

Rising to the Challenge:

Assessing the Massachusetts Response to Climate Change

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Clean Energy States Alliance (CESA) is a national nonprofit organization dedicated to advancing state and local efforts to implement smart clean energy policies, programs, technology innovation, and financing tools to drive increased investment and market making. CESA works with the leading state and public clean energy programs and provides information sharing and technical assistance to states and local governments on “best in class” clean energy programs and policies. CESA also facilitates collaborative networks to coordinate efforts between states, federal agencies, and other stakeholders to leverage accelerated progress on deploying clean energy projects and markets.

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One the cover: The Jiminy Peak windturbine, nicknamed Zephyr, under construction.
Photo Credit: Roman Iwasiwka

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By Warren Leon
Sonia Hamel
Benjamin Forman
Val Stori

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April 2012

Dear Friend:

MassINC is proud to present *Rising to the Challenge*, the first independent assessment of the state's ambitious and comprehensive response to climate change.

This report builds on MassINC public opinion research released last April, which demonstrated that a majority of residents want state and local government to take steps to address Global Warming, but few residents have any knowledge of the impressive effort that leaders on Beacon Hill and within state and local governments across the Commonwealth have fashioned in response to the problem.

Climate change is the challenge of our age. For the obvious reason – failing to respond could alter the environment with profound and dire consequences – but also because it is a critical test of government's ability to accomplish something complex for the common good.

As this report shows, Massachusetts has been a true laboratory of democracy on this issue. Working across agencies, across levels of government, and across state and national boundaries, we have put in place an array of sophisticated programs and policies to curb our greenhouse gas emissions without inhibiting economic growth or degrading our quality of life. Our progress to date is truly astounding.

Yet with any undertaking of this magnitude and difficulty, it is inevitable that we will run into stumbling blocks. This report catalogs the challenges we are likely to face and demonstrates that there is more work to do to meet the reduction targets the state is legally obligated to achieve. Overcoming these obstacles will require deep public commitment and resolve.

Toward that end, this report seeks to make a contribution by describing the various threads of our policy, and the choices and tradeoffs we will face in the coming years as we weave them into an effective response. We hope that this study provides a resource for civic leaders working to inform and engage residents on these important issues.

We thank the many advisors who contributed to this project by offering their guidance, ideas, and critiques. While they are too numerous to name individually, we are extraordinarily grateful for their time and insight. We would also like to express our gratitude to our partners at the Clean Energy States Alliance. The extreme dedication of Warren Leon and his colleagues are evidenced in this thorough and thoughtful analysis.

MassINC's mission is to provide solid, objective research to inform critical policy debates. We hope you find *Rising to the Challenge* a provocative and timely resource. As always, we welcome your feedback and invite you to become more involved in our work.

Sincerely,

A handwritten signature in black ink, appearing to read "Greg Torres", with a stylized flourish at the end.

Greg Torres

President

MassINC

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Rising to the Challenge:

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EXECUTIVE SUMMARY

On July 2, 2008 Governor Deval Patrick signed the landmark *Green Communities Act* proclaiming: “Climate change is the challenge of our times and we in Massachusetts are rising to that challenge.”* Massachusetts is indeed rising to the challenge, but will we succeed in reaching the greenhouse gas reduction targets we have committed to achieving?

This question is critical because Massachusetts has much at stake. If global emissions are not significantly reduced, credible projections suggest the state will face sea level rise of two to six feet. Hundred-year floods will likely occur every few years. Summers would bring 30 to 60 days with temperatures over 90 degrees. These threats can only be avoided if political entities around the world do their part to reduce emissions of carbon dioxide and other greenhouse gases.

In this spirit, Massachusetts has pledged to reduce greenhouse gas emissions 25 percent from 1990 levels by 2020 and 80 percent below 1990 levels by 2050. This report examines how far along the state is with implementing climate change actions to achieve these goals.

We place particular focus on the state’s trajectory toward the 2020 target. By reaching this interim goal, Massachusetts will show that significant greenhouse gas reduction is possible and can influence others to take action.

With eight years remaining to cut emissions 25 percent, this is the moment to take stock of our progress. Implementation is well underway, but there is still time to make any necessary adjustments to meet the 25 percent target.

While progress toward these targets provides one frame for assessing the state’s response to climate change, given the complexity of the challenge, it is important to look more broadly as well. The report examines other topics, such as the state’s preparations for adapting to a changing climate, the state’s leadership role nationally and internationally, and the extent to which the state is cost-effectively pursuing emissions reductions. We present this comprehensive review of the Massachusetts response in four sections:

- Section 1 provides a primer on the climate change problem, the urgent need for state and local action, and the policy response in Massachusetts to date.
- Section 2 assesses the state’s comprehensive response to climate change, answering three key questions: Is the state on track to meet its targets? Is the state successful in the key realms of energy efficiency, electricity generation, transportation and land use, and adaptation? And is the state playing a leadership role?
- Section 3 compares the economic costs of addressing climate change to the economic benefits of the policies that the state is implementing.
- Section 4 examines the achievements of local climate change action in cities and towns across the state.

* Citations for material in the executive summary are listed in the related sections in the main body of this report.

To prepare this thorough, impartial assessment of climate change activity in Massachusetts, we reviewed the rich compendium of information that is included in reports and other documents produced by state agencies. We interviewed more than three dozen state officials and stakeholders to understand their viewpoints and to get answers to specific questions about various programs. We learned about the opinions of an even wider group of stakeholders by reading commentary on the

Massachusetts climate response, including all the November 2011 testimony provided to the Joint Committee of Telecommunications, Utilities, and Energy on the *Green Communities Act*. To put Massachusetts's activities into perspective, we studied the climate change responses of six other leading states and examined particularly intriguing program ideas from around the world.

While this review led us to conclude that more work remains before citizens can be assured

Overview of Findings and Recommendations

Our overarching conclusion is that, although Massachusetts has implemented many effective and indeed nation-leading programs, there is a real likelihood that the state will fall short of its 2020 greenhouse gas reduction goal. To ensure Massachusetts hits the target it is legally bound to achieve, the state must accelerate its effort.

While renewed focus and additional action is required, achieving the 2020 target is within reach because the state's response to date provides a very strong foundation. More specifically:

- **Massachusetts state government—across several administrations and in both the executive and legislative branches—has taken the climate change problem seriously and has adopted many important policies and programs.** Governor Deval Patrick, in particular, and state government, in general, have shown leadership when it comes to climate change action.

- **The Massachusetts Clean Energy and Climate Change Plan for 2020, which was issued in 2010, is based on solid analysis and identifies an array of appropriate, logical actions.** The plan indicates that a 25 percent emissions reduction by 2020 is feasible and realistic.
- **The state is making good progress on many of the initiatives that were put in place in the three years before the climate plan was announced in December 2010.** Among the initiatives that are generally progressing well are the state's energy efficiency programs, the renewable portfolio standard, the Green Communities program, and the Leading by Example program. Those programs are achieving meaningful results and appear to be effectively managed.

However, there are several ways in which the state's climate change plan implementation could and should be better:

- **There is insufficient direction of overall implementation.** Even though climate change activities are better coordinated in Massachusetts than in most other leading states and the various key players in the different departments and agencies appear to work cooperatively, the current degree of coordination is inadequate given the importance and complexity of the greenhouse gas reduction tasks. It is not sufficiently clear who exactly is in charge of the overall effort.
- **Progress indicators and metrics are not clear and progress monitoring is insufficient.** The climate plan did not include a full work plan and one has not been developed since its release, nor has a tracking and monitoring system been put into place. For some pre-existing activities, such as oversight of the utilities' energy efficiency programs and the renewable portfolio standard, there is extensive monitoring and solid data. But for many of the items in the plan, it is hard for state officials or outside stakeholders to know what the specific expecta-

that Massachusetts will meet its mark, we want to establish at the outset that this finding is neither shocking nor disheartening given the state's ambitious goal. In the last analysis, success will only be achieved through continued thoughtful, determined action. Toward that end, this report seeks to provide useful guidance.

1. The State's Response to Global Warming

Massachusetts's leadership in energy efficiency, dating back to the 1980s, provided a solid foundation for action to address global warming starting in the 1990s. In 1997, the legislature passed important legislation establishing dedicated funds for energy efficiency and renewable energy. In 1998, the state started its first climate planning, holding stakeholder meetings and public discus-

tions or measures of progress are or whether the state is on track to meet those expectations.

- **The government response to climate change needs more visibility.** To build long-term public support for climate change action and to encourage citizens to get involved in addressing the problem, it is important for government to educate the public about the threat of global warming, the fact that it requires a sustained response, and the actions the government is taking to address it. Although Massachusetts leaders have discussed climate change, the focus has recently been so heavily on the economic benefits of building a clean energy industry that the climate change message has been barely visible to the public. Even though the current political/economic climate makes it difficult, it is important for state government to talk directly and forcefully about the threat of climate change and what is being done to address it.

- **The implementation of new initiatives and activities is lagging.** Many of the new initiatives and activities that the plan called for have been slow to launch. Among them are clean car consumer incentives, stationary equipment refrigerant management, pay-as-you-drive insurance, GreenDOT, deep energy efficiency improvements for buildings, and the regional clean fuel standard (low-carbon fuel standard). Because there are only eight years until 2020, these initiatives must be implemented quickly in order to achieve the desired results by that date.

This leads us to four primary recommendations:

1. The Governor should appoint a single individual to be responsible for directing the overall effort and keeping track of progress in all departments.
2. The state should set up an effective, transparent progress tracking and monitoring system. For each item in the climate plan, there should be

year-by-year milestones, metrics, progress indicators, and a methodology to determine whether the state is on track to meet its goals.

3. The state should make a concerted effort to inform the public that there is a coherent climate change plan with specific goals and actions to reduce the state's greenhouse gas emissions. The Commonwealth should create a public education campaign explaining what citizens can do to help achieve the Massachusetts climate targets.
4. The state should reassess the 2020 plan's lagging initiatives and determine whether these efforts can still feasibly achieve the reductions they were responsible for producing. To the extent that they can still generate reductions in time, the state should accelerate implementation. To compensate for programs that are no longer realistic or will take longer to generate measurable reductions, the state should look for viable replacement strategies.

sions on how and what action to take. Shortly after that, Massachusetts's government officials helped convince other governments in the region to address global warming.

Then, when Governor Deval Patrick took office in 2007, there was a dramatic increase in activity:

- The Governor signed Massachusetts onto the Regional Greenhouse Gas Initiative, a region-wide, market-based program to reduce emissions from all power plants larger than 25 megawatts and to create an active carbon market and an auction that generates energy efficiency funding. The initiative had been developed under the Romney Administration but Governor Romney eventually withdrew Massachusetts from the program.
- *The Green Communities Act* of 2008 required utilities to undertake all investments in energy efficiency that are less expensive than purchasing additional power, strengthened the state's renewable portfolio standard (a requirement that electricity supplies get an increasing share of their electricity from clean energy sources), required utilities to enter into long-term contracts with renewable energy generating facilities, established a Green Communities Program, and included other provisions to support and increase net metering (a policy allowing customers to receive credit at retail rates for electricity they generate onsite) and green buildings.
- *The Global Warming Solutions Act* placed more specific legislative, regulatory, and administrative initiatives into an overarching framework and provided a legal mandate for greenhouse gas emission reductions. It established a statewide legislative goal of reducing emissions to 80 percent below 1990 levels by 2050. It directed the Secretary of Energy and Environmental Affairs to determine a

2020 goal, which was ultimately set at an ambitious 25 percent below 1990 levels, and to produce a plan to meet that goal. It also provided state agencies with broad authority to regulate greenhouse gas emissions and required them to issue regulations.

- The state's energy and environmental agencies were combined into a single secretariat, the Executive Office of Energy and Environmental Affairs, making interdepartmental coordination on global warming easier.
- Two other laws—the *Oceans Act* and the *Green Jobs Act*—also contributed to the state's climate change response, but in more modest ways.

Taken together, all this legislation and action was an impressive and far-reaching accomplishment. What made it possible was bipartisan commitment and leadership in both the executive and legislative branches, and strong cooperation among the branches. In fact, when passing the *Global Warming Solutions Act*, not a single dissenting vote was cast. The Governor made it clear throughout 2007 and 2008 that clean energy was one of his top priorities.

In December 2010, the Executive Office of Energy and Environmental Affairs released the 2020 climate plan mandated by the *Global Warming Solutions Act*. The plan set out a series of policies and initiatives that it projected would lead to a 27 percent reduction in emissions from 1990 levels by 2020, slightly more than the 25 percent target. Reflecting the uncertainties inherent in any predictions of the future, the plan indicated that the ultimate end result of the proposed actions could be anywhere from 18 percent to 33 percent below 1990 levels.

2. How Successful Is the Massachusetts Response to Global Warming?

We assess Massachusetts's progress in addressing climate change by asking three questions, each of which illuminates a part of the picture and provides additional perspectives: (1) Is the state on track to meet its targets? (2) Is the state successful in the four key realms of energy efficiency, electricity generation, transportation and land use, and adaptation? (3) Is the state playing a leadership role?

Is the State on Track to Meet Its Targets?

The 2020 Goal

It is unclear whether Massachusetts will meet the 25 percent by 2020 greenhouse gas reduction target, partly because the state does not have control over key factors, such as the rate of economic growth, gasoline prices, natural gas prices, and federal policy. Because there is not any publicly accessible central scorecard of emissions, milestones, and projected effects of different initiatives, it is difficult for an outside analyst—or even someone within state government—to know how well or poorly some state programs are performing and how outside factors will affect the state's ability to meet the 2020 target. For example, because some of the reductions up to now have occurred as a result of a poor economy, it would be wise to evaluate what a revival in the economy could mean for emissions.

Looking at all the initiatives in the plan for 2020, the most significant likely or possible deviations to the plan's results on both the positive and negative sides are:

- The initial projections in the plan totaled 27 percent, providing a 2 percent cushion.
- The likely continuation of low natural gas prices may yield some greater than anticipated reduction in emissions because of less use of coal and oil.

- Without expanded electricity transmission from Quebec, which still faces significant hurdles, it will be impossible to achieve the 5.4 percent emissions reduction target attributed to clean energy imports.
- Many of the more difficult initiatives, totaling a projected 7.1 percent emissions reduction, are not currently at a point where it is reasonable to expect that they will all achieve their targets. A more reasonable current estimate might be that they will only achieve half of that or less.

Because the potential shortfalls could be significant, it is important for the state to begin to make concrete plans now for how it will make up the gaps, if necessary. The initial priority should be to assess realistically all those initiatives in the 7.1 percent category of potential shortfalls, to determine their likely results. A prompt assessment could help state officials decide if they need to move faster and how.

At the same time as the state reviews the 7.1 percent of unknowns, it should give attention to the transmission constraints that limit the ability of clean energy imports from Canada to reach Massachusetts, and even impede some potential wind farms in northern Maine from participating in the Massachusetts renewable portfolio standard. There is opposition in northern New England to expanded transmission, as well as some concerns about costs being imposed on ratepayers.

It is also possible that the state has taken actions that will yield unexpected emissions reduction dividends. For example, the Department of Environmental Protection's innovative new Clean Energy Results Program may achieve additional emission reductions from activities, such as diverting organic material from landfills. State officials should therefore determine whether there will be potential positive effects of any new

The Massachusetts 2020 Climate Plan: Reduction Target by Category and Strategy

BUILDINGS	9.8%**
All cost-effective energy efficiency/RGGI	7.1
Advanced building energy codes	1.6
“Deep” energy efficiency improvements for buildings	.2
Expanding energy efficiency programs to C/I heating oil	.1
Developing a mature market for solar thermal water/space heating	.1
Tree retention & planting to reduce heating and cooling loads	.1
Federal appliance and product standards	.6
ELECTRICITY GENERATION	7.7%**
Expanded Renewable Portfolio Standard (RPS)	1.2
More stringent EPA power plant rules	1.2
Clean energy imports	5.4
TRANSPORTATION	7.6%**
Federal & California vehicle efficiency and GHG emissions standards	2.6
Federal emissions & fuel efficiency standards for medium & heavy-duty vehicles	.3
Federal renewable fuel standard & regional low-carbon fuel standard	1.6
Clean car consumer incentives	.5
Pay As Your Drive (PAYD) auto insurance	1.1
Sustainable Development Principles	.1
GreenDOT	1.2
Smart growth policy package	.4
NON-ENERGY EMISSIONS	2.0%**
Reducing emissions from motor vehicle air conditioning	.3
Stationary equipment refrigerant management	1.3
Reducing SF6 emissions from gas-insulated switchgear	.2
Reducing GHG emissions from plastics	.3
TOTAL	27%**

*Information drawn from *Massachusetts Clean Energy and Climate Plan for 2020*.

**To avoid double-counting, the plan’s authors adjusted the subtotals downward to account for overlap among individual policies.

initiatives that were not included in the climate plan. Finally, the state should find additional ways to reduce emissions in order to compensate for possible shortfalls. In addition to the recommendations below for securing further emissions reductions, the state could consider whether it would be possible to move even faster than currently planned in implementing energy efficiency.

Recommendations:

❑ Massachusetts should push hard to strengthen RGGI because that is the most obvious near-term opportunity for additional reductions. The RGGI states are currently in the middle of a program review that was specified in the original agreement and it appears that the state supports some form of RGGI enhancement. There are several different ways in which the program could be modified to achieve additional reductions by 2020, but the important thing is to do something to enhance RGGI’s future impact. In addition, the state should consider expanding the sectors covered under the RGGI program to include transportation, industrial sources, or other sectors.

❑ The state should use the considerable regulatory authority granted under the *Global Warming Solutions Act* to ensure additional emissions reductions by 2020. In fact, that Act tells state agencies to “promulgate regulations that reduce energy use, increase efficiency and encourage renewable sources of energy in the sectors of energy generation, buildings and transportation.”

❑ The state should focus on reducing leaks of methane from aging natural gas pipelines. Per molecule, methane is 21 times more potent as a greenhouse gas than carbon dioxide, so even small leaks can have a big impact. Although the natural gas distribution companies have been gradually replacing older pipes and repairing leaks, they have some perverse financial incentives that tend to discourage them from prioritizing leak repair and infrastructure replacement unless there is clear risk to public health and safety. It is not clear how much gas is currently leaking, so an initial step should be for the Department of Environment Protection and the Department of Public Utili-

ties to work with the gas companies to develop and agree on an accurate estimate of the extent of the problem. Then, the rate compensation structure should be adjusted so companies have an incentive to fix leaks.

❑ The state government should either decide to work more aggressively to help overcome the difficult barriers to increased transmission or acknowledge that the goal of a 5.4 percent emissions reduction from clean energy imports may need to be revised downward or even eliminated.

The 2050 Goal

The Commonwealth has 30 additional years to achieve its 2050 goal, but that will not make the task easier. An 80 percent reduction in emissions is a daunting challenge and it will not be achieved simply by extending the same strategies that can meet the 2020 goal.

It is difficult for politicians and state governments to focus on anything decades into the future, yet there are modest ways in which government officials can and should address the long-term. Some of the near-term actions included in the current climate plan, including those related to building codes and smart growth, can make it easier to achieve the longer-term goal and early action can make a difference. Another thing the state can do now to prepare for achieving the 2050 goal is to identify especially relevant future technologies for which there are valid other reasons for providing near-term support.

For political leaders and stakeholders to understand the types of choices that will need to be made to reach the 2050 goal, they need more information than they currently have about the technologies and strategies that could fit into an effective long-term plan. Because government leaders will not likely have the time or resources to think intensively about the period beyond 2020, the private sector should assist the state

by envisioning the technologies, strategies, and policies needed for 2050.

Recommendation:

❑ NGOs, foundations, and academics should launch a visioning exercise with the cooperation of state government. These groups should produce a report showing options for how an 80 percent reduction in greenhouse gas emissions could be achieved by 2050. The study should examine how other leading jurisdictions, such as California and European countries, are planning to reach this magnitude of reductions. It should be done on a regional New England basis and be carried out with relatively modest resources in less than a year. To support this activity, the state should publicly declare that it understands that preparation for achieving its 2050 goal is necessary and that the visioning exercise is a useful way to jump-start planning.

Is the State Successful in the Four Key Realms of Energy Efficiency, Electricity Generation, Transportation and Land Use, and Adaptation?

Energy Efficiency

Massachusetts has been most successful in implementing energy efficiency—both in terms of gross greenhouse gas reductions and in comparison to other states. Because of the state's long history in energy efficiency, when the push to accelerate energy-efficiency investment started to be made in the mid-2000s, there was already the infrastructure and expertise in place to oversee and implement those investments.

Two provisions in the 2008 *Green Communities Act* have been especially important to the successful expansion of energy efficiency programs: the requirement to implement all cost-effective energy efficiency and the establishment of the Massachusetts Energy Efficiency Advisory Council. Spending on energy efficiency has risen

dramatically, with the budget for electric utilities' efficiency efforts reaching \$401 million in 2011. This gave Massachusetts the highest per capita spending on electricity-related efficiency and second-highest spending on efficiency for natural gas customers. The current plans developed by the utilities and approved by the Advisory Council aim to achieve a 2012 savings equal to 2.4 percent of electricity sales and 1.15 percent of natural gas sales. Preliminary results indicate that the electric program administrators met 99 percent of their savings targets and the gas program administrators met 83 percent of their savings targets in 2010. The 2011 results are likely to be nearly as successful.

Most stakeholders within the state appear to be broadly satisfied with the overall delivery and results of the energy efficiency programs. In October 2011 the American Council for an Energy Efficient Economy ranked Massachusetts first in its annual energy efficiency rankings. This was the first time that California was displaced from the top spot.

Despite the aggressive, successful way that the state and utilities have implemented energy efficiency over the past few years, the path forward will not be easy. The state's climate change plan assumes that there will be a continued increase in the percentage of revenues that utilities spend on efficiency. That may be hard to sustain. Policy-makers should not be sanguine about the future performance of the efficiency program based only on its past successes. They will need to continue to innovate and refine the existing programs, seeking new effective energy reduction strategies to enable future rounds of reductions.

Electricity Generation

A state can reduce the greenhouse gas emissions associated with electricity generation both by reducing the climate impacts from fossil fuel generation and by bringing less polluting, renewable energy generators online. Massachusetts has



taken important steps in both areas. Yet, in the case of reducing emissions from fossil fuel generation, market forces have played a bigger role in closing and scaling back fossil-fuel facilities. High prices for oil and low prices for natural gas first sharply reduced output from oil-burning powerplants and more recently replaced some coal generation with natural gas. Because natural gas emits much less carbon dioxide than either coal or oil, this has led to large reductions in emissions.

While market conditions have been favorable, the state has also been especially bold in promoting renewable energy. Its most important renewable policy is the renewable portfolio standard (RPS). This ambitious initiative has been well-managed by the Department of Energy Resources. A variety of other state programs and policies have encouraged renewable energy development, including net metering, Massachusetts Clean Energy Center incentives, and utility purchases. Collectively, they have been responsible for bringing a significant quantity of renewable energy online throughout New England.

In 2010, the last year for which full data are available, five percent of the electricity supply was



Photo Credit: Massachusetts Executive Office of Energy and Environmental Affairs

required to come from renewable energy projects completed after the start of 1998. In complying with this requirement, electricity suppliers relied overwhelmingly on out-of-state facilities that used three energy sources: wind, landfill gas, and woody biomass.

The RPS percentage is slated to increase one percent annually, reaching 15 percent in 2020. If the RPS remains on track, it is probable that the vast majority of new renewable capacity by 2020 will be powered by wind. However, if natural gas prices remain low and the federal government neither renews the Production Tax Credit for wind energy nor substitutes a comparable incentive, it could become more difficult to develop wind projects. Massachusetts needs to monitor federal policy and market conditions closely to determine if any changes in the state's renewable energy policies are warranted.

Recommendation:

- To help ensure that significant renewable generation is added to the electricity supply, the state should implement additional measures to help renewable energy projects secure financing and/or long-term contracts.

The state has previously taken useful steps to address this issue and legislation recently debated in the Senate proposes to require the investor-owned utilities to enter into additional long-term contracts with renewable generators. Such contracts could reduce the cost of developing renewable energy facilities. Other measures related to financing renewable projects should also be considered.

Looking forward, the three big potential sources of renewable energy for the Massachu-

Recently built wind turbines at the MWRA Deer Island Sewage Treatment Plant (left) and Allen Farm in Chilmark were made possible by state support.

STATE PROGRAMS AND POLICIES HAVE ENCOURAGED RENEWABLE ENERGY DEVELOPMENT.

setts electricity supply are wind from the north (northern Maine and Canada), offshore wind, and hydroelectric from Canada. Wind from the north is likely to continue to be developed gradually and will remain an important resource. The other two resources have even greater potential, but they require special attention from the state.

The offshore wind potential is tremendous,

especially in deep waters. The amount of wind energy that could be secured off the coast dwarfs the amount that can be reasonably expected to be developed on land in the region. Although the costs for offshore wind projects are currently high, they will come down over time and the potential resource is so great that Massachusetts should continue to devote significant attention to it.

Large-scale hydroelectric, in contrast, is a

THE STATE HAS THE POWER TO TAKE MEANINGFUL ACTIONS TO REDUCE TRANSPORTATION EMISSIONS.

well-established, low-cost technology that does not require subsidies and is not included in the RPS. The province of Quebec has plans for significantly expanding its output of hydroelectric power and wants to sell some of it to New England. This could be a good way to bring down Massachusetts greenhouse gas emissions cost-effectively. But for the state to achieve its climate change goals and to maintain momentum behind renewable energy technologies, it is important for hydroelectric power from Canada to be additional to the RPS goals, rather than a replacement for them.

Compared to the potential to develop large-scale wind offshore or import renewable energy from out of state, the renewable energy possibilities on land within Massachusetts are much more modest. From a near-term, greenhouse gas reduction perspective, instate projects cannot and will not achieve anywhere near as much. Although they will not be major contributors to achieving the state's 2020 climate reduction target, there may be economic development benefits and other valid reasons for supporting solar, community wind, and other instate renewables.

Transportation

Transportation is responsible for 36 percent of Massachusetts's greenhouse gas emissions, the largest share by sector, and perhaps the hardest to tackle.

The most significant progress in reducing transportation emissions is coming from the federal government's improved fuel economy standards, which will cut emissions from cars and light trucks by approximately 21 percent by 2030. However, because of projected increases in the number of miles people drive, just improving the efficiency of vehicles will not be sufficient to reduce transportation sector greenhouse gas emissions significantly.

The state has only partial influence over many of the key factors in emissions—people's choice of vehicles, the fuels they use, and the total vehicle miles traveled. Moreover, many other issues—from the safety of bridges to the MBTA's budget woes and road repairs—compete for transportation officials' attention. Nevertheless, the state has the power to take meaningful action to reduce transportation emissions and the state climate change plan identifies some good strategies for doing so. Two particularly important pieces are GreenDOT and the Regional Clean Fuels Standard.

GreenDOT. Under the Patrick administration, there has been an attempt to integrate environmental sustainability into the conversations and decision-making within the Massachusetts Department of Transportation (MassDOT). There is evidence of a gradual, but real, culture shift within the bureaucracy.

In mid-2010, the Department launched GreenDOT as a "comprehensive environmental responsibility and sustainability initiative that will make MassDOT a national leader in 'greening' the state transportation system." No other state department of transportation has articulated such clearly stated and comprehensive sustainability goals. To make that vision a reality and to reach the climate goals established will require enhanced management within MassDOT, as well as collaboration among the state's many partners in the transportation arena, including local governments and the 13 regional metropolitan planning organizations

(MPOs) across the state.

GreenDOT has clearly tried to point the transportation system in a climate friendly direction. Although it has started some interesting, useful activities, its implementation has been inconsistent for a policy that is supposed to be a high priority. With the current slow pace and poorly resourced way it is proceeding, it is difficult to believe that GreenDOT will achieve the emissions reductions projected for 2020.

This is especially the case because other forces are pulling in the opposite direction. With fare increases and service cutbacks pending for the MBTA, some residents will switch some of their trips to cars, increasing emissions. And cutbacks in some categories of federal funding will likely hamper the state's ability to launch major new efforts to reduce single occupancy travel.

Recommendations:

❑ Because the MBTA represents one of the state's most effective existing strategies for constraining greenhouse gas emissions, it is counter-productive to reduce ridership. Although the financial challenges are daunting, the legislature and the Governor should work on providing sufficient long-term funding for public transportation so that ridership can expand rather than contract.

❑ MassDOT is scheduled to announce its GreenDOT implementation plan this spring. It would be highly desirable for that plan to explain in detail how GreenDOT will achieve its 2020 climate goal and how staff across the agency will be assigned roles, responsibilities, and management targets. The plan should include interim metrics and milestones.

Regional Clean Fuel Standard. The state's climate plan included a Regional Low Carbon Fuel Standard (the previous name for the Clean Fuel Standard) as one of its major programs. The program was conceived as a variation on California's

Low Carbon Fuel Standard, which was established in 2007 and was designed to reduce the carbon intensity of transportation fuels used in California by at least 10 percent by 2020. In November 2007, Governor Patrick, along with Senate President Murray and House Speaker DiMasi announced an Advanced Biofuels Task Force that ultimately led to the legislature passing a law requiring that the state seek to create a low carbon fuel standard with the other states in the northeast.

Agency staff members from Massachusetts took a leading role in guiding the technical team to develop the regional program. This led to a Memorandum of Understanding in December 2009 signed by the governors of the 11 northeast states.

While the 11 states in the northeast are currently developing a framework for the standard, a California judge earlier this year granted a request for a preliminary injunction against the California standard on the grounds that it is preempted by the federal Renewable Fuel Standard, making it unconstitutional under the dormant commerce clause of the Constitution. Although California is said to have a strong case and its standard could be upheld, Massachusetts would be wise to move forward with other policies and programs related to electric vehicle deployment and natural gas use. The state should also continue to work with the other northeast states on cooperative efforts.

Land Use

More broadly, transportation investments shape land use patterns, which affect greenhouse gas emissions by influencing travel patterns and the built environment. The state's climate plan recognizes the relationship between transportation and land use and includes a "smart growth policy package" aimed at facilitating more compact development. Like those in other leading smart growth states, the Commonwealth's policies have so far had only modest success. However, Massachusetts continues to implement smart

growth policy innovations in ways that could be meaningful to reaching the 2050 reduction target if the state can maintain this focus.

Unfortunately, in implementing smart growth strategies, state law still makes it difficult for communities to facilitate more compact and energy efficient development in two respects. First, local governments are restricted in their ability to generate revenue, which makes them heavily reliant on local property taxes and creates fiscal incentives that tend to produce larger housing units and decentralized development. Second, while communities have the ability to regulate zoning, restrictions in the state's outdated zoning statutes make it difficult for municipalities to manage growth.

To reduce fiscal disincentives for more compact development, in 2003, the legislature enacted Chapters 40R and 40S, which provide communities with incentives for zoning and permitting housing in higher density smart growth districts. As a result, the state has approved 33 smart growth districts providing for more than 10,000 units of new housing. However, communities worry that the state will not fulfill its obligations to reimburse municipalities for new school costs, because funding is running out.

State government is well positioned to encourage compact development by making greenhouse gas impacts a consideration in determining where the state invests its own resources and locates key public infrastructure. The state has been attempting to do this since 2004, when the Romney administration issued the state's first Sustainable Development Principles and established Commonwealth Capital, which used municipal planning and regulation as a factor in awarding state grants and loans. The Patrick administration updated the Sustainable Development Principles in 2009. Although it discontinued Commonwealth Capital for the current fiscal year, it continues to target state investment in other ways and has policies that emphasize smart growth.

Another major stumbling block for efforts to

promote sustainable land use in Massachusetts is the long-held aversion to regional coordination. The Patrick administration has intelligently used priority funding as an opportunity to promote regional collaboration. This effort began on the South Coast, where communities came together to prepare an unprecedented regional land use plan in preparation for the proposed South Coast Rail corridor. The Patrick administration is now using the South Coast model to develop a similar regional land use plan for 37 growing communities along Interstate-495.

Recommendations:

❑ The legislature should establish some ongoing revenue measure so that the development of smart growth districts under Chapter 40S can continue.

❑ The state legislature should pass zoning reform. If comprehensive zoning reform turns out to be unachievable, the legislature should expedite passage of components of currently pending legislation that will lead to more efficient development patterns and reduce greenhouse gas emissions.

❑ The state should undertake additional regional planning efforts and target state funding according to the priority development and protection areas identified in these plans.

Adapting to a Changing Climate

Because the climate has already begun to change, residents of Massachusetts have had to begin adjusting to those changes in modest ways. As the climate changes more dramatically, the adaptations will need to be greater. It makes sense for residents, as well as state government, to prepare ahead of time for some of the likely future changes, rather than react to changes after they occur and the damage is done.

Many state agencies have been working for at least several years to consider what global warming

could mean for their operations and to prepare to adapt to climate change. Two of them deserve special recognition for their work to prepare for global warming: the Massachusetts Office of Coastal Zone Management and the Massachusetts Division of Fisheries and Wildlife.

The Commonwealth moved adaptation planning along significantly when the *Global Warming Solutions Act* required the Executive Office for Energy and Environmental Affairs, with the help of a specially convened advisory committee, to analyze and recommend strategies for adapting to the predicted impacts of climate change. The resulting report, which appeared in September 2011, was an unusually comprehensive and rigorous piece of research and analysis. Virtually all of its many recommendations are logical and well-supported by research.

Yet, despite the quality of the analysis, the report has not served, so far, as a loud call to action. It has received little attention beyond the network of people who were involved in producing it or who are already engaged in activities to manage the impacts of climate change. Part of the reason is that the report sidestepped setting priorities. To make more rapid progress on climate change adaptation, the state needs agreed-upon priorities, clear targets, and defined metrics.

Recommendation:

- ❑ The Executive Office of Energy and Environmental Affairs should move quickly to dissect the climate adaptation report and identify a few well-defined priority actions and goals for the next several years.

Is the State Playing a Leadership Role?

Massachusetts will be a good global citizen simply by meeting the goals in the state's climate action plan and thereby doing its fair share toward bringing down global greenhouse gas emissions. Yet there is the opportunity to do more by influencing players outside its borders in the following four ways:

- **Demonstrating that state action can produce reductions.** Governments and people across the country will be watching to see whether states like Massachusetts, with ambitious commitments to 2020 emission reductions, follow through on those commitments and achieve their goals.
- **Providing regional leadership by encouraging other nearby states to take collective action.** This is especially important in the case of Massachusetts, because it is the biggest state in New England and has historically been a policy leader. Massachusetts played an important role in forging an agreement among the New England Governors and eastern Canadian Premiers and in developing RGGI. Among the specific other climate-related actions in which Massachusetts has also led the region include advancing efficient use of biomass, encouraging regional transportation policy, supporting offshore wind, and implementing a strong renewable portfolio standard.
- **Developing policies and testing strategies that others can emulate.** Good ideas that are implemented in one place can and do often spread near and far. Massachusetts has already developed some exemplary practices, programs, and policies that have been copied elsewhere and there are many more opportunities for Massachusetts to play this role. Ways in which Massachusetts has already been a climate action model for others or will likely become a model include committing to all cost-effective efficiency, organizing a combined energy and environment secretariat, creating the Green Communities program, communicating economic development benefits, establishing GreenDOT, encouraging adaptation of a stretch building energy code, and considering climate impacts in MEPA project reviews.

- **Nurturing technologies and businesses that can play an important part in addressing climate change.** The world needs businesses to continually commercialize new and improved technologies and mitigation strategies. A state can help this process of innovation by providing assistance—financial and otherwise—to businesses and technologies that have the potential to have a significant impact, both in the state and beyond. Because Massachusetts is a major center for research, innovation, and start-up companies, it has greater potential than most states to influence the introduction of valuable technologies and strategies for climate change mitigation and adaptation. The Massachusetts Clean Energy Center has vigorously and effectively undertaken a variety of activities to assist individual clean energy businesses and build a clean energy industry cluster.

Recommendations:

- Massachusetts state officials should give even greater attention to promoting, leading, and shaping regional initiatives.
- The Clean Energy Center should make a company's potential to reduce global greenhouse gas emissions an explicit factor in decisions about investments.

3. The Economic Costs and Benefits of Climate Change Action

There is considerable disagreement about how much it will cost to address climate change and how much public funding should go to dealing with the problem.

Part of the challenge in assessing the costs and benefits of climate change action is to track the many ways government policies and programs ripple out through the economy. Take the case of the development of a renewable energy project

in the state. If it creates jobs for people installing and maintaining the equipment, then that needs to be considered. But there would be a negative economic impact if the project causes electricity rates to go up, leaving consumers with less money to spend. Healthcare savings associated with reduced air pollution, and the many other indirect costs and benefits should also be considered.

Although it is beyond the scope of this report to undertake the very substantial task of fully assessing all the costs and benefits of the many policies and programs that are collectively designed to address the threat of climate change, we can make some general observations to help frame the discussion about costs and benefits. A good starting point for looking at this subject is a useful study that the legislature requested as part of the *Economic Development Reorganization Act* of 2010. The Executive Office of Housing and Economic Development and the Executive Office of Energy and Environmental Affairs analyzed the costs and benefits of the state's energy efficiency and renewable energy programs. Their report reached four conclusions that are sound but require further discussion and qualification:

1. The high cost of electricity in Massachusetts is not primarily the result of state policies. As the state report points out, the main reason that electricity prices are higher in Massachusetts than in most other states is "that Massachusetts has virtually no indigenous energy resources, requiring us to import almost all of our energy resources from outside the region or overseas."

2. The benefits of energy efficiency have been substantial. Because of their scale, the energy-efficiency programs impose the highest upfront costs of any of the clean energy programs, but also yield significant returns on investment, making their benefits far outweigh the costs. Sophisticated methodologies developed over the past several decades help state regulators measure the costs

and benefits of efficiency programs. The central conclusion is that it costs more to build additional powerplants and additional transmission than it does to eliminate the need for those powerplants by implementing energy efficiency measures that reduce electricity demand. The process of developing the utilities' efficiency plans is designed to select efficiency efforts that meet the test of being cheaper than building new generation.

