Center for American Progress

Part of *Progressive Growth*, CAP's Economic Plan for the Next Administration

Capturing the Energy Opportunity

Creating a Low-Carbon Economy

By John Podesta, Todd Stern, and Kit Batten

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Contributors

The editors and authors of *Progressive Growth* thank their colleagues, the fellows, and staff of the Center for American Progress, listed below, who work on related issues and/or contributed to select portions of *Progressive Growth*. While the ideas and analyses of these experts inspired many of the recommendations in *Progressive Growth*, the recommendations in each report are those of that report's authors and the Center's leadership, and do not necessarily represent the views of all associated with the Center.

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Dan Restrepo, Director of the Americas Project
Louis Soares, Director of the Economic Mobility Program
Jonathan Jacoby, Associate Director for International Economic Policy
Andrew Jakabovics, Associate Director for the Economic Mobility Program
Peter Ogden, Senior National Security Policy Analyst
Benjamin Goldstein, Research Associate for Climate and Energy Policy
Tim Westrich, Research Associate for Economic Policy
Amanda Logan, Research Assistant for Economic Policy
Kari Manlove, Fellows Assistant for Climate and Energy Policy

A list of earlier reports published by the Center for American Progress describing policy incorporated into the *Progressive Growth* plan can be found on the inside back cover.

Cover photo: A man works atop a wind turbine at the Delaware Mountain Wind Farm in Culberson County, Texas. Residents of Houston can choose the non-polluting power generated at the farm as an alternative to traditional power. Image courtesy of Corbis.

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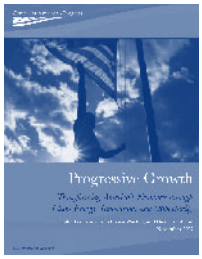


The Center for American Progress offers a fiscally responsible investment plan to:

- *Grow our economy* through the transformation to a low-carbon economy and leadership in innovation, technology, and science.
- *Recreate a ladder of economic mobility* so that Americans may make a better life for themselves and their families, and America may be a land with a thriving and expanding middle class prospering in the global economy.

An overview of the entire plan can be found in:

Progressive Growth
Transforming America's Economy through Clean Energy, Innovation, and Opportunity
By John Podesta, Sarah Rosen Wartell, and David Madland

Other reports detailing aspects of the challenges and recommendations in the *Progressive Growth* plan are:

Capturing the Energy Opportunity
Creating a Low-Carbon Economy
By John Podesta, Todd Stern, and Kit Batten

A National Innovation Agenda
Progressive Policies for Economic Growth and Opportunity through Science and Technology
By Tom Kalil and John Irons

Opportunity and Security for Working Americans
Creating the Conditions for Success in the Global Economy
By Louis Soares, Andrew Jakabovics, and Tim Westrich *(forthcoming)*

Virtuous Circle
Strengthening Broad-Based Global Progress in Living Standards
By Richard Samans and Jonathan Jacoby *(forthcoming)*

Responsible Investment
A Budget and Fiscal Policy Plan for Progressive Growth
By David Madland and John Irons *(forthcoming)*

Other reports developing these and other new ideas will be published as part of the *Progressive Growth* series of economic policy proposals from the Center for American Progress. The first, ***Serving America: A National Service Agenda for the Next Decade***, by Shirley Sagawa, was published in September 2007. Future reports will include: ***New Strategies for the Education of Working Adults***, by Brian Bosworth *(forthcoming)*; and ***Social Entrepreneurship and Impact: Creating a Climate to Foster Social Innovation***, by Michele Jolin *(forthcoming)*.

Progressive Growth: A Summary

The American Dream has been a story of progressive policy establishing conditions in which individuals have been able to seize opportunities and make a better life for themselves, their children, their families, and their communities. It can be so again. The United States faces unprecedented challenges. Yet at the Center for American Progress, we are optimistic about America's economic future. We are confident that the ladder of economic mobility can be rebuilt with the right leadership and progressive policy.

