America on the Move

State Leadership in the Fight Against Global Warming, and What it Means for the World

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Tony Dutzik, Rob Kerth and Kari Wohlschlegel, Frontier Group
Rob Sargent, Environment America Research & Policy Center
Dan Jacobson, Environment California Research & Policy Center

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Executive Summary

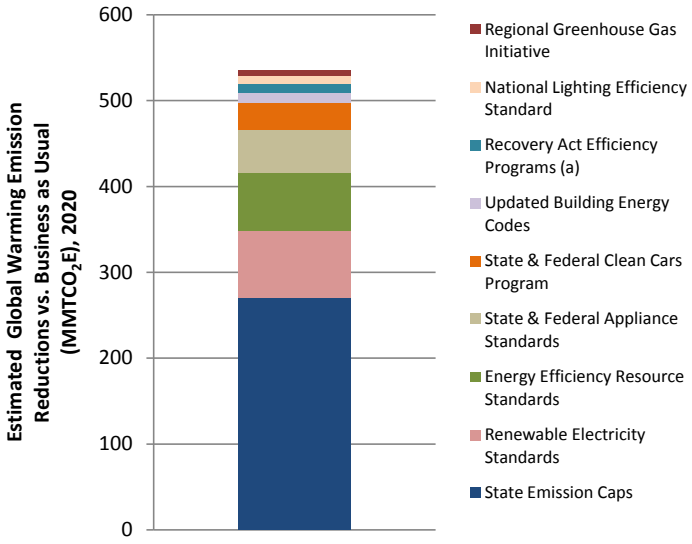
As world leaders prepare to meet in Copenhagen to develop a plan of action to combat global warming, all eyes are on the United States. As the world's largest economy, the second-largest emitter of global warming pollution, and the nation responsible for more of the human-caused carbon dioxide pollution in the atmosphere than any other, the success of the Copenhagen negotiations – and the future of the planet – depend on American leadership.

The United States has gained a reputation, exacerbated during the presidency of George W. Bush, of obstructionism in the fight against global warming. But, over the last decade, America's state governments – where the bulk of on-the-ground energy policy decision-making is made in America's federal system of government – have taken the nation on a different course, one of innovative and increasingly aggressive action to reduce global warming pollution.

The impact of state-level actions to reduce global warming pollution is significant on a global scale. A review of dozens of individual state policies, federal policies based on state models, and new federal policies in which states will have key roles in implementation suggests that state actions will reduce carbon dioxide emissions by approximately **536 million metric tons per year by 2020**. That is more global warming pollution than is currently emitted annually by all but eight of the world's nations, and represents approximately 7 percent of U.S. global warming pollution in 2007.

America's clean energy revolution – led by the states – shows that the nation is ready to commit to the emission reductions science tells us are necessary to prevent the worst impacts of global warming. President Obama should build on these actions by working to forge a strong international agreement to address global warming during the Copenhagen talks.

Figure ES-1. Projected Emission Reductions from Selected State and Federal Policies



(a) Includes only those programs in which funding has already been allocated.
Chart excludes emission reductions from overlapping policies.

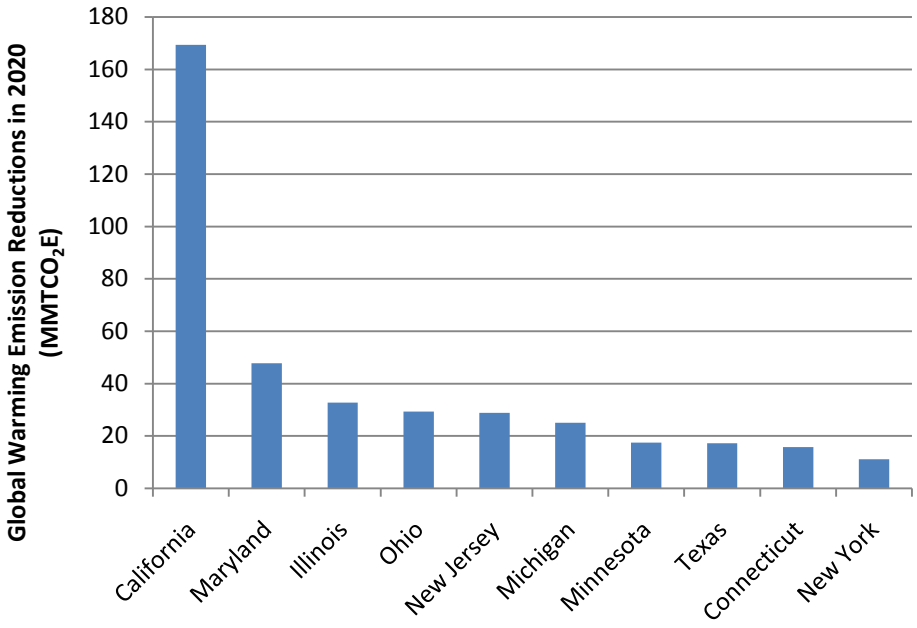
In America's federal system of government, states matter.

- State governments have an important – often primary – role in setting environmental and energy policy in the United States. States have the power to limit carbon dioxide emissions, to regulate electric and natural gas utilities, to adopt standards for the energy performance of buildings and equipment, to regulate land use and transportation policy and, on a limited basis, to establish emission standards for vehicles.
- Over the past decade, states have begun to employ their power to reduce global warming pollution in a variety of ways. As "laboratories of democracy," states have developed innovative policies to address global warming that have later been adopted by other states, or at the federal level.

Six U.S. states, and one U.S. region, have adopted enforceable caps on global warming pollution.

- Six U.S. states – California, Connecticut, Hawaii, Massachusetts, Maryland and New Jersey – have adopted binding caps on global warming pollution from their states' economies. Combined, these six states produce nearly a quarter of America's economic output and 13 percent of its fossil fuel-related carbon dioxide emissions. If these six states were a separate country, they would rank as the world's fifth-biggest economy and seventh-leading emitter of carbon dioxide.
- Collectively, these six states have committed to reducing global warming pollution by approximately 13 percent below 2005 levels by 2020.

Figure ES-2. Emission Reductions from Selected State and Federal Policies by State in 2020 (Compared with No Action)



- Ten northeastern U.S. states have created a regional cap-and-trade system for emissions from electric power plants, and two other regions of the country are considering similar regional efforts.
- State and regional emission caps will reduce carbon dioxide emissions by 113 million metric tons below 2005 levels by 2020, and by approximately 270 million metric tons versus what emissions otherwise would have been under business-as-usual conditions.

Dozens of U.S. states have adopted clean energy policies designed to reduce global warming pollution.

- **Renewable electricity standards**: 29 states have adopted minimum standards requiring a percentage of their electricity to come from renewable energy. These efforts will reduce global warming pollution by 79 million metric tons nationwide, in addition to the reductions achieved by emission caps.
- **Energy efficiency resource standards**: 22 states have adopted policies that require a share of their energy needs to be met through energy efficiency improvements. These energy efficiency standards will deliver additional reductions of approximately 67 million metric tons of carbon dioxide by 2020.
- **Other actions**: States have also pursued other innovative clean energy initiatives, such as low-carbon fuel standards designed to reduce the impact of transportation fuels on global warming, and "lead by example" efforts to reduce energy consumption and pollution from government activities.

State actions have triggered recent steps to reduce global warming pollution at the federal level.

- The **Clean Cars Program** – originally adopted by 14 states and now in the process of adoption at the federal level – will dramatically reduce per-mile emissions of global warming pollution from vehicle tailpipes. The national program will reduce emissions by approximately 31 million metric tons of carbon dioxide equivalent per year by 2020 in states without economy-wide emission caps.
- The federal government is in the process of issuing new **appliance and lighting efficiency standards**, following up on standards adopted by 14 states. Should those standards take full advantage of the potential for energy efficiency improvements, they will reduce emissions by as much as 61 million metric tons per year by 2020.
- States have also pioneered the adoption of strong **building energy codes**, which will become more widespread as a result of the recent federal economic recovery package. Improved building energy codes will reduce emissions by approximately 12 million metric tons per year by 2020, with those emission reductions locked in for decades to come.
- The **American Recovery and Reinvestment Act** (ARRA) includes several new federal energy efficiency initiatives in which state and local governments will have prominent roles in implementation. Programs already funded under the law can be expected to reduce emissions by approximately 10 million metric tons per year by 2020.

State efforts to encourage energy efficiency and renewable energy are already making a material difference in reducing global warming pollution.

- Energy efficiency programs implemented by utilities, typically at the behest of state regulators, averted approximately 37 million metric tons of global warming pollution in 2007.
- Similarly, the growth in renewable energy generation between 2004 and 2009 – much of it driven by state policy initiatives, including renewable electricity standards, and federal tax incentives – averted the release of approximately 44 million metric tons of carbon dioxide pollution in 2009.

America's track record of state energy policy innovation and the broad support of the American people for a transition to a clean energy economy suggest that America is ready to make a strong commitment to do its part to reduce global warming pollution.

- President Obama should lead the way in negotiating an international agreement that will deliver sufficient emission reductions to prevent an increase in global average temperatures of more than 2° C (3.6° F) above pre-industrial levels – a commitment that would enable the world to avoid the most damaging impacts of global warming.
- The United States should commit to emission reductions equivalent to a 35 percent reduction in global warming pollution from 2005 levels by 2020 and an 83 percent reduction by 2050, with the majority of emission reductions coming from the U.S. economy.
- Individual states should move forward with effective implementation of policies already adopted while continuing to shift toward a clean energy economy and aggressively reducing global warming pollution.

Introduction

It was during the presidency of George W. Bush that the United States finally began to take serious action to deal with the challenge of global warming.

To most observers, the above statement might seem nonsensical – even absurd. But when the history of humanity's efforts to address global warming is finally written, the Bush years may well be looked back upon as the time when America began to rise to the challenge.

The change certainly did not emanate from the White House. George W. Bush withdrew the United States from the Kyoto Protocol, reneged on a campaign promise to regulate carbon dioxide as an air pollutant, and promoted energy policies designed to deepen America's dependence on fossil fuels. By any reasonable measure, the Bush administration's climate policies were an unmitigated disaster – a failure of leadership with massive consequences for the planet.

But in America's 50 states, where the "rubber meets the road" on many areas of energy policy in our federal system – from utility regulation to transportation to home energy efficiency – a different story was being written. There, building on a legacy of state energy policy innovation dating back to the mid-1970s, states began to devise and implement strategies to shift to cleaner sources of energy and reduce global warming pollution.

While leading-edge states – particularly on the East and West coasts – moved first, the clean energy revolution has spread rapidly into America's heartland. Today, most states have taken at least the first steps to encourage improved energy efficiency in homes and businesses, spur the use of renewable energy, curb emissions from automobiles, and plan

for future reductions in global warming pollution.

States had once been forced to steer their clean energy efforts into the headwind created by the pro-fossil fuel policies of the Bush administration. But with the arrival of the Obama administration, state clean energy innovators now have the wind at their backs. The first year of the new administration has seen the lifting of federal policies that once impeded state action, as well as the nationwide adoption of key clean energy policies initially developed in the states. States also have been given a key role in implementing the specifics of President Obama's economic recovery strategy, which is built around the promise of enduring prosperity achieved through a transition to a clean energy economy.

Taken together, the actions initiated by the states, coupled with the clean energy policies and programs implemented thus far by the Obama administration, rival the scope and ambition of the actions taken to address global warming anywhere in the world.

Of course, there is far more work to be done. To date, the actions taken by the United States and the rest of the world pale in comparison to the challenge posed by global warming. The United States must implement mandatory emission reductions at the pace and scale science tells us are necessary to prevent the most dangerous impacts of global warming. The rest of the world must do the same.

But make no mistake: it is the record of widespread state innovation and leadership on global warming over the past decade – not the recalcitrance of the Bush administration, nor even the slow legislative pace of a U.S. Senate that, in the American system of government, is uniquely sensitive to regional interests – that should characterize America's reputation before the world as the crucial negotiations begin in Copenhagen.

It is the record of widespread state innovation and leadership on global warming … that should characterize America's reputation before the world as the crucial negotiations begin in Copenhagen.

Time and again, when the American people have been given the choice, they have demonstrated that they are ready to move the nation toward a clean energy economy and reduce global warming pollution. The states, America's laboratories of public policy, have demonstrated the path forward. The Obama administration is beginning to make good on the promise of renewed American leadership to meet the challenge of addressing global warming.

When it comes to addressing global warming, America is on the move.

The Challenge: Preventing Dangerous Global Warming

Time is running out for the world to prevent the worst impacts of global warming. Over the past decade, scientific warnings about the threats posed by global warming have become increasingly dire. Without immediate action to curtail emissions of global warming pollutants – and even more ambitious efforts in the years to come – the world risks catastrophic changes that would result in the destruction of key ecosystems, the death of countless species, and unimaginable threats to human health and welfare.

The Stakes at Copenhagen

In December, delegates from 192 nations will meet in Copenhagen with the task of crafting an international agreement to reduce global warming pollution. The talks, scheduled to begin on December 7, are the latest in a series of meetings that began in 1992 at the Earth Summit in Rio, and are intended to produce a successor agreement to the Kyoto Protocol, which expires in 2012.

According to Yvo de Boer, the executive secretary for the United Nations Framework Convention on Climate Change, there are four issues that the countries will grapple with during the summit: how much should industrialized countries reduce their global warming pollution; to what extent should developing countries mitigate their emissions; what financial support should industrialized nations provide to developing countries to assist in their emission reductions; and how should that financial support be managed.[1]

While addressing global warming will require cooperation from all nations, China and the United States have crucial roles in ensuring the success of the Copenhagen talks. These two nations are the world's top emitters of global warming pollution by a large margin, and neither has yet committed to enforceable reductions in emissions of global warming pollution.

