東京大学 公共政策大学院
ワーキング・ペーパーシリーズ
GraSPP Working Paper Series
The University of Tokyo

GraSPP-DP-E-08-001 and SEPP-DP-E-08-001

Addressing Global Climate Change:

Grassroots Initiatives and Technology Diffusion in the U.S.

George R. Heaton, Jr.
Christopher T. Hill
Patrick Windham

May 2008

GraSPP Discussion Paper E-08-001

SEPP Discussion Paper E-08-001

GRADUATE SCHOOL OF PUBLIC POLICY
THE UNIVERSITY OF TOKYO
HONGO, BUNKYO-KU, JAPAN

GraSPP-DP-E-08-001 and SEPP-DP-E-08-001

Addressing Global Climate Change: Grassroots Initiatives and Technology Diffusion in the U.S.

George R. Heaton, Jr.
Christopher T. Hill
Patrick Windham

May 2008

A Report and Presentation
by Technology Policy International

George Heaton, Managing Principal
739 Commonwealth Ave.
Newton Center, MA 02459
Phone: phone 617-965-2841
Facsimile: 617-244-2505
E-mail: GRHeaton@aol.com

注： 著者の所属、連絡先はいずれも執筆当時のものです。
本稿に関するお問い合わせは、東京大学公共政策大学院寄付講座「エネルギー・地球環境の持続性確保と公共政策」（略称 SEPP）（〒113-0033 東京都文京区本郷 7-3-1 03-5841-1324　sepp@pp.u-tokyo.ac.jp）までお願いします。

Table of Contents

Preface

In the spring of 2007, discussions between members of the SEPP Program at Tokyo University and Technology Policy International revealed a strong common interest and belief: the power of "bottom-up" actions by individuals, companies, cities, and states to address global climate change. Realizing that such actions continue to be under-recognized in both the U.S. and Japan, the SEPP Program decided to commission a study by TPI to examine trends in the U.S. and present its findings in Tokyo in May 2008.

This document contains the results of TPI's investigations. It is presented in a combined format – both as text and complementary Power Point slides – so as to make it both an item for distribution and seminar presentation.

Although financial support was provided by Tokyo University, the views expressed herein are solely those of the authors.

George R. Heaton, Jr.**
Newton Centre, MA
GRHeaton@aol.com

Christopher T. Hill
Washington, D.C.
Chrishll@erols.com

Patrick Windham
Atherton, CA
PatWindham@aol.com

** Project Manager and Managing Principal, Technology Policy International

About the Authors

George R. Heaton, Jr. is a member of the faculty at the Worcester Polytechnic Institute in Massachusetts and an independent consultant in science and technology policy, environmental policy and law. Trained as a lawyer, Mr. Heaton has been on the faculty of the Massachusetts Institute of Technology, and has worked widely for public and private technical and policy institutions in the U.S and abroad. Maintaining extensive professional and personal relations in Japan, Mr. Heaton was a Visiting Professor at Saitama University in 1986-87 and the First Foreign Scholar of the Ministry of Health and Welfare in 1989-90.

Christopher T. Hill is Professor of Public Policy and Technology and former Vice Provost for Research at George Mason University in Fairfax, Virginia. After earning three degrees in chemical engineering and practicing in that field at Uniroyal Corporation and Washington University in St. Louis, he has devoted the past three decades to practice, research and teaching in science and technology policy, including service at MIT, the Office of Technology Assessment, the Congressional Research Service, the National Academy of Engineering and the RAND Critical Technologies Institute.

Patrick Windham is a consultant on science and technology policy issues and a Lecturer in the Public Policy Program at Stanford University. From 1984 until 1997, he served as a Senior Professional Staff Member for the Subcommittee on Science, Technology, and Space of the Committee on Commerce, Science, and Transportation, United States Senate. He helped Senators oversee and draft legislation for several major civilian science and technology agencies and focused particularly on issues of science, technology, and U.S. industrial competitiveness. Mr. Windham received an A.B. from Stanford University and a Master of Public Policy degree from the University of California at Berkeley

Addressing Global Climate Change: Grassroots Initiatives and Technology Diffusion in the U.S.

George R. Heaton, Jr.
Christopher T. Hill
Patrick Windham

Technology Policy International

Presentation to SEPP Program
Tokyo University
May 2008

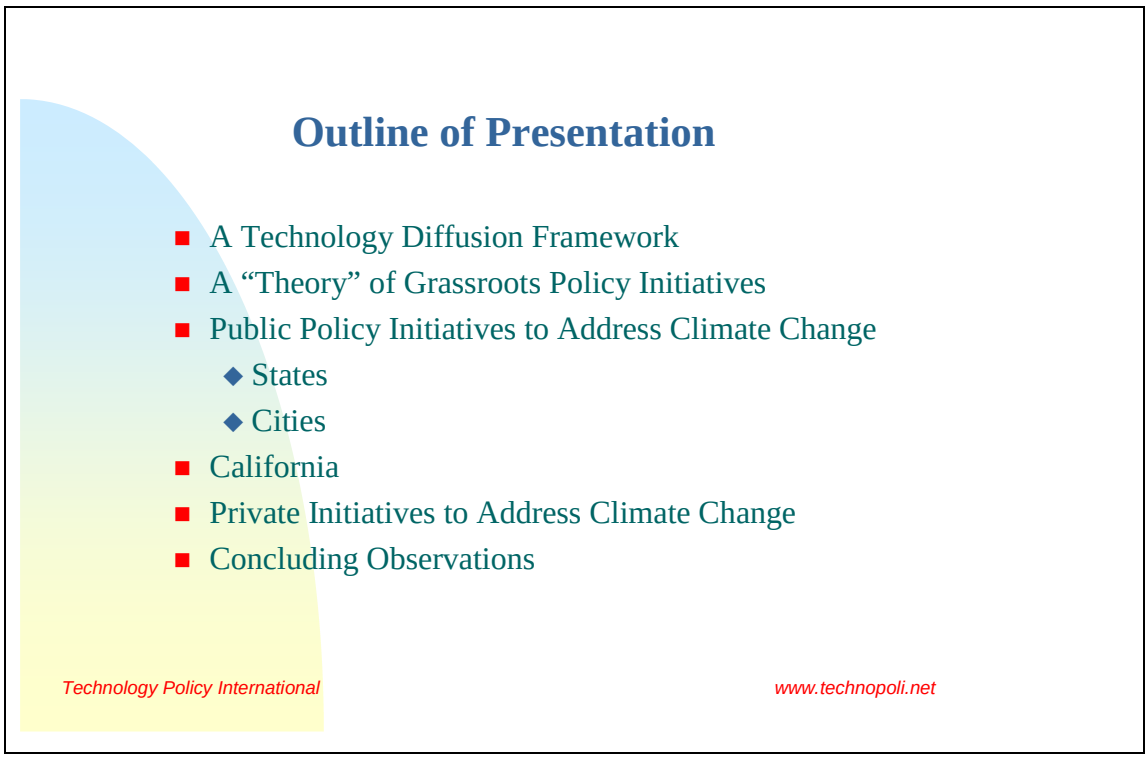
1. INTRODUCTION

Although few would dispute the proposition that global climate change is the most challenging environmental problem the world faces, many – at least in the United States – vigorously dispute what to do about it. To be sure, the debate in America today is far from what it was even a few years ago, when "climate skeptics" scoffed at both theory and evidence, and top policy makers openly disavowed international climate accords. As recently as January 28, 2008 President Bush's State of the Union Address "reaffirmed" the US effort to work to complete a new international climate change agreement, and pledged to commit $2 billion to a new international clean energy technology fund.[1] At face value, this rhetoric might suggest a national consensus about the urgency of the problem, the need for international solutions and the central role of technology in solving it.

Looking beneath the surface, however, we see major rifts in American thought and action toward the issue of how to address global climate change. Two in

[1] See http://www.whitehouse.gov/stateoftheunion/2008/initiatives/energy.html. It should be noted, however, that the US will support a new agreement "only if it includes commitments by every major economy and gives none a free ride," and that all the details of the clean energy fund remain to be worked out.

particular are the subject of this paper: the locus of agenda-setting in public policy and the focus of efforts to promote technological change. More specifically we are concerned, in the first case, with policy initiatives that originate in local, state and regional efforts that are not led by (or may even be antagonistic to) Federal policy. Second, we focus on the importance of strategies aimed at encouraging technological diffusion, as opposed to innovation, as a means of attacking climate change. We believe that these two approaches, though distinct, are nevertheless rooted in a common paradigm: a commitment to immediate, broad-based, often small-scale or incremental actions to combat climate change that need not depend on the long-term fruits of R&D or the vagaries of national and international political decisions. In short, what we portray is a bottom-up, grassroots movement in two parallel realms – public policy and technological change – that is occurring in the U.S.



The structure of the paper is as follows. We begin conceptually, in Section 2, by putting forth a framework to examine the genesis of public policy change in the U.S. as well as the process of technological change in commerce.

In Section 3, attention is directed to the groundswell of regional, state and local initiatives that are now being mounted to combat climate change. Given the

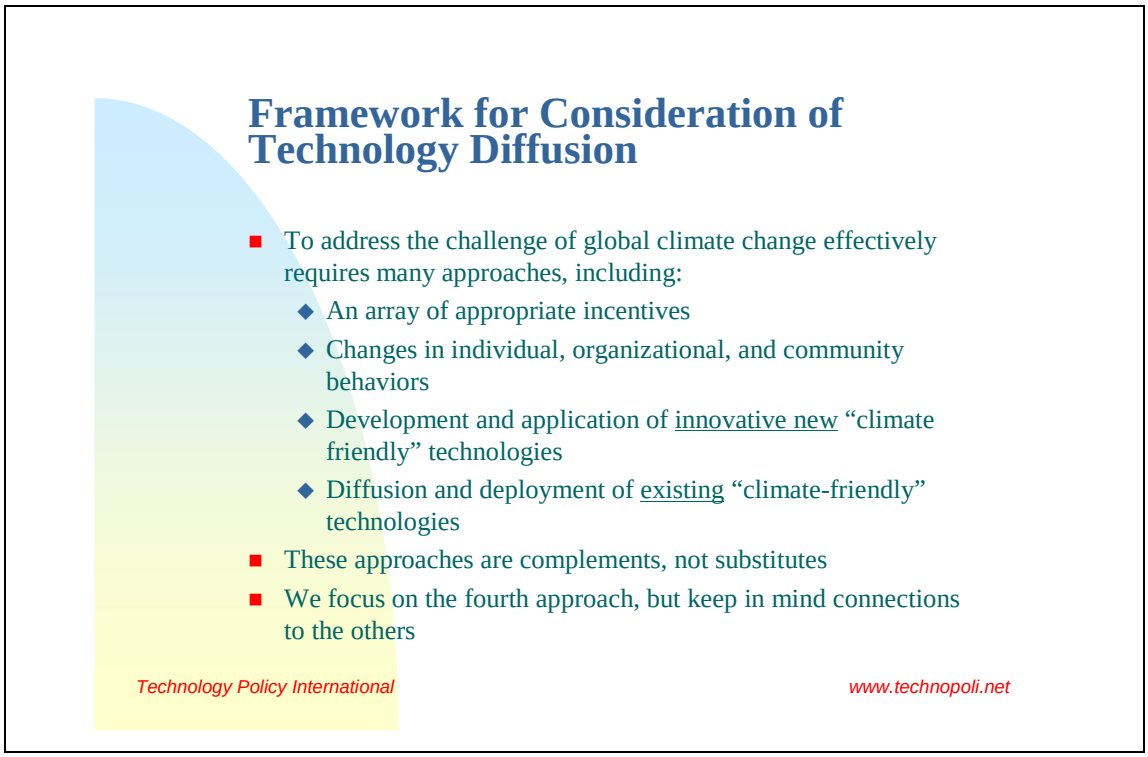
large number and fast-changing character of these initiatives, we have chosen to analyze a small number of representative examples, without attempting to be exhaustive. Since some of the most aggressive and important experiments are taking place in the State of California, it is given separate treatment in Section 4.

In Section 5, the focus is shifted to initiatives in the private sector, including academia, as well as private-public cooperation, to combat climate change, absent the legal compulsion to do so. Overwhelmingly, these efforts focus on the diffusion of existing technologies.

A concluding chapter, Section 6, both recapitulates the main findings and leaves the analysis with a number of hard questions about the long-term adequacy of grassroots policy change and technological diffusion in a context where world-wide action and major innovations may also be necessary.

2. CONCEPTUAL FRAMEWORK

2.1 Framework for Consideration of Technology Diffusion

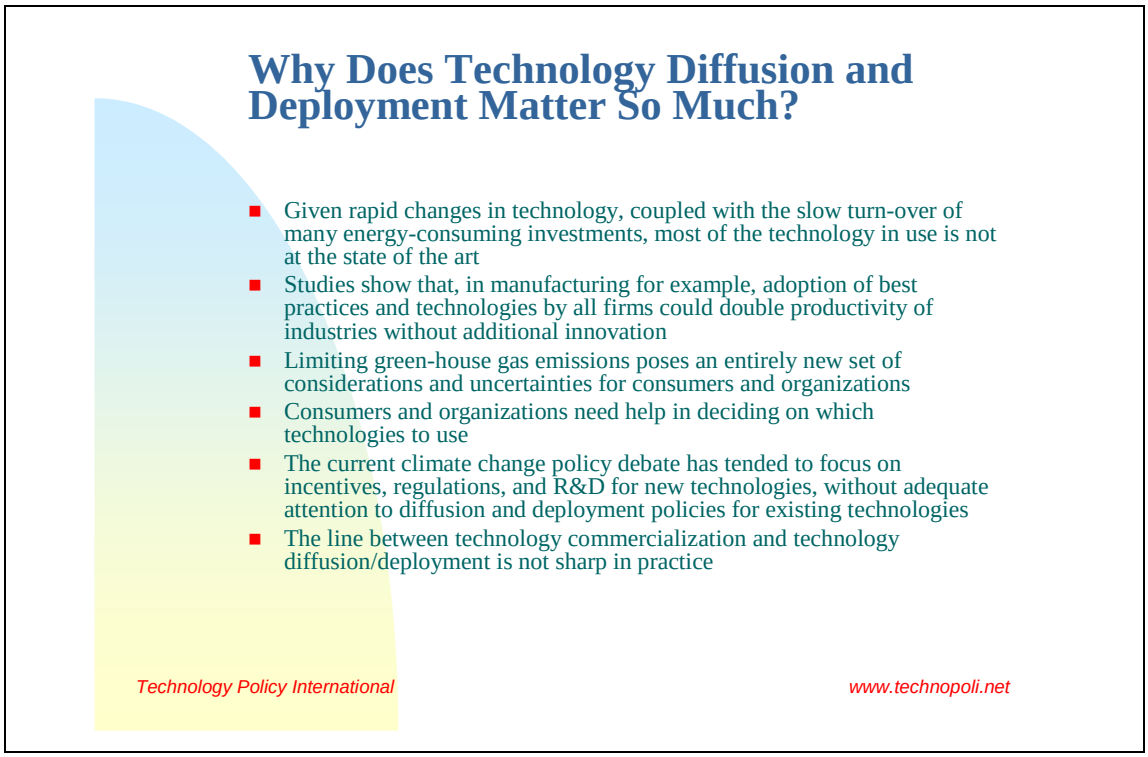


Addressing the challenges of global climate change will require actions on a broad front, both private and public. While some would seek to focus actions in only one or a few areas, we recognize the importance of a complementary set of public policies.

On the one hand, there can be no substitute for establishing more appropriate economic incentives to guide the behavior of individuals, organizations and corporations. One way or another – via a carbon tax, a cap and trade system, or user regulation – the price of emitting carbon dioxide and other green house gases (GHGs) must be raised to reflect the costs of the damage that they do to the environment.

Technology will play an essential role in coping with the threat of environmental damage due to GHG emissions, as well as in coping with the changed GHG price conditions that are expected to pertain in the future. Over the long term, there is a critical need for new and more efficient technologies –breakthrough

technologies, as some call them – to use to make the radical reductions in emissions that will be required if the world needs to limit atmospheric GHG levels to on the order of 550 ppm or even lower. In the near term, however, more effective utilization of existing technologies that have better GHG performance than technologies now in widespread use can play a substantial role in reducing emissions until more radical technologies are developed and put into practice. In this report, we focus on actions to encourage adoption of these existing "climate-friendly" technologies throughout the United States.