When the efficiency program administrators from the state's investor-owned electric utilities and municipal aggregator submitted their current three-year plans, they were required to include benefit-cost analyses. Their projections showed that the benefits would outweigh the costs roughly three to one. Even if one assumes that there is some margin of error in the analysis, the ratio of benefits to costs is so high that there can be little doubt that current efficiency efforts are economically desirable. Using a different methodology, the Analysis Group in late-2011 published an assessment of the efficiency spending in Massachusetts related to the Regional Greenhouse Gas Initiative and concluded that the benefits of efficiency spending far outweighed the costs, including reducing electricity rates and increasing the number of jobs.

The rosy picture of the economics of efficiency programs needs to be qualified in two ways, however. First, even if energy efficiency initiatives benefit the economy as a whole, not everyone benefits equally. Some businesses and residents are in a good position to take advantage of the various efficiency incentives and programs, while other businesses and residents are not, for a variety of reasons. Second, as Massachusetts goes deeper and broader in the efficiency market, some actions may be more costly, and certain efficiency measures may not be as cost-effective in the future. There has been a great deal of so-called "low-hanging fruit," but that could eventually all be picked. Based on past experience, there is a good chance, but no guarantee, that new technologies will come

on the market to make further rounds of cost-effective efficiency possible.

3. The state's renewable portfolio standard (RPS) has so far provided cost savings. Electricity suppliers are required to get a share of their electricity from renewable energy. They do that by purchasing renewable energy certificates (RECs) from eligible renewable energy generating facilities. Those certificates in effect represent the difference in price between power from renewable energy and from conventional fossil fuel generators. Electric distribution companies pass on the additional cost of procuring REC's to their default service customers and competitive retail suppliers incorporate the additional costs into the price they charge customers.

Counterbalancing the extra money spent for the certificates is a price suppression factor that reduces wholesale electricity prices because

ANALYSES PROJECT THE BENEFITS OF UTILITY EFFICIENCY PROGRAMS TO OUTWEIGH THE COSTS THREE TO ONE.

the highest-priced electricity generators (peaking facilities) do not need to come online as frequently. Based on data from the Department of Energy Resources, the price suppression effect has recently been greater than the premiums paid for renewable energy certificates, meaning that it has saved ratepayers money to bring large-scale renewable energy online.

It is not, however, guaranteed that the renewable portfolio standard will continue to provide savings in the future. The state report assumes that the cost of renewable energy certificates will remain at \$20 per megawatt hour. Some certificates have recently traded at more than \$50. If the price stays at that elevated level, the cost of the certificates would be greater than the price suppression benefits. That would not mean that the state's renewable portfolio standard policy should



Weatherization and other energy efficiency activities have expanded significantly in recent years.

be abandoned, since it is certainly worth spending some money to diversify the electricity supply and reduce emissions. On the other hand, it will be important to monitor the situation carefully to see if modifications should be made.

4. The immediate direct economic benefits of local energy generation initiatives, such as solar and offshore wind, do not outweigh the costs to ratepayers, especially if one looks only at electricity rates, according to the state's cost-benefit report. Compared to the large out-of-state renewable energy facilities (mainly wind, landfill gas, and biomass) that are the primary source of renewable energy certificates for the main tier of the state's renewable portfolio standard, solar generation requires higher public incentives that are financed in part by a system benefits charge and annual reconciliations that are included in electric bills of the state's distribution companies. State officials justify the spending by explaining that it produces other sorts of economic benefits—creating local clean energy jobs, supporting local clean energy businesses, and contributing to the growth of a vibrant clean energy industry sector. Although state officials and clean energy advocates can point to the considerable growth of the clean energy industry as a whole, there is little detailed data on how much of that growth is linked to public spending on a particular initiative,

such as solar installation incentives. It would be desirable for the state, working with the utilities and various stakeholder groups, to analyze more fully the costs and benefits of some of the state's sector development activities, especially for solar, keeping in mind that the cost of solar installations has been declining rapidly.

It is good that the State Senate, as part of legislation to update the *Green Communities Act*, has been seeking to identify ways to reduce rates that can receive the support of a wide range of stakeholders. Even after that legislation passes, the groups should continue to work together to implement strategies that can especially help those people and businesses that are not in a good position to benefit significantly from the state's clean energy activities. Some potential solutions are well known, such as reducing electricity use at peak times and bringing in low-priced clean power from northern New England or Canada. However, there could be more cooperation and focus on implementing such solutions.

Recommendations:

❑ The state should monitor the costs of solar closely and make adjustments to its solar program if necessary. Up to now the state's solar programs have not been a significant factor in overall electricity prices, because the quantity of solar installed represents a small share of total electricity generation. But, as the installation targets for solar increase over time, it could become a larger driver of electricity prices, especially if the cost of installations does not continue to fall.

❑ State leaders, the business community, and environmental and clean energy advocates should work together more closely to see if they can agree on strategies to help reduce rates without sacrificing climate change or clean energy goals.

The Costs of Adaptation, Smart Growth, and Transportation Measures

The state cost-benefit study looked only at energy efficiency and clean energy. The economic costs and benefits of other aspects of the state's response to climate change have been less studied.

In the case of enhancing resilience to climate change impacts, it is improbable that near-term actions represent the optimal economic development strategy for maximizing immediate economic growth. Instead, they will reduce the risk of economic harm. In this situation, the standard for judging the state's policies and programs should be whether the state is getting the maximum amount of climate protection for the least cost.

For transportation and smart growth initiatives, the cost-benefit approach will vary depending upon the program. In some cases, such as improved transit, costs can be compared to demonstrable reductions in congestion. Stronger public transportation systems can also lead to more efficient land assembly and a more productive economy, but these longer-term gains are not easy to quantify.

Reduced reliance on imported fuel is another area where climate change action should produce compelling and measurable economic benefits. Massachusetts, like the rest of the country, is facing increased energy costs for transportation because of the recent spike in gasoline and oil prices. Massachusetts residents and businesses currently spend more than \$10 billion annually on transportation fuels. If even a small portion of the energy required to move people could be saved, many millions of dollars a year would be returned to the state economy.

4. Global Warming Action at the Community Level

Massachusetts is a national leader in climate change action at the local level. It has achieved results through a combination of strong interest among municipal officials, aggressive action on the part of local climate change activists, and

favorable state policies that support and encourage municipal action.

The Green Communities Program has been especially successful. Eighty-six municipalities, representing 42 percent of the state population, have met the requirements under the *Green Communities Act* to become a Green Community. To achieve that recognition, they needed to clear several relatively high hurdles, including adopting the stretch energy code (a code that requires more efficient buildings than the standard state code), making zoning more favorable for renewable energy projects, and putting in place a plan to reduce municipal energy use by 20 percent within five years. The cities and towns have been diligent, in part because of the incentive of state grants ranging in size from \$130,725 to \$1 million. But according to a survey conducted for this report, the availability of grant funding was the primary motivation for less than one-quarter of the communities. More local government officials stated that the first motivation was a pre-existing desire to reduce municipal energy use.

MASSACHUSETTS IS A NATIONAL LEADER IN CLIMATE CHANGE ACTION AT THE LOCAL LEVEL.

The municipal officials involved in the Green Communities Program feel very good about the effect of their activities on their municipalities and are pleased with the state's administration of the program. The Green Communities Program has been so successful because it was designed to help municipalities do something they already had a desire to do (save energy). In addition, the program is user-friendly. The state has managed it well and carried out effective outreach to local governments. The state also offers MassEnergyInsight, a helpful, free, web-based tool that local governments can use to understand their energy consumption, create a baseline, and analyze changes to their energy use over time.

Although a good start has been made at addressing climate change at the community level, the state will need to take additional steps to maintain the momentum.

While the Green Communities Program focuses on municipal regulations and municipal facilities, there are also efforts underway in many communities to encourage residents and businesses to reduce their greenhouse gas emissions and to make it easier for them to do so. In some cases, the municipal government is the driving force behind the outreach effort, but in other cases grassroots climate action organizations are leading the way.

One particularly important type of program that is presently being implemented in Boston and an increasing number of other cities and towns is

a partnership between the municipal government and the utilities to deliver energy efficiency services more widely and more effectively. It is too soon to know how successful these partnerships will be, but the early indications are positive.

Recommendation:

□ The state should continue the grants to local governments under the Green Communities Program; encourage more communities to appoint and retain a municipal energy officer; regularly monitor and analyze how well the Green Communities are doing in achieving their five-year 20 percent energy reduction goal; encourage more community engagement to reduce citizen energy use; and do more outreach, information-sharing, and network-building among the Green Communities.

INTRODUCTION

On July 2, 2008 Governor Deval Patrick signed the landmark *Green Communities Act* proclaiming: “Climate change is the challenge of our time and we in Massachusetts are rising to that challenge.”¹ Massachusetts is indeed rising to the challenge, but will we succeed in reaching the greenhouse gas reduction targets we have committed to achieving?

In the pages that follow, we take a step-by-step approach to answering this question. Section I begins by providing general context, describing the problem, what it could mean for the citizens of the Commonwealth, and identifying several obstacles that make it difficult for governments to tackle climate change. This opening section also provides an overview of policy development in Massachusetts, beginning with efforts initiated in the 1990s and 2000s, and providing particular focus on action since 2007, when the legislature passed several key pieces of legislation and the Patrick administration ramped up climate change and clean energy activities.

Section II assesses the state’s responses to climate change. Because no one single measurement can tell whether or not Massachusetts is having success, we evaluate progress in three different ways. Each lens focuses on a different key question: (1) Is the state on track to meet its targets? (2) Is the state successful in the four key realms of energy efficiency, electricity generation, transportation, and adaptation? And (3) Is the state playing a leadership role?

In preparing this analysis, we used the rich compendium of information that is included in reports and other documents produced by state agencies. We also interviewed many state officials and stakeholders to understand their viewpoints and to get answers to specific questions about various programs. We learned about the opinions of an even wider group of stakeholders by reading their commentary on the Massachusetts cli-

mate response, including all the November 2011 testimony provided to the Joint Committee of Telecommunications, Utilities, and Energy on the *Green Communities Act*.

Section III compares the economic costs of addressing climate change to the economic benefits of the policies that the state has been implementing. Although there is a strong majority view in Massachusetts that the climate is changing because of human activities and that it is desirable to reduce greenhouse gas emissions, there is considerable disagreement about how much climate change action is currently costing and how much public funding should be devoted to dealing with the problem.² We use available data to clarify how the costs and benefits have balanced out so far, as well as what they might be distributed in the future.

An effective response to global warming requires action at the local level, as well as by state government. Fortunately, there has been considerable activity by communities in Massachusetts. We describe and assess this progress in Section IV. Our research for that part of the report included interviews with 21 local climate change activists, as well as a survey of municipal representatives from the 86 designated Green Communities under the state’s Green Communities Program. The survey achieved a 91 percent response rate and we use highlights from it to inform our analysis in Section V. The full survey results are included in Appendix B.

Finally, to put Massachusetts’s activities into perspective, we studied the response to climate change in six other leading states, and examined particularly intriguing program ideas from around the world. The policies from six leading states are summarized in Appendix D; Appendix E describes a few programs that could be particularly relevant to Massachusetts in more detail.

Taken together, the content presented in this

report provides a comprehensive assessment of the Massachusetts response to the very serious problem of global warming. As you will see, the state has been a true leader in recognizing the significance of this problem and in taking action. Many individuals—from Governor Patrick to legislative leaders to state agency officials to municipal leaders and local activists—have acted with commitment, vigor, and creativity and they deserve considerable credit. But there are also ways in which the state and its citizens can and should be more effective. Scattered through this report, we offer many recommendations for how Massachusetts can better address climate change at both the state and local levels.

1 Quoted in Beth Daley, “Patrick Signs Landmark Energy Legislation,” *Boston Globe*, July 2, 2008.

2 For public attitudes about climate change, see Steve Koczela et al., *The 80 Percent Challenge: A survey of Climate Change Opinion and Action in Massachusetts* (Boston: MassINC and MassINC Polling Group, 2011). That survey found that 74% of the public felt it would be either a very serious or somewhat serious problem for Massachusetts if nothing were done to reduce global warming in the future; 83% believed that “we have a moral obligation to do what we can to reduce global warming;” and 84% agreed that “developing renewable energy sources is critical to our national security” (pages 45-6). The report is available at www.massinc.org/Research/The-80-percent-challenge.aspx.

I. THE MASSACHUSETTS RESPONSE TO THE CLIMATE CHANGE CHALLENGE

As a primer for those concerned about global warming, but uncertain about its impact and how and why a state like Massachusetts should respond, this section provides important context. We detail the threats posed by global warming, describe how the state has fashioned its increasingly serious response to these threats, and explain why it is important for individual states like Massachusetts to take action.

Scientific Views of the Threat to Massachusetts

Using the scientific community's time-tested process of peer review and vigorous debate, scientists have become ever more certain that human-caused greenhouse gas emissions are causing climate change. In 2010, the National Academy of Sciences, which is the organization of distinguished scientists that has served as the scientific advisory body for the federal government for nearly 150 years, concluded that "there is a strong, credible body of evidence, based on multiple lines of research, documenting that climate is changing and that these changes are in large part caused by human activities. While much remains to be learned, the core phenomenon, scientific questions, and hypotheses have been examined thoroughly and have stood firm in the face of serious scientific debate and careful evaluation of alternative explanations."¹ The Academy—like the overwhelming majority of other scientists who have studied the climate—concluded that global warming "poses significant risks for a broad range of human and natural systems."²

Although Massachusetts would not likely be the place in the world to suffer most from a changing climate, the potential negative impacts here are many and serious. Climate change is already producing significant impacts in Massachusetts, and those impacts will most likely



Photo Credit: Massachusetts Executive Office of Energy and Environmental Affairs

Deerfield River at flood stage.

increase greatly over time. Although scientists cannot be certain about the rate and the extent to which climate change will affect Massachusetts, they predict it will have serious consequences all across the state.

To develop predictions of the impacts of climate change around the world, the scientists of the Intergovernmental Panel on Climate Change, the leading international organization assessing climate change, have envisioned both low- and high-emissions scenarios. They found that some impacts will not likely manifest themselves for several decades, while others are already occurring, such as the frequency of flooding, hotter summers, and warmer waters. Their general analysis has formed the basis for more detailed projections by scientists looking specifically at Massachusetts and its region.

In the case of Massachusetts, impacts to the sea coast and floodplains are especially troubling concerns. Many of our most populous and historic communities are along the coast. Under the high-emissions scenario, projections of sea-level rise range from two to six feet by the end of the century, inundating much coastal land and many

historic places. Even a sea level rise of 26 inches in Boston could damage assets worth an estimated \$463 billion.³ In addition, the coast will experience more frequent wave surges, accelerating cliff retreat and failure.⁴

In either the low- or high-emissions scenario, by 2050, Boston could experience the current 100-year flood every two to three years on average, and by 2100, it could experience such floods every one to two years. Key Boston landmarks and infrastructure, such as North Station and Faneuil Hall, would be threatened, erasing historic and beloved places, as well as some of the things that bring tourism to the state, one of our most important industries.⁵

Because of projected changes in the timing of precipitation, Massachusetts is expected to experience a 75 percent increase in drought occurrences, which could last one to three months under the high emissions scenario.⁶ Precipitation is projected to rise 5-10 percent over the course of the year, but the increase would likely all occur during the winter, and mostly as rain. The region's winter recreation businesses will be adversely affected, because the area is expected to experience 10-20 percent fewer skiing days, resulting in a loss of \$405 million to \$810 million per year.⁷ Having less winter snow will reduce available water supplies.

Under the Intergovernmental Panel on Climate Change's high-emissions scenario, Massachusetts would expect a 5-10°F increase in the average ambient temperature, with more days of extreme heat in the summer. Currently, the state experiences 5-20 days annually above 90°F, but, by the end of the century, Massachusetts would experience 30-60 days per year with temperatures above 90°F. Moreover, 28 days would likely be above 100°F per year, as compared to two days now.⁸ Rising temperatures will lengthen the growing season for food production, but emblematic crops, such as cranberries, apples, and maple syrup, may disappear. Cranberries, which gener-

ate the largest revenue of any individual Massachusetts crop, are especially at risk under the high-emissions scenario because they require long winter-chill periods for optimum flowering, fruit setting, and seed development. Massachusetts may become unsuitable for cranberry production as soon as mid-century.⁹

Rising ocean temperatures will result in substantial habitat boundary shifting. For example, under the high-emissions scenario, cod likely will disappear later this century from waters south of Cape Cod. The storied Georges Bank fishing grounds would be vulnerable to substantial loss of suitable cod habitat. Other economically important species, such as lobster and other shellfish, will also lose critical habitat and conditions necessary for their survival. In addition, rising ocean temperatures will facilitate the spread of lobster-shell disease, oyster Dermo, and other diseases that render shellfish unmarketable.¹⁰

Climate-related illnesses are also projected to rise and are of particular concern for the elderly and other vulnerable populations. The possible impacts on health include increased heat stress; increased respiratory and cardiovascular diseases; higher pollen counts; increased vector-borne diseases; increased outbreaks of water-borne diseases; degraded water quality; and outbreaks of infectious diseases. The number of days with poor air quality in Boston is expected to quadruple under the high-emissions scenario.¹¹ Even under the low-emissions scenario, the Northeast region can expect a 50 percent increase in the number of days exceeding the EPA's eight-hour ozone standard.

The Barriers to Government Action

Given the information and predictions coming from the scientific community, it would initially seem obvious that Massachusetts should acknowledge the problem and take action. But global warming has been an issue that governments and politi-

cal leaders at all levels in the United States have been shown to address. The reasons for this hesitation are many and have increased in recent years:

- Global warming is a long-term, gradually increasing problem, but political leaders tend to find it more urgent and straightforward to focus on immediate needs and short-term problems. No matter how serious a long-term problem is, there is no particular motivation or deadline that compels a government to take up the issue by a certain specific date.
- Fossil fuels, which are the major cause of global warming, have been so central to the economy and the existing energy infrastructure that meaningful action is difficult and complicated. A government cannot simply issue one or two small regulations or modifications to procedures. Instead, there needs to be many significant changes that require governments to overcome numerous barriers and deal with complex implementation issues.
- Because climate change is a global problem, no individual government—and certainly not one at the state level—can unilaterally solve the problem. An effective solution requires many governments to take significant action individually and collectively. That makes it tempting for government leaders to wait until other political entities have taken the first steps.
- Although the scientific view that global warming represents a serious risk should be undeniable, it has instead become highly contentious. In the past, when there has been a strong scientific consensus around an issue, political debate has generally moved beyond the science to focus on the ways to

address the issue. Yet, in the case of climate change, the science itself has become a divisive battlefield of debate and confusion. Part of the reason for this is that it is impossible for scientists to provide 100 percent uncontested proof about something that will happen in the future. And there is less deference these days to all sources of authority, including scientists. Moreover, and probably most important, fossil fuel companies and other powerful economic interests have strong financial incentives to convince policymakers that aggressive action to reduce greenhouse gas emissions is not warranted. As part of their well-funded campaigns to discourage political leaders from acting, they have attacked the findings and methods of climate scientists.

- The economic downturn that began in the mid-2000s has made it harder to get policymakers and the public to focus on non-economic issues and to invest in new major public interest initiatives. It also makes them sensitive to any actual or perceived negative economic impacts of climate change action.

The Commonwealth's Increasingly Serious Response

Given the tendency for governments to defer addressing climate change, Massachusetts deserves credit for taking the problem seriously and especially for ramping up its activities since 2007.

Recent efforts build on pre-existing, long-standing initiatives and an early acknowledgment of the importance of global warming. Several decades ago, well before scientists were sounding the alarm on climate change, a desire to reduce dependence on foreign oil, cut air pollution, and lower electricity costs led the Commonwealth to make a strong commitment to energy efficiency. Through the 1980s, Massachusetts

was one of the leading states, along with California and New York, to develop and implement energy-efficiency practices'. When the Commonwealth later wanted to advance energy efficiency in order to reduce greenhouse gas emissions, the regulatory framework and infrastructure were already in place.

Through the 1990s and early 2000s, the state took a variety of gradually increasing steps to study climate change action options and implement policy to slow the growth in greenhouse gas emissions. When the state restructured the electric utility system in 1997, renewable energy received special attention, in great part because energy technologies like wind and solar do not produce greenhouse gas emissions. Two major measures were included in the restructuring legislation to promote renewable energy—a renewable portfolio standard (RPS), which required electricity suppliers to get a gradually increasing share of their electricity from renewable energy sources, and the Renewable Energy Trust Fund, which used ratepayers' payments for grants, loans, and investments that supported renewable energy. The existence of both of these mechanisms has been important to the state's accelerated greenhouse gas reduction activities since 2007.

In 1998, the state started its first climate planning, holding stakeholder meetings and public discussions on how and what action to take. Three years later, in great part because of concerns about pollution from the so-called "Filthy Five" large, old coal-fired power plants in the state, the Department of Environmental Protection issued stronger regulations controlling four pollutants (nitrogen oxides, sulfur dioxides, particulates, and carbon dioxide). For the first time, the state government included carbon dioxide among the regulated pollutants.

Massachusetts leadership was essential in encouraging other governments in the region to address global warming. In 2001, for example, Massachusetts took a leading role in forging an

agreement with all the other New England states and with the Eastern Canadian provinces to produce the first international plan on climate change. That plan committed all of the states and provinces to reducing regional emissions to 1990 levels by 2010 and then to 10 percent below those levels by 2020.¹² The plan also committed the states to writing their own action plans to meet these goals.

Then, in 2003, New York responded to the implied challenge from the New England states with a proposal to craft a regional greenhouse gas emissions cap on power plants. Massachusetts co-chaired the effort to develop a regional program, the Regional Greenhouse Gas Initiative (RGGI), to cap carbon dioxide emissions from power plants in New England and the Mid-Atlantic region. Massachusetts was instrumental in crafting the cap agreement and the apportionment of emissions under RGGI.

In 2004, the Commonwealth issued its first attempt at a comprehensive plan to address global warming. The *Massachusetts Climate Protection Plan* detailed "a range of strategies to achieve near-term reductions" in greenhouse gas emissions.¹³ It described over 75 separate efforts that the state was either starting or proposing as new initiatives.

A solid foundation was therefore in place when the executive and legislative branches embarked on an unusual flurry of activity in 2007 and 2008. Right at the beginning of his administration in 2007, Governor Deval Patrick signed on to RGGI. He reversed a decision by Governor Mitt Romney, who had decided against signing the RGGI agreement, withdrawing Massachusetts from the program at the end of 2005.

Governor Patrick also established the Executive Office of Energy and Environmental Affairs, which brought together under a single Secretary the various environmental and energy functions of government, including the Departments of Energy Resources, Public Utilities, Environmental Protection, Conservation and Recreation, Fish and Game, and Agricultural Resources. Although

there had been earlier efforts at coordinating environmental and energy policy, this reorganization represented a more fundamental structural change. It also had important symbolic value by demonstrating the high priority the Governor placed on addressing the environmental impacts of energy use.¹⁴

Throughout 2007 and into 2008, the legislative and executive branches worked on major legislation to accelerate the transition to clean energy and give greater priority to climate change. In May 2008, Governor Patrick signed the *Oceans Act*, which was aimed in part at setting rules and procedures for developing offshore wind and marine renewable energy. As the Patrick administration's press release described it, the legislation required "Massachusetts to develop a first-in-the-nation comprehensive plan to manage development in its state waters, balancing natural resource preservation with traditional and new uses, including renewable energy."¹⁵

Of the three additional bills that were then enacted during the summer of 2008, the *Green Communities Act* was the most important in terms of additional funding and programs for greenhouse gas reduction measures. Most notably, the law enshrined energy efficiency as the preferred choice going forward and required utilities to undertake all investments in energy efficiency that are cost-effective or less expensive than purchasing additional electricity or natural gas. This mandate has led to rapid and significant growth in such investments. In addition, the *Green Communities Act* established the Green Communities Program, which has stimulated many towns and cities to give increased attention to reducing their greenhouse gas emissions. In terms of renewable energy, the law increased the RPS targets and made other adjustments to that standard, and it required utilities to enter into long-term contracts with renewable energy generating facilities. Additional provisions addressed net metering (a policy allowing cus-

tomers to receive credit at retail rates for electricity they generate onsite), green buildings, and other measures that made it easier to reduce greenhouse gas emissions.¹⁶

The other key piece of legislation that same summer was the *Global Warming Solutions Act*. It set an ambitious statewide legislative greenhouse gas reduction goal for 2050 of an 80 percent reduction from 1990 emissions levels. It directed the Executive Office of Energy and Environmental Affairs to determine a 2020 goal that would be between 10 percent and 25 percent below 1990 levels, and then to produce a plan to meet that goal, as well as another plan with strategies for adapting to the changes that would likely come with global warming. Among other provisions, it required the Department of Environmental Protection to develop a baseline inventory of emissions in 1990 and to collect regular emissions reports from the state's largest sources of emissions. It also required the state to take "climate impacts and effects" into account with all significant deci-

THE GREEN COMMUNITIES ACT ENSHRINED ENERGY EFFICIENCY AS THE PREFERRED CHOICE GOING FORWARD.

sions, licenses, approvals and regulations, and gave state agencies the authority to "promulgate regulations that reduce energy use, increase efficiency and encourage renewable sources of energy in the sectors of energy generation, buildings and transportation."¹⁷ More generally, the true significance of the *Global Warming Solutions Act* was that it provided a general context into which the various more specific legislative, regulatory, and administrative initiatives can fit.

The Green Jobs Act passed that same summer of 2008. It provided additional funding for state investments in clean energy companies and created the Massachusetts Clean Energy Center as the agency responsible for promoting the growth of the state's clean energy industry.

It is rare for so much important, related legislation to pass in such a short period of time. What made this possible was strong commitment and leadership in both the legislative and executive branches. The top leaders—the Governor, House Speaker, and Senate President—as well as others in the House, the Senate, and the Executive branch—worked together cooperatively and successfully. The Governor made it clear throughout 2007 and 2008 that clean energy was a top priority for him. House Speaker Sal DiMasi, along with Secretary of Energy and Environmental Affairs Ian Bowles, played the lead role in initiating and pushing the *Green Communities Act* and *Green*

STRONG LEADERSHIP IN THE LEGISLATIVE AND EXECUTIVE BRANCHES MADE THE RAPID LEGISLATIVE PROGRESS POSSIBLE.

Jobs Act. Senator Marc Pacheco, Chair of the Senate Committee on Global Warming and Climate Change, initially developed the *Global Warming Solutions Act* and shepherded it through the legislature with Representative Frank Smizik and others. Of course, there were many stakeholders and constituency groups that advocated effectively for and significantly shaped the various pieces of legislation. But it is unlikely that it could have all been passed without such cooperation and leadership from the government leaders.

The Importance of State Action

By the fall of 2008, Massachusetts had a strong basis for moving forward more aggressively to address climate change. But why does such aggressive action make sense even though Massachusetts cannot single-handedly solve global warming, since it is directly responsible for only 1.23 percent of US greenhouse gas emissions and .23 percent of the world's emissions?¹⁸

The most harmful and costly possible impacts of climate change can only be avoided if a critical

mass of political entities around the world takes action and each of those entities does its individual part to reduce emissions. By starting into action sooner rather than later, Massachusetts can more easily meet long-term emission-reduction goals that represent our state's proportionate share of what needs to be done on a global scale. Moreover, the early movers, by showing that greenhouse gas reduction is possible, can influence other entities to take action and do their part. It is reasonable to hope and expect that climate change action can and will gain momentum over time with ever more states, cities, and countries signing on to do their part. In addition, if a mandatory federal climate policy and program is implemented in the future, early movers like Massachusetts are likely to be given "credit" for already implemented reduction results.

Nevertheless, some groups and individuals have worried that Massachusetts places itself at an economic disadvantage by voluntarily choosing to focus on greenhouse gas reductions when it is not required by federal law to do so and when some other political entities are staying on the sidelines. They point to the costs associated with reducing emissions.

There are practical, self-serving reasons, however, why it would be a mistake for the Commonwealth to be a laggard rather than a leader. For one thing, serving as a climate change leader strengthens the Massachusetts brand and avoids diminishing the appeal of the state for potential new businesses and potential new residents. This is especially important in the increasingly globalized economy in which Massachusetts competes. Massachusetts projects an image as a knowledge-based economy. Two intertwined, enduring characteristics of the state are especially meaningful and appealing to businesses, institutions, and people from other parts of the world: Massachusetts as a center of innovation and Massachusetts as a center of education and research.¹⁹ These characteristics are central to

the Massachusetts brand, burnishing the state's reputation and attracting students to our universities, investors to our businesses, and tourists to our hotels and restaurants.

To maintain our brand and its advantages, the state needs to show that it takes science, education, and innovation seriously. Being at the forefront of the innovation required to address global warming does that. Massachusetts would undercut its brand and standing with relevant parties around the world if it did not show that it respects the knowledge and findings of the scientific community and takes the problem of climate change very seriously.

Massachusetts therefore has practical reasons to be a climate change leader. And such leadership need not be a drain on the economy. If implemented carefully, a plan of action to reduce greenhouse gas emissions can produce a host of other social and economic benefits, such as reduced illness from air pollution, less vulnerability to spikes in fossil fuel prices, and creation of additional jobs in clean energy businesses. Especially in the early years of carbon reduction efforts, when there are many alternative ways to achieve emission reductions, it is possible to choose strategies with multiple benefits.

Both of the two most recent Governors have realized this. When introducing the 2004 Massachusetts Climate Protection Plan, Governor Romney emphasized the concept of "no regrets" policies, ones that provide net benefits to the state even if it turns out that climate change does not happen. He indicated that there were many such policies and, as an example, he pointed to action to protect the climate that "also promotes Massachusetts businesses that are at the forefront of the new markets for renewable energy technologies."²⁰

Governor Patrick has viewed the clean energy industry as a pillar of the state's innovation economy and has spoken repeatedly of it as an important driver of economic growth and job creation.

For example, in July 2011, he observed that "Bringing the technological capability that is here in the Commonwealth to bear on solving that question of energy independence has been a great, big economic pick up for us."²¹

To be sure not all policies and programs to reduce emissions will provide economic benefits, and there have been times when the costs have been underestimated and the benefits exaggerated. However, that does not undercut the basic point that many of the steps that need to be taken to reduce emissions produce other social and economic benefits and do not represent a drain on the economy.

But Is It Working?

Massachusetts and its leaders have clearly made a serious commitment to tackle global warming, and that has been very important. However, ultimately, the threat of climate change will not be reduced by commitments, but by meaningful actions that lead to measurable reductions in greenhouse gas emissions and that inspire others to take action. The rest of this report examines how well Massachusetts is doing at turning its words and promises into deeds.

CHAPTER I. ENDNOTES

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II. HOW SUCCESSFUL IS MASSACHUSETTS? VIEWS THROUGH THREE LENSES

No single measuring stick can be used to provide a complete picture of how well Massachusetts is doing in addressing climate change. Instead, we examine Massachusetts's success below in three ways, each of which provides additional perspective by answering a different key question: (1) Is the state on track to meet its targets? (2) Is the state successful in the four key realms of energy efficiency, electricity generation, transportation and land use, and adaptation? (3) Is the state playing a leadership role?

1. Is the State on Track to Meet Its Targets?

The *Global Warming Solutions Act* set a target of reducing greenhouse gas emissions by 80 percent below 1990 levels by 2050, and delegated to the Secretary of Energy and Environmental Affairs the task of first selecting a 2020 goal between 10 and 25 percent below 1990 levels. It also required that the Executive Office of Energy and Environmental Affairs develop a plan to achieve the goal.

With that in mind, and in part at the direction of the legislation, the Executive Office of Energy and Environmental Affairs and the Department of Environmental Protection produced several studies to establish a 1990 baseline of emissions, to project what emissions would be in 2020 without any new climate action initiatives, to estimate the emission reductions that existing policies would produce, and to analyze potential cost-effective new policy initiatives for reducing emissions.¹ Notably, the resulting state estimate of emissions in 2009 found that they were already between 2 and 3 percent lower than in 1990.²

With reassuring results from the studies, then-Secretary of Energy and Environmental Affairs Ian Bowles opted for a 25 percent emis-

sions reduction by 2020, the largest possible target under the legislation. He felt comfortable with that ambitious goal because the analysis seemed to show that policies that had already been enacted at the federal or state level, including in the *Green Communities Act* of 2008, would lead to an 18 percent reduction, thereby leaving the state more than two-thirds of the way to the 25 percent goal. Moreover, at a series of eight public hearings in June 2010, for which nearly 200 individuals and organizations provided comments, "The vast majority of commenters called for the Secretary to set the GHG limit at 25 percent 1990 levels."³

In December 2010, the Executive Office of Energy and Environmental Affairs released the 2020 climate plan mandated by the *Global Warming Solutions Act*. Numerous staff members from various state agencies participated in developing it, as did many outside stakeholders. Before it was released, it was reviewed by the advisory committee mandated in the legislation, a distinguished group co-chaired by Susan Avery (President of the Woods Hole Oceanographic Institute) and Martin Madaus (former CEO of Millipore Corporation).

The plan set out a series of policies and initiatives that it projected would lead to a 27 per-

IN DECEMBER 2010, THE STATE RELEASED THE 2020 CLIMATE PLAN MANDATED BY THE GLOBAL WARMING SOLUTIONS ACT.

cent reduction in emissions from 1990 levels by 2020, slightly more than the 25 percent target. But, because of the many inherent uncertainties in any predictions of the future—everything from the rate of future economic growth to the effectiveness of some of the proposed new initiatives—the plan indicated that the ultimate end result of the proposed actions could be anywhere from 18 percent to 33 percent below 1990 levels.

The plan's recommended measures fall into four categories: buildings, electricity generation, transportation, and non-energy emissions.

In addition, the plan included actions or policies whose impacts were difficult to quantify or would contribute to one of the other policies already on the list. For example, many of the impacts of the state's Leading by Example Program, which seeks to reduce energy use in government buildings and facilities, were recognized as part of the "All cost-effective energy effi-

ciency" target. The other non-quantified policies are building energy rating and labeling, clean energy performance standard, *Massachusetts Energy Policy Act* (MEPA) greenhouse gas policy, the Green Communities Program, and consideration of greenhouse gas emissions in state permitting, licensing, and administrative approvals.

An Assessment of Progress toward the 2020 Target

In evaluating progress toward the target of a 25 percent reduction in emissions by 2020, there are two very different questions to be asked: (1) how good a job is the state doing in trying to achieve the goal and (2) how likely is it that the goal will be achieved?

The reason why both questions need to be asked is that state government does not have complete control over the quantity of emissions produced in the state. The federal government and broader social and economic forces play important roles. For that reason, it is conceivable that the goal will be achieved even if the state does a poor job of implementing its climate plan. Conversely, even if the state diligently pursues everything in the plan, it could still end up missing the targets for reasons beyond its control.

How good a job is the state doing?

In terms of the first question—the effectiveness of state government's overall climate change strategy and its implementation—the record so far is mixed. On the one hand, the Patrick administration, from the Governor on down, appears to be sincerely committed to addressing global warming and reducing greenhouse gas emissions. Its climate change plan is based on solid analysis and sets out an array of appropriate, logical actions. Staff members have been working diligently to implement them. There is solid evidence of effective administration and solid progress related to many of the initiatives that were put in place in the three years before the 2010 plan was announced.

Figure 2.1:
The Reduction Goals in the Massachusetts Plan for 2020⁴

BUILDINGS	9.8%*
All cost-effective energy efficiency/RGGI	7.1
Advanced building energy codes	1.6
"Deep" energy efficiency improvements for buildings	.2
Expanding energy efficiency programs to C/I heating oil	.1
Developing a mature market for solar thermal water/space heating	.1
Tree retention & planting to reduce heating and cooling loads	.1
Federal appliance and product standards	.6
ELECTRICITY GENERATION	7.7%*
Expanded Renewable Portfolio Standard (RPS)	1.2
More stringent EPA power plant rules	1.2
Clean energy imports	5.4
TRANSPORTATION	7.6%*
Federal & California vehicle efficiency and GHG emissions standards	2.6
Federal emissions & fuel efficiency standards for medium & heavy-duty vehicles	.3
Federal renewable fuel standard & regional low-carbon fuel standard	1.6
Clean car consumer incentives	.5
Pay As You Drive (PAYD) auto insurance	1.1
Sustainable Development Principles	.1
Green DOT	1.2
Smart growth policy package	.4
NON-ENERGY EMISSIONS	2.0%*
Reducing emissions from motor vehicle air conditioning	.3
Stationary equipment refrigerant management	1.3
Reducing SF6 emissions from gas-insulated switchgear	.2
Reducing GHG emissions from plastics	.3
TOTAL	27%*

*To avoid double-counting, the plan's authors adjusted the subtotals downward to account for overlap among individual policies.

For example, as discussed below, the state's recent energy efficiency efforts have generally been quite successful and there are good reasons to believe that future energy efficiency activities will continue to reduce emissions.

Many stakeholders credit the Governor, in particular, and state government, in general, with leading when it comes to climate change action. For example, when we asked 21 leading grassroots climate change activists from across the state which level of government (federal, state, regional, county, municipal) was doing the most to address climate change, 15 said the state government. No one responded the federal government and only two said municipal governments. The remaining four people believed that there was a tie between state government and one or two of the other levels.

On the other hand, there are at least four ways in which the state's climate change plan implementation could and should be better:

I. Progress indicators are not clear and progress monitoring is insufficient. While the *Massachusetts Clean Energy and Climate Plan for 2020* described the various necessary policies and initiatives well, it did not include a full work plan. Such a work plan has not been developed and publicized subsequent to the publication of the climate plan, nor has a tracking and monitoring system been put into place. For some pre-existing activities, such as oversight of the utilities' energy efficiency programs and renewable portfolio standard, there is extensive monitoring and solid data. But for many of the items in the plan, it is hard for state officials or outside stakeholders to know what the specific expectations are or whether the state is on track to meeting those expectations. For example, the plan states that stationary equipment refrigerant management will lead to a 1.3 percent reduction in total emissions by 2020, but it is unclear what needs to be done by the end of 2012 or 2015 to remain on

track for achieving that reduction. Without such information, state officials cannot effectively oversee the work being carried out by the various departments and cannot know whether things are moving forward as fast as they need to.