There are signs of movement in both countries. In September, Chinese leader Hu Jintao pledged to reduce the nation's carbon intensity – the amount of global warming pollution produced per unit of economic output – by a "notable margin" by 2020.[2] Such a commitment would enable emissions to continue to increase, but it could slow China's runaway growth in emissions, which have roughly doubled over the past decade, and put China in a better position to stabilize and ultimately reduce its emissions in the years to come.[3]

Meanwhile, in the United States, the U.S. House of Representatives passed legislation in June that would, if adopted by the U.S. Senate and signed by President Obama, commit the nation to its first-ever mandatory, economy-wide reductions in global warming pollution.

Despite these signs of hope, international negotiators in Copenhagen face the difficult task of crafting an agreement that does what is necessary to prevent the worst impacts of global warming while, at the same time, balancing the needs of developed and developing countries. While climate negotiators from the countries party to the convention have been meeting since March to establish a framework for the agreement, the big decisions, such as the setting of emissions-reduction targets, are unlikely to be made until the final days of the Copenhagen talks. The talks could even extend into 2010.

Scientists warn that continued emissions of global warming pollution could accelerate melting of glaciers worldwide.
Credit: National Oceanic and Atmospheric Administration

The Consequences of Failure

The Copenhagen talks take place against a backdrop of increasingly urgent scientific warnings about the dangers of global warming.

Global warming is already happening. Since pre-industrial times, average global temperatures have increased by more than 1.4° F. Meanwhile, sea level has risen 8 inches as glaciers have melted and the ocean has absorbed much of the extra heat in the climate system, causing the water to expand.[4] In certain climates, hurricanes have become more intense and the frequency of extreme rain and snowstorms has increased.[5] In other regions, droughts have become longer and more severe.[6]

In the United States, rising temperatures are changing the timing of the seasons, while the habitable areas for plants and animals are shifting northward and higher in altitude across the country.[7] High levels of carbon dioxide are also causing the oceans to become more acidic, contributing to the decline of ocean ecosystems. The Florida Keys have already witnessed a 50 to 80 percent decline in coral on reefs.[8] And in western forests, the milder winters have

increased the survival of winter beetles, allowing the beetle population to increase dramatically. Coupled with hotter summers, which have impaired the ability of trees to fight off the beetles, the increase in population has enabled the insects to destroy more than 6.5 million acres of forest in the United States.[9]

Unfortunately, these climatic changes are only the beginning of the impacts the world can expect if emissions of global warming pollutants continue to increase. Indeed, the damaging impacts of warming are happening even faster than the most eye-opening predictions made by the United Nations Intergovernmental Panel on Climate Change just two years ago.[10] Scientists warn that critical climate "tipping points" are a matter of years or a few decades away. Crossing those tipping points would make inevitable dramatic and irreversible changes to our world and our way of life.[11]

If global warming emissions continue unabated, global temperatures may increase 11.5°F and sea levels could rise 6.5 feet by the end of the century, causing massive flooding and displacement.[12] Warming on this scale would have catastrophic consequences for the planet, such as the extinction of as much as 70 percent of all species on earth; widespread drought across as much as a third of the globe; more intense wildfires and hurricanes; extreme heat waves with temperatures reaching 120°F in the central, southern, and western United States; and the loss of unique ecosystems like the Amazon.[13]

What the World Must Do

Given the pollution humans have already produced, some impacts, such as the melting of mountain glaciers and the resulting disruption of water supplies, will be unavoidable.[14] However, with immediate action on an international scale, we still have a chance to avoid many of the most catastrophic impacts of global warming.

The international community has committed to limit global warming to 3.6°F above temperatures in the pre-industrial period.[15] According to current scientific understanding, to have a 50-50 chance of meeting this goal, humanity can emit no more than a total of 3.7 trillion metric tons of carbon dioxide from the beginning of history onward through the next 500 years.[16] Humanity has already emitted more than 1.9 million metric tons of carbon dioxide pollution so far, and at current emission rates we are on pace to exceed our "carbon budget" in less than four decades.[17] For the world to have a 75 percent chance of limiting warming to 3.6°F, we will have to accept a global budget of 1 trillion metric tons of carbon dioxide emissions during the first half of this century.[18]

In order to meet this target, the chief of the Intergovernmental Panel on Climate Change, Rajendra Pachauri, has called for global emissions to peak no later than 2015.[19] Emissions must then fall rapidly thereafter. A large panel of top United Nations scientists and Nobel Prize winners has called on developed nations to reduce emissions of global warming pollution by 25 to 40 percent below 1990 levels by 2020.[20]

The world must then continue to slash emissions rapidly, achieving cuts of at least 50 percent by mid-century, and perhaps substantially more.[22] Developed countries with the largest capacity to act will need to reduce emissions by 80 to more than 95 percent.[23] Afterwards, the world must then embark on a program to zero out all emissions of global warming pollution, and very possibly deploy technologies to remove carbon dioxide from the atmosphere.[24]

What the United States Must Do

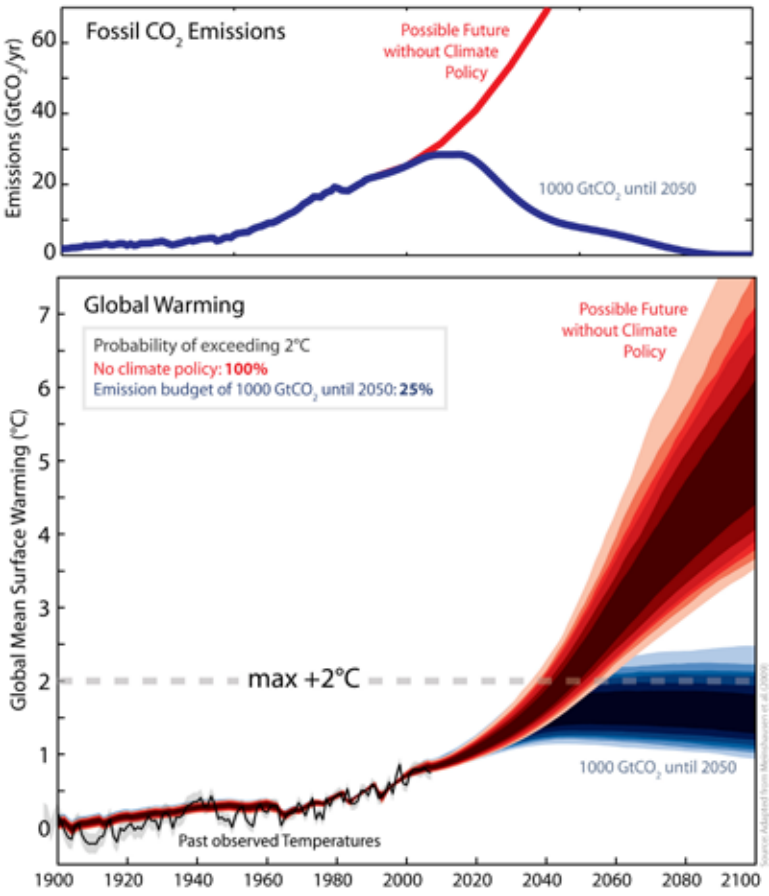
Until recently, the United States was the largest emitter of global warming pollution. Though China has surpassed the United States in annual emissions, we are still responsible for more of the carbon dioxide in the atmosphere than any other nation. As a result, the United States must act more quickly and more aggressively to reduce emissions than developing countries.

Specifically, the United States must endeavor to reduce global warming emissions by 35 percent below 2005 levels by 2020 and by at least 83 percent by 2050.[25] The United States could achieve some of its near-term emission reductions through assistance to other nations – particularly efforts to reduce tropical deforestation. But in any event, the U.S. must achieve the majority of its emission reductions – even in the near term – domestically.

There are many options available for the United States to reduce global warming pollution while still maintaining a robust economy and a high quality of life for its people. But with every year of delay, the scale of the emission reductions required becomes greater, and the challenge of meeting our obligations becomes harder.

Had the United States taken strong national action over the past decade to reduce emissions, the nation would be farther along in the transition to a clean energy economy – and face an easier path toward achieving our emission reduction goals. But while the Bush administration squandered that opportunity, state governments picked up some of the slack – adopting a series of innovative public policies to reduce global warming pollution and set the nation on course to a cleaner energy future.

Figure 1. Limiting Total Global Emissions of Carbon Dioxide to 1 Trillion Metric Tons From 2000 to 2050 Would Yield a 75 Percent Chance of Limiting Warming to 3.6° F (2° C) or Below[21]



State Governments Play an Important Role in Fighting Global Warming

The United States is the largest economy in the world, the second-leading emitter of global warming pollution, and the third-largest nation by population. There is no solution to the prospect of dangerous global warming that does not include the involvement – and leadership – of the United States.

But the United States is not a monolith. Despite the perceived power of the U.S. federal government – embodied in the president – power over environmental and energy policy is actually dispersed throughout various levels of government. Individual states have the power to reduce global warming pollution within their borders, to develop innovative policy solutions that can be honed and implemented elsewhere, and even to spur the development of clean technologies that can benefit people and the environment around the world.

Over the past decade, state governments have begun to use that power to drive globally significant reductions in America's contribution to global warming.

States as Important Policy Decision-Makers

In America's federal system of government, states have great authority over energy and environmental policy. In some areas, such as land-use regulation, states have the policy playing field virtually to themselves. In other areas, such as electricity regulation, states have primary authority. In still other areas, including environmental regulation, federal law leaves the states with important roles in policy implementation.

Environmental Regulation

States have broad authority to regulate emissions of global warming pollution – particularly in the absence of any federal law that preempts state action. States have used their environmental regulatory powers both to limit pollution from specific facilities and to establish enforceable caps on global warming pollution from entire state economies.

In 2001, Massachusetts became the first U.S. state to regulate carbon dioxide

emissions from power plants, adopting regulations targeting six highly polluting power plants in the state. Massachusetts' action – followed by adoption of a similar policy in neighboring New Hampshire – paved the way for creation of the Regional Greenhouse Gas Initiative, a 10-state pact to limit emissions from electric power plants. (See page 22.)

More recently, states have used their broad regulatory power over air pollution to adopt economy-wide limits on global warming pollution. In 2006, California became the first state do so by adopting the Global Warming Solutions Act (AB 32), which requires reducing California's global warming pollution to 1990 levels by 2020. Five other states have adopted similar caps. (See page 20.)

Utility Regulation

States are also the primary regulators of both electric and natural gas utilities – which are responsible for more than half of the nation's emissions of global warming pollution.[26]

As far back as the 1980s, utility regulators in some states were experimenting with ways to integrate environmental impacts and a conservation ethic into utility decision-making. Those efforts included the incorporation of the cost of environmental externalities – such as the health impacts of air pollution – into utility decision-making, as well as requirements that utilities invest in cost-effective energy efficiency programs.

In recent years, utility regulators – often at the direction of legislators, but sometimes on their own authority – have taken even bolder steps. States have required utilities to invest in renewable energy and energy efficiency, established policies leveling the playing field for clean energy resources to compete with traditional fossil fuel-fired power plants, implemented "loading orders" giving preference to clean over dirty resources, and paved the way for new investments in the electric grid that will expand the ability of renewable energy and energy conservation to meet the nation's energy needs.

State governments are the primary regulators of utilities that supply electricity and natural gas, which, combined, produce more than half of the nation's global warming pollution.
Credit: Stock.xchng

Transportation Policy

State and local governments are also primarily responsible for carrying out public policy with regard to transportation, which accounted for 28 percent of U.S. greenhouse gas emissions in 2007.[27]

While federal transportation funding policies tend to encourage certain types of transportation projects and discourage others (often with the end result of promoting highway construction that

contributes to increased global warming pollution), states have a significant amount of flexibility in how they spend federal transportation money. States can decide to invest in expanded public transportation networks or in bicycle and pedestrian infrastructure in lieu of more highways. States with chronic air pollution problems also have the power under the federal Clean Air Act to adopt California's limits on global warming pollution from vehicle tailpipes – a step 13 states have taken. (See page 29.)

States also have authority – shared with local governments – over land-use and development regulation. Historically, local land-use regulation in the United States has tended to foster dependence on automobiles for transportation, but some local and state governments have taken steps to promote land-use practices that encourage transit-oriented development, limit suburban sprawl, and preserve natural areas, all of which can contribute to reducing global warming pollution.

Building Codes

Finally, state and local governments are primarily responsible for setting rules for the construction of buildings, which account for 76 percent of electricity consumption in the United States, and 48 percent of overall energy consumption.[28] Building codes are set entirely on the state level or below, although many state and local codes are based on model codes adopted by national or international bodies. Building energy codes help to dictate the energy efficiency of the 5 billion square feet of new building space built in the United States each year, meaning that the adoption and enforcement of strong codes can have a large impact on long-term demand for energy.[29]

In sum, state authority over the sources of global warming pollution is wide-ranging and multi-layered. As a result, states have great capacity for leadership in addressing the root sources of global warming pollution – even in the absence of a strong federal commitment to reduce emissions.

States as Policy Innovators

> It is one of the happy incidents of the federal system that a single courageous state may, if its citizens choose, serve as a laboratory; and try novel social and economic experiments without risk to the rest of the country.
>
> – U.S. Supreme Court Justice Louis Brandeis, dissenting opinion in *New State Ice Co. v. Liebmann*, 1932[30]

U.S. states have long been, in a popular paraphrase of Justice Brandeis' opinion from the 1930s, "laboratories of democracy," experimenting with new approaches to solving social problems. Successful experiments are often adopted by other states, and even the federal government. Therefore, state policy can often be a "leading indicator" of the policy direction of the entire nation. If states are adopting large numbers of widely varying policies to address global warming pollution, it is likely that the most successful approaches will eventually find their way into federal legislation.

The pattern of state innovations leading to broader changes in national policy has occurred over and over throughout the nation's history – including on environmental and energy policy.

Appliance Efficiency Standards

An early example of state innovation on energy policy came during the energy crisis of the 1970s, when researchers in California recognized that common

household appliances, such as refrigerators, were wasting large amounts of energy. Simple changes in design could dramatically reduce refrigerator energy consumption, but manufacturers were not adopting those changes on their own.