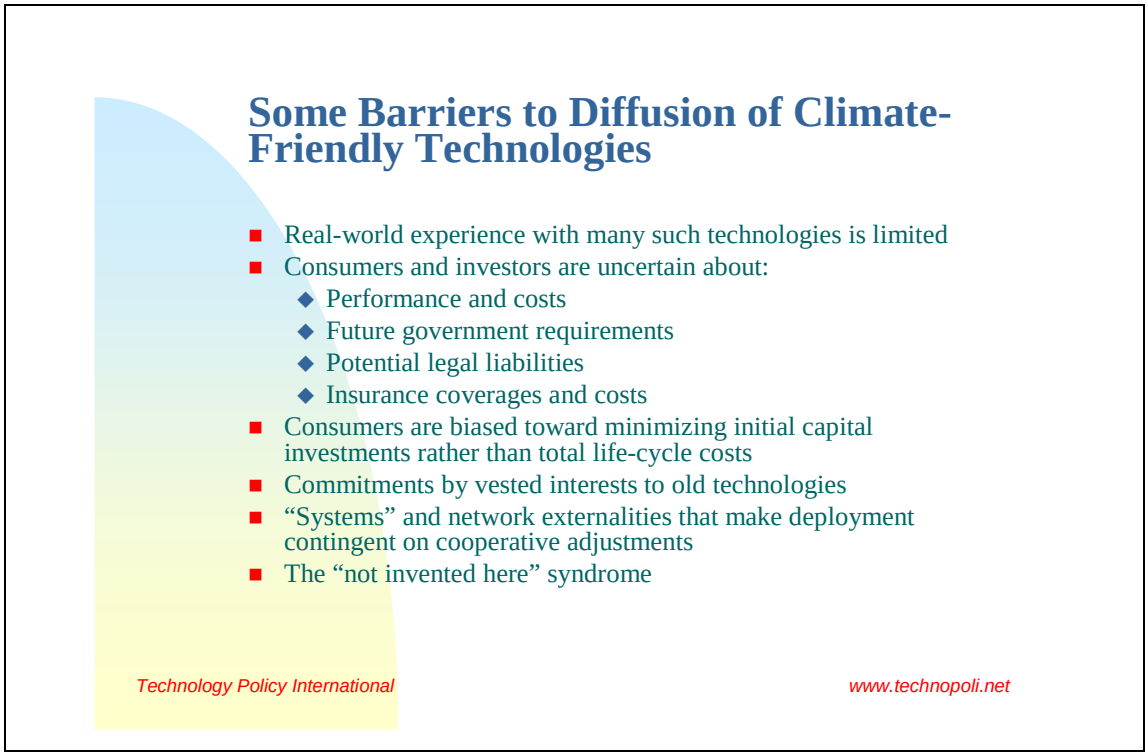
Diffusion of existing technologies is key to near-term reduction in GHG emissions, but it also can influence emissions over the next several decades as well. Energy consuming investments, such as power plants and basic materials industries, as well as commercial and residential construction, have expected useful lives of several decades. If such investments that are made in the next few years do not incorporate the most energy efficient and climate-friendly technology currently available, they will continue to impose a burden of excessive GHG emissions for decades to come.

In other contexts, diffusion of existing and better technologies has been shown to offer considerable potential for organizational improvements. In one study done by one of us (Heaton) in collaboration with the late J. Herbert Hollomon, it was determined that applying better and existing technology in manufacturing firms, equivalent to that used in leading firms in each industry, could yield an overall productivity improvement of a factor of two or more.

However, the case of GHG-related technologies poses a new set of considerations and uncertainties for consumers and industry. The uncertain GHG price environment means that making major new investments may not be optimal if the prices set on carbon and other GHGs are either lower or higher than anticipated. Furthermore, many special interests are now making strong claims for the "greenness" of their products and services; claims that are difficult either to support or refute. In light of this, potential buyers of new GHG-related technologies need advice and expertise from trusted sources, and they need encouragement to take the first steps toward using better technologies.

In considering the role of technology in addressing climate change challenges, many observers are biased toward basic research and long-term, high-risk technology development programs, as compared with technology diffusion activities. In the United States, there has long been a bias in federal science and technology policy toward a preference for fundamental research. This reflects both an ideological presumption against public policies that encourage applied research, as well as the influence of the academic community on research policy. That community will generally benefit more from basic research than from technology deployment programs.

One premise of this paper is that this bias toward basic research is misplaced and that much can be gained from technology deployment and adoption programs. Our premise seems widely shared, as efforts are underway in the United States at many levels to encourage technology deployment and adoption. In the sections to follow, we discuss a number of these kinds of efforts.



Students of the processes of technology deployment and diffusion have long recognized certain systematic barriers to such activity. These barriers tend to exist across a wide range of societal concerns, but there are some that are more particular to the energy and climate-related concerns.

For example, while the technologies themselves are not necessarily new, they often appear to be quite novel to potential buyers and users. Many buyers make purchase choices based on their own past experience as well as on the experiences of others whom they can observe and/or whom they trust. Climate-friendly technologies have not spread widely so that there are not a great many "leaders" or "early adopters" for others to emulate.

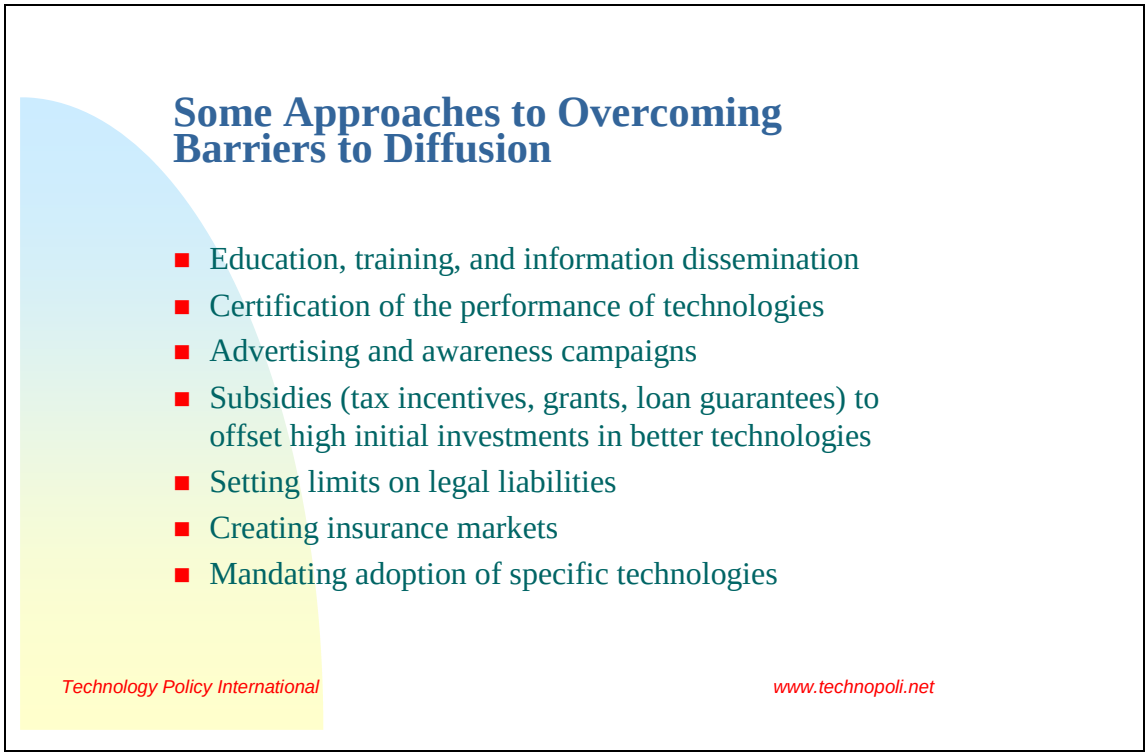
As noted above, uncertainty abounds in purchase and use decisions regarding many climate-friendly technologies, and this uncertainty causes many potential buyers to "wait and see" before investing in technologies and systems they don't understand. Purchasers and users worry that untried technologies may pose uncertain risks of harms that might bring the wrath of injured parties down on them via product liability law suits or via the action of regulatory bodies. In the same manner, insurance

companies may be reluctant to provide coverages to early adopters of technology, or may only provide coverage at very high prices.

Analysts have noted systematic biases against making energy-related investments that cost more in the beginning (have high capital costs) while promising lower operating costs. Typically, investors are led by market forces to try to minimize first costs and to absorb higher operating costs later on. For energy investments, higher operating costs usually translate into higher fuel use and cost and, thus, more GHG emissions.

We also must note that in certain cases, GHGs are the product of large networked systems of investments for which changes in any one part of the system may be inhibited by the costs of coordinating or incentivizing complementary investments in other parts of the system. So-called network externalities, which are often thought of as positive, can also be negative if complementary assets must be purchased to complete the picture.

Finally, there are major vested interests in key elements of the energy-consuming and GHG producing sectors that militate against entry of improved technologies, even if they would be cost-effective for consumers and users.



Identifying these barriers tends to lead relatively directly to insights into how they might be overcome. Clearly, the *sine qua non* of efforts to overcome technology diffusion barriers is education, information dissemination and training. Sophisticated means of mass advertising on the one hand, and grass roots community demonstration projects on the other can play a role in these kinds of programs.

More subtly, official or professional certification of the performance of new technologies can help overcome consumer reluctance, reduce somewhat the threat of successful products liability suits, and give comfort to insurance underwriters.

Public policies that help offset the high initial investment costs of some such technologies can be important in overcoming barriers to their adoption. Various sorts of subsidies (grants, tax incentives, concessional loans, loan guarantees) can all be helpful.

In some cases, legislative action has been taken to limit the potential liability exposure of early users of new technologies. In the United States, for example, the Price-Anderson Act, which limited the financial liability of electric utilities in case of

malfunction, played a role in helping overcome the reluctance of these utilities to embrace nuclear power, when that technology was in its infancy.

Some states, where insurance is typically regulated in the United States, have required that, as a condition of selling insurance in the state, companies must offer insurance coverage for new technologies that they might otherwise prefer to avoid.

Finally, and in the extreme case, governments have mandated adoption and diffusion of more efficient technologies. In the United States, for example, automotive fuel use is controlled via the so-called CAFÉ standard approach. Also, major home appliances, such as air conditioners and refrigerators, must comply with certain mandated energy efficiency standards if they are to be sold in the country.

2.2 A "Theory" of Grassroots Policy Change in the U.S.

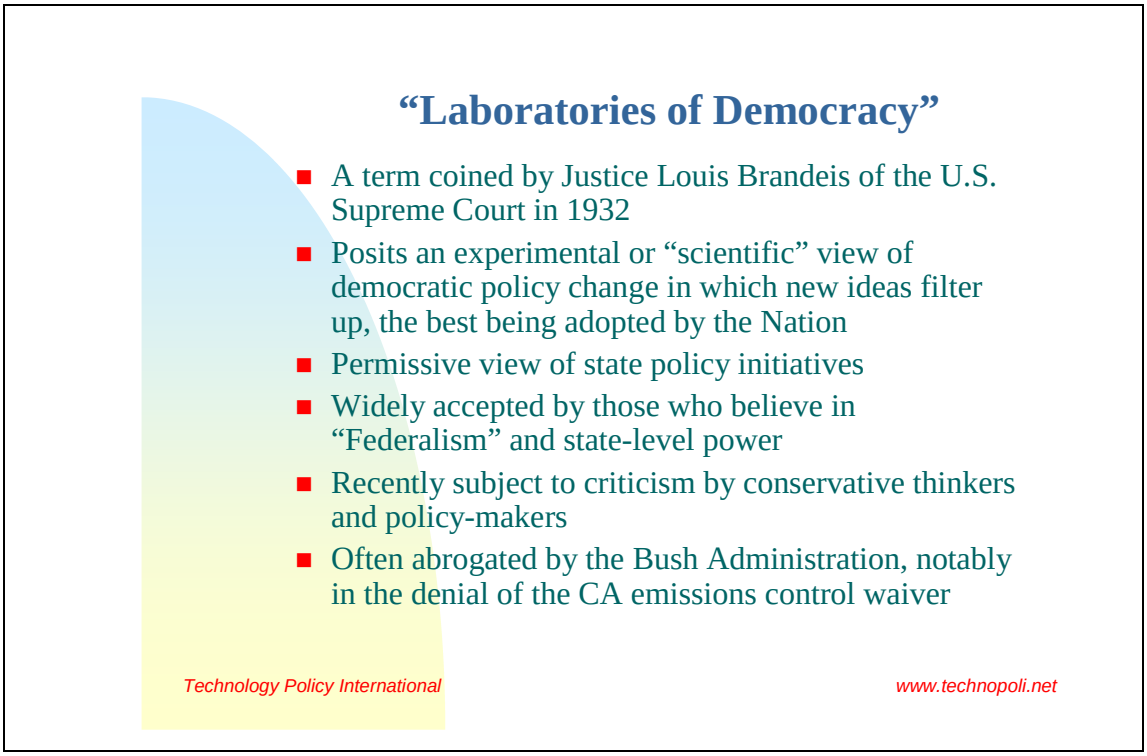
The U.S. is structured, according to its Constitutional theory, as a "federal" system, in which the nation was created through a federation among preexisting, sovereign component states. This federal system guarantees the perpetuation of both the national government and states, and assumes different spheres of responsibility for

each. The U.S. federal system stands in contrast to "unitary" countries – such as England, France or Japan – in which the nation-state is the theoretical source of power, and in which the central government has the ability to reorganize the country's political subdivisions. Indeed, to a certain extent, the U.S. system was designed as a reaction to and a means of avoiding the centralized power that could be seen in many other countries. Thus, the "grassroots" tendency in the United States is a built-in feature that is well-recognized and cherished.

In practice, therefore, the impetus for many U.S. national policies to address major problems actually begins with local, state and private action. And this is often the case even when the problem at hand is national or international in scope. In short, neither private interests nor state and local governments assume that leadership will come from the Federal government. On the contrary, it is typically assumed that Federal action will follow experimentation in the "laboratories of democracy" at the state and local levels.

The term "laboratories of democracy" is often used to describe the process by which diverse policy "experiments" are initiated at the state and local levels in the U.S., with the most successful being adopted subsequently by the nation as a whole. This term was coined by the Supreme Court Justice Louis Brandeis in an opinion he wrote in 1932 considering the spheres of Federal and state power.[2] Brandeis was well-known as a progressive thinker, with a belief in what is sometimes called "scientific socialism;" i.e., the view that public policy's role is to improve social welfare through continuous trial and evolution.

[2] "It is one of the happy incidents of the federal system that a single courageous state may, if its citizens choose, serve as a laboratory; and try novel social and economic experiments without risk to the rest of the country." New State Ice v. Liebmann (1932)



Those who cite the "laboratories of democracy" theory today tend to have a permissive view of state policy initiatives, and are reluctant to see them wiped out by across-the-board Federal regulation. Oddly enough, there is no consistent ideology attached to those who make this argument: it can be seen in the positions of both the highly conservative opponents of abortion who are attempting to abolish it at the state level, and the highly liberal proponents of homosexual marriage who also operate entirely at the state political level. Odder still, recent critics have pointed out that Brandeis' phrase was probably much less focused on the concept of Federalism and much more on social improvement. Indeed, his later opinions routinely argued in favor progressive Federal policies that would override state action.[3]

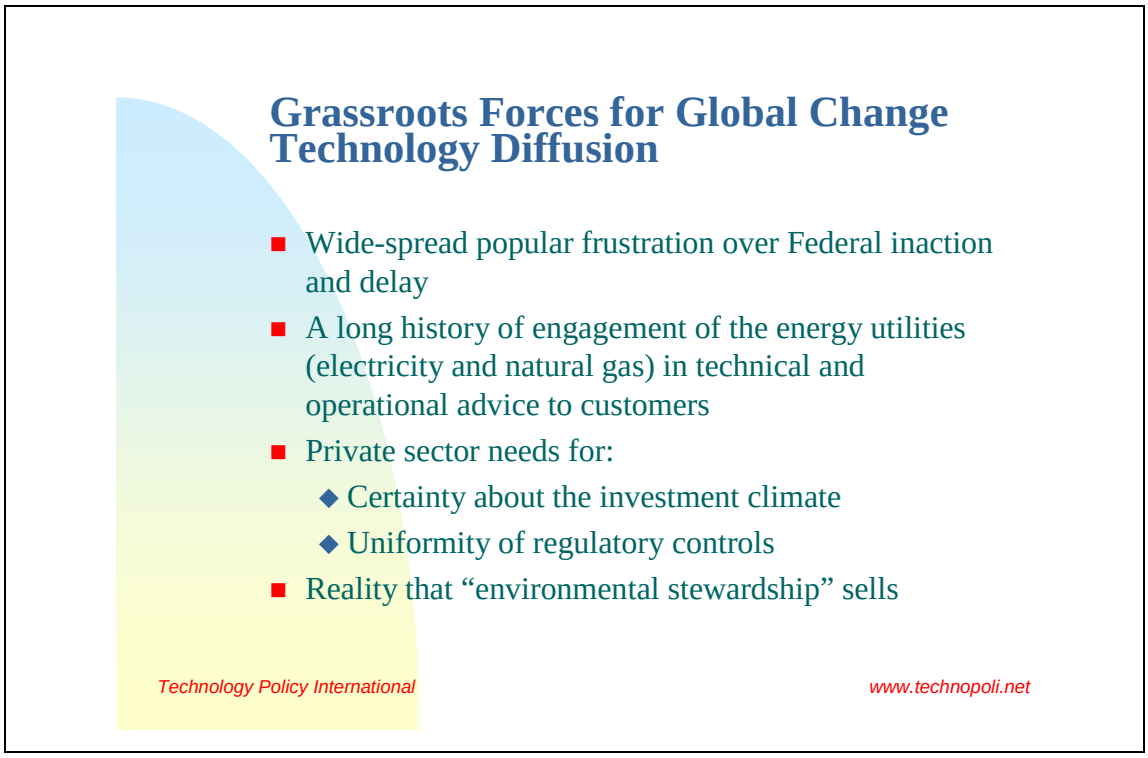
In the context of climate change policy today, we see the proliferation of state and local initiatives that are described subsequently as clear evidence of the health of the "laboratories of democracy theory" in the U.S. Although the Bush Administration is frequently on record in favor of this tendency and against Federal domination, its stance has not been consistent. Mostly notably, in the context of automobile emissions standards to control GHG, the Administration has recently

[3] "Laboratories of Democracy: Anatomy of a Metaphor," Michael Graves, American Enterprise Institute, http://www.aei.org/publications/pubID.12743/pub_detail.asp