Therefore, the state should make it a priority to set up an effective progress tracking and monitoring system. For each item in the climate plan, there should be year-by-year milestones, progress indicators, and a methodology for how the state will determine whether it is on track to meet its goals. Of course, it is easier to quantify the results for some of the initiatives in the plan than for others, but the state needs to devise some type of measurement of progress for each item, even if only qualitative in nature.

This sort of transparency will be useful to state leaders administering the climate change mitigation effort, as well as to the state Global Warming Advisory Committee, interested stakeholders, and other citizens who want to understand how the state's efforts are proceeding. Moreover, having a serious monitoring and evaluation program in place will underline the importance of ensuring success in reaching the 2020 goal.

The state has a statutory obligation to move in the direction of the monitoring program we are calling for. *The Global Warming Solutions Act* instructs the Department of Environmental Protection to "promulgate regulations establishing a desired level of declining annual aggregate emission limits for sources or categories of sources that emit greenhouse gas emissions." The Act further requires the Department to have the regulations in place by January 1, 2012 and to take effect starting on January 1, 2013. These regulations have not yet been promulgated.

For models for monitoring, tracking, and reporting, the state may want to look to California. That state developed and made public near-term implementation plans for each measure and strategy in its climate action plan.⁵ In addition, the California Environmental Protec-

tion Agency is required to produce an annual report card describing the actions of the various state agencies to reduce emissions. The report card includes: a list of measures each agency implemented, the emissions reduced as a result of those measures, a comparison of emissions achieved to the agency's specific targets, and a list and timetable for adopting additional measures that are needed to reach the agency's targets.⁶

Another possible model could be the United Kingdom. The format, structure, and timing of that country's annual reports could possibly be adapted to Massachusetts, as could its Committee on Climate Change. (For more information on climate change governance and implementation in the United Kingdom, see Appendix E.)

2. There is insufficient direction of overall implementation. Even though coordination of climate change action activities is much better in Massachusetts than in most states, greater coordination and direction is still needed. On the plus side, the creation of the Executive Office of Energy and Environmental Affairs made Massachusetts the first state in the country to combine all energy and environmental agencies into a single department and made coordination among those agencies much easier and stronger. In addition, other relevant departments, including the Department of Transportation and the Division of Capital Asset Management, as well as quasi-public agencies, such as Massport, have been actively involved in climate change initiatives. To outside observers, it appears that the various key players in the different departments and agencies are working together cooperatively and they sincerely want the state's climate change plan to succeed.

Nevertheless, the current degree of coordination is insufficient given the importance and complexity of the greenhouse gas reduction task. Currently, it is not sufficiently clear who is in

charge of the overall effort and how the various pieces fit together. Because so many different agencies are involved, not all in the same secretariat, the Governor should appoint a single high-level individual to be responsible for directing the overall effort and keeping track of policy and program implementation in all departments. Of course, if the type of transparent tracking and monitoring system recommended above is put in place, it will be much easier for an individual to provide direction and make sure that the various pieces of the plan are proceeding as desired.

3. The launch of new initiatives and activities is lagging. Those programs and initiatives that were underway before the December 2010 release of the *Massachusetts Clean Energy and Climate Plan for 2020* are generally receiving sustained attention and showing progress, as will be discussed below. However, the plan called for quite a few new initiatives, regulations, and activities, and many of those have been slow to launch and their status is unclear, at least to outsiders. Because there are less than eight years until 2020, these initiatives need to be implemented quickly in order to achieve the desired results by that date. Programs such as clean car consumer incentives, tree planting, pay-as-you-drive insurance, GreenDOT, and deep energy efficiency retrofits for buildings are moving forward slowly. Some of these programs were initially projected to yield only small changes in emissions by 2020 (e.g., 0.1 percent for tree planting), but some others are far more significant (e.g., 1.3 percent for stationary equipment refrigerant management, which works out to 5 percent of all the emission reductions needed to reach the 2020 target).

4. The government response to climate change needs more visibility. To build long-term public support for climate change action and to encourage citizens to get involved in addressing the problem, it is important for governments

to educate the public about the threat of global warming, the fact that it requires a vigorous response, and the actions the government is taking to address it. Although Massachusetts has taken strong actions and state leaders have discussed climate change, the focus has recently—especially over the past year—been so heavily on the economic benefits of building a clean energy industry that the climate message has been barely visible to the public.

The Patrick administration has generally provided less publicity for activities with a climate change emphasis than for those with a clean energy economy focus. In part for this reason, few people have read the state’s climate change action plan, or even know about it. Even most grassroots climate change activists are unfamiliar with it. During our interviews of 21 leaders of community-based climate change organizations, only three indicated that they had read the plan. Of the remainder, 14 had not read it and many were unaware that there was such a plan. Four said they had glanced at it or had skimmed parts, but had not read it.

Admittedly, in the current political climate, with controversy over climate change science and anxiety about the economy, it is difficult for any politician to emphasize climate over the economy. We realize that messaging around climate change would likely not help the Patrick administration get favorable energy legislation passed on Beacon Hill, and could even lead to criticism. Although it will remain important for political leaders and the administration to continue to highlight economic reasons for taking particular actions related to clean energy, there should be greater attention to the threat of global warming to the state and region, and the rationale for actions in addition to industry growth. In particular, the administration should make a concerted effort to inform the public that there is a coherent state plan to reduce the state’s greenhouse gas emissions. It should also explain to

the public what citizens, businesses, and private organizations can do to help the state achieve its climate goals.

Will Massachusetts reduce emissions by 25 percent by 2020?

Because there is no publicly accessible central database or scorecard of emissions, milestones, and projected impacts of different initiatives, it is difficult to know where things will end up in 2020. But one way to begin to get a handle on this question would be to divide the various items in the state’s climate plan into several categories and then consider each of those categories.

Fuel switching and consumption reductions caused by external forces

Over the nearly three years since the Department of Environmental Protection issued its business-as-usual projections, the biggest factors in reducing short-term emissions have been low natural gas prices and warm weather. Increased reliance on natural gas power plants and heating systems has reduced the use of coal and oil, which produce

Figure 2.2: Categories of Emission Reductions

CATEGORY	PROJECTED EMISSIONS REDUCTION IMPACT	SHARE OF TOTAL REDUCTIONS NEEDED TO REACH A 25% REDUCTION*
Fuel switching and consumption reductions caused by external forces	0	?
Initiatives originating outside Massachusetts	5.0%	20.0%
The big pieces	12.5%	50.0%
On track	2.9%	11.6%
Unknowns	7.1%	28.4%

*Numbers exceed 100 percent because the policies and initiatives in the Massachusetts climate plan are projected to achieve a 27 percent reduction in emissions rather than 25 percent and because the state reduced the total to be achieved by the individual initiatives from 27.5 percent to 27 percent to account for overlap among the policies. In addition, reductions from higher than expected fuel switching were not included in the plan.

much higher greenhouse gas emissions than natural gas. Warm winters have reduced energy use for heating and electricity. In addition, the slow recovery from the recession has suppressed emissions due to lower-than-projected overall economic activity, construction, and travel.

Interestingly, despite the severity of the recession, an analysis of regional emissions for New England and the Mid-Atlantic by the New York State Energy Research and Development Authority (NYSERDA) found that warm weather and fuel switching from coal and oil to natural gas were each more than five times more important than the economy in the decline of emissions in the region between 2005 and 2009.⁷ It is reasonable to believe that Massachusetts experienced trends similar to the wider region.

Although we hope that the economy grows faster than in the mid-2000s and winters may be colder, it seems highly likely that natural gas prices will remain relatively low, keeping down the use of coal and oil for electricity generation. This is mak-

ing it easier for Massachusetts to hit some of the targets in the 25 percent goal. In particular, the state's plan assumed that the state's energy efficiency program and the Regional Greenhouse Gas Initiative (RGGI), a region-wide, market-based program to reduce emissions from power plants larger than 25 megawatts, would drive some fuel switching. Because of the broader trends, RGGI is meeting its current goals easily. As we discuss below, it may now be possible for the state to achieve some greater than anticipated emissions reductions by strengthening RGGI.⁸

Federal and California initiatives

Assuming that the quantitative analysis that underlies that Massachusetts plan is accurate, some reductions will take place with little need for action by the state. Five of the listed initiatives in the plan have origins outside of Massachusetts. Federal initiatives obviously affect the entire country, including Massachusetts. In the case of initiatives originating in California, Massachusetts

Figure 2.3: Relying on Outside Initiatives

PROGRAMS AND POLICIES	PROJECTED IMPACT	COMMENTS
More stringent national EPA power plant rules	1.2%	The ultimate outcome of these rules is uncertain and the federal government is moving more slowly than anticipated when the Massachusetts climate plan was developed in 2010. However, the Massachusetts modeling assumed that the main results of the rules would be the closing of the Salem and Somerset coal-burning powerplants and that is happening for other reasons. That means that the state should reach this target no matter what the federal government does.
Federal appliance and product standards	.6	Regulations have been approved and are being implemented by the federal government.
Federal & California vehicle efficiency and GHG emissions standards	2.6	The July 2011 agreement between the US government and the automobile companies goes beyond the assumptions in the Massachusetts plan. This should lead to some modest additional savings by 2020.
Federal emissions & fuel efficiency standards for medium & heavy-duty vehicles	.3	Regulations have been approved and are being implemented by the federal government.
Reducing emissions from motor vehicle air conditioning	.3	California's strengthened standards are in the process of being approved there and Massachusetts will start using them in 2017.
Total	5.0%	

would need to agree to adopt California standards, but that has generally been done in the past and will likely be done in the future.

Looked at as a whole, these initiatives should achieve their collective target by 2020. If the state’s underlying analysis of their impacts is correct, that will yield a total reduction of 5.0 percent, which is one-fifth of the emission reductions the state needs to achieve by 2020. Some initiatives may exceed their targets while others may fall behind, but likely balancing out. Here is a summary of these initiatives:

The big pieces

In the state’s climate action plan, two initiatives—all cost-effective energy efficiency/RGGI and clean energy imports—have especially large reduction effects. They are responsible for a 12.5 percent reduction in greenhouse gases, half of what is needed to reach the 25 percent target. The Patrick administration is therefore counting a great deal on the success of these two initiatives. It will be much harder to reach the 25 percent reduction target if there is a serious shortfall in either area.

Figure 2.4: The Big Pieces

PROGRAMS AND POLICIES	PROJECTED IMPACT
All cost-effective energy efficiency/RGGI	7.1%
Clean energy imports	5.4%
Total	12.5%

These two large components of the state’s climate change response are quite different from each other in terms of feasibility. In the case of importing electricity from clean energy generators from outside New England, there is the possibility of failing completely. The state’s plan envisions importing hydroelectric power from Canada, most likely Quebec. That would be a cost-effective approach to reducing greenhouse gas emissions,

since Quebec hydropower is relatively inexpensive and does not require government incentives to be competitive with other electricity sources. However, because the transmission lines from Canada are near capacity, new transmission lines need to be built to make significantly greater imports possible. Also, because land inundated for hydroelectric reservoirs produces carbon emissions, there are issues with the timing of emission reductions from hydro which we review below.

Although transmission proposals are on the table, most notably the Northern Pass Project from Quebec through northern New Hampshire, there is no guarantee that any of them will be permitted, financed, and built. Massachusetts has limited influence over whether these transmission projects succeed. Therefore, for reasons beyond the state’s control, the projected 5.4 percent reduction in emissions may not materialize, at least not by 2020. That would represent a 21.6 percent shortfall in all the reductions needed to meet the state’s 25 percent target.

There is opposition in northern New England to expanded transmission, as well as some concerns about costs being imposed on rate payers. Massachusetts state government should either decide to work more aggressively to help overcome the difficult barriers to increased transmission or acknowledge that the goal of a 5.4 percent emissions reduction from clean energy imports may need to be revised downward or even eliminated.

The other big piece—all cost-effective energy efficiency and the Regional Greenhouse Gas Initiative—is already underway. State officials are monitoring these programs closely enough to know that they will achieve significant reductions. The remaining question is whether they achieve everything projected in the climate plan. For reasons that will be discussed in the section below on energy efficiency, there is the possibility that the state could fall short of its target, despite having very strong efficiency programs. On the other

hand, the state could seek to strengthen RGGI and expand its efficiency programs to try to exceed the 7.1 percent target.

Figure 2.5: On Track Initiatives

PROGRAMS AND POLICIES	PROJECTED IMPACT
Advanced building energy codes	1.6%
Developing a mature market for solar thermal water/space heating	.1%
Expanded Renewable Portfolio Standard (RPS)	1.2%
Total	2.9%

On track

Three other programs and initiatives are in the implementation phase and seem to be on track to achieve their targets, assuming that the quantitative analysis that underlies the Massachusetts climate plan is reliable—building codes, expanding the Renewable Portfolio Standard (RPS), and increasing solar thermal use. Changes to the economy or to federal policy could derail them, but currently that is not the most likely scenario. Moreover, even if these initiatives fall short, because they are well underway, they should still get a significant way toward their goals. Here’s the status of each of them:

Advanced building energy codes. Massachusetts has “adopted a requirement that building energy codes meet or exceed the latest International Energy Conservation Code (IECC) and stay current with its three-year update cycle.”⁹ In addition, as part of the *Green Communities Act*, municipalities have been encouraged to adopt a “stretch building code” that goes beyond the IECC requirements. Because the next version of the IECC will be the most dramatic update ever, in part because of the role Massachusetts has played, and because more than the expected number of communities have adopted the stretch code, the codes are advancing more rapidly than anticipated in the 2010 climate plan. That would

theoretically lead to a larger reduction in emissions than the projected 1.6 percent. However, because construction is proceeding more slowly than projected, it will take longer for the impact of the new codes to ripple out into the built environment. On the other hand, there will be fewer emissions associated with the process of construction. We can assume that these various factors will roughly balance out, suggesting that this initiative is on track to meet its target.

Developing a mature market for solar thermal water/space heating. In June 2011, the Massachusetts Clean Energy Center launched the Commonwealth Solar Hot Water Residential Pilot Program, which will run until the end of June 2012. The agency’s intention is to learn from this pilot and then roll out a follow-on program. Because the emissions reduction target for this initiative is modest (.1 percent) and because the Clean Energy Center has the expertise and resources to follow through, we assume that the initiative will meet its target.

Expanded Renewable Portfolio Standard (RPS). The Renewable Portfolio Standard has been in place since 1998, but it was strengthened in the *Green Communities Act* of 2008. It requires electricity suppliers to procure a gradually increasing percentage of their electricity from renewable and other clean energy sources. Because the RPS is a market-based mechanism and the obligation to meet it falls on electricity suppliers, there is sometimes an imbalance between supply and demand, causing suppliers to pay a fee called an Alternative Compliance Payment. When that occurs, Massachusetts does not achieve the greenhouse gas emissions reductions that it seeks.

The most recent report on the RPS by the Department of Energy Resources showed that supply fell slightly short of demand in 2010 for large-scale renewable energy and somewhat shorter in

the Alternative Energy Portfolio Standard focused on combined-heat-and-power installed by electricity customers.¹⁰ However, these shortfalls came after three years of surpluses in the main RPS and, as in the past, the market should end up balancing out over time. Even if there is a modest shortfall in 2020, the RPS would still achieve the vast majority of the climate change plan's target of a 1.2 percent reduction in emissions.

It is possible that the federal government will not renew the production tax credit for wind energy or provide a substitute incentive mechanism. If that happens, wind development in New England could be slowed, making it harder for Massachusetts to achieve its RPS goals. However, because federal incentives may remain in place or Massachusetts could find another way to ensure continued renewable energy development if they do not remain in place, we assume that this initiative is currently on track.

Unknowns

We are not able to determine whether or not many of the initiatives in the climate change plan will meet their targets. Collectively, these initiatives are projected in the plan to cut emissions by 7.1 percent, which is more than one-quarter of the total target. If the state falls significantly short here, it would have serious implications for Massachusetts's ability to reach the 25 percent goal.

Some of these initiatives are not far enough along to know whether they will work or not. In some cases, no concrete programs or plans have been announced. In other cases, such as the smart growth policy package, it is difficult to quantify the impacts of state policy and the state does not have a meaningful procedure to measure these impacts.

Without a full work plan showing that these initiatives will meet their targets, it is reasonable to assume that they will collectively fall short by some significant amount. The relevant state agencies should make it a priority to develop

Figure 2.6: Unknowns

PROGRAMS AND POLICIES	PROJECTED IMPACT
"Deep" energy efficiency improvements for buildings	.2%
Expanding energy efficiency programs to C/I heating oil	.1
Tree retention & planting to reduce heating and cooling loads	.1
Federal renewable fuel standard & regional low-carbon fuel standard	1.6
Clean car consumer incentives	.5
Pay As Your Drive (PAYD) auto insurance	1.1
Sustainable Development Principles	.1
GreenDOT	1.2
Smart growth policy package	.4
Stationary equipment refrigerant management	1.3
Reducing SF6 emissions from gas-insulated switchgear	.2
Reducing GHG emissions from plastics	.3
TOTAL	7.1%

detailed plans for each of the items and also assess by how much they may fall short of their goals. In some cases, the plans should include enforceable regulations to ensure completion.

Summing it all up

After looking at the status of the various initiatives in the state's climate action plan, here are the current most significant likely or possible deviations from emission reduction targets on both the positive and negative sides:

- The initial projections in the plan totaled 27 percent, providing a 2 percent cushion.
- The likely continuation of low natural gas prices may yield some greater than anticipated reduction in emissions because of less use of coal and oil.
- Without expanded electricity transmission from Quebec or elsewhere in Canada, it

will be impossible to achieve the 5.4 percent emissions reduction target attributed to clean energy imports.

- Many of the more difficult initiatives, totaling a projected 7.1 percent emissions reduction, are not currently at a point where it is reasonable to expect that they will all achieve their targets. A more reasonable current estimate might be that they will only achieve half of that or less.
- It is possible that there could be some additional modest slippage in other categories that are generally on track. For example, the state could fall slightly short in the very large “all cost-effective efficiency/RGGI” category and in the RPS category.
- It is also possible that there could be some modest to greater-than-anticipated emissions reductions in some other categories, such as federal vehicle efficiency regulations.

Because the potential shortfalls are greater than the potential upsides, it is important for the state to begin to make concrete plans now for how it will make up the shortfalls, if necessary. The initial priority should be on realistically assessing all those initiatives in the 7.1 percent “unknowns” category to determine their likely current trajectory. In some cases, state officials need to move faster. In other cases, they must acknowledge that the climate change plan may have been unrealistic, and they will not be able to implement some of the ideas as quickly as projected.

The state should also determine whether there are other initiatives, not quantified or identified in the original plan, which will yield emission reductions not already captured in the projections for 2020. For example, in November 2011, the Department of Environmental Protection launched the

Clean Energy Results Program, through which the Department will play a larger role in promoting and implementing clean energy. Activities will include diverting organic materials from landfills and encouraging water utilities to rely on renewable energy.¹¹ To the extent that these activities will lead to additional emission reductions not already counted in the 2020 targets, projections should be made for them and counted.

After realistically assessing the 7.1 percent unknowns and adding uncounted initiatives, there will still likely be a potential 2020 shortfall. The state should therefore look aggressively for additional ways to reduce emissions in order to compensate. In addition to the three areas described below for securing further emissions reductions, the state could consider whether it would be possible to move even faster than currently planned in implementing energy efficiency. State officials may also want to reconvene the Climate Protection and Green Economy Advisory Committee to get its ideas on how the state can best achieve additional emission reductions not identified in the original climate plan.

Strengthening RGI, promulgating regulations, and repairing natural gas leaks are three opportunities to reduce emissions that deserve careful consideration:

Regional Greenhouse Gas Initiative. The most obvious opportunity for additional reductions is by strengthening RGGI. The RGGI states are currently in the middle of a program review that was specified in the original agreement among the states back in 2005. They are assessing what is going well and what needs to be improved, and have sought input through a number of stakeholder meetings. Given the low cost of natural gas, as well as other factors, emissions from power plants in the RGGI program have fallen significantly below the program cap.¹² Because the economy was not the main cause of the emissions decline, emissions are unlikely to increase dramatically as the

economy recovers. The states could capitalize on structural changes in the electric sector by resetting the cap at appropriate levels.

This summer the states will prepare a set of recommendations for how RGGI should proceed. It would be desirable to adjust the RGGI targets and to retire any unsold allowances going forward to ensure that RGGI leads to additional emission reductions in the future. There are several ways in which this could be done, but the important thing is to do something to enhance RGGI's future impact.

Over the next few months, Massachusetts officials should work vigorously within RGGI to push for such a strengthening of the agreement. Indeed, it appears that the state supports some form of RGGI enhancement. A more ambitious RGGI would make it easier for Massachusetts to reach its 2020 emissions reduction goal.

Regulations. Another way for the state to make up for possible shortfalls, is to use the considerable regulatory authority granted under the *Global Warming Solutions Act* to ensure additional emissions reductions by 2020. In fact, that Act tells state agencies to “promulgate regulations that reduce energy use, increase efficiency and encourage renewable sources of energy in the sectors of energy generation, buildings and transportation.”

Natural Gas Leaks. A third possibility would be to focus on reducing leaks of methane from aging natural gas pipelines. Per molecule, methane is a much more potent greenhouse gas than carbon dioxide, so even small leaks can have a big impact. According to gas company records, there are more than 21,000 reported and catalogued leaks in the Massachusetts pipeline system.¹³ Recent research out of Boston University using new leak detecting technology suggests that the number of leaks is likely much greater than that.¹⁴ Natural gas leaks are so prevalent because Massachusetts has the nation's second-oldest gas system with many old, corroding cast-iron pipes.

Although the natural gas distribution companies have been gradually replacing older pipes and repairing leaks, they have some perverse financial incentives that tend to discourage them from prioritizing leak repair and infrastructure replacement. Federal regulations require them to repair leaks that are a hazard to public health and safety, but they do not have to repair leaks simply

MASSACHUSETTS OFFICIALS SHOULD WORK TO STRENGTHEN RGGI.

because they contribute to greenhouse gas emissions. The way the compensation system works, the gas companies receive a rate allowance for gas that is “lost” in its system, either because it is stolen or leaks out. Fixing leaks that do not represent a safety threat therefore adds to expenses while reducing revenue.

It is not clear how much gas is currently leaking. The natural gas companies reported to the Department of Environmental Protection that leakage in 2010 was equivalent to roughly 700,000 metric tons of carbon dioxide. However, their reports to the Department of Public Utilities of “lost and unaccounted for natural gas” (what the companies are reimbursed for) indicated that the total was approximately 3.6 million metric tons, which would represent almost 4 percent of total Massachusetts greenhouse gas emissions. Even the smaller number is significant.

The two state agencies should work with the gas companies to agree on an accurate estimate of the extent of the problem. Then, the compensation structure should be adjusted so that companies have an incentive to fix leaks rather than ignore them. Legislation has been introduced into the Massachusetts house to address this issue.

The 2050 Target

The state will have 30 additional years to reach its 2050 target than the 2020 one, but that will not make the task easier. An 80 percent reduction in emissions is a daunting challenge and it will not be achieved simply by extending the same strategies that can meet the 2020 goal.

By design, the state is currently focusing on the low-hanging fruit, in terms of cost and ease. Although that strategy makes sense, it means that the actions that will be needed to achieve the more ambitious long-term goal will be more difficult. The current climate change plan acknowledges that additional strategies will be needed to reach the 2050 target. It points out that it is difficult to predict how technology and the economy will develop in the future and that it is therefore hard to know which will be the most effective post-2020 strategies.

Despite the public imperative to address the climate change issue, it is rare for political leaders and state governments to focus on any issue decades into the future. Their attention is inevitably drawn to near-term needs and immediate deadlines. It is unrealistic to think that this dynamic can or will change radically.

Nevertheless, there are some modest ways in which government officials can and should address the long-term timeframe. For one thing, some of the near-term actions included in the current climate plan can make it easier to achieve the longer-term goal and early action can yield increasing results as time passes. As an example, because buildings last a long time, by accelerating upgrades to the building energy code by five years, a significant number of buildings that will still be around in 2050 will be more efficient than would otherwise be the case. Similarly, near-term implementation of smart growth principles and sustainable land-use planning can shape many long-lasting decisions having to do with transportation and energy use patterns. In addition to those initiatives in the state's climate action

plan related to building codes and smart growth, other initiatives in the plan that will yield their greatest emission reductions after 2020 are the ones related to a low-carbon fuel standard and building rating and labeling.

Even though estimates of the long-term impacts of these pre-2020 activities will be preliminary and imprecise, state officials should nevertheless still attempt to quantify them. That will provide some sense of how far along Massachusetts might already be towards achieving the 2050 goal and it will help policymakers understand the implications of accelerating or delaying the ramp up of those activities.

Another thing the state can do now to prepare for achieving the 2050 goal is to identify technologies that could be important for achieving the goal and for which there are valid other reasons for providing near-term support. For example, to move away more dramatically from fossil fuels for electricity generation will require substantial energy storage capability. Massachusetts has the potential to be a leader in the energy storage industry. The state could begin to develop and implement policies that would encourage the use of energy storage as part of the electricity system.

Envisioning solutions for 2050

For political leaders and stakeholders to understand the types of choices that will need to be made to reach the 2050 goal, they require more information than they currently have about the technologies and strategies that could fit into an effective 2050 plan. While it is difficult for government leaders to find the time or resources to think intensively about the period beyond 2020, it is important that this occur now.

Because state government cannot be expected to take the lead in contemplating post-2020 emission reduction strategies, the private sector should consider helping. Specifically, NGOs, foundations, and academics should launch a visioning exercise with the cooperation of state government.

These groups should produce a report showing options for how an 80 percent reduction in greenhouse gas emissions could be achieved by 2050. Although state government need not take the lead on the study, it could meaningfully support this activity by publicly declaring that it understands that preparation for achieving its 2050 goal is necessary and that the visioning exercise is a useful way to jump-start planning.

It would make most sense to carry out such a study on a regional New England basis, given that Massachusetts is a relatively small state and is part of a regional electricity and transportation system. The study should develop a menu of options for cutting emissions by 80 percent and should cover the following points:

- How are other leading jurisdictions, such as California and European countries, planning to reach this magnitude of reductions?
- Which carbon reduction/stabilization technologies could possibly be available sufficiently in advance that they could be employed at large scale by 2050?
- How soon would governments need to act to make such widespread deployment possible, and what are the most effective government interventions to support this deployment?
- What are the potential economic, social, and political implications of each of the major technology choices?

It is likely that such a report would end up suggesting that aggressive energy efficiency measures will need to be continued, but will be nowhere near sufficient. The big technology options are likely to include (1) renewable energy combined with significant energy storage to overcome the intermittency of wind and solar, (2) nuclear power, and (3) carbon capture and storage at natural gas electric-

ity generating facilities. But rather than simply list these options, a useful report would show how much of each deployment strategy would be necessary to achieve an 80 percent reduction and would test the feasibility of building out each option by 2050. For example, how many wind turbines, nuclear power plants, or carbon-capture-and-storage facilities would be needed? The study would likely suggest that some combination of these or other technologies will be necessary.

Although the questions are broad-ranging, a New England regional study need not take years or cost hundreds of thousands of dollars to produce. Instead, a well-designed study could efficiently get answers at a sufficient level of detail to be useful to policymakers, in part because there are at least two good starting points for thinking about what an 80 percent emissions reduction might mean for New England and how a report on the topic might be structured:

1. **Stabilization wedges concept.** The Carbon Mitigation Initiative at Princeton University has promoted the idea of thinking about emissions reduction strategy in terms of a series of climate stabilization wedges. Each possible policy is envisioned as a wedge, or piece of a pie, taking a percentage cut out of total business-as-usual emissions, envisioned as the full pie. The size of the different pie wedges can be quantified and the Carbon Mitigation Initiative has suggestions for how to do that. For a 2050 New England regional study, the various pie wedges would need to add up to 80 percent.¹⁵

2. **California report.** In 2011, the California Council on Science and Technology published *California's Energy Future—The View to 2050*, a report along the lines of what we are suggesting here.¹⁶ Although the California report conducted more extensive research and analysis than what we are

recommending for New England and there are significant differences between the two regions, its approach and methodology could help inform a New England study.

In addition to these two models, New England could draw on the findings and approach of the European Union in its *Roadmap for Moving to a Competitive Low-Carbon Economy in 2050*.¹⁷ The roadmap is described below in Appendix E.

2. Is the State Successful in the Four Key Realms of Energy Efficiency, Electricity Generation, Transportation and Land Use, and Adaptation?

Having looked at the 2020 and 2050 Massachusetts climate change goals, we can turn to a second way of assessing the Massachusetts response to climate change. That is to focus one at a time on the four major areas of activity—energy efficiency, electricity generation, transportation and land use, and adaptation.

Energy Efficiency

This is the realm in which Massachusetts is doing the best job and is making the most progress—both in terms of gross greenhouse gas reductions and in comparison to other states.

Massachusetts has a long history in energy efficiency and was an early leader in implementing it. For that reason, when the push to accelerate energy efficiency programs started to be made in the mid-2000s, there was already the infrastructure in place to oversee and implement those investments. The major utilities, as well as the Department of Energy Resources, had experienced energy efficiency program managers and program evaluators. Many businesses that provide and install energy efficiency technologies were already located in the state and had extensive experience dealing with local customers. There were also nonprofit organizations and community groups with energy efficiency experience. Of

course, all of these entities had to expand their efforts and hire additional staff, but they were starting with a solid foundation that made ramp up easier.

Two provisions in the 2008 *Green Communities Act* have been especially important to the successful expansion of energy efficiency programs:

I. Requirement to implement all cost-effective energy efficiency. The law requires electric and natural gas utilities to procure “all available energy efficiency and demand reduction resources that are cost effective or less expensive” than the cost of additional electricity or natural gas supply.¹⁸ This is a departure from the past, not just in Massachusetts but generally in states across the nation. Previously, the utilities had a fixed budget to work with. The efficiency budget for electric utilities was based on the money collected from a set fee of 2.5 mills per kilowatt-hour on retail customers’ electric bills, which generated about \$125 million annually. The utilities could not exceed this amount even if additional efficiency efforts would save customers money and forestall the need to purchase expensive new energy. Under the new system, if saving a kilowatt-hour of electricity or thermal unit of gas is cheaper than buying one, the energy-saving measure receives preference. This has changed the utilities’ frame of reference and led to a dramatic expansion of energy efficiency spending.

2. Establishment of the Massachusetts Energy Efficiency Advisory Council. The law created an advisory body with an important role in overseeing the state’s energy efficiency efforts and approving the utilities’ plans. The council is appointed for five-year terms by the Department of Public Utilities and represents diverse sectors of stakeholders, including residential customers, the Low-Income Energy Affordability Network, manufacturers, labor, commercial businesses, the environmental community, and various state agencies. The Com-

missioner of the Department of Energy Resources chairs the Council. By all accounts, the Council has been a valuable addition. Through broad stakeholder engagement and the technical assistance of expert consultants, the Council has ensured that energy efficiency plans have been carefully scrutinized and vigorously debated. There is now much greater transparency about energy efficiency activities and more opportunity for input from a wide range of stakeholders. This has ensured that efficiency programs have targeted the needs of various economic interests and population groups.

Under the new framework, every three years, the utilities develop and submit for approval joint, comprehensive energy efficiency plans, one for the electric utilities and one for the natural gas utilities. Each of the plans for the period 2010-2012 totals well more than 300 pages. Extensive evaluation is then undertaken to track the utilities' outputs (e.g., number of energy audits, quantity of efficient lighting and other equipment installed), outcomes (i.e., reductions in energy use), and the cost of delivering those outcomes.¹⁹ To make it easier for customers to access energy efficiency services, all the utilities have banded together under the banner of MassSave, a central clearinghouse that lists all the available services and directs customers to the appropriate ones.

Results of the expanded efficiency programs

Since passage of the *Green Communities Act*, spending on energy efficiency has increased dramatically, with the budget for electric utilities' efficiency efforts reaching \$401 million in 2011. Massachusetts now has the highest per capita spending on electricity-related efficiency programs.²⁰ Its spending on efficiency for natural gas customers, at \$84 million for 2010 is the second highest spending per customer after New Hampshire.²¹ Of course, spending levels may not be the best gauge of program impacts, but it seems that Massachusetts has recently not only been spending a lot but also accomplishing

a lot. The plan for the electricity program aimed to achieve savings equal to 2.4 percent of sales in 2012 and the plan for natural gas utilities aimed to achieve savings equal to 1.5 percent of sales. The program administrators met 99 percent of their electric savings targets and 83 percent of their gas savings targets in 2010. The 2011 results are likely to be nearly as successful.

Our interviews of various stakeholders and climate change activists suggest that there is broad satisfaction with the overall delivery and results of the energy efficiency programs since 2008. In recognition of the vitality and accomplishments of Massachusetts's energy efficiency programs, in October 2011 Massachusetts came in first in the annual energy efficiency rankings of the American Council for an Energy Efficient Economy (ACEEE), surpassing California for the first time. ACEEE is a well-respected research and policy advocacy nonprofit. Its annual efficiency scorecard considers not just a state's efficiency spending and financial incentives but also energy savings, policies, and regulations in six categories: (1) utility and public benefits policies and programs, (2) transportation policies, (3) building energy codes, (4) combined heat and power, (5) state government initiatives, and (6) appliance efficiency standards.

Massachusetts scored especially high in the first, most heavily weighted category, which looked at the utility efficiency programs, and in the categories for building energy codes and state government initiatives. ACEEE concluded, "Central to Massachusetts' success is the continued implementation of the 2008 *Green Communities Act*, which laid the foundation for greater investment in energy efficiency programs."²²

The increasingly steep hill for energy efficiency

Despite the aggressive, successful way that the state and utilities have implemented energy efficiency over the past few years, the path forward will not be easy. The state's climate change plan assumes

that there will be a continued increase in efficiency implementation and in the amount of funding the utilities spend on efficiency. But it may be difficult to sustain this acceleration. Policymakers should not be sanguine about the future performance of the efficiency program based on its past successes.

Most of the improvements in efficiency are projected to come from commercial and industrial customers. Those customers are quite cost-sensitive and generally require a payback period of less than three years to make significant efficiency investments. The current low price for natural gas has increased the payback period for many projects, sometimes making businesses less willing to move forward. In addition, many of the easier sales have already been made and the low-hanging fruit picked. If the utilities start to have more difficulty convincing companies to invest in efficiency projects, it will not only be harder to reach the increasingly ambitious goals, but also increase the cost of delivering energy efficiency services.

We do not suggest that the efficiency programs should be scaled back but rather reassessed and revised for future success. In conjunction with the utilities, the Energy Efficiency Advisory Council should determine what is truly realistic and achievable. The Council should scrutinize carefully whether the new three-year plans that will be issued by the utilities later this year set aggressive but attainable goals and whether there are additional strategies that can be used to help the efficiency programs meet their targets. We expect that the Council and the utilities are already planning to do that.

One opportunity for efficiency that should not be ignored is to make it possible for commercial and industrial customers who heat with oil to participate in the efficiency programs that are available to customers who heat with electricity or natural gas. At the moment, commercial and industrial oil heating customers are ineligible for most of the efficiency incentives because they do not pay into the efficiency funds that are collected through nat-

ural gas and electricity bills. Residential oil heating customers are eligible for some measures, in part because they use electricity for other purposes, yet the electric programs are geared primarily toward reducing electric consumption. Although that is also true for the commercial and industrial customers, there may not be legal authorization for them to participate in the efficiency programs. The state's climate change plan recognized this as a problem and identified those commercial and industrial customers as appealing targets for greenhouse gas emission reductions, since oil has high emissions.²³ Because a funding stream needs to be identified, nothing has happened yet, but it should be a priority to make these customers eligible for energy efficiency support. A bill is pending before the legislature to address this and its prospects seem promising.

Rebound effects

Some critics of energy efficiency programs have argued that their impacts are always much less than advertised because efficiency reduces the marginal cost of energy, making it more likely that people will use more of it, creating a so-called "rebound effect." A simple example of such a direct effect is a household that installs a new, more efficient heating unit, but then raises the thermostat settings because it does not cost as much as previously for heating.

There are also a variety of indirect rebound effects. For example, a family may use the money it saves on heating to purchase furniture or go on a vacation and that alternative use of the money consumes energy. To the extent that a manufacturing business becomes more competitive, it may increase output, thereby requiring additional energy. And there may be other indirect effects.²⁴

Even if these rebound effects are real, energy efficiency remains desirable. After all, it is good if people can more easily afford things they want and if businesses in Massachusetts prosper.

In 2011, the Breakthrough Institute issued

a widely quoted report that argued that total rebound effects could wipe out 50-100 percent of all the envisioned energy-use reductions from efficiency.²⁵ Various analysts have thoroughly critiqued the Breakthrough Institute's report.²⁶ Most economists and energy experts feel this report significantly exaggerated likely rebound effects. More balanced, better supported estimates suggest that the effect is probably 10-30 percent for households and about 10 percent for



Photo Credit: Massachusetts Executive Office of Energy and Environmental Affairs

THE STATE LEADS BY EXAMPLE

Massachusetts state government, including the MBTA, is directly responsible for considerable energy use. In April 2007, Governor Patrick issued Executive Order 484, which established the Leading by Example Program. This program seeks to improve the energy performance of state buildings and facilities, and otherwise increase the environmental sustainability of state government. It is overseen by the Executive Office of Energy and Environmental Affairs and the Executive Office of Administration and Finance. As the name implies, part of the goal is to serve as a model for others in the state by showing that deep reductions in emissions are feasible.