In 1974, California's then-governor, Ronald Reagan, signed into law the nation's first set of appliance efficiency standards. Other states followed suit. By 1986, enough momentum had been created that the federal government adopted its first appliance efficiency standards. Due in part to the chain reaction started by California's initial step, appliance efficiency standards – both state and federal – will result in U.S. electricity consumption in 2020 being 11.5 percent lower than it would have been otherwise.[31]

Appliance efficiency standards – both state and federal – will result in U.S. electricity consumption in 2020 being 11.5 percent lower than it would have been otherwise.

Automobile Emission Standards

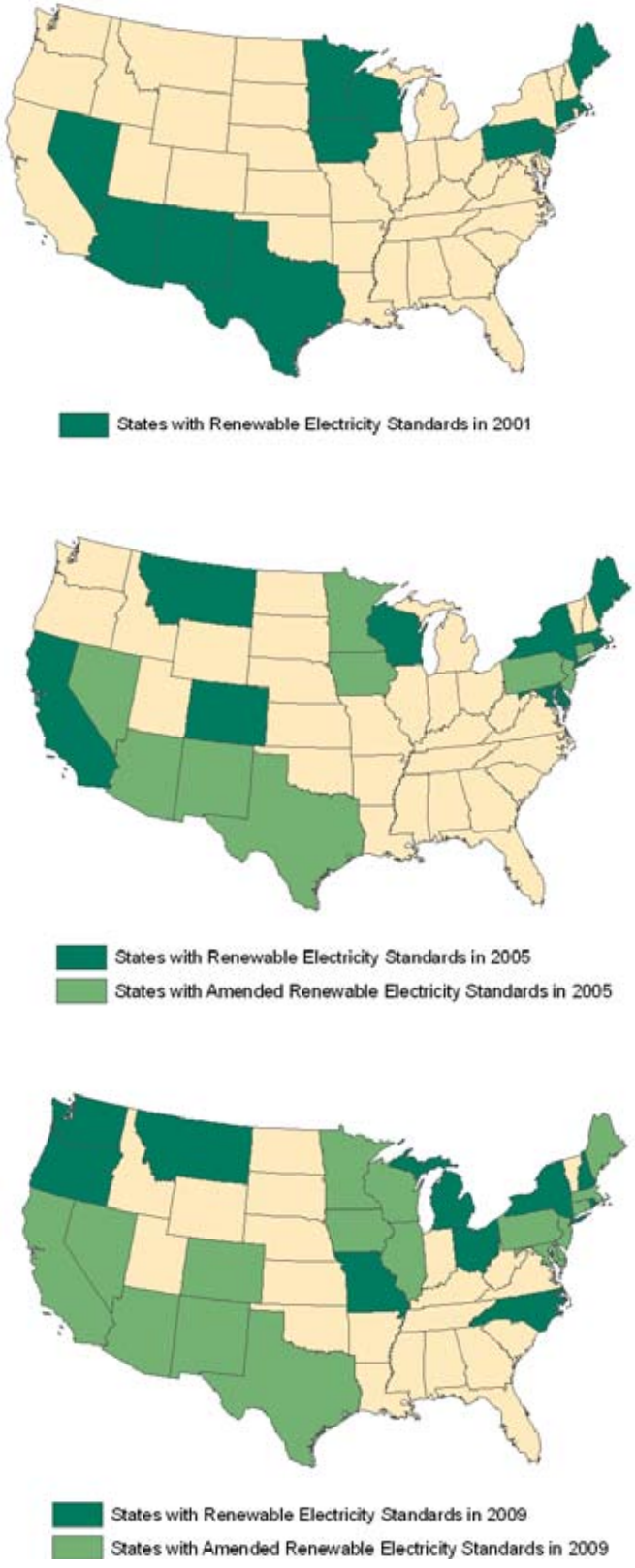
In addition to being the first state to adopt appliance energy efficiency standards, California was also the first state in the nation to adopt tailpipe emission standards for automobiles, in the late 1960s. Because California's air pollution is the worst in the nation – and because it acted in advance of the federal government – the federal Clean Air Act gives California, alone among the states, the power to set vehicle air pollution standards stronger than those in place at the federal level. Other states with chronic air pollution problems can choose to adopt the California standards if they wish.

For decades, California has set ambitious tailpipe standards for vehicles, only to be followed years later by the federal government. Most recently, in 2004, California adopted the nation's first-ever standards for vehicle tailpipe emissions of global warming pollutants – standards that were also adopted by the 13 other states with California's vehicle emission rules. In 2009, the Obama administration announced that it would apply standards similar to those in place in California across the nation – the latest example of state leadership resulting in nationwide change. (See page 29.)

Renewable Electricity Standards

Policy innovation does not need to reach the federal level to have a broad impact. Renewable electricity standards (RESs) set minimum thresholds for the share of electricity produced with renewable resources. The first such standard was adopted in Iowa in 1983. Then, in the late 1990s, Massachusetts, Nevada, Connecticut, Maine, New Jersey and Wisconsin all enacted standards in the space of a few years.[32] RESs spread even more widely in the 2000s, while many states that had been among the first to adopt the policy updated their legislation to adopt more aggressive renewable energy goals and to smooth implementation of the policy. Today, 29 states and the District of Columbia have RESs and those states have been national leaders in renewable energy development. Seventy percent of the record amount of wind power developed nationwide in 2008,

Figure 2. The Spread of Renewable Electricity Standards



for example, was built in states with a renewable electricity standard.[33] (See Figure 2.)

To date, despite widespread public support for federal policies to promote renewable energy, Congress has not enacted a federal RES.[34] Yet, as will be discussed later (see page 23), state RESs will make a measurable contribution toward reducing global warming pollution.

States as Drivers of Technological Innovation

States can make an even larger contribution toward environmental protection by driving the development and adoption of clean technologies. By pushing forward technological progress, state policymakers can have an impact that extends far beyond their borders – and even the borders of the United States.

States can achieve the goal of fostering technological innovation by adopting "technology-forcing" regulations – standards for environmental protection that cannot be met with current technologies. The idea behind technology-forcing standards is to drive investments in research and development that will result in cleaner technologies. A good example was the federal Clean Air Act of 1970, which set ambitious standards for air pollution from vehicle tailpipes. Those standards eventually led to the development and widespread implementation of catalytic converters, which are now standard equipment on vehicles worldwide.[35]

California has been the leading U.S. state engaged in adoption of technology-forcing environmental standards. A classic example was the 1990 adoption of the state's Zero-Emission Vehicle program, which originally required that electric vehicles make up 2 percent of new car sales by 1998 and 10 percent of sales by 2003. Ultimately, California did not achieve

those targets, but by forcing the automakers to invest in research and development of electric car technologies, the standards helped bring about advances in batteries and other vehicle components that ultimately led to the commercialization of hybrid vehicles. A 1994 California Air Resources Board review of the standard found universal agreement that the requirement had driven significant technological advancement.[36] Indeed, in the United States alone, the number of patents for electric car technology rose from two in 1989 to 200 in 1995.[37] Consumers worldwide have access to superior and cleaner vehicles, in part because of this state-level policy from the 1990s.[38]

The most recent example of the impact of technology-forcing standards has been the effort to improve the energy efficiency of lighting. In 2007, both Nevada and California adopted energy efficiency standards for light bulbs that were thought to be unachievable by traditional incandescent bulbs. The U.S. federal government adopted legislation in late 2007 that would require similar standards to be implemented nationwide by 2012.[39] The standards – coupled with similar efforts in other nations – have triggered a surge in research and development efforts by incandescent light bulb manufacturers, which has led to the creation of incandescent bulbs that meet the new efficiency standards. According to one industry consultant, quoted in the *New York Times*, "[t]here have been more incandescent innovations in the last three years than in the last two decades."[40]

California's Zero-Emission Vehicle program did not lead to the widespread commercialization of electric vehicles, but it did spark technological innovation that led to the development of gas-electric hybrids.
Credit: Electric Vehicle Association of Canada

Energy Savings and Emission Reductions from State-Led Actions

States have great power over environmental and energy policy within their borders. Over the past decade, U.S. states have begun to use that power to implement a wide variety of policies to reduce global warming pollution. Some of those policies have served as models for action at the federal level. And in other cases, the federal government is relying on states to implement new energy efficiency initiatives.

The emission reductions produced by these efforts – while difficult to quantify with certainty – are significant on a global scale, and represent a down payment toward future nationwide reductions in global warming pollution in the United States.

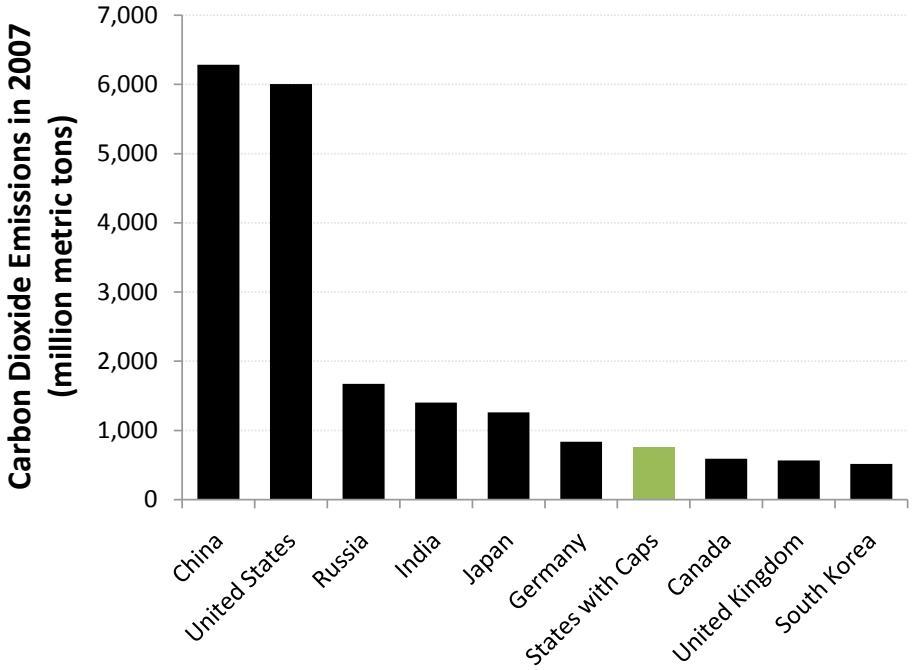
State-Level Actions

State Caps on Global Warming Pollution

Six U.S. states have adopted comprehensive, multi-sector caps on global warming pollution. Those states – California, Connecticut, Hawaii, Maryland, Massachusetts, and New Jersey—represent 23 percent of U.S. gross domestic product.[41] Internationally, they would rank as the world's fifth largest economy, behind the U.S. as a whole, China, Japan, and Germany.[42]

In terms of emissions, these six states account for approximately 13 percent of America's fossil fuel-related carbon

Figure 3. Carbon Dioxide Emissions from Six States with Caps, Compared with Leading Emitting Countries[45]



dioxide emissions.[43] Taken together, they would represent the world's seventh biggest emitter of carbon dioxide, behind only China, the U.S. as a whole, Russia, India, Japan and Germany.[44]

California became the first U.S. state to cap global warming pollution with the adoption of the Global Warming Solutions Act in 2006. The legislation ordered the California Air Resources Board (CARB) to develop a comprehensive strategy for reducing emissions to 1990 levels by 2020.[46] The plan approved by the CARB in 2008 employs over 60 specific measures, mixing regulatory and market-based approaches, to achieve the pollution reductions.[47] These range from large, sector-wide measures—such as implementing a cap-and-trade system for power plants—to narrow programs aimed at small categories of sources, such as electrifying seaports to eliminate emissions from idling ships. Other states are currently in the process of developing their own strategies for meeting their emission reduction targets.

Taken together, the emission caps adopted by these six leading states will reduce emissions in those states by 13 percent below 2005 levels – or by 113 million metric tons of carbon dioxide equivalent – by 2020. This equates to approximately 1.5 percent of total U.S. global warming emissions in 2005.[48]

Compared with business-as-usual projections produced by the various states, the global warming emission caps will produce **emission reductions of 270 million metric tons by 2020** – a 26 percent reduction.

The six states with mandatory caps are not the only ones considering economy-wide measures to reduce global warming pollution. An additional 17 states have

Table 1. Emission Reductions Required Under State Global Warming Emission Caps[49]

State	2005 emissions ($MMTCO_2E$)	2020 emission target ($MMTCO_2E$)	Reduction below 2005 levels ($MMTCO_2E$)
California	479.9	427.0	52.9
New Jersey	142.0	131.0	11.0
Hawaii (a)	24.3	23.1	1.1
Massachusetts (b)	97.0	85.0	12.0
Connecticut	48.7	40.4	8.3
Maryland (c)	107.5	80.3	27.2
Total	**899**	**787**	**113**
Percentage reduction below 2005 emissions			13%

(a) Emission reduction based on Hawaii 2007 emissions, in lieu of 2005 emissions, due to the availability of a detailed greenhouse gas inventory for 2007.

(b) Emission reduction based on minimum 10% emission reduction target in Global Warming Solutions Act. Emission reductions could be as high as 25% below 1990 levels, depending on the outcome of an ongoing state rulemaking.

(c) Emission reduction based on Maryland 2005 emissions, as opposed to the 2006 emissions level used as the benchmark for compliance in the law. Detailed 2006 emission data were unavailable.

adopted non-binding goals for reducing global warming pollution, and many have completed climate action plans laying out a policy framework for achieving targeted emission reductions.[50]

Regional Emission Caps

In addition to the economy-wide emission caps described above, states in several U.S. regions have joined together to develop regional approaches to reducing global warming pollution. These regional bodies reflect the reality that energy markets in the United States – particularly for electricity – cross state lines.