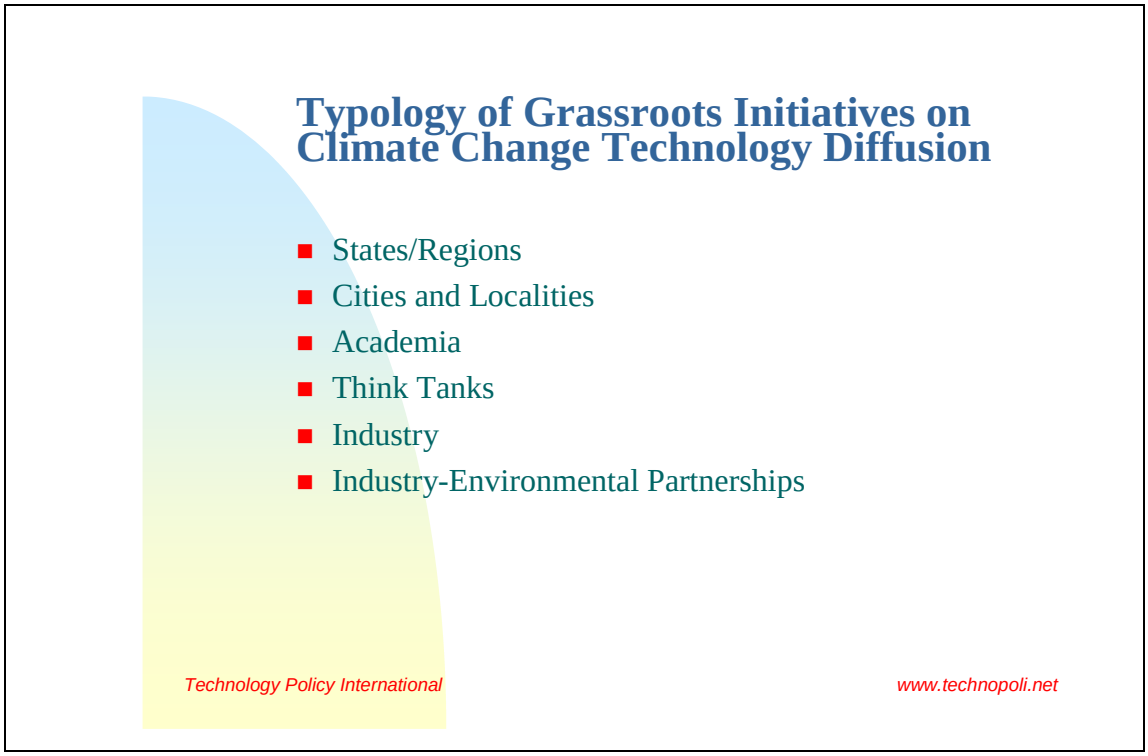
refused California's request to experiment with its own standards, denying the state the waiver from the uniform Federal standard which is necessary to do so. (See discussion below).

Combining Constitutional theory with other social and economic forces, a general context for grassroots initiatives that focus on technology diffusion can be sketched out. A first point – that governance is shared among the states and the Federal government – deserves repeating, especially with the corollary that the mission of economic development has traditionally been seen as a state-level function. While economic regulation, springing from the Constitutional power to control interstate commerce, has largely been a Federal role, functions as diverse as building codes, the licensing of corporations, and government venture capital for new technology have generally occurred at the state level. In the realm of technical standard-setting, most of the organizations that originate standards for products, processes and systems are private rather than national, with the result that best practice tends to diffuse from the bottom up and across sectors, rather than from the national level down. Civic organizations and activity, often focusing on improvements to economic well-being, are much more local than national in scope. Such ventures are encouraged importantly by Federal and state tax laws that both make such

activities tax-exempt, and allow donations to them to result in a tax deduction. Lastly, U.S. universities and other intellectual institutions routinely see addressing major public challenges as a core aspect of their mission, and frequently function as a forum where various sectoral actors can be united with a common purpose.



More specifically at the moment, it has become clear that the grassroots forces for technology diffusion to attack climate change have moved remarkably to the forefront. In the population at large, there is widespread popular frustration over Federal inaction and delay in "doing something." In industry, the firms that are perhaps expressing this most clearly are the energy utilities (electricity and natural gas), which are promoting the diffusion of energy and materials savings technology, as well as general knowledge of the issues. This is very much in line with their historic role of conveying technical and operational advice to customers. Within the private sector more generally, there is a felt need for public policy to improve the certainty of the long-term investment climate in sectors that will be most affected by climate change, and to undertake some uniformity of regulatory controls. Lastly, firms in all sectors – from retail foods to automobiles to cosmetics – are promoting the reality that "environmental stewardship" sells as never before with the American consumer.



In the discussion that follows, we present a wide range of specific examples of grassroots initiatives that focus on climate change and technology diffusion. Given the extremely large – and fast-changing – number of such developments, it is not possible to do an exhaustive survey.[4] It is possible, nevertheless, by way of preamble, to offer a

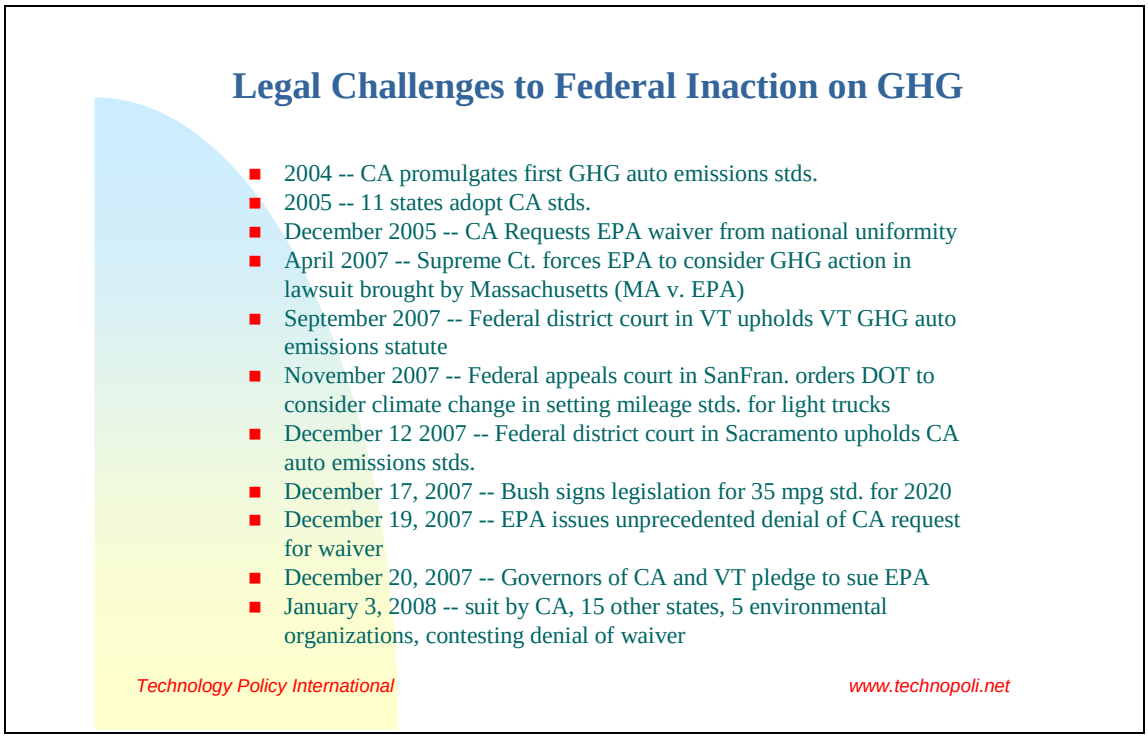
[4] We have recently become aware of the new "GreenPRO" on-line data base that includes environmental and energy conservation policy initiatives in many local and regional communities in the United States. It can be found at www.greenpolicy.us.

typology of such initiatives. Our survey suggests that at least seven major categories should be noted:

- State actions
- Aggregation of states into regional compacts
- Cities and other local governments
- Academic institutions
- Private think tanks
- Industry
- Industry partnerships with environmental groups.

3. STATE, REGIONAL AND LOCAL INITIATIVES TO COMBAT CLIMATE CHANGE

3.1 Legal Challenges to Federal Inaction on GHG



The US legal system accords a remarkable degree of openness to litigants of all types who wish to challenge the actions of the Federal government. To a significant extent, this is due to the environmental movement, which urged the courts as early as the 1960s – and with considerable success – to grant "standing to sue" to citizens groups, environmental organizations, and even (on occasion) natural entities. Although the environmental statutes enacted during the 1970s represented a significant shift of power from the states to the Federal government, they by no means inhibited the states' ability to challenge Federal action in court. Law suits in the US often represent a form of public jousting that escalates legal controversies into the higher-profile realm of political agenda-setting and notoriety. Controversies that make their way to the Supreme Court take on a special significance, not only because of the power of the legal precedent. In addition, because the US Supreme Court is universally recognized as the final arbiter of questions of Constitutionality, it is able – and often quite willing -- to invalidate the actions of other branches of government

and thus force dramatic changes in policy.

The area of climate change has recently brought these general tendencies into clear focus. States, localities and environmental groups, frustrated by Federal inaction, have used the courts as a way to validate their own policy initiatives in this sphere, to call public attention to Federal failures to address climate change, and – where possible – to force Washington to act. By and large, they have been remarkably successful.

Most of the important recent litigation has developed under the Clean Air Act (CAA), which regulates air pollution according to a complicated scheme first put forward in 1970. The CAA creates entirely different regulatory systems for stationary sources of pollution, such as factories, and mobile sources, such as automobiles. In neither context have Federal regulators taken any action pertaining to GHG or climate change. They have justified themselves by arguing that GHG are not pollutants explicitly recognized by the CAA, that the science of their relationship to climate change is uncertain, and that non-regulatory approaches are the most appropriate policy alternative. On the other side, state and environmental groups argue that GHG are well-recognized pollutants that should be regulated from stationary sources, and that a separate set of emissions standards should be mandated for automobiles.

California, as has often been the case in air pollution regulation, has played the initiating role. Indeed the CAA itself recognizes California's unique situation, and allows EPA to grant a "waiver" for California automobile regulations that go beyond those in the remaining states. This was clearly the process envisioned by the California auto emissions standards promulgated in 2004. In addition, California adopted its own unique GHG emissions reduction system, pertaining to stationary sources. Based on California's example, around a dozen other states have pursued similar strategies. The resulting litigation has involved the industry, environmental groups, the states, cities and the Federal government in a wide range of controversies.

Thus far, the alliances of states and environmental groups have won all important judicial contests with the Federal government. The most dramatic victory to date is probably the decision by the Supreme Court in the suit led by Massachusetts

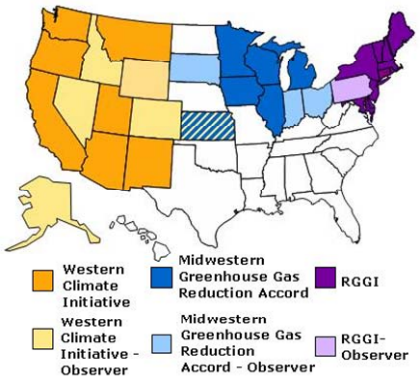
against EPA, to force it to consider GHG, especially CO2, as pollutants under the CAA. As a result of this litigation, in which the Court repudiated both EPA's scientific assessments and its legal interpretations, EPA has been forced to commence rulemaking to attack GHG emissions.

A more equivocal picture is emerging with respect to state auto emissions regulation. Although diverse Federal courts throughout the country have upheld the authority of the states, led by California, to undertake such regulation, EPA disagreed with this rationale when, in December 2007, it refused California's request for a waiver. Within two weeks, California, along with 15 states and 5 environmental groups, had brought suit in Federal court to challenge EPA's determination.

While it is certainly true that the litigation during the Bush era has been a contest between environmental activism in Democratic states and the inaction of a Republican Administration, the tension between Federal and non-Federal policy goes much deeper than partisan politics. The litigation that has emerged must also be seen as part of the continuing dynamic in US environmental policy to determine at which level of government the agenda is set, as well as who sets the standards by which agendas are implemented. The history of this litigation accurately reflects the tendency for experimentation and diversity to occur at the state level, and the tendency for uniformity and large-scale action to be reflected in Federal policy.

3.2 Regional Climate Change Initiatives

Regional Climate Change Initiatives



http://www.pewclimate.org/what_s_being_done/in_the_states/regional_initiatives.cfm

Technology Policy International *www.technopoli.net*

Regional Initiatives to Combat Climate Change in the US and Canada

- Now cover 31 states and several Canadian provinces
- 2001 -- New England governors' Climate Change Action Plan: 10% GHG reduction by 2020; includes Eastern Canada Association
- 2003 -- West coast governors' Global Warming Initiative: CA, OR, WA
- 2004 -- Western Governors' Association: clean and diversified energy: 30,000 MW clean energy by 2015; 20% efficiency improvement by 2020
- 2005 -- Regional Greenhouse Gas Initiative (RGGI): 7 New England states, other observers
- 2006 -- Southwest Climate Change Initiative: AZ, NM
- 2007 -- Western Climate Initiative: 6 state members, 2 Canadian provinces; 15% GHG reduction by 2020
- 2007 -- Midwestern Regional Greenhouse Gas Reduction Accord: 6 state members, one Canadian Province, 2 observers; inventory and cap and trade
- 2007 -- Energy Security and Climate Stewardship Platform for the Midwest: carbon capture and energy efficiency
- Sept 10, 2008 – First national auction of CO2 allowances by New England, NY, NJ, MD, DE

http://www.pewclimate.org/what_s_being_done/in_the_states/regional_initiatives.cfm?preview=1

Technology Policy International *www.technopoli.net*

Regional initiatives to combat climate change now cover 31 states and several Canadian provinces. As the map shows, they are concentrated in the Northeast, Far

West, and Upper Mid-West of the country, which are the most environmentally progressive regions. The initiatives were from their inception seen both as a way to do something about the problem of global warming, and as a direct challenge to the lack of action on the part of the Federal government. Indeed, as recently as March 18, 2008, the New York state environmental commissioner, announcing the first-in-the-nation auction of CO2 allowances, reiterated the rationale for the regional initiatives: "Climate change is the most significant environmental problem of our generation, and the 10 states cannot wait for Federal action."[5]

The timeline in the slide above shows the expansion of the regional initiative concept over the last seven years. In 2001, the New England Governors agreed to a common Climate Change Action plan, with GHG reductions of 10% by 2020. This accord expanded into the Regional Greenhouse Gas Initiative. In 2003 the West Coast Governors launched their plan, which added the Southwest states of Arizona, New Mexico and Colorado in 2006. In 2007, the trends spread into the Midwest, with the establishment of the Midwestern Regional Greenhouse Gas Reduction Accord.

Broadly speaking, these accords take the same approach. Most have a specific GHG reduction target. Clean energy is promoted through various means. Carbon inventories are being undertaken in the anticipation of an eventual cap and trade approach. The first example of this will occur in New York in September, 2008.

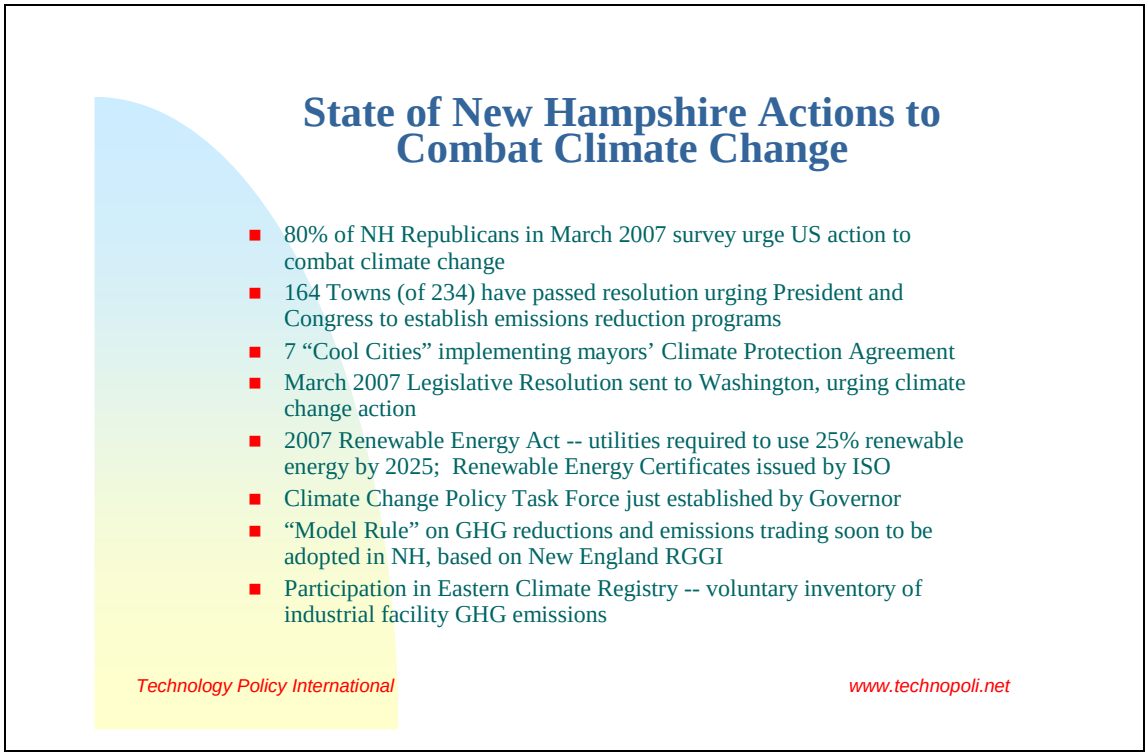
It has to be noted that, thus far, the accords do not seem to be achieving their environmental goals. For example, a recent report for New England show that GHG emissions have increased in all sectors and almost all states (Rhode Island alone showed a drop).[6] Nevertheless, these programs are very much in the public eye and high on the agenda of policy-makers throughout the region. They clearly represent a strong consensus to act, as well as a strong consensus over the appropriate policy levers – namely, mandatory GHG reductions, a trading system, and energy R&D.

