated pollution toward newer, cleaner, and hopefully more sustainable energy sources. California is pleased to be charting the course toward this new future.

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Roger Pielke and Daniel Sarewitz impressively highlight the marginal inutility of the quest for ever more uncertainty-reducing research on climate change. They expose the error of delaying hard policy choices by hiding behind scientific uncertainty, while they resist the temptation of advocates who, by exaggerating climate dangers, only

discredit the case for action. Dispassionate observers now recognize that, notwithstanding uncertainties, we already know enough about climate risks to justify meaningful action.

What kinds of action? As the authors correctly observe, mitigating potentially serious climate change implies decarbonizing the global economy. We should begin reducing CO₂ emissions, not because the ill-conceived Kyoto Protocol says so, but because it makes sense from the perspective of both risk management and national security. Serious measures to reduce energy inefficiencies and to promote much greater energy conservation would reduce dangerous dependence on Middle East oil. Many major corporations have demonstrated that energy efficiency and conservation are feasible and profitable. Removing subsidies for fossil fuels, investing more in renewable energies, imposing challenging fuel standards on our gas-guzzling vehicles, and tightening energy efficiency codes for new construction and appliances would all send the right signals.

However, the century-long transformation of the world’s energy system will require a technological revolution comparable to the conquest of space. We cannot rely on the market, with its short time horizon, to come up with needed investments in research and infrastructure. This is quintessentially a task for government. A \$5/ton carbon tax, translating into little more than a penny a gallon at the gas pump, would yield over \$8 billion—enough to quadruple the annual public sector energy

R&D budget. New energy technologies will facilitate political decisions—and private investments—to limit emissions. And like the space program, a major research initiative would yield political benefits by generating jobs and commercial spin-offs.

Yet the root of the current situation is absence of political will. The insistence on resolving uncertainties is a mask for policymakers who have already made up their minds that no contentious actions should be undertaken on their watch. Here I feel Pielke and Sarewitz place an unrealistic burden on scientists themselves to break the impasse.

Two decades ago, efforts to avert destruction of the ozone layer also faced powerful political and economic opposition, both here and abroad. Nevertheless, the United States played the central role in negotiating the 1987 Montreal Protocol to drastically reduce use of ozone-depleting chemicals. I now believe that a crucial difference between the ozone and climate issues is the degree of public concern over potential dangers, which reinforced the warnings of scientists. Even before the U.S. ban on chlorofluorocarbons in spray cans, consumer demand for these products dropped by two-thirds. Never underestimate the power of the consumer: The idea that extraterrestrial radiation could wreak havoc with our genes made the politicians take notice.

Interestingly, when President Reagan later overruled his closest friends and approved the State Department's recommendation for a strong ozone treaty, he had recently been operated on for skin cancer.

Today, absent a revelational climate experience at the top, the responsibility devolves again to us in our myriad consumer choices. A mass boycott of SUVs might have a powerful effect on climate policy, but I see no sign of such public concern.

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The arguments presented by Roger Pielke, Jr., and Daniel Sarewitz that effective action on global change is being hindered by climate scientists and that climate science will not reduce uncertainties in a manner that is useful for decisionmakers are basically flawed.

Pielke and Sarewitz do raise three valid and important issues: (1) the needs of many decisionmakers have played too small a part in the agenda of research on global change; (2) “uncertainty” has been used extensively as part of the calculus of avoiding action, despite the fact that our society routinely makes decisions in the face of uncertainty; (3) focused research related to energy policy, impacts, and human responses to change has been avoided or poorly supported. These issues stand out as fundamental weaknesses in the way we have approached climate and global change research.

Unfortunately, Pielke and Sarewitz have detracted from this important message with two arguments:

1) Self-interest trumps responsibility: The problem occurs

because the primary beneficiaries of the research dollars related to “uncertainty” are the scientists themselves. As early as 1988, the Committee on Global Change (CGC) called for more human dimensions research in order to be “more useful and (to provide) effective guides to action.” During the 1990s, the discussions within CGC and its partners (such as the Board on Atmospheric Sciences and Climate and the Climate Research Committee), as well as our discussions with federal agencies, envisioned a human dimensions and policy component that matched, in total dollars, the physical sciences budget of the U.S. Global Change Research Program (USGCRP). This sense continues right up to recent reports by the Committee on Global Change Research: the so-called “pathways” report and the report on “putting global and regional science to work.” The National Research Council report, *Our Common Journey*, which includes climate scientists as authors, stands as a masterful and compelling call for a new research agenda. The USGCRP effort, *Climate Change Impacts on the United States: Overview* also offers a research agenda. In this report, the fifth item on the list of priorities calls for improvements in climate predictions. The preceding priorities are tied directly to assessing impacts and vulnerabilities, examining the significance of change to people, examining ecosystem response, and enhancing knowledge of how societal and economic systems will respond. The facts are that throughout the USGCRP tenure, the federal political leadership

never agreed to put the dollars in place to link our sciences to policy, despite the recommendations of the scientists that Pielke and Sarewitz take to task. This continues today. It is impossible for this community to avoid seeing that the Climate Change Impacts assessment has been excluded from the first draft of the new Climate Change Science Program Strategic Plan. Yet it was clearly proposed in the workshops and discussions that preceded the release of the draft plan.

2) More research will not yield a useful reduction in uncertainties. The authors are overreaching by suggesting that a reduction in uncertainty won't aid decisionmakers and that it will take "forever" for the Climate Change Science Program to produce simple, tangible recommendations. The proof is the history of weather forecasting. Fifty years ago, weather forecasting was thought to be so full of uncertainty as to be practically meaningless. But fortunately these scientists did not give up their research in order to focus on the science of decision-making and of risk assessment, as the authors seem to suggest for climate research. The investment in weather forecasting, although it took decades, has yielded a remarkable system of observing systems and predictive models that have huge value for a very broad set of decisionmakers. Climate science has similar potential.