The first such regional program to be implemented – indeed, the first cap-and-trade program for global warming pollution implemented anywhere in the United States – is the Regional Greenhouse Gas Initiative (RGGI), which aims to reduce carbon dioxide emissions from power plants in 10 northeastern states. The emission reduction goals of the RGGI program are modest – the 10 states have agreed to cap global warming pollution from power plants through 2014 (at projected 2009 levels) and to reduce emissions by 10 percent by 2018. However, the program has broken new ground through its embrace of an auction-based system for distributing pollution allowances. Virtually all emission allowances under RGGI are auctioned, rather than distributed to polluters for free, preventing the accumulation of windfall profits and generating needed revenue that can be invested in energy efficiency improvements and other programs to reduce global warming pollution. Despite the program's small size and limited emission reduction goals, the RGGI allowance auction is already the world's largest.[51]

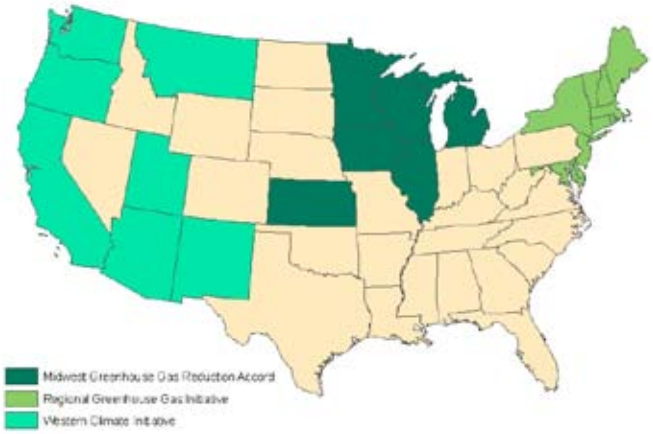
Compared with actual 2005 emission data, the RGGI program will reduce

emissions from power plants in the region by approximately 8 percent by 2018, for total reductions versus 2005 levels of approximately 13.9 million metric tons.[52] Since four states in the RGGI region – Connecticut, Maryland, Massachusetts and New Jersey – already have economy-wide emission caps, the cuts driven by RGGI will not be additional in those states. Not counting the capped states, the RGGI program will deliver **additional emission reductions of approximately 6.6 million metric tons by 2018**.[53]

RGGI is just one of several regional efforts to address global warming pollution. (See Figure 4.) Seven U.S. states and four Canadian provinces have joined together in the Western Climate Initiative (WCI), which has set a goal of reducing emissions across the region by 15 percent below 2005 levels by 2020. The WCI states plan to begin the first phase of a cap-and-trade program in 2012. When the program is fully implemented in 2015, it will cover close to 90 percent of emissions from the participating states' economies.[54]

Meanwhile, in the Midwest, the leaders of six U.S. states and one Canadian province signed the Midwest Greenhouse Gas Reduction Accord, signaling their intention to work together to reduce emissions. A recent report from an advisory group convened by the region's leaders recommended the adoption of an emission reduction target of 20 percent below 2005 levels by 2020.[55]

Figure 4. Regional Global Warming Initiatives in the United States



Renewable Electricity Standards

A renewable electricity standard (RES) (sometimes known as renewable portfolio standard) is a law that requires utilities to develop renewable energy resources as part of their energy portfolio. In most cases, an RES requires utilities to obtain a certain share of the electricity they deliver to consumers from renewable resources. No two RESs are exactly alike: some include specific mandates for renewable energy production instead of percentage goals, the mix of resources eligible for credit varies greatly from one state to the next, some include "carve outs" for particular technologies (most often solar power), and some allow out-of-state resources to count on an equal basis with in-state resources through credit trading.

Thus far, 29 states and the District of Columbia have adopted an RES.[56] The Union of Concerned Scientists projects that, if the renewable energy targets in the policies are met, they will reduce U.S. carbon dioxide pollution by 183 million metric tons per year by 2025.[57]

Based on our review of RES policies nationwide, we assume that state RESs will reduce carbon dioxide pollution by approximately 119 million metric tons by 2020 – including emission reductions in states with emission caps but also factoring in the reductions in electricity consumption that will result from other policies examined in this report. Excluding the 12 states in which emissions from

Renewable electricity standards have helped drive the dramatic growth in renewable energy production in the United States.
Photo: ACUA

electric power plants are already capped, RES policies will deliver at least **79 million metric tons in additional emission reductions nationwide in 2020**.

Energy Efficiency Resource Standards

The success of renewable electricity standards in sparking the development of clean energy has led to similar efforts to ensure that energy efficiency improvements have a place in the nation's electricity resource mix. Energy efficiency resource standards (EERSs) are, broadly speaking, requirements to achieve specific levels of energy savings through programs to improve the energy efficiency of homes, businesses and factories.

As with the RES, the concept of the EERS has spread quickly. Currently, 23 states, accounting for 57 percent of U.S. electricity sales, have some form of EERS on the books.[58] (See Figure 5, next page.) The amount of electricity consumption covered by EERSs amounts to 13 percent of world electricity consumption, and accounts for more electricity than is consumed by any other nation besides the U.S. as a whole and China.[59]

EERSs vary in their form and method of implementation. Some establish annual percentage savings goals on a set schedule, similar to most renewable electricity standards. In other cases, such as in Rhode Island and Washington, states have adopted mandates requiring that utilities pursue "all cost-effective" energy efficiency, with utility regulators charged with setting specific energy efficiency targets. In still other cases, energy efficiency is considered one of many resources that can be used to meet a renewable electricity standard.

The amount of energy efficiency savings that will be driven by EERSs is significant. Some leading states, such as New York, Illinois and Minnesota, aim to reduce projected electricity consumption by 15 percent or more within the next 10 to 15 years. The experience of ratepayer-funded energy efficiency programs (see page 36) suggests that these targets are eminently achievable.

Quantifying the impact of energy efficiency resource standards on future global warming pollution is difficult – in part because the impact of many standards is tied to future changes in electricity consumption and in part because specific energy savings targets for some states have yet to be set. Including only those targets that have already been set, EERSs for electricity and natural gas will likely deliver emission reductions of approximately 94 million metric tons of carbon dioxide in 2020, in the absence of any other policies to reduce emissions. Not counting the 12 states with caps on power plant emissions, EERS will

deliver additional emission reductions of approximately **67 million metric tons of carbon dioxide by 2020**.

Energy Efficiency and Renewable Energy Programs

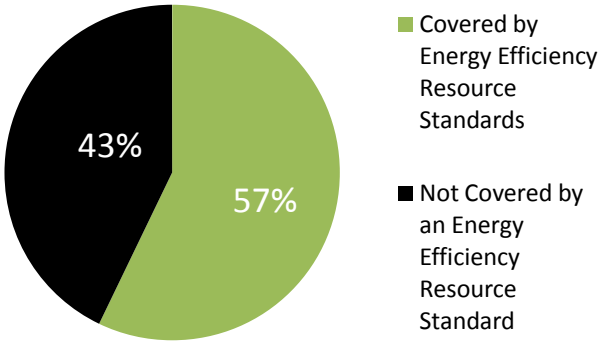
Some states, in addition to setting specific targets for renewable energy development and energy efficiency savings, provide ratepayer funding for efforts to encourage these clean energy resources. As of 2007, all but three U.S. states provided at least minimal funding for energy efficiency programs, with leading states such as Vermont, Washington, California and Oregon spending more than 2 percent of utility revenue on energy efficiency.[60] In addition, 26 states provide some level of funding for natural gas energy efficiency programs.[61] Other states have similar programs designed to encourage renewable energy development.

Because funding for these programs often varies from year to year – and because many of the programs are designed to assist in achieving the goals of an EERS – we do not estimate their future impact on emissions here. A review of the emission reductions already being delivered by state energy efficiency programs can be found on page 36.

Generation Performance Standards

Even an ambitious program to develop additional clean energy resources will have little impact on global warming if the United States simultaneously builds large numbers of high-emitting coal-fired power plants. A number of states – particularly in the western U.S. – have taken steps to prevent an increase in coal-fired generation by adopting generation performance standards, which limit the rate at which new power plants that supply electricity to their states can produce carbon dioxide pollution.

Figure 5. Percentage of U.S. Electricity Sales in States with Energy Efficiency Resource Standards



Washington state, for example, now bars utilities from entering into new long-term contracts with power plants that produce more carbon dioxide per unit of electricity produced than a typical natural gas-fired power plant.[62] Among coal-fired power plants, only those that use carbon capture and storage (CCS) could meet such a standard. California has similar standards.[63]

Other states have taken action to prevent the construction of new conventional coal-fired power plants contingent upon other actions to address carbon dioxide pollution. Montana, for example, has adopted legislation preventing the construction of new coal-fired power plants until the federal or state governments adopt rules governing CCS or unless the new plant captures and stores at least 50 percent of its carbon dioxide pollution.[64] Minnesota adopted legislation in 2007 preventing the construction of any new fossil fuel-fired plants that would lead to a net increase in emissions until the state adopts a comprehensive law limiting global warming pollution.[65]

Generation performance standards in several states aim to prevent the construction of new coal-fired power plants that contribute to global warming.

Credit: istockphoto.com/Andy Olsen

Finally, a number of U.S. states have adopted temporary moratoriums on the construction of new coal-fired power plants. In 2006, Idaho approved a two-year moratorium on new coal-fired power plants in the state – a move that led directly to the cancellation of at least one proposed plant.[66] Maine adopted a similar moratorium in 2008.[67]

The adoption of generation performance standards, coal plant moratoriums, and caps on global warming pollution from the electric sector – coupled with changing economic circumstances – has led to a collapse in demand for new coal-fired power plants. As recently as 2006, analysts were predicting a "coal rush" in the United States that could include the construction of up to 150 new coal-fired power plants. Instead, coal-fired generation capacity in the United States has held relatively steady over the last five years.[68]

Other State-Led Actions

States have also taken numerous other actions to reduce global warming pollution. The Center for Climate Strategies and New America Foundation, for example, have documented hundreds of state policy proposals – some already implemented, others in the process of implementation, and still others under consideration – intended to reduce emissions of global warming pollutants.[69]

The impact of many of these actions is difficult to quantify, but they hold a great deal of potential to reduce emissions of global warming pollutants. A few of the most significant actions are described below.

Low-Carbon Fuel Standards

Improving the energy efficiency of vehicles is just one step toward addressing the challenge of global warming pollution from transportation. Indeed, those efforts may prove to be fruitless if drivers come to rely on carbon-intensive sources of fuel – oil from tar sands and oil shale, coal-to-liquids fuels, and forms of biofuels that result in deforestation and other harmful land-use changes. The emission reductions from more efficient vehicles could be magnified, however, if vehicles were instead run on low-carbon fuels, such as sustainable biofuels and electricity generated from renewable sources of energy.

Low-carbon fuel standards are policies that require fuel marketers to lower the

carbon intensity of their products. Such standards attempt to account for emissions produced over the entire life cycle of fuels, including their production, delivery and consumption, and promote the use of alternative fuels with lower overall global warming pollution impacts. Low-carbon fuel standards are alternatives to renewable fuel standards adopted in the United States and elsewhere that push the use of non-petroleum fuels that may or may not reduce global warming pollution in the aggregate.

In early 2009, California adopted regulations to implement a low carbon fuel standard requiring a 10 percent decrease in the carbon intensity of transportation fuel by 2020. A group of 11 northeastern and mid-Atlantic states has also committed to implementing a low carbon fuel standard in that region, while Oregon has adopted legislation that will lead to implementation of a similar standard there.[70] By the early 2010s, therefore, as many as 13 states may have low-carbon fuel standards on the books, helping to encourage a transition away from petroleum and toward low-carbon forms of vehicle fuel.

Land Use and Transportation Policy

Another approach to reducing emissions from transportation involves reducing growth in the number of vehicle-miles traveled (VMT). States have taken a variety of steps to reduce the need to drive through land-use policies that restrain sprawl-style development, support for transit-oriented development, and efforts to promote the use of transportation alternatives.

The most ambitious states have adopted statewide goals for reducing VMT and are marshalling resources to achieve those goals. Washington state, for example, has adopted a legislative target of reducing per-capita VMT by 18 percent by 2020 and by 50 percent by 2050.[71] The state plans to achieve those targets through a wide variety of measures including investments in public transportation, ride-sharing, changes in land-use patterns, road pricing, and encouragement of cycling and walking.[72]

Washington and Oregon are among the states with the most success in addressing the growth of car travel – they are the only two states in the nation where fewer vehicle-miles were traveled per person in 2007 than in 1990.[73] Both states have experienced strong increases in public transportation ridership over the past two decades. Washington has long been a leader in transportation demand management – the use of a variety of tools to improve the efficiency of the trans-

Cities and states have expanded access to public transportation in recent years, reducing global warming pollution and providing alternatives to driving.
Photo: istockphoto/Nancy Johnson

portation system. Oregon, meanwhile, has a track record of promoting "smart growth" policies that stretches back to the 1970s. Smart growth can reduce the number of miles driven by encouraging compact, mixed-use development where more tasks can be completed by bike, on foot, or via transit. Since the early 1970s, Oregon has also been a leader in investing in infrastructure for bicyclists and pedestrians. Those investments have paid dividends – residents of Portland bike to work at approximately eight times the national average rate.[74]

Local governments have also begun to institute policies to reduce driving and encourage the use of transportation alternatives. New York City's "PlaNYC" includes a number of initiatives to promote the use of transportation alternatives. The city installed more than 80 miles of bike lanes in 2008 and reported a 35 percent increase in bike commuting between 2007 and 2008.[75]

Government "Lead by Example" Measures

One of the first steps states looking to reduce global warming pollution can take is to set goals for the use of clean energy resources in state government operations. "Lead by example" measures, as these efforts are called, help move towards a cleaner economy in several ways.

First, state programs demonstrate the feasibility of steps that reduce global warming pollution. Private corporations are more likely to renovate buildings for energy efficiency or construct more efficient buildings after seeing a similar state program save money.

Second, state purchasing and construction decisions can also help create a market for clean energy technologies and services. States have significant purchasing power, and state demand for renewable energy and energy efficiency was responsible for 64,000 jobs in 2006.[76] By promoting the development of clean energy industries, states make it easier for the private market to follow their lead.

