States and Climate Change: Leaders or Lab Rats?

Jeffrey Domanski, Editor

Essays and commentary sponsored by the Policy Research Institute for the Region at the Woodrow Wilson School of Public and International Affairs, Princeton University, and Environmental Defense.

The Policy Research Institute for the Region was established by Princeton University and the Woodrow Wilson School of Public and International Affairs to bring the resources of the University community to bear on solving the increasingly interdependent public policy challenges facing New Jersey, metropolitan New York, and southeastern Pennsylvania.

The Policy Research Institute for the Region
Woodrow Wilson School of Public and International Affairs
Princeton University
Corwin Hall
Princeton, NJ 08544

Cover design by Leslie Goldman
Printed by PrintMedia Communications, Anaheim, CA
Produced by the Office of Communications, Princeton University

Contents

Publications from the Policy Research Institute for the Region

BEYOND POST-9/11: The Future of the Port Authority of New York and New Jersey
Edited by Keith S. Goldfeld

STATES AND STEM CELLS: The Policy and Economic Implications of State-Funded Stem Cell Research
Edited by Aaron D. Levine

JUSTICE AND SAFETY IN AMERICA'S IMMIGRANT COMMUNITIES
Edited by Martha King

THE RACE FOR SPACE: The Politics and Economics of State Open Space Programs
Edited by Keith S. Goldfeld

FROM CAMPAIGNING TO GOVERNING: Leadership in Transition
Edited by Udai Tambar and Andrew Rachlin

CONSENT AND ITS DISCONTENTS: Policy Issues in Consent Decrees
Edited by Andrew Rachlin

THE POLITICS OF DESIGN: Competitions for Public Projects
Edited by Catherine Malmberg

NEW DOWNTOWNS: The Future of Urban Centers
Edited by Jonathan R. Oakman

MAKING EVERY VOTE COUNT: Federal Election Legislation in the States
Edited by Andrew Rachlin

TANF AT 10: A Retrospective on Welfare Reform
Edited by Keith S. Goldfeld

MOVEMENT OF GLOBAL TALENT: The Impact of High Skill Labor Flows from India and China
Edited by Udai Tambar

MARSHALING EVERY RESOURCE: State and Local Responses to Human Trafficking
Edited by Dessi Dimitrova

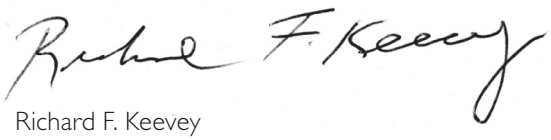
THE ECONOMIC GEOGRAPHY OF MEGAREGIONS
Edited by Keith S. Goldfeld

Letter from the Director

Since its inception, the Policy Research Institute for the Region (PRIOR) has worked to facilitate the application of powerful analytical resources to timely and consequential policy issues with particular resonance in New Jersey, New York, and Pennsylvania. As posterity likely will identify this period in human history as the moment when global climate change captured the attention of the wider world and as an increasing sense of urgency elevates the matter as a priority for state leaders and policymakers, the forum "States and Climate Change: Leaders or Lab Rats?" provided an excellent opportunity for PRIOR to contribute to the understanding and treatment of a topic with tremendous relevance in the region.

Held on March 30, 2007, and cosponsored by Environmental Defense, "States and Climate Change" allowed scholars, industry leaders, and advocates to explore the intent, breadth, and efficacy of targeted environmental initiatives recently undertaken in the states, especially New Jersey, New York, and Pennsylvania. While the event included remarks and presentations by Robert Socolow of Princeton University and Lisa Jackson, commissioner of the New Jersey Department of Environmental Protection, this volume features the original research that drove the symposium, with Clinton Andrews of Rutgers University writing on energy technology options within the region, the University of New Hampshire's Stacy VanDeveer and Boston University's Henrik Selin examining climate change innovations enacted in various states, and Dallas Burtraw of Resources for the Future and William Shobe of the University of Virginia touching on how states have influenced the national debate on climate policy.

As the conference demonstrated, the questions and challenges of climate change will continue to demand awareness and action well into the future. With the gathering and through this publication, PRIOR hopefully has helped to advance the consideration of this important subject with some benefit to the region and beyond.



Richard F. Keevey
Director
Policy Research Institute for the Region, Princeton University

Preface

By early 2007, the level of consensus within the science community regarding the significance of the human contribution to global climate change accelerated acceptance of the phenomenon among the wider population. Early releases of information that would be contained in the fourth assessment report of the Intergovernmental Panel on Climate Change, perhaps the most distinguished international group of scientists assembled to address a question of policy, further enhanced the call to policymakers around the world to take action sooner than later. However, in the United States, the federal government continued its pattern of climate policy disengagement, marked most clearly by President George W. Bush's formal withdrawal from the Kyoto Protocol negotiations in 2001. Spurred by the lack of climate policy engagement at the federal level, a growing number of U.S. states expanded both independent and collaborative efforts to craft policies to respond to the looming crisis.

On March 30, 2007, a conference was held at Princeton University to examine the content of, and motives behind, these state policies, the likelihood of greater federal action, and how such actions might affect state activities. "States and Climate Change: Leaders or Lab Rats?" brought together policymakers, scholars, and other stakeholders from across the country for a full day of discussion of the practical, political, and moral questions surrounding the response the U.S. is taking, and should take, to address climate change. The symposium provided a public forum to explore the U.S. response, with a focus on efforts in New York, New Jersey, and Pennsylvania. With a mission of providing useful guidance to all parties engaged in developing solutions to this challenge, and in light of the numerous and evolving state and national policy proposals, this conference occurred in the midst of what remains a pivotal period in the formulation of climate policy.

The conference was organized because Princeton's Policy Research Institute for the Region noted the dearth of critical analysis of the state policies being pursued and proposed, including assessment of interaction among the policies and

potential coordination opportunities. Specifically, the conference was designed to address the following questions:

- What are the policies being proposed and pursued to address the human contribution to climate change?
- How effective are they?
- Do these policies interact? If so, do they enhance or interfere with each other?
- What are the impacts of these policies on the states and the region?
- What impact will state-level efforts have on the formation of national policies?
- If and/or when national policies emerge, what will be the impact on the states?

Exploration of these questions centered on two keynote addresses and three papers prepared for the conference. The papers are included in the following pages. Conference participants included national experts on climate change and energy policy, especially those with understanding of the New York, New Jersey, and Pennsylvania region. To enhance both the generality and depth of the discussion, experts with knowledge of policies outside the region were also invited to participate. The conference organizers deemed it particularly important to have the experiences of California and Texas represented—key states often on the forefront of energy and environmental policy challenges. Though the discussions that took place during the day were relevant throughout and beyond the region, there was a relatively large amount of focus on New Jersey. This was due perhaps to the location of the event, but was also likely due to the uniquely aggressive response New Jersey has taken in response to climate change, particularly compared to Pennsylvania. Appendix B presents the conference agenda, while the biographies of the authors, panelists, moderators, and keynote speakers are presented in Appendix C.

Though there have been significant developments in the climate change policy world since this event took place, the information presented and associated discussions are still relevant. Despite increasing societal awareness of climate change and in related policy development since the symposium, there continues to be insufficient strategic planning and evaluation of policy cost and effectiveness. It is hoped that the conference added understanding of the context of climate change decision making, provided insight into the technology and policy options available with a framework to think about those options within the region, and offered both advice and warnings to policymakers and other stakeholders at both state and national levels that may assist them in making decisions in this critical

time. Further, much of the information, particularly the discussions regarding federal preemption of state efforts, are applicable to other environmental policy concerns and even to other policy areas.

Many people contributed to the success of the conference. Thanks are due to the authors, speakers, and panelists, as well as the diverse group of attendees. This event was cosponsored by Environmental Defense, who provided crucial assistance in shaping the agenda. Additional support was provided by the Program in Science, Technology, and Environmental Policy at the Woodrow Wilson School of Public and International Affairs as well as Students United for a Responsible Global Environment. These groups assisted greatly in identifying participants and publicizing the event.

Jeffrey Domanski
Program Coordinator
Policy Research Institute for the Region, Princeton University

Introduction
States and Climate Change: Context and Policy Overview

Jeffrey Domanski
Princeton University

Responding to climate change is proving to be the greatest environmental policy challenge the world has yet faced. This challenge is uniquely significant because the gases that cause climate change result from activities that are fundamental to our economy and daily activities. Additionally, climate change can exacerbate most other environmental challenges, including water and food production shortages, coastal flooding and erosion, and biodiversity loss. Assessing the potential impacts and identifying the winners and losers that result from various policy approaches is extremely difficult due to the size and complexity of the natural and economic systems that must be considered.

Three sets of numbers are fundamental to the climate change policy debate. First, it is necessary to understand the state of the atmosphere in terms of the past, present, and possible future atmospheric concentration of greenhouse gases. Through this, one may assess the significance of mankind's contribution and gauge what may be anticipated if insufficient action is taken to slow the accumulation of these gases. Second, it is important to be aware of the rate of change in greenhouse gas emissions from human activities, and the degree to which these emissions may be reduced by changes in activity, including the adoption and/or expansion of existing technologies. Third, the policy debate is commonly framed in terms of emission reduction goals, often expressed as levels of reduction from current or past levels of emissions. Princeton professor Robert Socolow provided an overview of these three sets of numbers in his opening address, as well as a discussion of the commitments proposed by relevant countries, states, and organizations.

In addition to being aware of the numbers behind the policy debate, to assess the current shape of climate change policy efforts at the state and federal levels, it is helpful to review the history of U.S. environmental policymaking. The next section provides a brief and relevant review of environmental policymaking in the U.S. This is followed by a brief summary of the papers prepared for the conference. This chapter concludes by highlighting useful commentary and advice for stakeholders with interests at both the state and federal level derived from the conference papers, presentations, and discussions.

A HISTORY OF U.S. ENVIRONMENTAL POLICY

CYCLICAL EVOLUTION

The locus of environmental pollution control activity in the U.S. may be viewed as having

undergone a cyclical evolution. Decades of local responsibility were followed by pressure for increasingly centralized federal action, with a return to greater action at the state level. The latter position is particularly representative of climate change policymaking.

For the majority of U.S. history, air and water pollution control was considered to be a local problem. In the 19th and first half of the 20th centuries, air pollution protection in the U.S. was largely limited to litigation based on common law concepts such as trespass, nuisance, and injury (Bailey 1998). Coupled with the primitive state of analytical methods at that time, it is not surprising that identification of the source of pollution was limited by what one could easily see, smell, or taste. Policy efforts began in the late 1800s with adoption of municipal laws to control smoke emissions in a number of major U.S. cities. Through the mid-1950s, pollution control responsibility remained at the state, local, and regional levels (Bailey 1998).

Increased public awareness of both the magnitude of environmental pollution and the inadequacy of the states to sufficiently respond resulted in a move toward greater federal activity. National concern over industrial air pollution was sparked by an acute incident that killed 20 people and sickened thousands more in Donora, Pennsylvania, in October 1948. While this episode caused a shock, it was persistent air pollution problems in California that would lead to sustained efforts to address pollution at the national level; legislators from California seeking solutions for chronic air problems associated with automobile emissions were an early driving force (Bailey 1998). The first federal legislative actions were limited to mandating that states conduct federally supported scientific research to identify the problems associated with pollution and how to address them (Bailey 1998). These studies began to draw links between growing health issues in the U.S. and air and water pollution and, through identification of trans-boundary pollution issues, increased awareness of the inadequacies of sub-federal-level efforts to protect against pollution (Cook 1988). By the late 1960s, federal air pollution control legislation was limited to directing the states to take action to control air pollution despite the growing awareness of state shortcomings (Liroff 1986). State and local governments frequently had too few resources to fulfill their mandates to provide adequate protection and were criticized as being too beholden to local interests (Levin 1982, Rabe 2006). Increased public pressure, often expressed in large demonstrations, such as the first Earth Day celebration in April 1970, created a window of opportunity for environmental advocates and sympathetic legislators to push for direct federal-level controls over pollution (Layzer 2002, Kingdon 1997). The 1970 Clean Air Act Amendments (1970 CAAA) were produced largely in response to this pressure and have been identified as being among the most important environmental laws ever passed, particularly because of the unprecedented centralization of pollution control law at the federal level (Bryner 1993).

Though the 1970 amendments placed significant responsibility on the states to meet national requirements, implementing the laws

to achieve these goals proved to be a serious challenge for the federal government. Chronically missed deadlines, inefficient measures, and legal challenges throughout the 1970s and 1980s prompted a search for alternatives to the federal control structure. States had not been idle following the 1970 CAAA, greatly expanding their capacity to craft and implement policy (Rabe 2006) spurred in large measure by the federal mandates. By the late 1980s, a movement toward greater decentralization was gaining strength as states were increasingly viewed as centers of innovation and more adept at responding to local needs and conditions (Rabe 2007). In recent accounting, states have assumed much of the responsibility of environmental policy, though the degree of environmental protection pursued from state to state is not consistent. Though responsibility is still delegated from the federal government, Rabe (2006) reports that states regulate approximately 20 percent of the U.S. economy, issue more than 90 percent of all environmental permits, complete more than 75 percent of all environmental enforcement, and have the ability to move beyond federal standards in air pollution and pesticide regulation.

VARIATION AMONG THE STATES

While some states rely on the federal government to provide as much as half of their program funding needs, many states receive as little as one quarter of the funding they dedicate to pollution control from this source (Rabe 2006). Variation in state-level control efforts is a source of justified concern expressed by advocates of unified federal environmental policy (Rabe 2006). Unequal pollution requirements across states can result in a movement of industries from states with strict laws to states with laxer laws, thereby lowering a company's compliance costs. The result is no change in overall pollution levels. This phenomenon is commonly termed "leakage." Beyond an inability to change the status quo, there is concern that inconsistency can cause emissions reduction efforts to be undermined by laxer standards in another state. Political and economic expediency typically underlie the variation in levels of state policy exhibited. A tendency for some states to "free ride" on efforts of states with more aggressive environmental policies is an additional reason for the variation (Rabe 2006).

STATE AND FEDERAL POLICY EXCHANGE

Throughout this cycle of policymaking and implementation focus, there has been influence in both directions between state and federal levels. There are many examples of state efforts that have been translated into federal programs. Experience with state-level hazardous waste, drinking water, and air programs help shape federal laws such as the federal Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (a.k.a., "Superfund") and amendments to the Clean Water and Clean Air acts (Cook 1988, Liroff 1986). Interestingly, the success of these state-level efforts has been attributed to state emulation of federal institutional arrangements. In particular, state environmental agencies frequently mirror the organizational framework found at the federal EPA (Rabe 2006). Federal policies also result

in state policies. The proliferation of state and regional air emissions permit trading programs in the 1990s are attributable to the success of the acid rain program included as part of the 1990 Clean Air Act Amendments. Further, though demonstrating a significant degree of autonomy in implementing environmental policy, as described above, the states also are reliant on federal support for many programs, especially multi-state and larger regional efforts (Rabe 2006).

CLIMATE CHANGE AND STATE LEADERSHIP

Climate change is the epitome of a trans-boundary issue. As such, it would not be surprising for states to wish to defer action to the federal government, especially as the global issue will continue to require international negotiation and cooperation. Indeed, there is much discussion within the policy community regarding the advantages of and preference for national legislation. In addition to simplifying international negotiations, federal control would provide a more unified set of requirements for businesses to navigate rather than a spectrum of varied state laws. However, there are a number of reasons that climate change policies are being pursued at the state level. First, many state actors feel a responsibility to address the issue and recognize that states can make a difference. The greenhouse gas emissions from many states exceed those of many nations (Rabe 2006). Second, addressing climate change has the potential of being economically advantageous. In her keynote address, New Jersey Department of Environmental Protection Commissioner Lisa Jackson described the potential economic impacts of climate change in the region, with a focus on the impacts in New Jersey. In addition to mitigating the potential damages caused by climate change, taking action can enhance economic development through the creation of new industries and jobs (Pew 2004). Third, federal action in the U.S. has been less than sufficient, relying largely on voluntary commitments, despite the increasing intensity of international efforts. Fourth, environmentalists focusing on climate change have found it preferable to act at the state level for a number of reasons, including the ability to generate support among local interests, preempting a "race-to-the-bottom" among states, and avoiding confrontation on a national stage that many see as dominated by fossil fuel-based industries and other climate policy opponents (Layzer 2002).

State exploration into climate policy began in the 1990s but expanded significantly after the Bush administration's rejection of the Kyoto Protocol in 2001 (Rabe 2007, Pew 2004). By the date of this conference, more than half the states had active climate programs (Rabe 2007). The programs represent a varied and often complex array of direct and indirect policy responses, including legislation and nonbinding commitments. Direct policy responses include mandates to reduce greenhouse gas emissions, and policies to adopt or alter technologies and behaviors that achieve such reductions. Early adoption of these programs commonly focused on areas within the purview of government control, such as government auto and truck fleets. Appliance efficiency standards, auto emissions standards, and building code changes represent more far-reaching efforts. Emissions trading markets,

such as the Regional Greenhouse Gas Initiative and the proposed Western Regional Climate Action Initiative, would cap emissions from major sources but allow flexibility in achieving compliance by allowing the trade of emissions permits among sources. Indirect approaches include policies that foster development and deployment of renewable energy and energy efficiency to displace fossil fuel use. Examples include state renewable portfolio standards and tax schemes commonly identified as "social benefit charges" that source funding from a surcharge on consumer energy bills. Direct climate policy via taxation (i.e., carbon tax) is rarely discussed at the state level due to the traditional unpopularity of taxes among politicians. Master planning efforts to guide energy policy, underway in both New York and New Jersey, may reflect both direct and indirect approaches. A number of relatively large commitments to future reductions, such as New Jersey's Global Warming Response Act, currently lack the details of how such goals will be achieved, though will likely utilize a combination of the approaches identified above.

To counter federal inaction, or what climate policy advocates have interpreted as inappropriate or insufficient actions, state-led litigation has been used as a strategy to prompt the federal government to either act or to challenge obstructive actions (Layzer 2002). Examples of successful efforts include legal challenges to the George W. Bush administration's efforts to weaken air conditioner efficiency standards and to the EPA's refusal to recognize and address carbon dioxide as a pollutant (Rabe 2006, 2007).

CHANGING LANDSCAPE?

Though much of the federal stagnancy that inspired such state activity remains, the national landscape has changed over the last year. The November 2006 elections brought a change in leadership in both chambers of Congress. The slight dominance of the generally more climate-friendly Democratic Party has resulted in numerous congressional hearings on climate change and a steep increase in the number of climate policy bills introduced. Nearly all of these bills include provisions similar to the state-level policies identified above. State legislative commitments to emission reductions continue to increase as well. Significant events outside of government may also have an influence on policy development, including the awarding of the 2007 Nobel Peace Prize to Al Gore and the Intergovernmental Panel on Climate Change. Successful litigation efforts discussed above are also changing the prospects for policy support among numerous parties. However, despite these advancements, state efforts continue as do the extensive wrangling over federal response.

SUMMARY OF PAPERS

The three papers prepared for the conference further describe the policies and strategies identified above. This section briefly summarizes the concepts emphasized within the papers and from the discussions that took place in association with the author's conference presentations. Appendix A provides a relatively brief synopsis of presentations and discussions that took place at the conference, including those associated with these papers. Webcasts of the presentations, panels, and

keynote addresses may be viewed at the Policy Research Institute for the Region's website.[1]

THE CURRENT OUTLOOK: TECHNOLOGIES IN THE REGION

In the search for solutions to climate change, much attention is paid to the role of technology. In his paper, "Regional Energy Technology Options," Clinton Andrews provides an assessment of the current outlook on technologies relevant in the New York, New Jersey, and Pennsylvania region. Andrews identifies four categories of promising mitigation strategies: (1) efficiency enhancement; (2) decarbonization of power; (3) decarbonization of fuel; and (4) land use changes. The author describes relevant characteristics of the three states and identifies unique characteristics of this region, including its relative economic independence. Andrews then discusses current national-, regional-, and state-level conditions and trends related to the pursuit of the mitigation strategies identified and offers a matrix based on six filters "to match technological options to regional circumstances."

On the question of the relative role of state or federal leadership in producing solutions, Andrews acknowledges the tendency for policy incubation at the local level but notes cases in which local efforts have been misdirected. Andrews concludes that policies must be selected that are both individually attractive under various possible futures and that increase flexibility of the region's energy supply. Accordingly, he suggests four relatively near-term and two long-run solutions as most suitable, and advantageous, for the New Jersey–New York–Pennsylvania region. In his conference presentation, Andrews emphasized the main points of his paper, including recognition of the tradeoff that occurs in policymaking in a federalist system, elaboration of his regional technology decision-making matrix, and the potential benefit of approaching the pursuit of solutions with a "systemic perspective" that acknowledges and takes advantages of "nodes" where policymakers and stakeholders meet and make decisions. Panelist discussion reinforced the need for fundamental changes in organizational structures and attitudes to achieve the necessary emissions reductions in the coming decades.

THE CURRENT OUTLOOK: THE POLICIES

Henrik Selin and Stacy VanDeveer's paper provides an assessment of the current policy outlook. In "Climate Change Policy Innovation and Emulation in Northeastern States," Selin and VanDeveer provide an overview of climate change policymaking efforts of the states in the region with special attention to New York, New Jersey, and Pennsylvania, including relevant events that took place through the summer of 2007. These efforts include multilevel emission reduction goal setting, pioneering policy designs (e.g., state renewable portfolio standards and regional emissions trading markets), funding support schemes (e.g., public benefit funds), and state-led litigation. In addition to identifying important leadership efforts in the Northeast, they also discuss important activities taking place outside the region that may have significant influence both locally and at the federal level, particularly actions in California. Selin and VanDeveer also identify motivations for state-level action and pathways by which such state actions may have

influence on future state and federal responses.

Selin and VanDeveer identify factors that have driven current policy efforts and describe four pathways by which these efforts can influence future policy developments, including intentional efforts to lead other states by example and demonstrate the feasibility of climate change policies to federal observers. The authors conclude their paper with observation of the limits of these efforts to meet the significant challenge of tempering the human contribution to climate change and the challenges that may be anticipated in future efforts. These challenges include local stakeholder opposition; coordination among policies between neighboring municipalities, across state borders, and between nations; potential competition among these entities; and the costs of policies. Though acknowledging the benefits of state-level action, the authors emphasize the benefits of federal action in addressing these challenges.

IMPACTS IN THE SHORT AND LONG TERM

In Dallas Burtraw and William Shobe's paper, "Local Options on Global Stocks: How the States Are Affecting the U.S. Debate on Climate Policy," the authors explore motivations for state actions to address climate change in the short- and long-term perspective, especially those motivations that go beyond prompting federal action. The authors provide observations on state-level and local efforts within the context of limits on these entities, and examine the potential efficacy of these efforts and their influence on the federal debate and international climate change negotiations. In particular, the authors assess whether states are good laboratories for testing policies that may be deployed in other states or regions, or by the federal government—in other words, whether state-level policy efforts can be properly viewed as good experimental method.

The authors conclude that policies that are deployed in the future will inevitably be affected by their source. This means that both the leader states and the reluctant federal stakeholders will affect future policy design. They suggest that local stakeholders will influence the development of an entrenched status quo that addresses their interests and that states fail to undergo a process of self-evaluation to determine whether policies are successful. These two facts challenge the view of sub-federal policymaking efforts as scientific laboratories and lead to a pattern of policy deployment that varies across the U.S. in response to differing interests, levels of interest, and the vagaries of free-riding. Burtraw and Shobe find that while the federal level of government may be the most appropriate for deployment of climate change policy, the success of any policy depends on the style of control effort. Greater success at any level may be greatly enhanced by instilling greater flexibility and self-determination within the policy design. They assess a spectrum of relevant approaches that have been, or are in the process of being, deployed, including standard regulation, economic inventive policies (particularly emissions cap-and-trade markets), and numerous policies targeted at enhancing technological development in energy and transportation. They close by offering advice to enhance the relevance of

states, and secure fiscal advantage, in the face of federal action. During the panel discussion, the authors emphasized that caution must be exercised when using economic forecasting related to climate change since the system is complex and requires flexibility in modeling in response to climate change.

CONCLUSION

The papers presented and discussions that took place during the conference suggest that although many policies are being explored, collective and sufficient efforts are still nascent and rare. There is no clear answer as to the level of policymaking most appropriate to address the issue. However, the conference provided a good deal of useful commentary and advice for stakeholders with interests at both the state and federal level.