Leading by Example has set higher targets for itself than under the *Global Warming Solutions Act*. Its goals are to reduce energy use by 20 percent by 2012 and 35 percent by 2020, and to reduce greenhouse gas emissions (through a combination of efficiency and renewables) by 25 percent by 2012 and 40 percent by 2020. In addition, there are goals related to bioheat and water use reduction. The program also promotes waste reduction, recycling, and sustainable transportation. Because the state and its agencies, including higher education, control 70 million square feet of buildings, 8,000 vehicles, and 29 college campuses, the potential greenhouse gas reductions would be quite significant, beyond any inspirational value they might have for others.

To help meet its targets, the Leading by Example Program established a Green Building Standard, which requires all the state's new construction and major renovation projects to use at least 20 percent less energy than the Massachusetts Building Energy Code. Among its many other initiatives, the program requires the use of energy performance contracts at all facilities over 100,000 square feet by 2012 and retro-commissioning at all buildings over 50,000 square feet, as well as the purchase of only EnergyStar-rated equipment and the installation of combined-heat-and-power or bioheat where appropriate.²⁸ According to Eric Friedman, the Department of Energy Resources' Division Director for the Leading by Example program, "In the last three years, energy efficiency efforts have been completed or initiated at close to 20 million square feet of state buildings, almost one-third of the total building portfolio."²⁹

Although the program is by no means unique and other states are implementing similar successful initiatives, Leading by Example is an ambitious, effective effort that should reduce the state's energy costs while cutting greenhouse gas emissions. It also represents strong inter-agency cooperation and coordination among the different parts of state government.

North Shore Community College's Health and Student Services Building, which opened in 2011, is the first state-owned, zero-net-energy building.

SWITCHING FROM OIL TO NATURAL GAS

An issue that matters to oil heating customers, but that is not about conventional energy efficiency, is the conversion of oil heating systems to natural gas. At first glance, it would seem obvious that the state should encourage such fuel switching because natural gas produces significantly fewer emissions than oil and customers can often save money by switching to the lower-priced fuel. This suggests that the state should consider helping, perhaps by making low-interest loans available.

However, the situation is complicated, because it would be necessary to make natural gas infrastructure upgrades. From the natural gas companies' perspective, the current cost-recovery system does not provide them with sufficient revenue soon enough to justify investing in most upgrades. On the other hand, some environmental groups believe it would be shortsighted to provide incentives to the gas companies to bring more natural gas into more neighborhoods because they believe priority should be placed on moving the state away from reliance on fossil fuels.

It seems to us that there is simply not enough solid information about the costs and benefits of investing in additional natural gas infrastructure to make informed decisions. The state should undertake a study to analyze fully both the economic and environmental costs and benefits of making a big push on fuel switching. The study should consider how much money customers would likely save and whether the jobs created in gas pipeline construction and gas delivery would outweigh the jobs lost at heating oil companies. Timing should also be considered—how much money would need to be invested in the short run to achieve savings in the long run? And would the greenhouse gas emissions associated with making the infrastructure improvements outweigh the emissions reductions from the fuel switching? Would it instead be better to invest more money in eliminating methane leaks from old natural gas pipes, which is a significant source of emissions? Would investment in fuel switching slow the eventual transition from natural gas to zero carbon resources? It would be desirable to have definitive answers to these and related questions.

transportation fuel efficiency.²⁷

The precise extent of rebound effects remains uncertain, but is almost certainly modest enough to make it worthwhile to pursue energy efficiency vigorously as a greenhouse gas reduction strategy. Although the state's energy efficiency programs take some account of rebound effects, it is possible that those programs and the state's climate change plan have underestimated the various near-term rebound effects. This is another reason for the state to implement additional measures to ensure that the 2020 emissions reduction target is achieved.

Electricity Generation

A state can reduce the greenhouse gas emissions associated with electricity generation both by reducing the carbon intensity of fossil fuel use and by bringing less polluting, renewable energy generators online. Massachusetts has taken important steps in both areas.

The state's four-pollutant (4P) regulations, dating from 2001, included carbon dioxide as a regulated pollutant and put pressure on the most-polluting facilities to either clean up or close. As useful as those regulations were, market forces—especially high prices for oil and low prices for natural gas—have turned out to play a bigger role in closing and

scaling back fossil fuel facilities. In the mid-2000s, output from oil-burning powerplants declined dramatically because they were much more expensive to operate than newer, combined-cycle natural gas plants. More recently, declining natural gas prices have contributed to reducing the output from coal-fired powerplants in Massachusetts. Because natural gas emits much less carbon dioxide than either coal or oil, this has led to sharp reductions in emissions. It is unlikely that there will be a return to higher coal or oil use in the next few years. In fact, the state should consider taking additional steps to close down the remaining dirty coal-powered facilities.

The Renewable Portfolio Standard

The state has been especially ambitious in promoting renewable energy. The most important renewable policy has been the renewable portfolio standard (RPS), which requires an increasing share of the electricity supply to come from renewable energy. This is an aggressive initiative that has been well-managed by the Department of Energy Resources. It is responsible for bringing a significant quantity of renewable energy online throughout New England.

In 2010, the last year for which full data are available, five percent of the electricity supply was required to come from renewable energy projects completed after the start of 1998.³⁰ In complying with this requirement, electricity suppliers relied overwhelmingly on three energy sources: wind (38.5 percent), landfill gas (31.7 percent), and woody biomass (25.2 percent). They also used hydro (3.5 percent), anaerobic digestion (1 percent), and solar photovoltaic (.3 percent).³¹ The facilities providing this electricity were located in Maine (36.5 percent, mostly wind but also biomass), New York (25.0 percent, mostly landfill gas and wind), Canada (12.2 percent, mostly wind),



Photo Credit: First Wind

New Hampshire (12.1 percent, mostly biomass), Massachusetts (8.5 percent, mostly landfill gas with some wind and solar), and the rest of New England (5.7 percent).

In addition to the RPS, a variety of state programs and policies have encouraged greater reliance on renewable energy and have been essential to the state being able to achieve its RPS annual targets in recent years. The Renewable Energy Trust Fund, currently administered by the Massachusetts Clean Energy Center and previously by the Massachusetts Technology Collaborative, has supported a variety of pre-development activities. The *Green Communities Act* required utilities to enter into long-term contracts with renewable energy generating facilities. Net metering supports solar and other customer-sited renewables by allowing customers to receive credit at retail rates for electricity they generate onsite. And many agencies, including the Department of Environmental Protection and the Department of Agriculture, have either offered targeted incentives or addressed siting issues and other barriers to installing renewable energy within the state.

Under the RPS, the percentage of renewables in the electricity supply is slated to increase one percent annually, reaching 15 percent in 2020. There are ample renewable resources available in

The Massachusetts RPS has helped advance wind projects across the region, including the Stetson Wind project in northern Maine.

the region to be tapped and the RPS is an effective driver of demand. If the RPS remains on track, it is probable that the vast majority of new renewable capacity by 2020 will be wind, especially from northern Maine, from Canada, and from the Cape Wind project.

However, factors beyond the Commonwealth's control could prevent that capacity from coming online. Most importantly, if the federal government neither renews the Production Tax Credit for wind energy nor substitutes a comparable incentive, it could become much more difficult to develop wind projects. If natural gas prices fall further, or even remain at their current levels, that could also make it difficult for new wind projects to compete. Massachusetts needs to monitor federal policy and market conditions closely to determine if any changes in the state's renewable energy policies should be made.

But no matter what happens to federal incentives or fossil fuel prices, the state can take one step to help ensure that significant renewable generation is added by implementing additional measures to help renewable energy projects secure financing and/or long-term contracts. One weakness of an RPS as a policy mechanism is that it is not inherently adequate to guarantee that a project developer can secure financing for a cost-effective renewable energy project. Even when a developer can show that the projected revenue stream would make the project economically viable, financial institutions may remain hesitant to lend or invest money in the project. They may feel that, because of fluctuating prices for renewable energy certificates and the possibility that the state will make future changes to the RPS, project revenue is not sufficiently guaranteed to justify an investment. Long-term contracts for both power and certificates may be required to ensure that a project can receive financing. The state has taken useful steps to address this problem in the past, but should continue to implement solutions to it. Legislation recently debated in the Senate proposes to require

the investor-owned utilities to enter into additional long-term contracts with renewable generators. That would be desirable, but additional measures related to financing renewable projects should also be considered.

Another issue related to the renewable portfolio standard is its impact on electricity prices. That issue is addressed in Section III below on the costs and benefits of climate change action.

The big pots of renewables

Looking out over the next 20 years, the three big potential sources of renewable energy for the Massachusetts electricity supply are wind from the north (northern Maine and Canada), offshore wind, and hydroelectric from Canada. Wind from the north is likely to continue to be developed gradually and will remain an important resource. The other two resources have even greater potential, but they require special attention from the state.

The offshore wind potential is tremendous, especially in deep waters. The amount of wind energy that could be secured off the coast dwarfs the amount that can be reasonably expected to be developed on land in the region. However, the economic and logistical challenges are great. Massachusetts has taken many useful actions to make offshore wind possible, including supporting the large Cape Wind project, aiding a proposed smaller project for the Town of Hull, initiating the US Offshore Wind Collaborative (an information-sharing consortium for state governments, the wind industry, and other stakeholders), supporting a wind blade testing facility, developing an ocean management plan that indicates the offshore wind sites with the lowest potential conflicts with other ocean uses, and setting rules and procedures for developing offshore renewable energy. Although the costs for offshore wind projects currently seem high, they will come down over time and the potential resource is so great that Massachusetts should continue to devote sig-

LARGE HYDRO PROJECTS AND GLOBAL WARMING

At first glance, hydroelectric projects might appear to have no climate change impacts, since no carbon dioxide or other greenhouse gas emissions are produced when the electricity is generated. However, a lifecycle analysis of hydroelectric projects shows that they do indeed add to emissions.

The main way in which a hydro project contributes to global warming is from the impacts related to creating a water reservoir behind a dam. When land is inundated to create a reservoir, the flooded vegetation and soil organic matter decompose, releasing methane and carbon dioxide. This release is greatest in the initial years after the land is flooded. Even after those early years, emissions can continue to be greater than would have occurred if the reservoir had never been created.

When scientists and environmentalists first focused on this phenomenon, there was considerable debate and some uncertainty about the total lifecycle global warming impacts of new, large hydroelectric projects. There were even suggestions that some hydro projects could have higher emissions than fossil fuel generating stations. That led to many scientific studies of particular reservoirs and of the general phenomenon.

Last year, two comprehensive, peer-reviewed scientific reports summarized what is currently known: the Intergovernmental Panel on Climate Change reviewed the environmental impacts of hydroelectric projects as part of a Special Report on Renewable Energy Sources and Climate Change Mitigation and an international team of researchers surveyed the various studies of carbon emissions from hydroelectric reservoirs.³² Here are key points from these documents:

- The Intergovernmental Panel on Climate Change concluded that “lifecycle assessments indicate [hydropower has] very low carbon emissions.”³³
- The emissions from reservoirs in northern latitudes are much lower than those in the tropics.³⁴

- Emissions are greatest in the first several years after a new reservoir is created. They fall rapidly and tend to reach equilibrium at a very low level after 10-15 years. This means that hydroelectric power from older facilities or run-of-the-river generating stations is proportionately responsible for fewer emissions than power from new dams.

- There is variation between hydroelectric facilities in their lifecycle emissions, mostly connected to the amount and type of land inundated to create a reservoir. The poorer performing projects have a low ratio of electricity generated to amount of land inundated. But a more typical hydroelectric project does much better than even the most efficient fossil fuel plant in terms of greenhouse gas emissions.

Scientists connected to Hydro-Quebec have studied the emissions from some of the hydro reservoirs in Canada. Their data appears to be credible and generally in line with that collected by other researchers in comparable locations elsewhere. A recent study of Eastman 1 Reservoir in Quebec compared its emissions to those from a natural gas combined-cycle power plant. It showed much higher emissions for the hydro project in the first year but less than one-quarter of the emissions by the tenth year. It took about five years for the accumulated carbon emissions from the hydro project to fall below the accumulated emissions from a natural gas plant.³⁵

It is also worth keeping in mind that no generating source, no matter how clean, is entirely emissions-free over its entire lifecycle. In the case of solar and wind, for example, there are emissions associated with manufacturing and installing the solar panels and wind turbines. Yet a recent study done for the Conservation Law Foundation by Synapse Energy Economics suggests that the life cycle emissions from new hydropower projects remains higher than for wind or solar—although lower than for fossil fuel generation.³⁶

nificant attention to it. In the short run, there are some good opportunities involving collaborations with other states along the Atlantic coast and with

the federal government to advance technology, develop the supply chain, and reduce costs for offshore wind deployment.

Large-scale hydroelectric, in contrast, is a well-established, low-cost technology that does not require subsidies and is, therefore, not included in the RPS. The province of Quebec has plans for significantly expanding its output of hydroelectric power and wants to sell some of it to Massachusetts and other New England states. That could be a good way to bring down Massachusetts greenhouse gas emissions cost-effectively. But for the state to achieve its climate change goals and to maintain momentum with other renewable energy technologies, it is important for hydroelectric power from Canada to be additional to the RPS goals, rather than a replacement for them.

Hydropower projects are highly controversial for a variety of reasons, including that new dams significantly alter natural habitats and can damage wildlife. Very careful assessments of the potential impacts of specific proposed hydro projects need to be made to determine whether they are desirable or not. Massachusetts should therefore look carefully at any new projects from which it might buy power to make sure the environmental benefits in lower greenhouse gas emissions will outweigh the environmental costs. Or alternatively, the state could decide to support only those projects that meet certain environmental standards.

Although not all hydro projects are beneficial, some are. The state's climate plan is sensible in calling for the purchase of significant amounts of electricity from hydro projects in Canada.

Local renewables

Compared to the potential to develop large-scale wind offshore or import renewable energy from out of state, the renewable energy possibilities on land within Massachusetts are much more modest. From a near-term, greenhouse gas reduction perspective, instate projects cannot and will not achieve anywhere near as much.

Although they will not be major contributors to achieving the state's 2020 climate reduction target, there may be other valid reasons for sup-

porting instate renewables. For example, there could be economic development benefits. There could also be advantages to the electricity system to having more distributed local generation. In the case of solar photovoltaics, the significant long-term potential of the technology to increase efficiency and reduce costs may justify near-term investments in order to build a foundation for the future. The state may also feel the need to be responsive to many people's desire to install renewable energy projects and have solar installations as a part of their community. The public also learns from seeing renewables in action and becomes more inclined to believe that the fight to slow climate change is real.

In evaluating the value of the state's efforts to support local renewable projects, all these factors need to be considered. But that goes well beyond the scope of our current report, which focuses specifically on climate change.

Life-cycle analysis of energy sources

As in the case of hydropower, there is an increasing understanding that some long-standing, common assumptions about the greenhouse gas impacts of different energy sources may have been too simplistic. Most notably, in the case of woody biomass, advocates for its use for energy frequently claimed that it did not contribute to global warming. They argued that the emissions produced when it is burned or gasified are cancelled out by the carbon dioxide taken in by the trees planted to replace the ones harvested for energy. That view turns out to be incomplete.

Until recently, energy policymakers across the country set biomass policy under the assumption that all its uses are beneficial for reducing greenhouse gas emissions. Governor Patrick's administration began to re-examine this assumption about biomass in 2009, in great part as a response to sustained opposition from some local residents in western Massachusetts to proposed biomass powerplants there. Although the project opponents



The Keller home in Gloucester is one of the increasing number of homes across the Commonwealth that have installed a photovoltaic system.

were primarily concerned about air and water pollution and truck traffic, they also pointed to studies that suggested that the greenhouse gas impacts of biomass were often much worse than generally assumed.

The Department of Energy Resources addressed this subject in a serious, thorough manner. It commissioned the first major study on the topic by a state. The Manomet Center for Conservation Sciences headed the study team, which also included researchers from the Biomass Energy Resource Center and other groups. The resulting report concluded that emissions from biomass facilities varied considerably, based on the technology used and the source of the wood. They further concluded that there is always an initial period where the biomass facility has a negative impact, because the carbon dioxide in the trees used for energy is sent into the atmosphere all at once, but it takes time for new growing trees to absorb an equivalent amount of carbon dioxide. According to Manomet, in the worst case scenarios, it could take more than 90 years for a biomass powerplant to achieve lower cumulative emissions than a comparably sized natural gas facility.³⁷

The Manomet study findings were highly controversial and set off a firestorm in the biomass industry.³⁸ The report may have overstated its conclusions because of the assumptions it

However, Manomet's basic point was sound—there is some delay in achieving greenhouse gas benefits from biomass use.

The Department of Energy Resources responded to this re-assessment of the role of biomass in reducing carbon emissions in an appropriate, balanced manner. It did not ban all biomass use, but instead adjusted its policies to emphasize those biomass uses—for either heating or electricity—that are most efficient and most likely to have a quick climate change benefit. The Department is still finalizing its biomass regulations, but has generally handled a complex situation fairly.

Hydroelectric and biomass are not the only energy sources that deserve detailed life-cycle analysis. Concerns have lately been raised about the life-cycle greenhouse gas impacts of natural gas. When natural gas is burned, it releases much less carbon dioxide than coal or oil. But a different greenhouse gas, methane, may be released during the hydraulic fracturing process of drilling for natural gas, perhaps making the natural gas obtained in this way no better than coal. Scientists are starting to study this issue in greater detail and it may be possible that effective regulations can sharply reduce the methane leaks.³⁹ Because many other parties are already focused on this issue, Massachusetts does not need to initiate its own study. The state should instead carefully monitor emerg-

ing research and be prepared to adjust its policies, if necessary, based on the results.

Transportation and Land Use

Transportation is responsible for 36 percent of Massachusetts's greenhouse gas emissions, the largest, fastest growing share by sector, and perhaps the hardest to tackle.⁴⁰

The most significant progress in reducing emissions is coming from the federal government's improved fuel economy standards. The combined 2012-2016 standards will cut emissions from cars and light trucks by approximately 21 percent by 2030.⁴¹ However, the federal government forecasts that vehicle miles of travel will go up during that same time, counterbalancing some of the efficiency gains.

Should that increase in vehicle miles travelled occur, it would continue a long-term trend. Based on gas tax records for Massachusetts and on the fuel efficiency of vehicles nationally, we can esti-

all efficiency of the transportation system, and the total vehicle miles travelled. Moreover, many other issues—from the safety of bridges to the MBTA's budget woes and road repairs—compete for transportation officials' attention.

Nevertheless, the state has the power to take some meaningful actions to reduce transportation emissions and the state climate change plan identifies some of them. Under the Patrick administration, there has been an attempt to integrate environmental sustainability into planning and decision-making within the Massachusetts Department of Transportation (MassDOT). During his tenure, Secretary of Transportation Jeffrey Mullen showed real passion for sustainability and that had an especially powerful impact on the perceptions of the staff in the various transportation agencies because of his long career spent focused on highways. There is evidence of a gradual, but real, culture shift within the bureaucracy.

The establishment of MassDOT in 2009 as a single, unified transportation agency made coordinated climate change planning easier and offers the promise of greater emissions reduction potential. For example, MassDOT now has the authority and the ability to explicitly compare all the costs and benefits of a transit project to a highway project. Additionally, by including the Registry of Motor Vehicles, MassDOT has new data and avenues for communication with the driving public.

GreenDOT

In mid-2010, the Department launched GreenDOT as a "comprehensive environmental responsibility and sustainability initiative that will make MassDOT a national leader in 'greening' the state transportation system." This initiative committed MassDOT "to incorporate sustainability into all of its activities; from strategic planning to project design and construction to system operation."⁴² And it enunciated more specific objectives, including reducing greenhouse gas emissions in

ONE OF GREENDOT'S APPROACHES IS TO HAVE TRANSPORTATION PLANS TAKE INTO ACCOUNT GREENHOUSE GAS EMISSIONS.

mate that the vehicle miles driven in Massachusetts rose 21 percent between 1992 and 2007. During that same time, the population of Massachusetts rose 7 percent. Most of the rise came from increased driving per person. This suggests that just improving the efficiency of vehicles will not be sufficient to reduce transportation sector greenhouse gas emissions significantly. It will instead also require action in several different arenas.

Compared to the powerful new national fuel-efficiency standards, the state has few options for making rapid reductions in the climate impacts of the transportation system. The state has only limited influence over many of the key factors affecting transportation emissions—people's choice of vehicles, the fuels they use, the over-

the transportation sector by 2.1 million tons below 1990 levels by 2020.⁴³ This would represent a 7.3 percent reduction in the transportation sector. It is probably the case that no other state department of transportation has expressed such clearly stated and comprehensive sustainability goals. It is truly a vision of national leadership in its aspirations and approach.

One of GreenDOT's innovations is to try to have key transportation plans (e.g., Long-Range Transportation Plans and Transportation Improvement Programs) take into account greenhouse gas emissions and ensure that selected projects, in the aggregate, will reduce emissions over time. As GreenDOT explains, "In cooperation with regional planning agencies, MassDOT will set statewide greenhouse gas reduction targets, and meet these targets by balancing highway system expansion projects with other projects that support smart growth development and promote public transit, walking and bicycling."⁴⁴

To make the ambitious GreenDOT vision a reality and to reach the emissions reduction goals will require enhanced management within MassDOT, as well as collaboration among the state's many partners in the transportation arena, including local governments and the 13 regional metropolitan planning organizations (MPOs) across the state. To date some progress is being made to move collectively on sustainability. For example, when the MPOs write their upcoming regional transportation plans, they will describe the overall greenhouse gas implications of the group of initiatives they propose. It will be revealing to evaluate the plans to see the extent to which efforts to reduce greenhouse gas emissions are included in them.

GreenDOT has clearly tried to point the transportation system in a climate friendly direction. It has started some interesting, useful activities, such as additional bike paths and Complete Streets workshops, which help transportation planners to design streets that accommodate all

roadway users, including cyclists and walkers. Yet GreenDOT's implementation has been inconsistent and not broad-reaching given its goals. At its current slow pace, it is difficult to believe that GreenDOT will achieve the emissions reductions projected for 2020.

This is especially true because other forces in the state transportation sector are pulling in the opposite direction. Pending MBTA fare increases and service cutbacks will cause some residents to switch some of their public transit trips to cars, increasing emissions. And cutbacks in some categories of federal funding will likely hamper the state's ability to launch major new efforts to reduce single occupancy travel.

MassDOT is scheduled to announce its GreenDOT implementation plan this spring. It would be highly desirable for that plan to explain in detail how MassDOT plans to achieve its 2020 climate goal and how staff across the agency will be assigned responsibilities to incorporate carbon-reduction-related actions into their own work, as that is what is required. The plan should include interim metrics and milestones, as well as a management component to ensure that responsibilities for deliverables are clearly assigned inside the agency in the proper departments.

As part of the establishment of appropriate milestones, MassDOT should move forward more quickly to measure greenhouse gas emissions from transportation. Federal regulations on the Scope of Statewide Transportation Planning (23 CFR 450.206) mandate that air quality and environmental stewardship be included in the transportation planning process which is increasingly being interpreted to include greenhouse gas emissions. As a result, some states are seeking ways to measure greenhouse gas emissions in an effort to add them to their traditional air pollutants as part of complying with these transportation planning regulations. Massachusetts is beginning that work, but it could be vastly improved with some technical assistance or support from others who

are already doing it elsewhere. More generally, MassDOT should consider seeking outside assistance and expertise related to GreenDOT.

Regional Clean Fuel Standard

The Clean Fuel Standard is designed to reduce the overall carbon content of transportation fuels used in the Commonwealth and to diversify fuel supply options in the long run. The state's climate plan included a Regional Low Carbon Fuel Standard (the previous name for the Clean Fuel Standard) as one of its major programs. The program was conceived as a variation on California's Low Carbon Fuel Standard, which was established in 2007 and was designed to reduce the carbon intensity of transportation fuels used in California by at least 10 percent by 2020.⁴⁵ The program was designed to be technology-neutral and market-based.

In November 2007, Governor Patrick, along with Senate President Murray and House Speaker DiMasi, announced an Advanced Biofuels Task Force to "promote the development of an advanced biofuels industry in the Commonwealth." In 2008, the Task Force reported out recommendations and the legislature subsequently passed "An Act Relative to Clean Energy Biofuels," which required the state to seek to create a low carbon fuel standard with the other states in the northeast.

Agency staff members from Massachusetts took a leading role in guiding the technical team to develop the regional program. With analytic and convening support from the Northeast States for Coordinated Air Use Management (NESCAUM), 11 New England and Mid-Atlantic states agreed to work together to develop a Clean Fuel Standard. Their early work was made more visible with a Memorandum of Understanding in December 2009, signed by the states' governors.⁴⁶

When NESCAUM analyzed the economic impacts of a Clean Fuels Standard that would reduce the carbon intensity of fuels used for transportation by 5 percent to 15 percent over the next 10 to 15 years, it found that transitioning to lower

carbon fuels such as electricity, advanced biofuels, and natural gas could significantly reduce carbon pollution, enhance energy independence, reduce vulnerability to price swings in imported oil, and strengthen the region's economy.⁴⁷

Rather than favoring a particular technology or specific fuel, the standard would allow fuel suppliers to choose how they meet emissions targets. For example, they could blend biofuels into the gasoline they sell, reduce emissions in their production processes, or purchase credits from utilities supplying low carbon electricity to electric vehicles.

The 11 states in the Northeast are currently developing a framework for the standard, but a potential legal barrier emerged earlier this year when a California judge granted ethanol producers' request for a preliminary injunction against the California standard. The plaintiffs argued that the Low Carbon Fuel Standard is preempted by the federal Renewable Fuel Standard (RFS) and is also unconstitutional under the dormant commerce clause of the Constitution. The California Air Resources Board is appealing the decision.

Although California is said to have a strong case and its standard could be upheld, Massachusetts would be wise to move forward with other policies and programs related to electric vehicle deployment and natural gas use as a transportation fuel for certain types of vehicles. One approach would be to increase the Commonwealth's engagement in the Transportation and Climate Initiative (see Appendix C on regional initiatives), as well as to lead the region in deeper electric vehicle deployment efforts and in upcoming consideration of a regional natural gas transportation policy.

New initiatives

Beyond the climate-change-related transportation initiatives that have already been slated for GreenDOT or otherwise included in the state's climate plan (e.g., pay as you drive insurance), the state has other opportunities for reducing greenhouse gas emissions from the transportation sector,

THE MBTA REDUCES ITS ENERGY USE

On Oct. 25, 2011, ground was broken on the Kingston Wind Turbine Program at the Kingston Layover Facility. A 100-kilowatt wind turbine will provide 65 percent of the Kingston commuter rail station's electricity supply. The \$2.5 million project is funded through a 2009 ARRA grant and builds on the Patrick administration's efforts to invest in energy efficiency and renewables.⁴⁸

At the Alewife Garage, the MBTA is replacing more than 1,900 T-12 40-watt fixtures with T-8 32-watt lamps and ballasts. The current lenses will also be exchanged with new tube guards to improve efficacy further. Lighting improvements will be made to 87 percent of the fixtures at the garage. The estimated payback through energy savings for the \$1 million in ARRA funds invested is less than 2.5 years.



State officials and guests inspect improved Alewife Garage lighting at a 2011 kickoff event for a new state energy-efficient lighting program.

Photo Credit: Massachusetts Executive Office of Energy and Environmental Affairs

some of which have begun, much to the credit of champions within the agencies.

For example, there are significant opportunities to increase energy efficiency in state and related authorities, including at the MBTA and at Massport. The MBTA is the largest single electricity consumer in Massachusetts. Over the past two years, the MBTA has begun to use engineering and management support for energy efficiency projects that have improved the energy performance of buildings, stations, and garages. (For examples, see sidebar.)

Beyond the MBTA, there are additional opportunities to increase energy efficiency at other transportation facilities, including the 37 public-use airports, 184 private landing areas, and 2 seaplane bases in Massachusetts. Of these airports, 24 are owned either by Massport or municipalities.

Massport deserves praise for improving its own fleets, supporting compressed-natural-gas refueling, and making energy efficiency a priority in new and renovated buildings (e.g., the centralized rental car facility). But it could go much further. Consultants based in Massachusetts are working around the country to make airports more efficient while less is being done at the state's own airports. The climate plan being

implemented at San Francisco International Airport could be a good model.⁴⁹

There is another opportunity for Massachusetts related to the intersection of information technology and transportation. Information technology is increasingly being applied by car manufacturers, transit systems, and transportation planners around the world to reduce traffic congestion and improve the efficiency of transportation systems. Because congestion and system inefficiency lead to unnecessarily higher greenhouse gas emissions, there are climate benefits to speeding the introduction of information technology. As one of the leading global centers for the information technology industry, Massachusetts could and should be in the forefront of this trend.

The MBTA has done some leading work in this area. MassDOT and the MBTA deserve great credit for their open approach in releasing public data (bus GPS data, for a start) and their in-depth work with the information technology developer community.⁵⁰ It would be useful to see this approach expanded across the entire set of state transportation agencies for the benefit of the consumer and the environment. Possible subjects include enhanced ridesharing, community outreach for reduction in vehicle miles

traveled, improved congestion management, and peak period demand reduction.

Land use

Transportation investments shape land use patterns, which impact greenhouse gas emissions by influencing travel patterns and the built environment. The amount of driving each person is likely to do is largely a function of land use patterns and available modes of transportation. As people live farther from their destinations, they usually walk, bicycle, or use public transportation less and drive more often and for longer distances.

Relative to most other states, growth in Massachusetts in the late-20th century was more decentralized.⁵¹ At least until the recent deep recession, people were living further from job centers and public transit systems. This lower density development meant that more homes were built on large lots and were larger in size, requiring more energy for heating and cooling.⁵² This lower density development, generally on undeveloped land, meant that trees and vegetation were lost along with their capacity to remove carbon from the air.⁵³

The state's climate plan recognizes the relationship between transportation and land use and includes a "smart growth policy package" aimed at facilitating more compact development. The state examined a wide range of options and

targets.⁵⁵ However, Massachusetts continues to implement smart growth policy innovations in ways that could be very meaningful to reaching the 2050 reduction target if the state can maintain this focus and steadily build on success.

Local government and land use

Limited home rule in Massachusetts empowers municipalities to regulate how land is developed within their borders. State law, however, makes it difficult for communities to facilitate more compact and energy efficient development in two respects. First, local governments are restricted in their ability to generate revenue, which makes them heavily reliant on local property taxes and creates fiscal incentives that tend to produce larger housing units and decentralized development. Second, while communities have the ability to regulate zoning, there are important restrictions on how municipalities can manage growth.⁵⁶

Local finances have been challenging for Massachusetts municipalities since the early 1980s, when voters passed Proposition 2½, which limited annual growth in property taxes. The law has strained municipal finances, especially in recent years with escalating health care costs and reductions in local aid from the state. Communities have responded with regulations that limit new development that might generate costs in excess of revenues. In practice, this means enacting zoning ordinances that require large lot sizes. This forces developers to build bigger, more expensive homes, which produce more municipal revenue relative to costs. But this large lot zoning also tends to push development outward, leading to longer commutes and is much more resource-consumptive.

To reduce the fiscal disincentives to promote more compact development, in 2003, the legislature enacted Chapters 40R and 40S, which provide communities with incentives for zoning and permitting housing in higher density smart growth districts. Chapter 40S is designed to overcome the challenge of educational costs

STATE LAW MAKES IT DIFFICULT FOR COMMUNITIES TO FACILITATE MORE COMPACT AND ENERGY EFFICIENT DEVELOPMENT

chose a group of policies that are both bottom-up—giving local governments more control over land use—as well as top-down—reforming practices at the state level.⁵⁴ Like those in other leading smart growth states, the Commonwealth's policies have so far had only modest success relative to the magnitude of change that will be needed to achieve the climate change reduction

(the majority of local spending in most municipalities) by reimbursing communities for the net costs of educating any new students living in smart growth districts.

Since these statutes were enacted, the state has approved 33 smart growth districts providing for more than 10,000 units of new housing. Despite the weak real estate market, more than 1,200 units have already been built and an additional 1,200 are expected to break ground this year.⁵⁷

Although chapters 40R and 40S have considerable potential to incentivize higher-density, mixed-used development and reduce vehicle travel, communities worry that the state will not fulfill its obligations to reimburse municipalities for new school costs. Chapter 40S is supported by a trust fund capitalized through the sale of surplus state land. The money in that fund is running out. While a bill has been filed to address this shortfall, passage is unlikely. Failure to create a revenue mechanism that securely capitalizes the smart growth trust fund would be a serious blow to the Commonwealth's effort to address climate change.

Land use regulation

In recent years, there have been several efforts to modernize the state's antiquated zoning law which makes it difficult for communities to control sprawl. The most recent effort began in 2007 when Governor Patrick appointed a zoning reform taskforce. The taskforce worked diligently over an 18-month period to develop the *Land Use Partnership Act* (LUPA), which was filed during the 2009-2010 legislative session and again in the current legislative session. The climate plan's smart growth policy package identifies passage of this act as a top priority.

LUPA's provisions eliminate some of the most serious shortcomings of the state's current zoning law, such as restrictions on regulating maximum residential floor area. In addition, communities that develop a land use plan and

enact zoning consistent with that plan would have access to other tools to control development.⁵⁸

Supporters of the act have sought to maintain a tenuous coalition of developers, who face highly restrictive anti-growth regulation, and municipal and environmental stakeholders, who are eager to manage growth and promote more efficient land use. Developing consensus among all parties has been difficult. Because the bill is highly technical and the problem with the state's current law is evidenced mostly by development patterns that emerge over long periods of time, there has been little public pressure to move the bill through the legislative process.

The legislature should strive to pass comprehensive zoning reform, but if it is not achievable in this session, the legislature should expedite passage of components of the currently pending legislation that will lead to more efficient development patterns and reduce greenhouse gas emissions. For example, allowing for transfer of development rights between communities would be one effective tool to concentrate development and protect environmentally sensitive areas.

Targeting state investment

State government is well positioned to encourage compact development by making greenhouse gas impacts a consideration in determining where the state invests its own resources.⁵⁹ The climate change plan notes several examples of how this can be done. This concept of targeting state investment to promote smart growth has enjoyed strong bipartisan support.

In 2004, the Romney administration issued the state's first Sustainable Development Principles and made them the foundation for Commonwealth Capital, a nationally recognized model for investing state resources in ways that incentivize smart growth. The Commonwealth Capital program used municipal planning and regulation as a factor in awarding state grants and loans. More than \$600 million annually in grants and

low interest loans were awarded based in part on how communities matched up against the Commonwealth Capital criteria. The vast majority of municipalities engaged in the program and many undertook planning activities and adopted regulations in order to boost their scores.⁶⁰

The Patrick administration updated the Sustainable Development Principles in 2009, but recently determined that, in its current form, Commonwealth Capital had achieved as much as is feasible. The administration discontinued the program for Fiscal Year 2012.

However, the administration continues to target state investment in other ways. For example, the new MassWorks Infrastructure Program relies on the Sustainable Development Principles to target state resources. Many of the grants that previously fell under Commonwealth Capital have been consolidated into this fund. Regulations established by the administration place a heavy emphasis on smart growth.

The administration set an excellent precedent in awarding these funds according to criteria that promote smart growth, but the legislation submitted to formally consolidate these grants only references sustainable development in general terms. It does not solidify the selection criteria in the current regulations in statute. The legislature would not need to limit necessary administrative flexibility if it chose to set thresholds in the statute. For instance, the pending legislation could be amended to include the provision from the current regulation that requires housing projects to support a minimum density of at least four units per acre. Such endorsement from the legislature would show a firm commitment to the Sustainable Development Principles.

Regional coordination

A major stumbling block for efforts to promote sustainable land use in Massachusetts is the long-held aversion to regional coordination. A comprehensive review of state smart growth policies conducted by the Lincoln Institute of Land Policy in 2009 found that programs implemented by local governments pursuing their own parochial interest without regional coordination are unlikely to have success.⁶¹

The Patrick administration has intelligently used priority funding as an opportunity to promote regional collaboration. This effort began on the South Coast, where communities came together to prepare an unprecedented regional land use plan in preparation for the proposed South Coast Rail corridor. In the 2010, Governor Patrick issued Executive Order 525, which calls for implementation of this South Coast Rail Economic Development and Land Use Plan by requiring that state agencies align spending with the priority development and preservation areas established in the plan when making new investments in the region.

To help ensure that this mandate has an impact, the executive order included language calling for the Executive Office of Administration and Finance to conduct a two-year retrospective analysis of all significant investments for consistency with the plan. Additionally, to promote transparency, the executive order called for the development of a web-based tracking system to record investment decisions in the development corridor.

The Patrick administration is now building on the South Coast success by developing a similar regional land use plan for 37 growing communities along Interstate-495. When this plan is completed, the administration is expected to issue another executive order to align state spending with the strategy. The state should unfurl this approach across the Commonwealth, working closely with communities to build buy-in around

forward-looking regional land use planning, and making these plans meaningful by investing state funds consistent with the priority development and preservation areas identified.

Adaptation

The climate has already begun to change and this requires Massachusetts residents to make adjustments to adapt to those changes. So far, because the changes have been small, the necessary adjustments have also been small. But it makes sense for residents, as well as state government, to prepare ahead of time for some of the likely future changes, rather than wait to respond to negative consequences after they are already doing serious damage. For example, the state should prepare for the likelihood that it will need to deal with increased flooding and more summer heat waves in the future. Advance planning and preparedness represent sound risk management.

Until a few years ago, many environmental groups were reluctant to raise the subject of climate change adaptation. They worried that it would distract the public from efforts to reduce greenhouse gas emissions and could even give the impression that such efforts are hopeless because it is too late to prevent climate change. However, it has become ever more apparent that some global warming is inevitable, although the extent of that warming will be influenced by the human emissions in the coming years.