Lastly, lead by example programs result in outright energy savings and global warming emission reductions. State and local governments own and operate 16 billion square feet of building space nationwide and spend $11 billion a year on energy.[77] Efficiency improvements and clean energy purchasing undertaken by state governments can directly result in appreciable reductions in the state's emissions.

Nationwide, 42 states and the District of Columbia have implemented one or more lead by example programs for their buildings, vehicle fleets, or purchasing.[78] In New York, for example, former Governor George Pataki issued an executive order in 2001 calling for energy savings and use of clean energy across all sectors of state government. The program called for 35 percent reductions below 1990 levels of energy use in all state owned, operated, or leased buildings; instructed state agencies to meet the Leadership in Energy and Environmental Design (LEED) standard for green building in new construction; set targets for state electricity purchasing of 10 percent renewable energy by 2005 and 20 percent by 2020; and required state agencies to purchase an increasing percentage of alternative-fueled vehicles, reaching 100 percent by 2010. As of 2006-7, the program had reduced state energy usage by 12 percent since 2001, and state renewable energy purchasing had increased to 9.3 percent.[79]

Arizona, meanwhile has taken a direct approach to demonstrating the feasibility of renewable energy generation in its high solar-potential environment. To provide electric power to the state's Army Aviation Training Facility, Arizona

constructed a $196,000 solar power plant that provides one third of the facility's electricity and saves the state $20,000 every year.

State Leadership Has Triggered Nationwide Action

In addition to the steps above, states have taken a variety of actions that have led to similar emission reduction steps being taken at the federal level. Often, the imposition of energy-saving standards in multiple states creates pressure on the federal government to impose similar standards nationwide – relieving manufacturers of the need to comply with several different sets of rules. This "state to federal" policy dynamic has accelerated in the early months of the Obama administration, which has adopted many of the best policy ideas from the states as a foundation for a strong federal push toward clean energy.

The Clean Cars Program

The most significant recent example of a state-pioneered policy being adopted federally is the Clean Cars Program. As noted earlier, California has the unique right under the federal Clean Air Act to impose its own, more stringent standards for air pollution from vehicle tailpipes. States with severe air pollution problems may choose to follow California's standards in lieu of the more lenient federal rules.

Historically, California's emission standards targeted air pollutants that contribute to the formation of smog and soot. But that changed in 2002, when California adopted the nation's first law regulating global warming pollution from automobiles. The law required California to achieve the maximum, cost-effective reductions in global warming pollution from tailpipes – a level later established at a 34 percent reduction in per-mile emissions from cars by 2016 and a 25 percent reduction in emissions from light trucks.

Thirteen other states and the District of Columbia – accounting for 40 percent of the U.S. market for new cars and light trucks – followed California in adopting the rules.[80] But the state efforts ran into major obstacles thrown up by the automobile industry and the Bush administration Environmental Protection Agency (EPA).

The automobile industry filed a series of lawsuits challenging the legality of the standards. Meanwhile, the Bush administration EPA delayed issuing the waiver necessary for California to implement the standards, ultimately denying the waiver outright in 2008. As the legal battles played out – and particularly in the wake of the U.S. Supreme Court's landmark 2007 decision acknowledging the EPA's authority to regulate carbon dioxide as an air pollutant under the Clean Air Act – it became increasingly likely that California and the states would eventually have the opportunity to implement the standards.

In late 2007, the U.S. Congress took the first step toward following the states' lead by adopting stronger federal corporate average fuel economy (CAFE) standards for automobiles. It was the first increase in the standards since 1990 and set a fuel economy target of 35 miles per gallon by 2020.

Then, in 2009, the Obama administration came to an agreement with the automobile industry and the state of California in which car makers agreed to drop legal challenges to the Clean Cars Program in exchange for national adoption of a modified version of the California standards. In September 2009, the EPA and the National Highway Traf-

fic Safety Administration (NHTSA) proposed a nationwide vehicle carbon emissions program for the model years 2009-2016. Assuming that the final federal standards closely mirror the California program, this will result in nationwide emission reductions of 33.2 $MMTCO_2E$ by 2020 more than would be achieved by the 2007 CAFE standards. In addition, the Obama administration finally granted California the waiver needed to implement the original emission standards. That decision has limited relevance between now and 2016, since California has agreed to allow compliance with the new federal standards to count as compliance with California law. However, the granting of the waiver gives California the ability to adopt stronger standards beyond 2016, something the state has communicated its intention to do. Other states would be able to adopt the California standards as well.

By 2020, this second phase of the Clean Cars Program could result in 14 percent greater reductions in per-mile emissions than the first phase alone. In the 14 states that have adopted the program, this would reduce emissions by an additional 13 $MMTCO_2E$.

Between the new federal standards and the assumed adoption of stronger post-2016 standards by the 14 states that have adopted the program, the Clean Cars Program will deliver emission reductions of approximately 46 million metric tons (CO_2 equivalent) of global warming pollution. Excluding states that have adopted economy-wide emission caps, the program will deliver additional emission reductions of **31 million metric tons by 2020.**

Building Energy Codes

Nearly half of America's energy is consumed in buildings. And since buildings stand for decades, investments now in reducing the amount of fossil fuels used to power buildings can reap big dividends in reduced emissions of global warming pollution in the years to come.[81]

Building codes have been used for centuries to ensure that new buildings are safe for their inhabitants, but it wasn't until the early 1970s that energy efficiency criteria began to be integrated into building codes.[82] The establishment and implementation of building codes is exclusively a state (and sometimes local) matter, but states are aided in setting energy codes by several nongovernmental bodies that prepare model codes, including the International Code Council, publishers of the International Energy Conservation Code (IECC), and the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). The ASHRAE 90.1 code for commercial construction and the IECC code for residential and commercial construction are the two most widely adopted codes, and are updated every three years. States can choose between adopting an edition of one of these codes in its entirety, adopting one of these codes with amendments, or creating their own code.

As of 2009, 39 states and the District of Columbia had adopted either a residential or a commercial energy code equivalent to or better than the 2001 IECC codes. Many of these states, moreover, are continuing to push for stronger energy efficiency measures. In 2009, the IECC released a code that is by far its most aggressive to date, reducing energy usage by 9 to 14 percent compared with the 2006 editions of that code.[83] By 2011, eight states and the District of Columbia will have adopted codes equivalent to or more stringent than the 2009 IECC. Several other states – including California, Florida, Oregon and Washington – already have state codes that are either stronger than the 2009 code or nearly as strong.[84]

The federal government does not force states to adopt a particular energy code, but it does provide carrots and sticks – as well as technical and financial support – to encourage states to adopt stronger codes. The American Recovery and Reinvestment Act, passed in February 2009, requires state governors to demonstrate that their states are taking steps toward implementing an energy code equivalent to or better than the 2009 IECC, and achieving 90 percent compliance with it, by 2018 in order to qualify for $3.1 billion to be dispensed to states for energy efficiency improvements through the Department of Energy's State Energy Program.[85]

States that have already adopted the most recent IECC and ASHRAE codes, combined with those that will do so as a result of the provisions of the economic recovery bill, can expect to reduce global warming pollution by a total of 12.6 $MMTCO_2E$ by 2020.[86] Excluding states with emission caps (or states in which energy savings from building codes count toward achievement of EERS targets), the additional emission reductions would be **11.7 million metric tons CO_2-equivalent by 2020**.Those short-term savings, however, are only the beginning, as more efficient buildings will continue to yield emission reductions for decades to come.

Residential clothes washers are among the appliances for which stronger federal appliance efficiency standards are due to be set over the next several years. *Photo: David Jones*

Appliance Efficiency Standards

States have adopted appliance energy efficiency standards since the 1970s to clamp down on sources of energy waste. Over the past three decades, the setting of appliance standards has followed a familiar pattern: leading-edge states adopt standards for new appliances, followed a few years later by the federal government.

During the 2000s – with the federal government neglecting to update old energy efficiency standards or to develop new ones – new momentum began to build at the state level for improved appliance efficiency standards. Between 2001 and 2007, 14 states moved to adopt energy efficiency standards for a range of appliances and products – ceiling fans, clothes washers, commercial refrigerators and freezers, light fixtures, vending machines and many more.[87]

In 2007, the federal government responded to those actions by implementing standards for many of those products as part of that year's energy bill. The most significant such action will be the imposition of new energy efficiency standards for certain types of fluorescent and incandescent lamps. Those standards

will reduce carbon dioxide pollution by approximately 12.9 million metric tons by 2020.[88]

Meanwhile, the Obama administration is moving toward the release of a number of overdue standards between 2009 and 2014. In addition, some states are continuing to implement their own standards until their federal replacements take effect, and are looking at new products such as televisions as potential targets for energy savings. Assuming that the federal government implements strong standards for appliances for which new standards are due, and that states continue to pursue their own standards in the interim, the nation can expect emission reductions of approximately 59 million metric tons of carbon dioxide by 2020, exclusive of other policies to reduce emissions. Between prospective appliance standards and the new federal lighting standard, and taking into account states that have capped emissions, total savings from new efficiency standards could total **61 million metric tons by 2020**.

States Play a Critical Role in Implementing New Federal Initiatives

With the arrival of the Obama administration in Washington, D.C., the federal government is now a willing partner – not an obstacle – in state efforts to reduce global warming pollution. States have important roles in implementing some of the clean energy policies already adopted by Congress and the Obama administration over the past year – most notably the programs created under the American Recovery and Reinvestment Act (ARRA).

Many ARRA programs have a significant state or local government component. At least four of those programs should lead to quantifiable reductions in global warming pollution over the next decade:

- **Weatherization:** The ARRA provides $5 billion in funding to expand the Weatherization Assistance Program, which works with states to implement programs to improve residential energy efficiency for low-income homeowners. Weatherization programs typically reduce heating bills by approximately 32 percent, curbing emissions and helping low-income families make ends meet.[89]
- **State energy program:** The ARRA also allocates $3.1 billion to the Department of Energy's State Energy Program, which distributes funds to help state governments improve energy efficiency and expand the use of renewable energy in their states. The program has historically saved more than $7 in energy costs for every federal dollar invested.[90]
- **Energy efficiency and conservation block grants:** An additional $2.6 billion is directed under the ARRA toward grants to state and local governments for specific energy efficiency initiatives.
- **Public housing energy efficiency:** Finally, $250 million is allocated through the U.S. Department of Housing and Urban Development for improving the energy efficiency of public housing developments, which are generally owned and operated by local government agencies.

Programs already funded through the ARRA can be expected to deliver emission reductions of at least 12 million metric tons of carbon dioxide, including **10 million metric tons** in states without global warming emission caps. Because

not all funding under ARRA has been distributed, emission reductions will likely be even greater than this estimate.

In addition to funding state-based efforts, the recovery act also makes long-term investments in clean energy development. The ARRA allocates $2.5 billion for research into renewable energy and $400 million for research into electric vehicle technologies. An additional $2 billion has been allocated for constructing battery system components.

The ARRA will also help spark renewable energy deployment by extending until 2014 tax credits for renewable energy that had previously been scheduled to expire and by providing $6 billion worth of loan guarantees for renewable electricity development. As a result of these provisions, the EIA projects that 36 percent more renewable energy will be generated in 2020 than would otherwise would have been the case, and 24 percent more will be generated in 2030.[91]

The recovery act also invests funds in developing an improved electricity grid. Infrastructure upgrades to the country's transmission system have the potential to reduce energy losses, make clean energy available over greater distances, and reduce demand at peak times. These effects are difficult to quantify, especially since the stimulus investments will result in an incremental, not a wholesale, transformation of the grid. The EIA, however, projects that the $4.5 billion spent on smart grid demonstration projects will result in a 10-15 billion kilowatt-hour reduction in line losses in 2030.[92] Beyond this, $11 billion will be invested in general improvements to the grid, another important step towards a grid that will allow for more flexible and efficient generation and use of power.

The American Recovery and Reinvestment Act gave a boost to home weatherization programs, which are proven to save both energy and money.
Photo: West Virginia Governor's Office of Economic Opportunity

Adding it Up: The Contribution of State Actions to Reducing Global Warming Pollution

The clean energy movement in the states is widespread and it is significant. States have adopted more than 100 individual policies in just the categories of action reviewed in this report. This does not count myriad other state and local efforts to promote a transition to a clean energy economy through transportation policy reform, reductions in energy consumption in government buildings, realignment of the tax code to encourage clean energy investments, and other initiatives.

Those efforts are yielding reductions in global warming pollution that are significant on a global scale – and the emission reductions will only increase in the years to come as states follow through on the commitments they've made to clean energy. In this analysis, we use simple, transparent methodology to estimate the emission reduction benefits of state and recent federal actions in an effort to highlight the role these actions will play in efforts to reduce global warming pollution.

Specifically, we look at the impact of recent measures through three lenses:

- The emission reductions delivered *to date* by state energy efficiency efforts and recent renewable energy installations (many, though not all, of which are driven by state or federal policy initiatives).
- The emission reductions required in 2020 *compared to 2005 levels* as a result of state global warming pollution caps.
- The emission reductions that will occur by 2020 *compared to what would have occurred otherwise*, as a result of various state and federal clean energy initiatives.