Stakeholders that focus on the state level may find it useful to consider the states as both leaders and lab rats—embracing the benefits while being wary of the drawbacks of being on the forefront of climate policy development. State-level policymaking can be more responsive to local concerns. The level of detail associated with state programs has a better chance of leading to more equitable and locally advantageous distribution outcomes. This can be especially true for policies that focus on adaptation to the effects of climate change. For advocates of stringent climate change policy, keeping efforts at a more local level can help insure against insufficient action. Many states have concerns that federal action often results in watered-down policy. However, for a number of reasons it would be a mistake to overestimate the benefit of state-level efforts. Though states may adapt policies to local needs, the model of innovation may be best viewed as one of "following the leader" rather than many independently operating laboratories of experimentation. Additionally, the potential for economic and pollution leakage across state borders is a very real and significant challenge that requires coordination among policy efforts. Such coordination may be best handled by the federal government, though regional organizations may play this role sufficiently.

The conference offered much guidance for policymakers and stakeholders at all levels, as well. There is general agreement that in the near term, there should be a focus on energy efficiency and technologies to displace carbon-intensive fuels. In the longer term, it is important to think in broader terms to address the infrastructural and settlement patterns that will stay with us for decades to achieve the significant reductions needed. This requires a careful focus on land use and transportation planning. Many decisions made now will have significant impact in these areas. Additionally, those engaged in policy selection, design, and critique should be aware of the lack of policy evaluation described by Burtraw and Shobe. While the extensive representation of cap-and-trade policy in existing and proposed legislation may speak to the potential superiority of the approach, it also may indicate that this approach has achieved dominance in part through its familiarity. In other words, it may be the policy pursued because it is what has been used before and is most frequently discussed, regardless of whether or not it is the best approach.

The conference provided useful criticism of this approach and identified potential alternatives, such as carbon taxes. The pursuit of cap-and-trade offers an example of the importance of evaluation to enhance design within a policy. There are many design elements that inspire debate, such as the use of emission offsets and price safety valves. Discussion also suggested that it may be important to appreciate the evolution of policies. For example, it was suggested that cap-and-trade may be an evolutionary step toward the use of a carbon tax. More generally, there is a need to be wary of policies implemented that are not specifically focused on carbon reductions—other motivations can skew their effectiveness and impact on other stakeholders.

Climate change is a pressing problem that requires urgent action, but nonetheless effective policy evaluation is needed. The short time frame upon which decisions need be made exacerbate the policy challenge. No one will be helped by policies that are ineffective, counterproductive, or needlessly costly. The information shared at this conference should help policymakers better identify, analyze, and compare potentially useful policies to limit the negative impacts of climate change.

References

Bailey, Christopher J. (1998). *Congress and Air Pollution: Environmental Policies in the USA*. Manchester University Press.

Bryner, Garry C. (1993). *Blue Skies, Green Politics: The Clean Air Act Amendments of 1990 and Its Implementation.* Washington, D.C.: Congressional Quarterly Press.

Cook, Brian J. (1988). *Bureaucratic Politics and Regulatory Reform: The EPA and Emissions Trading.* New York: Greenwood Press.

Kingdon, John W. (1997). *Agendas, Alternatives, and Public Policies.* Pearson Education.

Layzer, Judith A. (2002). *The Environmental Case: Translating Values into Policy.* Congressional Quarterly Press.

Levin, Michael (1982). "Getting There: Implementing the "Bubble" Policy in Social Regulation: Strategies for Reform." In *Social Regulation: Strategies for Reform,* edited by Eugene Bardach and Robert A. Kagan. San Francisco: Institute for Contemporary Studies.

Liroff, Richard A. (1986). *Reforming Air Pollution Regulation: The Toil and Trouble of EPA's Bubble.* Washington, D.C.: Conservation Foundation.

Pew Center on Global Climate Change (2004). *Climate Change Activities in the United States: 2004 Update*. Pew Center on Global Climate Change.

Rabe, Barry G. (2007). "Environmental Policy and the Bush Era: The Collision between the Administrative Presidency and State Experimentation." Publius: *The Journal of Federalism* 37 3: 413–431.

Rabe, Barry G. (2006). "Power to the States: The Promise and Pitfalls of Decentralization." In *Environmental Policy: New Directions for the Twenty-First Century,* edited by Norman J. Vig and Michael E. Kraft. Congressional Quarterly Press.

Notes

1. PRIOR website for the State and Climate Change conference: http://www.princeton.edu/prior/events/conferences/past_events/conference_56.html.

Regional Energy Technology Options

Clinton J. Andrews
Rutgers University

Global warming has arrived as a policy issue. It is advancing on both the systemic agenda, as shown by media coverage and Oscar awards, and on the institutional agendas of political bodies ranging from town councils to the United Nations.[1] Scientists observe that humans must adapt in significant ways to the warming that is already underway, and that we ought to shrink future greenhouse gas emissions to keep the climatic changes manageable.[2] Many of this region's political leaders now accept that humans need to cap greenhouse gas emissions at current levels and then reduce them dramatically to avoid a "dangerous" level of global warming. To allow developing countries the opportunity to grow, richer places like New Jersey, New York, and Pennsylvania should do much more than stabilize emissions—they should reduce emissions to a small fraction (about one-fifth) of their current levels.[3]

Princeton researchers have made a splash with the "wedges" framework for evaluating technological options for mitigating climate change.[4] This framework identifies 15 types of technology that are currently mature enough to play a significant role in solving the climate problem. Each technology reduces greenhouse gas emissions by a significant amount over a long period, showing up as a "wedge" in a graph plotting emissions over time compared to a business-as-usual case. They suggest that we only need to implement seven of these wedges over the next half-century in order to stabilize global greenhouse gas emissions. They make two overarching points. First, we have many options today, so we should start the process of choosing among them and implementing these solutions. Second, none of the options will serve as the sole solution to the problem—the solution will involve several wedges.

TECHNOLOGICAL OPTIONS

Socolow and Pacala offer a list of technological options that provides a good starting point for the current regional analysis.[5] Four major mitigation strategies are available: efficiency, decarbonization of power, decarbonization of fuel, and land use choices (see Table 1).

EFFICIENCY

Efficiency is the foundational technology choice. By improving the miles per gallon of vehicles, it becomes possible to use less gasoline or diesel fuel to travel the same distance, thereby avoiding carbon emissions. U.S. fleet average fuel economy has been static at 21 miles per gallon for 20 years[6] and policy

TABLE 1
Suitability of technology options for the region

Criterion Technology	Available?	Mature?	Economic?	Secure?	Clean?	Implement locally?	Overall likelihood
Efficiency							
Efficient vehicles	Likely	Likely	Likely	Likely	Likely	Unlikely	Less likely
Reduced use of vehicles	Less likely	Likely	Likely	Likely	Likely	Likely	Likely
Efficient buildings	Less likely	Likely	Likely	Likely	Likely	Likely	Likely
Efficient baseload coal plants	Likely	Likely	Likely	Likely	Less likely	Likely	Likely
Decarbonization of power							
Gas baseload power for coal baseload power	Likely	Likely	Less likely	Less likely	Likely	Likely	Likely
Capture CO_2 at baseload power plant	Less likely	Less likely	Less likely	Likely	Likely	Less likely	Less likely
Nuclear power for coal power	Likely	Likely	Likely	Unlikely	Less likely	Likely	Less likely
Wind power for coal power	Less likely	Likely	Likely	Likely	Likely	Likely	Likely
Photovoltaic power for coal power	Likely	Unlikely	Unlikely	Likely	Likely	Likely	Less likely
Decarbonization of fuel							
Capture CO_2 pt at H2 plant	Likely	Unlikely	Unlikely	Likely	Likely	Less likely	Less likely
Capture CO_2 pt at coal-to-synfuels plant	Likely	Less likely	Less likely	Likely	Unlikely	Likely	Less likely
Wind H_2 in fuel-cell car for gasoline in hybrid car	Less likely	Unlikely	Less Likely	Likely	Likely	Less likely	Less likely
Biomass fuel for fossil fuel	Likely	Less likely	Less likely	Likely	Less likely	Likely	Less likely
Land use choices							
Reforestation, afforestation, and new plantation	Less likely	Likely	Likely	Likely	Likely	Likely	Likely
Conservation tillage	Less likely	Likely	Likely	Likely	Likely	Likely	Likely

interventions will be required to improve the performance of the transportation sector.

By making settlement patterns more compact, it becomes possible for some people to walk or take mass transit instead of driving for certain trips, thereby reducing the distance traveled by car and the associated emissions. All three states have zoning laws and a land use planning framework, but New Jersey has

adopted a particularly aggressive state land use master plan encouraging growth in designated centers and not elsewhere. Actual development patterns differ dramatically from this ideal, with New Jersey's rates of land conversion from forest, agriculture, and wetlands to suburbia all actually increasing since implementation of the planning framework.[7]

Buildings can deliver heating, cooling, lighting, and other comforts using less energy if efficiency is a design criterion. New buildings designed to standards set by the U.S. Green Building Council routinely achieve 30 percent and greater reductions in energy use per square foot compared to conventional buildings.[8] Building code updates are necessary to force these efficiencies into standard practice.

Energy supply is a long chain with energy conversion losses stealing systemic efficiency throughout. Thus, by improving the combustion efficiency of a coal-fired power plant, or by reducing resistance losses during the transmission of electricity, or by reducing parasitic pumping loads in natural gas pipelines, the supply system can avoid carbon emissions too.

DECARBONIZATION OF POWER

Decarbonization of power means replacing coal-fired power plants with less carbon-intensive alternatives including natural gas, nuclear, and renewables. A majority of U.S. electricity comes from coal-fired power plants. However, during the 1990s, many more megawatts of natural gas-fired gas-turbine combined-cycle (GTCC) plants than coal-fired steam plants were built nationwide in the U.S.[9] The drivers were not the lower carbon content of natural gas but rather the GTCC's fuel flexibility, higher combustion efficiency, ease of construction, lower capital cost, and lower emissions of criteria air pollutants. As natural gas prices have risen since 2000, coal has regained competitiveness at the investment margin. The economic feasibility of this decarbonization strategy is thus highly sensitive to the relative prices of coal and natural gas.

Nuclear power plants have very successfully competed with coal to serve the steady base load in the regional power system. Although highly capital-intensive and difficult to site and build, plant operators have learned from the terrible Three Mile Island and Chernobyl accidents. Since 1990, they have improved operating reliability and plant utilization remarkably, so that nuclear has returned to economic competitiveness.[10] The first generation of nuclear power plants is now coming up for relicensing. Their ability to continue displacing coal will depend on whether this reformed industry has successfully regained the public trust. In the future, a new generation of modular, safer, cheaper, and more proliferation-resistant nuclear power plants could enter the supply mix.

Renewables also are entering the mainstream, with wind power making especially strong inroads. The region already has hundreds of megawatts of wind farms in place and more planned.[11] Like most electricity generating technologies, wind farms generate siting controversies before they generate any power. Rural areas in upstate New York and Pennsylvania have welcomed wind, but that has not been the case in the highly populated

urban and coastal areas. Offshore wind may be New Jersey's only option for large-scale wind deployment, both to avoid siting debates and to exploit the best wind speed regimes. Solar photovoltaic cells that convert sunlight into electricity also are entering use with help from a generous subsidy regime in New Jersey. Although solar is currently very expensive, early adopters are installing several megawatts annually on buildings and parking lots.[12] Wind and solar are both nondispatchable technologies, which means that they generate electricity only when the wind blows or the sun shines, and not necessarily when the grid operators need power to meet the shifting demand for electricity.

A final way to decarbonize power production is to capture carbon dioxide emissions rather than allow them to go up the smokestack. Carbon capture and sequestration technologies have been investigated and full-scale plants operate in a few places globally. Capture is most cost-effective when coupled with new power plants. Rather than building a conventional power plant that burns pulverized coal in a standard boiler grate, an integrated coal gasification combined cycle (IGCC) technology that separates carbon dioxide from other flue gasses is necessary. IGCC plants are more costly to build and operate than conventional coal-fired power plants and hence few have been built to date. Once the carbon is captured, it must then be transported and sequestered somewhere that can safely hold it for several hundred years. Carbon dioxide pipelines are quite feasible and not too costly. Plausible candidate sites for sequestration are harder to come by in the New Jersey–New York–Pennsylvania region. There may be some geologically suitable formations in western Pennsylvania near depleted gas and oil fields and unmineable coal seams, or in deep saline formations offshore on the continental shelf near New Jersey.[13]

DECARBONIZATION OF FUEL

Decarbonization of fuel means replacing gasoline and oil with less carbon-intensive alternatives. Candidate technologies include biofuels such as ethanol, synthetic fuels made from coal (with carbon capture), hydrogen for use in fuel cells, and electric vehicles.

Biofuels are already in use throughout the world, and they are competitive with gasoline and diesel motor fuel. Conventional automobiles burn gasoline-ethanol blends (85/15) without difficulty, and flex-fuel cars such as those sold in Brazil can easily handle a 15/85 mix. However, the corn-based ethanol produced in the United States is currently a carbon-intensive choice that requires substantial fossil fuel inputs. By using alternative feedstocks ranging from sugar cane to switchgrass, and with process improvements that improve the efficiency with which cellulosic feedstocks get converted into sugars, biofuels can approach carbon neutrality. Although advanced ethanol and biodiesel will still emit carbon dioxide when burned, the amounts they emit will be resequestered by subsequent planting of bioenergy crops. There is not much suitable land for growing bioenergy crops within this region, thus most biofuels will be imported from the West and South. Urban sources of bioenergy including municipal solid

waste, yard waste, and sewage are unlikely to provide more than 5–10 percent of regional liquid fuel needs.[14]

Synthetic motor fuel derived from coal is a well-proven technology used widely by Germany during World War II and South Africa during the apartheid years. The resulting fuel has in the past been more expensive than petroleum-based fuels but it is well within the competitive range given oil prices in the current 50-plus dollars per barrel range. The carbon capture technology that would necessarily accompany coal-based synthetic fuels has been deployed before but its use is not widespread.

Some advocates envision a radically new transportation system based on hydrogen as an energy carrier and fuel cells as the source of motive power. The hydrogen vision is attractive because fuel cells with hydrogen are clean, emitting only water vapor. Yet there are many technological hurdles to overcome in achieving this vision, including inadequate onboard hydrogen storage capabilities, short-lived and costly fuel cells, and above all, clean and cost-effective sources of hydrogen.[15] Currently hydrogen can be produced by means of steam reforming of natural gas, petroleum and coal gasification, electrolysis of water using any source of electricity, and thermal cracking of water at nuclear power plants. To make hydrogen carbon neutral it will be necessary to capture and sequester carbon dioxide emitted during the hydrogen production process, or produce it from nonfossil primary energy sources such as nuclear or wind power.

Those skeptical of the hydrogen automotive vision often favor electricity, a more familiar energy carrier. Especially when the hydrogen is electrolyzed from water using electricity generated from zero-carbon nuclear or wind power, it is hard to imagine how hydrogen could ever compete.[16] The plug-in hybrid car provides a plausible transition pathway from the current gasoline internal combustion era to the all-electric era.

LAND USE CHOICES

Plants and soils can sequester or release carbon, making land use choices influential on the regional carbon budget. Reforestation, afforestation, and new tree plantations can sequester carbon for a century or more. Conservation tillage of agricultural soils helps preserve the large amounts of carbon sequestered in the soil. Shifting land from forest cover to suburban development releases carbon from both plants and soils. More compact growth patterns free up acreage for reforestation projects and also allow people to escape their carbon-intensive cars.

SOLUTIONS IN REGIONAL CONTEXT

Regional characteristics affect the viability and attractiveness of technological options for local use. New Jersey is small but densely populated, has little vacant land, has a relatively poor onshore wind resource but a good offshore wind resource, and is a consumer state that traditionally has imported nearly 100 percent of its primary energy resources and is closely tied into regional energy grids. New York has a large population, mostly concentrated down-

state, with substantial amounts of arable land upstate, some good onshore wind resources, and much independence in energy decision making because it manages its own grid and produces much hydro power. Pennsylvania also is a large state but with a more dispersed population and substantial coal, land, and wind resources; economically and politically it is a quintessential producer state. In energetic terms, this is not a homogenous region.[17]

The tri-state region is nonetheless economically interdependent, and it makes sense to discuss regional contributions to solving the problem of global warming. Six filters are useful to match technological options to regional circumstances: availability, maturity, cost-effectiveness, security, cleanliness, and local implementation.

Resource availability constrains technology choices. The region has wind, solar, hydro, and biomass resources, plus coal and a small amount of oil. It has good access to natural gas and oil via ports and pipelines. The electric grid is densely interconnected and the utilities have substantial experience with nuclear power. The region appears to have a modest amount of carbon sequestration capability. The mature building stock and dense land use patterns offer opportunities for energy efficiency improvements.

Technology maturity varies widely. Natural gas-fired power plants are technologically mature, whereas solar photovoltaic power technologies are still evolving in a fairly dramatic fashion from one year to the next. Incandescent lights represent a mature, even senescent end-use technology, more efficient compact fluorescents are newly mature, and even better light emitting diodes are approaching widespread readiness. Less mature technologies represent riskier bets that regional investors need to hedge against, using diverse portfolios of energy solutions. The decades-long perspective required to think systematically about global warming will force decision makers to look upstream in the technology pipeline and choose the right moment to support new solutions—not too soon and not too late.

Economic viability is a function of technologies, policies, and resources. Wind power in good wind resource areas is economically competitive with natural gas and coal, whereas solar photovoltaic power is not competitive at the present time anywhere within the region. Over several decades the relative costs change. Natural gas prices have doubled in the last five years whereas coal prices hover near historic lows.[18] With better operations management, nuclear electricity is cheaper than it was 20 years ago. Wind is even more dramatically cheaper than it was two decades ago because of new materials, designs, and controls, as well as scaled-up manufacturing. The price of solar photovoltaic power has dropped by an order of magnitude in 40 years, but it still needs to drop by another order of magnitude to be cost-competitive in utility applications. Cost-effective regional carbon management will pursue the cheapest solutions first, while still encouraging emerging solutions.

Secure energy supplies are essential for economic progress and social stability. There are two key dimensions: is energy reliably avail-

able, and is it safe? Flows of oil from politically troubled areas of Africa and the Middle East have been disrupted before and they could be again. Flows of natural gas from the Gulf Coast have been disrupted by hurricanes before and they could be again. Portions of electric transmission and distribution systems in the region regularly fail in bad weather, and more rarely, cascading widespread outages occur because of human error or organizational failure. The present generation of nuclear power plants has experienced a few catastrophic safety failures, and the associated proliferation problems and vulnerability to terrorism further add to their security problems. Generally, energy efficiency and renewable energy sources are less prone to security concerns. However, the intermittent nature of wind and solar generation poses operational challenges to the operators of the electric grid.

Clean energy supplies will avoid carbon emissions and also reduce other pollutants such as nitrogen oxides, particulate matter, and toxic or radioactive waste. Conventional energy sources are major contributors to these problems, so the opportunity to solve global warming is also our best chance to reduce a wider range of environmental harms in the region.

Locally implementable solutions to the problem of global warming are especially attractive in an era of federal inaction. Thus it is important to ask whether state and local actors can implement each proposed solution on their own. For example, land use regulation is within state and local control, whereas automobile fuel efficiency standards are not.

RECOMMENDED CHOICES

Table 1 summarizes the expected performance of the many alternatives in our regional market. For each criterion discussed in the previous section, the table shows whether the technological option is likely, less likely, or unlikely to meet that criterion by the year 2020. This is a subjective assessment that represents the consensus view of the author and three colleagues. Readers should of course feel free to apply their own probabilities to this analysis.

In the short term, over the next decade or two, four solutions stand out as being suitable for the NJ-NY-PA region. First on the list are energy efficiency initiatives targeting vehicles, buildings, and energy supply systems. These reduce the total amount of energy needed, and thereby make it easier to reduce carbon emissions. Next is continued aggressive pursuit of renewable wind power. Offshore sites should be the major target. Third, nuclear power plants that have demonstrated safety, reliability, and cost-competitiveness should be relicensed, thereby avoiding increased carbon emissions. Finally, biofuels or electricity (using flexible, plug-in hybrid vehicles) should begin to displace petroleum in the transportation sector. The key here will be to get off corn-based ethanol and onto less carbon-intensive alternatives as soon as possible.

Carbon sequestration, solar photovoltaics, and widespread fossil fuel decarbonization are less likely to achieve a widespread, near-term impact in our region. They may become important in the longer term.

Now is also the time to plan for implementing two solutions that will only play out over the long run, say 30 years from now. First is policymaking to encourage much more compact settlement patterns. It will take a generation or more to shift from the current pattern of predominantly suburban land usage to a more compact form that is walkable, can support mass transit, and preserves interstitial open space.

The other long-term effort should be to support basic energy sciences research. In order to reduce the economic pain of switching away from cheap, ubiquitous carbonaceous fuels, the world needs to invent disruptive new technologies. Energy biosciences research could lead to efficient processes for using genetically engineered algae to produce biofuels. Energy materials science research could lead to new photovoltaic nanomaterials that cheaply convert sunlight to electricity. Energy physical science research could finally achieve cost-competitive and stable fusion energy generation. If any of those breakthroughs are invented here, this region will likely benefit economically.

CLIMATE STABILIZATION UNDER FEDERALISM

Lest the grand challenge of climate stabilization sound too abstract and unsuited for state and local actors, remember that much change in the federal system works its way up from the bottom. That was the path for air and water pollution laws and for the regulation of energy markets.

Historically, the electricity industry started locally and even though it has expanded to the regional scale, it remains regulated largely at the state level. The natural gas industry started locally and even though it has expanded to the continental scale, its distribution remains regulated at the state level. Even the oil industry started at the local scale—in Pennsylvania—and although it now has a global market, motor fuel taxes are set at the state level. The growth of the energy sector takes place in a context of local and state policies that can strongly affect the ultimate structure of national policies and global markets.

Land use policies are very much in state and local hands and can have a profound impact on energy use patterns. The same is true of public infrastructure investments, where the relative commitment to mass transit versus roads, for example, affects the energy intensity of the daily commute.

Some policies that are available to states might not be attractive or beneficial to them. New Jersey has recently undertaken a policy experiment to stimulate the demand for solar photovoltaic power. It has discovered that most of the subsidies spent on solar installations have flowed out of state; that is, New Jersey attracted installers but not manufacturers.[19] Green building policies and building efficiency standards, by contrast, capture more of the economic benefits locally. Local contractors learn a new and valuable skill set, even as local residents and workers occupy healthier and higher quality spaces. Automobile fuel efficiency standards are reserved for federal action.

Although global warming is an important concern, it is not the only reason we pay attention to energy markets and land use policies. We will only make reasonable progress towards a low-carbon future if we find the sweet spot that satisfies multiple objectives of environmental improvement, energy security, and economic progress.

AN ENERGY NETWORK PERSPECTIVE

There is value in going beyond the wedges framework to adopt a systemic perspective. It is useful to think of the energy economy as a complex network with nodes and links. Nodes are points at which conversions or transformations take place, as when coal becomes electricity, or electricity is converted into a home entertainment experience. Links are flows between nodes, as when electricity flows from the power plant to the home, or when carbon dioxide flows from your car's tailpipe to the atmosphere. As we attempt to reconfigure this complex system while still using it, those investing in its future will appropriately prize elements that demonstrate flexibility and adaptability as much as efficiency and cost-effectiveness.

Flexible, adaptable nodes will deliver value under a variety of future scenarios. Thus, end-use efficiency improvements such as better light bulbs and lighter cars will be valuable regardless of whether we enter a nuclear or solar future, a hydrogen or biodiesel future. Gas turbine combined-cycle power plants and integrated gasification combined cycle ("clean coal") plants will be valuable under a variety of carbon tax scenarios because they can be retrofitted for carbon sequestration and burn a variety of fuels.

Links also need to promote flexibility and adaptability in the energy network. Smart use of energy carriers will be a crucial part of the carbon transition. An ideal energy carrier is like a universal currency: it is convenient, ubiquitous, standardized, transparently valued, and readily converts many available resources into many desired functions. Electricity is the most widespread energy carrier, able to convert sun, wind, water, biomass, coal, oil, natural gas, and uranium into light, heat, information, and motive power. Perhaps hydrogen or liquid synthetic fuels will also enter the arena, and if they do, there will be some very interesting complementarities among carriers. The current great weakness of electricity, for example, is that is cannot be stored cost-effectively, making intermittent solar and wind resources less valuable, and making electricity less useful in the transportation sector. Easy conversion of electricity to hydrogen or liquid fuel could address these weaknesses.