---

[5] Remarks by Peter Grannis, NY Environmental Commissioner, reported by the Associated Press, Tuesday, March 18, 2008.

[6] "Falling Behind: New England Must Act Now to Reduce Global Warming Pollution," combined authorship from The Frontier Group, the New England Climate Coalition, and the Natural Resources Council of Maine, released March 26, 2008.

3.3 The State of New Hampshire



New Hampshire is a relatively small (population 1.3 million) New England state, notable for granite, snow cover, the direct democracy of Town Meetings – and for holding the Nation's first presidential primary election every four years. It is a politically aware and activist state, with a reputation for independent voters who eschew traditional party and ideological labels. Within the last few years, the issue of global climate change has become a major concern among the New Hampshire citizenry, and, during 2007, it has virtually exploded onto the agendas of cities and towns, the state legislature, universities and businesses.

With a small land area, population and lack of industry, New Hampshire's impact on global climate change is inconsequential. But what makes it of particular interest in this context is the breadth and fervor of the actions its public has taken to combat global climate change, to a significant extent outside of the conventional party-based political debate. New Hampshire is often seen as a bellwether state in Presidential politics; this may be the case in climate policy as well.

Although New Hampshire had long been seen as a solid Republican state, this has changed in recent years, with Democrats now slightly outnumbering Republicans, and "Independents" outnumbering both. It is therefore significant that 80% of the state Republicans – arguably the most "conservative" bloc – expressed themselves, in March 2007, to be in favor of the proposition that action should be taken at the national level in the U.S. to combat climate change.

The enthusiasm for national action has carried over into New Hampshire cities and towns in a unique way. All of New England – but especially the more rural areas – has clung for more than 300 years to the "Town Meeting" form of governance. Perhaps the leading US example of direct democracy, Town Meetings of all citizens are convened yearly to authorize town activities and expenditures – and to provide a forum to air whatever issues the people wish to put forward. In practice, all manner of resolutions are offered, and debate usually goes on into the early morning hours. Within the last two years, 164 of New Hampshire's towns (about two-thirds of the total of 234) have passed resolutions urging the U.S. President and Congress to establish GHG emissions reduction programs. Although it is of course well recognized that such resolutions have no legal effect, the towns have wanted to put their voice before national policy-makers, and want it to be heard outside the realm of partisan politics (about three-quarters of these towns are Republican).

Though dominated by towns, New Hampshire also has a few cities (the largest with a population of 100,000) that grew out of "mill towns" from the textile manufacturing boom of the 19th century. Today, as textiles have been abandoned, most cities are trying to move into technology-based sectors, in which environmental considerations are a central strategy. Thus, seven "Cool Cities" (referring both to lowering the carbon footprint and to their allure) have signed and developed plans to implement the US Mayors' Climate Protection Agreement. Typically, these include Energy Action Plans to educate the citizenry, overall targets for GHG reductions, and the use of municipal facilities as test and demonstration sites to help educate the citizenry.

At the State government level, there has been a similar impetus. For example, in March, 2007, the Legislature sent a formal Resolution to Washington, to the President, and to all State representatives, urging them to take action on climate change. Even politicians not previously known as pro-environmental appear to have heeded this voice. More concretely, a Renewable Energy Act was passed by the Legislature in 2007, which requires all utilities to use 25% renewable energy by 2025. The implementation of this requirement will be made in cooperation with the ISO, who will examine facilities and issue "Renewable Energy Certificates" to document progress. Lastly, the Governor has just established a Climate Change Policy Task Force, to assess the current situation in the state and the possibilities for the future.

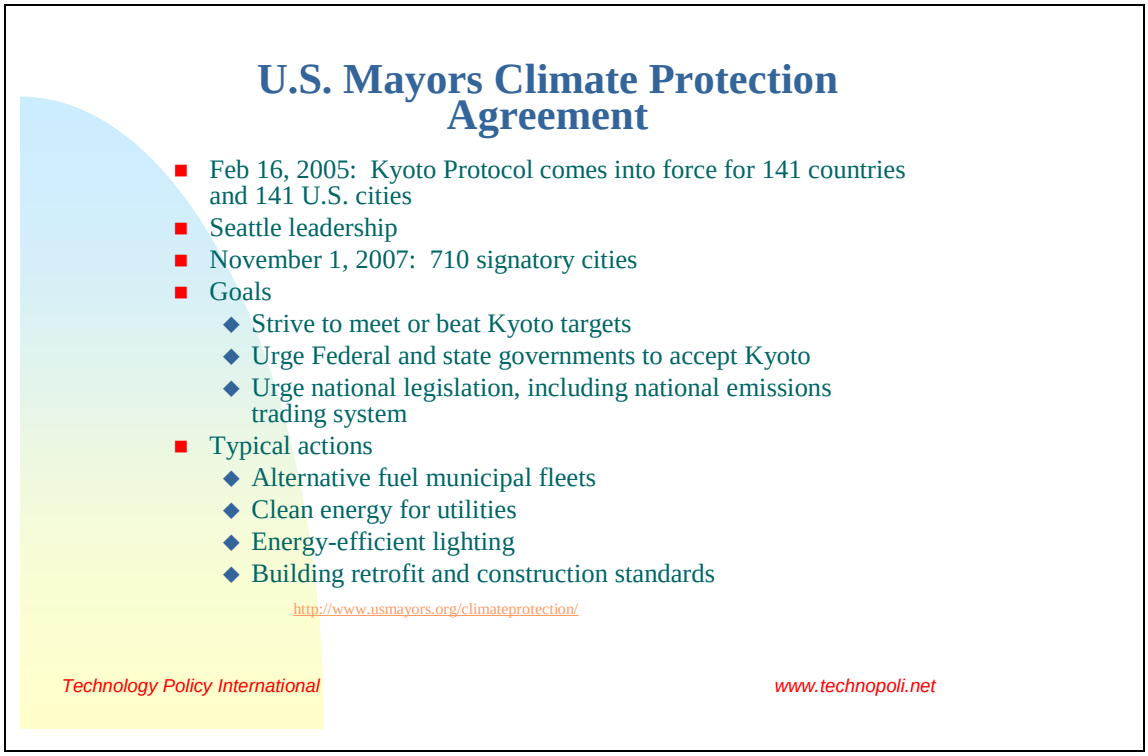
At the regional level, New Hampshire has for some time been a member of the New England-wide Regional Greenhouse Gas Initiative (RGGI). It has been participating in the development of a "Model Rule" for GHG reductions and emissions trading that should soon be unveiled and adopted. Lastly, a voluntary GHG emissions census – the Eastern Climate Registry – is just getting underway in the industrial sector.

3.4 Initiatives in U.S. Cities

Beginning a decade or so, a number of U.S. cities began to express their concern for the problem of climate change. By and large, these cities are ones characterized by a high degree of education and environmentalism, and have been located mostly on the West Coast and in the Northeast. Since then, the movement has spread, resulting in hundreds of climate change action plans throughout the country. While people in these cities realize that their actions alone are of no physical consequence in mitigating climate change, the fact that they choose to undertake them is consistent with the American tendency to emphasize grassroots beginnings to the solutions to large problems. Indeed, it is probably the American cities that are leading the country in this respect.

The diversity and number of climate change initiatives in urban areas makes it virtually impossible to survey them fully. So does their constantly changing nature.

What is attempted here instead is a focus on three examples: the U.S. Mayors Climate Protection Agreement, which represents the highest degree of coordination to date; the climate change plan of the City of New York, which is the Nation's largest; and the energy action plan of the City of Newton, Massachusetts, which typifies smaller-scale activism.



Credit for the initiative that has resulted in the U.S. Mayors Climate Protection Agreement is usually given to the Mayor of Seattle, WA, Greg Nickles.[7] The City of Seattle has long been in the forefront of environmental consciousness, and Mayor Nickles was able to capitalize on this by spearheading what has now become a national movement. After modest beginnings early in the decade, the mayor's initiative launched its most dramatic action on February 16, 2005. On this day, when the Kyoto Protocol came into force for 141 countries, 141 U.S. cities also "signed" the Protocol. Although it was well-recognized that cities have no standing to take any actions in the international legal context, their mass endorsement of the climate change regime was an important symbolic act. Its persuasiveness may be seen in the

[7] http://www.seattle.gov/mayor/climate/

fact that by November 1, 2007, a total of 710 U.S. cities had signed the Mayors Agreement.

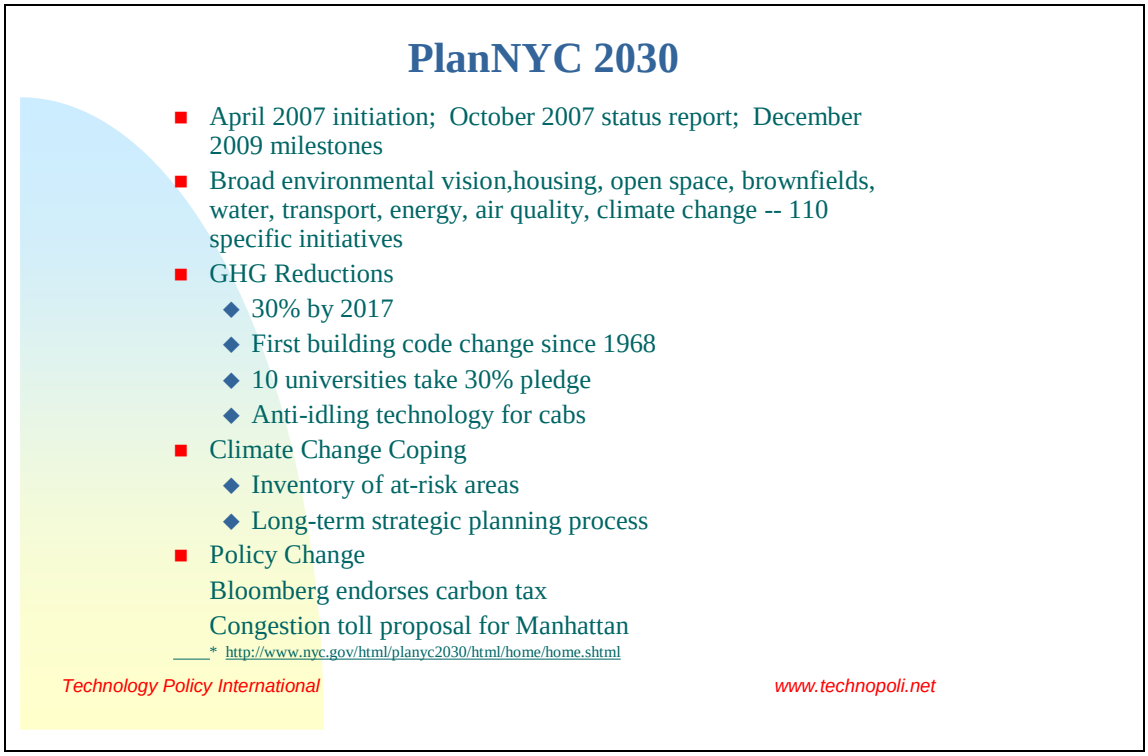
The Mayors Agreement relies both on certain standard provisions that all signatories agree to, and the possibility of widely disparate further actions. The three standard provisions are:

- A pledge to work to meet or exceed the Kyoto targets in their own jurisdictions (i.e. 7% GHG reduction by 2012, compared to the baseline of 1990)

- Urging both the states and the Federal government to accept the Kyoto Protocol

- Lobbying for national GHG emissions legislation, including a national emissions trading system.

Beyond this, most of the municipalities have established their own particular plans, which typically include such actions as: alternative fuels for municipal vehicle fleets; clean energy goals for utilities; energy-efficient lighting; building retrofit; and new, green construction standards.



The most comprehensive and ambitious plan of any U.S. city has probably been mounted by New York City. The result of a fairly long planning process set in motion by Mayor Bloomberg, "Plan NYC 2030," was initiated in April 2007. In October 2007, a six-month status report was released, and the first milestones of accomplishment are targeted for December 2009.

Plan NYC 2030 goes far beyond the mayors agreement on climate change. Its purpose is to articulate a broad environmental vision for the City, covering issues such as housing, access to parks, open space, transport, and air quality, as well as climate change. Across all the component areas, one hundred ten discrete initiatives are proposed.

In the area of climate change, the plan takes three broad approaches. First, there are various GHG reduction strategies that the City intends to pursue on its own, which are estimated to result in a 30% decline in GHG emissions by 2017. Some require sweeping legal change – such as the first building code revision since 1968. Others involve the private non-profit sector; for example, 30 universities have pledged 30% reductions in their own operations.

A second major component of the plan is based on the realization that New York is highly vulnerable to the global effects of climate change – particularly sea-level rise – and there is essentially nothing to be done but cope. Thus, the City is now undertaking and inventory of those areas most at risk, and implementing a long-term planning process to mitigate the danger.

Lastly, the Bloomberg Administration has been aggressive in recommending policy changes, not only for itself, but also for the State of New York and the U.S. Generally speaking, the strategies endorsed by New York rely on economic incentives. Specifically, the Mayor speaks consistently in favor of a national carbon tax. In addition, a proposal is on the table for congestion tolls for Manhattan. While the Federal government (that is, the U.S Department of Transportation) has been supportive of this idea, its future is very much in doubt, as it requires authorizing legislation at the state level, and this has not met with much enthusiasm thus far.[8]

The City of Newton, MA is a suburban community of about 80,000 residents, bordering on Boston. For many years, Newton has been among the most environmentally conscious cities in Massachusetts, and within the last five years has embarked on an Energy Action Plan, which went into effect in 2005. Its goals are to reduce GHG by 7% by 2020, over the 1998 base year, to reduce the municipal sector GHG emissions by 20%, and to establish an Energy Office and municipal investment fund, which will support investments in energy-saving technologies.

[8]The congestion tolls initiative failed to get enough support to be considered in the New York legislature and, as of April 7, 2008, there appears little likelihood that it will be adopted. See: Nicholas Confessore, "$8 Traffic Fee for Manhattan Gets Nowhere," *The New York Times*, April 8, 2008.

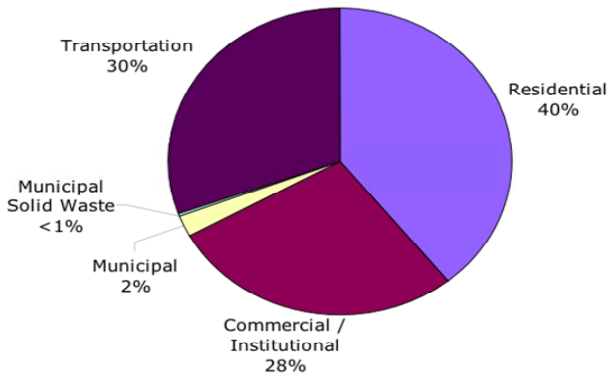
City of Newton, MA Energy Action Plan

- Initiated February 2005
- Goals
  - Reduce energy/GHG 7% from 1998 level by 2020
  - Reduce municipal sector GHG 20%
  - Energy Office/Investment Fund
- Strategies
  - Purchase renewable elec. 16,100 ton GHG reduction
  - Building energy efficiency 68,000 ton
  - Energy distribution 20,450 ton
  - Transportation 36,000
  - Reduce solid waste 1,000

*http://www.ci.newton.ma.us/sunergy/EAP021005.pdf

Technology Policy International www.technopoli.net

City of Newton, MA 2002 GHG by Sector

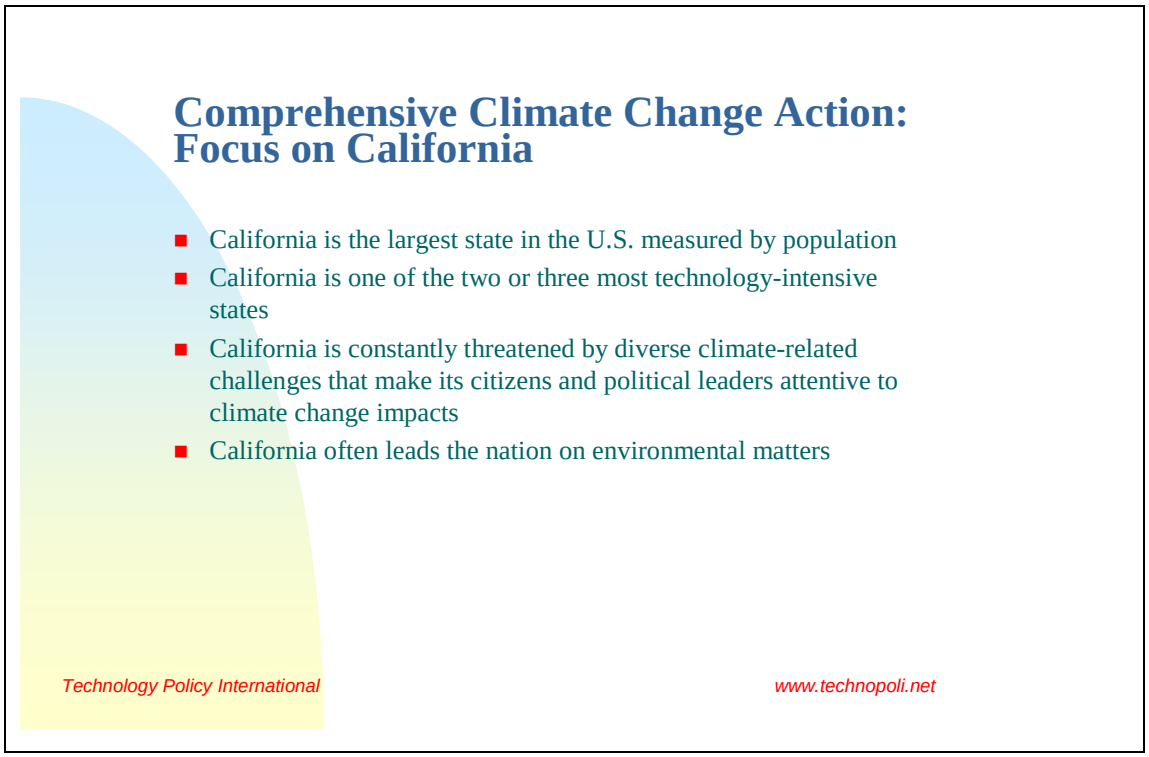


Technology Policy International www.technopoli.net

While Newton and its citizens are highly committed to the Energy Action Plan, the problem it, and other similarly small-sized communities, face is that it is hard to accomplish much. As shown in the attached chart, about a third of Newton's GHG emissions are from transportation, over which it has virtually no control. The

residential component -- even larger at 40% -- consists largely of old housing stock, whose energy
profile cannot change quickly. In addition, since building codes are promulgated by the state of Massachusetts, it is hard for Newton or other communities to make much headway. Still, Newton has made its goals very specific in terms of tons of GHG to be reduced. Whether or not it is able to achieve them will offer a meaningful example to other communities.