Progress to Date

The future ain't what it used to be. -Yogi Berra

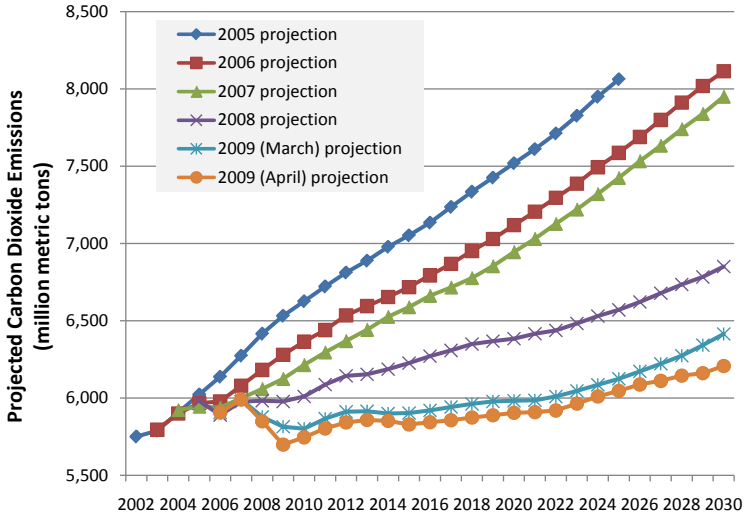
America's future emissions of global warming pollution look fundamentally different than they did just five years ago. At that time, the nation appeared to be heading toward a future of ever-increasing carbon dioxide emissions. Emissions of global warming pollutants set new records on a nearly annual basis. Gas-guzzling SUVs continued to proliferate on American roads, while the number of miles driven in those vehicles each year marched steadily upwards. And more than 150 new coal-fired power plants were on the drawing boards across the United States.[93]

Future projections of U.S. carbon dioxide emissions were unsettling. In 2005, the U.S. Department of Energy projected that carbon dioxide emissions would increase by one-third by 2025, adding another 2 billion metric tons of pollution to the atmosphere every year.[94]

Today, just under five years after those predictions were made, the future looks very different. Over the past four years, more wind power has been added to the grid than coal-fired generation.[95] Vehicle fuel economy is on the rise, the number of miles traveled on America's highways has been falling, and public transportation ridership hit a 52-year high in 2008.[96]

The U.S. Department of Energy now projects that the nation's energy-related carbon dioxide emissions in 2009 will be the lowest since 1995, down 8 percent from the 2005 peak.[97] Looking forward, the federal government anticipates that – even in the absence of further action to reduce emissions – America's carbon dioxide emissions will not return to 2005 levels until the mid-2020s.[98] (See Figure 6.)

Figure 6. Projected Carbon Dioxide Emissions by Year in Which U.S. Department of Energy Made the Projection[99]



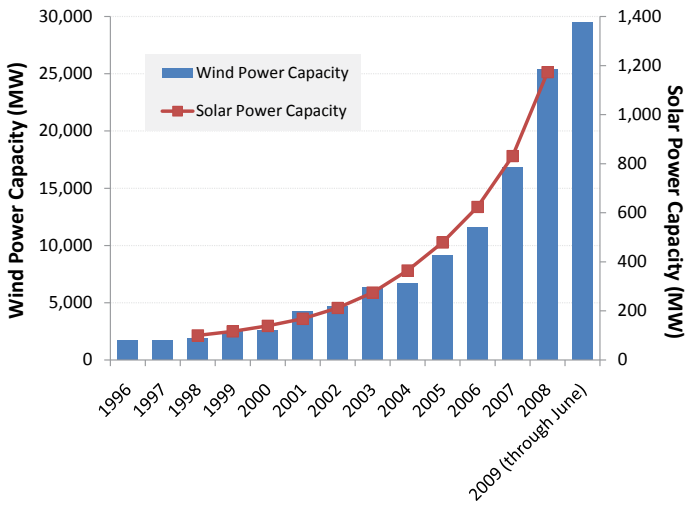
Clearly, something has happened to change America's course. One important change, obviously, is the worldwide recession that is the leading reason for the sharp decline in emissions over the past year.[100] But there is also strong evidence that the revolution in clean energy policy that has been taking place across the country is also driving emission reductions.

Indeed, recent renewable energy development and state energy efficiency programs, combined, are reducing carbon dioxide emissions by **approximately 81 million metric tons per year**. Since many state programs to encourage energy efficiency and renewable energy are just now getting underway, those savings will likely grow in the years to come.

Renewable Energy

The past five years have seen a surge in renewable energy development in the United States – aided by renewable electricity standards and other state policies

Figure 7. Installed Wind and Solar Power, United States[101]



to encourage the development of clean energy sources, as well as federal tax credits. Since 2004, the amount of wind power capacity installed in the United States has quadrupled, to nearly 30,000 MW. (See Figure 7.) In 2008, the United States surpassed Germany to reclaim the world's leadership in installed wind power capacity. Similar rapid increases have been occurring with installation of solar power.

In 2008, wind turbines generated 3.7 times more electricity in the United States than they did in 2004.[102] Had that electricity been generated instead by typical power plants in the U.S. electricity mix, emissions of carbon dioxide would have been 26.6 million metric tons greater than they were.[103] Moreover, the U.S. Department of Energy attributes approximately 17 million metric tons of the decline in carbon dioxide emissions during 2009 to expanded production of zero-emission electricity compared to 2008 levels, primarily from wind.[104] As a result, the increase in renewable energy production since 2004 – much of which was driven by state and federal policies – could be assumed to have reduced emissions in 2009 by roughly 44 million metric tons.

Energy Efficiency Programs

Energy efficiency programs run by electric and natural gas utilities – typically undertaken at the direction of state utility regulators – are also helping to reduce emissions. As of 2007, energy saved through those efforts was averting approximately 37 million metric tons of carbon dioxide pollution per year.[105] With leading states such as California having expanded their energy efficiency efforts over the last two years, the amount of emissions averted in 2009 is virtually certain to be greater today.

Future Emission Reductions From State-Led Actions

As noted above, mandatory global warming emission caps in six states, combined with the northeast's Regional Greenhouse Gas Initiative, will lock in significant reductions in global warming pollution in those states compared with 2005 levels. Those policies will yield reductions of approximately 113 million metric tons from covered states and sectors of the economy by 2020 when compared with 2005 emission levels, and 270 million metric tons by 2020 compared with business-as-usual assumptions.

Adding in the impact of state policies, state policies that have been adopted federally, and recent federal actions that will be implemented by the states, the total emission reduction that will be achieved by the policies reviewed in this report will be approximately **536 million metric tons** per year by 2020, relative to anticipated emission levels.

These emission reductions are significant on a global scale, exceeding the

annual energy-related carbon dioxide emissions of all but eight nations in the world. Indeed, the steps taken by leading individual states, such as California, are themselves important from a global perspective. (See Figure 9.)

Unfortunately, it is beyond the scope of this report to project the ultimate level of U.S. global warming emissions in 2020 resulting from these policies. The estimated emission reductions reported here are compared with "business as usual" projections produced at various times by various entities using various methodologies. The impact of many – though not all – of these state policies is reflected in the EIA's projections of future carbon dioxide emissions from energy use. The programs reviewed in this report will likely drive U.S. global warming pollutant emissions below the level projected by the EIA, but the degree of the additional reductions is difficult to ascertain.

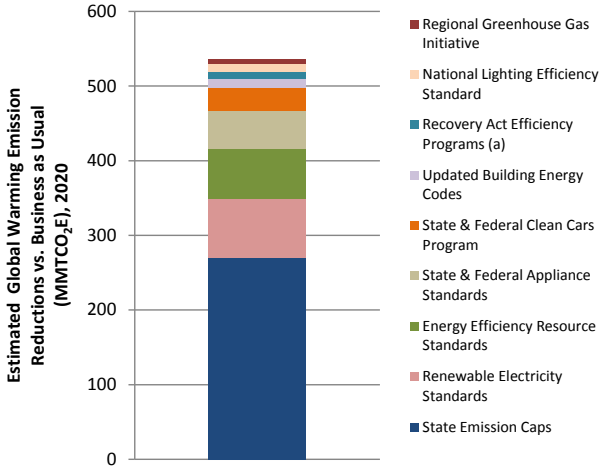
The unmistakable conclusion, however, is that state actions are making a meaningful and measurable contribution to reducing global warming pollution in the United States … and that those actions are paving the way for similar actions at the federal level. Those actions, coupled with broader economic shifts, have already changed America's projected emission trajectory from one of ever-increasing emissions of global warming pollution to one of stable emissions for decades to come.

The next challenge for the United States is to move quickly beyond policies to stabilize emissions and to take action to reduce global warming pollution consistent with the nation's obligation to do its share to prevent the worst impacts of global warming.

Taking the Next Step

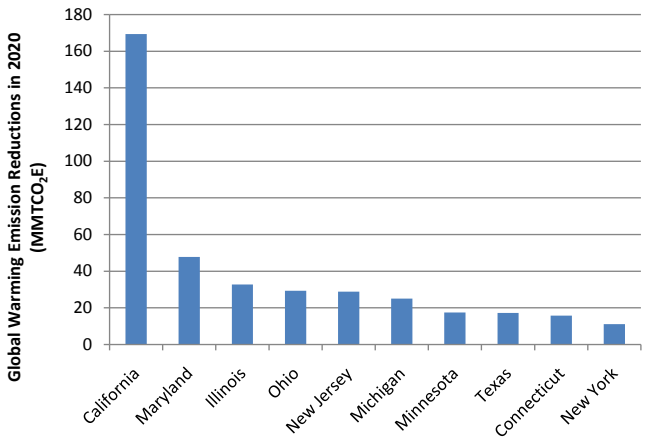
Through their support for cutting-edge energy policies at the state level – and now at the federal level – the American people have shown that they are ready for the United States to take a leadership role in grappling with the challenge of global warming. Now it is time for the Obama administration, Congress and the states to take the next steps toward putting America on track for a clean energy future.

Figure 8. Projected Emission Reductions from Selected State and Federal Policies



(a) Includes only those programs in which funding has already been allocated

Figure 9. Emission Reductions from Selected State and Federal Policies by State in 2020 (Compared with No Action)



Specifically:

- President Obama should take leadership in negotiating an international treaty that does what is necessary to prevent the most dangerous impacts of global warming.
- The federal government should limit emissions of global warming pollution to levels consistent with what science says is necessary to prevent the most dangerous impacts of global warming. Specifically, the United States should achieve emission reductions equivalent to 35 percent of 2005 levels by 2020 (with the majority of those reductions occurring domestically) and reduce emissions by 83 percent by 2050.
- The federal government should implement nationally the best clean energy policies adopted by the states, including:
  - A renewable electricity standard that would require 25 percent of the nation's electricity to come from renewable sources by 2025.
  - A federal energy efficiency resource standard requiring a 15 percent reduction in electricity consumption and 10 percent reduction in natural gas consumption versus business as usual in 2020.
  - Generation performance standards that will prevent the construction of new coal-fired power plants (without carbon capture and storage), the expansion of existing coal-fired plants, or the construction of other, high-emitting forms of power generation.
  - A federal low-carbon fuel standard that will encourage the development and use of electricity and sustainable biofuels as transportation fuel and discourage the use of carbon-intensive forms of energy such as oil from tar sands and oil shale, coal-to-liquids fuel, and environmentally damaging forms of biofuel.
- States should ensure full implementation of the clean energy policies they have already developed and improve those policies to achieve even greater emission reductions wherever possible.
- States should continue to build on their track record of innovation in clean energy policy, including by:
  - Developing and implementing more ambitious building codes that will put the nation on track toward ensuring that all new buildings use zero net energy by 2030.
  - Continuing investments in the retrofits of existing buildings with a goal of reducing energy consumption in existing buildings by at least 30 percent by 2030.
  - Providing policy and financial support to accelerate the deployment of solar energy technologies – including rooftop solar panels and solar water heating systems.
  - Developing the infrastructure that would allow for a long-term transition to plug-in vehicles, including plug-in hybrids and electric cars.
  - Reprioritizing transportation funding to expand the transportation choices available to Americans, including public transportation and passenger rail.
  - Launching efforts to train workers for jobs in clean energy industries.

Methodology

This analysis attempts to quantify the reductions in global warming pollution that would occur from implementation of clean energy policies adopted by the states, as well as federal policies initiated by the states or in which the states have prominent roles in policy implementation.

This report represents, to the authors' knowledge, the first attempt to quantify the impact of the recent wave of state energy and climate policies on future global warming pollution across various policy instruments and segments of the economy. It is built upon policy-specific analyses of energy savings and emission reductions produced by a variety of governmental and non-profit entities, as well as original analysis of federal energy data. However, it is admittedly a "first cut" at quantifying the impact of these policies and leaves key questions – such as the ultimate level of U.S. emissions after implementation of these state policies – unanswered.

The authors strongly believe that state policy initiatives have the potential to play a meaningful role in reducing global warming emissions in the United States – and that assessing the impact of those initiatives is a topic deserving of additional attention and study by the energy analysis community. We welcome efforts by future researchers to refine and expand upon this analysis in the hopes of both arriving at a better understanding of the role of state policy and of providing useful perspective for state and federal decision-makers as they evaluate potential policy options to address global warming.

Cross-Cutting Issues

Energy Consumption Projections and Emission Factor Calculations

Many of the policies evaluated here – including renewable electricity standards and energy efficiency resource standards – are articulated in terms of percentage change compared either with a historical base year or a projected future year. All estimates of energy consumption are based on data from the U.S. Department of Energy, Energy Information Administration (EIA). Baseline 2007 electricity consumption numbers are based on EIA, *Electric Sales, Revenue and Price*, downloaded from www.eia.doe.gov/cneaf/electricity/esr/esr_sum.html, 15 October 2009. Natural gas consumption figures were based on EIA, *Natural Gas Navigator*, accessed on 16 October 2009.

Energy consumption projections for future years are based on regional energy consumption projections derived from EIA, *An Updated Annual Energy Outlook 2009 Reference Case Reflecting Provisions of the American Recovery and Reinvestment Act and Recent Changes in the Economic Outlook*, April 2009 *(AEO 2009 Updated)*. The regional energy consumption figure for each fuel (delivered electricity or natural gas) was allocated to the states based on their share of 2007 regional consumption of that fuel, derived from the EIA sources listed above.

To estimate carbon dioxide emission reductions from reductions in electricity consumption, we assumed that renewable energy added to the grid as a result of state policies or electricity saved through energy efficiency policies would offset carbon dioxide at the average emission rate for a power plant in the region in which the state resides and in the year being evaluated. (The implementation of renewable electricity standards was not assumed to affect the projected emission factor derived from *AEO 2009 Updated*, since many state renewable electricity standards are already factored into the EIA's electric sector projections.) To generate state-specific emission factors for electricity generation, we relied on *AEO 2009 Updated* for data on projected electricity generation and power plant emissions for each EIA electricity market module (EMM) region.