CONCLUSIONS

In the title I used the word "option" in a technological sense, meaning that there are alternatives from which we can choose. In closing, I want to highlight the economic meaning of the word. Economists define an option as a tool for preserving flexibility, for managing irreversible investments during uncertain times. We are in an era where regulatory uncertainty increases the value of flexible choices that preserve economic value. This call for flexible, adaptable investments is not a call

to postpone action, but rather to undertake smarter actions.

As we enter an era of carbon regulation and taxation, investments in power plants, oil refineries, buildings, and even cars change their risk profiles. The timing and extent of carbon policies are uncertain, at both the state and national levels. So it becomes very important to select investments that (1) are individually attractive under a variety of possible futures, and (2) increase the overall flexibility of the region's energy economy. Investments in efficiency, small and modular energy sources, energy storage, and energy carriers all meet these criteria. State-level policies that serve local goals of improved air quality, energy security, and economic progress regardless of the timing and direction of federal policy also meet these criteria. Support of scientific research on new energy sources is a good example.

A corollary insight is that we should pay more attention to the lifetimes of investments. Thus, new buildings last decades, even centuries, and therefore should be subject to much stricter performance standards than they are today. Neighborhoods, highways, power plants, and refineries operate on a similar time scale and are therefore worth vigorously fighting about in public hearing rooms. Explicit plans for retrofitting the existing built environment become a necessity. In contrast, cars and water heaters have much shorter lives, and it is easier to force efficiency improvements into the marketplace because replacements regularly occur.

In this mature, densely populated region, we have much to work with: a relatively good multi-modal transportation system; land use patterns with defined centers (albeit submerging under sprawl); dense and reliable electric, gas, and oil pipeline networks; governments with a high capacity to analyze and act; progressive officials who serve as national innovators; a business community with a rich history of innovation and market leadership; an enviable position at the command hub of global economy; and an active and diverse population that brings energy even to energy debates. We are less rich in energy resources than some other regions, and we must work with our existing built environment rather than on greenfields. Those constraints will actually be helpful in framing our choices realistically as we make the transition to a low-carbon world.

References

1. Roger W. Cobb and Charles D. Elder (1971). "The Politics of Agenda-Building: An Alternative Perspective for Modern Democratic Theory." *The Journal of Politics* 33(4): 892–915.

2. Intergovernmental Panel on Climate Change (2007). Fourth Assessment Working Group Reports I, II, and III: Summaries for Policymakers, available at www.ipcc.ch/ (May 25, 2007).

3. New Jersey Governor Jon Corzine adopted this position in Executive Order 54, February 13, 2007, establishing statewide greenhouse gas emissions targets. Available at www.state.nj.us/infobank/circular/eojsc54.htm (May 25, 2007).

4. Stephen W. Pacala and Robert H. Socolow (2004). "Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies," *Science* 305: 968–972.

5. Robert H. Socolow and Stephen W. Pacala (2006). "A Plan to Keep Carbon in Check." *Scientific American* 295(3): 50–57.

6. Robert M. Heavenrich (2006). "Light-Duty Automotive Technology and Fuel Economy Trends: 1975 through 2006," Report No. EPA420-S-06-003, U.S. Environmental Protection Agency, Office of Transportation and Air Quality, available at www.epa.gov/otaq/fetrends.htm (May 25, 2007).

7. Richard G. Lathrop and John Hasse (2007). New Jersey Maintains Rapid Rate of Urban Development and Subsequent Loss of Open Space, preliminary report, Grant F. Walton Center for Remote Sensing & Spatial Analysis, Rutgers University, available at http://crssa.rutgers.edu/projects/lc/ (May 25, 2007).

8. U.S. Green Building Council (2007). Leadership in Energy and Environmental Design, design criteria, available at www.usgbc.org (May 25, 2007).

9. Compare capacity addition tables in the 1990, 2000, and 2005 editions of the Annual Energy Outlook published by the Energy Information Administration, U.S. Department of Energy, available at www.eia.doe.gov/cneaf/electricity/epa/epat2p6.html (May 24, 2007).

10. Two articles in a special issue of *IEEE Power and Energy Magazine* 4(6)(November–December 2006) demonstrate this point. See John P. Carter, "The Transformation of the Nuclear Power Industry," pp. 25–33; and Spencer W. Semmes, "Nuclear Renaissance," pp. 34–42.

11. American Wind Energy Association (2007). Wind Energy Projects throughout the USA, available at www.awea.org/projects/ (May 25, 2007).

12. New Jersey Clean Energy Program, New Jersey Board of Public Utilities (2007). New Jersey Solar Market Update: January 2007, available at www.njcep.com/ (May 25, 2007).

13. National Energy Technology Laboratory, Office of Fossil Energy, U.S. Department of Energy (2007). Carbon Sequestration Atlas of the United States and Canada, Albany OR, available at www.netl.doe.gov/publications/carbon_seq/refshelf.html (May 24, 2007).

14. New Jersey Agricultural Experiment Station, Rutgers University (2007). Assessment of Biomass Energy Potential in New Jersey, report prepared for the New Jersey Board of Public Utilities, NJAES, New Brunswick, N.J.

15. See the special issue of the *Proceedings of the IEEE* 94(10)(October 2006) devoted to the hydrogen economy for articles summarizing the state of the technology and policy.

16. Ulf Bossel (2006). "Does a Hydrogen Economy Make Sense?" *Proceedings of the IEEE* 94(10): 1826–1837.

17. For detailed characterizations, see the NJ, NY, and PA State Energy Profiles prepared by the Energy Information Administration, U.S. Department of Energy. Available at www.eia.doe.gov/overview_hd.html (May 24, 2007).

18. Caruso, Guy F. (2007). "Long-Term Energy Market Trends," presentation at the 2007 Pepper Hamilton Energy Conference, Washington, D.C., April 19, 2007, available at www.eia.doe.gov/neic/speeches/speech1.html (May 15, 2007).

19. Clinton J. Andrews (2006). "Sustainable Energy in New Jersey," in Dianne Rahm, ed. *Sustainable Energy and the States,* McFarland.

Climate Change Policy Innovation and Emulation in Northeastern States

Henrik Selin
Stacy VanDeveer

STATES OUT FRONT

Since early 2000, U.S. states have greatly intensified and expanded their policymaking on issues related to climate change (Rabe 2004, 2006; Selin and VanDeveer 2005, 2006a, 2007).[1] State actions differ greatly across the U.S., with some states enacting much more ambitious policy than others. States can address greenhouse gas (GHG) emissions directly through the many policy areas where they have policymaking and/or regulatory competence including the generation and distribution of electricity, transportation infrastructure, land use and planning, agriculture and forestry, and waste management (Rabe, 2004). The reasons inspiring state action vary substantially, but a growing number of studies and reports identify emerging and possible regional weather and climatic changes—and their associated costs and implications—of a warming global and North American climate (Clean Air-Cool Planet 2005; Union of Concerned Scientists 2006; Dutzik, Liou, and Mottola 2006; Daley 2007).

The Pew Center on Global Climate Change maintains an extensive database on state activities in the areas of climate change and GHG policy, energy policy, transportation policy, and building policy.[2] On climate change and GHG policy, more than half of all states have formulated climate change action plans, often in conjunction with the creation of a GHG registry to track emissions, and a growing number of states are setting specific GHG reduction targets. On energy, states are taking a host of actions including the adoption of renewable portfolio standards requiring electricity providers to obtain a minimum percentage of their power from renewable sources. On transportation, states are formulating ethanol incentives and mandates, and several plan to adopt California's CO_2 vehicle emissions and fuel standards. For the building sector, states are updating energy codes and adopting green building standards.

Much of this rapidly expanding state policy innovation and emulation has moved ahead of federal standards and requirements. This is particularly true for state actions in the Northeast and policy developments among the West Coast states led by California. This paper briefly examines major developing state policies of relevance to climate change and GHG mitigation. First, we discuss how states frame climate change issues, identifying drivers of such state action. That is followed by a look at state climate change action in the Northeast including a discussion of policy developments

in New York, New Jersey, and Pennsylvania more specifically. Next, we discuss four pathways through which pioneering climate change action and policy change may influence future state and federal policy developments. We end with some brief remarks on the status and future of state- and local-level climate change leadership.

STATE FRAMING AND POLICY NETWORKS

State-level political actors frame their climate change relevant policy developments in many different ways (Rabe 2004). Some states at the forefront of climate change policymaking have formally recognized climate change as a serious threat and have explicitly identified GHG reduction as a policy goal. This is true for many northeastern states, those on the West Coast, and a few in the Great Lakes region. Other states, however, have developed programs that may reduce GHG emissions, but choose to rhetorically accentuate opportunities for economic development and energy security and downplay specific references to CO_2 emissions and/or climate change. For example, Texas' relatively early adoption of renewable portfolio standards and growing investments in wind power are motivated by efforts to stimulate energy diversification and smart economic growth rather than reducing GHG emissions (Rabe 2004).

Ongoing climate change policymaking efforts in many northeastern states are based on a combination of moral and strategic reasoning (Selin and VanDeveer 2007). Moral arguments ("it is the right thing to do") are underpinned by an acceptance of the science behind human-induced climate change and a sense of intergenerational responsibility to act for the benefit of future generations. Strategic arguments ("it is the economically sensible thing to do long-term") are based on growing belief that local, national, and international GHG controls will only increase in scope in the future, and that a carbon-constrained future will create both economic limitations and possibilities for public and private sector entities. Together, such moral and strategic arguments are fuelling rapid policy change and action across public, private, and civil society sectors throughout the Northeast. In addition, public debates around energy security and independence combine similar moral and strategic arguments.

A dense network of policy entrepreneurs from across the public, civil society, and private sectors has been an important driver behind climate policy innovations among northeastern states (Selin and VanDeveer 2005, 2006a, 2007; Rabe 2006). These policy entrepreneurs often frame climate change issues in regional and local terms and exchange scientific, technical, and political information in ways that help to shape policy choices of elected officials for the purpose of developing more progressive climate change policy. In many cases, these state-level public officials have been involved in cooperative environmental state policymaking for many years—particularly around acid rain and mercury pollution issues—and they are now able to propose and debate new policies within their professional networks building on previous experiences with emissions trading and energy efficiency initiatives. Such networks are also critical vehicles for policy emulation

TABLE 1
State-wide GHG reduction targets
(as of April 2007)

State	Goal	
CT	1990 levels by 2010	10% below 1990 levels by 2020
DE	None	
ME	1990 levels by 2010	10% below 1990 levels by 2020
MD	None	
MA	1990 levels by 2010	10% below 1990 levels by 2020
NH	1990 levels by 2010	10% below 1990 levels by 2020
NJ	1990 levels by 2020	80% below 2006 levels by 2050
NY	5% below 1990 levels by 2010	10% below 1990 levels by 2020
PA	None	
RI	1990 levels by 2010	10% below 1990 levels by 2020
VT	1990 levels by 2010	10% below 1990 levels by 2020

among public, civil society, and private sector representatives.

State officials in the Northeast also frequently interact with civil society climate change advocates and private sector representatives. Regional advocacy groups such as Clean Air–Cool Planet, Environment Northeast, and Environment New Jersey are highly active and are in close contact with state officials and policymakers. State officials are also working with experts in the region's many universities and research organizations, including NESCAUM which is an interstate association of air quality control divisions in the Northeast. NESCAUM was, for example, intimately

TABLE 2
Renewable portfolio standards
(as of April 2007)

State	Goal
CT	10% by 2010
DE	10% by 2019
ME	30% by 2000
MD	7.5% by 2019
MA	4.0% by 2009
NH	Under debate
NJ	20% by 2020
NY	25% by 2013
PA	18% by 2020
RI	16% by 2020
VT	Equal to load growth (2005–2012)

Source: www.pewclimate.org/what_s_being_done/in_the_states/rps.cfm

involved in the development of regional emissions inventories and registries linked to RGGI.[3] Collaborative efforts in the region also include increasing participation by private sector representatives particularly from the utilities and cleaner/renewable energy sectors.

NORTHEASTERN LEADERSHIP

Northeastern states—individually and in groups—have been at the forefront of state climate change policymaking in the face of lagging federal policy. All states in the region have formulated climate change action plans and almost all have set specific GHG reduction goals (see Table 1). All northeastern states from Maryland to Maine have enacted renewable portfolio standards, except New Hampshire (see Table 2). While most state renewable portfolio standards are legally binding, most statewide GHG reduction targets

are not. The Northeast is also home to the most well-developed regional policy efforts to date: The 2001 New England Governors and Eastern Canadian Premiers (NEG-ECP) Climate Change Action Plan and the ongoing Regional Greenhouse Gas Initiative (RGGI). Most northeastern states also plan to adopt California CO_2 vehicle emission standards and fuel standards, if they become legally binding in California.

The first case of regional collaboration around climate change in the Northeast began in the late 1990s and resulted in the adoption of the NEG-ECP Climate Change Action Plan by the six New England governors (Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut) and five Eastern Canadian premiers (Nova Scotia, Newfoundland and Labrador, Prince Edward Island, New Brunswick, and Quebec) in 2001 (Selin and VanDeveer 2005, 2006a). Under this regional action plan, participating states and provinces committed to reduce their GHG emissions to 1990 levels by 2010 and 10 percent below 1990 levels by 2020. They also pledged to ultimately decrease GHG emissions to levels that do not pose a threat to the climate, which according to an official estimate would require a 75–85 percent reduction from 2001 emission levels.

The action plan sets general goals and allows states and provinces to take many different actions. Since 2001, states and provinces have worked to develop and implement several policies and programs in support of the regional plan (Selin and VanDeveer 2005, 2006a). Maine was first to write the regional goals into state law in 2003. Connecticut passed similar legislation in 2004, and today all New England states have issued state-level action plans. The New England states have also created public benefits funds to support energy efficiency and/or renewable energy development. Connecticut, New Hampshire, and Massachusetts have also taken initial steps to cap and reduce CO_2 emissions from major coal-fired power plants independent of RGGI. In April 2007, Massachusetts officials announced new regulations on private development, requiring that all developments needing an environmental impact assessment include estimates of the development's GHG emissions and options for reducing said emissions (Ebbert 2007).

To date, the New England states have created several relatively small-scale abatement programs seeking to save money through energy efficiency while reducing GHG emissions. Examples of such "win-win" measures include the use of more efficient light emitting diodes in traffic lights, promoting the purchase of Energy Star products in state governments, and switching to more energy efficient vehicles in state vehicle fleets. Yet, all New England states have struggled to reduce their GHG emissions since the adoption of the regional action plan in 2001. Available evidence suggests that every New England state will miss the NEG-ECP emissions target for 2010 (a return to 1990 emissions levels). In fact, all the northeastern states continue to see annual overall GHG emissions growth (Thurber 2005; Point Carbon 2007).

RGGI, the second major regional policy development in the Northeast, was originally

proposed by Governor Pataki of New York in April, 2003 (Selin and VanDeveer 2006b). As of April 2007, RGGI's 10 members are Maine, Vermont, New Hampshire, Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Delaware, and Maryland. After several years of negotiation, states agreed on a model rule in August 2006 (Bogdonoff and Rubin 2007). RGGI will create a regional emissions inventory, registry, and trading mechanism for CO_2 emissions from power generators of 25MW or greater. Participating states must enact similar policies within their respective jurisdictions and according to their respective regulatory processes and authority in order to create a market for regulated firms and other actors to trade emissions allowances. Table 3 summarizes the rulemaking procedures for RGGI's participating states.

RGGI draws heavily on the experiences of Northeast states in regulating SO_2 and NO_x emissions within a trading scheme, and on the European Union's Emissions Trading Scheme for CO_2 emissions. Under RGGI, states will issue one allowance for each ton of CO_2 emissions up to the amount of the total cap. Each power plant is required to have enough allowances to cover its CO_2 emissions during each compliance period, which may require the purchase of allowances. RGGI's goals are to stabilize CO_2 emissions from the power sector between the start of the program in 2009 and 2015. From 2015 through 2018, each state's annual CO_2 emissions budget will decline by 2.5 percent per year, achieving a total 10 percent reduction by 2019. Some emissions reductions can also be achieved outside the electricity sector through offset projects. The appropriate use of offsets is much debated, however, and critics argue that their inclusion weakens RGGI (Madsen, Gorke, and Sargent 2005).

TABLE 3
RGGI rulemaking and auctioning
(as of April 2007)

State	Implementation type	Auctioning
CT	Executive branch rulemaking	100% recommended
DE	Executive branch rulemaking	Undecided
ME	Legislature and executive branch rulemaking	Considering 100%
MD	Unclear	Undecided
MA	Executive branch rulemaking	100% recommended
NH	Legislature and executive branch rulemaking	Reviewing 25%, 100%
NJ	Executive branch rulemaking	Undecided
NY	Executive branch rulemaking	100% recommended
RI	Legislature and executive branch rulemaking	Undecided
VT	Legislature and executive branch rulemaking	100% decided

Source: Adapted and expanded from Point Carbon 2006. Note: In most states, some legislative action is needed related to auctioning issues because these relate to financial matters, while the executive branch environmental agencies generally have authority over other aspects of RGGI implementation.

The RGGI model rule mandates that at least 25 percent of state allowances be auctioned, rather than simply allocated for free. However, officials in several states have proposed to

auction 100 percent of allowances (see Table 3). New York is particularly important with approximately 50 percent of all allowances. Proceeds are to be used for public benefit purposes, which could support clean energy technology development, investments in renewable energy facilities, energy efficiency programs, and so on. If most or all RGGI states proceed to auction 100 percent of allocations —or any large majority—RGGI would be the first major emissions trading scheme do so. In contrast, the European Union's Emissions Trading Scheme began with free allocation of allowances in 2005 (Wettestad, 2005). Auctioning significant proportions of allowances would strengthen RGGI both economically and politically, and could set a powerful design precedent for other, future GHG trading schemes in the U.S. and abroad.

Continuing a long tradition of state-led legal actions, northeastern states also led legal efforts to force the federal government to regulate CO_2 emissions. In 1999, a group of environmental NGOs petitioned the EPA to set standards for CO_2 emissions from vehicles. This petition was rejected by the EPA, which argued that the Clean Air Act does not provide authority to regulate CO_2. In 2003, attorneys general from 12 states—California, Connecticut, Illinois, Maine, Massachusetts, New Jersey, New Mexico, New York, Oregon, Rhode Island, Vermont, and Washington—filed a legal suit in federal court challenging this ruling. In addition, many state regulatory agencies, city officials, and environmental groups expressed strong support for this legal challenge (Janofsky 2006; Hileman 2006).

In 2006, the U.S. Supreme Court accepted a request to review the CO_2 case and heard oral arguments (Barnes 2006; Donnelly 2006; Greenhouse 2006). In April 2007, the Supreme Court ruled in a 5 to 4 decision that the Clean Air Act gives the EPA the authority to regulate emissions of CO_2 and other GHGs from vehicles (Greenhouse 2007; Mauro 2007). This ruling may prove a major driver of policy change. If federal authorities are convinced to set CO_2 standards for vehicles emissions, that would also open up the door for more aggressive GHG policy in other areas. For example, it may help pave the way for a national cap-and-trade scheme for CO_2 emissions as well as mandatory national renewable energy portfolio standards. The ruling appears likely to energize those in Congress who are pushing for the adoption of more aggressive national climate change policy but is unlikely to lead to immediate action by the Bush administration (Barringer and Yardley 2007).

In addition to developing state action, a growing number of municipalities in the Northeast are setting citywide GHG reduction goals and are formulating a host of supporting policies. Municipalities are collaborating through the International Council for Local Environmental Initiatives (ICLEI) and its Cities for Climate Protection (CCP) program, and the U.S. Mayors Climate Protection Agreement.[4] Furthermore, Boston and Cambridge Massachusetts have announced new, more ambitious GHG reduction and energy efficiency programs, replacing their earlier rather modest and largely goal-oriented policies (Palmer 2007, Mishra 2007, Foy and Healy 2007). While no

state in the Northeast has followed California, Oregon, and Colorado in using direct democracy allowing the public to vote on climate change initiatives (Rabe 2006), a 2007 grassroots campaign in New Hampshire—a critical presidential primary state—has resulted in citizens in over 157 town meetings voting in favor of a motion calling on the federal government to adopt more aggressive climate change policies (Laidler 2007; Zezima 2007).[5]

TRI-STATE ACTION: NEW JERSEY, NEW YORK, AND PENNSYLVANIA

In the climate change action database maintained by the Pew Center on Global Climate Change, New Jersey, New York, and Pennsylvania rank among the states with the greatest number of climate change related policy actions. As of February 2007, New Jersey and New York are listed as having 15 different programs each with Pennsylvania having 14 programs in place (Connecticut leads the list with 18 programs followed by California with 17 programs). Many of these programs are consistent with the range of policy developments in other northeastern states, and New York and New Jersey were also part of the lawsuit against the EPA (noted above) that resulted in the ruling in favor of the states by the U.S. Supreme Court in April 2007.

New Jersey and New York have both established statewide GHG reduction targets.[6] In fact, New Jersey was among the first states to formally acknowledge the climate issue and formulated GHG emission reduction goals as early as 1989 (Rabe 2004). New Jersey's early policy called for a 3.5 percent reduction in the state's GHG emissions by 2005. With little in the way of implementation efforts, this goal was missed by a wide margin (Algoso and Rusch 2005). Adopted in February 2007, New Jersey's current GHG reduction target states that emissions should be brought down to 1990 levels by 2020 and be 80 percent below 2006 levels by 2050. New York's GHG reduction target is set at 5 percent below 1990 levels by 2010 and 10 percent below 1990 levels by 2020. In contrast, Pennsylvania has not yet adopted any statewide GHG reduction goals.

As RGGI members, New Jersey and New York have also formulated specific GHG targets for large power plants, which Pennsylvania as a non-RGGI member has yet to do. All three states have adopted renewable portfolio standards. New Jersey requires that utilities meet 6.5 percent of customers' electricity need from renewable sources by May 31, 2009, to be increased to 20 percent by 2020. New York's standards, enacted in 2004, set a target of 25 percent renewable electricity by 2013. Pennsylvania's standards, also from 2004, set an initial goal of renewable electricity of 1.5 percent by 2007 and a long-term goal of 18 percent by 2020. New York and Pennsylvania are also East Coast leaders in wind energy production with several new wind farms on the way (yet, both states are far behind Texas and California, the two states that by far have invested most in wind power).[7]

New Jersey, New York, and Pennsylvania have all set up public benefit funds that administer different kinds of ratepayer-funded programs that support increased use of more energy-efficient technologies and renewable energy

sources. New Jersey's efforts in this area are run through its Clean Energy Program. Funds collected by New York's System Benefits Charge go to the New York State Energy Research and Development Authority. In Pennsylvania, there are five separate sustainable energy funds supporting clean energy initiatives.[8] The three states' clean energy funds are also members of the Clean Energy States Alliance, which was created by 17 publicly managed clean energy funds from 12 states in 2003. The alliance works to expand the use of clean energy across states by supporting clean energy projects and companies.[9] Furthermore, New Jersey officials plan to finalize an ambitious "Energy Master Plan" in 2008 that includes goals for increased renewable energy production and reductions in energy use, attempting to link energy policy with the state's GHG reduction goals and RPS standards.[10]

On transportation, all three states, like most New England states, are poised to adopt California's CO_2 emission standards for vehicles if they survive legal challenges. New Jersey and Pennsylvania have also created ethanol mandates and incentives. Additionally, all three states have set green building standards for state buildings and formulated energy codes for both residential and commercial buildings. Approximately 70 municipalities in the three states are members of ICLEI's CCP and/or have signed the U.S. Mayors Climate Protection Agreement. This includes New York City, which under Mayor Bloomberg has been moving aggressively to improve energy efficiency through, for example, expanded use of hybrid buses, installing more energy-efficient appliances in public buildings and housing projects, changing to more energy-efficient traffic lights, and mandating green building codes (DePalma 2005). In April 2007, Bloomberg released the city's first GHG inventory and proposed a host of policy changes designed to reduce its GHG emissions by 30 percent by 2030 (ENS 2007; Lueck 2007).