Today, working Americans feel less and less secure, and their prospects for economic mobility seem more and more remote. People are working longer hours than ever before, change jobs more frequently, and have more volatile incomes. Forty-seven million live without health insurance. Few are represented by a union. Many face tough competition from lower-wage workers abroad. The land of the American Dream now has less inter-generational income mobility than many other developed countries. Family incomes have risen on average within generations only because the incomes of women have risen as their participation in the workforce has grown dramatically; incomes of men have stagnated. The additional income from the second earner is essential to cover the rising cost of healthcare, energy, and childcare, among other things.

Each of the traditional pathways to progress is littered with roadblocks. Incomes are not rising; the historical link between greater productivity and higher wages has broken down. Personal savings in the United States is near record lows. From pre-school through high school, we are failing to prepare many for college and the workplace. Those who begin degree or credential programs to improve earnings complete them at alarmingly low rates. Until recently, homeownership was a pathway to wealth accumulation, but many now see their equity slipping away. **American workers feel less secure with good reason. Their prospects for getting ahead are more limited. Working hard and playing by the rules is not enough.**

In recent years, economic growth has been relatively strong, but the economy has added jobs at a lackluster rate compared to similar times in the economic cycle. The share of the nation's income that goes to those in the middle is lower than it has been in 50 years. The benefits of economic growth have all flown to those at the very top.

Key Steps to *Progressive Growth*

Accelerate America's transformation to a low-carbon economy.

- Implement an economy-wide cap-and-trade program for greenhouse gases.
- Dedicate cap-and-trade revenues to, first, offset energy costs for low- and moderate-income consumers and support the employees and communities of carbon-intensive firms, and second, invest in innovation and the transformation to a low-carbon economy.
- Implement complementary policies to reduce emissions and increase energy efficiency in the transportation and electricity sectors.
- Create a White House National Energy Council to manage the transformation and ensure that the federal government leads the way.
- Exercise global leadership.

Spur innovation to sustain productivity growth *and* job creation.

- Make significant new investments to stimulate innovation to address our nation's grand challenges and emerging opportunities.
- Build a flexible, problem-solving workforce that includes more workers with world-class science, technology, engineering, and math skills.
- Restore the integrity of American science.

Rebuild the ladder of opportunity by restoring economic security and mobility.

- Guarantee quality, affordable *health care* regardless of employment or life circumstance.
- Expand access to effective *education* for our children and adult workers to ready the workforce for 21st century jobs in the global innovation economy.
- Make work pay and *incomes* keep pace with growth through the minimum wage, expansion of the Earned Income Tax Credit and Child Tax Credit, the right to organize, and reforms to unemployment insurance and adjustment assistance.
- Provide greater opportunities to build and secure *wealth* through work, retirement savings, affordable and safe financial services, and home ownership.

Create a virtuous circle of rising economic fortunes for a growing global middle class—future consumers of U.S. products and services.

- Refocus the three main elements of our international economic policy—trade, aid, and monetary policy—on achieving progressive growth around the globe.
- Enlist all the international institutions—the International Labor Organization, the International Monetary Fund, the World Bank, the World Trade Organization, and regional multilateral development banks—in a coordinated strategy to promote decent work: quality jobs, fundamental rights at work, social protection, and social dialogue.
- Support construction of the laws and institutions that will enable middle-income nations to share new growth widely within their populations.
- Support low-income nations in meeting basic human needs, advancing decent work, moving more workers into the formal economy, eliminating trade barriers to their exports, and supporting the creation of trade-related infrastructure.

Adopt a responsible fiscal policy to finance needed investments in national priorities.

- Make needed investments in economic growth and restoring economic mobility.
- Dedicate cap-and-trade revenues to ease the transition to a low-carbon economy and invest in policies to spur innovation and the energy transformation.
- Adopt a tax system that is fair and rewards human capital by:
  - Rewarding work and wealth equally.
  - Expanding the Earned Income Tax Credit and Child Tax Credit to help make work pay for low-income workers.
  - Providing tax breaks to employers and employees to encourage more investment in credentialed and portable education of adult workers.
  - Improving retirement security through matching contributions for lower-wage workers in a new Universal 401(k) plan.
  - Lifting the cap on which the employer pays social security taxes while maintaining the employee cap.
  - Permanently reforming the estate tax so that only a tiny fraction of the wealthiest heirs would be subject.
  - Closing loopholes and improving tax enforcement.
- Put America on course to reduce our debt as a share of our Gross Domestic Product.