4. TECHNOLOGY DIFFUSION ACTIVITIES IN CALIFORNIA



4.1 Introduction

California is the world's fifth largest consumer of energy.[9] Today it is also a leader in reducing greenhouse gas (GHG) emissions, and home to many efforts that use existing technologies to help reduce these emissions. The best-known initiative comes from the state government, the ambitious Global Warming Solutions Act of 2006. But in addition to this and other important "top-down" efforts by the state government, California also has many "bottom-up" activities by local governments, private companies, entrepreneurs, and non-profit organizations. Together, these efforts are using three types of existing technologies to reduce GHG emissions: energy-efficient products, low-pollution renewable energy sources, and pollution-control technologies. This paper can only briefly introduce these various initiatives, but together they show that California is beginning a huge and important experiment in reducing GHG emissions.

---

[9]California Energy Commission, "California Energy Commission – An Overview," http://www.energy.ca.gov/commission/overview.html

4.1.1 Background: California's Attitudes Towards the Environment and Towards Technology

Why has California begun such an ambitious effort to reduce GHG emissions? The main reason is that a strong political coalition wants to protect the environment. At the same time, important political, cultural, and business factors lead California to emphasize technological solutions as the most acceptable way to meet these environmental goals.

4.1.2 A Strong Political Coalition in Favor of Environmental Protection

Politically, Californians in general are pro-environment.[10] The pro-environment attitude comes not only from living in a beautiful state but also from a deep sense of vulnerability. Nature can be threatening in California, causing water shortages, fires, landslides, earthquakes, eroding coastlines, and invasive species. In addition, we have human-made pollution. Climate change seems like a real possibility to many Californians, because they have seen nature's fury and environmental degradation.

Moreover, specific groups and political actors have helped to build a strong political coalition in favor of dealing with global warming. Many Californians are Democrats who are generally pro-environment and also comfortable with government activism. Democrats control the state legislature. At the same time, California now has a moderate, pro-environment Republican governor, Arnold Schwarzenegger.

In addition, major California industries do not oppose environmental protection. California has no coal industry, only a small remaining oil industry, utility companies that are comfortable with energy efficiency and renewable energy, and many manufacturing and service companies that see energy efficiency as a way to reduce costs.

Finally, the pro-environment coalition in California includes many entrepreneurs and research institutions, which not only care about the environment but also hope to create new companies and jobs from "clean-tech" ("clean technology," also known as "green tech"). Californians in Silicon Valley and elsewhere see a business opportunity in clean-tech – and in government regulations that encourage people to adopt clean-tech technologies (both existing technologies and possible future ones). Like Japan, California hopes to be a world leader in this business. One might almost say that clean-tech is the latest in California's long history of "gold rushes," where entrepreneurs and investors rush into businesses that they hope will

[10]For one perspective on the attitudes of Californians regarding environmental policy, see: Mark Baldassare, *et al*, *Californians & the environment*, Public Policy Institute of California, July 2007, http://www.ppic.org/content/pubs/survey/S_707MBS.pdf

lead to huge profits. This hope may be exaggerated, but of course California does indeed have superb capabilities in research, technology, and entrepreneurship. Clean-tech in fact could be California's next great industry.

4.1.3 Political, Cultural, and Business Factors That Emphasize Technological Solutions to Global Warming

At the same time, however, Californians have political, cultural, and business reasons to emphasize technological solutions to global warming, instead of changes in life styles.

Politically, Californians do not like higher taxes or significantly higher consumer prices. Environmental protection is fine so long as it does not cost too much. So, for example, proposals for higher gasoline taxes or expensive new investments in public transportation generally are unpopular. In this political environment, people like the idea that technologies – both existing ones and future ones – will "save the planet" without imposing big costs on citizens.

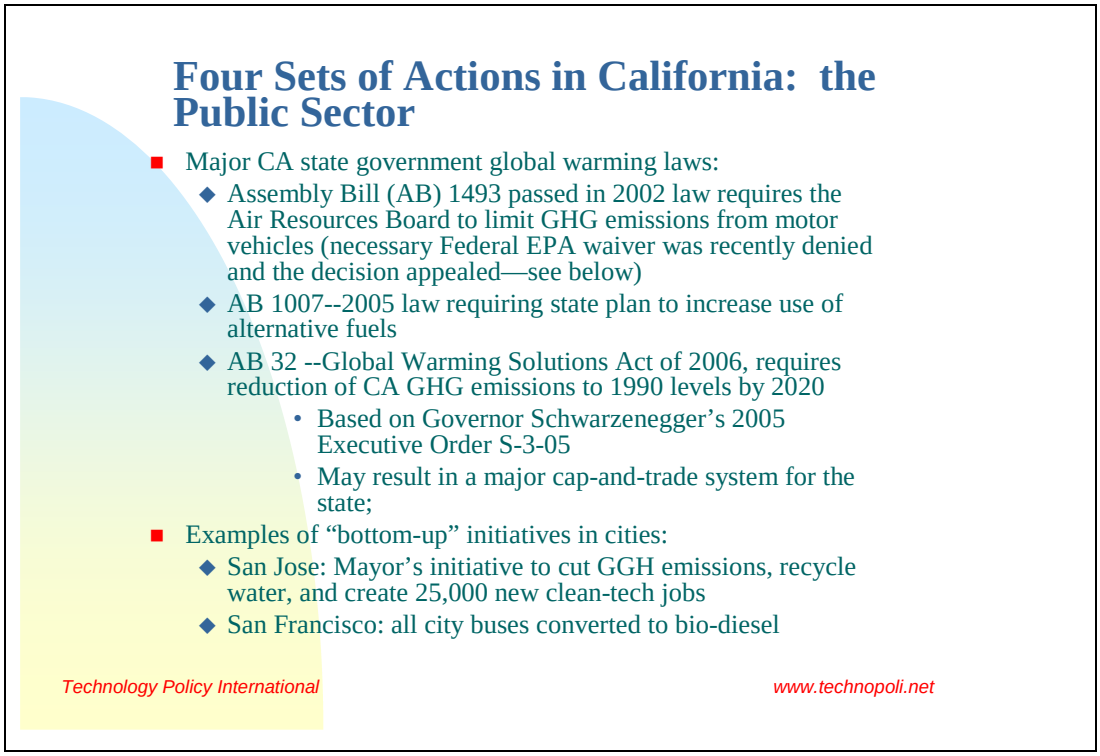
These political attitudes are related to a California culture that makes technology a particularly attractive tool for reducing GHG emissions. That culture has two important features. First, many Californians are highly individualistic and do not want to change their "life styles." For example, Californians like their cars and do not want to give them up, and many residents like living in suburbs. So proposals that would change how people live or change land-use patterns often encounter cultural – and political – resistance. In this culture, it is easier to persuade people to use technologies that improve cars than to persuade them to give up their cars. Second, many Californians are comfortable with new technologies and willing to try them. One example is the large number of Toyota Priuses sold in the state.

Finally, California companies eagerly tell citizens that new products based on advanced technology can save the planet. For example, California has an increasing number of companies that manufacture and install solar panels. Tesla Motors, a start-up company in Northern California, is manufacturing an electric sports car.

4.1.4 The Resulting Bias Towards Technological Solutions

In summary, California has a powerful political coalition in favor of actions to reduce GHG emissions, and it has powerful political, cultural, and business reasons to use technology – as opposed to changes in life styles – as the primary policy instrument for reducing those emissions. California's current policies regarding technology diffusion reflect this underlying attitude.

4.2 Four Sets of Actions That Promote Technology Diffusion



4.2.1 State Government Initiatives

For many decades, California's state government has successfully regulated air pollutants,[11] promoted energy conservation,[12] and promoted clean energy sources.[13]

Recently, the state government has taken several important regulatory steps to reduce GHG emissions: a 2004 ARB "greenhouse gas" rule (the first in the US) that requires automakers to begin selling vehicles with reduced GHG emissions by model year 2009; a 2006 law, Assembly Bill (AB) 1811, on alternative fuels; and most

---

[11]State regulation of air pollutants began with a 1947 California law that authorized the creation of an air pollution control district in every county of the state and a 1959 law that required air quality standards and controls for motor vehicle emissions. In 1967, the Federal Air Quality Act allowed the State of California a waiver to set and enforce its own emissions standards for new vehicles, and that same year Governor Ronald Reagan signed state legislation that established the California Air Resources Board (ARB), the state's air quality regulator. In 1975, ARB required the first two-way catalytic converters in cars, in 1976 it limited lead in gasoline, and in 1988 it required that cars be equipped with on-board computer systems to monitor emission performance. Source: Air Resources Board, "California's Air Quality History Key Events," http://www.arb.ca.gov/html/brochure/history.htm More recently, the ARB has required car companies to sell thousands of "zero-emission" vehicles (hydrogen or electric) and hybrids. See, for example, Joseph B. White, "Getting All the Carbon Out of Cars," *The Wall Street Journal*, April 7, 2008.

[12]California has long been a leader in energy conservation, especially for household appliances. See, for example, Arthur H. Rosenfeld, Commissioner, California Energy Commission, "California's Success in Energy Efficiency and Climate Change: Past and Future," May 24, 2007, http://www.energy.ca.gov/2007publications/CEC-999-2007-026/CEC-999-2007-026.PDF

[13]California has also long pursued clean energy sources for electrical generation. This is partly a matter of geography: mountain rivers offer opportunities for dams and hydroelectric power, and volcanic areas provide limited but important opportunities for geothermal power. But air pollution considerations have also driven California's decisions. It is hard to avoid using gasoline in motor vehicles, so that the state has sought to reduce air pollution by using clean sources of electricity. California does not use coal or oil for its power plants – although it imports some coal-produced electricity from other states. California prefers natural gas, some nuclear power (controversial in California), hydroelectric power, some wind power, and most recently distributed renewable sources, particularly solar panels on California homes and buildings that now plug into the California electrical grid. For an overview California's sources of electricity, see California Energy Commission, "California's Major Sources of Energy," http://www.energy.ca.gov/html/energysources.html

importantly 2006's AB 32, the California Global Solutions Act.[14]

Under AB 32, the ARB will issue and enforce regulations to reduce California's 2020 GHG emissions to 1990 levels, a reduction of about 29 percent from what the 2020 levels would otherwise be. The ARB is now writing a draft plan, and will then issue regulations that will start taking effect in 2010. As part of these regulations, it probably will create a major cap-and-trade system to control emissions. The ARB is now consulting with stakeholders and technology experts to develop its plan and regulations.[15]

California's GHG emissions come primarily from four sources: transportation (41.2 percent of total emissions in 2002); industrial (22.8 percent); electric power (19.6 percent); and agriculture and forestry (8.0 percent). The ARB regulations will try to reduce emissions from all four sources.

One important point is that California's government is not relying just on emissions regulations to meet AB 32's goals. As discussed earlier, it also promotes the use of existing energy-efficiency measures and renewable-energy technologies to help meet the 2020 target. In the energy-efficiency area, for example, California has high electric prices (which have encouraged conservation and made California the most electricity-efficient state in the US); a "Green Building Initiative;"[16] and updated appliance efficiency regulations.[17] In the renewables area, it has a "renewable portfolio standard" (RPS)[18] and offers tax credits to encourage the use of renewable energy.[19] The state also funds approximately $62 million a year in energy research and development to help develop new technologies for the future.[20]

---

[14]Air Resources Board, "California's Air Quality History Key Events."
[15]The 29 percent figure comes from Lawrence H. Goulder, "California's Bold New Climate Policy: The Challenges Ahead," Policy Brief, Stanford Institute for Economic Policy Research, November 2006, http://siepr.stanford.edu/papers/briefs/policybrief_nov06.html
[16]See: http://www.energy.ca.gov/greenbuilding/index.html
[17]See: http://www.energy.ca.gov/appliances/index.html
[18]On the RPS, see: http://www.energy.ca.gov/portfolio/index.html
[19]See, for example, the California Solar Initiative. Approved in January 2006 by the California Public Utilities Commission (PUC) – with active support from Governor

Based on opportunities to use technology to reduce GHG emissions, in 2006 the California government's Climate Action Team examined how existing technologies and other steps (such as reduced driving and forestry management) could be used to meet AB 32's targets. Table 1 summarizes the Team's conclusions.[21] The Air Resources Board will now decide exactly what steps it wants to take and what regulations are necessary to implement those steps.[22]

Schwarzenegger and the California Legislature – it authorizes $3.2 billion in state funding over 11 years to offer rebates for rooftop solar systems. This program is sometimes called the "million solar roofs" initiative. See: http://www.cpuc.ca.gov/PUC/energy/Solar/ California also offers rebates on wind and fuel cell systems. See: http://www.consumerenergycenter.org/erprebate/

[20]R&D is through California Energy Commission's Public Interest Energy Research (PIER) Program. See: http://www.energy.ca.gov/pier/

[21]This table comes from Goulder and is adapted from the March 2006 report from the California Climate Action Team. For a detailed list of specific regulatory actions the ARB could take, see Air Resources Board Staff, *Expanded List of Early Action Measures to Reduce Greenhouse Gas Emissions in California Recommended for Board Consideration*, October 2007, http://www.arb.ca.gov/cc/ccea/meetings/ea_final_report.pdf

[22]It is likely that the ARB will try to write its regulations to encourage not only the diffusion of *existing* technologies but also the development of *new* innovative technologies. And of course California's research institutions and entrepreneurs hope to develop and sell these innovative technologies. For an example of how California policy analysts are thinking about the innovation topic, see: Margaret Taylor, Edward W. Rubin, and Gregory F. Nemet, "Chapter 3: The Role of Technological Innovation in Meeting California's Greenhouse Gas Emission Targets," in W. Michael Hanemann and Alexander E. Farrell, *Managing Greenhouse Gas Emissions in California*, January 2006, http://calclimate.berkeley.edu/3_Innovation_and_Policy.pdf Also see Economic and Technology Advancement Advisory Committee, *Final Report: Technologies and Policies to Consider for Reducing Greenhouse Gas Emissions in California*, a report to the California Air Resources Board, February 11, 2008, http://www.arb.ca.gov/cc/etaac/ETAACFinalReport2-11-08.pdf

Table 1
Low-Cost Reduction Opportunities Identified by the Governor's Climate Action Team

Source	Potential Reductions in 2020*
Vehicle Greenhouse Gas Emissions Standards**	30
Incentives to Reduce Vehicle Miles Traveled and Encourage Use of Low-Carbon Fuels in Vehicles	39
Policies to Reduce Emissions of Hydrofluorocarbons and Perfluorocarbons (two greenhouse gases)	11
Waste Reduction and Landfill Methane Capture Programs	6
Forest Management, Aforestation, Fuels Management, and Related Measures	34
Statewide Building, Appliance, and Tire Efficiency Standards	11
Municipal Utilities: Increasing Efficiency and Renewable Energy Programs, Reducing Coal Imports	19
Public Utilities Commission: Renewable Energy Programs	14
Public Utilities Commission: Efficiency, Combined Heat and Power, and Carbon Programs	22
Other	4
Total	**190**
Estimated Required Reduction under AB32	**174**

* Units are millions of metric tons of carbon dioxide equivalents.

** These standards were imposed in Assembly Bill 1493, which passed in 2002. This bill is currently facing a court challenge.

Adapted from *Climate Action Team Report to Governor Schwarzenegger and the California Legislature*, California Environmental Protection Agency, March 2006.