PATHWAYS OF POLICY CHANGE

Emerging state climate change policymaking in the Northeast and elsewhere can collectively influence future policy developments in both states and nationally through four overlapping pathways: (1) the strategic demonstration of the feasibility of climate change action; (2) the creation and expansion of markets; (3) policy diffusion and learning; and (4) the creation and promulgation of norms about the need for more aggressive climate change action (Selin and VanDeveer 2005, 2007).

First, forerunner states are often explicit about their desire to lead by example in the face of lagging federal standard-setting and policymaking. To this end, many state policy advocates seek to strategically demonstrate the feasibility of more aggressive climate change action. Historically, states have often acted as environmental policy innovators on several different issues influencing future policymaking in other states as well as at the federal level (Rothenberg 2002; Rabe 2003). As such, it is reasonable to believe that pioneering and rapidly expanding state climate change policymaking can be important in part because it demonstrates the technical and economic feasibility of more expansive action to address climate change for other states and the federal government to emulate.

Second, many climate policy advocates seek to promote behavioral change by expanding and creating markets related to climate change mitigation. For example, the adoption of statewide renewable portfolio standards expands regional markets for renewable energy production and use. Market issues are also central in RGGI, which will create a regional mechanism for setting a market-based monetary value on CO_2 emissions from the power sector. RGGI and other efforts also expand markets for consultancy and accounting firms offering their services to private and public organizations that want to participate in credit and/or offsets schemes for CO_2 reductions.[11] In addition, state policies are expanding markets for more energy-efficient consumer goods, including vehicles.

A third pathway of promoting change is through policy diffusion and learning. Climate change-related policies developed among leader states, municipalities and/or firms frequently serve as models for subsequent initiatives by other such actors and federal policymakers. As a future national cap-and-trade scheme is developed, many political and technical aspects of these state-led efforts are likely to be critically assessed and emulated. Organizations such as national and regional governors associations, the U.S. Conference of Mayors, and the PEW Center on Global Climate Change act as important organizational nodes as they facilitate policy diffusion and learning around climate change policy issues.

A fourth pathway of policy influence lies in the creation and promulgation of norms related to expanding climate change action and policymaking. Normative change can be a powerful influence on policymaking, as norms shape norms and behaviors that are viewed as "appropriate." A growing number of political leaders in the Northeast are declaring that they believe that human behavior has a discernible influence on the climate and that there is a need for political measures beyond those mandated by the federal government to act more aggressively to reduce GHG emissions. For example, states and local governments appear to be well on the way to establish CO_2 as "a pollutant" that should be regulated in different ways.

Furthermore, political office holders and candidates in many parts of the country seem to be tapping into—and helping to create—public expectations that public and private sector decision makers are expected to have explicit positions on climate change issues. In other words, climate change is becoming a more mainstream issue that is increasingly publicly debated and addressed alongside other major policy issues. In addition, particular policy instruments can gain status over time as the most "appropriate" mechanisms to address particular issues. On climate change, market-based policy instruments such as the creation of emissions trading schemes increasingly appear to have attained this status for GHG mitigation efforts. In contrast, there is little public advocacy for carbon taxes.

CONCLUDING REMARKS

Climate change policymaking and action are becoming increasingly institutionalized in the Northeast. Most states in the Northeast are climate change policy innovators, and they are

also demonstrating a willingness to emulate ideas and programs developed outside their own jurisdictions. In taking action, many state policymakers and officials are explicit about their desire to lead and push Congress and the federal government to enact stronger and more appropriate national legislation (Selin and VanDeveer 2005, 2006a). For example, New Jersey Governor Corzine recently called for the creation of a Governors' Climate Protection Leadership Council to help coordinate policymaking and implementation among leader states and to influence federal policy debates (Corzine 2007).

Rapidly developing climate change policymaking among the many states and municipalities in the Northeast that proceed beyond federal policy and standards is driven by a combination of factors, including an acceptance of the science of human driven climate change, concerns about regional vulnerabilities to a changing climate, efforts to protect the long-term viability of local economies, and a sense of responsibility to act in the face of lagging federal climate policy (Selin and VanDeveer 2005, 2006b). State-level climate policy in the Northeast has moreover developed under both Democratic and Republican governors and legislatures, and regional initiatives in the Northeast demonstrate that Republicans and Democrats can successfully cooperate around the formulation and implementation of modest climate change action.

Yet, the effectiveness of state GHG mitigation efforts to date should not be exaggerated. All northeastern states are struggling to reduce their GHG emissions. They are not likely to meet their relatively modest short-term reduction targets and must find more efficient ways to reduce emissions from energy and transportation sectors (Stoddard and Murrow 2006: Colón et al. 2007). On energy, some proposals for wind farms have engendered considerable local opposition and no state in the region has enacted the kinds of policies common in European countries such as Denmark and Germany to incentivize local investments in such energy. Highly integrated energy markets also means that states are extensively exporting and importing electricity. For example, only 16 percent of New Jersey's CO_2 emissions come from in-state electricity generation, but New Jersey imports much carbon intensive electricity from other states (Dutzik, Liou, and Mottola 2006).

It also remains unclear how different programs fit together, including RGGI's emissions trading market and state renewable portfolio standards. For example, will firms and/or states be competing for much of the same, scarce renewable power? Also, states' definitions of renewable energy actually differ (Rabe 2006). In addition, many states find it particularly challenging to reduce transportation emissions. These continue to rise in every state in the region—often at faster rates than other emissions sources. Adoption of California's developing CO_2 vehicle emissions and fuel standards may help northeastern states to address some of these issues. The effort by New Jersey to include transportation issues in its Energy Master Plan is another positive development where otherwise most state energy and transportation policies are developed separately.[12]

Many municipalities also find it hard to meet their GHG emission reduction targets (Selin and VanDeveer, 2006b). State and municipal actions are not well connected; in fact, they are largely developing separately all over the Northeast, missing possibilities for collaboration between state and city officials and programs. As states and municipalities continue to develop more and more climate change goals and programs, issues of responsibility and transparency become more important. States and municipalities should clearly assign responsibility for implementation and conduct periodic implementation reviews. Currently, information about implementation progress in states and municipalities is often hard to find, and there is a need to increase public transparency by, for example, publishing annual changes in GHG emissions on state and municipal websites.

Issues of costs are critical. Climate change mitigation costs are difficult to calculate, but estimates suggest that costs of existing state policy will be relatively low. For example, RGGI participants produced scenarios projecting retail price impacts and household bill impacts from RGGI. Under the "best estimate" scenario, RGGI would lead to an increase of 0.3 percent to 0.6 percent in retail price in 2015. Projected direct household electricity bill impact from RGGI ranged from $3 to $16 per average household annually in 2015. Estimates from Maryland and Massachusetts also suggest that investments in energy efficiency over time may result in net household savings, and other energy-saving measures may also produce net benefits (DOER 2005; CIER 2007). Of course, RGGI costs are likely to be modest in part because RGGI's emission reduction goals are modest. More aggressive GHG reductions from a larger set of emissions sources may cost more.

Northeastern states are also influenced by rapid climate change policy developments in California and other West Coast states. While some of California's initiatives may be relatively easily emulated by northeastern states—such as those on vehicle emissions and fuel standards—others may be more difficult to combine. For example, if the emissions trading scheme currently under discussion among five western states—Washington, Oregon, California, New Mexico, and Arizona—were to come to fruition, it is not a given that a West Coast trading scheme will be based on goals, rules, and procedures that are identical to RGGI's. In that case, linking regional emissions markets on the East and West Coasts may be difficult. The other West Coast states are also, in effect, competing with states in the Northeast for financial investments in renewable energy and venture capital for the development of new, GHG-reducing technology.

The West Coast states are also challenging their northeastern counterparts for national leadership. As federal climate change policy is expanded, debates about differences between Californian and northeastern approaches will move to Washington. That is, leader states and their representatives in Congress have strong incentives to compete to upload their state-specific standards and programs to federal policy. At the same time, state officials and climate change advocates all over the Northeast acknowledge the importance of the

development of federal policy that support state efforts. There is little indication that leader states in the Northeast and elsewhere will slow down their efforts to reduce GHG emission anytime soon, but supportive federal policy will be necessary for reaching state medium and long-term GHG emission reduction goals (Corzine 2007; Selin and VanDeveer 2007).

Finally, U.S. states in the Northeast are the same size as many large and middle-sized European countries, and they release comparative levels of GHG emissions. Moreover, U.S. states and European countries with similar highly industrialized and technologically-developed societies and economies face many related challenges in substantially reducing GHG emissions from energy and transportation sectors. It is likely that U.S. states and European countries will cooperate more closely in the future. U.S. states and European officials already interact, such as on issues of creating effective cap-and-trade schemes, and both U.S. states and European countries are likely to benefit from deepening transatlantic cooperation and lesson-learning around climate change mitigation and adaptation issues.

References

Algoso, Dave and Rusch, Emily (2005). Global Warming Pollution in New Jersey: Key Steps to Reduce Emissions from Electricity Generation and Transportation. NJPIRG Law & Policy Center.

Barnes, Robert (2006). "Court Hears Global Warming Case" *Washington Post,* November 30, 2006.

Barringer, Felicity and Yardley, William (2007). "Bush Splits With Congress and States on Emission" *New York Times,* April 4, 2007.

Bogdonoff, Sondra and Rubin, Jonathan (2007). "The Regional Greenhouse Gas Initiative: Taking Action in Maine" *Environment* 49(2): 8-16.

Center for Integrated Environmental Research (CIER) (2007). "Economic and Energy Impacts from Maryland's Potential Participation in the Regional Greenhouse Gas Initiative," College Park, Md.

Clean Air-Cool Planet (2005). Indicators of Climate Change in the Northeast 2005. Portsmouth, N.H.: Clean Air-Cool Planet.

Colón, Jessica et al. (2007). *The Garden State in the Greenhouse: Climate Change Mitigation and Coastal Adaptation Strategies for New Jersey.* Princeton: Woodrow Wilson School of Public and International Affairs, Princeton University.

Corzine, Jon S. (2007). Written Testimony, United States Senate Committee on Environment and Public Works, Full Committee Hearing "State, Regional, and Local Perspectives on Global Warming," March 1, 2007.

Daley, Beth (2007). "Winter Warm-up Costing N.E. Region" *Boston Globe,* January 28, 2007.

DePalma, Anthony (2005). "It Never Sleeps, But It's Learned to Douse the Lights" *New York Times,* December 11, 2005.

Donnelly, John (2006). "High Court Hears Global Warming Case" *Boston Globe,* November 30, 2006.

Dutzik, Tony; Liou, Suzane Leta; and Mottola, Dena (2006). A Blueprint for Action: Policy Options for Reducing New Jersey's Contribution to Global Warming. Trenton: Environment New Jersey Research and Development Center.

Ebbert, Stephanie (2007). "Massachusetts Steps Up Climate Rules for Developers" *Boston Globe,* April, 22.

Environmental New Service (ENS) (2007). "New York City Tallies Its Greenhouse Gas Emissions" April 11.

Foy, Douglas and Healy, Robert (2007). "Cities Are the Answer" Boston Globe, April 4.

Greenhouse, Linda (2006). "Justices' First Brush With Global Warming" *New York Times,* November 30, 2006.

Greenhouse, Linda (2007). "Justices Say E.P.A. Has Power to Act on Harmful Gases" *New York Times,* April 3, 2007.

Hileman, B. (2006). "Scientists Support Curbing CO_2" *Chemical & Engineering News,* 11 September, 2006.

Janofsky, M. (2006). "Justices Agree to Consider New Case on Emissions" *New York Times,* 27 June, 2006.

Laidler, John (2007). "N.H. Prepares to Vote on Global Warming" *Boston Globe,* February 18, 2007.

Lueck, Thomas (2007). "The Mayor Draws Blueprint for a Greener City" *New York Times,* April 23.

Madsen, Travis; Gorke, Frank; and Sargent, Rob (2005). "More Heat Than Light: Global Warming Pollution from the Northeast's Dirtiest Power Producers." National Association of State PIRGs.

Massachusetts Division of Energy Resources (DOER) (2005). "The Impact of Energy Efficiency Measures Integrated with the GGI Policy on Residential, Commercial, and Industrial Consumption and Bills."

Mauro, Tony (2007). "High Court Orders EPA to Review Greenhouse-Gas Emissions" *Legal Times,* April 3, 2007.

Mishra, Raja (2007). "Mayor Aims to Cut City's Greenhouse Gas Emissions" *Boston Globe,* April 13, 2007.

Palmer, Thomas C. Jr. (2007). "Cambridge Sets $70M Energy Initiative" *Boston Globe,* March 29, 2007.

Point Carbon (www.pointcarbon.com) (2006). Carbon Market North America, December 20, 2006.

Point Carbon (www.pointcarbon.com) (2007). Carbon Market North America, February 14, 2007.

Rabe, Barry (2003). "Power to the States: The Promise and Pitfalls of Decentralization" in N. J. Vig and M. E. Kraft (Eds.) *Environmental Policy: New Directions for the Twenty-first Century.* Washington, D.C.: CQ Press.

Rabe, Barry (2004). *Statehouse and Greenhouse: The Emerging Politics of American Climate Change Policy.* Washington, D.C: Brookings Institution Press.

Rabe, Barry (2006) "Second Generation Climate Policies in the States: Proliferation, Diffusion, and Regionalization" in H. Selin and S. D. VanDeveer (Eds.) *Climate Change Politics in North America: The State of Play.* Occasional Paper. Canada Institute of the Woodrow Wilson International Center for Scholars, Washington, D.C.

Rothenberg, Lawrence S. (2002). *Environmental Choices: Policy Responses to Green Demands*. Washington, D.C.: CQ Press.

Selin, Henrik and VanDeveer, Stacy D. (2005). "Canadian-U.S. Environmental Cooperation: Climate Change Networks and Regional Action" *The American Review of Canadian Studies* 35(2): 353–378.

Selin, Henrik and VanDeveer, Stacy D. (2006a). "Canadian-U.S. Cooperation: Regional Climate Change Action in the Northeast" in Philippe Le Prestre and Peter Stoett (Eds.) *Continental Ecopolitics.* Aldershot: Ashgate.

Selin, Henrik and VanDeveer, Stacy D. (2006b). "Climate Leadership in Northeast North America" in H. Selin and S. D. VanDeveer (Eds.) *Climate Change Politics in North America: The State of Play.* Occasional Paper. Canada Institute of the Woodrow Wilson International Center for Scholars, Washington, D.C.

Selin, Henrik and VanDeveer, Stacy D. (2007). "Political Science and Prediction: What's Next for U.S. Climate Change Policy?..." *Review of Policy Research* 24(1): 1–27.

Stoddard, Michael D. and Murrow, Derek K. (2006). "Climate Change Roadmap for New England and Eastern Canada." Environment Northeast (www.env-ne.org).

Thurber, Brian (2006). "New England and Eastern Canada 2006 Report Card on Climate Change Action." New England Climate Coalition.

Union of Concerned Scientists (2006). *Climate Change in the U.S. Northeast: A Report of the Northeast Climate Impact Assessment.* Cambridge: Union of Concerned Scientists.

Wettestad, Jørgen. (2005). "The Making of the 2003 Emissions Trading Directive: An Ultra-quick Process Due to Entrepreneurial Proficiency?" *Global Environmental Politics* 5(1): 1–23.

Zezima, Katie (2007). "In New Hampshire, Towns Put Climate on the Agenda" *New York Times,* March 19, 2007.

Notes

1. The authors thank Jeffrey Domanski and participants at the conference "States and Climate Change: Leaders or Lab Rats?" for helpful observations and comments on an earlier draft of this article.

2. See www.pewclimate.org/policy_center/state_policy.

3. For more on NESCAUM, see www.nescaum.org.

4. By early 2007, the CCP program had 674 participating local governments from 30 countries, 152 of which were located in the U.S. As of March 2007, 425 U.S. mayors representing more than 61 million Americans had signed a declaration committing them to meeting or exceeding the U.S. emissions reductions called for in the Kyoto Protocol (7 percent reduction from 1990 emissions levels by 2012). For more on the CCP program, see www.iclei.org. For more on the U.S. Mayors Climate Protection Agreement, see www.seattle.gov/mayor/climate.

5. For more information, see www.carboncoalition.org.

6. See www.pewclimate.org/what_s_being_done/in_the_states/emissionstargets_map.cfm.

7. See www.eere.energy.gov/windandhydro/windpoweringamerica/wind_installed_capacity.asp.

8. Pennsylvania's five sustainable energy funds are: Metropolitan Edison Company Sustainable Energy Fund of the Berks County Community Foundation; Pennsylvania Electric Company Sustainable Energy Fund of the Community Foundation of the Alleghenies; Sustainable Development Fund of the Reinvestment Fund; Sustainable Energy Fund of Central Eastern Pennsylvania; and West Penn Power Sustainable Energy Fund.

9. See www.cleanenergyfunds.org.

10. See http://nj.gov/emp/index.shtml.

11. See, for example, the activities and publications of the Environmental Markets Association at www.emissions.org.

12. For more on the New Jersey Energy Master Plan, see http://nj.gov/emp.

Local Options on Global Stocks:
How the States Are Affecting the U.S. Debate on Climate Policy

Dallas Burtraw
William Shobe

INTRODUCTION

Climate change is a global problem and its solution will require international and probably global cooperation. That would seem to make climate change a problem that is particularly well suited for policy at the national level. However, in the U.S. and in some other nations including Australia, state and local governments have been very active in developing policy. Clearly one justification for policy initiatives at the state and local level is the sense of local political bodies that they have to do something to address the problem. The federal government has not been very active in addressing problems related to climate change, and some states will conclude that it is in their interest to take steps to address the issue even if they will receive only a very small fraction of the climate change benefits of their own actions. The state policy makers undoubtedly recognize the importance of joint effort and view their own actions not as ultimate policy solutions but rather as providing an impetus for federal and even international action.

When states craft climate change policy, the policies will likely be designed in a way that maximizes their own net benefits. Thus, locally designed policies on climate change will reflect local conditions: natural resource endowments, concentrations of industry and agriculture, and the distribution of political influence in the state. In addition, state policies will likely act to export costs and import benefits whenever possible. The U.S. Constitution places a variety of constraints on the form and extent of state control over activities within the state's own boundaries, and even tighter constraints on efforts to extend state authority over activities in other states and over the trade of goods across state boundaries. The combination of local interests and conditions will result in a pattern of regulatory development that results in higher costs of compliance and reduced gains in actual impact on climate change while constitutional constraints limit the ability of states to control the full range of economic activities that result in greenhouse gas emissions from the state.

When businesses encounter regulatory initiatives that vary across states in stringency and method, it can raise their costs, and historically one finds business in the position of arguing for federal action to reduce the diversity and even inconsistency of independent state regulatory actions. For those who view pending state regulatory actions as overly strict, the preemptive power of federal rules may provide an avenue for setting less stringent federal standards that

preempt the implementation of stricter local policies.

We are interested in motivations for state actions addressing climate change that are in some ways deeper than the desire to provoke federal action. Other motivations include setting a model for federal action, providing a testing ground for policy alternatives, and the possibility that state governments are better placed to address some aspects of the problem. With these motivations in mind, in this paper we investigate the potential efficacy of state efforts. We examine the political economy of environmental federalism to see how state efforts may influence the federal debate.

States have been famously referred to as the laboratory where learning can occur that can influence federal policy. In a laboratory, experimenters may make discoveries through educated theorizing (guesses), or through trial and error, but always with lots of failed efforts to light the way. How might one consider the array of state initiatives underway in this light? Are state innovations well-designed experiments? Are many destined to fail? Will failed policy experiments be abandoned, or will they become entitlements that hang on as costly, anachronistic appendages to state policy? Are they a precursor to eventual federal action? Or are they, simply, local efforts to realize local change at a scale where citizen-activists can affect policy (and perhaps not the best scale for ultimately implementing that policy)? Are state policies an end unto themselves, or a path to federal policy? Ultimately, any U.S. effort on climate change will be an amalgam of national and local decision making, and, as such, will undoubtedly bear the markings of its diverse origins.

In what follows, we examine some of the implications of local policymaking with regard to the global issue of climate change. First, we assess what one may expect when small open economies, such as states, implement policies designed to affect global pollutants. Next, we briefly analyze some of the legal constraints on state actions. We then catalog some of the specific technologies used in the states to address carbon emissions. Finally, we provide some analysis of how states might implement emission control policies in a way that compensates important interests for some of their increased costs without losing the benefits of efficient policy design.

SOME OBSERVATIONS ABOUT STATE-LEVEL POLICY INITIATIVES

Greenhouse gases act on a global scale. A unit of greenhouse gas with a given temperature forcing potential has the same effect whether it is emitted in Australia or in Appalachia. The global scale of the effect argues for a global policy response. Yet, in the case of greenhouse gases, an effective international response has yet to emerge. Instead, there have emerged a set of regional initiatives that, by themselves, can do little to reduce the anticipated consequences of increasing concentrations of greenhouse gases in the atmosphere. For example, the 10 states of the Regional Greenhouse Gas Initiative (RGGI) have implemented a cap on carbon emissions from the electric utility sector. The total emissions from this sector amount to only around 2 percent of global carbon dioxide emis-

sions (Energy Information Administration 2005). The reductions in CO2 emissions due to the full implementation of the RGGI cap are only a fraction of this amount. Thus, a full implementation of the RGGI cap has only a trivial impact on global carbon emissions.

The Kyoto Protocol, while intending to take a global approach, is largely a unilateral effort by European countries to reduce their contribution to global emissions. An even more dramatic departure from the match of global policy to the global scale of the problem is the case of the U.S., which has declined to establish any national policy of limiting greenhouse gas emissions. Rather, the U.S. observes a wide variety of state and local governments and institutions voluntarily undertaking policies that are advertised as efforts to reduce local greenhouse gas emissions.

No city, state, or even region of the U.S. can independently have any appreciable effect on global greenhouse gas emissions. As with the case of Europe and the Kyoto protocol, one interpretation of these efforts at reducing emissions is as an offer to participate in broader cooperation to reduce emissions. By making unilateral emission reductions, a state or group of states are expressing a commitment to a cooperative outcome in the prisoner's dilemma game of exploiting the global atmospheric commons. These early commitments will ultimately be seen as successful by the adopting states if they result in the establishment of a national policy limiting greenhouse gas emissions, and one that is sufficiently stringent so that it matches those state-level efforts. By this logic, the early adoption of policies limiting greenhouse gas emissions serves to push the national political agenda in the direction of a national policy on reducing emissions.

What will be the outcome of this topsy-turvy pattern of having local policy development driving the national agenda on a global pollutant? How is it likely to differ from the development of an international treaty or from the top-down establishment of a national policy? In this section, we will address some of the implications of local policy experimentation. In the section that follows, we will briefly discuss the political economy of state efforts to control greenhouse gas emission in a federal system.

LABORATORIES OF DEMOCRACY

By taking the lead in policy development, the states become the "laboratories of democracy" where new policy innovations in the U.S. may be designed, implemented, and evaluated (Strumpf et al. 2002). The model of policy development implicit in this statement would have 50 independent policy laboratories inventing new policies, testing those policies in the field, and selecting the best policies based on the outcome of the design and test cycle. The best policies then will survive to be adopted by other states or by the federal government while the unsuccessful policies will be discarded or sent back to the lab for redesign. By putting many independently developed policies to the test, such a system of policy development might have significant advantages over a single, top-down, federal policy development process.

But is this the way that policy innovation actually plays out in the states? The "laboratories of democracy" model suggests several pieces of evidence we might examine in order to answer this question. While there is often little data that we can use to fully evaluate these questions, we can develop a qualitative picture that may be instructive.

FOLLOW-THE-LEADER POLICYMAKING

Investment in policy design and evaluation can be expensive and can expose innovators to political as well as financial risk. And since innovative policy designs are public goods, a single state cannot hope to capture all or even a significant share of the benefits created by a successful innovation (Strumpf et al. 2002). Insofar as states simply copy policies implemented in other states or coordinate their policy development, then there may be correspondingly fewer different new policies put to the test. "Follow-the-leader" policy development occurs when one state or a few states implement new policies, and these new policies diffuse across other states often before a careful evaluation can be made of the true impact of the new policies. Coordinated policy development may occur through state organizations such as the National Governor's Association, the Council of State Governments, or the Environmental Council of the States.

This is not to suggest that state-level policymaking does not produce good outcomes, only that the process of policy design in the case of "follow-the-leader" or coordinated policy development does not necessarily differ as markedly from federal policymaking as the "laboratories" model seems to suggest. It may be true that, in both cases, policy design investments are highly concentrated. One would not necessarily expect to observe a wider variety of policy proposals or even a qualitatively different set of proposals.