Various state agencies have taken steps to consider what global warming could mean for their operations and to prepare to adapt to climate change. For example, with the Deer Island Waste Water Treatment Plant, the Massachusetts Water Resources Authority became the first American public agency to consider possible sea level rise in the design of a facility. The Massachusetts Department of Public Health's Bureau of Environmental Health was one of 10 agencies across the country to receive a grant from the Centers for Disease Control and Prevention "to conduct an

assessment of current gaps in public health preparedness to address climate change and further develop plans to address public health impacts related to climate change."⁶²

Many other agencies have undertaken useful actions but two deserve special recognition for their work to prepare for global warming:

1. Massachusetts Division of Fisheries and Wildlife (DFW). This agency, and the Department of Fish and Game generally, realized that they needed to understand the likely implications of climate change in order to target their efforts at preserving wildlife and protecting biodiversity. They wanted to know which locations and species were likely to be stressed by global warming, as well as which specific ecosystems would be difficult or impossible to preserve if the climate changes.

In early 2008, with a grant from the Wildlife Conservation Society, DFW, the Manomet Center for Conservation Sciences, and other partners embarked on a project to study such questions as: how vulnerable are Massachusetts ecological resources to climate change and what are the options for preserving valued resources? According to the partners, the goal "was to make 'climate-smart' the state's existing State Wildlife Action Plan (SWAP)—DFW's 'blueprint' for future conservation in the state."⁶³ In April 2010, they issued three volumes under the title of *Climate Change and Massachusetts: Fish and Wildlife*. They evaluated many different habitats for climate change vulnerability. The reports will have a significant ongoing impact on the state's conservation efforts.

2. Massachusetts Office of Coastal Zone Management (CZM). In 2008, CZM launched StormSmart Coasts, a program "designed to help coastal communities address the challenges arising from storms, floods, sea level rise, and climate change."⁶⁴ The agency provides online resources

and works with local communities on projects to address vulnerable infrastructure. For example, CZM helped the Town of Hull set up a program that waives building fees for structures that are elevated at least two feet off of the ground, in order to reduce the risk of flooding. The Town of Oak Bluffs, with assistance from CZM and the Federal Emergency Management Agency (FEMA), passed new zoning by-laws that prohibit construction in vulnerable areas. In the case of Falmouth, CZM helped the town connect its existing planning efforts with hazard mitigation planning related to climate change. As part of that project, CZM “developed a survey to gain public input on vulnerabilities and build support for actions that will reduce Falmouth’s vulnerability to natural hazards.”⁶⁵ In addition to working with individual communities, the agency is putting together a coastal zone hazards atlas and is preparing maps showing projections of sea level rise along the entire Massachusetts coast.

The state’s climate change adaptation report

The Commonwealth moved adaptation planning along significantly when the subject was included in the *Global Warming Solutions Act*. The law required the Secretary for Energy and Environmental Affairs to “convene an advisory committee to analyze strategies for adapting to the predicted impacts of climate change in the Commonwealth.”⁶⁶ The committee was mandated to include representatives with 18 different types of expertise, ranging from wetlands to manufacturing to low-income consumers.

Although the law requested the committee to issue its findings and recommendations by the end of 2009, the committee’s report did not appear until September 2011. The delay was disappointing, but the end result was an unusually comprehensive and rigorous piece of research and analysis. It was shaped by a 34-member Climate Change Adaptation Advisory Committee and a 14-member State Agencies Steering Committee, supplemented by many other staff mem-

bers from various state departments. This large group of authors divided itself into eight subcommittees each responsible for a different section of the report.

The completed report starts with an overview of the likely changes to the climate and their projected impacts on Massachusetts, then offers “a set of guiding principles to follow, and key adaptation strategies that cut across multiple sectors.”⁶⁷ The second half of the report focuses on the vulnerabilities to climate change in five areas—natural resources and habitat; infrastructure; human health and welfare; the economy and government; and coastal zone and oceans. It describes response strategies in each of those areas and makes literally hundreds of suggestions of what the state could do to make Massachusetts less vulnerable to global warming and better prepared to deal with it.

In great part because so many knowledgeable people were so heavily involved and seriously committed to the writing of the report, it is solid and thorough. Virtually all of its many recommendations are logical and well-supported by research. It proposes numerous ideas for activities that the various agencies will surely find useful and will help guide their work.

Yet, despite the quality of the analysis, the report has not served, so far, as a loud call to action. It has received little attention beyond the network of people who were involved in producing it or who are already engaged in activities to manage and respond to the impacts of climate change. Part of the explanation for the report’s public invisibility is that the Patrick administration released it in a low-key way with just a press release and no event or extensive roll-out strategy.

But there is another reason why it has had little impact so far. By striking a sober, academic tone and aiming for comprehensiveness in its recommendations, the report did not present the media or the public with a few bold messages that could grab their attention. More problematic, the

report sidesteps setting priorities. While it is true that agency staff can incorporate many of the recommendations into their ongoing work without competing for resources with activities in other agencies, it would be good to agree on a handful of most important things to accomplish over the next few years. As with the state's greenhouse gas reduction efforts, there should be clear targets, agreed upon priorities, and defined metrics.

Next steps for the state's climate change adaptation efforts

Massachusetts is wellplaced to address climate change preparedness in an effective manner. As noted above, many agencies are already active and the climate adaptation report gave them additional ideas for their day-to-day work. There is good cooperation among the states in the region and with federal agencies, including EPA and FEMA. In October 2011, the US Department of Interior awarded a major grant to the University of Massachusetts at Amherst to establish a Northeast US Climate Science Center, which will coordinate research among seven institutions across the region.⁶⁸ There is little doubt that Massachusetts will continue to make progress with targeted efforts across a wide range of agencies.

But that important, detailed, agency-by-agency work does not eliminate the need for the priority setting called for above. The Executive Office of Energy and Environmental Affairs should move quickly to dissect the climate adaptation report and identify a few clear priority actions and goals for the next several years. Various staff members in that office, including Secretary Richard K. Sullivan Jr., have acknowledged that this needs to happen and have promised to pull together a small team of agency staff members and outside stakeholders to work on it, but little has happened so far. The priority-setting process should be accelerated. Ideally, the priorities that come out of such a process will include several that can capture the public's imagination and mobilize citizen involvement.

Among the specific actions that might be considered, whether or not they turn out to be top priorities are:

1. **Executive Order on state development.**

As was recommended in the climate adaptation report, the Governor should "explore issuing an Executive Order that specifically directs state development and significant redevelopment, as well as state-funded projects, out of vulnerable coastal areas."⁶⁹

2. Give more attention to building preparedness. The state could develop a list of actions that should be taken to make buildings less vulnerable to flooding and other impacts of climate change. Those actions could then be implemented by the state routinely over time as part of regular building maintenance, repairs, and renovations. As an example of this, Stephen Estes-Smargiassi, Director of Planning for the MWRA, reports that his agency now has a standing rule that, if electricians need to go into a building to do electrical work and the building is potentially vulnerable to flooding, the electrical services boxes are moved higher. Similarly, storm surge protectors are placed at the bottom of garage doors, costing \$10,000 but potentially preventing much more costly water damage.⁷⁰

3. Provide additional support for community-level adaptation planning. CZM is helping some municipalities with issues related to flooding and sea level rise, but other communities would benefit from help preparing for climate change. Some cities and towns, like Boston and Cambridge, are starting to address this issue and would benefit from assistance. Massachusetts could consider offering competitive grants to municipalities to advance detailed community-adaptation planning.

The state could take this same approach of incorporating climate change risk reduction mea-

tures into routine building repair projects and promote it to local governments and the private sector for their buildings. The state can also play a useful role by much more aggressively educating builders, homeowners, businesses, and other property owners of the financial risks of flooding and the changes they could make to reduce those risks. For example, if potential home purchasers knew that three feet of flooding in a vulnerable community would likely inflict \$10,000 in damages to a typical home, they may be more likely to make sure that their home has sufficient clearance or is protected in other ways, such as using flood-resistant materials. Just as the state provides building owners with energy-efficiency suggestions described in relationship to their ease of installation, cost, and likely payback period, it could provide flood protection suggestions.⁷¹

This outreach should be linked to efforts to modify building codes to account for the likely climate that new buildings will face over the course of their useful life. There should be similar efforts made to modify zoning ordinances to account for a changing climate.

In developing its adaptation plans and activities, Massachusetts can draw on some of the other jurisdictions around the world that are addressing the issue. In Appendix D and E, we describe interesting programs aimed at making Maryland, the Netherlands, and the Thames Estuary more resilient to climate change impacts.

3. Is the State Playing a Leadership Role?

Massachusetts will be a good global citizen by simply meeting the goals in the state's climate action plan and thereby doing its fair share toward bringing down global greenhouse gas emissions. But because the state's emissions comprise only a small fraction of the global total, Massachusetts will have only a minimal impact on the overall trajectory of global climate change, even if it meets its 2020 and later targets. There is opportunity to

do more. Since the struggle to reduce emissions plays out at several levels simultaneously, the state should think about and act on all those levels. By doing so, Massachusetts would not be resigned to only playing a small role in the global effort to prevent catastrophic global warming.

The main way for any state, locality, or region to increase its impact on total global emissions is to influence other players outside its borders. All governments should be judged, in part, by the extent to which they persuade others to act. There are good reasons for Massachusetts, in particular, to try to affect places outside the state lines. There are four ways in which this can be done:

Demonstrating that state action can produce reductions.

Governments and people across the country will be watching to see whether the states like Massachusetts, with ambitious 2020 emission reduction commitments, follow through and reach their goals. Massachusetts can demonstrate that it is politically feasible and practical to meet serious reduction targets. Success in that endeavor will encourage other states and localities to set their own ambitious targets and to continue to work to fulfill their own commitments. If, instead, Massachusetts fails in its quest to reduce emissions, it could have a chilling effect on other players.

Providing regional leadership.

Massachusetts has often been a leader on climate change and energy policy within the geographic region, whether that region is defined as New England, the Northeast, New England and Eastern Canada, or the Northeast and Mid-Atlantic. As mentioned above, Massachusetts played important roles in starting RGGI and getting the New England Governors and Eastern Canadian Premiers to commit to cooperating on addressing global warming. Here are some of the other ways in which Massachusetts has been a leader in stimulating states to work together on climate-change-related matters:

- **Biomass.** Massachusetts provided a valuable service to the states in the region by initiating and funding the Manomet study on the climate change impacts of biomass powerplants. As noted previously, while this report was not flawless, it brought attention to an important issue and has gotten some other states to begin to think differently about their biomass policy.

- **Offshore wind.** By creating the US Offshore Wind Collaborative, Massachusetts has helped to bring stakeholders together throughout the Eastern Seaboard. If the Cape Wind project moves forward, it will help advance the entire US offshore wind industry.

- **Renewable portfolio standard.** The Massachusetts state renewable portfolio standard has served as model for other states in the region, both in terms of its detailed provisions and in its administrative procedures.

- **Coordinate regional renewable power procurement.** With Governor Patrick's leadership, Massachusetts secured the New England governors' agreement to work together, through the New England States Committee on Electricity (NESCOE), to coordinate procurement of renewable power. The governors hope that this approach will make large-scale renewable energy project development easier and less expensive.⁷²

- **Massachusetts Ocean Plan.** This plan set an important example of how to better manage a state's marine environment and to plan for the appropriate siting of renewable energy projects in the ocean.

Massachusetts could strengthen its leadership role in the coming few years in the following ways:

- **Place a high priority on preserving and strengthening RGGI.** RGGI is the most important regional initiative related to climate change and, as noted above, it has the potential to yield greater emission reductions than are currently projected for it in the Massachusetts climate plan. Unfortunately, it is also possible that RGGI could be weakened because of opposition to it among some politicians and stakeholders in other states. Massachusetts leaders should commit to being more active and forceful in working to ensure that all the states end up supporting a stronger rather than a weaker RGGI.

- **Consider the implications of self-congratulations.** Virtually all politicians and governments seek to point out ways in which they have been successful, and there is generally nothing wrong with that. For example, the Patrick administration is rightly proud that Massachusetts came in first in the ACEEE energy efficiency rankings and the administration should celebrate the accomplishment. Competition among states for such accolades can be healthy, causing them all to increase their efforts. But it is important to avoid alienating other states or making them less interested in working with Massachusetts on regional activities. A few times in recent years, Massachusetts government representatives have given the impression that certain actions were only worth taking because Massachusetts got to claim that it started them first. That impression discourages other states from taking similar actions because they will not be able to claim that they were first.

Developing policies and testing strategies that others can emulate.

Good ideas that are implemented in one place can and do often spread to other places near and far. In that way, the pioneers have an outsized influence. Sometimes a state develops a policy for its own purposes and that policy unexpectedly spreads to other places. But a state can also intentionally experiment with a policy or strategy in the hope that it will become a model for others. This latter approach is especially desirable in the case of global warming because so many different government entities need to implement climate change action strategies and there is such a need for innovative, effective policies.

In fact, the ripple effect can be so great that it could make sense for Massachusetts to shift some resources toward piloting creative new strategies even if it means that the state does not maximize its own short-term emission reductions. When taking this approach, it is important to start with an understanding of the realistic potential for other players outside the state to adopt the policy or strategy.

Here are some of the ways in which Massachusetts has already served as a climate action model for others or will likely become a model:

- **All cost-effective energy efficiency measures.**

The concept of implementing all cost-effective energy efficiency measures had been discussed widely in energy policy circles before Massachusetts adopted that policy as part of the *Green Communities Act* of 2008. When Massachusetts took this step, many people outside the Commonwealth began to monitor how the policy was being implemented here. Its general success has influenced the thinking of policymakers in other states and has helped encourage some states to increase their funding for energy efficiency.

- **Combined energy and environmental secretariat.** The decision to combine the state's energy and environmental departments into a single agency was a sound one. It made it easier and more efficient to address climate change. Other states, like Connecticut, have moved in this direction.

- **The Green Communities Program.** This program, which will be discussed in Section IV, has been quite effective at engaging municipalities in climate change action. The program is a good model for other states. There is now sufficient data about its success, including the survey conducted for this report, to warrant the state disseminating information about it to others. Perhaps in response to the success here in Massachusetts, New York State has begun a similar program called the Climate Smart Communities Program.⁷³

- **Communicating economic development benefits.** The state has given much attention to documenting and communicating the economic benefits of clean energy development. Some of its approaches are being used by other states or deserve to be used by other states. For example, the Massachusetts Clean Energy Center's 2011 *Massachusetts Clean Energy Industry Report* was well done and is worthy of emulation. The report used a solid research methodology to profile the clean energy industry in the state and quantify the number of companies and jobs related to clean energy.⁷⁴ Officials in several other states have taken advantage of opportunities to learn about the report and its approach, and have an interest in replicating it.

- **Stretch building energy code.** The *Green Communities Act* of 2008 introduced the concept of a stretch building energy code. In response, the Board of Building Regulations

and Standards issued such a code the following year, making Massachusetts the first state in the nation with an optional, more energy-efficient code. Compared to the base state code, it aims “to achieve approximately a 20 percent improvement in building energy performance.”⁷⁵ Municipalities are given the option of adopting the enhanced code and the Green Communities Program provides incentives for them to do so. More than 100 communities have chosen it, indicating its significant appeal and suggesting that this policy will have a meaningful impact on lowering greenhouse gas emissions.

Not only is the concept of a stretch code a useful model for other states, but Massachusetts developed it in a way that influenced national energy code standards. The *Green Communities Act* committed the Commonwealth to having its base energy code be derived from the International Energy Conservation Code (IECC), a standard that was developed and is periodically revised by the International Code Commission. It is therefore in the interest of the state’s climate change efforts for revisions to the IECC to require increased energy efficiency.

When writing the language for the stretch code, state officials worked closely with the IECC in the hope that the stretch code could then be used as a model for the next IECC revision. And indeed, the IECC 2012 version takes many aspects from the Massachusetts stretch code. This means that the state will have a positive impact on all the jurisdictions outside the state that adopt it. And because the 2012 version is stronger than the previous one, all Massachusetts communities will now require improved energy performance. The Massachusetts stretch code has been upgraded as well, since it remains geared to achieving a 20 percent improvement over the base code.

- **Valuation of carbon dioxide emissions.** The Department of Public Utilities (DPU) is investigating how to count the benefits of reducing carbon pollution in its regulatory decision-making. Conventional utility regulation does not account for all the avoided costs of reduced emissions. Depending upon what the DPU concludes, it could have a significant impact in Massachusetts and could serve as a model for other states.

- **Consideration of climate change impacts in MEPA project reviews.** Construction and development projects that exceed certain thresholds are subject to the provisions of the *Massachusetts Environmental Policy Act* (MEPA), which aims to minimize damage to the environment. Those projects must undergo a thorough public study. This is not an approval process but rather is designed to foster better information and a careful look at all the potential impacts of a development in order to improve regulatory decision-making. To that end, the results of the study are shared with permitting agencies. Starting in 2007, MEPA began to consider greenhouse gas emissions and other potential climate change impacts when reviewing certain projects. Its authority to do that was strengthened in the *Green Communities Act* and its greenhouse gas policy was revised to apply to all projects that require a MEPA study. Project developers need to submit an environmental impact report that estimates project-related greenhouse gas emissions and examines feasible alternatives to reduce those emissions. As MEPA explains it, “By conducting this early-stage impacts and alternatives analysis, project proponents can integrate sustainable design considerations directly into project planning, which will allow the project to achieve GHG emissions reductions in the most cost-effective manner.”⁷⁶

Nurturing technologies and businesses.

The world needs businesses to continually commercialize new and improved technologies and mitigation strategies. A state can help this process of innovation by providing assistance—financial and otherwise—to businesses that have the potential to have a significant impact, both in the state and beyond.

Because Massachusetts is a major center for research, innovation, and start-up companies, it has a greater ability than most states to influence the introduction of valuable technologies and strategies for climate change mitigation and adaptation. This is an area where actions that are good for the global climate can also be good for the growth of local businesses.

When the legislature in 1997 established the Renewable Energy Trust at the Massachusetts Technology Collaborative, it gave it a broader mission than many clean energy funds in other states. The Renewable Energy Trust was explicitly charged with helping renewable energy businesses grow. Over the next decade, the Trust provided loans, grants, and investments that were valuable to some of the state's renewable energy start-up companies.

After the Massachusetts Clean Energy Center was established and the Renewable Energy Trust was folded into it, the Center devoted even more attention and resources to stimulating clean

energy business development in Massachusetts. The legislation authorizing the Center allowed it to invest in a wider range of clean energy companies than the Trust had been permitted. The Center has worked to help define and build a vibrant clean energy business cluster. It has not only provided support to individual companies, but has worked on training and other workforce development activities.

The Clean Energy Center has worked in close cooperation with the state's Office for Business Development. It has also partnered on many activities with the New England Clean Energy Council, a recent, but rapidly growing industry association. It has been a positive development that state government has worked so collaboratively with the Council and others in the private sector.

The Clean Energy Center should be applauded and encouraged to continue its efforts. Our one recommendation for an improvement is that the Center make a company's potential to impact global greenhouse gas emissions an explicit factor in decisions about investments. Although a company's economic potential, as measured in jobs and economic activity in the state, should remain primary considerations, the Clean Energy Center should give preference to those companies that are likely to play the biggest role in the global response to climate change.

CHAPTER II. ENDNOTES

- 1 These studies are Department of Environmental Protection, *State Greenhouse Gas Emissions Level: 1990 Baseline and 2020 Business As Usual* (Boston: Department of Environmental Protection, 2009); Paula Fields et al., "Initial Estimates of Emissions Reductions from Existing Policies Related to Reducing Greenhouse Gas Emissions," Memo to Climate Protection and Green Economy Advisory Committee, April 30, 2010; and Eastern Research Group et al., *Cost-Effective Greenhouse Gas Mitigation in Massachusetts: An Analysis of 2020 Potential* (Boston: Eastern Research Group, 2010). All three documents are available at www.mass.gov/dep/air/climate/gwsa_docs.htm#2020.
- 2 *State Greenhouse Gas Emissions Level*, p. 5.
- 3 Executive Office of Energy and Environmental Affairs, *Massachusetts Clean Energy and Climate Plan for 2020* (Boston: Executive Office of Energy and Environmental Affairs, 2010), p. ES-5.
- 4 Information drawn from *Massachusetts Clean Energy and Climate Plan*, p. ES-6.
- 5 See www.climatechange.ca.gov/climate_action_team/reports/index.html#reportcards.
- 6 For the most recent California Report Card, which appeared in January 2012, see www.climatechange.ca.gov/climate_action_team/reports/2012_CalEPA_Report_Card.pdf.
- 7 New York State Energy Research and Development Authority, *Relative Effects of Various Factors on RGGI Electricity Sector CO2 Emissions: 2009 Compared to 2005* (New York: RGGI Inc.: 2010), pp. 1-4. Available at http://www.rggi.org/docs/Retrospective_Analysis_Draft_White_Paper.pdf.
- 8 The future of RGGI is discussed below. RGGI is described more fully in Appendix C, which covers various regional initiatives.
- 9 *Massachusetts Clean Energy and Climate Plan*, p. 20.
- 10 Massachusetts Department of Energy Resources, *Massachusetts Renewable and Alternative Energy Portfolio Standards (RPS and APS): Annual Compliance Report for 2010* (Boston: Massachusetts Department of Energy Resources, 2012). Available at www.mass.gov/eea/docs/doer/rps/rps-aps-2010-annual-compliance-rpt-jan11-2012.pdf.
- 11 For an overview of the program, see Kenneth Kimmell, "Clean Energy Results," a presentation to the Restructuring Roundtable, February 17, 2012. Available at www.raabassociates.org/main/roundtblw.asp?sel=111.
- 12 According to analysis by Environment Northeast, emissions in 2011 fell 34 percent below the cap. Environment Northeast, *RGGI Emissions Trends* (Rockport, ME: Environment Northeast, 2012). Available at www.env-ne.org/resources/detail/rggi-emissions-trends-report-jan-2012.
- 13 Neena Satija, "Thousands of Gas Leaks in Boston Area," *Boston Globe* (August 17, 2011). Available at http://articles.boston.com/2011-08-17/news/29897396_1_gas-leaks-natural-gas-gas-companies.
- 14 Rich Barlow, "Fueling Global Warming, Not Homes," *BU Today* (September 29, 2011). www.bu.edu/today/2011/natural-gas-leaks-fuel-global-warming-not-homes.
- 15 The Carbon Mitigation Initiative has information on stabilization wedges on its website at <http://cmi.princeton.edu/wedges>.
- 16 California Council on Science and Technology, *California's Energy Future—The View to 2050: Summary Report* (Sacramento: California Council on Science and Technology: 2011). Available at <http://ccst.us/publications/2011/2011energy.pdf>. One of the co-chairs of the California study explains the implications and daunting challenges of trying to achieve a 80 percent emissions reduction in Jane C.S. Long, "Piecemeal Cuts Won't Add Up to Radical Reductions," *Nature* (October 27, 2011), p. 279. For several reasons, it should be easier to achieve an 80 percent reduction in New England than in California, but would still be quite challenging.
- 17 European Commission, *Roadmap for Moving to a Competitive Low-Carbon Economy in 2050* (Brussels: European Commission, 2011). Available at <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0112:FIN:EN:PDF>.
- 18 Acts of the General Court of Massachusetts, 2008, Chapter 169, Section 21.
- 19 The website of the Massachusetts Energy Efficiency Advisory Council includes the utilities' energy efficiency plans, as well as monitoring and evaluation reports. See www.ma-eeac.org.
- 20 Per capita spending by state extrapolated from Adam Cooper et al., *Summary of Ratepayer-Funded Electric Efficiency Impacts, Budgets, and Expenditures* (Washington: Institute for Electric Efficiency, 2012), p. 12. Available at www.edisonfoundation.net/iee/Documents?IEE_CEE2011_FINAL_update.pdf.
- 21 Michael Sciortino et al., *The 2011 State Energy Efficiency Scorecard* (Washington: American Council for an Energy-Efficient Economy, 2011), p. 14.
- 22 Ibid., p. iii. www.aceee.org/research-report/e115.
- 23 *Massachusetts Clean Energy and Climate Plan for 2020*, p.28.
- 24 For descriptions of various indirect rebound effects, see Horace Herrell and Steve Sorrell, eds, *Energy Efficiency and Sustainable Consumption: The Rebound Effect* (New York: Palgrave Macmillan, 2009), p. 5. This book provides a thorough treatment of many different ways to consider rebound effects when setting energy policy.
- 25 Jesse Jenkins et al., *Energy Emergence: Rebound & Backfire as Emergent Phenomena* (Oakland: Breakthrough Institute, 2011). Available at http://thebreakthrough.org/blog/Energy_Emergence.pdf.
- 26 Shakeb Afsah et al., *Energy Efficiency Is for Real, Energy Rebound a Distraction* (Winter Park, FL: CO2 Scorecard, 2012). Available at <http://co2scorecard.org/home/researchitem/21>.
- 27 Ibid., p. 4.

- 28 For more information about the Leading by Example program, see its website at www.mass.gov/eea/grants-and-tech-assistance/guidance-technical-assistance/leading-by-example/leading-by-example.html.
- 29 Eric Friedman, personal e-mail correspondence, April 10, 2012.
- 30 Because of the complicated accounting rules for the RPS, which allows excess renewable energy credits from one year to be carried over into future years, the actual number of credits that suppliers purchased during 2010 was equivalent to 4.7 percent of the total electricity supply. All our data about the RPS in 2010 comes from the state's thorough report: Department of Energy Resources, *Massachusetts Renewable and Alternative Energy Portfolio Standards (RPS & APS) Annual Compliance Report for 2010* (Boston: Department of Energy Resources, 2012), Available at www.mass.gov/eea/docs/doer/rps/rps-aps-2010-annual-compliance-rpt-jan11-2012.pdf.
- 31 To arrive at the .3 percent total for solar photovoltaics, we combined the .16 percent solar that was recorded under the main tier of the RPS with the .11 percent of the solar through the separate solar carve-out. In the states' Compliance Report, these two numbers are kept separate in different parts of the report.
- 32 Arun Kumar et al., "Hydropower," in *IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation* (Cambridge: Cambridge University Press, 2011), available at <http://srren.ipcc-wg3.de>; and Nathan Barros et al., "Carbon Emission from Hydroelectric Reservoirs Linked to Reservoir Age and Latitude," *Nature Geoscience* (September 2011), pp. 593-596.
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- 34 Barros, "Carbon Emissions," p. 594.
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III. THE ECONOMIC COSTS AND BENEFITS OF CLIMATE CHANGE ACTION

There is a strong majority view among Massachusetts political leaders, among stakeholder organizations, and among the public at large that the climate is changing because of human activities and that it is desirable to reduce greenhouse gas emissions and develop clean energy.¹ But it is more difficult to reach consensus when the subject turns to the cost of addressing climate change and how much public funding should go to dealing with the problem.

Not only is there disagreement about how much is appropriate to spend on reducing greenhouse gas emissions, but there is often significant debate about the economic costs and benefits of particular policies. Some people, for example, have argued that the Cape Wind project will cause electricity prices to skyrocket and damage the economy, while others have claimed that it will actually reduce electricity prices and produce sub-

stantial economic benefits for the state.²

In these discussions, advocates for a particular position sometimes focus on just part of the picture and suggest that the cost situation is more clear-cut than it is. As an example, when testifying at a legislative oversight hearing on the *Green Communities Act* (GCA) in November

IT IS DIFFICULT TO REACH CONSENSUS ON THE COST OF ADDRESSING CLIMATE CHANGE.

2011, Attorney General Martha Coakley stated, “The costs to implement the GCA programs over the next four years will be more than \$4 billion. This will cause the total delivered costs of electricity to rise an estimated seven percent over the next four years.”³ Although she noted that there would also be savings from energy efficiency,

Photo Credit: Massachusetts Clean Energy Center



The City of Medford's wind turbine provides electricity to the McGlynn Elementary and Middle School. It was made possible with state support.

she did not quantify them and left the unmistakable impression that the state's energy programs were going to cause major economic harm.

On the other side, some clean energy advocates imply, if not directly state, that all spending on clean energy—no matter what the technology nor what the policy incentive—is inherently good for the economy. They sometimes give the impression that they believe it is inappropriate to question the costs of any clean energy program.

Part of the challenge when thinking about the costs and benefits of climate change action is to bear in mind all the many ways that government policies and programs ripple out through the economy. Take the case of the development of a wind farm in the state. If it creates jobs for people installing and maintaining the wind turbines, then that needs to be considered. But, if electricity rates go up because of the policies that support wind development and that causes people to have less money to spend on other things, then that needs to be considered as well. On the benefit side, healthcare savings associated with reduced air pollution are also relevant, as are many other indirect costs and benefits.

In this report, we do not have the ability to undertake the very substantial task of fully assessing all the costs and benefits of the many policies and programs that are collectively designed to address the threat of climate change. But, we can offer observations to help frame the discussion about costs and benefits.

The State's Assessment of Costs and Benefits of Efficiency and Renewables

A good starting point for looking at this subject is a useful report that the legislature requested as part of the *Economic Development Reorganization Act of 2010*. The Executive Office of Housing and Economic Development and the Executive Office of Energy and Environmental Affairs studied the costs and benefits of the state's energy efficiency

and renewable energy programs. The requested scope of the report did not include transportation policies, land-use planning, or climate adaptation, but the report reached the following conclusions related to its assigned topics:

- The high cost of electricity in Massachusetts is not primarily the result of state policies.
- Because of their scale, the energy-efficiency programs impose the highest upfront costs of all the clean energy programs, but also yield significant returns on investment, making their benefits far outweigh the costs.
- “The state requirements mandating that a percentage of all electricity generation be by clean or renewable energy... are producing cost savings for ratepayers.”
- “[L]ocal energy generation initiatives, including locally-generated solar and offshore wind, do not produce an immediate direct economic benefit to all ratepayers that offsets their costs.” But those investments have other benefits, such as creating local jobs, possibly “offsetting employment losses in other industry sectors due to higher electricity prices.”⁴

Each of these conclusions is fair and seems to reflect well the available evidence, but they require further discussion.

High Prices Not Primarily Caused by State Policies

As the state report points out, the main reason that electricity prices are higher in Massachusetts than in most other states is “that Massachusetts has virtually no indigenous energy resources, requiring us to import almost all of our energy resources from outside the region or overseas.”⁵

Stakeholders concerned about high prices

in Massachusetts have tended to point especially to the cost impacts of renewable energy development in recent years, yet prices were high here long before any of the state's renewable energy policies were in place. In fact, Massachusetts had the third or fourth highest average electricity rates of any state in the country through most of the 2000s, but since 2010 we have had only the seventh highest rates.⁶ On that basis alone, it is hard to argue that state policies have caused significant recent price spikes.

Of course, this does not mean the state policies are unrelated to prices or that they cannot have a rate impact. But it does mean that they are not the primary explanation for the current rates in the state.

Strong Evidence that Efficiency Has Been Cost Effective

The Massachusetts Department of Public Utilities (DPU), as well as its predecessor agencies, has been keenly interested in the question of the cost-effectiveness of the state's energy efficiency programs. Sophisticated methodologies have been developed over the past several decades to help state regulators across the country measure the costs and benefits. Significant time and money go into evaluating the programs. This has been important to do, not only because it is desirable to know the impacts of government-mandated programs, but because the utilities' goals and rates are determined in part from what is learned through evaluation.

The central conclusion is that it costs more to build additional powerplants, additional transmission, and additional natural gas supply than it does to eliminate the need for those supply-side investments by implementing energy efficiency measures that reduce electricity and gas demand. The process of developing the utilities' efficiency plans is designed to select only those efficiency efforts that meet the test of being cheaper than building new generation. That is



Photo Credit: Renew Boston

the whole premise of the state's policy of funding all cost-effective efficiency.

When the efficiency program administrators from the state's utilities and municipal aggregator submitted their current three-year plans, they were required to include benefit-cost analyses that were reviewed not only by the DPU, but by the Department of Energy Resources, the Attorney General, and the Energy Efficiency Advisory Board. All those parties concluded that savings to all ratepayers by reducing overall electricity and gas demand would outweigh the costs. In addition, those ratepayers who implement energy-efficient measures will see additional savings. For each of the three years in the plan, the benefits are projected to outweigh the costs roughly three to one.⁷ Even if one assumes that there is some margin of error in the analysis and that there will be some rebound effect (see Section IIIB1 above), the ratio of benefits to costs is so high that there can be little doubt that current efficiency efforts are economically desirable.⁸

The methodology used by the DPU and the utilities quantified many cost and benefit factors. The research approach was appropriate for utility planning and ratemaking, but it did not include all the indirect ways in which efficiency spending affects the economy. However, including more indirect impacts in the analysis would not change the basic picture. A recent report by the Analysis

Through Renew Boston, the City of Boston and MassSave are providing energy efficiency improvements to Boston buildings.

Group on RGGI cast a wide net when analyzing efficiency spending in Massachusetts between 2009 and 2011. It used IMPLAN, an economic input-output model, to trace the impacts through the economy of the dollars collected for efficiency and then spent on efficiency. This solid study found that efficiency spending reduced electricity rates and increased the number of jobs. The benefits far outweighed the costs.⁹

Two caveats

We need to qualify this rosy picture of the economics of efficiency programs in two ways:

1. **Even though the state's energy-efficiency initiatives have benefitted the overall economy and all users' electricity rates have been reduced, the benefits of efficiency are distributed unequally across society.** Some businesses and residents are in a good position to take advantage of the various efficiency incentives and programs, while others are not, for a variety of reasons. Unsurprisingly, non-participants and limited participants are often unenthusiastic about public spending on efficiency.
2. **Efficiency may not be as cost-effective in the future.** Up to now, efficiency has been less expensive than adding new generation and has been the most cost-effective way to reduce emissions. But it is possible that this will not always be the case in the future. Up to now, the efficiency programs have been able to focus on mature, easy-to-implement technologies and strategies, the so-called "low-hanging fruit." That could eventually all be picked, leaving only more costly options. Based on past experience, there is a good chance, but no guarantee, that new technologies will come on the market to make further rounds of cost-effective efficiency possible. Even if the costs of energy efficiency start to outweigh the benefits, it

will remain important for Massachusetts to continue to use efficiency measures as a central strategy for reducing greenhouse gas emissions as long as it is less expensive than other strategies.

The Renewable Portfolio Standard Has Recently Saved Ratepayers Money but May or May Not in the Future

Under the renewable portfolio standard, electricity suppliers are required to get a share of their electricity from renewable energy. They do that by purchasing renewable energy certificates (RECs) from eligible renewable energy generating facilities. Those certificates in effect represent the difference in price between power from renewable energy and from conventional fossil fuel generators. By tallying up the cost of all those certificates—something that is not always easy because some of the information is not public—one can determine the total premium for state-mandated renewable generation.

At first glance, it would seem that this is a straight-forward case where climate change action costs extra money. But there is a less visible countervailing factor that balances out some or all of the additional cost. Wholesale electricity prices in any given hour are set by the highest-price generator during that hour. The operator of the regional electricity system therefore first uses the lower-priced generators before calling on ones that offer power at higher prices. Because some clean energy facilities, like wind farms, do not use fuel, they are able to offer their power at the lowest price, since there is no additional cost for them to operate during a particular hour. This keeps more expensive powerplants offline, holding down the hourly price.

This price suppression effect can be significant. Based on data from the Department of Energy Resources, the price suppression effect has recently been greater than the premiums paid for renewable energy certificates, meaning that it has saved

ratepayers money to bring large-scale renewable energy online.¹⁰ The state's cost-benefit analysis report projects this continuing into the future.

But that is not guaranteed. The state report assumed that the cost of renewable energy certificates would remain at \$20 per megawatt hour. Some certificates have recently traded at more than \$50 per megawatt hour. If the certificate price stays at that elevated level, the cost of the certificates would be greater than the price suppression benefits. That would not mean that the state's renewable portfolio standard policy should be abandoned, since it is certainly worth spending some money to diversify the electricity supply and reduce emissions. On the other hand, it will be important to monitor the situation carefully. If certificate prices seem likely to remain high for a period of years (perhaps because of the possible elimination of federal incentives), it could be appropriate to make program modifications to avoid unacceptably high program costs.

But it is important to keep in mind that only looking at dollars spent on renewable energy certificates gives an incomplete and misleading picture of the cost of adding renewable energy generation. The price suppression impacts must always be considered when weighing costs and benefits. In addition, there are many non-monetized benefits that are provided by renewable energy, such as cleaner air and water.

The Costs and Benefits of Local Clean Energy Generation Are Unclear

The most divisive area of the cost-related debate is over locally based solar generation and offshore wind, most notably the Cape Wind project. In part because both the cost and benefit numbers are hard to quantify, there has been considerable room for contentious disagreement.

Both solar generation and offshore wind require higher public incentives than the large out-of-state renewable energy facilities (mainly wind, landfill gas, and biomass) that are the pri-

mary source of renewable energy certificates for the main tier of the state's renewable portfolio standard. When business groups like the Massachusetts Competitive Partnership have criticized the high cost of clean energy and of implementing the *Green Communities Act*, their biggest concerns have been about solar and Cape Wind, even if that has not always been highlighted explicitly. These groups fear that electricity rates will be driven sharply higher, making Massachusetts businesses uncompetitive.¹¹

The state cost-benefit analysis concluded that the costs of these local clean energy projects outweigh their direct economic benefits, if one looks only at electricity rates (although a March 2012 Charles River Wind Associates' study of the Cape Wind Project suggests that project can reduce rates).¹² State officials justify the spending by explaining that it produces other sorts of economic benefits by creating local clean energy jobs, supporting local clean energy businesses, and contributing to the growth of a vibrant clean energy industry sector. Indeed, the Massachusetts Clean Energy Center's 2011 industry report found that more than 64,000 people in Massachusetts work in clean-energy-related jobs, representing 1.5 percent of all the jobs in the state. Between 2010 and 2011, the number of jobs grew by 6.7 percent.¹² The report provides solid evidence that the sector is growing rapidly and that it can play an increasingly important role in the state's economy.