4.2.2 Examples of "Bottom-up" Initiatives from Local Governments

As in other parts of the United States, dozens of California cities have initiatives to reduce energy use and GHG emissions. These initiatives can include green buildings, more solar energy, less polluting vehicles, improved public transit, and other steps. Because this chapter must be brief, we will cite just two examples. One is modest, and the other is very ambitious.

The modest but valuable example comes from San Francisco, where in November 2007 the city completed its yearlong project to convert all of its public buses to biodiesel fuel. The buses are now using soy oil bought from producers in the American Midwest.[23]

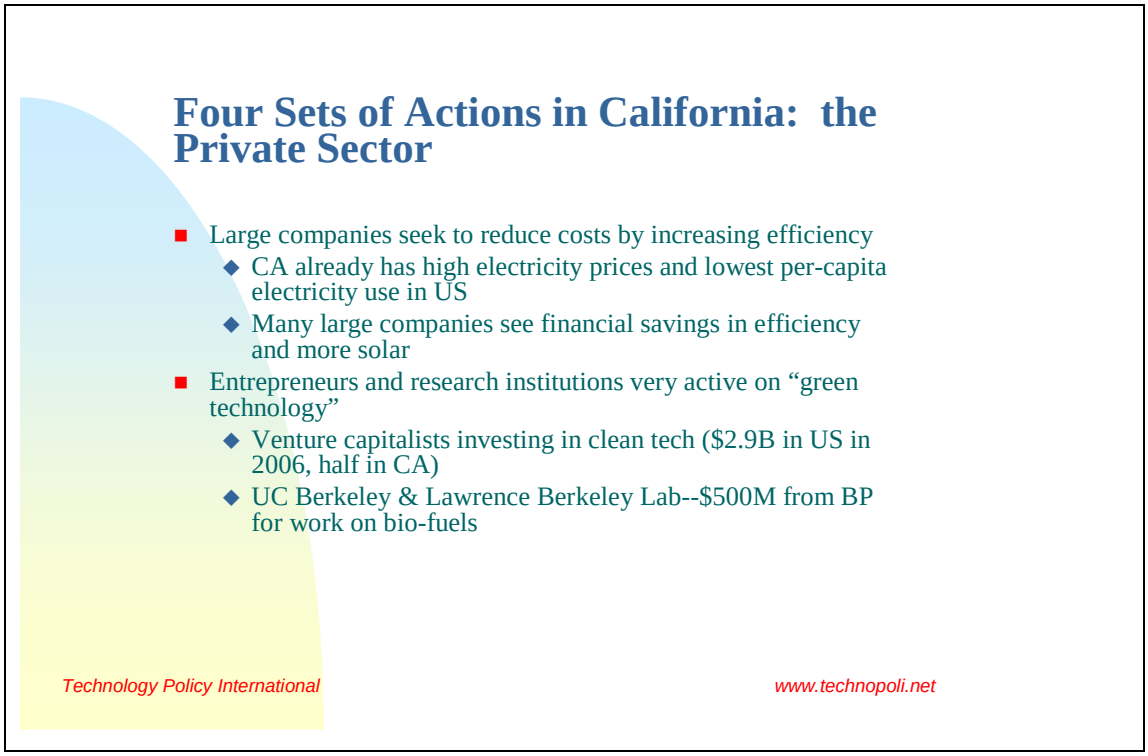
The ambitious example comes from San Jose, California. In October 2007 Mayor Chuck Reed announced his "green vision," which calls on citizens to drastically cut energy use, proposes that the city to get its energy from renewable sources, and envisions 25,000 new clean-tech jobs by 2022, mostly from the solar industry. That number sounds high, but already Silicon Valley is becoming a major center for the US solar industry.[24]

4.2.3 Examples of Initiatives from Utilities and Other Private Companies

One of the most important features of California's energy policy allows and encourages electrical utility companies to push for conservation and efficiency and still earn good profits. Traditionally, the more electricity a utility sold, the more profit it made. California has changed that policy, giving rewards to utilities for promoting efficiency. This method for utility profits combines with California's high electricity costs to give the state the lowest *per capita* energy use in the United States. And if one looks at Web sites for California utility companies, they are full of information on how to conserve.[25]

---

[23]Carolyn Marshall, "San Francisco Fleet is All Biodiesel," *The New York Times*, December 2, 2007.
[24]Matt Nauman, "San Jose mayor unveils green vision, *San Jose Mercury News*, October 5, 2007.
[25]See, for example, Pacific Gas and Electric's home page for residential users ("for my home"), at: http://www.pge.com/myhome/



In addition, many of the large California companies that use electricity also emphasize energy efficiency and renewable energy. Energy efficiency, of course, saves money, and this is an important reason for efficiency programs within company offices and factories. In addition, creating energy-efficient products can also help companies with their sales. Hewlett-Packard is an example of both points: it is reducing its own electrical use and GHG emissions,[26] and it emphasizes the benefits of its new energy-saving personal computers, workstations, and servers.[27] As for renewable energy,

Google has launched an ambitious program to place large numbers of solar panels on its buildings.[28]

Many general manufacturing companies in California are concerned that AB 32 may lead to higher energy prices. In August 2006, for example, the California Manufacturers and Technology Association (CMTA) described the proposed AB 32

[26]See: http://www.hp.com/hpinfo/globalcitizenship/environment/operations/climate.html
[27]See: http://www.hp.com/hpinfo/globalcitizenship/gcreport/energy/products.html
[28]Information on the Google Solar Panel Project is available at: http://www.google.com/corporate/solarpanels/home?gsessionid=rCu5FT5iygU.

as a big risk to the California economy.[29] But after AB 32 became law, the Association-affiliated "AB 32 Implementation Group" began working with the Air Resources Board. Today, the Association is still concerned about how AB 32 regulations might hurt California business, but it is also now very interested in creating and retaining "green-collar jobs" – jobs in the clean-tech sector.[30]

4.2.4 Entrepreneurs, Research Institutions and Non-Profit Organizations

In California, many venture capitalists, university professors, and entrepreneurs hope that clean-tech is "the next big thing" – the next big technology-based industry. They want California to lead the way in the creation of new companies, jobs, and profits. California is in an excellent position to develop new clean-tech companies: it has world-class research institutions (e.g., the University of California at Berkeley, Lawrence Berkeley National Laboratory (LBNL), and Stanford University), venture capitalists, and a tradition of entrepreneurship. The San Francisco Bay Area, for example, has important research programs in biofuels – some supported by $500 million that BP gave UC Berkeley and LBNL for biofuels research – and several new companies making photovoltaic solar panels.

And the venture capitalists are investing large amounts of money in clean-tech: in 2007, venture capitalists invested $1.79 billion in California clean-technology companies (compared to $1.18 billion in 2006), with $1.05 billion of that amount invested in Silicon Valley (compared with $509 million in 2006). (Overall North American venture investments in clean-tech in 2007 were $3.95 billion, compared with $2.87 billion in 2006.)[31]

---

[29]See: http://www.cmta.net/coalition_event.php?coalition_event_id=17

[30]See Gino DiCaro, "Green tech jobs need stimulus despite – and because of – AB 32," February 29, 2008, blog posting, http://www.cmta.net/mpowered_blog.php

[31]Matt Nauman, "'Green" energy cleans up in '07," *San Jose Mercury News*, January 18, 2008. It is not clear, however, whether Silicon Valley start-up companies or large established companies will be most successful in clean-tech businesses. For an interesting discussion of this issue, see: Emma Duncan, "Cleaning up: A special report on business and climate change," *The Economist*, June 2, 2007.

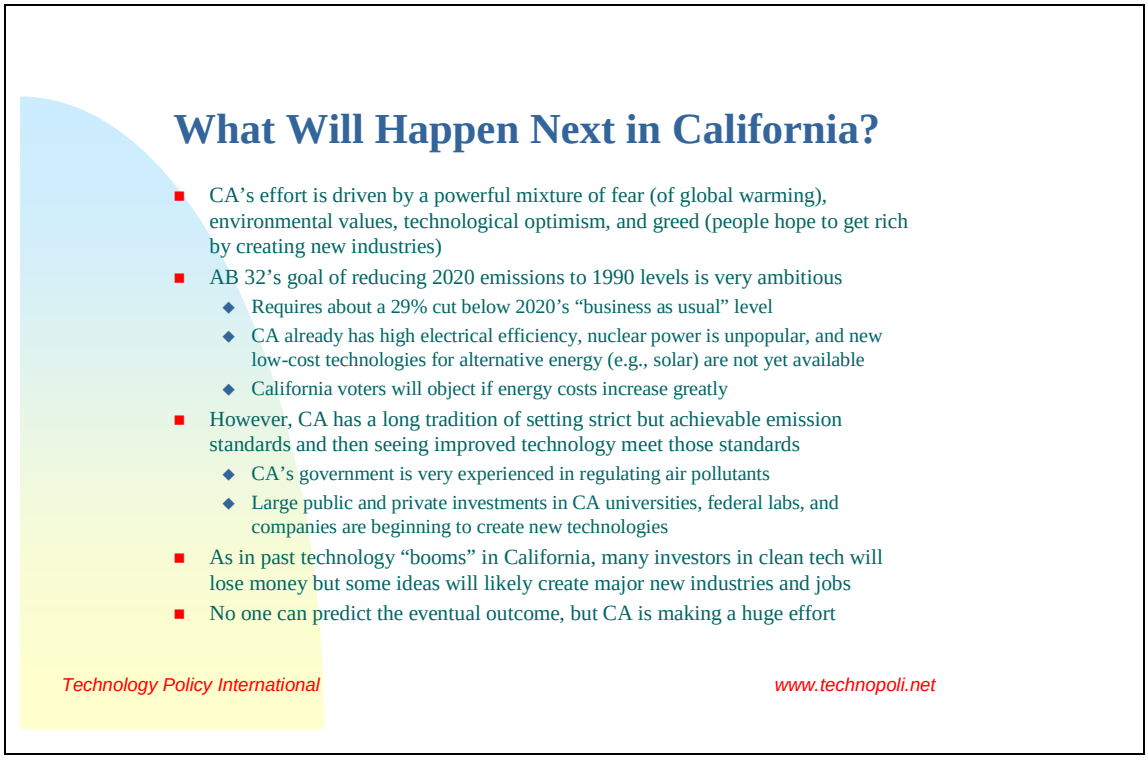
California also has non-profit groups that promote energy efficiency and renewable energy. Some are environmental groups and other policy-oriented organizations that provide political support for AB 32 and similar policies. But California also has non-profit groups focused on technology. These are generally enthusiastic people who believe that some technological change will help, and they want both to prove the technology and to build public awareness. For example, the California Cars Initiative ("CalCars") supports the idea of plug-in hybrid electric vehicles. They convert hybrid cars, especially the Toyota Prius, into plug-in vehicles.[32]

4.2.6 Interactions Among These Groups

One important point is that the "top-down" actions of California state regulators and the "bottom-up" initiatives of cities, companies, entrepreneurs, researchers, and non-profit organizations are not separate and unconnected. In California, these groups all talk to each other and learn from each other. In particular, the Air Resources Board and other state government officials have advisory committees and open meetings in which they hear the ideas and concerns of major groups. So, for example, the ARB will hear what Pacific Gas and Electric, Hewlett-Packard, Google, and start-up companies have learned about the most effective and least costly ways of reducing GHG emissions. And economists and technology experts from California's universities will provide valuable information and analyses. California has developed a type of "policy and technology ecosystem" that will help as the state implements AB 32.

4.3 What Will Happen Next in California?

[32]The CalCars Web page (www.calcars.org/about.html) has this description of the group: "The California Cars Initiative (CalCars.org) is a Palo Alto-based nonprofit startup of entrepreneurs, engineers, environmentalists and consumers promoting 100+MPG plug-in hybrid electric vehicles (PHEVs). Somewhat uniquely, we're ourselves a hybrid, focusing both on public policy and technology development, and harnessing buyer demand to help commercialize PHEVs. We're building demand among highly receptive markets to encourage auto makers to produce 100+MPG 'no-sacrifices' high-performance, clean hybrid cars." In the history of the California computer industry, similar non-profit groups eventually help create important companies (such as Apple); that may also happen with clean-tech.



California's AB 32 goals are extremely ambitious, and particularly ambitious because Californians want to reduce global warming without incurring higher taxes, significantly more expensive energy, or big changes in their life-styles. In addition, California faces a huge challenge because of its steady rise in population. The state currently has 36 million people. By 2025, it could have 50 million people – and with them more cars, more power plants, and more of every other source of GHG emissions.

But along with these challenges, California also has three great strengths.

First, it has – at least today – a strong political coalition that wants to fight global warming. This coalition is driven by a mixture of love for California's natural beauty; fears that global warming might lead to less water, more fires, and an eroding shoreline; and the greed and ambition that comes from wanting to create the next big American industry.

Second, California has capable and confident environmental regulators. Californians, like other Americans, are often cynical about government and, as discussed above, they do not want higher taxes. But the Air Resources Board, the

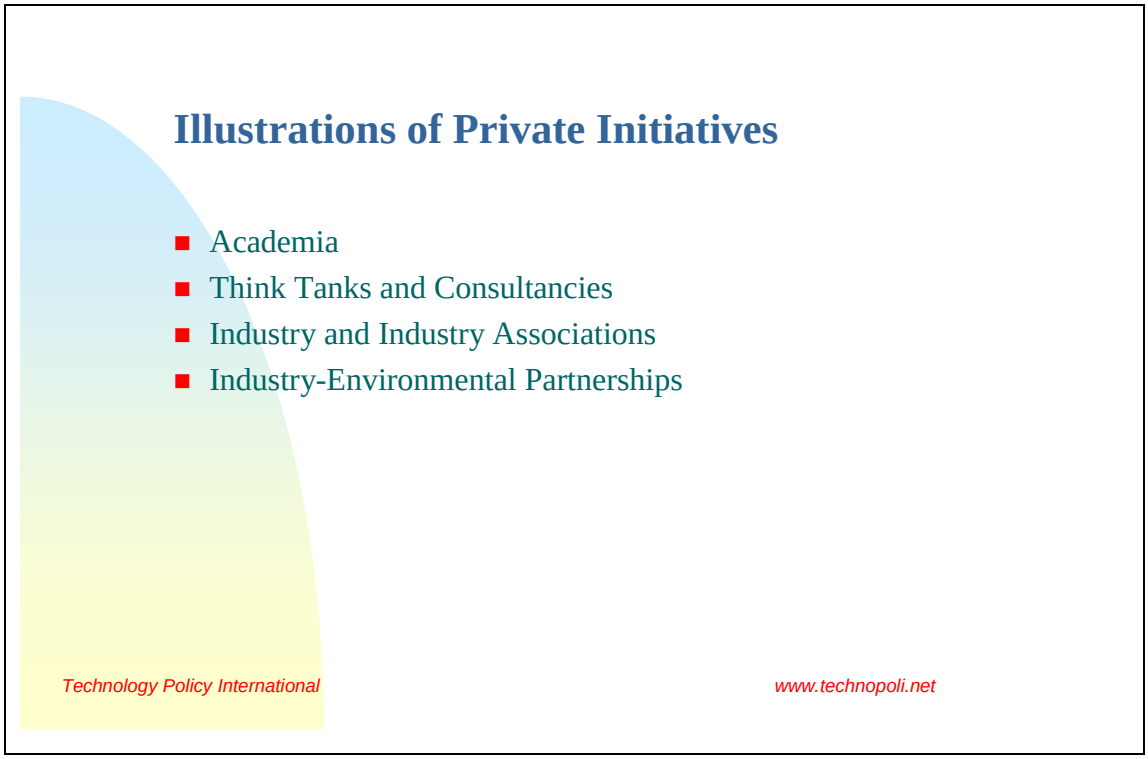
California Energy Commission, the Public Utilities Commission, and other California agencies have decades of experience in understanding technology and setting successful regulations.

Third, the state's researchers, venture capitalists, and entrepreneurs have a long tradition of understanding existing technologies, creating new ones, and building companies around both types of technology. If, as this section has suggested, Californians see technology as the preferred solution to global warming, then at least the state has major technological capabilities.

5. ILLUSTRATIONS OF PRIVATE INITIATIVES

5.1 Introduction

The United States is experiencing a "boom" in private sector initiatives to respond to the challenge of climate change and the demand for energy conservation. Even though the Federal government has not been aggressive in adopting or implementing climate change-related public policies (other than support for research and technology development), private interests across the spectrum from academia to major energy companies have taken steps to improve their own energy efficiency performance and to promote the more efficient use of energy and reduction of GHG emissions by their employees, customers and suppliers.



In this section, we review some illustrative examples of activities in academia, by think tanks and consulting firms, and in both individual companies and industry associations. We also note the growing trend toward alliances between industrial and environmental organizations – who are, of course, traditionally in opposition on many fronts – to promote energy efficiency and the control of GHGs.