LOCAL EXPERIMENTS WILL REFLECT LOCAL INTERESTS

Probably the key difference in the pattern of regulatory development between the federal and state governments is the voluntary nature of the decision to implement a given state-developed policy initiative. While it is axiomatic that local policymaking must necessarily reflect local interests, probably the most remarkable feature of a state-driven policy agenda on climate change is the apparent imbalance between aggregate local costs and benefits. Even for the larger states such as Texas, California, and New York, each of which contribute a significant fraction of U.S. atmospheric greenhouse gas accumulations, the benefits of a state's actions are spread out over the entire globe while any net costs are local. Aggressive policies to control greenhouse gas emissions in a state must raise costs in that state relative to costs in other places, causing economic activity to leak out of the state along with the associated emissions.

So we would expect to observe differences in state policies that reflect differences in the expected local gains, the local distribution of those gains, and the relative influence of various interests at the local level. For example, a recent study estimated the gains and losses to agriculture across the states from increasing temperatures expected from human-induced climate change.[1] The inter-state differences

were quite striking, with California losing around $1 billion annually and Pennsylvania gaining about half that much. Differences such as these may help explain some of the differences in the intensity of the responses that those states have made in reducing the state's contribution to global climate change.

Local policies on climate change will also be driven in part by local interests not necessarily related to climate change, often referred to as "policy capture." Agricultural interests within a state may be expected to support biofuel subsidies. The forestry industry in a state will benefit from the use of sequestration credits in clean generation portfolio standards. Coal-producing states will have constituencies strongly opposing limits on carbon emissions and supporting public expenditures on "clean coal" technologies, while states with stocks of oil and natural gas may gain from policies that favor these local stocks over coal imported from other states. The costs of implementing renewable portfolio standards will be shared by owners and ratepayers in states with unregulated electric rates, while in states with rate regulation a larger fraction of the added costs will be passed through to ratepayers.

Every policy designed to address climate change will have winners and losers, and potential winners and losers will attempt to bend regulatory policy in their favor. There can be no reasonable expectation that changes to rules in response to these interests will enhance the efficiency or effectiveness of the resulting policy. The relative size and intensity of these interests will vary from state to state and will affect the choice of policies toward climate change. The heavy weighting of local interests in establishing local policies toward global climate change may be expected to result in a mix of policies that greatly increase the aggregate costs of reducing global impacts by driving large differences in marginal control costs. In these laboratories of democracy, the determination of which policy experiments are successful will often depend less on measures of the policy's actual impact on greenhouse gas emissions than it will on the relative intensity of interests between the gainers and losers.

POLICY EXPERIMENTS CREATE ENTITLEMENTS AND ARE HARD TO ELIMINATE

It naturally follows that once a local policy has been established it will likely be hard to change because those receiving the benefits of the current policy will be willing to pay to retain the benefit. Their willingness to pay will be directly related to the size of the benefit received. This implies that policy experiments have a natural stickiness or inertia; they are hard to eliminate once they are in place. Policy inertia arises from the tendency of beneficiaries to view the benefits from the policy as an entitlement: every public policy is an entitlement to someone. This policy inertia creates yet another divergence between the ideal laboratory model and actual policy development by the states. Policy inertia and policy capture by interested groups has been amply demonstrated in many areas of regulatory policy (Posner 1974, Stigler 1971).

EXPERIMENTATION IMPLIES LEARNING FROM MISTAKES

The model of states as laboratories of policy

experimentation depends on the ability of states to learn from their mistakes. We have already noted that it may be difficult to abandon a policy once it is implemented due to entitlements created by the policy. Learning from mistakes also implies that states evaluate the effectiveness of new policies. However, for a variety of reasons, states do little effective ex post policy evaluation. First, there is the class of policies that are adopted largely because of their redistributive impact. These require no evaluation since any policy effectiveness is largely secondary to the redistribution of resources. Second, the people who vote to have policies put in place risk having their positions proven wrong by ex post evaluation and hence have a reduced incentive to conduct such evaluation. Third, like investments in policy development, policy evaluation is a public good, with all adopters of the policy benefiting from the ex post evaluation of the state carrying it out.

Policy evaluation capable of actually determining whether a new policy had succeeded can often be very expensive. Outcomes can have significant short-term variability that masks actual performance, or they may have consequences that are inherently difficult to measure. Renewable Portfolio Standards (RPS), a policy currently favored by 21 states for, among other things, reducing state contributions to global climate change, provide an instructive example. An RPS directly reduces carbon emissions by replacing some fossil carbon-based generation with generation that does not use fossil carbon sources. In addition to the direct impact, a state's RPS raises the cost of electricity, lowering demand. Most RPS rules allow utilities to purchase renewable energy credits (RECs), and in some cases carbon offsets, in order to meet the standards.

A full evaluation of the consequences of establishing an RPS requires a careful tracing of the effects of the change throughout the economy. Other things equal, an increase in generation costs in one state will cause some generation and some electricity-intensive activity to move to locations where costs are lower and hence where carbon limitations are less binding, and some users of electricity will substitute away from electricity to direct consumption of fossil fuels. Also, a reduction in the local demand for fossil fuels will lower the cost of these fuels to the rest of the world, resulting in some offsetting increase in their use elsewhere. The increased use of RECs will increase their price. This will increase the supply of RECs but will also increase the cost of RECs to others, thus reducing quantity demanded at the margin. One must make a realistic determination of how much renewable generation represented by the RECs would have occurred in the absence of the added incentives offered by them.

This partial list amply demonstrates the difficulty states face in fully evaluating the costs and benefits of a given climate change policy. The results of the analysis may depend on very difficult-to-measure behavioral responses to changed incentives. For example, an increase in the gasoline tax in a state generates behavioral responses at many different margins playing out over many different time horizons; all as the wholesale price of gasoline, the cost of housing, and the cost of cars and transit options undergo their own changes on their

own multiple time horizons. Unfortunately, without undertaking such an analysis, state policymakers cannot be in a position to make a fully informed decision about whether a policy experiment has promoted the intended goal and, if so, whether it has been worth the cost.

The foregoing analysis offers insight into some characteristics we might expect in climate policy development at the state level and climate policy development at the federal level. First, experimentation will not be independent and evenly distributed across the states. Some states follow the lead of other states, free riding on their policy development. Second, states have different interests in controlling carbon emissions. Those states with little to gain will not initiate policies. Local policies will reflect local interests and local political conditions. These differences may largely be driven by the distribution of gains and losses in the state and will result in significant differences in marginal reduction costs across states. Policy evaluation is expensive and subject to free riding, so it is likely that many state policy innovations will not be subjected to careful ex post analysis. This underinvestment in policy evaluation combined with the stickiness of regulatory entitlements may result in many ineffective or inefficient policies remaining in force and even being emulated by other states.

The enumeration of these characteristics of state policymaking on climate issues is not intended as an argument that policy innovation is best left to federal or international agencies. Many of these features are shared by policy development and implementation at any level. However, in choosing regulatory approaches, one should have a realistic expectation about the outcome of distributed policy development.

POLITICAL ECONOMY OF ENVIRONMENTAL FEDERALISM

THE "APPROPRIATE" LEVEL FOR ENVIRONMENTAL POLICY

Choosing the appropriate level of government for implementing environmental policies requires balancing a number of important factors. The decision would be relatively straightforward if the geographic extent of the environmental effects matched the geographical extent of a single government's authority to monitor and enforce. It is an unfortunate characteristic of most important environmental problems that they do not satisfy this geographic identity between the extent of government control and the extent of environmental impact (Perman et al. 2003). As a consequence, an efficient approach to this class of environmental problems requires some level of coordination between sovereigns. As between nations, the only tools available are those of international diplomacy. The nature of the strategic dilemmas of international environmental diplomacy is well documented elsewhere. Here we will be concerned with the relationship between the state and federal governments in the U.S. in addressing climate change.

It is one of the standard results from the environmental economics literature that where diverse localities have diverse valuations of environmental goods, then allowing those localities to set levels of environmental quality according to the local valuation can improve welfare (Perman et al. 2003). A single national

standard can, other things equal, lower welfare by having a single level of control that is too strong for some localities and too weak for others. In the long run, people will tend to sort themselves out according to their preferences for environmental quality. For environmental effects that cross jurisdictional boundaries, this logic is greatly weakened by the uncompensated effects that one locality's choices have on other localities. A single locality will not be able to set environmental quality standards according to local preferences, and opportunities for individuals to choose their preferred level of environmental quality by choosing where they live will be attenuated. This is clearly the case with climate policy.

Individual states or regional efforts, such as those implemented under RGGI, represent a small fraction of the global economy and their economies are open to interstate and international movement of goods and capital. Local efforts to regulate greenhouse gas emissions are subject to global market forces. Generally speaking, local regulatory efforts will raise local costs but will not change global prices. In this environment, any increase in local costs will result in some tendency for economic activity to shift away from higher cost regions and toward lower cost regions. Any resulting shift of greenhouse gas emissions away from regulated areas toward unregulated areas is referred to as leakage. Leakage may be direct, as when fossil fuel combustion moves from a state with strict greenhouse gas controls to a neighboring state, while the resulting production is sold back into the state with the stricter regulations. Or leakage may be indirect due to a general shift in economic activity away from the state with the stricter regulations. Another form of leakage occurs when greenhouse gas restrictions lead to a reduction in the local demand for carbon-based fuels. If the reduction in demand for fossil fuels is large enough to put some downward pressure on fossil fuel prices, then any reduction in price will result in some increase in demand for fossil fuels elsewhere partially offsetting the local reductions resulting from the regulations.[2]

Even when states implement policies that affect only their local businesses, successful policy implementation may benefit from (or even require) cooperation with other states. For example, policy coordination could help prevent the leakage of carbon emissions between neighboring states. Coordination may take the form of setting multi-jurisdictional standards. For example, where states have implemented RPS policies, they generally will include some provision for offsetting some of the local requirements with transferable renewable energy credits from other jurisdictions. However, in the absence of uniform standards for what activities may generate such credits and how they may be used, a state-by-state approach will cause the market for credits to become fractured and much of the potential gain in cost effectiveness would be lost.

CONSTITUTIONAL FEDERALISM

State efforts to control greenhouse gas emissions reprise all of the major recurrent themes in state and federal relations. The U.S. Constitution apportions powers between the federal government and the states (albeit with determined vagueness) and places a variety of

limits on the exercise of both state and federal power (Nowak et al. 1978). States may not place burdens on interstate commerce (unless given permission by the federal government) or international trade, they may not regulate activities in other states, and they may not take actions preempted by a valid exercise of federal power. The history of constitutional law in the U.S. is partly a history of the struggle between the states and the federal government over the apportionment of these powers and limitations.

The case of greenhouse gas controls turns the usual federalist struggle around. It is generally acknowledged by the states that greenhouse gas controls belong at the federal level, but in the absence of any federal policy initiative, the states are combining in regional consortia to initiate change. This bottom-up regulation of a global pollutant presents an unusual set of constitutional obstacles.

Limits on state powers

Section 8 of Article I of the U.S. Constitution, the "commerce clause" gives the federal government the right to regulate trade with other nations, with Indian tribes, and among the states. On its face, this language gives the federal government the power to actively control commerce between a state and any other jurisdiction. The first implication of this language is that the federal government has broad, plenary power to regulate commerce. As it has been interpreted, this clause implicitly grants the federal government the power to control matters that, while internal to a state, may affect commerce between a state and other states, countries, or Indian tribes.

In addition, the "supremacy clause" in Article VI, clause 2, provides that federal law overrides any state law that is in conflict with valid federal legislation. Congress may specifically preempt state authority in matters within its plenary power, or preemption is implied if state laws are in actual conflict with federal action under the commerce clause (Nowak et al. 1978).

While the commerce and supremacy clauses do not explicitly limit state regulation of commerce in areas not the subject of federal legislation, these provisions have been interpreted to imply a passive or "dormant" commerce clause restriction on the permissibility of states passing laws or regulations that place a burden on interstate commerce. Under the dormant commerce clause interpretation, states may not pass laws, under the guise of protecting public health and safety, that place a heavier burden on economic activity originating in other states compared to economic activity originating within the state unless there is no less burdensome or nondiscriminatory way of accomplishing the purpose. In other words, there is a strong constitutional presumption against rules that discriminate against economic activity from outside the state. Interestingly, this does not imply a prohibition against discriminating against economic activity from within the state. The rules are intended to protect commerce from regulations that protect local economic interests at the expense of interests from other states.

Article I, section 10, clause 1 of the Constitution prohibits states from entering into treaties, alliances, or confederations (with

other countries). There is no provision for congressional approval to override this prohibition. Further, section 10, clause 3 requires that no state shall enter into any interstate compacts and agreements (with other states) without the consent of Congress. The interstate compacts and agreements language only applies to cases where the cooperation between the states threatens the balance of power between the state and federal governments. Cooperative activities that do not shift the balance of political power need no approval (Nowak et al. 1978).

Finally, Article IV, section 2, clause1 of the Constitution provides that "[T]he Citizens of each State shall be entitled to all Privileges and Immunities of Citizens in the several States." This language may place some restrictions on whether citizens from other states may be limited in their access to goods, services, or licenses provided by a state government. Under some interpretations, this provision may place limits on a state's ability to differentiate it's own citizens from noncitizens in granting access to resources within the state's control.

Experimentation with policies on reducing climate change must take place within the restrictions on state power laid out in the previous paragraphs. A policy intended to reduce a state's greenhouse gas footprint must not conflict with existing federal rules. It must not place non-local economic interests at a competitive disadvantage relative to local interests. It must not require a significant obligation to a foreign government or too great a blending of governmental powers between states. And, any policy concerning a global issue such as climate change from greenhouse gas emissions is ultimately subject to preemption by federal policy.

State climate change policies invariably affect activities well within the reach of the federal power to regulate commerce: electricity generation, energy production generally, and trans-boundary air pollution. For example, states wishing to address the "leakage" of greenhouse gas generation in response to state regulations on electricity generation will face constitutional constraints on their ability to extend regulatory control over production of electricity imported into the state. Efforts to shift the fuel mix used in a state away from carbon-intensive fuels may run afoul of restrictions on states placing burdens on interstate commerce. Also, when states take the lead in establishing policies where there is a reasonable expectation of future federal preemption, the responses of firms to the state policies will take into account the likelihood of future federal policies. As a case in point, regional greenhouse gas trading programs such as RGGI must expect that firm responses to the regional market will reflect firm expectations about how the transition from regional to federal programs will be implemented.

Since the federal power to negotiate and approve international treaty obligations is a plenary federal power, the web of existing global treaty obligations may place substantial constraints on state regulatory options. Trade agreements, international rules on governing transport, and those covering use of ocean and atmospheric resources may be inconsistent with local climate change policies.

Limits on federal powers

The Tenth Amendment of the U.S. Constitution, the "reserve powers" clause, restricts the federal government from applying its powers in a way that threatens the sovereignty of state and (hence) local government. Congress cannot pass a law that unreasonably interferes with a state's exercise of its essential executive (plenary) powers or threatens its independent existence as a state. However, federal power can reach state activities that are not plenary. For example, state-owned power-generation facilities would not be considered an exercise of state plenary power and would be subject to federal preemption and regulation.

THE REGULATORY MAZE

It is generally accepted that, for firms with a scope of operations that spans multiple jurisdictions, regulatory standards that vary substantially from region to region will impose larger compliance costs than regulations with relative cross-regional uniformity. Given that this is true, then the development of greenhouse gas policies at the state level may result in higher compliance costs than would policies implemented on the national or even international scale. Standards may not only be different, they may be inconsistent with requirements imposed by other states. A regulatory standard in one state may encourage the use of a particular type of energy source, while another state's standard may specifically prohibit it. A power company selling into both markets will face significant managerial and technological costs in satisfying the joint but inconsistent requirements. Navigating this regulatory maze can place a substantial burden on commerce between jurisdictions, imposing substantial hidden costs on consumers.

State governments have an incentive to export the costs and import the benefits of a given policy. The prevalence of meals and lodging taxes is a testament to state efforts to export their tax burden.[3] The most effective arguments used to support RPS policies in the states probably have less to do with reducing climate change than they do with shifting jobs into the state and reducing exports of money paid to carbon-based energy suppliers. The tendency of states to use policies to export costs and import benefits will undoubtedly contribute to the development of a pattern of state regulations with high compliance costs and low aggregate effectiveness in lowering greenhouse gasses.

CONFLICTS OVER OWNERSHIP

Ownership of common pool resources such as air and water is generally seen as vested in the public. Legal writers often refer to these resources as being held in "public trust" for the benefit of the public. One of the beneficial uses of these common pool resources has been the disposal of waste products. This use of air and water has always had very substantial economic value; a value that was implicit rather than explicit because there was no mechanism for explicitly establishing a value for resources not traded in markets. The historic conflicts over air and water pollution have been over what share of these public resources should be allocated to waste disposal services and what share should be reserved to protect public consumption of air and water. For as long as environmental policy

was viewed primarily as an issue of what regulations to apply to the use of the air and water, the value of environmental resources remained implicit and the issue of ownership did not arise. Rather, the discussion was in terms of what level of government had the power to establish and enforce regulatory standards.

With the advent of environmental policies such as Pigouvian taxes and allowance trading, which are based on establishing market-like incentives for users of air and water, the disposal services of these resources are transformed into an asset with a stream of valuable monetary returns. The power to regulate now implies the power to determine the disposition of the stream of valuable returns on the regulated activity, adding a critical complication to the struggle between the states and the federal government over the allocation of regulatory powers. The issue of control is now also an issue of income.

Although no one seemed to remark on it at the time, the 1990 Clean Air Act Amendments transferred a valuable ownership interest from the states to the federal government by transferring the right to allocate the economic value of sulfur dioxide (SO_2) emissions from sources covered by the law. The law created an asset with substantial market value and gave the asset to regulated firms free of charge. An asset that had been held in trust by state government, for all intents and purposes, became the property of the federal government. As a rough measure of the magnitude of this transfer, the current annual market value of SO_2 allowances is approximately $5 billion or just under 1 percent of all state expenditures in 2006.

The next large federal air pollution control program to use a cap-and-trade structure followed a different pattern. The EPA rule to control the effects of the transport of NO_x over state lines, the NO_x SIP call, was developed through a process of negotiation among the states. These negotiations led to the establishment of state budgets for allowable emissions of NO_x. The states retained control over how the allowances were allocated to firms. The EPA rulemaking explicitly acknowledged the possibility that the states had the authority to charge for the allowances if they saw fit. While most of the states covered by the NO_x SIP call have chosen to give all of their allowances away for free, there were two notable exceptions. In 2004, Kentucky sold 5 percent of its NO_x allowances into the NO_x spot market. Also in June of 2004, Virginia held an auction for 8 percent of its NO_x allowances for the 2004 and 2005 compliance years. This auction raised $10.5 million for the state's general fund.

A conflict between the states and the federal government over ownership of air allowances is inevitable. The Bush administration's "Clear Skies" initiative for modifying the clean air act proposed expanded use of allowance trading programs and specified that, over time, increasing shares of allowances should be auctioned, and the revenues would have accrued to the federal government. The Congressional Budget Office (2005) has estimated the impact of a variety of air pollution fees on the federal budget.

The amount of money at stake rises dramatically with the prospect of limits on greenhouse

gas emissions. A policy aimed at holding carbon emissions steady through taxes or allowances would generate tens of billions of dollars each year. RGGI and other state efforts to control carbon and raise revenue could serve to establish state ownership of the value of carbon assets prior to the establishment of a federal program. The states are, in fact, making a claim of ownership to assets that federal proposals would claim for the U.S. Treasury.

TECHNOLOGY POLICY

One of the ways state and local governments consistently exercise authority in recent decades is in the promotion of policies that chart a course for technology development. These policies take shape in two venues. One is legislative, at the state level, where states occasionally have offered tax credits and other support policies for specific types of technological development. The second venue is regulatory where, for example, state public utility commissions influence investment and operation of the electricity system. Our major focus in this discussion will be on these state policies affecting the electricity sector.

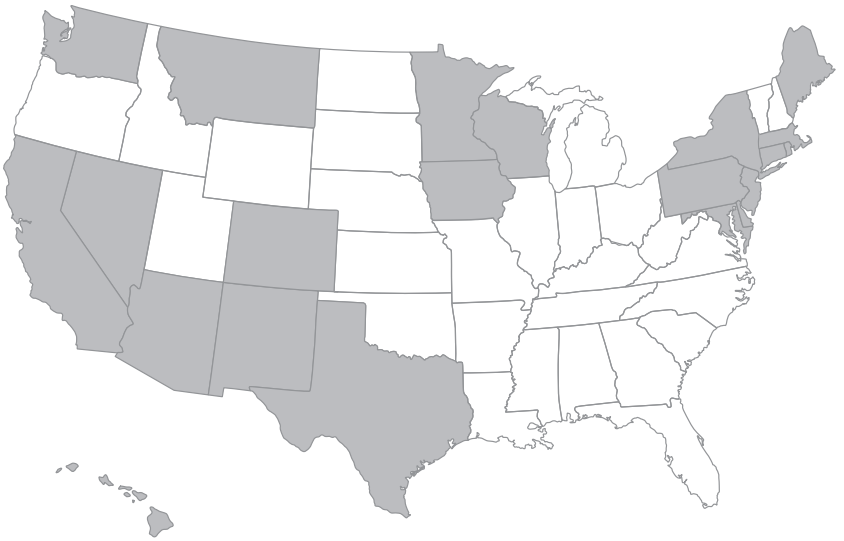
SUPPLY-SIDE MEASURES IN ELECTRICITY GENERATION

By the early 1990s, activity before state commissions that regulate the electricity industry was so great that it led some critics to suggest a theory of capture of state regulators by local interests (Joskow 1992). The 1992 Energy Policy Act reversed this trend by accelerating the introduction of competition into wholesale power markets, and in many jurisdictions also into retail markets. With that change the role of public utility commissions (PUCs) in resource adequacy planning was diminished, especially in states that deregulated. This removed a primary way that PUCs influenced technology. It is more than coincidence that states that deregulated their retail services were also among the most proactive states in setting technology policy through the PUC, and these also were the states with highest electricity prices (Ando and Palmer 1998). One perspective on this coincidence is that stakeholder involvement in state regulation raised the cost of electricity service and thereby fueled the drive to deregulate. Another perspective is that stakeholder involvement did not cause but actually came as a response to high prices. A third is that these states were generally sensitive to environmental issues, were located away from fuel supply, were relatively populous, and that this led to tighter markets that drove up prices.

Although the Energy Policy Act and subsequent deregulation in many states in the 1990s stripped the momentum and sometimes the authority for PUC activity, slowly since then there has been a recovery of interest in technology policy affecting the electricity sector in these states. Sometimes the new generation of policies is implemented through the legislature and sometimes through the PUC. These policies have two paths of influence: policies reflecting technological preferences in local supply local resources and policies promoting demand-side efficiency.