However, these economic impact numbers do not prove that a specific program, like the solar renewable energy carve-out, is cost-effective. Although state officials and clean energy advocates point to the growth of the clean energy industry as a whole, there is little detailed data on how much of that growth is linked to public spending on a particular initiative, such as solar installation incentives. Much of the overall job growth comes from expanded energy efficiency and from renewable energy activities that do not flow directly from the installation of local solar

generation. It is also hard to pin down the total cost of the solar program, since some of the subsidies are indirect, such as the utilities' spending to build or purchase solar generation.

It would be desirable for the state, working with the utilities and various stakeholder groups, to try to analyze the costs and benefits of some of the state's sector development activities more fully, especially for solar. The state's 2011 cost-benefit analysis and the Clean Energy Center's report provide good starting points, but are not specifically focused on this particular question.

A March 2012 presentation by two organizations at a meeting of the Northeast Energy and Commerce Association offered some preliminary answers to the question of the economic impacts of the Massachusetts solar program. Levitan & Associates looked at the direct impacts on electricity prices, while Regional Economic Models, Inc. (REMI) used its sophisticated economic modeling software to trace the more indirect economic effects. The REMI analysis was only meant to be suggestive rather than conclusive. It found that the solar program would lead to a slight drop in gross state product (GSP) over the next few years, as solar incentives are paid out, but that GSP and total state employment would ultimately be increased because of the solar program. This analysis may be able to serve as a starting point for a more complete analysis that includes stakeholder input.¹³

However, more complete data will not end the conflict over the costs and benefits of promoting the clean energy industry through solar installation incentives. Even if the state benefits as a whole from building that industry, some businesses will suffer economic losses as their electricity rates go up. It is therefore important to consider how to minimize those losses and where to strike the balance between developing a new industry and protecting older industries.

Although we do not know the exact right balance, especially without better numbers on costs

and benefits, we suggest the following ways to move forward:

- **Bring stakeholders together to work on reducing electricity rates.** Business groups and other Massachusetts citizens who are worried about the impact of high electricity prices on the state's competitiveness have a legitimate concern, even if efficiency and renewables are not the cause of those high rates. It is good that the State Senate, as part of legislation to update the *Green Communities Act*, has been seeking to identify ways to reduce rates that can receive the support of a wide range of stakeholders. Even after that legislation passes, state leaders, the business community, and environmental and clean energy advocates should continue to work together on additional strategies to help reduce rates without sacrificing climate change or clean energy goals. They should especially consider strategies that can help those people and businesses that are not in good position to benefit significantly from the state's clean energy activities. Some potential solutions are well known, such as reducing electricity use at peak times, which disproportionately influences electricity prices, and bringing in low-priced clean power from northern New England or Canada. However, there could be more cooperation and focus on implementing these solutions.
- **Monitor the costs of solar closely and make adjustments if necessary.** Up to now, the state's solar programs have not been a significant factor in overall electricity prices, because the quantity of solar installed represents a small share of total electricity generation. However, as more solar is installed, it could become a larger driver of electricity prices. Fortunately, the cost of solar installations has recently been declin-

ing precipitously because of falling prices for solar panels. Future price drops and technological advances could mean that the state can reduce the level of solar subsidies faster than currently projected. If that does not happen over the next several years, the state may want to make changes to reduce the impact of the program on ratepayers. This would not have a significant impact on the state's ability to reach its 2020 climate change goals.

The Costs of Adaptation, Smart Growth, and Transportation Measures

The costs and benefits for these other areas have been studied less than efficiency and renewables.

In the case of preparations for adapting to climate change, it is improbable that near-term actions represent the optimal economic development strategy for maximizing immediate economic growth. Instead, they will reduce the risk of economic harm. This is similar to a business purchasing hazard insurance—it is not done because it will increase sales or grow the size of the business, but because it protects the business's assets.

In this situation, the standard for judging the state's policies and programs should be whether the state is getting the maximum amount of climate protection for the least cost. When setting priorities for adaptation initiatives, the possible alternative policies and programs should be compared using this measure of relative cost-effectiveness. An additional factor to consider is the extent to which near-term actions (such as changes in building codes) that impose near-term higher costs eliminate the need for more expensive later actions (such as having to renovate buildings). By using appropriate discount rates when looking at potential policies, it is possible to get a good sense of the long-term economic benefits of those policies.

For transportation and smart growth initia-

tives, the cost-benefit approach needs to vary depending upon the program. In some cases, programs are similar to clean energy in that the economic costs and benefits can be measured, even if it is not easy to do so. Improved transit and other programs that reduce traffic congestion are examples of that kind of analysis. Some other initiatives impose upfront costs without any compensating near-term economic benefits, but, at a minimum, they will still lead to a better quality of life in the state in the long term. There is also reason to believe that stronger public transportation systems and more efficient land assembly can make the Commonwealth's economy more productive and competitive.

There is a compelling, more general argument for the economic benefits of reducing energy use in transportation. Massachusetts, like the rest of the country, is facing increased energy costs for transportation because of the recent spike in gasoline and oil prices. Massachusetts residents and businesses currently spend more than \$10 billion annually on transportation fuels.¹⁴ When gasoline averaged \$2.85 per gallon in October 2010, the average household spent \$249 per month on "motor fuels." In March 2011, when gasoline shot up to \$3.62 per gallon, that same household spent \$305. And prices are now even higher.

Any efforts to increase transportation efficiency and reduce gasoline use should ultimately translate into consumer savings and should reduce the amount of money flowing out of state to pay for fuel. If even a small portion of the energy required to move people each day could be saved, many millions of dollars a year would be returned to the state economy. To illustrate this, just a three percent reduction in transportation energy use would total \$300 million.

Rates versus Bills

In the discussion of the costs of climate change action and clean energy, the most frequently

used metric of costs is rates—for electricity, for natural gas and oil for heating, and for gasoline for vehicles. Although this is a relevant factor, it is not the best way to measure cost impacts.

By evaluating the value proposition of energy efficiency, it is easy to see why a focus on rates rather than consumers' electricity bills is misleading. If efficiency efforts are successful, the quantity of electricity that is used should decline. Yet the same transmission and distribution system of poles, wires, and transformers needs to be maintained. For the utilities to collect the same amount of money for maintaining that system, they need to charge more per kilowatt hour, because they would be spreading the costs over fewer total kilowatt hours. If things work out the way that the energy efficiency plans project, customers' total bills will decline even though the rates may rise. For example, based on implementing energy efficiency, a homeowner may end up spending 20 cents per kilowatt hour for 500 kilowatt hours (\$100) rather than 15 cents per kilowatt hour for 800 kilowatt hours (\$120).

The state should seek to present periodic data in an easily understood and widely disseminated format, showing trends in a typical homeowner and typical business's electricity and heating bills. Typical usage over time and the rates paid should be included to show overall cost trends.

The Costs of Inaction

Efforts to reduce greenhouse gas emissions are ultimately not being undertaken primarily as an economic development activity, but as a response to a serious and urgent problem that could greatly harm the state. Of course, it is desirable to pursue the goal of reduced emissions in ways that provide the greatest economic benefits to citizens of the Commonwealth. A focus on cost-effectiveness in climate change action will increase the likelihood that the public remains supportive of the state's initiatives.

In 2008, to help build the case for passing the *Global Warming Solutions Act*, the Senate Committee on Post Audit, along with the Senate Committee on Global Warming & Climate Change, issued a report that made an important point: just as there are costs associated with actions to try to limit global warming, there are also costs of inaction.¹⁶ If the state does not act aggressively, the likelihood that Massachusetts will suffer serious harm from climate change increases. We should try to minimize the cost of vigorous, effective action to address climate change, but we should be prepared to spend some money to avoid the much greater costs of inaction.¹⁷

CHAPTER III. ENDNOTES

- 1 For public attitudes about climate change, see Steve Koczela et al., *The 80 Percent Challenge: A survey of Climate Change Opinion and Action in Massachusetts* (Boston: MassINC and MassINC Polling Group, 2011). That survey found that 74 percent of the public felt it would be either a very serious or somewhat serious problem for Massachusetts if nothing is done to reduce global warming in the future; 83 percent believed that “we have a moral obligation to do what we can to reduce global warming;” and 84 percent agreed that “developing renewable energy sources is critical to our national security” (pages 45-6). The report is available at www.massinc.org/Research/The-80-percent-challenge.aspx.
- 2 For a summary of the economic criticism of Cape Wind, see the website of the Alliance to Protect Nantucket Sound at www.saveoursound.org/cape_wind_threats/economy. For a recent report that concluded that Cape Wind would lower electricity rates, see Charles River Associates, *Update to the Analysis of the Impact of Cape Wind on Lowering New England Energy Prices* (Boston: Charles River Associates, 2012). Available at <http://www.capewind.org/downloads/CRA-Updated-Cape-Wind-Report-29Mar2012.pdf>.
- 3 Testimony of Attorney General Martha Coakley, Joint Committee on Telecommunications, Utilities and Energy Oversight Hearing: *The Green Communities Act* of 2008, November 9, 2011, p. 5.
- 4 Executive Office of Housing and Economic Development and Executive Office of Energy and Environmental Affairs, *Recent Electricity Market Reforms in Massachusetts: A Report of Costs and Benefits* (Boston: EOHED and EEA, 2011), pp. 1-2. This report also includes useful background information on how the electricity system is structured and rates are set. Available at www.mass.gov/eea/docs/doer/publications/electricity-report-jul12-2011.pdf.
- 5 *Ibid.*, p. 1.
- 6 Data from the US Energy Information Administration on “Average Retail Price All Sectors.” Available at www.eia.gov/state/state-energy-profiles-more-prices.cfm.
- 7 EOHED and EEA, *Recent Electricity Market Reforms*, p. 22.
- 8 Another relevant look at the costs and benefits of efficiency is included in the most recent biannual avoided cost study conducted on behalf of the utilities and program administrators across New England. That study looked at Demand-Reduction-Induced-Program-Effects (DRIPE) of energy efficiency efforts and quantified the extent to which electricity prices are lowered because of efficiency measures. It compared its results to other studies of price suppression effects. Rick Hornby et al., *Avoided Energy Supply Costs in New England: 2011 Report* (Cambridge: Synapse Energy Economics, Inc., 2011), pp. 6-30 – 6-69. Available at www.synapse-energy.com/Downloads/SynapseReport.2011-07.AESC-Study-2011.11-014.pdf.
- 9 Paul J. Hibbard et al., *The Economic Impacts of the Regional Greenhouse Gas Initiative on Ten Northeast and Mid-Atlantic States: Review of the Use of RGGI Auction Proceeds from the First Three-Year Compliance Period* (Boston: The Analysis Group, 2011). Available at www.analysisgroup.com/uploadedFiles/Publishing/Articles/Economic_Impact_RGGI_Report.pdf. See also the report’s appendix for some Massachusetts-specific data. For another economic modeling study of the benefits of energy efficiency investments, see Jamie Howland et al., *Energy Efficiency: Engine of Economic Growth* (Rockport, ME: Environment Northeast, 2009). Available at www.env-ne.org/public/resources/pdf/ENE_EnergyEfficiencyEngineofEconomicGrowth_FINAL.pdf.
- 10 EOHED and EEA, *Recent Electricity Market Reforms*, pp. 24-25.
- 11 Massachusetts Competitive Partnership, *MACP Cost of Energy Study* (Boston: Massachusetts Competitive Partnership, 2011).
- 12 Charles River Associates, *Update to the Analysis of the Impact of Cape Wind*.
- 13 BW Research Partnership and New England Clean Energy Council, *2011 Massachusetts Clean Energy Industry Report* (Boston: Massachusetts Clean Energy Center, 2011), p. 3. Available at http://masscec.com/masscec/file/MassCEC%20Industry-Rept_DesignFinal%281%29.pdf.
- 14 Rod Motamedi and Chris Judson, “Modeling the Economic Impacts of Solar PV Development in Massachusetts,” presentation by REMI to the Northeast Energy and Commerce Association Renewables and Distributed Generation Committee, March 28, 2012. See also Seth Parker et al., “Power Market and System Operating Impacts of Solar Development in Massachusetts,” presentation by Levitan & Associates, Inc. to the Northeast Energy and Commerce Association Renewables and Distributed Generation Committee, March 28, 2012. Both presentations are available at www.remi.com/download/presentations/2012_miscellaneous_topics/Levitan_Solar_PV_Presentation.pdf.
- 15 In 2010, Massachusetts used 65,864 barrels of oil for travel. At 42 gallons per barrel, this equals 2,766,287 gallons a year.
- 16 Senate Committee on Post Audit & Oversight and Senate Committee on Global Warming & Climate Change, *The Cost of Inaction: Climate Change in the Commonwealth* (Boston: Senate Committee on Post Audit & Oversight and Senate Committee on Global Warming & Climate Change, 2008). Available at www.malegislature.gov/Communities/187/Document?Senate?S48/SPOA_SGW_S2780_2008.
- 17 Various studies have tried to estimate the costs of inaction and translate those costs into an externality cost for each ton of carbon dioxide emissions. This is, unsurprisingly, quite difficult to do. For a good discussion of the methodological issues and different approaches as they apply to New England, see Hornby, *Avoided Energy Supply Costs*, pp. 6-91 – 6-102.

IV. GLOBAL WARMING ACTION AT THE COMMUNITY LEVEL

Massachusetts is a national leader in climate change action at the local level. It has achieved this because of a combination of strong interest among municipal officials, aggressive action on the part of local climate change activists, and other favorable state policies, especially the Green Communities Program, that support and encourage action at the municipal level. Of course, there is more that could and should be done.

Here are a few indicators of the considerable extent and intensity of local climate change action:

- Eighty-six municipalities have met the requirements under the *Green Communities Act* to become a Green Community. Although that is less than one-third of the state's cities and towns, it includes many of the larger ones and represents 42 percent of the state's population. During our interviews of stakeholders, local climate change activists, and government officials, many people expressed surprise and gratification that so many communities have achieved Green Community status so quickly.
- More than 100 communities have agreed to adopt the stretch building code. This is an especially revealing measure since it requires a municipality to take public action, most often with a vote in town meeting.
- Forty-six grassroots groups of activists are focusing on climate change and are members of the Massachusetts Climate Action Network (MCAN).¹ Because some of the groups represent more than one community, there is a local activist presence in at least 76 cities and towns, representing the majority of the state's population. The existence of MCAN as a statewide network with an annual conference, a newsletter, and



other activities not only reflects the strong activist interest in climate change but also helps to nurture that interest.

- Twenty-eight municipalities have become members of ICLEI: Local Governments for Sustainability USA. This is the fourth highest ratio of ICLEI communities to population (after Alaska, Washington, and Maine).² ICLEI is a national network of communities committed to advancing sustainability, especially by addressing greenhouse gas emissions. Although the market penetration of ICLEI membership is an imprecise measuring stick, it nevertheless provides impressionistic evidence of local interest in climate change action.
- Energy-related officials in those municipalities that have become Green Communities believe that there is more interest in climate change at the local level than five years ago. In a confidential survey of municipal officials from the 86 Green Communities, 77 people, representing 78 Green Communities, responded (a 91 percent response rate). Fifty-one of the 77 respondents said that

Greening Greenfield, a citizen group, has used lawn signs to demonstrate widespread involvement in the organization's 10 Percent Challenge.

climate change is a more important issue to the people of their community than five years ago, while only one person believed it is a less important issue. The remainder thought there had been no change over those five years.³

Among the many reasons for the strong level of action and activism at the local level compared to other states are high electricity prices (making reductions in energy use more appealing), the political composition of the state (Democrats tend to be more interested in climate change action than Republicans), and the high level of educational attainment in Massachusetts compared to other states (college graduates are more likely to be convinced that global warming is a serious threat).⁴ However, the Green Communities Program deserves considerable credit for the recent spike in action at the local level. It has been one of the most successful of the state's climate change activities.

What Is the Green Communities Program and Why Is It Successful?

Massachusetts municipalities can apply to the Department of Energy Resources' Green Communities Division to be designated as a Green Community. To achieve that distinction, they need to meet five criteria:

1. Provide zoning for as-of-right siting of renewable or alternative energy facilities—either generating facilities, R&D facilities, or manufacturing facilities. DOER defines “as-of-right siting” as “siting that provides for the allowed use and that does not unreasonably regulate nor require a special permit.”⁵
2. Establish an expedited application and permitting process for facilities that meet the as-of-right zoning criteria.
3. Create a baseline inventory of municipal energy use—including municipal buildings, schools, vehicles, street lighting, wastewater treatment plants, and other energy uses—and “put in place a comprehensive program designed to reduce this baseline by 20 percent within 5 years of the baseline year.”⁶
4. Commit to purchase only fuel-efficient vehicles.
5. Adopt the Board of Building Regulations and Standards' Stretch Code or establish an alternative standard for minimizing the life-cycle energy costs for all new public and private construction in the community.

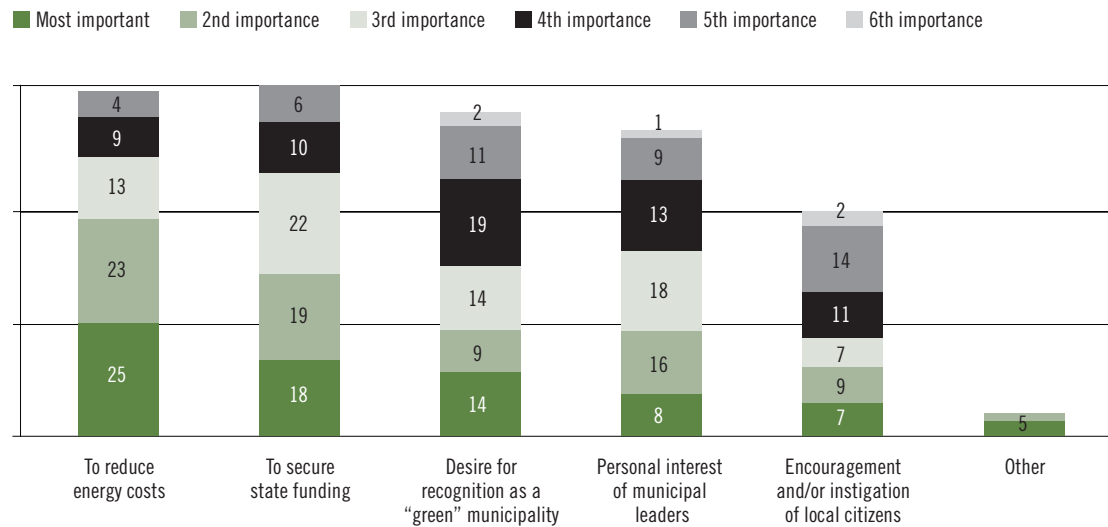
In return, the municipality receives recognition for being a leading-edge Green Community and receives a grant from DOER for energy efficiency or renewable energy projects and planning. Depending upon the size of the community and the specific projects proposed, the grants have ranged from \$130,725 to \$1 million. They have been used for a wide range of activities, including lighting retrofits at schools, solar hot water systems at fire stations, conversion of traffic lights to LED lighting, and buying down the cost of a contract with an energy services company.⁷

Admittedly, the availability of state funding has been a significant reason why municipalities have chosen to become Green Communities, 18 of the 77 respondents to our survey of Green Communities indicated that it was the most important reason why their town or city applied to be a Green Community. Another 19 stated that it was the second most important reason (see Figure 4.1). But the funding opportunity does not fully explain the strong response to the program. After all, even at this time of tight municipal budgets, the amount of funding—earmarked for energy-related activities only—is generally not sufficient to induce a municipality to undertake the significant amount

Figure 4.1:

Why did your community apply to be a Green Community?

(Rank all relevant factors in order of importance)



of work required to qualify for a Green Community award unless that municipality was already inclined to think of the focus on energy saving as valuable. Of the five requirements for Green Community designation, the development of a plan to reduce municipal energy use by 20 percent is particularly labor-intensive and the establishment of the Stretch Code generally requires public hearings and a vote of town meeting.

Municipalities—at least those that have applied to be Green Communities—have perceived the work preparatory to preparing an application to DOER to be worth undertaking. In great part, that is because they have had a pre-existing desire to reduce the municipality's energy use. In our survey, the largest share of respondents, 32 percent, gave that as the primary reason for becoming a Green Community and another 30 percent said it was the second most important reason.

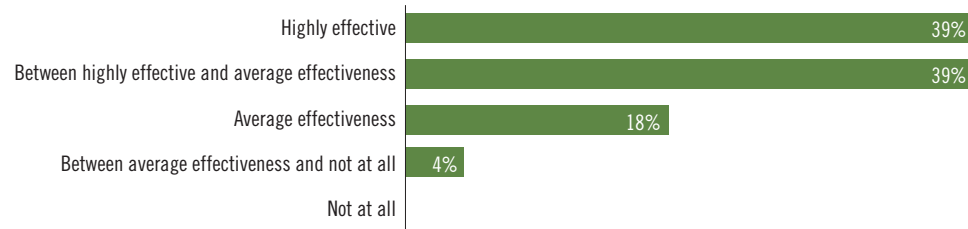
The Green Communities Program has been so successful because it was designed to help municipalities do something they already had a desire to do (save energy). The five prerequisites require relatively ambitious action on the part of the community, but most participating

municipalities have perceived these steps to be achievable and worthwhile in-and-of themselves. Moreover, the process of meeting the program's requirements has turned out to provide a useful, concrete focus of activity for the many local activists and citizen groups that are interested in tackling climate change.

Compared to many state programs aimed at municipalities, this one has been quite user-friendly. For one thing, grant funding at the end of the process has been virtually guaranteed for those cities and towns that follow the prescribed steps; it has not been an uncertain competition among applicants. In addition, DOER, through four regional coordinators, has provided ongoing information, advice, and assistance to municipalities. With all this help, most interested cities and towns have been able to navigate the process, although it is daunting for the smallest rural communities. DOER Commissioner Mark Sylvia reports that, "From the outset, staff members at DOER were vigilant in going out into the communities to meet with Select Boards, Energy Committees, Groups of Interested Citizens, anyone in a community who was seriously looking

Figure 4.2:

How effective has the Commonwealth Green Communities Program been in helping communities address climate change and energy use?



at this new opportunity and trying to figure out how to become a Green Community.”⁸ The state also offered planning assistance to many of the communities. The availability of federal funding through the *American Recovery and Reinvestment Act* of 2009 provided a few municipalities with another valuable resource for preparing an application to the Green Communities Program.

Another way in which DOER has helped municipalities meet the five requirements for Green Community designation was by creating MassEnergyInsight, a helpful, free, web-based tool that local governments can use to understand their energy consumption, create a baseline, and analyze changes to their energy use over time. The Green Communities Division has provided training—initially in-person but recently via webinar—to individuals from more than 200 municipalities.⁹

The Green Communities Program has offered another useful carrot beyond the financial grants. Many municipalities want to be recognized as environmental leaders and they have been motivated by the opportunity to achieve public acknowledgment. In our survey, 90 percent of respondents believed that the desire for public recognition as a “green” municipality was one of the factors in their community’s decision to apply to the program. Perhaps more surprisingly, 18 percent stated that it was the most important factor.

Overall, the designated Green Communities appear to be pleased with the state’s program. When asked how effective the program has been

in helping communities address climate change and energy use, 78 percent ranked the program as a 4 or 5 in effectiveness on a scale from 1 to 5, with 39 percent giving the program the highest ranking (see Figure 4.2).

Clearly, the Green Communities Program has been a significant success and Massachusetts should help other states learn about it and emulate it.

Community-Level Outreach

While the Green Communities Program focuses on municipal regulations and the energy use of municipal facilities, many communities are also involved in efforts to encourage residents and businesses to reduce their greenhouse gas emissions and to make it easier for them to do so. In some cases, the municipal government is the driving force behind the outreach, but in other cases grassroots climate action organizations are leading the way.

Partnerships between Municipalities and Utilities

An important experiment is underway in several cities to explore whether a closer partnership between the city government and the utilities can make it easier to reach energy efficiency goals and ensure that a broad cross-section of the population benefits from the reduced energy costs that result from implementing efficiency measures.

Boston, through its Renew Boston program, has the most ambitious and well-developed effort. Renew Boston conducts extensive outreach to the community and serves as a single entry point for Boston residents and businesses that want to access building energy assessments, weatherization, and other efficiency services. In effect, the city and the utilities have made a deal in which the utilities direct some of their energy efficiency efforts toward constituents that the city would like to reach, while the city promotes the utilities' programs and helps deliver energy savings from the largest energy users in the city—major institutions, large businesses, and the city government itself. To improve coordination with the largest utility serving Boston, an NStar staff member works out of City Hall.¹⁰

The government-utility partnership approach is easiest to implement in a large city like Boston, because of its significant staff resources and large potential energy reductions. But the model may also work in smaller municipalities and is now being tried in nine communities across the Commonwealth with the assistance of grant funding from the Barr Foundation and consulting support from Serrafix and Peregrine Energy.¹¹ Although most of these partnerships are still in a very early stage, there seems to be a promising effort beginning in Pittsfield and Northampton to target small-to medium-sized downtown retail establishments. Cities like these want to maintain the vibrancy of their downtowns, but businesses there are often economically vulnerable, so efforts that reduce energy costs are especially valuable.

Looking beyond this small group of cities, Massachusetts utilities seem to be willing to work in partnership with other municipalities, as long as those municipalities show that they are able to bring to the table plans for significantly reducing energy use in municipal facilities and buildings. Those savings are important for the utilities to meet their energy-efficiency targets.

However, for a variety of reasons, it is not easy



Photo Credit: Massachusetts Executive Office of Energy and Environmental Affairs

to mesh the disparate needs and approaches of utilities and municipal governments. Although the two sides seem to be sincerely trying to work together cooperatively, it is too soon to know how useful all these partnerships between utilities and local governments will be. They will undoubtedly lead to a larger number of end users of energy and a wider cross-section of the population participating in energy-efficiency programs. In the long run, such wide participation will be necessary to meet the state's climate change goals. Moreover, wider participation helps ensure that

Grant funding through the Commonwealth's Green Communities Program has helped Ayer and the other Green Communities implement important energy improvements.

WIDE PARTICIPATION WILL BE NECESSARY TO MEET THE STATE'S CLIMATE CHANGE GOALS.

the large amount of funding spent on energy efficiency is distributed equitably.

On the other hand, it is unclear whether wide participation will produce the fastest and most cost-effective reductions in greenhouse gas emissions in the short run. From the utilities' standpoint, the largest and cheapest reductions are achieved by focusing on a relatively few large consumers of energy. The experiments currently underway in various communities will test whether bringing municipal government into the picture can make targeting other consumers more cost-effective than in the past.

Sharing Information with Municipalities

As more towns and cities have gotten involved in outreach efforts to encourage their citizens to take action to reduce greenhouse gas emissions, they have often felt a desire for more data on the energy use of the homes, businesses, and institutions in their community, as well as information about the extent to which those consumers are accessing energy efficiency services through MassSave. After all, it is hard for a municipal government to know how to target its programs if it does not know where there is the biggest potential for energy savings. Moreover, a local government can only accurately evaluate the impact of its efforts if it has access to energy use data. As a general rule, transparency and information flow are important for designing effective strategies and evaluating program effectiveness.

The desire for more information has led many towns and cities to request a wide range of different data from the utilities, and they have sometimes been disappointed when the utilities do not deliver that data. The utilities sometimes have valid reasons for not responding to the requests for information, since they need to protect the privacy of their customers' records and do not want to anger customers by revealing too much information. It can also be time-consuming and expensive to provide the requested information, especially when different communities request different information and in different formats. And sometimes, a local government that requests specific information has not thought through exactly why it needs that information or how that government will use it.

At first glance, the logical solution to the information-sharing problem would be for the state, either through legislation or regulation, to sort through this issue and determine precisely what would be appropriate to require the utilities to provide for all communities. Once such a standard was in place, the municipalities would know exactly which information they are entitled

to receive. The utilities would not have to deal with so many divergent requests and would not be responsible for making difficult privacy judgments.

However, there is a risk that the process of producing state legislation or regulation could yield overly complicated and unnecessary information-sharing protocols. If the utilities are required to supply more information than is truly useful for helping municipalities to reduce consumers' energy consumption, it will only lead to higher electricity rates without meaningful public benefits. Therefore, the state should approach the subject of legislation or regulation gingerly and should consciously look at the likely concrete costs and benefits of any protocols it considers requiring.

Community-Level Activities Worthy of Replication

Many of the activities taking place in individual Massachusetts communities could be repeated successfully in other communities, and some are already being copied. Some of these model activities were initiated by municipal governments, and nongovernment civic groups started others. Without trying to be comprehensive and acknowledging that other communities have also implemented exemplary programs, we suggest that the following programs be replicated:

- A local government is much more likely to reduce the amount of energy used in municipal buildings if a municipal official is assigned responsibility for leading the effort and if that role as an energy manager or sustainability officer is publicly visible. Many towns and cities have assigned someone to such a role and more communities should do so. In an interesting variation on this, the Acton-Boxborough Regional School District has appointed a part-time Energy Advisor for the schools. This position recognizes that the

schools require special attention if the towns are to reach the 20 percent energy reduction goal required of designated Green Communities. While the Advisor helps implement physical changes to the buildings, she adds special value by also focusing on the behavior of the schools' faculty, staff, and students. No matter how efficient or inefficient a building's energy systems are, the behavior of its occupants will make a big difference in its energy consumption, and this is especially true for schools. The Energy Advisor engages the teachers and students on projects, such as a greenhouse gas audit by the 12th grade environmental studies class, and helps educate students on energy, such as by contributing to a 6th grade curriculum unit on energy. During the current school year, the school district's energy use has declined 5 percent from the previous year, in part because of behavioral changes.

- HEET (Home Energy Efficiency Team) is a nonprofit organization in Cambridge that organizes energy-upgrade work parties and provides hands-on training. The volunteers who participate in the work parties learn skills related to weatherization and other energy-efficiency measures. At the same time, the building's owners and residents get a more efficient building. As HEET describes the process, "Since the work is through volunteers, it is free to the owners/tenants. They only pay for materials, which range between \$200 and \$900 depending on the size of the building. We lower their heat, electricity and water bills by 6-10 percent and the work lasts a decade, saving between \$3,000 and \$9,600 overall."¹² According to a survey of the volunteers who participate in HEET work parties, over 70 percent of them subsequently apply the information and skills they learn to their own homes. HEET has been especially suc-

cessful at reaching economically and ethnically diverse Cambridge residents. The organization has helped more than 20 other groups to replicate its model elsewhere.

- In 2011, the Massachusetts Clean Energy Center launched a Solarize Massachusetts pilot program in four communities—Harvard, Hatfield, Scituate, and Winchester. The pilots tested the hypothesis that market penetration for photovoltaic systems would be accelerated by combining the reduced prices that can come from bulk purchasing with concerted outreach to local homeowners and small businesses. The pilot project in the Town of Harvard was particularly creative, because homeowners who could not site a solar system on their own property were able to purchase one in a community solar garden, thereby increasing the number of potential purchasers. Before the pilot began, there were only 13 residential solar systems in Harvard, but the special campaign led to the addition of 75 more systems.¹³
- Business, institutional, and civic leaders in Boston have joined together to establish the Boston Green Ribbon Commission. It's aim is to "develop shared strategies for fighting climate change."¹⁴ More than 30 leaders meet three times a year to share ideas about climate change action, monitor the city's progress, and expand civic involvement. Beyond providing the city government with useful advice, the commission has helped make energy efficiency a higher priority for many influential institutions and businesses by showing both the economic and environmental benefits of focusing on saving energy. As James Hunt, Boston's Chief of Environmental and Energy Services, has pointed out, "This is very much about lowering the cost of living and doing business in our city."¹⁵

- Many cities and towns have entered into an energy management services (EMS) contract with a private energy services company (ESCO), and many more should do so. With such a contract, the ESCO analyzes the municipality's facilities and its past energy bills in order to identify energy-saving opportunities and then implements energy-efficiency measures. A main attraction for local governments with tight budgets is that the municipality pays nothing up front for the ESCO's services or for the measures it installs. Instead, those things are paid for over time out of the ongoing energy savings. The municipality's payments are linked to the results and the ESCO guarantees those results. The ESCO is also responsible for hiring and managing the contractors who install the energy-saving measures. Massachusetts DOER has actively promoted energy management services and has provided ongoing advice to local governments.¹⁶

- Setting a community-wide greenhouse gas reduction goal can be useful, but often such goals receive little attention after they are announced. Greenfield and Needham, however, have found a compelling way to keep their goals in the public eye and use them to motivate people to take action. In the case of Greenfield, Greening Greenfield, a grassroots citizens group, started the 10 Percent Challenge with an initial goal of getting 10 percent of the households and businesses in the town to reduce their energy use by 10 percent. Every household and business that signed up to participate in the challenge was given a lawn sign to place on its property. That not only gave people tangible public recognition for the usually hidden energy-saving measures they were implementing, but it created a sense of momentum as the signs gradually popped up all

around town. In addition, everyone who signed up to participate in the challenge receives periodic information with additional energy conservation tips. In January 2011, the local newspaper, the *Greenfield Recorder*, devoted a full page to listing and celebrating the 900 households that had signed the pledge, and every month profiles a local "green hero" who is making changes to reduce energy use and help the environment.¹⁷ In Needham, the Green Needham Collaborative, a community group focused on sustainability projects, established a 10 Percent Energy Challenge for that community. Over 880 families and hundreds of local businesses have taken the challenge. To increase awareness of the project and provide recognition for participants, the Green Needham Collaborative has commissioned a bronze plaque on which local businesses and community groups that take part in the project will have their participation memorialized.¹⁸

- In Brookline, Climate Change Action Brookline and the Selectmen's Climate Action Committee have used networking among the town's businesses and organizations "to raise awareness about the importance of reducing the carbon footprint of our community."¹⁹ This effort, called Brookline Tomorrow: Climate Action Today, features a newsletter and website to keep more than 100 organizations and businesses informed about what is going on in town related to climate change. Each participant is asked to commit to three easy steps—taking at least one action to reduce emissions, greening their events, and spreading the word. The participants then describe what they have done on the website. The initiative is especially effective at encouraging and then demonstrating widespread community support for climate change action.

In a separate but related initiative, Climate Change Action Brookline each year holds Brookline Climate Week. By concentrating 40 events and displays in schools, parks, businesses, and other locations around town all in the same week, climate change gets much more attention and visibility than if those activities were spread throughout the year.²⁰

- Sustainable Arlington, a local climate change action group, executed a campaign to increase significantly the number of local households that receive home energy audits. Partnering with the town government and with a state-wide program administered by the Massachusetts Energy Consumers Alliance, Sustainable Arlington signed up 456 households for free home energy audits in little more than two months. The group used door-to-door canvassing, presentations at Town Meeting, and mailers from town government to make people aware of the program and convince them to sign up for audits.

More to Do

Although a good start has been made at addressing climate change at the community level, the state and others will need to take additional steps to maintain the momentum. Here are a few things that could make a difference:

- The grants to local governments under the Green Communities Program have been effective motivators and have paid for valuable activities. The state should find a way to continue such funding, including providing follow-up grants to the 86 communities that received initial grant support.
- The state and other stakeholders should continue to encourage more communities to appoint and retain a municipal energy officer.

The existence of someone in that role generally makes a big difference in how active and effective a local government is in addressing its energy use. Support for such municipal officials would be one beneficial use for continued grants from the state to local governments. In the case of smaller communities, it could make sense for a single energy officer to serve several municipalities.

- Just as the state needs to do a better job at tracking the results of its own actions, it should regularly monitor and analyze how well the Green Communities are doing in achieving their five-year 20 percent energy reduction goal. That information should be publicly accessible so anyone in a community can know how his or her local government is doing and how it compares to other municipalities.
- DOER has disseminated helpful information to municipalities and some of its webinars have been particularly useful. However, DOER should do more of this outreach and make some of its information easier to access and more user-friendly. For example, its electronic newsletter should be distributed more frequently and should include more practical information that will help local governments as they tackle climate change. In addition, DOER should try to cultivate a shared network among the 86 Green Communities, so that officials from those communities can discuss their successes, challenges, project ideas, and needs.
- The efforts of grassroots activists have been important to establishing and sustaining local climate change action, and they have often been crucial for getting local government programs off the ground. However, there are signs that such activism could be

starting to fade. The state, large environmental organizations, foundations, and other stakeholders should take steps to nurture grassroots action and help keep local activists engaged and motivated. The Massachusetts

Climate Action Network plays an important role in this but other groups should support its efforts and carry out additional activities that encourage grassroots involvement.

CHAPTER IV. ENDNOTES

- 1 Chapters of the Massachusetts Climate Action Network are listed at www.massclimateaction.org/chapters/chapter-list.html.
- 2 CLEI members are listed at www.icleiusa.org/about-iclei/members/member-list. In Massachusetts, there is one ICLEI member for every 235,000 people. The national average is one member for approximately every 550,000 people.
- 3 The full results from the survey are included in Appendix B. One person works for and represents two towns, Hamilton and Wenham.
- 4 In April 2011, MassINC published a detailed survey and analysis of Massachusetts public opinion towards climate change. The report shows the differences in attitudes based on education, party identification, income, sex, and race and ethnicity. See Steve Koczela et al., *The 80 Percent Challenge: A Survey of Climate Change Opinion and Action in Massachusetts* (Boston: MassINC, 2011), p. 19. Available at www.massinc.org/~media/Files/Mass%20Inc/Research/Full%20Report%20PDF/files/climatereport.ashx.
- 5 Massachusetts Department of Energy Resources, *FY 2012 Green Community Designation and Grant Program: Program Guidance* September 26, 2011, p. 3. Available at www.mass.gov/eea/docs/doer/green-communities/grant-program/gcprog-guidance-fy12.pdf.
- 6 Ibid., p. 6.
- 7 Massachusetts Department of Energy Resources, *Green Communities Division Annual Report to the Massachusetts General Court*, April 2011, Appendix A. Available at www.mass.gov/eea/docs/doer/green-communities/pubs-reports/gcd-annual-rpt-apr-2011.pdf.
- 8 Mark Sylvia, Testimony at Green Communities Act of 2008 Hearing, Joint Committee of Telecommunications, Utilities, and Energy, November 9, 2011, pp. 2-3.
- 9 MassEnergyInsight is available at www.massenergyinsight.net.
- 10 For information on Renew Boston, see <http://renewboston.org>.
- 11 The nine cities are Chelsea, Fitchburg, Greenfield, Leominster, New Bedford, Newton, Northampton, Pittsfield, and Somerville. For more information, see <http://serrafix.com/case.php>.
- 12 "What We Do" on HEET website: www.heetma.com/content/what-we-do.
- 13 For more information about Solarize Massachusetts, see www.masscec.com/index.cfm/pid/11150/cdid/12469.
- 14 Website of the Boston Green Ribbon Commission. See www.greenribboncommission.org/about.
- 15 James Hunt quoted in Mary Moore, "Hostetter Rallies Peers on Climate Change," *Boston Business Journal*, November 4, 2011. Available at www.greenribboncommission.org/downloads/BBJ_110411_Hostetter.pdf.
- 16 A recording and slides from a webinar that DOER's Green Communities Division held on February 16, 2011, are available at www.mass.gov/eea/energy-utilities-clean-tech/green-communities/webinars.html.
- 17 For more information on Greening Greenfield and the 10% Challenge, see www.greeninggreenfield.org.
- 18 For more information on Green Needham's 10% Energy Challenge, see <http://challenge.greenneedham.org>.
- 19 Home page of Brookline Tomorrow: Climate Action Today website, www.brooklinetomorrow.org.
- 20 For information on the January 2012 Brookline Climate Week, see www.climatechangeactionbrookline.org/climateweek2012.html.