For states in a single EMM region, the emission factor was calculated by dividing carbon dioxide emissions from power plants by total electricity generation in the region, with both data points coming from *AEO 2009 Updated*. For states with utilities in more than one EMM region, we used a weighted average emission factor, with the emission factors from the various EMM regions in the state weighted by the percentage of electricity sales by utilities in each region. Utilities were assigned to EMM regions using EIA's Form 861 database for 2005 (the last year in which Form 861 used the same regional definitions as used in *AEO 2009 Updated*). The one exception to this was Iowa, where the 2004 version of Form 861 was used. Electricity sales by utility were based on the 2007 edition of the Form 861 database. For future year projections, it was assumed that the share of electricity delivered by utilities in each EMM region in a state would remain constant through 2020.

Avoiding Double Counting

To the extent possible, emission reductions from overlapping policies were adjusted to avoid double counting. Total emission reductions from states with global warming pollution caps were based solely on the impact of the cap – all other policies were assumed to have no net additional effect. (The one exception to this

is Hawaii, where the most recent reference case projection of global warming emissions shows 2020 emissions to be below the level of the cap, due in large part to recent state and federal policy action. In order to accurately represent the impact of these policies in achieving Hawaii's emission reduction targets, we calculate emission reductions in Hawaii as if no cap were in place.) States with electric sector emission caps were assumed to gain no additional benefit from policies that reduce electric sector emissions. In Minnesota, the state's energy efficiency resource standard allows energy savings from building codes, appliance standards and other measures to count toward compliance. Therefore, emission reductions from those policies were considered to be non-additional.

Caps on Global Warming Pollution

The amount of emission reductions required per state, along with baseline emissions of global warming pollutants for 2005 and business-as-usual projections for 2020, were calculated based on the following sources, and with the following caveats:

California: The level of mandated emission reductions was based on California AB 32, Nunez and Pavley, Chapter 488, Statutes of 2006. The targeted emission level of 427 $MMTCO_2E$ by 2020 was based on California Air Resources Board, *California 1990 Greenhouse Gas Emissions Level and 2020 Limit*, downloaded from www.arb.ca.gov/cc/inventory/1990level/1990level.htm, 19 October 2009. Emissions in 2005 were based on California Air Resources Board, *Greenhouse Gas Inventory Data – 2000 to 2006*, downloaded from www.arb.ca.gov/cc/inventory/data/data.htm, 19 October 2009. Business as usual projections for 2020 were based on California Air Resources Board, *Greenhouse Gas Inventory – 2020 Forecast*, downloaded from www.arb.ca.gov/cc/inventory/data/forecast.htm, 21 October 2009.

New Jersey: Mandated emission reductions were based on the emission target (1990 emissions), 2005 emission level, and 2020 business-as-usual projection from New Jersey Department of Environmental Protection, *New Jersey Greenhouse Gas Inventory and Reference Case Projections, 1990-2020*, November 2008.

Hawaii: The level of mandated emission reductions was based on Hawaii H.B. 226, 24th Legislature, 2007, downloaded from www.capitol.hawaii.gov/session2007/bills/HB226_cd1_.htm, 19 October 2009. Emissions from 2007 were used in lieu of 2005 emissions due to the availability of a detailed emission inventory for that year. Emissions in 2007 were based on ICF International, *Hawaii Greenhouse Gas Inventory: 1990 and 2007*, 31 December 2008. Reference case projections for 2020 were based on ICF International, *Reference Projections of Hawaii's Greenhouse Gas Emissions, 2007-2020*, 3 September 2009.

Massachusetts: Emission reductions are based on the minimum required reduction of 10 percent below 1990 levels by 2020 under the Global Warming Solutions Act (the act empowers the Secretary of Energy and Environmental Affairs to set an emission reduction target of up to 25 percent below 1990 levels by 2020). The emission reduction target, 2005 emission levels, and 2020 business-as-usual projection were from Massachusetts Department of Environmental Protection, *Summary of Massachusetts GHG Emissions*, downloaded from www.mass.gov/dep/air/climate/gwsa_appendix1_final.pdf, 19 October 2009.

Connecticut: There is no state-issued global warming emission inventory that

covers both emissions for the 1990 base year and 2005. For both years, Connecticut global warming emissions were based on Timothy Telleen-Lawton and Sarah Payne, Environment Connecticut Research & Policy Center and Clean Water Fund, *Falling Behind: New England Must Act Now to Reduce Global Warming Pollution*, March 2008. The 2020 reference case projection was based on Connecticut Governor's Steering Committee on Climate Change, *Connecticut Climate Change Action Plan*, January 2005.

Maryland: Maryland's emission reduction target is established in reference to a 2006 baseline. A detailed 2006 emission inventory was unavailable, so a target of 25 percent below 2005 levels was used to simulate the impact of the policy. All emission information was taken from Maryland Commission on Climate Change, *Interim Report to the Governor and the General Assembly: Climate Action Plan*, January 2008.

Regional Greenhouse Gas Initiative: Emission reductions versus 2005 levels under RGGI were estimated as follows. First, the emission budget per state and historical carbon dioxide emission levels were obtained from Regional Greenhouse Gas Initiative, *CO_2 Emission Data Files for 2000-2007 for Electric Generating Units (EGUs) Subject to RGGI Program* (Excel spreadsheet), 22 February 2009. Required emission reductions for 2018 were assumed to be 10 percent below the emission budget set by the program, with reductions assumed to occur proportionately by state. The RGGI emission cap was assumed to continue at its 2018 level through 2020.

Renewable Electricity Standards

To estimate emission reductions from RESs, we assumed that the renewable electricity created by each state's standards would reduce emissions by the projected carbon dioxide emission factor for electricity consumption for that state in 2020 (calculated as described above). State RES policies were reviewed using summary information and links provided in the *Database of State Incentives for Renewables & Efficiency* (*DSIRE*), accessed during October 2009 at www.dsireusa.org. For each state, an estimate of the percentage of renewable energy required by the RES in 2020 was developed, assuming that the nominal targets of the RES would be met using renewable energy. For states with different RES requirements for various classes of utilities (e.g., municipal utilities and co-ops), the share of the electricity market subject to the RES was determined using 2007 electricity sales data from EIA, *Form 861 Database*, file 2, downloaded from www.eia.org, 29 September 2009. For states in which electricity from existing renewable generators was counted toward RES goals, existing renewables were removed from our estimate of renewable energy production based on data from EIA, *State Electricity Profiles 2007 Edition*, April 2009.

With regard to specific states, the Iowa and Texas RESs were not assumed to produce any additional renewable electricity by 2020, as the target thresholds for these states have already been met (however, the city of Austin's local RES was counted in the Texas total). The impact of the Kansas RES, which is expressed in the form of percentage of peak demand (rather than energy provided), was estimated based on projected peak demand from Kansas utilities from Kansas Electricity Council, *Kansas Electric Generation: Capacity and Peak Load, 2008 to 2028*, 24 November 2008. Current renewable electricity capacity (obtained from the EIA's *State Electricity Profiles*) was subtracted from the total used to calculate the renewable en-

ergy goal. After applying the percentage target for renewable energy development to the capacity figure, and correcting for the 10 percent bonus for new renewable generation, the amount of electricity expected to be produced by the RES in 2020 was calculated by multiplying the capacity figure by a projected capacity factor for wind energy installations of 38 percent.

The percentage of new renewable energy required by the RES was multiplied by projected 2020 electricity consumption in each state (calculated as described above) to arrive at the amount of renewable electricity anticipated to be produced by the RES. To estimate projected emission reductions, we multiplied the electricity created by renewables under the RES by the projected carbon dioxide emission factor for that state, calculated as described above.

For all policies in which reductions in electricity consumption due to energy efficiency measures were calculated, we reduced projected 2020 electricity consumption by the amount of energy saved before calculating the amount of renewable electricity that would be required under the RES. This step, which is necessary to avoid double-counting, reduces the amount of renewable electricity from what would be required were no energy efficiency measures in place, and therefore reduces the amount of carbon dioxide emission reductions projected as a result of the RES.

Energy Efficiency Resource Standards

Energy savings from EERSs were based on descriptions of the impact of EERS policies from several sources – including the American Council for an Energy-Efficient Economy's *State Energy Efficiency Policy Database*, DSIRE, and the original legislation. Generally speaking, year-by-year energy efficiency savings were estimated to accrue over time, with the estimated reduction in 2020 energy consumption being the sum of the year-by-year savings. Because this method does not reflect the potential for energy consumption to change over time due to factors independent of energy efficiency improvements, this method yields only a rough estimate of energy efficiency savings from EERSs.

Many states with EERSs have established only short-term energy savings targets. These targets were generally used to estimate energy savings in 2020 on the theory that those savings would – at a bare minimum – be maintained through 2020. In all likelihood, the EERS requirements in these states will generate additional emission reductions that are unaccounted for in this analysis.

To follow are detailed assumptions for the impact of EERSs in states without specific percentage requirements, or for which additional assumptions were necessary:

Electricity

Colorado: Estimated savings based only on projected savings from Public Service Company of Colorado's filing before the Colorado PUC, from Public Utilities Commission of the State of Colorado, *In the Matter of the Application of Public Service Company of Colorado for Authority to Implement an Enhanced Demand Side Management Program and to Revise Its Demand-Side Management Cost Adjustment Mechanism to Include Current Cost Recovery and Incentives: Order Granting Application in Part*, Docket No.: 07A-420E, 23 May 2008. Savings from other utilities covered under Colorado's EERS were not quantified.

Hawaii: Hawaii's EERS goal of saving 40 percent of electricity consumption in

2030 was prorated to 2020 assuming that energy savings of 25 percent would be achieved, a similar ratio as is achieved by the state's RES. See Hawaii H.B. 1464, 25th Legislature, 2009.

Iowa: Estimated savings from the Iowa EERS were based on Iowa Utilities Board, *Energy Efficiency in Iowa's Electricity and Natural Gas Sectors: Report to the Iowa General Assembly*, 1 January 2009.

Massachusetts: Massachusetts requires utilities to tap all cost-effective sources of energy efficiency. Savings included here are through 2012 and are based on National Grid, NSTAR, et al., *2010-2012 Massachusetts Joint Statewide Three-Year Electric Energy Efficiency Plan*, 16 July 2009.

Rhode Island: Rhode Island requires utilities to tap all cost-effective sources of energy efficiency. Savings included here are through 2011 and are based on State of Rhode Island and Providence Plantations Public Utilities Commission, *National Grid Least Cost Procurement: Report and Order*, Docket No. 3931, 2 September 2008.

Texas: Texas' EERS requires the state to avert 20 percent of load growth through energy efficiency. Load growth in Texas was estimated by calculating the projected increase in electricity consumption in Texas through 2020, calculated as described above and based on *AEO 2009 Revised.*

Vermont: Vermont savings are through 2011 and based on Efficiency Vermont, *Annual Plan 2009-2011*, 16 December 2008.

Virginia: Virginia's EERS calls for savings equivalent to 10 percent of 2006 electricity sales by 2022. Savings in 2020 were prorated based on consistent achievement of energy savings over time, with savings by 2020 assumed to equal 8.5 percent of 2006 electricity sales.

Washington: Washington requires utilities to achieve all cost-effective energy efficiency. However, the first firm energy savings targets under the Washington EERS have yet to be set and, as a result, savings from the Washington EERS are not included in this analysis.

Natural Gas

California: Savings from California's natural gas EERS were estimated through 2013, based on Public Utilities Commission of California, *Application of Southern California Edison Company for Approval of its 2009-2011 Energy Efficiency Program Plans and Associated Public Goods Charge (PGC) and Procurement Funding Requests and Related Matters: Decision Approving 2010 to 2012 Energy Efficiency Portfolios and Budgets*, Application No. 08-07-021, 24 September 2009.

Iowa: See "Electricity" above.

Massachusetts: Savings are through 2012 and are based on NSTAR, National Grid, et al., *2010-2012 Massachusetts Joint Statewide Three-Year Gas Energy Efficiency Plan*, 16 July 2009.

New Mexico: New Mexico's EERS requires natural gas utilities to achieve all cost-effective energy efficiency but does not set a numerical target for natural gas. See New Mexico H.B. 305, 48th Legislature, 2008.

Electricity savings were converted into avoided carbon dioxide emissions by multiplying them by the projected carbon dioxide emission factor for electricity generation in 2020, arrived at as described above. The emission factor for natural gas was assumed to be 117.08 pounds of CO_2 per million BTU of natural gas.

Clean Cars Program

For the 14 states that adopted the Clean Cars Program, estimates of emission reductions from the program are based on California Air Resources Board

(CARB), *Addendum to the February 25 Technical Assessment (Addendum)*, May 2008. These emission reductions are based on the assumptions that a) the federal global warming emissions program for automobiles will closely resemble the California program in its impact on emissions, b) the 14 states will all adopt a second phase of the standards, which would run from 2017 to 2020, and c) that those future standards will resemble those anticipated by the CARB.

The estimated benefits of the national vehicle emissions program were also based on CARB's May 2008 *Addendum*, but with the difference that states taking part in the national program are not assumed to follow along with the proposed second phase of the program. To estimate the emission reductions that would not occur in these states, we relied on CARB, *Comparison of Greenhouse Gas Reductions for the US and Canada Under U.S. CAFE Standards and California Air Resources Board Greenhouse Gas Regulations*, February 2008. In Table 11 of this report, CARB estimates the reduction in emissions in 2020 from the vehicle fleet by model year. We assumed that the percentage emission reduction for states following the national program would remain at the 2016 level through model year 2020, and recalculated the fleetwide emission reductions based on that assumption. That calculation showed that failure to implement the second phase of the program would reduce the emission savings under the program by 14 percent in California. We then applied that 14 percent reduction to the state-by-state estimates of emission savings from the May 2008 *Addendum* to arrive at the estimated emission reduction that would result from the national program.