There are a variety of policies now promoted at the state level that promote supply side renewable technologies. Some examples are:

FIGURE 1
State RPS mandates and purchase agreements



Arizona: 15% by 2025
California: 20% by 2010
Colorado: 10% by 2015
Connecticut: 10% by 2010
Delaware: 10% by 2019
Hawaii: 20% by 2020
Iowa: 105 aMW
Maine: 30% by 2000
Maryland: 7.5% by 2019
Massachusetts: 4% by 2009
Minnesota: 25–30% by 2020–25
Montana: 15% by 2015
Nevada: 20% by 2015
New Jersey: 22.5% by 2021
New Mexico: 20% by 2020
New York: 24% by 2013
Pennsylvania: 8% by 2020
Rhode Island: 16% by 2019
Texas: 5880 MW by 2015
Washington, D.C.: 11% by 2022
Washington: 15% by 2020
Wisconsin: 10% by 2015

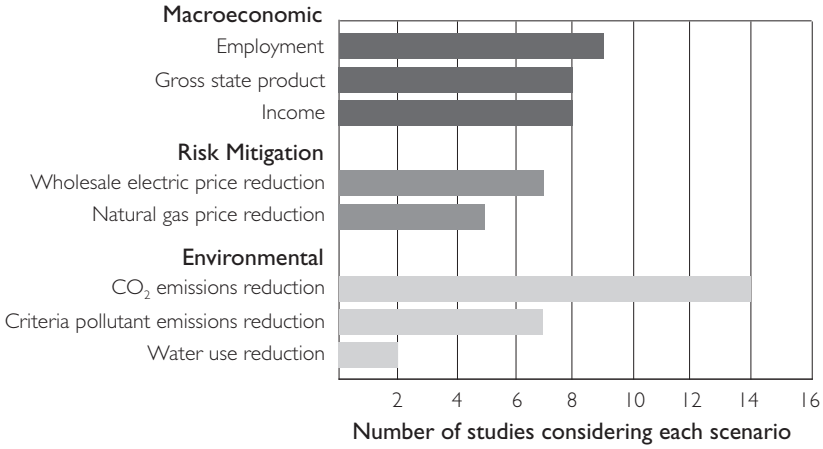
Source: Wiser, Chen, and Bolinger (2007)

- Renewable portfolio standards
- Net metering
- Green pricing
- Public benefit fund
- Renewable energy credit tracking
- Power plant offsets
- "Resource efficiency" standards
- Tax holidays on energy-efficient appliances
- State governments purchasing green power

Among the most common of these and one that has been widely studied is the use of renewable portfolio standards (RPS). As described above, these policies generally work by requiring that a minimum percentage of electricity generated or sold to customers is provided using the eligible set of technologies. National proposals usually allow flexibility in how the mix of technologies used to meet the standard is determined and allow for the use of tradable renewable energy credits, so that the owners of the eligible resources need not have a direct contractual relationship with the entity subject to the minimum requirement. Out front of the federal government, Figure 1 shows that 21 states and the District of Columbia have adopted renewable energy standards. These programs generally make retail utilities responsible for compliance. Unlike the federal proposals, only a handful of state policies allow credit trading among utilities, so under most state policies retail utilities do have to have direct contracts with renewable suppliers. Several have specific targets or requirements for particular types of renewables such as solar under broader RPSs.

There are a variety of motivations for promoting renewables. Figure 2 reports on a recent study (Chen, Wiser, and Bolinger 2007) that surveyed policies across the nation to identify

FIGURE 2
Potential public benefits of state RPS studies



Source: Wiser, Chen, and Bolinger (2007)

explicit motivations. The motivations are organized into three groups: environmental concerns, risk mitigation, and macroeconomic development. These concerns help to explain the fact that there often are a variety of restrictions on what types of renewables qualify.

Of the variety of restrictions on tradability in these programs, the restriction on geography appears the most robust common thread. While there is a general characteristic toward promoting environmentally benign policies, there is an overarching tendency to promote policies that make states and regions more self-sufficient. This is one manifestation of state self-interest as noted previously. Although there may be flexibility in the specific measures that are taken to achieve a standard, state policies consistently limit flexibility to a geographic area defined by a political or economic region.

Some explanations for the geographic focus include the desire to promote local jobs and to develop a supply chain in the state or region for emerging technologies. Restrictions on geography raise the cost of policies that promote specific technologies, but come at the benefit that revenues collected in utility bills or tax revenues are spent in the local economy and are thereby expected to have indirect economic benefits.

The geographic limitation on renewable energy credits in various programs places program goals in conflict because it raises the cost of achieving specific penetration rates for renewables. Palmer and Burtraw (2005) found that a national renewable energy portfolio standard aimed at achieving fairly stringent goals of 15 percent or 20 percent non-hydro renewables by 2020 could lead to a decline in electricity prices in areas that are rich in renewables. However, in many areas of the nation it appears virtually impossible to achieve penetration rates at this level without incurring large costs for new capabilities in

biomass or solar technologies. On the other hand some states have plentiful opportunities for development of renewable resources. One specific example is California, which according to Palmer and Burtraw could achieve over 30 percent of in-state generation from renewables and export renewable energy credits to other states under a national trading program. Although this level of renewables would be expensive even in California, electricity prices in California would fall if the resources were developed by the investor-owned utilities that are regulated by cost of service regulation in the state. The sale of renewable credits out-of-state at the national marginal cost of a renewable credit would bring revenues into the state in excess of development costs. Nonetheless, we see that California is no different from other regions that have pursued renewable policies. California also has implemented policies that limit geographic tradability, even when it would seem to be in the state's interest to promote an example of tradability. California's policy originally would not have allowed trading between various parts of the state, although that has now been relaxed to allow trading among the investor-owned utilities in the state.

Finally, it is noteworthy that it is not always the usual definition of renewables that qualify under these technology programs. In Pennsylvania, waste coal is considered a renewable resource that qualifies for credit. Moreover, one of the more prominent issues in the last decade has been the efforts by several states to promote the use of in-state coal (usually high sulfur coal) to comply with Title IV of the 1990 Clean Air Act Amendments. The promotion of in-state coal was accomplished with policies that gave regulatory preference for cost recovery for investments that promoted economic development in the state, which historically has been a common focus of state public utility commissions and that is sometimes even part of their charter in state constitutions (Bohi 1994, Burtraw 1996, Rose 1997, Arimura 2002, Sotkiewicz 2002).

END-USE EFFICIENCY MEASURES IN ELECTRICITY CONSUMPTION

The complement to supply-side electricity policies are those that target demand-side by promoting end-use efficiency. While policies affecting supply are altering the usual course of investment priorities, the motivating issue on the demand side is the general overall lack of investment. Historically, in electricity markets revenue is linked to sales, so utilities have a disincentive to invest in efficiency measures to reduce sales because it will reduce revenues. In addition, they often lack an ability to recover the cost of investments in the demand side.

State policies affecting building energy demand involve direct standards affecting the efficiency of new infrastructure and financial incentives for involvement of utilities to affect energy use in existing infrastructure. New infrastructure is affected by the following types of policies:

- Residential building energy codes
- Commercial building energy codes
- Green building standards for state buildings
- Appliance efficiency standards
- Decoupling revenues and sales
- Incentives for achieving efficiency targets

States, rather than the federal government, typically have been the first movers in adopting or strengthening these kinds of energy codes and they are well placed to fill this role because they can accommodate local conditions and preferences. However, ultimately the development of standards is more efficient at the federal level, especially for appliance standards because the extent of the market for appliances is national.

Engineering studies typically identify a vast opportunity to improve end-use efficiency at low cost. One study involving three national laboratories identify an achievable energy savings potential for electricity of 24 percent (Interlaboratory Working Group 2000).[4] Other studies find similar results for various regions of the country (Nadel et al. 2004). However, a variety of institutional and market barriers impair the ability of investors to harvest these opportunities. In addition, due to the diffuse nature of these opportunities, it is often an unrecognized or low priority for busy firms and households.

Policies promoting end-use efficiency measures target retail electricity companies. Most consumers have an exclusive relationship with their electricity companies, and these companies may be best placed to deliver energy-efficiency services. Many regulators have asserted that retail power companies in fact have an obligation to provide these services and created policies to do so, which have taken two forms. One is mandated public-benefit fees applied to every unit of electricity sales that is directed to programs for direct investment. The usual target has been industrial customers and relatively high-income residential customers who have the knowledge and desire to subscribe to various energy-efficiency programs.

The other form has moved away from mandated investments and toward correcting the incentives for end-use efficiency. Step one in this process is decoupling of revenues from sales. Decoupling involves the calculation of expected revenues, often indexed to weather and other exogenous components of demand, and guaranteeing the regulated firm that this level of revenue independent of the number of kilowatt-hour of sales. This step was initially taken in about one half dozen states in the 1990s, but the policy atrophied with industry deregulation. Decoupling removes the disincentive for investment in end-use efficiency, but it does little to provide a positive incentive. The second step in this process involves giving company shareholders a profit on invested capital in end-use efficiency measures. In the fall of 2007 the California Public Utility Commission adopted a policy framework that would allow utilities to earn additional profit if they exceed energy efficiency goals.

Now and in the future, supply-side policies affecting the choice of technology for electricity generation may be determined primarily at the federal level; however, demand-side policies in the electricity sector are likely to remain the prerogative of state and local government.

TRANSPORTATION MEASURES

There are a variety of other policies emerging at the state level affecting transportation with relevance for land use and other issues in the

local government domain. Some examples include:

- Vehicle GHG emissions standards
- Mandates and incentives promoting biofuels
- Promoting transit

Many of these policies at the state level are not about carbon policy directly. Some policies such as promotion of transit are policies targeting services to specific communities. But climate policy is a contributing and growing motivation for this suite of policies. As with demand-side policies in the electricity sector, transportation-related policies are likely to remain the prerogative of state and local government.

STATE LEADERSHIP ON CLIMATE POLICY

The plethora of climate-relevant policies shares the stage with explicit campaigns to cap overall carbon dioxide emissions. There are now several important state initiatives. The first to be implemented will be the Regional Greenhouse Gas Initiative (RGGI) that involves 10 northeastern and midAtlantic states who will cap emissions from the power sector beginning in 2009. This policy aims to reduce emissions from the electricity sector by about 35 percent from what they would otherwise be by 2020. Other initiatives include California's greenhouse gas legislation (AB 32) passed in 2006 that mandates emission reductions to 1990 levels by 2020. The state agencies are empowered to implement the policies, but a specific plan is not expected with implementing actions until 2012. State legislation declares that market-based approaches such as cap-and-trade may be used to achieve these goals; however, the governor and many other interests in the state are aggressively pursuing this option.[5]

ELECTRICITY SECTOR CAP-AND-TRADE

Although the RGGI policy is relatively moderate, it is the first law in the United States mandating emission regulations and the second such law in the world after the EU Emissions Trading Scheme. RGGI's most important contribution may already be accomplished—the architecture of the design of cap-and-trade. The RGGI architecture mirrors the design of the region's NO_x trading programs, where emission budgets were developed for each state but discretion was left to individual states to implement the policy, including the allocation of emission allowances to sources that were able to trade allowances in the market. This approach is evident also in the EU Emission Trading Scheme, where individual member states have obligations under a system-wide cap. Individual member states also have the authority to decide how to distribute emission allowances within guidelines that prohibited more than 5 percent of emission allowances from being auctioned in the program's first phase (2005–07) and no more than 10 percent in the second phase (2008–12). This restriction on auctions has contributed to a disproportionate share of program costs falling on consumers and extranormal profits for producers (Sijm et al. 2005).

Modeling shows a similar result would be likely to occur from cap-and-trade programs in the U.S. At the national level, Burtraw and Palmer (2007) show that a moderate climate

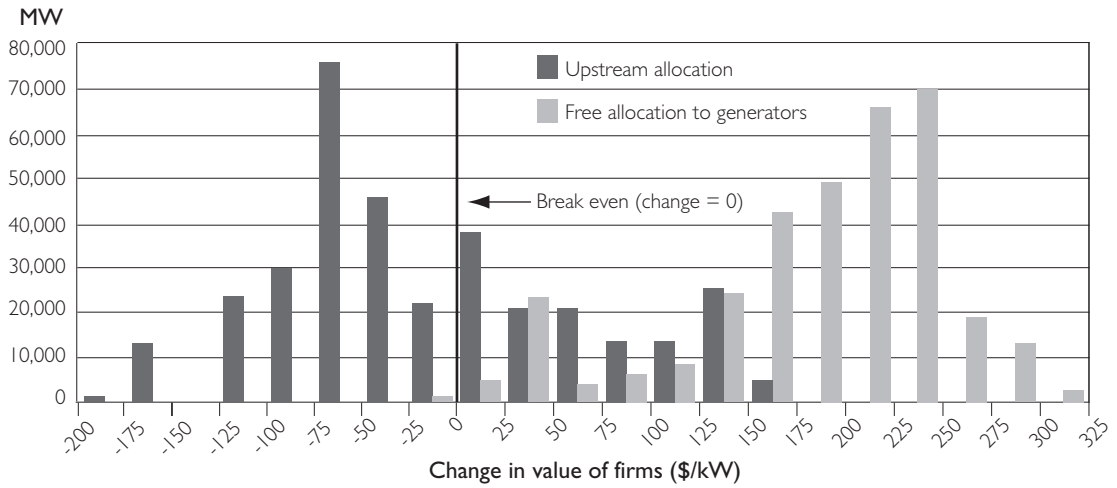
policy imposes costs on the industry equal to just 6 percent of the value of emission allowances created by the program. Free allocation would be likely to lead to windfall profits for the industry, with an increase in the market value of virtually every incumbent firm in the industry. In the RGGI region, Burtraw et al. (2006a) find a similar result under free allocation. Under 100 percent auction, they find that 11 of the 23 largest firms are strictly winners in the sense that the change in revenues from the increase in electricity price outweighs the change in costs for these companies, and the net present value of existing assets actually increase.

The innovation in the RGGI architecture, compared to the EU ETS, is the imposition of a floor rather than a ceiling on the portion of allowances that are to be auctioned. Every state is required to dedicate at least 25 percent of the value of allowances to strategic public benefit purposes such as investments in efficiency, and the presumed way to liquidate the allowance value is through an auction. In practice, states in the northeast are headed toward an auction of the vast majority of allowances. This policy architecture is based not only on the desire to avoid windfall profits, but also on the idea that auctions potentially can be a dramatically more efficient way to initially distribute emission allowances.[6] At the time of this writing, six of the 10 states have announced their allocation plans and all six are implementing 100 percent auction. The RGGI decision coupled with information about windfall profits in Europe appears to have already had an important influence on the national debate, where various proposed legislation suggests a substantial role for an auction, and that role has been growing as proposed legislation has evolved, certainly in response, in part, to the experience in the EU ETS and due to the RGGI precedent.[7]

Another aspect of the RGGI precedent is the designation of how the strategic public benefit resulting from expenditure of allowance value is implemented. In modeling on behalf of the State of Maryland, CIER (2007) found that investing this money into end-use efficiency could reduce demand to a sufficient degree that it offset the increase in electricity price that otherwise would occur when the state joins the regional initiative.

The states may have another role to play in the design of federal policy. The single largest hurdle in the federal debate, after identifying the stringency of the policy, is how the emission allowances should be distributed. The problem is confounded at the national level due to the variation among states in how the electricity sector is regulated. Nearly half of the nation, including most of the Northeast, has deregulated its electricity industry. In these regions, roughly speaking, the wholesale electricity price is determined by the marginal cost of the most expensive generation unit brought into service. Whether this change in cost includes the value of emission allowances depends on whether the unit has allowance costs. Since some firms own a relatively clean portfolio of generation assets, they can strictly win under such a policy. In contrast in the rest of the nation electricity price is set by the average cost of providing service. In these regions one can assume that long-run profits are zero

FIGURE 3
Distribution of costs among generators under upstream allocation (no allocation to electricity sector) and free allocation to electricity sector. The data includes the holdings in competitive regions of 81 firms and reflects implementation of the original Bingaman/NCEP proposal (Burtraw and Palmer 2007).



under any policy because the regulator allows for reasonable recovery of costs.

Figure 3 illustrates results by Burtraw and Palmer (2007) on the distribution in the change in the market value of firms under each of this type of market structures under two alternative approaches to the distribution of allowances—free allocation and an auction. The vertical axis represents the amount of generation capacity that experiences each level of change in value. Under both free allocation and an auction, roughly half the nation is excluded from the figure because under cost-of-service regulation, producers are assumed to be held relatively harmless. In these regions it is consumers that feel the effects of different approaches to allocation. In regulated regions, free allocation subsidizes electricity prices and provides compensation to consumers. However, under an auction, the original cost of acquiring allowances is passed on to consumers through changes in electricity prices.

Table 1 illustrates that no one approach can achieve the perception of fairness. In competitive regions, compensation in the form of free allowances goes to firms, and consumers are made strictly worse off by the program (ignoring the benefits of the policy). In regulated regions, that compensation goes to consumers, and firms are held harmless. Finding a uniform federal approach to allocation proves illusive, because any approach that compensates consumers in one type of region fails to do so in the other type of regions.

Since the fundamental feature that governs the effects of the initial distribution of emission allowances is the status of electricity market regulation, which is firmly the prerogative of the state, the RGGI architecture may prove a

TABLE 1

Annual compensation and percent of annual losses compensated with 100 percent free allocation: The table reports the effect on electricity producers and consumers of 100 percent free allocation to electricity generators relative to upstream allocation under implementation of the original Bingaman/NCEP proposal (Burtraw and Palmer 2007).

Year 2020 (billion $)	Producers	Consumers
Competitive regions	$11.14* (375%)	$-0.63 (-8%)
Regulated regions	—	$10.09 (91%)

**The estimate includes both producers who were losers and winners under upstream allocation.*

useful federal model. Taking this state decision about electricity regulation as a given, the only way to achieve the appearance of fairness is to delegate the allocation decision to the state. Then the decision to auction or use another means to initially distribute allowances can be made in a way that complements state policy with respect to electricity regulation. Former Senator Jeffords (I-VT) proposed legislation that would have accomplished this by apportioning to the states approximately two-thirds of the allowances under a national cap and trade program.

The significance of existing state policies in this regard is important. RGGI has established a precedent that in the Northeast states should auction the majority, if not all of the emission allowances in the electricity sector. In California a market-based program is not yet policy, but the state's Market Advisory Committee for the implementation of AB32 has recommend a philosophical principle of moving toward 100 percent allocation (California Market Advisory Committee 2007). These state decisions may have a significant influence in a national program, especially if the states play a role in the allocation decision.

EFFICIENT COMPENSATION

The apportionment to the states not only is useful for political economy but also may be relatively efficient, to the degree that policymakers attempt to deliver compensation for severely affected entities. Burtraw and Palmer (2007) examine ways in which compensation can be delivered to producers that are most harmed by climate policy. They consider various decision rules for free allocation of emission allowances, including allocation based on technology characteristics or emission rates for the fleet of power plants owned by companies. The authors consider whether these rules can be more effectively implemented by the federal government or state governments. They measure effectiveness according to the number of allowances that have to be given away for free, using various allocation rules, in order to achieve a given target of compensation for producers.

The answer as to whether compensation is delivered more efficiently at the federal or state level is not obvious because there are two offsetting factors. On the one hand, state governments provide a more precise characterization of technological characteristics and emission rates for a typical fleet of facilities than does the same measure taken from the national perspective, because differences among states can be sorted out. However, there also is a problem at the state level that firms that own facilities that lose value in one state may own facilities that gain value in another state. From a federal perspective these effects may net out, leaving no justification for a free allocation, but from a state perspective facilities that lose value may appear to deserve compensation.

The conclusion is that free initial allocation to compensate firms is accomplished more cost effectively by apportionment to states and by allowing states to determine rules for allocation, than by attempting to compensate at the federal level. Nonetheless, compensation is very expensive. Even under the best of circumstances, at the state level the cost of delivering $15 billion in deserved compensation is $27 billion in allowance value, because of the difficulty in matching compensation to need. At the federal level, however, the cost of just the last $2.6 billion in compensation requires the free allocation of $26 billion in allowance value at the federal level because of the difficulty in targeting compensation rules.

THE CHALLENGE OF FEDERAL PREEMPTION UNDER CAP-AND-TRADE

A crucial question is: What is the role for state climate programs in the future if federal legislation passes that establishes cap-and-trade policy? The existence of a hard cap at the federal level implies that any efforts at the state level, whether cap-and-trade or other types of policy, will be practically irrelevant. If one state were to exercise leadership by exceeding the federal standard, then its emission reductions would appear in some other state under a federal cap-and-trade program.

If states want to continue to be involved in climate policy in the face of a hard federal emission cap, there are two options. One would be to adopt state rules that require the surrender of emission allowances for emissions in the state that exceed the rate at the federal level. This type of legislation may face legal challenges. A second option would follow from a federal architecture that delegated some portion of emission allowances to the states in order for states to play a role in allocation to sources, or potentially to auction the allowances. In this case states could decide to hold some portion of emission allowances out of the market. Could it be in the states financial interest to do so?

If a state were to withhold emission allowances out of the market in a federal cap-and-trade program, two effects would follow. The state would have fewer allowances to issue through an auction or other allocation mechanism, and the national price of emission allowances would rise as a result of greater scarcity. The greater price means that any other emission allowances that were auctioned would fetch more revenue.

From the perspective of any single state it would not be cost effective to try to affect the national price of emission allowances by holding allowances out of the market. However, if there were strategic cooperation among a group of states—say a group of Northeast states and California—our analysis indicates that the group could actually increase the revenue it received from its allowance auction by withholding allowances. In this case, the change in price could be more important than the decline in quantity for the states. This type of strategic cooperation could enable states to remain in a leadership role and actually benefit fiscally from efforts to promote emission reductions. This is one way that states could remain permanently in a leadership role in the implementation of climate policy.

CONCLUSION

State-level efforts to adopt climate policy are continuing to proliferate. Yet it seems inevitable that federal policy will emerge. The degree to which federal policy preempts state efforts will be an important factor shaping the future types of activities among the states. To date, however, probably the major contribution of state efforts has not been direct emission reductions but instead indirect shaping of a policy architecture that affects the federal policy debate. At the federal level, the same political forces that have constrained national climate policy to this juncture will also affect the design of policy in the future. State efforts have changed the political environment at the federal level.

In this decade, we are still at the early stages of addressing climate change. Many climate scientists implore policymakers to act now, because the effects of global heating already are occurring, and major ecological change will be irreversible if we wait another decade. Nonetheless, it would not be a contradiction to suggest that the design of climate policy is more important than the stringency at this juncture. Climate policy involves the design of new institutions that most expect to have an important effect on the way we use energy in the future. These institutions have to be well designed if they are to facilitate the level of public commitment to climate policy that scientists feel will be necessary. The political interests that align in the states that are providing leadership already may coincidentally align to help us achieve the best architecture.

References

Ando, Amy W. and Karen L. Palmer (1998). "Getting on the Map: The Political Economy of State-Level Electricity Restructuring," Resources for the Future Discussion Paper 98-19-REV.

Arimura T. (2002). "An Empirical Study of the SO2 Allowance Market: Effects of PUC Regulations." *Journal of Environmental Economics and Management* 44(2): 271–89.

Bohi D. (1994). 'Utilities and State Regulators Are Failing to Take Advantage of Emission Allowance Trading." *Electricity Journal* 7(2): 20–27.

Burtraw, Dallas and Karen Palmer (2007). "Compensation Rules for Climate Policy in the Electricity Sector," 2007, Resources for the Future Discussion Paper.

Burtraw, Dallas, Karen Palmer, and Danny Kahn, (2006a). "CO_2 Allowance Allocation in the Regional Greenhouse Gas Initiative and the Effect on Electricity Investors," 2006. *The Electricity Journal,* 19 (2): 79–90 (March).

Burtraw, Dallas, Danny Kahn, and Karen Palmer (2006b). "Dynamic Adjustments to Incentive Regulation to Improve Efficiency and Performance," Resources for the Future Discussion Paper.

Burtraw, Dallas (1996). "The SO2 Emissions Trading Program: Cost Savings Without Allowance Trades," *Contemporary Economic Policy,* Vol. XIV (April) pp. 79–94.

California Market Advisory Committee (2007). Recommendations for Designing a Greenhouse Gas Cap-and-Trade System for California, (June 30) http://www.climatechange.ca.gov/policies/market_advisory.html.

Center for Integrative Environmental Research (2007). Economic and Energy Impacts from Maryland's Potential Participation in the Regional Greenhouse Gas Initiative: A Study Commissioned by the Maryland Department of the Environment. University of Maryland.

Chen, Cliff, Ryan Wiser, and Mark Bolinger, (2007). "Weighing the Costs and Benefits of State Renewables Portfolio Standards: A Comparative Analysis of State-Level Policy Impact Projections," Ernest Orlando Lawrence Berkeley National Laboratory, LBNL-61580.

Congressional Budget Office (2005). *Budget Options* 334–339.

Deschênes, Olivier and Michael Greenstone (2007). "The Economic Impacts of Climate Change: Evidence from Agricultural Output and Random Fluctuations in Weather," *American Economic Review* 97(1): 354–385.

Energy Information Administration (2005). *International Energy Annual* 2005. Washington, D.C.

Goulder, Lawrence H., Ian W. H. Parry, Roberton C. Williams III, and Dallas Burtraw (1999). "The Cost-Effectiveness of Alternative Instruments for Environmental Protection in a Second-Best Setting." *Journal of Public Economics* 72(3): 329–360.

Interlaboratory Working Group (2000). *Scenarios for a Clean Energy Future.* Oak Ridge National Laboratory, Oak Ridge Tennessee; Lawrence Berkeley National Laboratory, Berkeley, California; and National Renewable Energy Laboratory, Golden, Colorado.

Joskow, Paul (1992). "Accounting for Environmental Externalities," *The Electricity Journal,* May.