APPENDIX A: AN INVENTORY OF MASSACHUSETTS GREENHOUSE GAS EMISSIONS

In 2010, the Massachusetts Department of Environmental Protection prepared the most recent full inventory of Massachusetts greenhouse gas emissions.¹ The last year for which full data is available is 2007. The inventory for that year is shown below. More detailed information is included in the Department's report and in accompanying spreadsheets.

	2007
ENERGY TOTAL	85.3
CO₂ from Fossil Fuel Combustion	79.9
Residential CO ₂	13.4
Commercial CO ₂	5.3
Industrial CO ₂	4.7
Transportation CO ₂	33.1
Electric Generation CO ₂	23.4
Electricity Imports CO ₂ , CH ₄ , N ₂ O	2.6
Other Gases Total	2.8
Stationary Combustion	0.2
Electric Power	0.1
Other	0.2
Mobile Combustion	0.9
Natural Gas and Oil Systems	1.7
INDUSTRIAL PROCESSES	3.0
AGRICULTURE	0.3
WASTE	2.7
GROSS EMISSIONS	91.2

¹ Department of Environmental Protection, *Preliminary 2006-2008 Massachusetts Greenhouse Gas Emissions Inventory* (Boston: Department of Environmental Protection, 2010), p. 4. Available at www.mass.gov/dep/air/climate/ghg08inv.pdf.

APPENDIX B: RESULTS OF SURVEY OF GREEN COMMUNITIES (abridged)

As part of the research for this report, we conducted an electronic survey of municipal officials from the 86 communities that have been certified as Green Communities by the Massachusetts Department of Energy Resources. We received 77 responses, representing 78 of the communities, which represents a very high response rate of 91 percent.

The responses to the survey are included below. To protect the confidentiality of the individual responses, we have deleted the names of specific municipalities, individuals, and organizations.

Itemized response to open-ended questions are included in the full Appendix B available at www.massinc.org.

Question 1

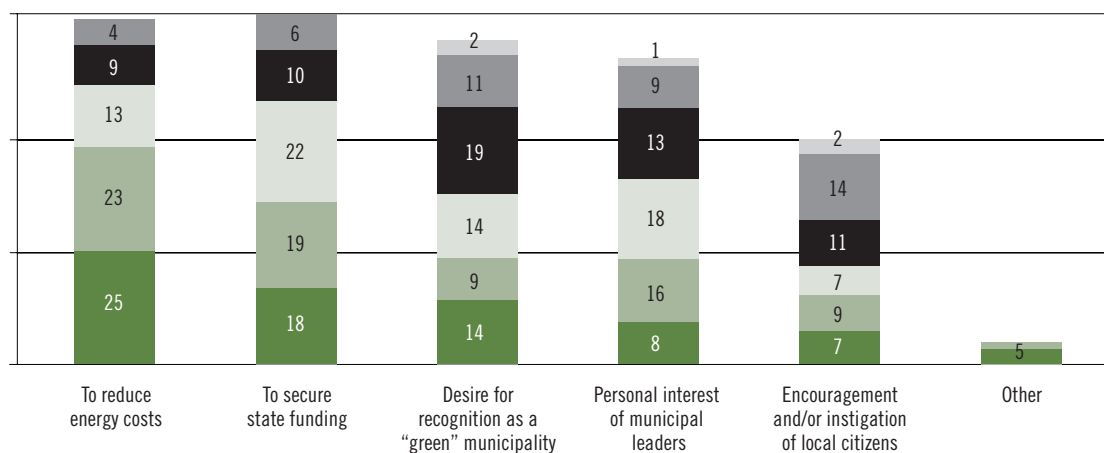
City or town?

Question 2

Why did your community apply to be a Green Community?

(Rank all relevant factors in order of importance)

■ Most important ■ 2nd importance ■ 3rd importance ■ 4th importance ■ 5th importance ■ 6th importance



Question 3

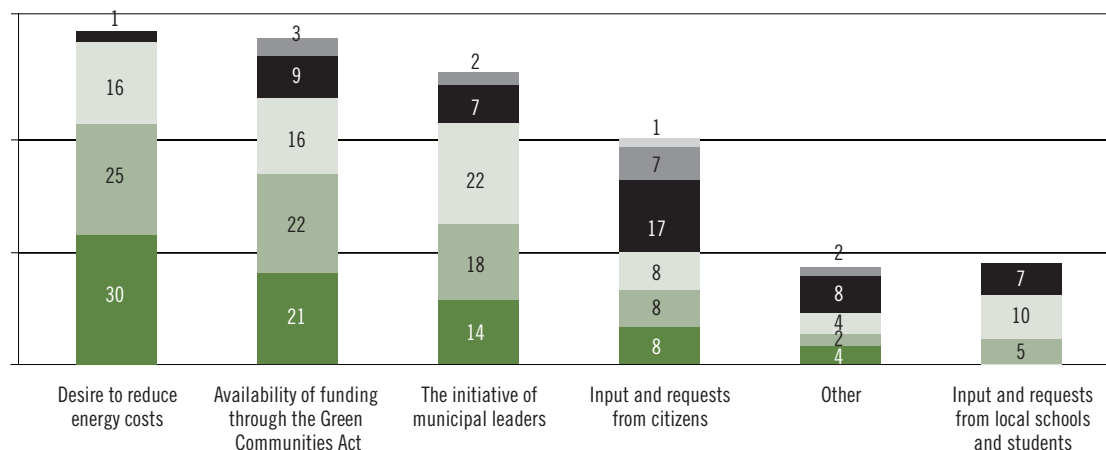
If you indicated "other" in the previous question, please explain.

Itemized responses provided in the full appendix

Question 4

Which of the following factors influenced your municipality's decision to take action to address climate?
(Rank all relevant factors in order of importance)

■ Most important ■ 2nd importance ■ 3rd importance ■ 4th importance ■ 5th importance ■ 6th importance



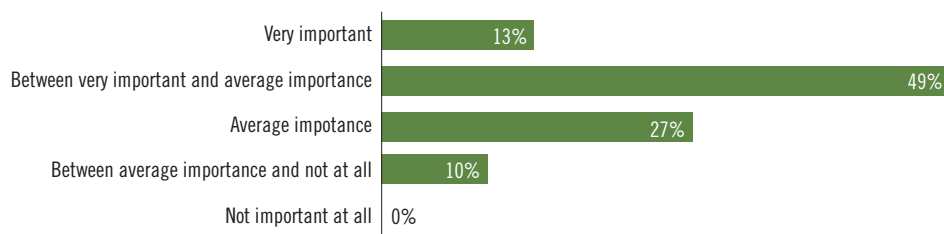
Question 5

If you indicated "other" in the previous question, please explain.

Itemized responses provided in the full appendix

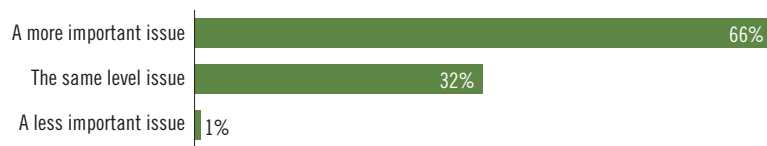
Question 6

How important is the issue of climate change to the people of your community?



Question 7

For the people of your community, compared to five years ago, climate change is:



Question 8

What have been the benefits to your community of the climate change and energy-saving actions that it has taken so far?

Itemized responses provided in the full appendix

Question 9

In terms of reducing greenhouse gas emissions, which of your city or town's activities have been most effective so far?

Itemized responses provided in the full appendix

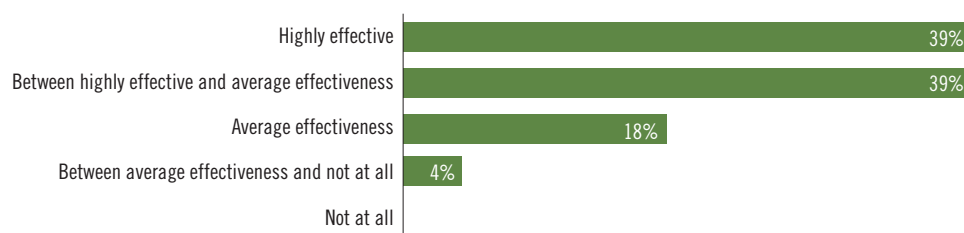
Question 10

Are there any climate change or energy actions that your municipality has taken that you think should be emulated by other communities? If so, what are they and why would it be desirable for others to adopt them?

Itemized responses provided in the full appendix

Question 11

How effective has the Commonwealth Green Communities Program been in helping communities address climate change and energy use?



Question 12

Which have been the most important ways in which the Commonwealth has helped communities to address global warming and energy use?

Itemized responses provided in the full appendix

Question 13

In what ways can the Commonwealth better help communities address climate change and energy use?

Itemized responses provided in the full appendix

Question 14

Other comments?

Itemized responses provided in the full appendix

APPENDIX C: REGIONAL INITIATIVES

New England Governors and Eastern Canadian Premiers (NEG-ECP) Climate Change Action Plan

In 2001, the NEG-ECP developed a Climate Change Action Plan, a comprehensive and coordinated regional plan for reducing climate pollution. It was the first international, multi-jurisdictional climate initiative of its type in the world. The Plan includes a goal of achieving 1990 emission levels by 2010 and a further reduction of 10 percent below 1990 levels by 2020. The region has also set a long-term reduction target of 75-85 percent below 2001 levels by 2050. The states and provinces have since developed a variety of programs and policies to meet these goals, including RGGI. A NEG-ECP Climate Change Steering Committee oversees the implementation of the Plan. Currently, the Committee is preparing an inventory of regional GHG emissions as a basis for assessing progress made in achieving the 2010 target. To facilitate future regional planning, the Committee also is working on establishing interim targets for the period between 2020 and 2050. In addition, the Committee is working on a regional agenda to address climate adaptation issues.

Regional Clean Fuel Standard

The Northeast and Mid-Atlantic Regional Clean Fuel Standard (previously called the Low Carbon Fuel Standard) is a program designed to reduce greenhouse gas emissions from transportation fuels. The CFS is a market-based program designed to address the carbon content of fuels through the use of low-carbon fuel alternatives. The CFS would work in conjunction with other programs to improve vehicle efficiency and reduced vehicle miles travelled. Ten Mid-Atlantic and Northeast states are already working together to reduce emissions from power plants; the regional CFS would further this collaboration by addressing carbon pollution from the

transportation sector. It includes all of the RGGI states plus New Jersey and Pennsylvania. The first Low Carbon Fuel Standard (LCFS), using a similar approach, began in California in 2007.

In 2008, Governor Deval Patrick invited Northeast and Mid-Atlantic governors to work together to evaluate the potential for implementing a LCFS on a regional basis. By December 2008, 11 state energy and environmental agency commissioners had signed a letter of intent to examine low carbon fuel supply options. By 2009, the preliminary assessment was complete and an MOU was signed, affirming each state's commitment to working together to develop a program framework by 2011.

At the outset of 2012, the California LCFS was temporarily delayed due to court challenges, so for the moment, the northeast states will also be examining additional implementation approaches to ensure that in the interim, they are not precluded from being able to move forward these clean, innovative fuels and technologies.

Regional Greenhouse Gas Initiative

Since 2005, ten New England and Mid-Atlantic States have been collaborating in a region-wide market-based carbon emissions reduction program, the Regional Greenhouse Gas Initiative, or RGGI. RGGI is the first market-based regulatory program in the US to cap and reduce emissions from power plants with a 25 MW or greater generating capacity. The nine states (Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, Vermont) have capped and will reduce CO₂ emissions from the power sector by 10 percent by 2018. Each of the participating states sets individual CO₂ Budget Trading Programs based on the RGGI Model Rule. The Program limits emissions from power plants, issues CO₂ allowances, and establishes participation in regional CO₂

allowance auctions.

Only a limited number of carbon pollution allowances are auctioned each year. After 2014, the amount of allowances shrinks gradually by 2.5 percent per year over four years. Regulated power plants can use CO₂ allowances issued by any of the participating states to demonstrate compliance within an individual state program. Auctioning began in September 2008; proceeds from the auctions are used to promote renewable energy and energy efficiency programs. States decide how to invest auction proceeds and determine the percentage of proceeds to be dedicated to renewable energy and energy efficiency programs. At the seventh quarterly auction on March 10, 2010, more than 41 million allowances were sold, yielding \$88 million for investment in clean energy development.

On December 7, 2011, more than 27 million allowances were sold, yielding \$51 million in proceeds. 86 percent of the auctioned allowances since 2008 have been purchased by electric generators and their corporate affiliates. Another auction was held on March 14, 2012. With RGGI auction proceeds, states have supported the following programs:

- Connecticut re-opened its oversold solar rebate program, providing a 40 percent tax cut for the installation of PV panels on schools, municipal buildings, and other buildings across the state.
- Maryland has used RGGI auction proceeds to create a new Strategic Energy Investment Fund, which has renovated nearly 2,000 apartment units for increased efficiency. Some auction proceeds have gone to the Home Energy and Weatherization Workforce training Program, providing EE job training to more than 600 contractors at 13 community colleges.

- In Massachusetts, DOER reports that expanded energy efficiency programs, funded in part by RGGI, are expected to create and maintain 4,000 jobs. In addition, the Massachusetts Green Communities program is funded by RGGI proceeds.
- New Hampshire Public Utilities Commission uses RGGI funds to support clean energy programs supporting over 200 full-time jobs.
- Vermont has used its RGGI funds to expand Efficiency Vermont's programs.
- In New York State, RGGI proceeds have been invested in training workers in energy efficiency improvements. NYSEDA is partnering with other organizations to build and expand training and certification programs.

Regional Transportation and Climate Initiative (TCI)

Eleven states and the District of Columbia created a new group in June 2010 to address sustainable growth and carbon-based transportation emissions. This new initiative, the Regional Transportation and Climate Initiative, includes Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and the District of Columbia, who will help shape the initiative's work plan. The group builds upon ongoing federal, state, and regional collaborations, such as RGGI and Low Carbon Fuel Standard. In addition, TCI works with Metropolitan Planning Organizations to help develop metropolitan transportation plans.

TCI aims to provide collaborating states with the opportunity to advance transportation technologies and options, attract federal invest-

ment, improve overall air quality, and encourage economic development. It is facilitated by the Georgetown Climate Center, a climate policy organization based at Georgetown Law.

By November, agency heads from the 12 jurisdictions had approved TCI's first work plan. The plan focuses on four key areas: the development of clean vehicles and fuels; promotion of the development of sustainable communities; implementation of communication and information technology; and improvement of the efficiency of freight transport. TCI will promote these goals by encouraging state-level policy development, working with local and regional land-use agencies, and collaborating with utilities, the private sector, and local governments. In October 2011, TCI participants formed the Northeast Electric Vehicle Network to promote clean vehicles and fuels, and facilitate planning for the deployment of electric vehicle infrastructure.

APPENDIX D: OTHER STATES' PROGRAMS

Other states across the country have responded to the threat of global warming and have implemented effective programs. Below are summaries of the legislation and actions of six states that have been climate change leaders: California, Connecticut, Maryland, New York, Oregon, and Vermont.

These summaries show the similarities among the approaches being taken by the leading states, including Massachusetts. But different states are especially strong and innovative in different areas. Maryland, for example, has given special attention to making coastal areas resilient to climate change and has implemented model adaptation programs. California's approach is especially comprehensive and builds on the state's extensive efforts to regulate air pollution.

In addition to summarizing each of the states' programs, we highlight a few of the ideas that may be particularly relevant to Massachusetts.

California

California has an ambitious approach to addressing climate change, which includes the establishment of key advisory committees, in-depth climate research, and development of regulations to reduce greenhouse gas emissions. California passed a landmark climate change law in 2006, the California Global Warming Solutions Act, also known as Assembly Bill 32 (AB 32). AB 32 applies to all major sectors of the economy, authorizing, but not requiring, the use of market-based compliance mechanisms. Under AB 32, greenhouse gas emissions must be reported by major sources and the state is required to reduce emissions to 1990 levels by 2020.

California's Climate Action Team, established by executive order in 2005, is responsible for coordinating state-level climate change actions. It is required to release biennial science assessments on climate change impacts and adaptation options, and implement emissions reduction pro-

grams. Operating under the California Environmental Protection Agency (Cal/EPA), the Team released a Climate Adaptation Strategy for agency response to climate change impacts in 2009.

The California Air Resources Board (CARB), a department within Cal/EPA, is the primary air quality regulating agency. It is tasked with developing rules for greenhouse gas mitigation, in cooperation with the California Public Utilities Commission and the California Energy Commission. In 2007, CARB adopted a regulation requiring the largest industrial sources to report and verify their GHG emissions. In addition, AB 32 required CARB to identify and adopt regulations for discrete early actions that could be enforceable by 2010. Consequently, CARB adopted regulations affecting landfills, motor vehicle fuels, automotive refrigerants, and other sources.

In addition, AB 32 directed CARB to prepare a scoping plan for how to best achieve maximum technologically feasible and cost-effective reductions in emissions by 2020. The Scoping Plan was first approved by CARB in December 2008, and then re-adopted by the Board in August 2011, after consideration of a revised environmental analysis prepared subsequent to an adverse ruling in a lawsuit. The Scoping Plan encourages local governments to pass ordinances, standards, and codes to mandate community-level action, and contains recommendations for provisions for direct regulations, voluntary actions, market-based mechanisms, and monetary incentives. The Scoping Plan identified cap-and-trade as one of the most cost-effective strategies California could use to reduce greenhouse gas emissions.

In October 2011, CARB adopted the country's first comprehensive, economy-wide cap-and-trade program. The program will begin in 2012, by setting a declining cap on greenhouse gas emissions from major sources. The 2013-2014 cap applies to utilities and large industrial facilities and will be

expanded to include transportation fuel and natural gas distributors in 2015. The program also creates a market trading system for emission allowances and offset credits that recognizes the most efficient companies. As CARB tightens the cap, the value of the permits should increase.

Other landmark and exemplary policies that California has adopted include the Assembly Bill 1493, the Low Carbon Fuel Standard, the Renewables Portfolio Standard, Senate Bill 1368, and the Sustainable Communities and Climate Protection Act. Each of these is discussed below.

Assembly Bill 1493 authorized CARB to approve regulations to reduce greenhouse gas emissions from passenger vehicles beginning in model year 2009. Transportation contributes nearly 40 percent of California's greenhouse gas emissions. The resulting regulations should reduce emissions from passenger cars 22 percent by 2012 and 30 percent by 2016. These regulations formed the foundation for the federal greenhouse gas program for light-duty vehicles for 2012-2016 model years.

Furthermore, CARB is taking the next step to create environmental standards that link formerly separate programs to reduce greenhouse gas emissions and toxic tailpipe emissions. Phased in from 2015 through 2025, the Advanced Clean Cars (ACC) program coordinates the goals of the Low Emission Vehicle (LEV) program, the zero emission vehicle program, and the Clean Fuels Outlet regulations to assure the development of environmentally superior cars and availability of ultra-clean fuels for these vehicles. CARB studies indicate that the ACC program will prevent 941 million tons of carbon dioxide from entering the atmosphere.

California's Low Carbon Fuel Standard was the world's first standard for transportation fuel and is intended to reduce the carbon intensity of transportation fuels. The standard applies to refiners, blenders, importers, and producers, who may meet the standards through market-

based methods such as credits for exceeding performance.

Senate Bill 1368 sets an emissions performance standard for electricity and requires the Public Utilities Commission to establish standards for all baseload generation of investor-owned electric utilities and the Energy Commission to do so for publicly owned utilities. Approximately 23 percent of California's emissions comes from the electricity sector. Under Governor Brown, the state's RPS was expanded by statute to require retail electricity suppliers to serve 33 percent of their load with renewable energy by 2020.

California's climate policy has resulted in significantly reducing emissions. The Energy Commission's 2007 annual report stated that California's per capita electricity use remained nearly flat due to energy efficiency programs, appliance efficiency standards, and cost-effective building efficiency standards. It also found that more than 97 percent of the state's 600 largest greenhouse-gas-emitting facilities complied with CARB's mandatory reporting requirements.

California's Land Use Law: An Idea for Massachusetts?

The Sustainable Communities and Climate Protection Act (Senate Bill 375), which was signed into law in 2008, is designed to link land use decisions to transportation funding decisions. The law seeks to harmonize three distinct but related policy areas—regional planning, transportation infrastructure development, and statewide greenhouse gas emissions goals—in one comprehensive program. By removing any misaligned or contradictory directives in the regional planning processes that were in place before the law's passage, it reduces the incidence of disjointed decision-making processes between local and regional levels of government.

As a result of the law, new regional land use plans called Sustainable Communities Strategies

are required. This new planning should produce more rational and coordinated regulation and public funding. The law builds upon existing regulatory structures and seeks to incentivize compact development through a mix of transportation project funding and process streamlining.

SB 375 requires Regional Transportation Plans to include Sustainable Communities Strategies and to be internally consistent, thereby better aligning transportation, housing, and land use planning as part of plans to reduce transportation emissions. If implemented as envisioned, the law could achieve the following economic benefits:

- Long-term savings in municipal service costs, because per capita savings in maintenance costs, municipal services, and infrastructure will outweigh the initial higher capital costs of supporting infill development;
- More efficient use of public transportation systems;
- Enhanced public health, because of walkable communities and improved local air quality;
- Reduced development pressure on the state's agricultural land;
- Decreased dependence on fossil fuels with more dollars staying in the local economy instead of being spent at the gas pump.

Connecticut

In 2001, Connecticut established the Governor's Steering Committee on Climate Change—an advisory body comprised of key state agency leaders in the areas of policy, energy, transportation, environment, administrative services, and clean energy. This Steering Committee developed a climate change stakeholder dialogue, which ultimately led to the 2005 Climate Change Action Plan pursuant to Public Act 04-252, An Act Concerning Climate Change. The goal of the plan was to reduce greenhouse gas emissions to 1990 levels by 2010 and an additional 10 percent below that level by 2020, and then to eventually reach a long-term reduction goal of 75 percent. These emissions targets

are in accordance with the regional goals set by the New England Governors/Eastern Canadian Premiers' Climate Change Plan.

The Governor's Steering Committee is analyzing additional strategies to reduce GHG emissions in its Draft Greenhouse Gas Reduction Strategies Table (2010), which also summarizes progress on meeting the actions included in the 2005 Action Plan. However, the table does not provide any data on the progress towards meeting the 10 percent by 2010 reduction goal. It does project the expected emission reductions by sector and action by 2020.

The Climate Change Plan paved the way for Connecticut's General Assembly to adopt, in 2008, Public Act No. 08-98, the Global Warming Solutions Act (GWSA), which set forth emission reduction requirements similar to the Plan, increasing the reduction to 80 percent below 2001 levels by 2050. The GWSA requires the Department of Environmental Protection (DEP) to inventory and analyze emission reduction strategies and recommend strategies to achieve the targets specified in the GWSA. Then, beginning in 2012, the DEP is required to develop a schedule of recommended regulatory agency actions and policies to show further progress towards achieving the targets. Furthermore, the GWSA requires the Department of Transportation to investigate the expansion of high-speed and light rail systems.

The following key climate initiatives have resulted from the Governor's Steering Committee, the climate change plan, and the GWSA's framework for reducing emissions:

1. The primary recommendation in the Connecticut Climate Change Action Plan was a regional cap-and-trade program for the electric generating sector. Connecticut became a participant in the multi-state regional effort to limit emissions—the Regional Greenhouse Gas Initiative in 2005.

2. Public Act 04-84 (Connecticut's Clean Cars law) required the DEP to adopt the California Low Emission Vehicle II program standards. The regulations required vehicle compliance beginning with the 2008 model year, committing Connecticut to a 30 percent reduction in new vehicle greenhouse gas emissions from 2002 levels by 2016. Furthermore, this Public Act directs the Commissioner to amend such regulations in accordance with any changes in standards made by California. Transportation accounts for nearly 40 percent of Connecticut's emissions.
 3. The state's Leading by Example program, initiated by former Governor Jodi Rell in 2007, directs state agencies to purchase vehicles with the best highway mileage, reduce the size of the non-emergency fleet, purchase only Energy Star appliances, and reduce overall energy use in state or state-funded buildings by 2 percent percent. The Governor's Steering Committee agencies also are required to make the same greenhouse gas reductions required of the state as a whole: 1 percent percent below 1990 levels by 2020 and 8 percent percent below 2001 levels by 2050.
 4. Public Act 09-192 required building projects costing at least \$5 million and renovation projects projected costing at least \$2 million to meet LEED silver or an equivalent standard. In 2009, the provisions were extended to schools and private sector projects receiving state funding.
 5. Connecticut's Motor Vehicle Labeling Law requires DEP to work with the state's Department of Motor Vehicles to establish a greenhouse gas labeling program. The labeling law went into effect in August 2009 for vehicles weighing 10,000 pounds or less. The California Air Resource Board's label was adopted as part of Connecticut's Low Emission Vehicle II Program.
 6. Pursuant to the GWSA directive to investigate low-carbon fuel standards, Connecticut has agreed to cooperate with other Northeastern states to develop a regional low-carbon fuel standard.
- In addition, Connecticut has a tiered 2 percent percent renewable portfolio standard and offers many financial incentives for clean energy and energy efficiency. Executive Order 32 directed state government agencies to obtain 10 percent percent of their power from Class I renewables by 2050. Interim targets include 2 percent percent by 2010 and 5 percent percent by 2020. The Connecticut Clean Energy Finance and Investment Authority implements renewable energy and energy efficiency programs through a utility surcharge on consumers. The \$30 million collected annually from a utility surcharge on consumers funds rebates, grants, and loans.
- Connecticut's strategies to reduce emissions from the transportation sector focus on increasing vehicle efficiency and reducing vehicle miles travelled (VMT) through smart growth and mass transit initiatives. The GWSA includes transit, smart growth, and VMT-reduction plans as a policy goal. However, subsequent legislation to address land-use patterns and sprawl has lacked any regulatory component and has instead focused on procedure (analysis of land-use patterns, offers of technical assistance) and regional planning. In 2010, Connecticut joined ten other Northeastern and Mid-Atlantic states in a new regional transportation initiative, the Transportation and Climate Initiative, to reduce emissions by minimizing the sector's reliance on high-carbon fuels, promoting sustainable growth, and addressing VMT.
- A subcommittee of the Governor's Steering Committee—the Adaptation Subcommittee—was created in 2008 to explore the potential impacts of climate change and how the state might adapt to those impacts. Connecticut's DEP has already developed an initial climate

adaptation report, *Facing our Future* (2009), which provides preliminary recommendations for alternative approaches to foster adaptation at the regional and local levels.

In 2010, the DEP and ICLEI partnered to assess the potential impacts of climate change on coastline communities and other municipalities. The Groton Coastal Climate Change Adaptation Project, for example, brought together more than 100 stakeholders. The project resulted in a DEP report identifying physical, planning, and educational strategies to increase local resilience to sea level rise and coastal flooding. Groton has begun to use these adaptation strategies. To aid municipalities in addressing climate change, ICLEI and DEP convened the Connecticut State Climate Protection Network, and are bringing together municipalities to share strategies for climate change mitigation and adaptation through the development of an Adaptation Resource Toolbox.

To further integrate energy policies and programs in Connecticut, the General Assembly recently passed legislation to create the Department of Energy and Environmental Protection (DEEP), a new agency bringing together the DEP, the Department of Public Utility Control, and the energy policy group from the Office of Policy and Management. Effective July 1, 2011, DEEP is charged with creating a new energy future for the state while protecting Connecticut's environment and natural resources. The integration of energy and environmental programs should result in more systematic and coordinated policies.

Connecticut's Community-Based Power Microgrids: An Idea for Massachusetts?

Governor Dannel P. Malloy's has been promoting a strategy of community-based micro electricity grids, or microgrids, that integrate distributed renewables, energy storage, combined-heat-and-power, and biodigesters. The goal is to lower transmission and allow communities to make their own decisions about their power preferences

by bringing the generators closer to the end users.

Governor Malloy has ordered state agencies to explore how the state could create microgrids that would be better prepared in an emergency and be able to keep critical facilities—hospitals, police and fire stations, water and waste water systems, and prisons—running. Pilot project plans are at an early stage, but the state has identified about possible 300 sites—120 critical facilities and about 180 town centers and commercial hubs. It expects to have several projects in place in 2013, if not earlier.

From a climate protection standpoint, this experiment will test the extent to which microgrids provide cleaner, more sustainable energy by emphasizing fuel cells, renewable energy, and efficient combined-heat-and-power. Working with the state's utilities in a state that was badly impacted by last year's storms, Gov. Malloy is also considering creating energy improvement districts and working with the legislature on financing. If Massachusetts were to find these concepts from Connecticut appealing, the two states could consider working collaboratively to explore implementation.

Maryland

In 2007, Governor Martin O'Malley issued an executive order establishing Maryland's Commission on Climate Change. The Commission, led by the Secretary of the Environment and including legislative and major state agency leaders, was charged with advising the Governor and the General Assembly on climate change matters and with developing a state climate action plan for mitigation and adaptation.

The Maryland Department of the Environment (MDE) was the principal facilitating agency for developing the plan. The resulting 2008 Climate Change Plan unveiled the Commission's greenhouse gas reduction goal of achieving a 2 percent percent reduction from 2006 levels by 2020 and put forth a strategy for meeting and exceeding that goal. Furthermore, the Plan

addressed necessary preparations for climate change impacts and established benchmarks and timetables for policy implementation.

The Plan's mitigation strategy includes 42 measures to meet the following goals (set on a 2006 base year): 1 percent percent reduction by 2012; 1 percent percent by 2015; 2 percent percent by 2020; and 9 percent percent by 2050. Mitigation policy options target the residential, commercial and industrial sector, the energy sector, agriculture and forestry sector, and transportation and land use sector. The strategy has three main messages—early actions are key; energy efficiency is the least expensive and fastest approach to reducing emissions; and mitigation measures will have many local benefits including boosting the state's economy.

Chapter five of the Plan, "Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change," focuses on coastal area impacts and sea-level rise. It recommends legislative and policy actions to reduce impacts to existing infrastructure and future development; to enhance preparedness and planning to protect human health, safety, and welfare; and to protect natural shorelines and natural resources.

Nearly all the Commission's early action recommendations for legislation were adopted into law in the 2008 session, including the Regional Greenhouse Gas Initiative (RGGI), High Performance Buildings Act, Energy Efficiency Performance Standard, a Publicly Administered Energy Investment Fund, and revisions to the renewable portfolio standard that added a solar set-aside, doubled the overall Tier 1 requirement, and accelerated the compliance schedule.

Prior to the adoption of the Climate Change Plan, the following programs were already in place:

- The Healthy Air Act was adopted as state law in 2006 and included a provision for Maryland to join (RGGI).
- In 2007, the state implemented California's

strict vehicle emission standards through its Clean Cars Program. Beginning with model year 2011, passenger vehicles are required to meet more rigorous emissions standards, achieving reductions of 6 million metric tons by 2020 of volatile organic compounds, NO_x, and CO₂. Additionally, the Clean Cars Program included a Zero Emissions Vehicle mandate that car manufacturers must meet; these vehicles produce zero or near zero tailpipe emissions.

- The EmPOWER Maryland initiative, launched in 2007, is designed to reduce per capita electricity use by 15 percent by 2015. The initiative encourages residents to adopt energy savings measures and works with five utility companies which offer lighting and appliance rebates, energy audits, energy efficiency services, and more. In addition, the initiative contains seven steps to help state government reduce its power consumption.

Shortly after the release of the Climate Action Plan, Governor O'Malley signed into law the Greenhouse Gas Emissions Reduction Act of 2009, requiring the state to achieve the emissions reduction target defined in the Plan. This law covers many economic sectors (but excludes the manufacturing sector). The Department of Environmental Protection (DEP) is tasked with developing and adopting a reduction plan by 2012. Moreover, the law requires the DEP to update its greenhouse gas emissions inventory every three years, and in 2015, it must report to the General Assembly on the State's progress toward achieving the 2 percent percent reduction target, as well as on the impact of the Greenhouse Gas Emissions Reduction Act on the economy. In 2016, the Legislature must conduct a mid-term review and make any necessary adjustments toward meeting the target.

Maryland's Department of Transportation

has taken several steps in support of the Greenhouse Gas Reduction Act of 2009, including: promoting the use of more fuel efficient vehicles including hybrid buses and fleet vehicles, and promoting carpooling and telecommuting. In addition, the department is the lead agency in assessing and developing emission reduction strategies that involve further integration of land-use planning and transportation; increasing transit capacity at the state and local level; and using transportation technologies to curb emissions. Maryland has agreed to cooperate with other Northeastern states to develop a regional low-carbon fuel standard.

Other climate-related bills in Maryland include the Sustainable Communities Act of 2010 and the Maryland Sustainable Growth Commission. The former reinvented an existing rehabilitation tax credit and promotes more affordable transportation options, energy-efficiency housing choices, and smart growth principles. In 2011, ten projects received a total of \$11 million in tax credits to leverage construction. The latter law charged Maryland's Sustainable Growth Commission with protecting and developing land sustainably and with increasing access to transit. Additionally, the 2009 Smart and Sustainable Growth Act serves as the state's smart growth bill and establishes statewide land use goals.

Maryland's Integrated Approach to Adaptation: An Idea for Massachusetts?

Maryland has developed a detailed integrated approach to the issue of vulnerability to climate impacts. An Adaptation and Response Working Group has produced a *Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change*. The working group has been effective in working cooperatively across the state's various natural resource agencies and with coastal zone communities.

The primary goals of the strategy are to:

- Promote programs and policies aimed at the avoidance and/or reduction of impacts to the existing built-environment, as well as to future growth and development in vulnerable coastal areas;
- Avoid the financial risk of development and redevelopment in highly hazardous coastal areas;
- Enhance preparedness and planning to protect human health, safety, and welfare;
- Protect and restore Maryland's natural shoreline and its resources, including its tidal wetlands and marshes, vegetated buffers, and Bay Islands, that shield Maryland's shoreline and interior.

New York

New York has demonstrated leadership in addressing climate change through a variety of actions. The following list includes key climate change actions; some of these are explained in further detail below.

- Executive Order No. 111 (2001) mandated government agencies and public authorities to increase renewable energy purchases and to adhere to green building guidelines. This order was last renewed in January 2011. In 2008, Executive Order No. 4 established the State Green Procurement and Agency Sustainability Program.
- In 2008, Executive Order No. 2 established the State Energy Planning Board and authorized the creation and implementation of a state energy plan. The 2009 Plan includes recommendations to guide clean energy legislation and to meet a goal to meet 4 percent percent of New York's electricity needs

through improved energy efficiency and renewable energy by 2015.

- Creation of the New York State Climate Action Council to identify mitigation and adaptation strategies and draft climate change action plan.
- Creation of the Department of Environmental Conservation (DEC) Office of Climate Change and the Governor's Smart Growth Cabinet.
- Participation in the Regional Greenhouse Gas Initiative (RGGI).
- Establishment of a Renewable Energy Task Force and a Sea Level Rise Task Force.
- Adoption of California emission standards for vehicles.
- Enactment of legislation requiring new motor vehicle labeling on greenhouse gas emissions.

In 2009, Governor David A. Paterson created the New York State Climate Action Council (CAC) and established the goal of reducing GHG emissions from all New York sources to 8 percent percent below 1990 levels by 2050. CAC was tasked with identifying the best opportunities for climate change mitigation and adaptation, reducing the costs associated with climate change activities, and drafting a climate change action plan. For benchmarking purposes, the CAC adopted an interim emissions reduction goal of 4 percent percent below 1990 levels by 2030. The New York State Climate Action Plan Interim Report was released on November 9, 2010; it includes proposals for state government and key economic sectors to reduce emissions, adapt to climate changes, and promote a green economy.

The DEC's Office of Climate Change has been tasked with developing programs and policies to mitigate greenhouse gas emissions, inventory emissions, and help municipalities and individuals adapt to the effects of climate change. The Office promotes voluntary emissions reporting through the Climate Registry. The Office is also responsible for evaluating the feasibility and benefits of other mitigation and adaption approaches, including renewable energy technologies, reduction in vehicle miles travelled, and carbon capture and sequestration.

The DEC chairs and staffs the New York Sea Level Rise Task Force, created by the State Legislature in 2007 to make recommendations on standards and enforcements in coastal development, wetland protection, shoreline armoring, and post-storm recovery. The Task Force released a report in January 2011 with recommendations for adaptive measures to protect coastal communities and natural habitats.