The emission reductions projected from the Clean Cars Program are relative to the increased corporate average fuel economy standards resulting from the 2007 federal energy bill.

Building Energy Codes

To analyze the impact of state building codes, we began by cataloguing existing building codes and changes scheduled to come into effect in coming years, based on data from the Building Codes Assistance Project, *Code Status* Web site, accessed on 16 October 2009. We also assumed, following the assumptions of the EIA, that by 2018 all states will adopt the 2009 IECC code for residential construction and the ASHRAE 90.1-2007 code for commercial construction in response to the requirements of the economic recovery package.[106]

To estimate energy savings and emission reductions from building codes, we multiplied the estimated energy savings that would be delivered by the updated building code per residential unit or square foot of commercial space by the number of new residential units or amount of square footage of commercial space projected to be completed between the year that the updated code is implemented and 2020. (Emission reductions from the application of codes to major renovations of existing buildings were not calculated.)

To calculate the quantity of new residential units or square footage of commercial space projected to be added over a period of time, we followed the methodology of the 2004 Brookings Institution Metropolitan Policy Program report, *Toward a New Metropolis: The Opportunity to Rebuild America*. That report estimated the need for residential and commercial space based on constant ratios of state residents to residential units and commercial workers to square feet of commercial space. It also provided a means of calculating the annual rate of loss of existing residential and commercial space for each state.

To estimate new residential construction, we multiplied the figure for

residential units per state resident in 2000 from the Brookings *Toward a New Metropolis* report by the U.S. Census Bureau's projection of state population in 2020 from Table 5 of the U.S. Census Bureau's report *State Interim Population Projections by Age and Sex, 2004-2030*, accessed at www.census.gov/population/www/projections/projectionsagesex.html on 20 October 2009. We used the difference between that figure and the existing number of residences in 2000 as the basis for our annual growth figures, assuming linear growth during those years. From this annual growth figure, we subtracted the annual loss figure and multiplied by the existing number of residential units in 2000, to obtain an estimate of the number of residential units constructed each year. This form of estimation is conservative as a result of subtracting loss rates from a constant, rather than expanding, baseline, and as a result of using the Brookings report's intentionally conservative numbers.

To estimate commercial construction, we took the Brookings report's figure for the size of the commercial workforce in each state in 2030, and assumed a constant rate of growth between 2000 and 2030 in order to interpolate an estimate for the size of the commercial workforce in 2020. We multiplied this annual growth number by the ratio of square footage of commercial space to workers that the Brookings report provides for each state to obtain an estimate for growth in commercial space each year. We then derived a number for square feet lost each year and total annual construction in a manner directly analogous to that used for residential construction.

We next broke down each state's population by DOE climate zone. To do this we combined a list of which counties fall into each climate zone (from the American Society of Heating, Refrigeration, and Air-Conditioning Engineers' *Advanced Energy Design Guide for Small Warehouses and Self Storage Buildings*, updated 11 June 2008) with the U.S. Census Bureau's estimates of 2008 population for each county from U.S. Census Bureau, *U.S. Counties Data Files: Population – Total and Selected Characteristics*, downloaded from www2.census.gov/prod2/statcomp/usac/excel/POP01.xls, 7 October 2009. By this method, we were able to identify what percentage of each state's population falls into each climate zone within that state. We used these population breakdowns as a proxy for breakdowns of new construction between the state's climate zones.

The basis for our analysis of the effect of commercial codes is the 2009 report from the U.S. Department of Energy, Building Energy Codes Program, *Impacts of Standard 90.1-2007 for Commercial Construction at State Level*. This report compares the efficiency of newly constructed buildings built to the state's existing code and the ASHRAE 90.1-2007 code in each climate zone of each state. For each climate zone in each state, we used the estimates of electricity usage and natural gas usage under both standards to obtain an annual, per square foot reduction from the old standard to 90.1-2007. We then combined the climate zone numbers into a population-weighted average for the state as a whole. We then credited each state with the reduction that would result from construction between the adoption of the 2007 standard and 2020. (We assumed that ASHRAE 90.1-2007 would be adopted in 2018 in all states that had not made specific plans to adopt it sooner.) For four states (Washington, Oregon, California and Florida), we were not able to obtain estimates, since they use building codes of their own that differ significantly from the codes the DOE modeled.

The basis for our estimate of the impact of residential code changes is the data compiled on the effect of the transition from the 2006 IECC to the 2009 IECC in each climate zone compiled by ICF International for the Energy Efficient Codes Coalition.[107] This source provided us with an estimate of electricity and natural gas savings per residential unit in each climate zone. We took population-weighted averages of these numbers for each state to produce a statewide per-unit savings estimate, and then followed the same methodology as with commercial codes to estimate the energy savings in 2020 from the adoption of the 2009 IECC. (We assumed that the 2006 IECC was the baseline standard in all states; this leads to an extremely conservative estimate of the savings estimated for upgrading to the 2009 version of that code.) All states were assumed to adopt the 2009 IECC by 2018, in the absence of plans calling for its adoption before that time.

To estimate savings in Florida, we used the Building Codes Assistance Project's estimate that the Florida Residential Construction Code (FRCC) is 17 percent more efficient than the 2006 IECC, but 3 percent less efficient than the 2009 IECC, to obtain a figure for expected savings from the FRCC over the 2006 IECC.[108] In the case of Washington and Oregon, we treated their existing codes as equivalent to the 2006 IECC and credited them, as in most other states, with the savings that would come from transitioning to the 2009 IECC in 2018. No estimate was obtained for California.

Appliance Efficiency Standards

Energy savings from appliance efficiency standards were based on separate estimates of three policy packages:

- Appliance standards due to be issued by the federal government between 2009 and 2013.
- The federal lighting efficiency standard announced by the Obama administration in 2009.
- State appliance standards for which there are no federal standards scheduled.

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Appendix: Estimated Impact of State and Selected National Policies on Global Warming Emissions, 2020

	Economy-Wide Caps	Electricity Sector Emission Limits		Renewable Energy Programs	Energy Efficiency Policies (a)						Transportation Policies	Total Emission Reductions in 2020 ($MMTCO_2E$)
State	Statewide Global Warming Emission Caps	Regional Emission Cap	Generation Performance Standard	Renewable Electricity Standard	Energy Efficiency Resource Standard (f)	Residential Building Codes	Commercial Building Codes	Appliance Efficiency Standards (b)	Lighting Efficiency Standard	Recovery Act Efficiency Programs	Clean Cars Program	
Alabama						0.1	0.1	1.1	0.2	0.2	0.6	**2.2**
Alaska						0.0	0.0	0.1	0.0	0.1	0.0	**0.3**
Arizona				**6.0**		0.1	0.0	**2.2**	0.1	0.2	**1.4**	**10.1**
Arkansas						0.3	0.0	0.7	0.3	0.1	0.3	**1.9**
California	**169.4**		*	**21.5**	**7.5**	**	**	**3.6**	**1.6**	0.9	**9.8**	**169.4**
Colorado				**5.6**	**2.6**	0.1	0.1	1.4	0.2	**0.2**	**0.5**	**10.7**
Connecticut	**15.8**	**0.9**		**1.8**	**0.4**	0.1	0.0	**0.3**	0.1	0.2	**0.8**	**15.8**
Delaware		**0.6**		**0.8**	**0.2**	**0.0**	**0.1**	0.1	0.0	0.1	0.0	**0.9**
Dist. Of Columbia				**0.5**		**0.1**	**0.0**	**0.1**	0.0	0.1	**0.1**	**1.0**
Florida						**2.5**	**0.0**	3.7	0.9	0.5	2.0	**9.7**
Georgia						0.2	0.1	2.0	0.4	0.4	1.1	**4.1**
Hawaii (c)	**0.0**			**1.2**	**2.1**	0.0	0.0	0.3	0.1	0.1	0.1	**3.8**
Idaho						0.0	0.0	0.2	0.1	0.1	0.1	**0.5**
Illinois				**11.0**	**15.4**	**0.6**	**0.7**	2.8	0.5	0.5	1.2	**32.7**
Indiana						0.1	0.2	2.0	0.3	0.3	0.8	**3.6**
Iowa (d)				**0.0**	**1.6**	0.0	0.0	0.8	0.1	0.2	0.4	**3.2**
Kansas				**5.4**		0.0	0.1	0.9	0.1	0.1	0.3	**6.9**
Kentucky						0.1	0.1	1.3	0.2	0.2	0.4	**2.2**
Louisiana						0.1	0.0	1.1	0.2	0.2	0.5	**2.0**
Maine		**0.3**	*	**0.3**		**0.1**	**0.1**	0.2	0.1	0.1	**0.4**	**1.2**
Maryland	**46.5**	**2.8**		**4.0**	**4.1**	0.0	0.1	**0.7**	0.3	0.2	**1.3**	**46.5**
Massachusetts	**9.2**	**2.0**		**2.1**	**0.9**	0.1	0.1	**0.6**	0.2	0.3	**1.4**	**9.2**
Michigan				**6.8**	**12.6**	0.1	0.4	3.1	0.4	0.5	1.1	**25.1**
Minnesota			*	**5.7**	**10.8**	0.1	0.2	1.5	0.2	0.3	0.6	**17.4**
Mississippi						0.0	0.1	0.6	0.1	0.1	0.4	**1.4**
Missouri				**4.0**		0.1	0.2	0.9	0.2	0.3	0.7	**6.5**
Montana			*	**0.5**		**0.1**	**0.1**	0.1	0.0	0.1	0.2	**1.0**
Nebraska						0.0	0.0	0.5	0.1	0.1	0.2	**0.9**

	Economy-Wide Caps	Electricity Sector Emission Limits		Renewable Energy Programs	Energy Efficiency Policies (a)						Transportation Policies	Total Emission Reductions in 2020 ($MMTCO_2E$)
State	Statewide Global Warming Emission Caps	Regional Emission Cap	Generation Performance Standard	Renewable Electricity Standard	Energy Efficiency Resource Standard (f)	Residential Building Codes	Commercial Building Codes	Appliance Efficiency Standards (b)	Lighting Efficiency Standard	Recovery Act Efficiency Programs	Clean Cars Program	
Nevada				2.2	***	0.1	0.0	0.4	0.1	0.1	0.3	3.3
New Hampshire		0.7		0.2		0.1	0.1	0.1	0.1	0.1	0.2	1.3
New Jersey	28.9	1.7		7.0	****	0.1	0.1	1.2	0.4	0.3	2.1	28.9
New Mexico				2.0	1.2	0.0	0.0	0.6	0.1	0.1	0.5	4.6
New York		4.7		2.2	13.4	0.1	0.1	1.9	0.8	0.8	2.8	11.2
North Carolina				6.8	***	0.2	0.1	2.0	0.4	0.3	0.9	10.8
North Dakota						0.0	0.0	0.2	0.0	0.1	0.0	0.4
Ohio				8.4	15.0	0.1	0.1	3.6	0.4	0.5	1.2	29.4
Oklahoma						0.1	0.1	1.2	0.1	0.2	0.4	2.1
Oregon (e)			*	2.3		0.0	0.0	0.5	0.2	0.1	0.8	4.0
Pennsylvania				3.1	1.4	0.1	0.1	1.4	0.5	0.5	2.5	9.6
Rhode Island		0.2		0.3	0.1	0.0	0.0	0.1	0.0	0.1	0.2	0.7
South Carolina						0.1	0.0	1.0	0.2	0.2	0.6	2.0
South Dakota						0.0	0.0	0.2	0.0	0.1	0.1	0.5
Tennessee						0.1	0.1	1.4	0.3	0.3	0.7	2.8
Texas				1.8	4.5	0.7	0.9	4.7	1.1	0.9	2.6	17.2
Utah						0.0	0.0	0.3	0.1	0.1	0.2	0.8
Vermont		0.0			0.1	0.0	0.0	0.1	0.0	0.1	0.2	0.4
Virginia						0.2	0.1	1.3	0.3	0.3	0.9	3.1
Washington (e)			*	3.2	****	0.1	0.0	0.9	0.3	0.2	1.3	6.0
West Virginia						0.4	0.0	0.6	0.2	0.1	0.2	1.5
Wisconsin				2.5		0.0	0.1	1.4	0.1	0.3	0.6	5.0
Wyoming						0.0	0.0	0.1	0.0	0.1	0.1	0.3
TOTAL REDUCTIONS (without overlap)	269.8	6.6	*	79.1	67.2	7.3	4.4	50.6	10.0	10.3	30.7	535.9
REDUCTIONS FROM ALL STATE POLICIES (including overlap)	269.8	13.9		119.3	93.8	7.8	4.8	58.7	12.9	12.2	46.1	

See explanatory notes, next page

Appendix: Estimated Impact of State and Selected National Policies on Global Warming Emissions, 2020

Explanatory notes

Colored cells indicate states that have adopted policies in these areas.

Bold numbers indicate savings from state policies.

Italicized numbers indicate savings from federal policies.

Bold and italicized numbers indicate combined savings from state and federal policies.

(a) Some unquantified overlap likely exists between energy efficiency policies described here.

(b) Estimated impact of appliance standards is based on projected savings from aggressive standards, not actual proposed standards.

(c) Total emission reductions are based on the sum of Hawaii's existing individual policies, which will provide the savings needed to achieve the state's cap.

(d) Iowa's RES is projected to provide no additional renewable energy, as its target has already been surpassed.

(e) Oregon and Washington have relatively strong building codes, but the impact of those codes is not quantified here. Rather, they are given credit only for adoption of stronger residential codes after 2018.

(f) Savings from the EERS include only those specific energy efficiency targets that have already been set through legislation or regulatory decisions. The policies will likely deliver greater savings in many states in future years.

* Emission reductions from generation performance standards not included in this analysis.

** California has strong residential and commercial building codes, but the impacts of these codes were not quantified here.

*** Energy efficiency can be used toward RES compliance. Emission reductions are accounted for in RES column.

**** Energy efficiency savings targets have yet to be set.

Row and column totals may not equal the sum of the individual measures due to rounding.