We need to accept Pielke and Sarawitz's concern that we have a fundamental flaw in U.S. climate and global change research and that this flaw must be addressed. However, to suggest that the flaw

is due to professional self-interest or to a lack of potential for climate research to aid society is unwarranted and ignores history.

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What has \$20 billion spent on climate change research since 1988 bought us? Roger Pielke, Jr., and Daniel Sarewitz claim that we have purchased quite a bit of academic understanding, but not much that helps policymakers. We must remember, however, that much more science is yet to come from this huge investment. And creating and discovering information is the foundation of higher living standards and environmentally sensible economic development. (As one who is paid to study climate by using satellites, I admit to "professional self-interest.")

Have we helped policymakers? Probably not, I would agree. Policymakers know that dealing with climate change by, for example, increasing energy costs, harms those who can least afford it. So in my view, to avoid giving their opponents in the next election any ammunition, policymakers tend to do no harm, especially on issues beset by uncertainty. Though much will be said in the coming election cycle about global warming, I believe that energy will remain affordable—good news to the many poor people of my state.

Pielke and Sarewitz are correct to call for direct investment in finding new energy sources. Energy, although remaining affordable for the masses, will be gradually decarbonized in the coming

century, just as transportation was "de-horsified" in the last. The federal role here should be to encourage discovery of the path of decarbonization with carrots (such as funding), not sticks. As the authors imply, regulating CO₂ emissions (a regressive and expensive stick) to lower levels that are somehow politically and economically tolerable will not perceptibly affect whatever the climate will do

In terms of funding for climate research, the authors suggest a shift from the present "reducing uncertainties" emphasis to, as they say, "developing options for enhancing resilience." As a state climatologist who deals daily with issues of climate and economic development, I find that there is no real payoff from knowing a climate model's probability distributions for whether the temperature will rise one degree in the next X or Y decades. What matters is reducing vulnerabilities (enhancing resilience) to the climate variability that we know now exists: the storm that floods a town, a three-month drought in the growing season, a hurricane that wipes out expensive condos at the beach.

How do we Americans enhance environmental resilience? Widening and renaturalizing our channelized (usually urban) waterways, removing incentives for building cheaply on the oceanfront, improving and expanding wastewater treatment plants, developing water policy that accommodates the extremes—these are common-sense actions whose benefits are tangible and to which climate research would directly apply.

In the developing world, enhancing resilience is tied to a more

basic set of initiatives that promotes human rights (especially for women), allows transformation to functional governance, reduces energy generation from biomass burning (wood and dung), develops infrastructure to withstand climate extremes, and so on.

If scientific leadership on climate directs research priorities in some way to help achieve these goals, our taxpayers will receive a real bargain.

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Roger Pielke, Jr. and Daniel Sarwitz's call to arms prompts an inevitable question: Who will show scientific leadership in the climate-forcing debate? A review of recent developments suggests that action is occurring independently of federal directives or strategies.

The recent 2001 Intergovernmental Panel on Climate Change (IPCC) report has catalyzed a general consensus that although climate dynamics are improperly understood, increases in tropospheric temperatures are a potentially serious global environmental threat. Even federal agencies seem to have come to the conclusion that global warming has the potential to disrupt both human habitats and natural ecosystems.

For more than 10 years, states have been formulating climate policy in the absence of a complete understanding of climate dynamics or vulnerability impacts. A range of programs have been or are in the process of being developed and implemented. They target renewable energy, air pollu-

tion control from both stationary and mobile sources, agricultural and forestry practices, and waste management strategies. A robust climate change discussion can occur at the state level with less dissension than within federal agencies.

Independent of regulatory or policy efforts, domestic and foreign corporations are seeking competitive advantage through the introduction of innovative product lines. These products create demand through product differentiation to acquire customers who value environmental performance, through reducing resource use that subsequently lowers operational costs (such as fuel efficiency), or through early conformity with regulatory requirements. In each case, businesses are using risk management strategies that balance market uncertainties with the need to create long-term value for environmentally friendly product lines.

Such state and corporate activities suggest that distributed approaches to climate-forcing mitigation may be as influential on federal policymakers as the scientific community continues to be.

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Future highways

In "Highway Research for the 21st Century" (*Issues*, Winter 2002–03), Robert E. Skinner, Jr. does a very good job of highlighting the importance of research in the highway field and explaining the

unique role that the Federal Highway Administration (FHWA) plays in a decentralized highway research community. The FHWA is committed to providing leadership to a nationally coordinated research and technology (R&T) program, championing the advancement of highway technological innovation, and advancing knowledge through research, development, training, and education.

The FHWA's leadership role in conducting research to address national problems and advancing new technologies to serve the public is directly related to its stewardship role in using national resources wisely. Stewardship requires that we continue to find ways to meet our highway responsibilities to the public by efficiently delivering the very best in safe, secure, operationally efficient, and technically advanced highway facilities, while meeting our environmental responsibilities. Since FHWA does not own or operate this country's highway system, providing leadership and working through partnerships are key to our success.

In response to our own agency assessment of our R&T business practices and the recommendations of Transportation Research Board (TRB) Special Report 261, *The Federal Role in Highway Research and Technology*, the FHWA currently has a major corporate initiative underway to raise the bar for research and deployment of technology and innovation. This effort includes increased stakeholder involvement in our R&T programs and achieving even greater collaboration with other members of the R&T community.