5.2 Engagement of Academia

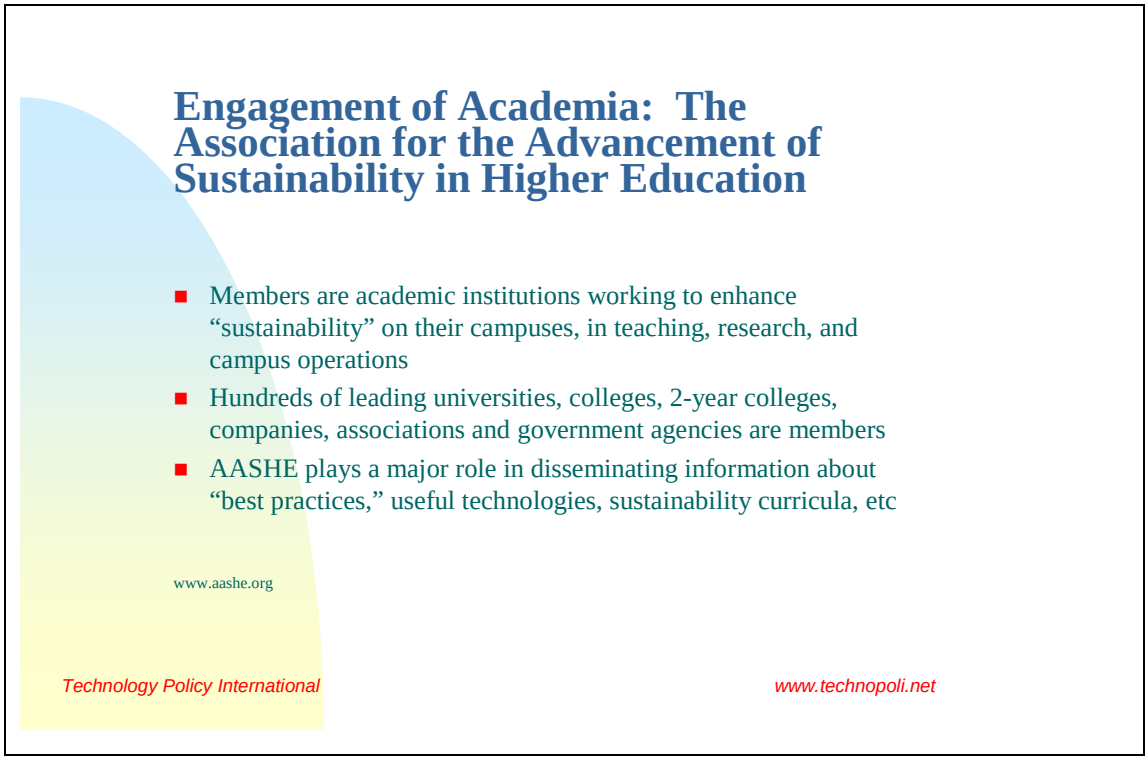
Many individual universities have made commitments at the institutional level to incorporate environmental sustainability, energy efficiency and climate change response into their teaching curricula, their research portfolios and their own operations. Such institutional commitments are not common in U.S. universities; more typically universities try to limit their engagement in social and political issues. Instead, such engagement is usually carried out by individual faculty members and students and by student organizations. It is a measure of the seriousness with which university administrators perceive the threat of damage to the environment that sustains life itself from GHG emissions and energy consumption that presidents and supervisory boards of universities have taken public positions in support of action.

One such example is the "American College and University Presidents Climate Commitment." More than 175 institutions, including some of the largest and most prestigious, have signed onto a commitment to plan for making their own campuses "climate neutral" as soon as possible. Even sooner than that they have

committed to making immediate reductions in their GHG emissions or at least in their "carbon footprint" by investing to reduce energy use, by fuel switching, and by purchasing carbon offsets on world markets. They have also agreed to be held accountable for accomplishing their commitments by publishing periodic reports on their institution's progress. In order to move the Commitment beyond rhetoric and into action, the organization disseminates guidelines to its members on concrete action they can take to reduce their climate impact.

Higher educational institutions are large, expensive and financial stressed in most cases. Because many of them budget separately for operating costs and for capital investments, they are not always well-positioned to make rational life-cycle-based decisions about energy-related investments. For these reasons, as a group they offer attractive opportunities for improving performance through the adoption of climate-saving measures and investments that will more than compensate for their up-front costs. Technology diffusion incentives and information may, therefore, be particularly effective in helping this large and important sector to upgrade its facilities and practices.

The Commitment's web site (www.presidentsclimatecommitment.org) includes long lists of companies, organizations and associations that have endorsed this action by the universities, including, importantly, such organizations as the National Association of College and University Business Officers, whose members typically oversee campus operations.

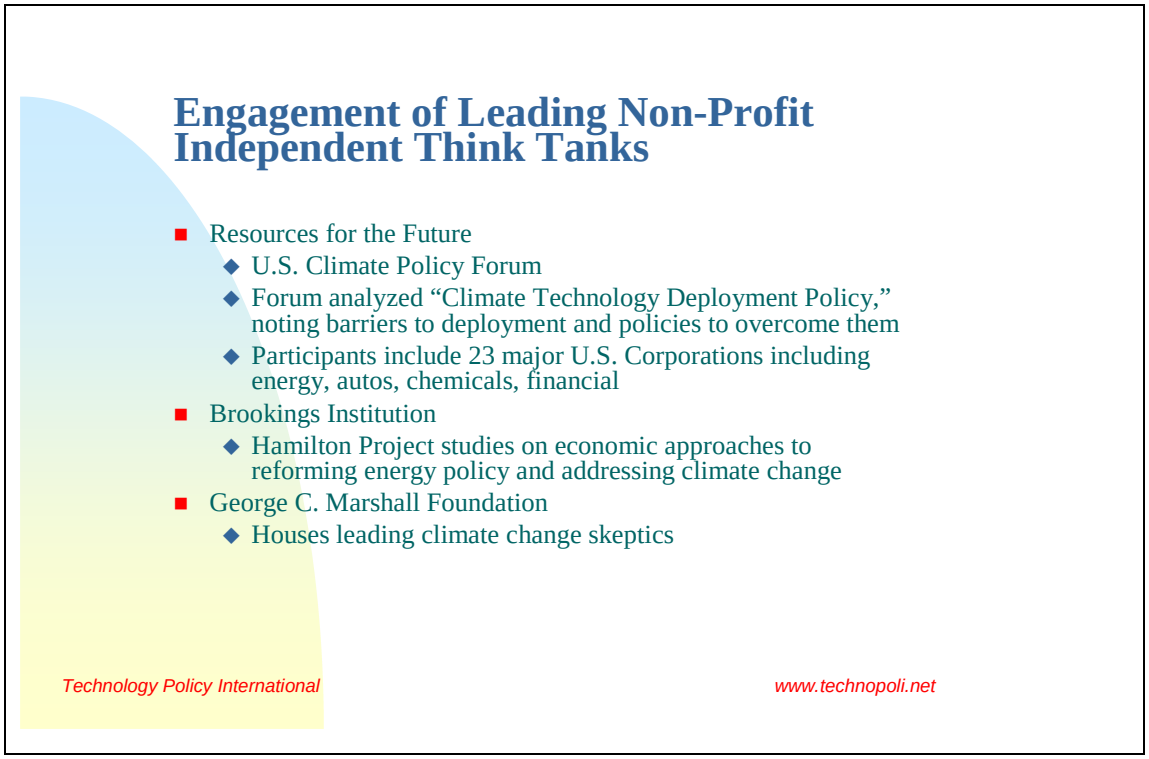


Another illustration of the engagement of academia in the field of climate change response is the new Association for the Advancement of Sustainability in Higher Education (AASHE). It has hundreds of member institutions including universities, colleges, two-year colleges, companies, associations, and government agencies that are working to enhance sustainability on academic campuses. AASHE plays an important role in disseminating best practices and information about useful technologies, as well as curricular materials. Thus, one of its core functions is to encourage diffusion of more efficient, existing technologies to the higher education sector.

5.3 Engagement of Think Tanks and Consultancies

It is characteristic of the U.S. policymaking system that the nation's vast array of non-profit think tanks and profit-making consulting firms produce numerous studies and analyses of any and every newly recognized policy problem that comes along. Interest groups establish their bona fides in part by commissioning studies that purport to establish a factual basis for promoting policies that would serve their needs.

Climate change policy is no different from other policy areas in this respect. Many organizations have produced or are producing studies in this area. For example, the National Research Council of the National Academies of Science and Engineering and the Institute of Medicine has embarked on a major new comprehensive study of energy policy emphasizing responses to global environmental challenges. This committee for this study, which is entitled, "America's Energy Future: Technology Opportunities, Risks, and Tradeoffs," sponsored a major national Summit on America's Energy Future on March 13 and 14, 2008.[33] A central theme of the Summit's many presentations was that a great deal of progress can be made by adoption of more efficient technologies that create less environmental and climate change damage and that are already available. In other words, most of the speakers at this high-level meeting recognized the importance of diffusing existing technologies, even as they also talked about the importance of research and development in the longer term.



Several other important studies have been made or are under way in the field of technology diffusion and climate change response. For example, the non-profit

[33]The full text and presentation materials for this summit meeting are available on line at the Summit's web site: http://www7.nationalacademies.org/energysummit/energy_summit_agenda.html

think tank, Resources for the Future, which does studies largely from an economic perspective, has established the U.S. Climate Policy Forum, with the support of some two dozen major U.S. corporations from a variety of industries. A major report of the Forum released in the fall of 2007 included an in-depth analysis of the potential for federal technology deployment policies to help overcome barriers to the adoption of improved technologies.[34]

The Brookings Institution, a long-established mainstream policy think tank, has issued three reports on climate policy options as part of its Hamilton Project that seeks to develop informed policy alternatives across a wide range of policy areas affecting economic growth and the standard of living of Americans.[35] In addition, Brookings has hosted numerous seminars and high-level workshops on topics affecting climate change, including a March 3, 2008, discussion between high-level Japanese and U.S. climate policy advisors.[36]

It would be somewhat misleading to suggest that every interest in the United States supports vigorous action to control climate change. Prominent among the groups that seek to discredit the scientific consensus on climate change is the George C. Marshall Institute in Washington DC, which issues reports from time to time on various aspects of the climate change debate.[37]

---

[34]"Assessing U.S. Climate Policy Options," November 2007. On line at: http://www.rff.org/rff/Publications/CPF_AssessingUSClimatePolicyOptions.cfm

[35]One of these is a paper by Robert Stavins on a cap and trade system (http://www.brookings.edu/papers/2007/10climate_stavins.aspx), one by Gilbert Metcalf is on a carbon tax (http://www.brookings.edu/papers/2007/10carbontax_metcalf.aspx), and the third by Joseph Furman and colleagues addresses a broader economic strategy for controlling climate change (http://www.brookings.edu/papers/2007/10climatechange_furman.aspx

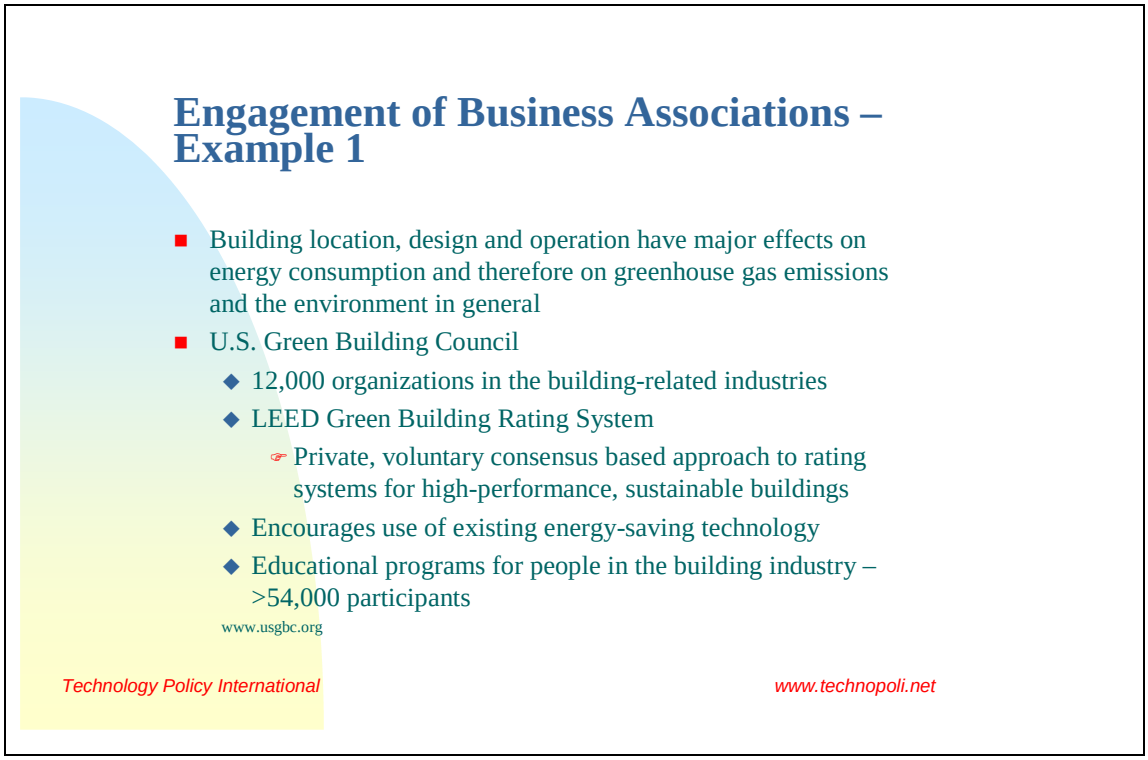
[36]Links to a number of these activities are at: http://www.brookings.edu/topics/climate-change.aspx

[37]A number of the Marshall Institute's papers and reports can be found at: http://www.marshall.org/subcategory.php?id=9 The Institute should not be confused with the George C. Marshall Foundation in Lexington, VA, which is devoted to public policy education and to honoring the life of General Marshall.

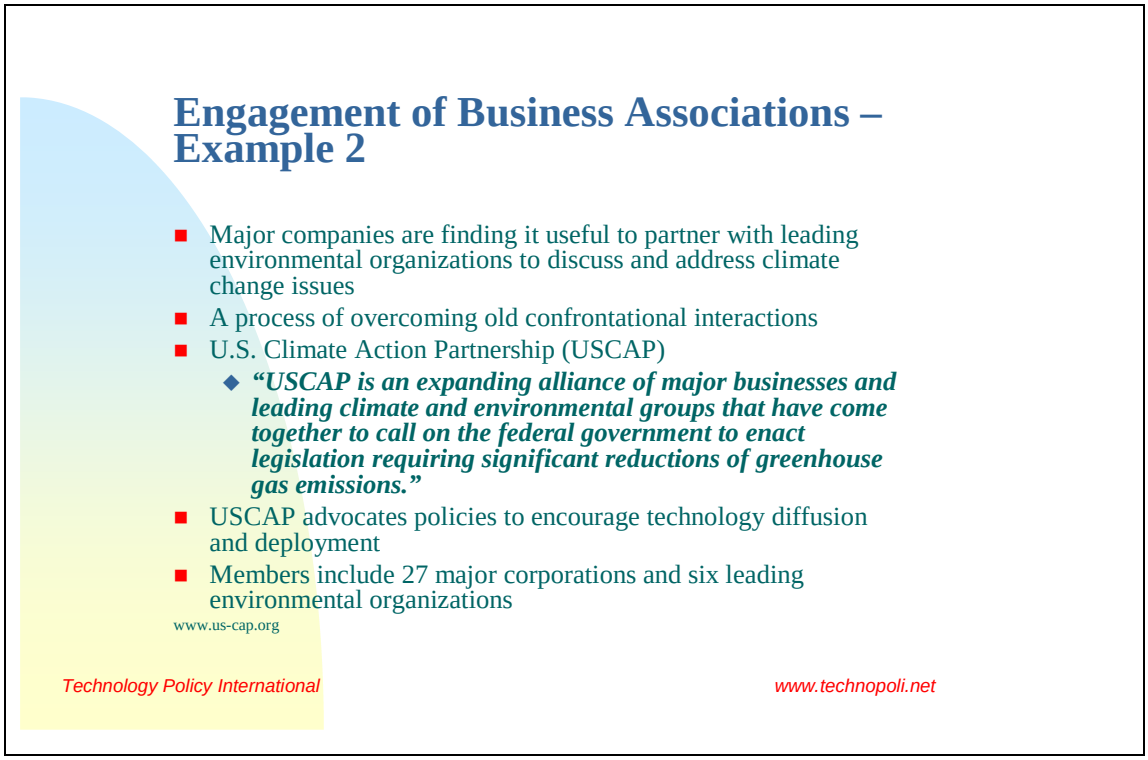
Of particular interest to the subject of diffusion of existing technologies to address climate change is a study done by the blue-chip consulting firm, McKinsey and Company, in cooperation with the Conference Board, an association of the leadership of major corporations.[38] Interestingly, the sponsors of the report also included five private companies and two of the nation's largest environmental organizations. The report examined the potential for reducing GHG emissions for each of some 250 technologies and operational changes. Many of the 250 and most of the most immediately attractive options in terms of reducing GHG represent the application of existing technologies, rather than the development of as-yet untried new technologies. A strong point of the report is its excellent graphical display of all of the options along two axes, cost and GHG reduction. In essence, the report offers a fully-developed "supply curve" for GHG reduction technologies.