Nadel, S., Shipley, A., and Elliott, R.N. (2004). *The Technical, Economic and Achievable Potential for Energy Efficiency in the U.S.: A Meta-Analysis of Recent Studies.* American Council for an Energy-Efficient Economy, Washington, D.C.

Nowak, John E., Ronald D. Rotunda, and J. Nelson Young (1978). *Handbook on Constitutional Law.* West Publishing Co., St. Paul.

Palmer, Karen and Dallas Burtraw (2005). "Cost-Effectiveness of Renewable Electricity Policies," *Energy Economics,* 27: 873–894.

Parry, Ian W.H., Roberton C. Williams III, and Lawrence H. Goulder (1999). "When Can Carbon Abatement Policies Increase Welfare? The Fundamental Role of Distorted Factor Markets," *Journal of Environmental Economics and Management* 37(1): 52–84.

Perman, Roger, Yue Ma, James McGilvray, and Michael Common (2003). *Natural Resource and Environmental Economics, 3rd ed.* Pearson Education Ltd., London. Chapter 10.

Posner, Richard (1974). "Theories of Economic Regulation," *Bell Journal of Economics & Management Science,* 5: 335–354.

Rose K. (1997). "Implementing an Emissions Trading Program in an Economically Regulated Industry: Lessons from the SO2 Trading Program." In *Market-Based Approaches to Environmental Policy: Regulatory Innovations to the Fore,* ed. Kosobud, R. and Zimmerman, J., New York: Van Nostrand Reinhold.

Sijm, J. S. Bakker, Y. Chen, H. Harmesen, W. Lise (2005). "CO_2 Price Dynamics: The Implications of EU Emissions Trading for the Price of Electricity." ECN report ECN-C-05-081, Petten, The Netherlands.

Sotkiewicz, P. M. (2002). *The Impact of State-Level PUC Regulation on Compliance Costs Associated with the Market for SO2 Allowances.* University of Florida Public Utility Research Center.

Stigler, George J. (1971). "The Theory of Economic Regulation," *Bell Journal of Economics & Management Science,* 2: 3–35.

Strumpf, K. S. and F. Oberholzer-Gee (2002). "Endogenous Policy Decentralization: Testing the Central Tenet of Economic Federalism." *Journal of Political Economy* 110(1): 1–36.

Notes

1. Deschênes et al. (2007).

2. This issue is discussed in more detail in the section titled "Experimentation Implies Learning from Mistakes" on page 52.

3. If a state can manage to "export" its tax burden by imposing taxes that fall predominantly on citizens of other states, then its own citizens will be better off since their government services will be paid for partly by others. Meals and lodging taxes are paid by travelers. As such, a higher proportion of these taxes are paid by people from other jurisdictions than are property taxes or general sales taxes.

4. The achievable potential is constrained by the rate at which homes and business will actually adopt energy saving technologies and practices.

5. California's Market Advisory Committee issued its report (CA MAC 2007) on the design of a potential cap and trade program in June 2007 after receiving extensive public comment almost unanimously in favor of such an approach, at least as a complement to other state policies.

6. Goulder et al. (1999), Parry et al. (1999). www.rff.org/rff/News/Releases/2007Releases/July2007ClimateChangeBillsinCongress.cfm. Accessed July 13, 2007.

7. Information on recently proposed legislation is available at: www.rff.org/rff/News/Releases/2007Releases/July2007ClimateChangeBillsinCongress.cfm. Accessed July 13, 2007.

Appendix A:
Discussion Summaries

This section provides a relatively brief synopsis of presentations and discussions that took place at each of the scheduled events of the conference. It is not a complete transcription of the statements and discussions. For a complete recap of the events, webcasts are available at the PRIOR website, www.princeton.edu/prior.

Panelists touched on a number of crucial issues regarding proposed state policies aimed at carbon control, such as their feasibility, economic impact, and effectiveness in reaching desired targets, as well as the overall outlook for implementing such actions given both state and federal political realities. Hot-button issues included the urgency of climate control initiatives, the extent to which states ought to experiment with untested strategies, and the trade-offs between a carbon tax and a policy that combines regulation with market forces, known as a cap-and-trade system.

Princeton engineering professor **Robert Socolow** launched the discussion with a sweeping and informative overview of the landscape for carbon dioxide control technology and policy. He insisted that the technology exists to significantly reduce carbon emissions by both businesses and individuals. A drastic reduction is indeed necessary if society aims to reduce carbon dioxide output to the level of its intake—or even lower. Currently, we emit 7 billion (metric) tons of carbon into the atmosphere each year, but the earth only absorbs 3 billion per year. He compared the earth's carbon emissions to filling up a bathtub at a far faster pace than it drains. Eventually, the excess carbon traps the sun's rays, potentially triggering significant consequences that have recently been documented in the popular press. Socolow said that previously held views that carbon-control policies should at least keep the emissions level flat at 7 billion per year have more recently been replaced by a more aggressive consensus that carbon output should be reduced to 3 or 4 billion tons per year.

Socolow, who serves as co-director of Princeton's Carbon Mitigation Initiative, cited three reasons why a lower target is realistic: (1) the world today has an inefficient energy system, so there is room for big changes and improvement; (2) carbon emissions have just begun to be priced, a process that will in part dictate how effective cap-and-trade schemes will be; and (3) most of the industrial and energy infrastructure that will be in place in 50 years has not yet been built, so there is time to make adjustments and better plans for future construction. Along those lines, Socolow and his partner, Stephen Pacala, worked to identify types of strategies that would each reduce

emissions by 1 billion tons per year, which he highlights as discrete policy options, or discrete one-billion-ton "wedges." Among these are electricity end-use efficiency, efficiency in other end uses, passenger vehicle efficiency, other transport efficiency, renewable energy sources, and carbon capture and storage. He said that the developed world must realize that the developing world is expanding economically, so America and other developed nations will have to take on a disproportionate share of the carbon-reduction burden.

Socolow proceeded to review the biggest carbon emitters by sector, showing that transportation, all told, represents the largest in New Jersey and the second largest in the United States; this sector represents a smaller proportion of carbon emission in the U.S. than it does in New Jersey. The electric power industry produces the second largest amount of carbon both in New Jersey and nationwide; industry is third. Socolow said he believes that electrical energy imported across state borders is not properly accounted for and is underestimated in the numbers; an efficient appliance in and of itself will not save much carbon, but if it stops the import of a unit of coal energy, it has a resonating impact.

Calling society's burning of fossil fuels "life, liberty, and the pursuit of mobility and comfort," he encouraged consideration of the commitments necessary to implement some of the one-billion-ton wedges. For instance, there will be about 2 billion automobiles on earth by 2050, and one car driven 10,000 miles emits about a ton of carbon per year. Therefore, one "wedge" strategy involving vehicles entails two options, one related to engineering and one related to city planning; each car driven 10,000 miles per year with fuel efficiency of 60 miles per gallon instead of 30 miles per gallon, or each one driven with 30-mile-per-gallon efficiency for 5,000 miles per year instead of 10,000 miles per year. Another way of cutting carbon production is through efficient use of electricity, including home and business motors, lighting, and cogeneration. A 25 percent reduction in electricity use in commercial and residential buildings by 2055 is necessary to reach targets set by Governor Jon Corzine, whose goals of a 20 percent reduction in projected energy use by 2020 and even more aggressive reductions in utilization and emission were hailed by panel members throughout the day.

Socolow also discussed renewables, saying that they are, on the whole, feasible and cost-effective, and can be implemented now. They include wind, nuclear, and solar power; states can play a crucial role in getting these types of power up and running by issuing permits for them and offering financial incentives to build them. He echoed Governor Corzine's sentiment that old, inefficient, carbon-spewing power plants ought not to be "grandfathered" into any proposed cap-and-trade system. He said most power plants can be retrofitted to be more environmentally friendly and that power companies ought to better deploy carbon-storage technology, including underground storage.

Socolow noted that there are two carbon-containment approaches that are rarely discussed, and they fall under the general

rubric of urban and economic planning: property tax systems that reinvigorate cities and discourage sprawl, and new norms of business that facilitate face-to-face contact, enabling work without travel. Socolow also discussed the pricing scheme for carbon emissions under a hypothetical cap-and-trade system. He asserted that at $100 per ton of carbon, there would be substantial potential for power and industrial companies to make money.

Rutgers professor **Clinton Andrews** described what he called the "jujitsu" of federalism in a discussion of which policy options would be most likely to navigate those treacherous waters and become adopted. He has created a matrix that evaluates alternatives to carbon emission by incorporating the availability, maturity, economics, security, cleanliness, and overall impact of each option. He said ascertaining total efficiency of each technology holds the crucial answers to identifying what will and will not work. Society has to take into account the total input and output of each new technology, so that, for instance, with certain technologies, "as we close the carbon loop, we ratchet up the nitrogen loop."

From a policy perspective, Andrews explained that there are certain inflection points, or places where policymakers and stakeholders converge, and those "nodes" must be addressed by those wishing to affect reductions in carbon emission. Andrews said there is a trade-off between implementing carbon-reduction policies at the state and local levels and pushing for them at the federal level, though they are by no means mutually exclusive. He described certain high-profile environmentally sound buildings, community planning, and policies, saying that those projects serve as symbols that encourage further action.

A roundtable discussion ensued on the prospects for the implementation of carbon-reduction initiatives in the region, including Andrews, **Jennifer Cox** of the Regional Plan Association (RPA); **Jeanne Herb**, an assistant commissioner at the New Jersey Department of Environmental Protection, and **Colin Loxley** of power company PSE&G. Referring to the title of the day's conference, Herb asserted that states should be both leaders and lab rats; they have proven good at being both. In particular, in environmental policy, states have always been on the forefront and tried different approaches, she noted. She said we also must know when it is time for a state to step back and allow more sweeping federal policy to take hold, but we are clearly not there in terms of climate change. State environmental policymakers in New Jersey and elsewhere indeed hope that a federal policy will emerge on the issue, but not just any policy. It will have to be strong, effective, and have teeth for implementation. Until then, the states are on the forefront of the fight, she said. Herb moved on to discuss some of the most pressing issues in New Jersey as they relate to climate change. Specifically, development and sprawl is rampant in the state and, of course, adversely affects the environment and results in carbon emissions. More than 50 acres of land are lost per day to development in the state, and much of it is forest land. She discussed how the state government is approaching Governor Corzine's goals, involv-

ing the Board of Public Utilities and creating other partnerships, especially with private industry.

Colin Loxley of PSE&G, which has committed to partnering with Corzine's initiative and to limiting carbon emissions long-term, concurred with other speakers that the technology to limit carbon emission is mature and ready to be implemented. However, he noted that with 380 million tons of carbon emitted per year in New Jersey and the state growing, it will take a lot of effort to keep atmospheric concentrations of CO_2 under 450 parts per million over the next few decades. Referring to Socolow's talk, he said there is no silver bullet, no one type of usage to eliminate or alter, no matter how many "wedges" we use; it will take both transportation policy as well as power-production policy. For instance, he encouraged the adoption of both plug-in electric cars and greater nuclear power. In other words, to achieve the kind of reduction necessary to counteract climate change, society must completely replace and reengineer the entire stock of buildings, cars, and transportation systems. He said that when policymakers price carbon and other chemicals, the prices must reflect the actual cost, as well as the cost of removal and replacement. He also echoed the sentiment of many other panel members during the day; international efforts to undertake carbon containment are essential and will be the biggest challenge.

Jennifer Cox, a senior planner at the RPA, held her own training as symbolic of how policymakers and planners ought to consider climate change policies: as a geographer, she and the RPA look at issues on local, state, and regional scales, which involves bringing different sectors and stakeholders to the table. Carbon-emission and renewables planning must take this holistic approach. She said the RPA has zeroed in on three focal points for work on climate change policy: buildings, which must be retrofitted to be made more efficient and installed with better power sources; land use, which involves connecting development with building, planning, and transportation standards; and transportation, such as vehicle efficiency and fewer miles traveled per trip, or what planners call VMT—Vehicle Miles Traveled. But she noted all potential policies must not endanger economic growth and must account for population growth. Therefore, we need to devise creative solutions, she said, citing the decision by the delivery company UPS to change their routes, so that their trucks minimize the number of left turns they make.

The director of the Climate and Air Program at Environmental Defense, **Peter Goldmark**, introduced the lunch speaker, **Lisa Jackson**, the commissioner of the New Jersey Department of Environmental Protection. She reiterated that Governor Corzine is committed to reaching carbon-emission reduction targets and to enacting policies to that end, which will involve transportation policy, as well as planning and regulation for energy use in commercial, industrial, and residential facilities. She then reviewed the evolution of the multi-state collaborative effort to which New Jersey belongs: the Regional Greenhouse Gas Initiative, known as RGGI. The initiative represents the first carbon dioxide cap-and-trade program in the United States. The process reached a critical mass in

2003, and negotiations between the original states, and within state legislatures and executive branches, have progressed since then; 10 states are slated to implement it starting in 2009. RGGI requires an allocation of at least 25 percent to provide consumer benefits, such as the auction of allowances and the use of revenue for more efficient and clean energy.

Jackson then discussed New Jersey's "Energy Master Plan," which goes beyond the RGGI structure and employs the state's Renewable Portfolio Standard, among other policies. She reiterated that achieving Governor Corzine's goals, such as reducing energy use by 20 percent by 2020, will require policies and cultural change that affects every aspect of our lives, as well as employing the state's financial incentive power. In response to a question, she said that the state's energy production is currently at 4.5 percent renewables. She said that Governor Corzine has argued for strong federal legislation on carbon and is proposing the formation of a Governors' Climate Protection Leadership Council, which would likely include California, as that state and Governor Arnold Schwarzenegger have been leaders on the issue. States need to articulate common climate change policy principles for strong federal legislation, Jackson said.

Subsequently, professors **Henrik Selin** of Boston University and **Stacy VanDeveer** of the University of New Hampshire and Brown University presented their paper, "Climate Change Policy Innovation and Emulation Among the States." They said almost every state is doing something—from actual action plans to electricity, transportation, agriculture, and waste management—but that policy actors in those states have different motivations, which shape the nature of the policies. Selin, presenting for himself and his partner, said some states are fighting climate change because they realize it is a significant problem; others want to address environmental "co-benefits," such as job creation or the economic benefits of technology development; still other states, such as California and Texas, where the creation of wind energy is proliferating, hope to create security by encouraging renewables and energy diversification.

He explained that states are pathways of policy change and that state action matters in four distinct ways: (1) as a strategic demonstration (a state wants to show that it is a leader in an area, that implementing the policy will not wreck its economy, and that it has the technology to do so); (2) market creation and expansion (as more and more states increase renewable energy standards, there will be a larger market for the production of renewable energy and vehicle technology); (3) policy diffusion and learning (policy actors talk with one another, a winnowing process of policies occurs, and policies are subsequently proliferated); and (4) norm creation and promulgation.

Despite these advantages and the leadership positions states are taking on climate change policies, substantial challenges remain, Selin said. He cited current initiatives and noted that the New England states are unlikely to meet their goals and that transport emissions seem likely to increase for the foreseeable future. He posed a series of tough questions.

How do various state policies fit together? Do RGGI and various state Renewable Portfolio Standards meld together in some kind of coherent policy approach? Now that RGGI and its attendant details are being mulled over in state capitals, how do we know the process is going to take the right course? Will all states implement similarly robust initiatives as the leaders? As California pushes ahead with its energy and transportation policy, how will that affect Northeast states? What kinds of opportunities are there for transatlantic policy coordination between states in the U.S. and European nations, which have a cap-and-trade system?

A roundtable discussion focused on state leadership in climate change policy and the possibility that states can make a serious dent. **Fred Butler**, commissioner of the New Jersey Board of Public Utilities, said that such issues as carbon emission and its effect on the environment are regional and national issues, especially given that some of the largest utilities are in other states. Nevertheless, he said he thought it was unprecedented to look at an energy master plan of a state, such as New Jersey, especially one that includes transportation policy. He said he was impressed that it included timelines, implementation, agencies to be employed, and other detailed plans. He encouraged both planners and regular citizens not to shy away from "the annoyance of a good example"—pestering people into changes in habit, such as telling people to put in energy-saving light bulbs.

Franz Litz, climate change policy coordinator for New York State, reiterated that many states have done a lot of work on climate change and energy already, but the levels of policy range from mild to strong. For instance, some states have initiated "no regrets" policies—win-win environmental policies that include economic development and job creation, such as the Renewable Portfolio Standards. But a group of some 15 states have decided carbon containment is an issue worth spending money on, with tailpipe standards (spearheaded by California), RGGI, and carbon caps being discussed in Western states. Reluctance to taking strong "adaptation" steps is waning, he said. When township boards begin to discuss sewage standards, then we know society is serious about fighting climate change.

Jim Marston, director of the Texas energy program at Environmental Defense, said he has been a part of many environmental battles, but was most recently on the front lines of a massive coal industry clash in Texas. Utilities were proposing 11 new coal plants, the pollution effect of which would have undone RGGI three times over, he said. Environmentalists thought they could never win the fight because in Texas, "regulators there don't regulate, they just approve." However, people began to give money, some lawyers donated pro bono time, and some 35 mayors organized against the proposed plants. The face of the fight changed, though, with the recent buyout offer for the giant utility TXU. The potential acquirers said they would rescind eight of the permit applications as long as the environmentalists would bless the deal, he said. Environmental groups made some additional demands, particularly related to operations in other states and tying executive compensation to the company's actions to fight global warming, as well as

committing to some emissions targets. In the end, Marston was amazed at the shifting winds—shifting toward climate-change policies. The Texas legislature is now actually considering some bills referencing climate change and/or global warming, a significant concession. As a result of this cultural and societal evolution, Marston believes the country will have federal legislation on climate change and carbon emissions either just before or after the next presidential race.

Dena Mottola, executive director of Environment New Jersey, stressed that states are the essential and effective venue in which to make policy changes in climate change and in energy. She said she was not bothered that a patchwork system has emerged from states taking the lead on global warming; what is important is that it is being addressed at the policy level. And there are actually benefits to the multitude of approaches being implemented by different states, as Selin and VanDeveer highlight in their paper. Mottola said she thinks the states will continue to be the standard-bearers in terms of climate change policy, in part because even if the federal government adopts a broad policy, it is unlikely to be strong enough to really combat climate change.

To initiate the final panel discussion, **William Shobe** and **Dallas Burtraw** introduced some doubts about states as pioneers in the climate change policy arena. While the notion of states as laboratories is an acceptable concept in general, we have to be careful about implementing policies without assessing their full impact, said Shobe of the University of Virginia. Every government policy is an entitlement to someone, he reminded the audience. If the policy fails and policymakers want to rescind it, there is likely to be resistance to the beneficiary. Governments, therefore, must be careful with the notion of trial-and-error carbon-containment policies—and be willing to overcome the resistance from the entitlement recipients if a policy fails, anticipate lawsuits, and possibly compensate the losers. Installing adequate and comprehensive evaluations of these policies is crucial, Shobe said. He raised the issue of international treaty obligations. Because it is ultimately a planetary problem, climate change policies will be the subject of treaty obligations, which will pose significant challenges given the entanglements of different nations, sovereignty concerns, and differing interests. People want to maintain diffuse living patterns and are even willing to pay for them, Shobe said, making unified policies particularly tough to establish. Finally, he discussed the "Tower of Babel" problem; with so many states trying so many different energy and carbon policies, there would be a benefit to coordination. However, coordinating between states will be difficult, primarily because of the "transaction costs" of interstate negotiation; the difficulty of evaluating power, energy, and industrial assets across states; and the establishment of credits and the notion of carbon content in cap-and-trade programs.

Dallas Burtaw, senior fellow at the organization Resources for the Future, challenged the efficacy and inevitability of cap-and-trade programs. He noted that allocating carbon emissions creates a massive new property right in our society and he wondered how we will decide where the value of those entitlements

is going to fall. This potential unevenness also applies to RGGI because states will decide who the "winners" and "losers" are in terms of the allocation of permits. He asserted that under a cap-and-trade program, changes in electricity prices in different parts of the country could be substantial. And he described the acceptance of a cap-and-trade mechanism by environmentalists—normally staunch in their advocacy for the strictest regulation—as a "Faustian bargain" because the impetus behind innovative transportation, industrial, and urban planning initiatives would dissolve. He also worried that some states will become higher polluters than others because their businesses would buy more permits.

Robert Shapiro, currently with Sonecon LLC and formerly U.S. Under Secretary of Commerce for Economic Affairs during the second Clinton administration, also criticized a cap-and-trade system and described the benefits of a carbon tax. He said cap-and-trade introduces natural and large volatility in energy prices, which is the natural result of any policy that manages the supply of a good. And because we cannot predict with any certainty when we will have extremely cold winters or extremely warm summers, or a really good or bad economy, the volatility will be compounded. Meanwhile, a carbon tax is more predictable in terms of positive benefit on emissions, particularly if the actual cost of reducing emissions fluctuates from current estimates that would be used to set policy. The money from a carbon tax could be used for some positive environmental purpose, whereas with a cap-and-trade system, the money is simply traded between businesses. Shapiro said that the nature of the carbon dioxide problem requires a national, if not global, solution—another reason that a carbon tax would be preferable.

Dale Bryk of the National Resources Defense Council, an environmental advocacy group, defended a potential cap-and-trade system. She said once states commit to a certain level of carbon emission, other states will not simply "race to the bottom," as some critics fear. Peer pressure to follow suit and be responsible will keep them in line. She noted that the 15 states already committed to caps are not even the most liberal states and that the commitment of Morgan Stanley, a paragon of Wall Street, to be the financial mediator, is significant. She added that there are near-term benefits to states trying to insulate businesses from the downside of future carbon regulation, both by attracting producers of renewables and by providing economic incentives to businesses to cut down on emission.

Randall Solomon of the New Jersey Sustainable State Institute discussed the impact of proposed environmental policies on the economy of New Jersey and the projected impacts of various carbon-reduction policies. His institute is wrapping up a study on the economy and state energy policy sponsored by the New Jersey Board of Public Utilities. He showed that the effects on the state economy of various policies, such as a carbon tax, would be relatively minor. He also showed a graph illustrating that strong implementation of advanced bio-fuels and high efficiency of vehicles and other emission sources still do not get the state anywhere near Governor

Corzine's aggressive 2050 target. Significant and sustained decreases to carbon dioxide emission will indeed be a massive challenge.

Peter Goldmark, a longtime public servant who recently served as CEO of the *International Herald Tribune* and currently directs the Climate and Air Program at Environmental Defense, capped the day by noting the global significance and urgency of the issue. We do not have a lot of time left and we must start initiatives in the United States now, he said. But the climate change problem is a new kind of problem—a truly global problem. As such, a carbon tax is a difficult long-term solution; tax regimes do not integrate well between different places of the world, Goldmark said. A cap-and-trade system, meanwhile, leaves the market to integrate, he asserted. In the end, we are all going to win together or lose together on carbon emission, Goldmark said.

Appendix B:
Conference Agenda

States and Climate Change: Leaders or Lab Rats?