Beyond participating in the Regional Greenhouse Gas Initiative, New York participates in other regional efforts to curb emissions, including the Regional Low-Carbon Fuel Standard and the regional Transportation and Climate Initiative. NY has adopted the most recent California Vehicle Emissions Standards, which would reduce emissions from cars by 3 percent percent and from light trucks 2 percent percent by 2016.

Executive Order No. 111 (2001), one of the most comprehensive directives mandating government procurement standards and design practices, provides green building guidelines for all State Executive Branch agencies, departments, and public authorities, and requires state entities to achieve a 3 percent percent energy consumption reduction from 1990 levels by 2010. The order directs state entities to increase their renewable energy purchases, starting at 1 percent percent of total electricity energy use in 2005 and increasing to 2 percent percent by 2010. The order was renewed in January 2011 by

Governor Andrew Cuomo.

Although New York has long given considerable attention to energy efficiency and renewable energy, the state has, in recent years, produced new plans for expanded efforts in those areas. In 2008, DEC's Renewable Energy Task Force comprised of 20 private-sector and government representatives, issued a report with recommendations for a comprehensive renewable energy policy roadmap. The report called for reducing electricity use of 1 percent percent by 2015, creating new appliance efficiency standards, establishing rigorous energy building codes, investing in renewable energy projects, and establishing an expedited review process for wind-power projects and solar projects.

The 2009 State Energy Plan, a non-binding plan, contains recommendations to guide clean energy legislation. The plan includes improvements in energy efficiency and increased reliance on domestic energy supplies, and is critical to the broad goal of meeting 4 percent percent of New York's electricity needs from energy efficiency and renewable energy by 2015. The Plan is being implemented through two key programs: a renewable portfolio standard (RPS) and an energy efficiency portfolio standard (EEPS). The State's RPS requires 3 percent percent of New York's electricity to come from renewable energy sources by 2015 and provides financial incentives to support the development of renewables. To date, the RPS has led to over 1300 MW of power from renewables. The EEPS is charged with reducing energy demand by 1 percent percent by 2015 through such measures as retrofitting properties, installing new efficient equipment, and strengthening efficiency standards for appliances and buildings.

The New York State Energy Research and Development Authority (NYSERDA) is responsible for administering the RPS and EEPS. It also administers a portfolio of efficiency and renewables activities that are funded through a Systems

Benefits Charge. Those activities include investing in RD&D for emerging technologies, supporting business development of companies providing innovative products, and providing support for market acceleration. NYSERDA also offers various green building services for commercial, industrial, and institutional buildings. For example, its New Construction Program provides performance-based incentives for energy-efficiency measures for new and substantially renovated buildings.

NYSERDA released *Responding to Climate Change in New York State* in November 2011. It provides a detailed state-level assessment of climate change impacts with recommendations geared to assist in the development of adaptation strategies across a broad range of sectors and with detailed information for decision-makers at the state and municipal level, and stakeholder agencies and organizations. The report presents a range of adaptation options by sector, offering near- and long-term options with relatively moderate cost. The report identifies sea level rise risks and coastal flooding risks as the greatest climate change-related challenges.

Other climate change programs and policies in New York include:

- The New York State Interagency Local Government Adaptation Workgroup—an ad hoc workgroup facilitating development of recommendations for local adaptation planning, and helping to design tools and management of pilot projects.
- State Wildlife Action Plan Vulnerability Assessments—these assessments address species of concern and identify potential actions to reduce climate change impacts on wildlife populations.
- New York Climate Smart Communities, a state-local partnership that includes a 10-point

pledge, helps municipalities reduce emissions, prepare for climate change, and invest in green economies. Launched in 2009, the program has been adopted by more than 90 communities. DEC's Open Space Conservation Plan includes a comprehensive suite of land use and acquisition recommendations to mitigate and adapt to climate change.

New York's On-Bill Energy Financing: An Idea for Massachusetts?

New York Governor Andrew Cuomo signed On-Bill Financing legislation into law, meaning that by this time next year many New Yorkers will be able to pay for energy efficiency improvements the same way they pay for energy—through their utility bill. Since the bill's passage, the Efficiency First New York Chapter has been hard at work communicating home performance industry priorities to NYSERDA, and educating New York members about how the program will function. The bill mandated that the large utilities in New York offer customers the ability to finance energy efficiency retrofits through loans paid back on customers' utility bills. The legislation delegated much of the implementation to NYSERDA, which runs other home performance programs as well.

Oregon

In 2004, Governor Ted Kulongoski convened a 28-member Advisory Group on Global Warming to develop a climate change strategy for Oregon that would provide long-term sustainability for the environment while protecting public health and welfare. A year later, in March of 2005, the Group released its report, *Oregon's Strategy for Greenhouse Gas Reductions*. The report's recommended actions for reducing emissions included improving energy efficiency, developing renewable energy, improving transportation routes, and reducing waste.

Based on the report's recommendations, Governor Kulongoski appointed a Climate Change

Integration Group (CCIG) in 2006 to assess climate change impacts and to prepare a framework for addressing climate change challenges. The CCIG was also tasked with creating an adaptation strategy for the state, implementing and monitoring mitigation measures from the 2004 Strategy, and serving as the clearinghouse for all Oregon climate change information. The most immediate charge to the CCIG was to deliver a detailed report by the end of 2007 on how the state should prepare for the impacts of climate change.

Based on the proposed targets of both the 2004 Advisory Group and the CCIG, the Legislature approved House Bill 3543 in 2007, codifying Oregon's commitment to reducing emissions by 1 percent percent below 1990 levels by 2020, and 7 percent percent below 1990 levels by 2050. To accompany the new legislation, the Global Warming Commission (GWC) was established to coordinate state and local efforts to reduce emissions and to recommend efforts to help the state prepare for the effects of global warming. The GWC may recommend statutory and administrative changes, policy measures, and other actions. Furthermore, the GWC has the authority to examine cap-and-trade systems, including a multistate carbon system and market-based mechanisms.

In 2008, CCIG released a report titled, *A Framework for Addressing Rapid Climate Change*. It urged Oregon businesses and governments to not only consider climate change in their planning, but to also develop dynamic and holistic planning processes that are designed to handle changing rather than stable conditions. The framework model is based on the key elements of preparation and adaptation; mitigation; education and outreach; and research.

Following the release of the 2008 *Framework*, Governor Kulongoski asked several state agencies and partners in Oregon's University System to identify the most significant risks to the state associated with climate change and to

develop an adaptation plan. The resulting 2010 document, *The Oregon Climate Change Adaptation Framework*, identifies 11 key risks, describes the consequences of those risks for different sectors, and recommends several key actions for the Governor, the Legislature, the GWC and state agencies. This Framework identified the following strategies:

- Require all agencies to adopt and implement climate change preparation plans. Agencies should work with economists and climate adaptation specialists to pose economic questions, analyses, and data to improve planning.
- Assess financing mechanisms and develop new funding options as needed to account for longer time frames required to address climate change.
- Continue to develop and refine the climate change research agenda.
- Incorporate public health implications of climate change. Enhance the public health system to prepare for and respond to heat waves.
- Integrate different monitoring efforts into a statewide system.
- Coordinate among federal, state, and local agencies.

CCIG recently issued a *Roadmap to 2020* report, which included the following four main draft recommendations:

- The GWC should recommend to the Legislature a 2030 goal; thereafter, it should revisit and recommend as needed 10- and 20-year goals.

- A greenhouse gas accounting framework should be established to allocate and sequence carbon reduction targets by cost, sector, and geography.
- The GWC should advocate for a national carbon cap or other marketplace tools to reduce economy-wide emissions.
- The GWC and the State should advocate that highest priority be given to federal research funding for energy and infrastructure that can deliver near-term greenhouse gas reductions.

Prior to the passage of the 2007 climate change legislation, the Oregon Legislature gave the Energy Facility Siting Council (EFSC) the authority to set CO₂ emissions standards for new energy facilities. The resulting standards apply to baseload gas plants, non-baseload power plants, and non-generating energy facilities emitting CO₂. Various compliance pathways are eligible for meeting the standard, including power plant design and cogeneration, sequestering emissions, or offsetting emissions. Additionally, an Advisory Committee on Carbon Dioxide Equivalent Offsets provides input to the EFSC and the Oregon Department of Energy on the development of rules for offset projects that reduce greenhouse gases other than CO₂.

The Oregon Department of Environmental Quality (DEQ) requires utilities, fuel distributors, and other facilities emitting more than 2,500 metric tons of CO₂ equivalent in one year to report GHG emissions. Although these facilities are also subject to the Federal greenhouse gas reporting requirements (EPA rules), Oregon rules authorize DEQ to require the submission of additional information in cases where the EPA report is not sufficient.

To reduce greenhouse gas emissions from using fossil fuels for transportation, Oregon

adopted California's emission standards for light and medium-duty vehicles in late 2005. The new requirements were adopted as the Oregon Low Emission Vehicle program and took effect beginning with 2009 model year vehicles. It is expected to reduce emissions 3 percent percent by 2016. In addition, the legislature authorized Low Carbon Fuel Standards in 2009. These standards do not mandate the use of any specific fuel, but ramp up over time, gradually requiring increasing use of lower carbon fuels. The goal is to reduce the carbon intensity of transportation fuels by 1 percent percent over a 10-year period.

The Oregon Sustainable Transportation Initiative was passed by the Legislature in 2010 as an integrated statewide strategy to reduce emissions from the transportation sector. It directed the Oregon Department of Transportation and the Department of Land Conservation and Development to provide a framework for reducing emissions from the transportation sector through metropolitan planning and local land use planning. The two lead agencies are working in conjunction with DEQ, Oregon Department of Energy, and stakeholder committees to develop strategies to reduce emissions per mile and vehicle miles travelled, consider the effects of vehicle technologies and energy sources on the environment, monitor land use system changes related to transportation, and evaluate policies and actions to reduce transportation emissions.

Oregon also has targeted emissions reduction through waste prevention and recycling. Through recycling efforts, Oregon claims to reduce emissions equivalent to the tailpipe emissions from nearly 700,000 vehicles. Consequently, DEQ has adopted a Waste Prevention Strategy and conducted inventories of consumption-based emissions, along with recommendations to reduce emissions. This strategy is based on a 2005 law establishing waste generation goals (no increase in per-capita waste in 2005 and no increase in total generation in 2009) and identifying waste

prevention and reuse as a top priority for managing solid waste. DEQ is developing a long-term vision and updating the state's solid waste management plan to reduce impacts.

In addition, Oregon's Biomass Coordinating Group's plan proposes that new biomass energy markets be developed, providing multiple environmental benefits, including reduced wildfire risk and their associated CO₂ emissions. Similarly, Oregon is supporting the development of anaerobic digesters, which can capture methane from wastewater treatment plants, landfills, and farms, thereby reducing the amount of methane that would otherwise be emitted.

Vermont

In 2002, Governor Howard Dean, through Executive Order No. 11-02, directed state agencies and departments to reduce emissions from state government buildings and operations. The executive order aligned its emissions reduction goals with the recommendations of the Climate Change Action Plan that had been produced by the Conference of the New England Governors and Eastern Canadian Premiers.

In 2005, Governor Jim Douglas signed Executive Order 07-05, establishing a six-member Governor's Commission on Climate Change to examine the impacts of climate change, produce an inventory of existing and planned actions that contribute to emissions, educate the public, and develop a climate action plan. By 2006, Vermont had established GHG emission reduction goals by statute (GA Act No. 168): 2 percent percent from 1990 levels by 2012; 5 percent percent by 2028; and, if practical, 7 percent percent by 205.¹ The Act set the highest goal of any state for reducing emissions. In 2007, the Commission issued its final report and a Climate Change Transition Team (CCTT) was created to develop a work plan for each recommendation within the report.

The CCTT consisted of representatives from four state agencies: Agriculture, Natural Resources,

Public Service, and Transportation. In September 2008, the CCTT released a report with work plans and an inventory of activities and programs already in place. The Team found that 3 percent percent of the recommended actions were already underway at some level. The report made the following major recommendations: maintain an ongoing workgroup of state agencies taking action to address climate change; report on the policies and actions implemented by state agencies; identify and track indicators; convene a biofuels task force; and establish a climate change funding source.

Several groups and agencies have been tasked in some way with tracking progress on climate change in Vermont. Subsequent agency reports have identified a wide range of actions; furthermore, the Legislature has passed several laws pertaining to heating and electrical efficiency targets and renewable energy incentives. The Agency of Natural Resources (ANR), Agency of Transportation (VTrans), Department of Public Service (DPS), Public Service Board (PSB), Agency of Agriculture, and the Department of Health are some of the agencies working to address climate change. The Legislature has also played a significant role in implementing climate-friendly programs. The PSB, for example, established Efficiency Vermont, a statewide organization implementing state-wide efficiency goals under authority granted to it by the Legislature in Act 60 of 1999. As another example, the Vermont Energy Act of 2009 directs DPS to update and amend the Vermont Residential Building Energy Standards.

The Vermont Climate Neutral Working Group (CNWG), established by Governor Douglas in 2003, is an interagency group tasked with documenting greenhouse gas emissions from Vermont State Government operations and with coordinating efforts to meet emission reduction goals. The CNWG prepares biennial reports that includes energy consumption data with a greenhouse gas inventory of Vermont state government operations, emission reduction strategies for state

government, updates on the state of the science related to climate change, and future steps for state government. The fourth biennial report in 2011 includes recommendations to implement a teleworking program for state employees, to collaborate with transportation agencies to improve transportation efficiency, and to improve synergies with the state agency energy plan and individual state agency energy implementation plans.

In May 2011, Governor Peter Shumlin heightened the attention the state was giving to climate change by creating the Vermont Climate Cabinet. The Cabinet succeeds the Vermont Climate Collaborative, a partnership between state government, academia, and the private sector that served as a hub for research, information, and activity related to climate change that was retired in early 2011. The Cabinet is chaired by the ANR Secretary and consists of senior government officials including the Secretaries and Commissioners of the administration. It is responsible for providing comprehensive leadership in climate change efforts across all state agencies and departments, identifying strategies to encourage alternative vehicles and more efficient vehicles, improving energy efficiency for existing and new buildings, fostering the development of in-state renewable and sustainable energy sources, reducing emissions, partnering with municipalities and regional planning agencies, and advancing the recommendations in the Vermont Comprehensive Energy Plan of 2011.

Within ANR itself, an inter-agency Climate Change Team undertakes activities related to mitigation, adaptation, and education on climate change issues. Current projects include development and maintenance of a state-centric web site (www.vtclimatechange.us); staffing of the Climate Cabinet; commissioning of a vulnerability assessment and adaptation strategy for Vermont forests, fisheries, wildlife and water resources; and development of white papers on adaptation in various sectors.

ANR's Air Pollution Control Division amended its low-emission vehicle regulation in November 2005 by enacting a rule to adopt California's low emission vehicle standards. Additionally, ANR's Waste Prevention Strategy (May 2008) recognizes that waste issues must be integrated into climate change discussions.

VTrans developed a Climate Change Action Plan in 2008 with three focus areas: 1) reducing greenhouse gases by promoting development of cleaner burning biofuels, increasing vehicle efficiency, and increasing the efficiency of the transportation system; 2) protecting Vermont's transportation infrastructure from the effects of climate change; and, 3) reducing VTrans operational impacts on climate change. The transportation sector contributes 4 percent percent of Vermont's greenhouse gas emissions and those emissions are projected to grow considerably over the next 15 years. VTrans is working closely with other state agencies to prioritize and implement the transportation-related recommendations from the 2011 Comprehensive Energy Plan.

Vermont joined the National 25 x '25 Initiative in 2008 and supports the goal of producing 25 percent percent of the energy consumed in VT through the use of renewable energy sources by 2025. Vermont was the first New England state to endorse that initiative. In Vermont, the Initiative comprises a broad coalition of agricultural, energy, and policy professionals. It reports annually to the Legislature on progress towards the 25 by '25 goal.

Like most other New England and Mid-Atlantic states, Vermont is participating in the Regional Greenhouse Gas Initiative.

In December 2011 the Vermont Department of Public Service finalized the state's 2011 Comprehensive Energy Plan (www.vtenergyplan.vermont.gov). The plan has set the ambitious goal of obtaining 9 percent percent of the state's energy from renewable sources by 2050. In 2012, the Legislature will review the plan's recommendations and determine whether to implement those requiring legislation.

APPENDIX E: POSSIBLE MODELS FOR MASSACHUSETTS FROM AROUND THE WORLD

Below are descriptions of some programs and projects from around the world that could serve as models for Massachusetts. This list does not try to be comprehensive, but instead seeks to show that many other cities, regions, and countries have developed ideas that could be applied to Massachusetts and other US states. Because it draws on the climate change activities with which we are most familiar, most of the examples come from the United Kingdom and elsewhere in Europe. It also includes one relevant program from a US city—New York.

Canada's National Capital Region: Integrated Land Use and Transportation Planning

The National Capital Commission (NCC), which administers federally owned lands and buildings in Canada's Capital Region (Ottawa and Gatineau), plans to reduce the region's overall carbon footprint by 30 percent between 2012 and 2017.¹ Sustainable transportation is a top priority for the NCC.

The NCC's planning mandate transcends municipal and provincial boundaries, supporting regional transportation and land-use planning in the National Capital Region. It works with each municipal government's land-use plan to develop an integrated regional transportation network. The NCC has partnered with the provinces of Ontario and Quebec to develop a transportation forecasting model and enhance transit planning capabilities. To this end, NCC has leased land for bus rapid transit, provided high-occupancy vehicle lanes on inter-provincial bridges, and partnered with city and regional transit providers to develop interprovincial transit systems.² The NCC and its partners have identified light guided technologies (LGT) such as light rail and guided tire systems as the best technologies for increasing commuter participation.

Among the other approaches that are being used to make transportation more sustainable are:

- Integrated land use and transportation planning to increase the proportion of residents that uses transit and bicycles to commute from outside the city cores.
- Construction of electric vehicle charging stations.
- Applying parking fees to alternative transportation.

European Union: Roadmap to 2050

The European Commission has been looking beyond its 2020 objectives and has set out a plan to meet the long-term 2050 target of reducing domestic emissions by 80 to 95 percent that was agreed to by European governments. In 2011, the Commission published its *Roadmap for Moving to a Competitive Low-Carbon Economy in 2050*.³ The roadmap outlines a strategy for steering an economic transition. It explores the most effective options for “decarbonising” the European economy and analyzes milestones on the path to 2050, including 2030 scenarios reflecting the contributions from key emitting sectors. It assesses ways to maximize the benefits in terms of stimulating technological innovation, economic growth, job creation, and strengthening energy security within the European Union.

The Commission's detailed analysis of cost-effective ways of reducing greenhouse gas emissions by 2050 has produced a number of important findings. In order to be in line with the 80 to 95 percent overall emissions reduction objective by 2050, the roadmap indicates that a cost-effective and gradual transition would require a 40 percent domestic reduction of greenhouse gas emissions compared to 1990 as a milestone for 2030, and 80 percent for 2050. The Roadmap gives ranges for emissions reductions for 2030

and 2050 for key sectors.

Building on what has already been achieved, the European Union (EU) is now starting to work on appropriate strategies to move in this direction, and all member states should soon develop national low carbon roadmaps, if they have not already done so. The Commission is prepared to help the members by providing some of the necessary tools and policies.

The EU's analysis has also shown that with existing policies, it will achieve its goal of a 20 percent emissions reduction domestically by 2020. If the revised energy efficiency plan were to be fully and effectively implemented, the EU would outperform the 2020 target and achieve 25 percent reductions.⁴

A good next step for Massachusetts would be to begin the process of looking forward to its 2050 commitments and, as such, the EU analysis is a good report to consider.

Finland: Action Plan for an Energy-Smart Built Environment

While green building practices are increasingly commonplace, near-zero or zero-energy buildings are emerging as a major next approach for reducing greenhouse gas emissions. Near-zero energy construction integrates energy efficiency and renewable energy technologies to improve system performance.

Finland's Action Plan for an Energy-Smart Built Environment for 2017 (ERA17)⁵ presents strategies for improving the energy efficiency of the built environment. Among other proposals, the plan establishes long-term targets and regulations for zero energy building construction. It seeks to reach the European Union's 2020 building efficiency targets three years early by 2017, Finland's centennial year. To accomplish this objective, Finland has developed a roadmap for building regulations, covering construction, repair, and renovation. Building inspections will be proactive and provide guidance to the building owner. Beginning

this year, Finland will assess total energy consumption of buildings, and new laws and regulations will give each building an upper limit for total energy consumption. Prior to the new regulations, energy regulations focused on the energy consumption of a particular system or component of the building (e.g., hot water heating). The new regulations focus on total energy consumption.

Other emission-reduction components of ERA17 include:

- Limits for the growth of urban regions
- Feed-in-tariffs for solar energy
- Decentralized energy production
- Energy-efficient land use⁶

And recommendations include:

- Creating a system to qualify service providers in construction and maintenance
- Issuing energy certificates for buildings
- Entering building energy certificates into the real estate register
- Motivating consumers through tax and other incentives

The Ministry of the Environment, which oversees the implementation of ERA17, estimates that these actions will lower the energy consumption of the built environment by 20-35 percent and result in emission reductions of 10-35 percent by 2050.⁷ The Ministry's roadmap for improving the energy efficiency of new buildings, which aims to have nearly zero-energy construction by 2020, has set interim targets. For example, by 2015, Finland will require buildings to exceed the passive house standard that was developed by the Passivehaus-Institute in Germany. By 2018, public buildings will be required to meet a low energy standard of a 40 percent improvement over current building stock.

London: Climate Change Action Plan

London's climate change mitigation and energy plan sets an aggressive goal of reducing the city's greenhouse gas emissions by 60 percent from 1990 levels by 2025.⁸ It strongly emphasizes off-grid and decentralized local energy systems. In addition to promoting the increased production of renewable energy at all scales from domestic solar to commercial wind, a key strategy of the plan is to develop combined-heat-and-power (CHP) for all new development within the city.⁹ The Mayor's Climate Change Agency and its joint venture with EDF Energy, the London Energy Services Company, will be the primary mechanism for unlocking CHP's potential in new and existing building stock. The London Development Agency will be a direct investor for CHP in major new developments.

Under the Greater London Authority Act of 2007, the Mayor has a statutory duty to contribute to the mitigation and adaptation of climate change in the United Kingdom. The London plan's policies seek to reduce emissions, primarily by reducing emissions from new development and supporting the development of low-carbon energy infrastructure. All development proposals must minimize their emissions according to the following energy hierarchy: 1) use less energy; 2) be energy efficient; and 3) use renewable energy. The Mayor has established targets for buildings, expressed as minimum improvements over a Target Emission Rate. At a minimum, energy assessments need to include proposals to further reduce emissions through the use of decentralized energy, such as CHP and district heating, or through on-site renewables. These targets apply to all major development proposals.

The London plan prioritizes the development of CHP networks. Boroughs are directed to develop policies and proposals to establish decentralized network opportunities, identify existing CHP networks, identify potential expansion of existing networks, and develop energy master plans for decentralized CHP, with any possible

opportunities to utilize energy from waste. The plan estimates that London has the potential to increase its distributed generation capacity ten-fold.

To help public agencies and private parties identify distribution generation opportunities (called "decentralized energy" opportunities in London), the London Heat Map, an interactive online tool, is available. The tool is also meant to aid in the development of detailed local energy master plans. It is continually updated with information on heat loads, existing heat supply networks, and other project information.¹⁰

Netherlands: Climate Change Adaptation

The Netherlands is implementing an adaptation strategy based on scientific evidence and rooted in long-term vision and spatial planning. Its climate defense system is a model for the world, especially for low-lying coastal cities. Moreover, the Netherlands has committed to increased adaptation research and has required public and private organizations to contribute matching funds for research.¹¹

The Netherlands' national adaptation strategy, adopted in 2007, consists of various strategy documents, which, together, represent all relevant ministries and government bodies at the state, regional, and local level and lay the foundation for substantive climate policy. Mechanisms have been set up to coordinate adaptation activities across administrative levels. The accompanying National Implementation Agenda describes how the adaptation strategy will be implemented. The current focus is on spatial planning, raising awareness, and identifying knowledge gaps.

The Dutch government has shown commitment to funding for adaptation and adaptation research through its national research program, Knowledge for Climate, which has been focusing on impacts at the local and regional level and on specific sectors to support the development

of context-specific adaptation strategies. In addition to the €100 million set aside for the research program for 2009-2014, the government estimates that it will spend \$100/year per person on climate-proofing over the next century.

The climate adaption plan includes a Living with Water strategy; this strategy has radically revised traditional flood-management thinking. Instead of working to control floods, the Netherlands is working to accommodate flood waters by allowing pre-designated areas to flood. A joint committee of various government ministries, including the Association of Water Boards, stated in its *Water Management Policy in the 21st Century* report that a change in water management policy was required, involving relinquishing space to water rather than winning space from it. This strategy compensates property owners in pre-designated areas. By 2009, 55 percent of the public was in favor of these designated “water squares.”

In addition, rivers and canals are being expanded to contain anticipated swells, the coastline is being re-engineered, farmers are being selectively relocated from flood-prone areas, and floating communities are being built on garages that double as floodwater containment units. In Rotterdam, for example, parks, city squares, and parking garages are designed to double as drainage and storage systems to keep homes above water. In Amsterdam, floating communities are being built on floating platforms of reinforced concrete that rise with floodwaters. Other strategies include revising Dutch law. Parliament is currently debating whether to raise the North Sea protection level requirements from a 1-in-10,000 years to a 1-in-100,000 year level.

A 2009 Partnership for European Environmental Research report reviewed several European national adaptation strategies in order to identify effective policies, tools, and strategies. According to that report, strengths of the Dutch adaptation planning and implementation process include:

- **Substantial research data** had been gath-

ered on climate change impacts. Many scenarios were available for review.

- **Local and regional government bodies and stakeholders** were able to identify their specific adaptation needs.
- The government provided **good planning tools** relevant to adaptation planning (e.g. spatial planning tools, urban planning support, river basin management, flood prevention planning).
- **Compliance instruments** were put into place to provide fair compensation between the “payers” and the “profiteers” of adaptation action.
- As a flood prone nation, the Netherlands already had broad national political support and commitment to flood protection measures.
- The government invested in a **good communication strategy**.¹²

New York City: Greener, Greater Buildings Plan

In December 2009, New York Mayor Michael Bloomberg signed a legislative package consisting of four local laws that collectively make up the Greener, Greater Buildings Plan (GGBP), a comprehensive building energy efficiency policy. GGBP initially applied to commercial and multi-family buildings larger than 10,000 square feet, but has since been expanded to include NYC's largest privately owned buildings.¹³

The GGBP was developed in concert with NYC's sustainability plan, PlaNYC, which was initiated by Mayor Bloomberg in 2007. PlaNYC set a goal of reducing city greenhouse gas emissions by 30 percent by 2030. Because 75 percent of the city's emissions results from energy use in buildings, it was necessary to focus on that sector. By focusing on the city's largest existing buildings, GGBP expects to achieve one-sixth of the overall 30 percent reduction goal. It will also reduce city-wide energy costs by \$700 million annually

through 2030 and create nearly 18,000 construction-related jobs.

GGBP mandates energy audits, requires annual energy and water benchmarking, and requires cost-effective efficiency upgrades for city-owned buildings. One of the laws that underlies GGBP requires all city owned buildings to receive an energy audit. Following the audit, the city must then implement any capital improvements with a payback period of seven years or less. Audits follow ASHRAE Level II energy audit guidelines and identify feasible energy retrofits with implementation costs and simple payback for each retrofit measure. For privately owned buildings greater than 50,000 square feet, an energy audit is required once every 10 years.

The benchmarking and disclosure requirements are especially significant, because they create transparency about the energy performance of individual buildings. Both city-owned buildings greater than 10,000 square feet and privately owned buildings greater than 50,000 square feet are required to participate in the program and provide benchmarking data on their energy use and water use. The buildings were required to submit their initial data to the city. The first data will be posted to a public web site beginning September 1, 2012, with information on multi-family buildings following in 2013.

One of the other laws requires sub-metering so tenants may see their own energy usage. The legislation also requires lighting system upgrades, which is commonly 30-40 percent of a commercial building's energy use.

GGBP finances its programs through the New York City Energy Efficiency Corporation (NYCEEC), a new non-profit corporation, created as a partnership between the City and energy efficiency leaders from the private and non-profit sectors. Two private utilities—Con Edison and National Grid—are helping out by offering energy-efficiency programs. And the New York State Energy Research and Development Author-

ity provides a program to assist building owners with funding for benchmarking, energy audits, and retro-commissioning studies.

Thames Estuary: Long-Term Flood Risk Management

The United Kingdom's Environment Agency has set up a flood risk management planning process for London and the Thames Estuary. The Thames Estuary 2100 Project seeks to design flood defenses, flood warning systems, and flood-resilient development to protect London over the next century. The area covered by the Project includes the Thames estuary, its tidal zones, and floodplains—an area with 500,000 homes and 40,000 non-residential properties, including government buildings and financial centers.¹⁴

The flood barriers currently in place were designed to protect against a 1000-year flood, but they are reaching the end of their structural integrity. And with climate change, flooding could become more frequent and more severe. The project's final plan seeks to implement policies that will minimize the impacts from flooding and provide guidance for land use planning and resilient development.

Given the uncertainty over the intensity of sea level rise and flood risk, the plan presents all plausible flooding scenarios in a low to high range. It also provides guidance on risk management activities that need to be undertaken in the short, medium, and long term. The project ensures that flood management measures are tested against different future climate change scenarios and integrates flood management with economic costs, benefits, and environmental concerns. In addition, the project drives research and modeling studies to predict future climate change effects, specifically storm surges, sea level rise, and river flow.

The final plan received public comment in 2009 and has been approved by the Environment Agency. The Agency is preparing an imple-

mentation plan and proposal for the Treasury. As part of the implementation process, it will undergo review every five years. Processes have been put into place to allow for revisions based on changing future climate projections.¹⁵

United Kingdom: Carbon Reduction Commitment Energy Efficiency Scheme

The British Government found that many of its large commercial and public sector organizations were failing to take up the full panoply of cost-effective energy efficiency opportunities. They were held back by a variety of barriers, including a lack of awareness, regulatory failures, and split incentives. To deal with this situation, the UK government developed an innovative program, the Carbon Reduction Commitment (CRC). It was developed with a great deal of stakeholder input and design assistance, to create a supportive environment for implementation.¹⁶

The CRC Energy Efficiency Scheme is a mandatory energy-efficiency program that uses emissions trading and deep incentives for those companies that are most effective in implementing their programs. It applies to companies that use about \$1 million per year or more of energy. These companies are required to cover their emissions with carbon allowances bought at auction.

The program cuts emissions from large commercial and public sector organizations (including supermarkets, hotel chains, colleges and universities, hospitals, government departments, and large public housing complexes) using an interesting set of fees and incentives. The revenue raised is recycled to participants proportional to their starting emissions, adjusted by a bonus or penalty related to their energy performance. By doing better on average than other companies, a company receives a direct financial return. So the more energy the company saves, the more bonus dollars it earns.

So far, the program has found that:

- Most small and medium businesses underes-

timate savings from greater energy efficiency. Nearly a quarter (23 percent) of the businesses believe they can only save between 1 percent and 4 percent on energy bills, whereas the average figure is 10 percent.

- Businesses cite competition and early adaptation as key reasons to change. Of those businesses that measured their emissions, 37 percent said it was to gain a competitive edge and 32 percent said they wanted to adapt now before legislation and compliance required them to do so.

The main criticism that has been made of the CRC Energy Efficiency Scheme is that it is too complicated. The UK government is therefore currently working to streamline and simplify it.

United Kingdom: Governance and Implementation

The UK offers a good model for a flexible and economically sound approach to implementing a plan of similar scale and scope to the one in Massachusetts. In some ways, it is similar to the Massachusetts approach but with stronger governance arrangements, policies, and feedback cycles related to the respective climate strategies.

Among the key differences from Massachusetts is that the UK has a much larger population, is a bigger economy, and is a country with binding goals under the Kyoto Protocol. But Massachusetts can still learn from the management and governance procedures that are working in the UK.

The main current goal of the UK government is to deliver a 12.5 percent reduction from 1990 levels in 2008-2012. However, in *Climate Change: The UK Programme 2006*, the government stated that “greater reductions in emissions are feasible, and that there will be real advantages to the UK in aiming to achieve them.”¹⁷ Similar to Massachusetts, the UK Climate Change Pro-

gramme is based on: a balanced approach with all sectors having a role; the need to safeguard economic competitiveness, encourage technological innovation, promote social inclusion, and reduce health risks; and the use of an integrated package of flexible, cost-effective policy options.

Within the government, two cabinet committees have climate change among their responsibilities. The Cabinet Committee on Energy and the Environment (EE) develops the government's energy and environmental policies, monitors the impact of government's policy, and considers issues of climate change, security of supply, and affordability of energy. The committee is chaired by the Prime Minister and involves most ministers.

A Ministerial Sub-Committee on Sustainable Development in Government seeks to improve the government's contribution to Sustainable Development and reports out annually. The Office of Climate Change (OCC) then works across government to provide shared resources for the analysis and development of climate change policy and strategy. It reports to a group of ministers (equivalent to agency heads in Massachusetts) from all relevant government departments.

On a more technical basis, progress on emission reductions is monitored through the Sustainable Energy Policy Network, a network of policy units from across government departments, the devolved administrations, regulators, and key delivery organizations. Stakeholders are

invited to provide their experience for various climate change policy measures, often through pilots and partnerships, and these approaches are incorporated into future-year efforts.

Perhaps most importantly, the Climate Change Programme is required to present an Annual Report to Parliament with an overview of greenhouse gas emissions in the UK and a review of government actions to reduce them. The first Annual Report was published in July 2007.¹⁸

Finally, the UK government created The Committee on Climate Change which is an expert, independent, statutory public body, created to assess how the country can best achieve its emissions reduction targets for 2020 and 2050 and to assess progress toward the statutory carbon budgets. It provides wide-ranging advice, including on the level of each five-year carbon budget in order to meet the 2020 and 2050 targets, how much effort should be made by the part of the economy covered by cap and trade schemes (the traded sector), and by the rest of the economy, and the implementation of the government's adaptation program. It could be appropriate to establish a similar committee in Massachusetts.

APPENDIX E. ENDNOTES

- 1 The NCC's environmental strategy report, *Building a Greener Capital*, lays out 5 key action areas. www.canadascapital.gc.ca/sites/default/files/pubs/NCC-Environmental-Strategy.pdf. To learn more about the NCC's Plans for the Future, visit www.canadascapital.gc.ca/planning.
- 2 Micah Lang and Alex Boston, *Choosing our Future: Climate Change* (Ottawa: Choosing Our Future, 2009), pp.10-12. Available at http://choosingourfuture.ca/resources/foundation_papers/climate_en.pdf.
- 3 European Commission, *Roadmap for Moving to a Competitive Low-Carbon Economy in 2050* (Brussels: European Commission, 2011). Available at <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0112:FIN:EN:PDF>.
- 4 European Commission, *Energy Efficiency Plan 2011* (Brussels: European Commission, 2011). Available at <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0109:FIN:EN:PDF>.
- 5 ERA17 has an English language website with extensive information on the program. See <http://era17.fi/en>
- 6 Finnish Ministry of the Environment et al., ERA 17: *For an Energy-Smart Built Environment 2017* (Helsinki: Erweko, 2010). Available at <http://www.ymparisto.fi/download.asp?contentid=122392&lan=en>.
- 7 Jarek Kurnitski, "Finland Launching New Energy Performance Regulation 2012 and ERA17 Action Plan for 2010-2017," *Scanvac Newsletter* (November 30, 2010). Available at www.scanvac.net/2010/11/finland-launching-new-energy-performance-regulation-2012-and-era17-action-plan-for-2010-2017.
- 8 The Mayor's climate change mitigation and energy strategy is titled "Delivering London's Energy Future."
- 9 The London plan addresses London's economic, social, transport, and environmental policies. Chapter 5 outlines the city's response to climate change. Mayor of London, *The London Plan: Spatial Development Strategy for Greater London* (London: Greater London Authority, 2011). Available at www.london.gov.uk/sites/default/files/The%20London%20Plan%202011.pdf.
- 10 The London Heat Map is available at www.londonheatmap.org.uk/Content/home.aspx.
- 11 A good summary of adaptation efforts in the Netherlands and other European countries up to 2009 is available in Rob Swart et al., *Europe Adapts to Climate Change: Comparing National Adaptation Strategies* (Helsinki: Partnership for European Environmental Research, 2009). Available at www.peer.eu/fileadmin/user_upload/publications/PEER_Report1.pdf.
- 12 Ibid. See chapters 7 and 9 for main policy findings and recommendations.
- 13 For information on GGBP, see www.nyc.gov/html/planyc2030/html/about/ggbbp.shtml.
- 14 More information on the Thames Estuary 2100 Project can be found in a strategic environmental assessment prepared in 2009: Environment Agency, *Thames Estuary 2100: Strategic Environmental Assessment, Environmental Report Summary* (London: Environment Agency, 2009). Available at www.environment-agency.gov.uk/static/documents/Leisure/TE2100_EnvironmentSum.pdf.
- 15 The United Kingdom's climate projections and their relationship to the Thames Estuary 2100 Project are discussed on a government website, <http://ukclimateprojections.defra.gov.uk/content/view/1889/500>.
- 16 For the UK government's website about the CRC, see www.decc.gov.uk/en/content/cms/emissions/crc_efficiency/crc_efficiency.aspx.
- 17 HM Government, *Climate Change: The UK Programme 2006* (Norwich, UK: TSO, 2006). Available at www.defra.gov.uk/environment/climatechange/uk/ukccp/pdf/ukccp06-all.pdf.
- 18 Department for Environment, Food and Rural Affairs, *UK Climate Programme: Annual Report to Parliament* (London: Department for Environment, Food and Rural Affairs, 2007). Available at www.decc.gov.uk/assets/decc/what%20we%20do%20global%20climate%20change%20and%20energy%20tackling%20climate%20Change%20programme%20ukcc-annrpt-07.pdf.

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