5.4 Engagement of Business Associations

[38]McKinsey and Company, "Reducing U.S. Greenhouse Emissions: How Much at What Cost," December 2007. The report can be downloaded for free at the Conference Board web site: http://www.conference-board.org/publications/describe.cfm?id=1384

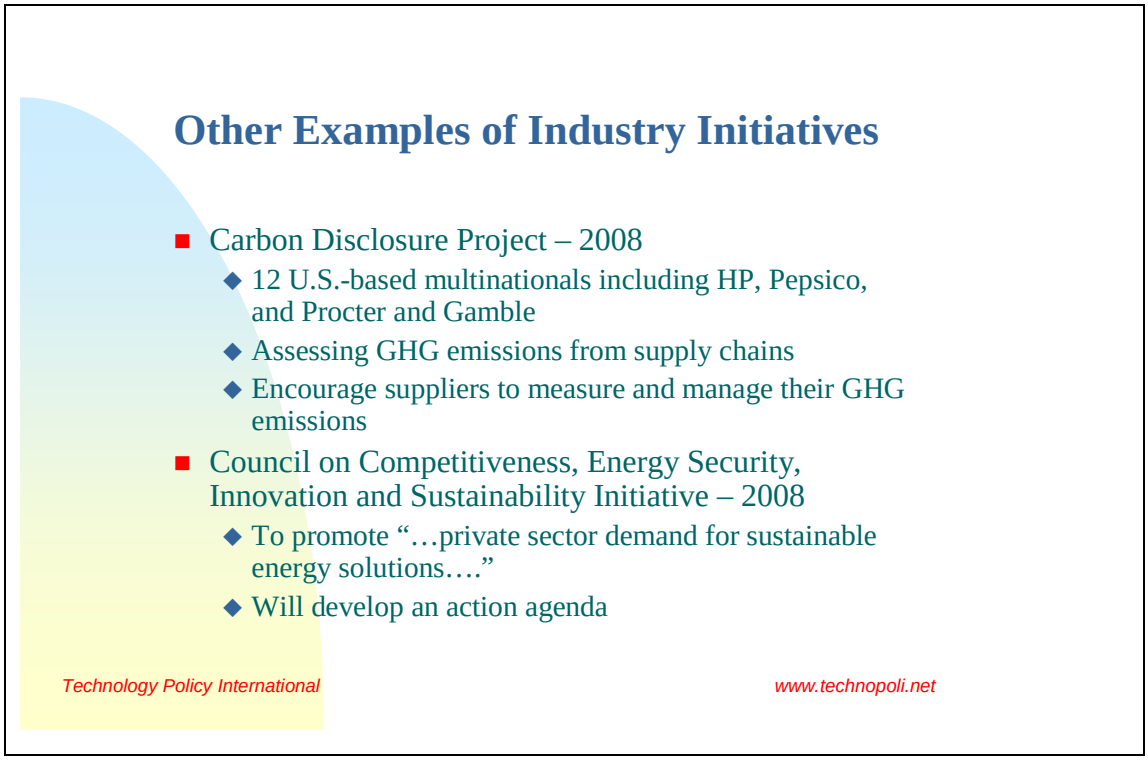


Many private companies have recognized that there is money to be made in marketing, selling, and constructing products and services that can make a credible claim to be "green." A leading illustration of this trend is the building construction industry, which has created the U.S. Green Building Council (www.usgbc.org), which claims membership of more than 12,000 organizations in the building related industries. It has established the LEED Green Building Rating System which allows building designers, owners and builders to assess their building's performance against a relatively objective set of performance targets and design criteria. The LEED system is private and voluntary and does not involve government, other than as an interested observer and building customer. The LEED system encourages use of existing energy-saving technology and is not a technology development strategy.



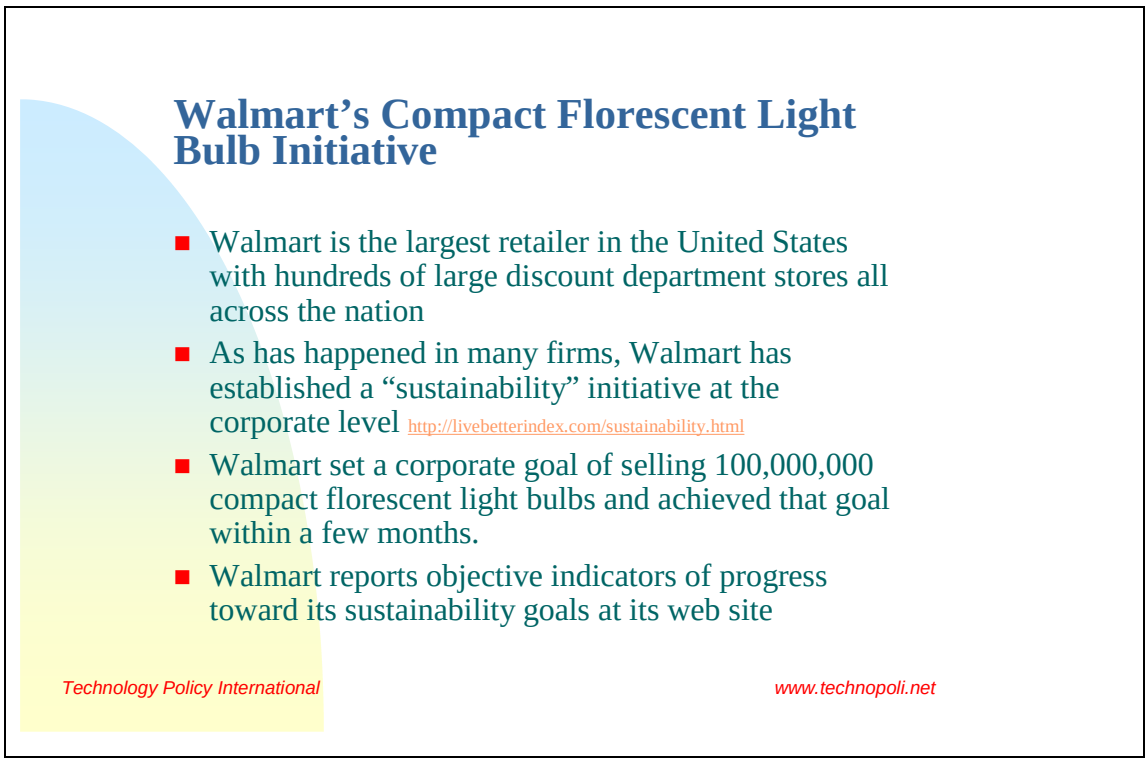
The U.S. Climate Action Partnership (USCAP) (www.us-cap.org) is an unusual alliance of more than 27 major corporations and six leading environmental organizations which has come together to "call on the federal government to enact legislation requiring significant reductions of greenhouse gas emissions." USCAP also encourages policies that would encourage technology diffusion and deployment.

USCAP represents an interesting undercurrent in the national debate over climate change policy. While the Bush Administration and, until recently, the Congress have been very reluctant to embrace mandates or incentives for GHG reductions, there is a sense among many industrial corporations, and certainly among environmentalists, that it is only a matter of time until tough new limitations are imposed on GHG emissions in the United States. So long as the policy stalemate exists, companies face a highly uncertain environment for making long-term investments in new plant and equipment that may impact the environment. Members of organizations like USCAP hope to accelerate the resolution of the uncertainty and, of course, hope to influence the nature of the control policies that are ultimately adopted.



The Carbon Disclosure Project established in 2008 is an effort by twelve major U.S.-based multinational corporations to incentivize their supplier firms to manage their GHG emissions. In light of the complex patterns of outsourcing to suppliers, these firms recognize that they cannot make effective claims that they are producing their goods for sale in "sustainable" ways unless there is some assurance that their suppliers are following sustainable practices.

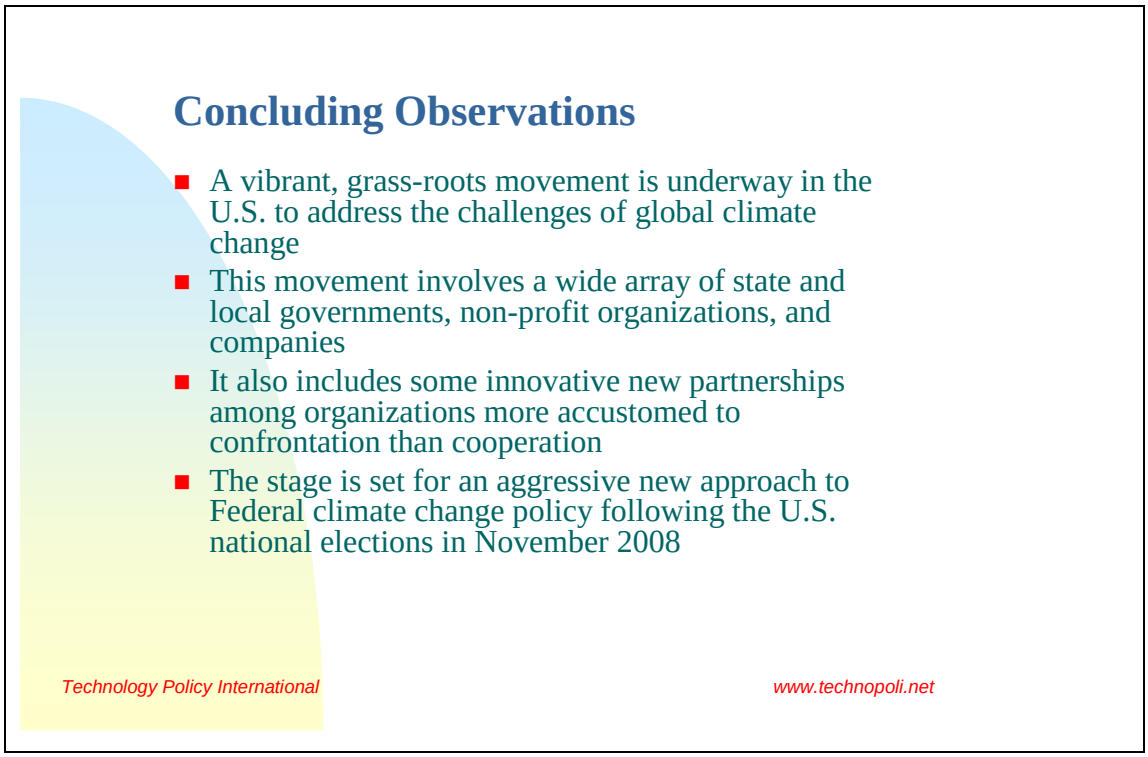
Another interesting example is the U.S. Council on Competitiveness project on Energy Security, Innovation and Sustainability announced in 2008. The Council, which was established in the middle 1980s as a forum for discussion of how the United States might best respond to the competitiveness challenge from Japan and elsewhere, is an organization whose members are corporate CEOs, university presidents, and labor organization leaders. That they have turned their considerable influence and energies to "promote private sector demand for sustainable energy solutions" is an indicator, once again, of the desire of the private sector for greater certainty in the future demands for GHG controls and in the availability of technologies that can meet those demands.



Our final illustration of private activities to control GHG emissions and improve energy efficiency is Walmart's compact fluorescent light bulb (CFL) initiative. Walmart is the largest retail sales corporation in the United States and, in fact, in the World, so its corporate strategies can have a major impact on the realities of how consumers shop, buy, and use products. Under the more general rubric of its sustainability initiative, Walmart decided to try to encourage the purchase and use of one hundred million CFLs, or about one such bulb per American household. The results far surpassed their publically stated goal – they sold that many bulbs in just a few months.

More interesting, perhaps, than this initial foray into green marketing is the fact that Walmart now collects data on its progress toward its sustainability initiatives and reports those data regularly on its sustainability web site.

6. CONCLUDING OBSERVATIONS AND QUESTIONS FOR THE FUTURE



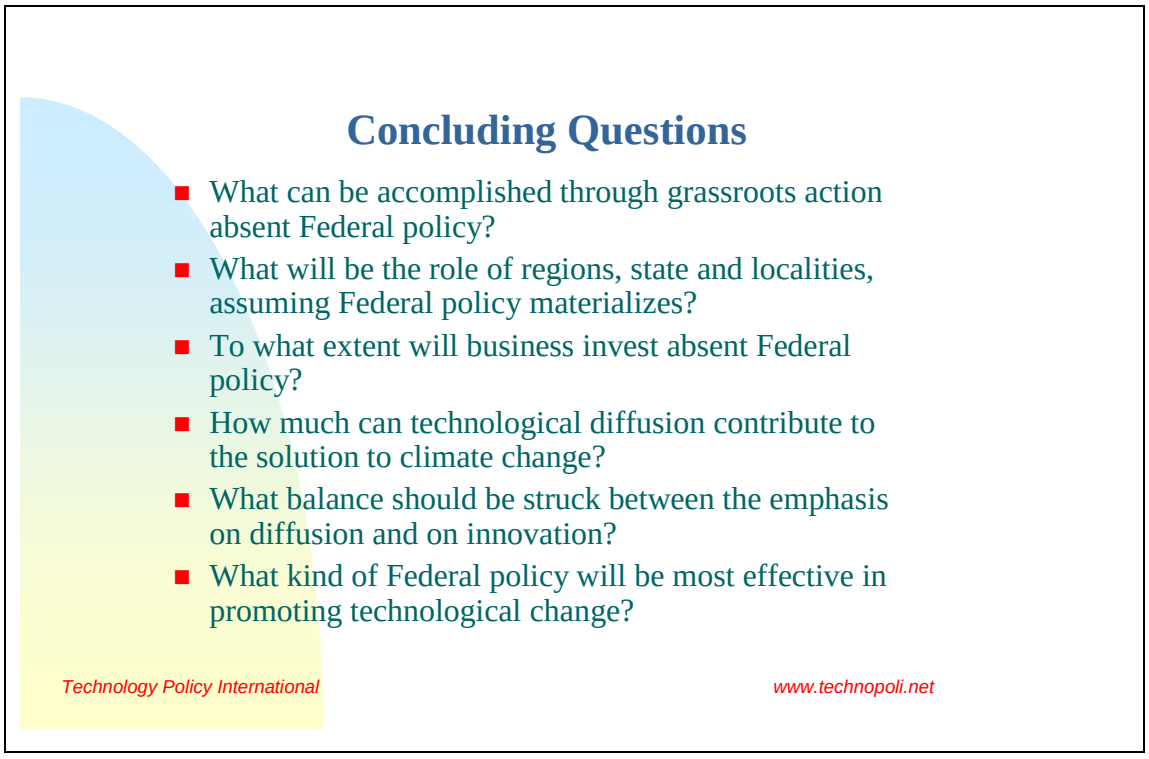
The grassroots initiatives mounted by cities, states and regions in the U.S. to address the challenges of climate change have been in existence for about a decade. As of this writing, they seem only to be increasing in number and intensity. Indeed, one of the challenges in writing this report was simply to keep up with the constant stream of new developments – a true "movement" from the bottom up which both urges and demonstrates that something must be done.

It was not only the number of the initiatives that presented a research challenge. In addition, the initiatives uncovered are highly diverse, involving a very wide array of state and local governments, regional entities that have been newly formed for the purpose, non-profit organizations both old and new, and private, profit making companies being pushed in new directions.

One of the most interesting organizational phenomena now being seen is the creation of innovative new alliances and partnerships. Many of these are frankly surprising as well, in that they bring together in common cause organizations that have in the past been more accustomed to confrontation than cooperation. They also

tend to span a wide diversity of actors, from local government to environmental groups, to think tanks, to companies in sectors as different as energy and insurance. And they span a wide variety of institutional forms.

It is undeniable that "the action" in the U.S. at the moment is not at the Federal level. Nevertheless, we believe that the stage is set for an aggressive new approach to Federal climate change policy before long. If the "laboratories of democracy" theory continues to have explanatory power, then such a development would seem to be inevitable. Given the reality of a Presidential election in November 2008, it is highly unlikely that any major policy initiatives will occur before 2009. On the other hand, the fact that all three of the current major Presidential contenders are on record in favor of strong new policies to address climate change suggests that major national initiatives are likely to occur soon in the new Administration.



This report has deliberately focused on only a single type of strategy for addressing the challenges of global climate change: small-scale, bottom-up, grass-roots efforts that are directed toward technology diffusion. In the U.S., such initiatives are proceeding independently of national policy, and – to reemphasize an unfortunate truth – in the absence of Federal policy. While we believe that the

strategy explored herein is of extraordinary value, we certainly cannot say that it is the only – or perhaps even the paramount – strategy needed to address global climate change. Thus, it is appropriate to end this report with a series of open-ended, hard questions about the role of technological diffusion and grass roots action in the overall policy scheme in the U.S.:

- What degree of progress can be achieved absent Federal policy? Are the policy levers over which states and localities have control so small as not to make a difference in the light of Federal inaction in the areas it controls, such as automotive fuel efficiency?

- Assuming that an aggressive Federal policy does materialize, what will be the role that localities continue to play? In other environmental contexts (e.g. clean air and water), the states have largely been assigned an implementing role and localities are largely irrelevant.

- To what extent will businesses in the private sector really invest in energy-saving and other "green" technologies absent a Federal mandate to do so? And to what extent will R&D investments in new technology be made without a clear and certain trajectory of national policy?

- How much can the diffusion of existing technologies really contribute to the solution to global climate change? This is a debate that is currently at the forefront of discussion in the U.S. [39]

- Given the reality that technological change across the entire spectrum is necessary, what kind of balance in public and private policy should be struck between efforts to generate new technologies and to improve and diffuse existing ones?[40]

- Assuming that aggressive new policies will arise at the national level in the U.S., what approach is likely to be most effective in encouraging technological change, both innovation and diffusion? In particular, what can be said about the virtues of a cap and trade system as opposed to a carbon tax, which are the two most-discussed options?

---

[39] See " A Shift in the Debate Over Global Warming," Andrew C. Revkin, New York Times, April 6, 2008

[40] See "MIT's Burgeoning Role in the Green Movement," by Susan Hockfield (President of MIT) Boston Globe, April 7, 2008. See: http://www.boston.com/bostonglobe/editorial_opinion/oped/articles/2008/04/07/mits_burgeoning_role_in_the_green_movement/