MARCH 30, 2007

Sponsored by the Policy Research Institute for the Region at Princeton University and Environmental Defense

Welcome

Nate Scovronick, Acting Director, Policy Research Institute for the Region, Princeton University

Getting Serious about Carbon Mitigation

Robert Socolow, Professor of Mechanical and Aerospace Engineering and Co-Director, Carbon Mitigation Initiative, Princeton University

Regional Energy Technology Options

Presenter, **Clinton J. Andrews**, *Associate Professor and Director, Urban Planning and Policy Development Program University, Rutgers University*

Moderator, **Robert Socolow**, *Professor of Mechanical and Aerospace Engineering, Co-Director, The Carbon Mitigation Initiative, Princeton University*

Panelists, **Jennifer Cox**, Regional Plan Association; **Jeanne Herb**, Assistant Commissioner for Policy, Planning, and Science, New Jersey Department of Environmental Protection; **Colin Loxley**, PSE&G

Introduction of Keynote Speaker

Peter Goldmark, Director of the Climate and Air Program, Environmental Defense

Keynote Speech: New Jersey's Response to Climate Change

Lisa Jackson, Commissioner, New Jersey Department of Environmental Protection

Climate Change Policy Innovation and Emulation among the States

Presenters, **Stacy VanDeveer**, *Associate Professor of Political Science, University of New Hampshire, and* **Henrik Selin**, *Assistant Professor of International Relations, Boston University*

Moderator, **David Goldston**, *Visiting Lecturer, Woodrow Wilson School of Public and International Affairs, Princeton University*

Panelists, **Frederick Butler**, Commissioner, New Jersey Board of Public Utilities; **Franz Litz**, Climate Change Policy Coordinator, New York State Department of Environmental Protection; **Jim Marston**, Environmental Defense; **Dena Mottola**, Environment New Jersey

Local Options on Global Stocks: How the States Are Affecting the U.S. Debate on Climate Policy

Presenters, **Dallas Burtraw**, *Senior Fellow, Resources for the Future, and* **William Shobe**, *University of Virginia*

Moderator, **George Hawkins**, *Lecturer in Environmental Law and Policy, Princeton University and Director, New Jersey Future*

Panelists, **Dale Bryk**, Natural Resources Defense Council; **Robert Shapiro**, Sonecon LLC; **Randall Solomon**, New Jersey Sustainable State Institute

Closing Remarks

Peter Goldmark, Director of the Climate and Air Program, Environmental Defense

Appendix C:
Participant Biographies

Clinton J. Andrews
Associate Professor, E. J. Bloustein School of Planning and Public Policy, Rutgers University

Clinton J. Andrews directs the planning program at Rutgers University's Edward J. Bloustein School of Planning and Public Policy. He was educated at Brown and Massachusetts Institute of Technology as an engineer and planner, and he holds professional certifications in engineering, planning, and green building. Previous experience includes working in the private sector as a design engineer and energy technology assessor, helping to launch an energy policy project at MIT, and helping to found a science policy program at Princeton University. At Rutgers, he has launched initiatives in energy policy, green building, and innovation studies. Andrews has been elected to leadership posts in the Institute for Electrical and Electronics Engineers and the International Society for Industrial Ecology, and he is a winner of the IEEE's *3rd Millennium Medal.* He serves on the editorial boards of *Local Environment* and the *Journal of Industrial Ecology.* His books include *Humble Analysis* (Praeger, 2002), *Regulating Regional Power Systems* (Quorum, 1995), and *Industrial Ecology and Global Change* (Cambridge, 1994, co-edited with R. Socolow, F. Berkhout, and V. Thomas). Andrews also has published dozens of scholarly articles on energy and environmental planning and management, and he is a regular columnist in *Technology and Society* magazine. He is currently leading a project to assess scenarios for New Jersey's energy future.

Dale Bryk
Senior Attorney, Natural Resources Defense Council

Dale Bryk is a senior attorney with the Natural Resources Defense Council (NRDC), where she heads up the organization's state climate policy work. Her expertise is in the area of state energy and climate policy, including utility regulation, energy efficiency and renewable energy programs, greenhouse gas emission registries and regulation, emissions trading, green building, and smart growth. Bryk joined NRDC in 1997, prior to which she practiced corporate law at Davis Polk & Wardwell in New York. Since 2002, she has also taught the Environmental Law Clinic at Yale Law School. Bryk has a J.D. from Harvard Law School, a master's degree in international law and policy from the Fletcher School of Law and Diplomacy, and a B.A. from Colgate University.

NRDC is a national, nonprofit organization of scientists, lawyers, and environmental

specialists dedicated to protecting public health and the environment. Founded in 1970, NRDC has over a million activists and members nationwide, served from offices in New York, Washington, Los Angeles, and San Francisco. More information is available through NRDC's website at www.nrdc.org.

Dallas Burtraw

Senior Fellow, Resources for the Future

Dallas Burtraw is a senior fellow at Resources for the Future. He holds a Ph.D. in economics and a Master in Public Policy from the University of Michigan. Burtraw has a long-standing interest in the design of incentive-based environmental policies in the electricity industry and has authored extensively on the performance and design of emission trading programs in the U.S. for sulfur dioxide and nitrogen oxides and the EU's Emission Trading System for carbon dioxide. In 2004, Burtraw and his colleagues completed a major project on estimating benefits of the value of natural resources in the Adirondacks Park. He currently serves on the Environmental Protection Agency *Advisory Council on Clean Air Compliance Analysis,* on the National Academies of Science *Board on Environmental Studies and Toxicology,* and on California's *Market Advisory Committee* for implementation of Assembly Bill 32, the states' greenhouse gas legislation.

Frederick F. Butler

Commissioner, New Jersey Board of Public Utilities

Frederick F. Butler is a member of the New Jersey Board of Public Utilities currently serving in his second term. He was first appointed in 1999 for a four-year term and was reappointed in 2003 to a full six-year term.

He currently represents New Jersey on the board of the Organization of PJM States. He is former president of the Mid-Atlantic Conference of Regulatory Utility Commissioners and is an active member of the National Association of Regulatory Utility Commissioners (NARUC). He has served as chairman of NARUC's International Relations Committee, Committee on Water, and Ad Hoc Committee on Climate Change. He currently serves as NARUC's second vice president and is a member of its executive committee. In addition, he serves as a member of the Board of Directors of the National Regulatory Research Institute.

He currently serves on the advisory board of the Michigan State University Institute of Public Utilities, the New Mexico State University Center for Public Utilities' Advisory Council, and the advisory council to the University of Florida's Public Utilities Research Center.

His previous recent work experience includes: executive director of the New Jersey General Assembly Democratic office, deputy director of the New Jersey Department of Treasury's Commission on Capital Budgeting & Planning, and research faculty member of the Eagleton

Institute of Politics' Center for Legislative Research and Service at Rutgers University.

He received a bachelor's degree in modern languages and political science from Villanova University in 1968, and earned a master's degree in international relations from the Johns Hopkins University School of Advanced International Studies in 1973. He participated in the Ph.D. program at Rutgers from 1973–79.

Jennifer R. Cox

Senior Planner, Regional Plan Association

Jennifer R. Cox is a senior planner at the Regional Plan Association. Her research focuses on incorporating climate and energy issues into planning and advocacy efforts. Her projects combine multiple scales and interdisciplinary approaches to garner local, regional, and national attention needed to address climate and energy policy. Since 2001, she has directed the geospatial analysis for a variety of land use, growth, and impact studies within the NY-NJ Harbor, Highlands, Long Island Sound, Regional Visioning, and the America 2050 Initiatives. Cox is completing her doctorate at CUNY Grad Center in Earth and Environmental Sciences, where she is investigating the interrelation between public policy, hazards, and sustainability. She holds a B.A. in geography from State University of New York–New Paltz and a master's in geography from Hunter College of the City University of New York. Currently, Cox is the coordinator of NYCARC Users Group and a research associate for the CUNY Institute for Sustainable Cities.

Jeffrey Domanski

Program Coordinator, Policy Research Institute for the Region; Associate Manager, Princeton University Office of Sustainability

Jeffrey Domanski is serving as a program coordinator for the Policy Research Institute while also pursuing his Ph.D. at Princeton University's Woodrow Wilson School of Public and International Affairs. As a member of the Wilson School's Science, Technology, and Environmental Policy division, he is exploring the development and implementation of environmental emissions trading markets with a focus on the regional and international markets that are forming to address carbon emissions linked to global climate change. His analyses will examine the impacts of individual/group behavior and decision making on the successful application of these markets. Prior to coming to Princeton, Domanski served for six years as an environmental scientist and program manager with a private environmental planning and consulting firm in New York City. He also served in the U.S. Peace Corps as a science and mathematics teacher in Fiji. He received his B.S. in environmental chemistry from SUNY College of Environmental Science and Forestry at Syracuse.

Peter C. Goldmark

Director, Climate and Air Program, Environmental Defense

Peter Goldmark currently directs the Climate and Air program for Environmental Defense.

Prior to joining Environmental Defense, he was chairman and CEO of the *International Herald Tribune*. He has had exceptional careers in both the public and private sectors. His public service was highlighted by his tenure as budget director for the State of New York during the 1970s' city- and state-wide fiscal crisis, where he was an architect of its rescue, and as executive director of the Port Authority of New York and New Jersey through to 1983.

He served as president of the Rockefeller Foundation from 1988 to 1997, encouraging its involvement in environmental issues, particularly as they related to energy. Goldmark was also a trustee of the Rockefeller Brothers Fund (1982–88), member of Board Overseers and chair of Harvard University's Finance Committee (1984–90), director of Knight Ridder Inc. (1991–98), director of the Dreyfus Third Century Mutual Fund (1992–98), member of the National Commission on Civic Renewal (1997–98), and trustee of the Financial Accounting Foundation. In addition, he serves as a board member of Lend Lease Corporation (1999–present), trustee of the Whitehead Institute for Biomedical Research (2000–present), and member of the Council on Foreign Affairs.

In November 2006, he was selected to co-chair the transition team for incoming New York Governor Eliot Spitzer.

Goldmark is a recipient of the Wilson Wyatt National Award for Urban Revitalization and a member of the Legion of Honor, France. He has taught courses at the John F. Kennedy School of Government, Harvard; Yale College; The New School; and Brandeis University. He has returned to the Woodrow Wilson School of Public and International Affairs at Princeton University as a visiting professor of public and international affairs in spring 2007. He holds a B.A. from Harvard University.

David J. Goldston

Lecturer and Practitioner in Residence, Princeton University

From 2001 through 2006, David Goldston was the chief of staff of the U.S. House of Representatives Committee on Science, which oversees most of the federal civilian science agencies, including the National Science Foundation, NASA, and portions of the Department of Energy. Goldston first came to Capitol Hill in 1983 as a press secretary and in addition to committee work has served as a key congressional aide on environmental policy, playing a central role in most of the environmental policy battles on Capitol Hill since 1995. He has a B.A. in history from Cornell University and has completed the course work for a Ph.D. in American history at the University of Pennsylvania.

George Hawkins

Lecturer in Environmental Law and Policy, Princeton University
Director, New Jersey Future

George S. Hawkins is lawyer, teacher, consultant, and activist about the preservation of both natural lands and healthy, livable communities. Hawkins is currently the executive

director of New Jersey Future, a statewide nonprofit organization that advocates for a balance of ecological preservation and economic growth. He also has served as the director of the Stony Brook-Millstone Watershed Association, where he orchestrated its growth from a small local group to the largest such association in the country—building a program to protect land, educate children and adults, work with municipalities to improve zoning, and partner with businesses to improve stewardship. He also has held senior positions with the U.S. Environmental Protection Agency as an enforcement lawyer, with the Vice President Albert Gore's National Performance Review, and with the Boston law firm Ropes & Gray. Hawkins graduated cum laude from Harvard Law School and summa cum laude from Princeton University, and since 1999, he has taught environmental law and policy to undergraduates at Princeton for the Princeton Environmental Institute.

Jeanne M. Herb

Director of Policy, Planning, and Science, New Jersey Department of Environmental Protection

Jeanne Herb is director of policy, planning, and science at the New Jersey Department of Environmental Protection. As a member of the Executive Management Team, Herb's responsibilities include developing new and innovative policies in cross-cutting areas such as environmental health tracking, climate change, environmental justice, smart growth, coastal management, and health and ecological based environmental standards.

Prior to joining the department in March 2002, Herb was a senior scientist at the Tellus Institute of Boston for six years. While at Tellus, Herb managed the public policy program, which focused on research and support to state and federal agencies related to innovative environmental policies. Earlier in her career, Herb served as the director of the Department of Environmental Protection's Office of Pollution Prevention. She holds a bachelor's degree from Rutgers University and a master's degree from New York University.

Lisa P. Jackson

Commissioner, New Jersey Department of Environmental Protection

As commissioner of the New Jersey Department of Environmental Protection (DEP), Lisa P. Jackson leads a staff of 3,400 professionals dedicated to protecting, sustaining, and enhancing New Jersey's water, air and land, and preserving its wealth of natural and historic resources. Before her nomination by Governor Jon Corzine, Jackson served as the DEP's assistant commissioner for land use management. Under her leadership, the DEP crafted regulatory standards for implementing the landmark Highlands Water Protection and Planning Act. Upon joining DEP, Jackson served as assistant commissioner for the Division of Compliance and Enforcement. As the department's chief environmental enforcer, Jackson led pioneering compliance sweeps in Camden, New Jersey, and Paterson, New Jersey, where families live in close proximity to regulated facilities. Working with the county

officials, state police, and EPA, DEP mobilized more than 200 inspectors to conduct more than 2,100 compliance investigations and issued more than 500 violations in the two cities.

Prior to joining DEP, Jackson served for 16 years with the U.S. Environmental Protection Agency, initially at its headquarters in Washington and more recently at its regional office in New York City. During her tenure at the EPA, Jackson worked in the federal Superfund site remediation program developing key hazardous waste cleanup regulations, overseeing hazardous waste cleanup projects throughout central New Jersey and directing multimillion-dollar cleanup operations. She later served as deputy director and acting director of the region's enforcement division. Jackson currently serves on several boards and committees, including the NJ Outdoor Women's League, Inc., New Jersey Sustainable State Institute, New Jersey Development Council, NJ Intergovernmental Protection Commission, Executive Committee of the Natural Resources Leadership Council of the States, Board of Trustees for Prosperity NJ, FIX DMV, and the Governor's Intergovernmental Relations Commission. A native of New Orleans, Jackson earned a master's degree in chemical engineering from Princeton University. She is a summa cum laude graduate of Tulane University's School of Chemical Engineering. Jackson resides in East Windsor.

Franz T. Litz

Climate Change Policy Coordinator, New York State Department of Environmental Protection

Franz T. Litz is the climate change policy coordinator for the New York State Department of Environmental Conservation, a position he has held since 2003. In that capacity, he serves as the chief policy adviser on climate change issues to New York's commissioner of environmental conservation. He also heads the agency's executive-level climate change office.

Litz has served as New York's principal representative to the Regional Greenhouse Gas Initiative (RGGI), an effort by eight Northeast states to implement the first flexible, market-based cap-and-trade program for carbon dioxide in the United States. Since RGGI began, he has chaired the group of state staff representatives conducting the RGGI discussions. As chair, he has been instrumental in bringing the states to consensus around RGGI decisions. He facilitated the multi-state RGGI staff meetings, served as the principal author of the Memorandum of Understanding that was executed by the region's governors in December 2005, and was a principal drafter of the RGGI model rule—the set of rules for the RGGI carbon trading program.

Litz is a member of the California Environmental Protection Agency's Market Advisory Committee for climate change policy and the Advisory Board of The Climate Group, a worldwide nonprofit organization dedicated to

spotlighting positive action on climate change by businesses and governments. He is a participant in a number of ongoing climate change policy initiatives, including the Earth Institute's Global Roundtable on Climate Change and the Center for Clean Air Policy's National Climate Change Dialogue. In early 2006, he was selected to study the European Union Emissions Trading Scheme in depth as part of the European Union Visitor's Program. He is a frequent contributor to and speaker at conferences on climate change policy and emission trading worldwide.

Prior to entering public service in New York in 2001, Litz practiced environmental law with Brown Rudnick, a large Boston law firm, where he represented both private and public clients on a wide range of environmental matters. He is a graduate of Boston College Law School, cum laude, where he served as executive editor of the *Boston College Environmental Affairs Law Review,* and a graduate of Union College, magna cum laude.

Colin Loxley
Director, Resource Planning, PSE&G

Colin Loxley is currently responsible for process improvement and performance management in PSE&G's electric delivery business, including new technology, street lighting, telcomm attachments, new service policy, net metering, power quality/EMF, business controls, and the ED balanced scorecard. His previous experience at Wharton and Chase Econometrics includes economic analysis, forecasting and consulting, including energy forecasting, policy analysis, transportation and fuel use modeling, and emissions analysis.

James D. Marston
Director of the Energy Program in the Texas Office, Environmental Defense

James D. Marston is the founding director of the Texas office of the Environmental Defense located in Austin, where he has served since its beginnings in 1987. The office is comprised of scientists, attorneys, economists, and policy analysts who address environmental issues related to climate and air, ecosystems, oceans, and environmental health. He holds the position of state climate initiatives director, working in states from California to New England that are initiating legislation and regulation to reduce the emission of global warming gases. He has worked closely with California on the passage of AB 32, the first statewide carbon cap legislation that includes all sectors of the economy. His Austin office includes a staff of 27.

Currently, Marston is president of the Texas League of Conservation Voters, and he currently serves on the board of directors of Texas Observer, Texas Environmental Research Consortium, the Green-e Governance Board, and the Central Texas Clean Air Force. He is the former chair of the U.S. Good Neighbor Environmental Board, Presidential Advisory Committee, and served as vice chairman of the Texas Ethics Commission from 1992 to 1994. He has served on numerous

other advisory boards for the State of Texas, the City of Austin, electric utilities, and a university.

Dena Mottola

Executive Director, Environment New Jersey

Dena Mottola was born in Hoboken, New Jersey, and grew up in Old Bridge, New Jersey. She graduated from Cornell University in 1993 with a degree in history and worked as a community organizer and health care consumer advocate in Chicago prior to joining NJPIRG staff and holding various positions with the group, including executive director from 2003–06. In 2006, she led the separation of NJPIRG's consumer and environmental program, launching Environment New Jersey, the new home of NJPIRG's environmental program. Since joining the PIRG advocacy network, she has led the organization to several victories including the landmark passage of the New Jersey Clean Cars Act, one of the nation's broadest diesel pollution clean up programs, adoption of strong new protections for over 300 miles of New Jersey waterways, and adoption of a state renewable energy standard that ensures 20 percent of New Jersey's energy will come from renewable energy by 2020.

In addition to lobbying and policy advocacy, Mottola directs the organization's extensive grassroots organizing and fundraising network, and she is involved in state and national efforts to recruit and train young, new organizers for jobs in the public interest with NJPIRG, Environment New Jersey, and affiliated groups around the country.

Mottola sits on several boards, including the Work Environment Council (a community/labor coalition that works on toxics issues), the Sustainable State Institute's steering committee, the Governor's Clean Energy Council, the Tri-State Transportation Campaign, and the Save NJ Coalition working to save New Jersey's last remaining open spaces, and she co-chaired Governor Jon Corzine's Energy Policy Transition Group.

Nate Scovronick

Acting Director, Policy Research Institute for the Region, Princeton University; Director, Undergraduate Program at the Woodrow Wilson School of Public and International Affairs, Princeton University

Nathan B. Scovronick is the acting director of the Policy Research Institute for the Region and the director of the Undergraduate Program at the Woodrow Wilson School of Public and International Affairs at Princeton University. He was the director of the Program in New Jersey Affairs at the Woodrow Wilson School from 1993 to 1995. He previously served as executive director of the Treasury Department of the State of New Jersey and as deputy director of the New Jersey General Assembly. He is the coauthor, (with Jennifer L. Hochschild) of *The American Dream and the Public Schools* (Oxford University Press, 2003).

Henrik Selin

Assistant Professor of International Relations, Boston University

Henrik Selin is an assistant professor in the Department of International Relations at Boston University, where he conducts research and teaches classes on global, regional, and national politics and policymaking on environment and sustainable development. On these issues, he has published numerous journal articles, book chapters, and working papers. Prior to his current faculty position, he spent three years as a Wallenberg Postdoctoral Fellow in Environment and Sustainability at the Massachusetts Institute of Technology.

Robert J. Shapiro

Chairman, Sonecon, LLC

Robert J. Shapiro is the chairman of Sonecon, LLC, a private firm that advises U.S. and foreign businesses, governments, and nonprofit organizations on domestic and international market conditions and economic policies. Shapiro has advised, among others, President Bill Clinton and Prime Minister Tony Blair; private firms including Amgen, AT&T, Google, Gilead Sciences, Exxon-Mobil, MCI, NASDAQ, SLM Corporation, Nordstjernan of Sweden, and Fujitsu of Japan; and nonprofit organizations including the American Public Transportation Association, the Education Finance Council, and the U.S. Chamber of Commerce. He is also a senior fellow of the Progressive Policy Institute, co-chair of the Argentina Task Force America, director of the Globalization Initiative of the New Democrat Network, and a board member of the Axson-Johnson Foundation in Sweden.

From 1997 to 2001, Shapiro was U.S. Under Secretary of Commerce for Economic Affairs. In that position, he directed economic policy for the Commerce Department and oversaw the nation's major statistical agencies, including the Census Bureau while it planned and carried out the 2000 decennial census. Prior to his appointment as Under Secretary, he was cofounder and vice president of the Progressive Policy Institute and the Progressive Foundation. He was principal economic advisor to Governor Bill Clinton in his 1991–92 presidential campaign and senior economic advisor to Vice President Albert Gore and Senator John Kerry in their presidential campaigns. Shapiro also served as legislative director for Senator Daniel P. Moynihan, associate editor of *U.S. News & World Report,* and economic columnist for *Slate.* He has been a fellow of Harvard University, the Brookings Institution, and the National Bureau of Economic Research. He holds a Ph.D. from Harvard University, a M.Sc. from the London School of Economics, and an A.B. from the University of Chicago.

William Shobe

Director of Business and Economic Research, Weldon Cooper Center for Public Service, University of Virginia

William Shobe is the director of business and economic research at the Weldon Cooper

Center for Public Service at the University of Virginia. He also is adjunct faculty in the economics department and public policy programs at UVA, where he teaches environmental economics and policy analysis. Prior to that, Shobe was the associate director for economic and regulatory analysis with the Virginia Department of Planning and Budget. In 2000, he received a Fulbright Fellowship for work on environmental economics and policy in Prague, Czech Republic. Shobe has taught at Virginia Tech, Virginia Commonwealth University, and the University of North Carolina–Greensboro. In 2002, he received a Patrick Henry Award for commitment to effective government. He earned his Ph.D. in economics from the University of Minnesota and received a J.D. from Lewis & Clark Law School.

Robert H. Socolow

Professor of Mechanical and Aerospace Engineering, Princeton University; Co-Director, The Carbon Mitigation Initiative, Princeton University

Robert H. Socolow is a professor of mechanical and aerospace engineering at Princeton University. He was the director of the University's Center for Energy and Environmental Studies from 1979 to 1997. He teaches in both the School of Engineering and Applied Science and the Woodrow Wilson School of Public and International Affairs.

Socolow's current research focuses on the characteristics of a global energy system responsive to global and local environmental and security constraints. His specific areas of interest include carbon dioxide capture from fossil fuels and storage in geological formations, nuclear power, energy efficiency in buildings, and the acceleration of deployment of advanced technologies in developing countries. He is the coprincipal investigator (with ecologist Stephen Pacala) of Princeton University's Carbon Mitigation Initiative, www.princeton.edu/~cmi/, a 10-year (2001–10) project supported by BP and Ford. Pacala and Socolow are the authors of "Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies," which appeared in the August 13, 2004, issue of *Science*.

Randall E. Solomon

Executive Director, New Jersey Sustainable State Institute

Randall E. Solomon is the founder and executive director of the New Jersey Sustainable State Institute. Solomon's policy experience includes positions as a policy adviser on sustainable development for the New Jersey Board of Public Utilities, director of the States Campaign for the Resource Renewal Institute in San Francisco, and policy director for the nonprofit New Jersey Future. He has participated on advisory boards for federal and state government and civic organizations, and he has advised major corporations. In other positions he was a field researcher in ecology, a national park ranger, and a member of the first class of AmeriCorps national service volunteers. He has a B.S. in biology from the Richard Stockton College of New Jersey and an M.S. in public policy from the Bloustein School at

Rutgers University. He is currently pursuing a Ph.D. in public policy at the Bloustein School, focusing on the social and institutional factors that govern the success of statewide and community sustainability efforts. He writes and speaks frequently on sustainable development, land use policy, and using indicators in public decision making.

Stacy D. VanDeveer

Associate Professor of Political Science, University of New Hampshire

Stacy D. VanDeveer is an associate professor of political science at the University of New Hampshire and a 2006–07 visiting fellow at the Watson Institute for International Studies at Brown University. His research interests include international environmental policymaking and its domestic impacts, the connections between environmental and security issues, and the role expertise in policymaking. Before taking a faculty position, he spent two years as a postdoctoral research fellow in the Belfer Center for Science and International Affairs at Harvard University's John F. Kennedy School of Government. He has received research funding from the National Science Foundation and the Swedish Foundation for Strategic Environmental Research, among others. He has published on issues related to climate change policy and politics in the U.S., Canada, and Europe. In addition to authoring and co-authoring numerous articles, book chapters, working papers, and reports, he co-edited *EU Enlargement and the Environment: Institutional Change and Environmental Policy in Central and Eastern Europe* (Routledge, 2005), *Saving the Seas: Values, Science, and International Governance* (Maryland Sea Grant Press, College Park, Md., 1997) and *Protecting Regional Seas: Developing Capacity and Fostering Environmental Cooperation in Europe* (Woodrow Wilson International Center, Washington, D.C., 1999).