The prospects for long-term growth are also weak. Our economy is increasingly reliant on unsustainable, debt-driven spending (by consumers and the federal government), instead of innovation and investment. Between March 2001 and March 2007, 84 percent of economic growth came from consumption spending, while less than 4 percent came from investment. The United States has fallen behind many countries when it comes to equipping the workforce with the education and training necessary for individual and national success, doing a mediocre job especially of preparing our children for careers in the innovation economy. Younger cohorts moving into the workforce in coming years will be smaller and have less education than the older generations leaving the workforce.

Globalization and technology have changed the rules of the game. Unsustainable appreciation in the housing market buoyed the economy for too long. And we face a clear and present danger to our economy and the earth itself from global warming. As Rajendra Pachauri, Chairman of the Intergovernmental Panel on Climate Change and recipient of the 2007 Nobel Peace Prize, said recently, "If there's no action before 2012, that's too late. What we do in the next two to three years will determine our future. This is the defining moment." America needs policymakers with a plan for restoring U.S. economic leadership in a global and carbon-constrained economy, making it possible, once again, to dream that our children can look forward to a better future.

The next administration can offer a new vision of America as an economic leader with a growing middle class in a vibrant global economy. America's economy could be driven by ongoing invention and the production of high value-added goods and services. America could lead a global energy transformation based on more efficient technologies and clean, renewable fuels. These forces could fuel the creation of good jobs and good prospects for workers at all skill levels. America's students and workers could be readied to meet the demands of the innovation economy. Moreover, we could ensure the economic security necessary, so that people can take risks and generate wealth for themselves and our country. America could put globalization and change to work for American workers and for millions around the globe.

At the center of this vision is a strategy to address the greatest moral and economic challenge of our time—climate change—and turn it into our greatest opportunity. Left unchecked, the economic disruption caused by climate change will sap our resources and dampen our growth. But with low-carbon technologies and clean, renewable energy, we can capture a new global market, drive American economic growth, and create green jobs for American workers, offering new skills and new earnings opportunities up and down the economic ladder.

CAP's economic blueprint for a new administration would also leverage our creativity, entrepreneurial culture, and a restored leadership in science and technology to create an innovation economy and spur economic growth. It would seek to enhance economic security and mobility for American workers by creating the conditions in which they could protect and improve their own health, education, incomes, and wealth. It would refocus our international economic policy on promoting decent work and higher living

standards around the globe, helping to generate additional demand for American products and services, restoring American leadership, and ensuring that the rising tide produced by economic integration lifts all boats. Finally, CAP's plan offers a responsible pro-growth fiscal policy that would value work and fairness and support necessary investments in our economic future while setting us on a course to reduce the debt as a share of GDP and ready ourselves for the additional demands of the aging baby boom generation.

Restoring economic mobility for Americans, sustaining economic growth in a global economy, and combating global warming are great challenges, but America is up to the task. From sweatshops to segregation to the space race, the progressive commitment to fairness, human dignity, and what FDR called "bold, persistent experimentation" has driven our country to overcome obstacles as great as these we face today.

Introduction

The energy challenge we face in this new century is extraordinary in its urgency, its stakes, its scope, and its opportunity. Of course, energy has long been at the intersection of the economy, environment, and national security, and its availability and price have always been important factors in economic performance. Because energy has been produced over the past two centuries mainly by burning fossil fuels, dirty byproducts soon threatened our air and water and spawned the modern environmental movement. Because critical elements of world energy supply come from unstable regions and hostile nations, energy has, for decades, played an important role in our national security.

But something different is afoot now. The realities of global warming and our growing dependence on oil, much of it imported, will make energy more pivotal than ever to our economic, environmental, and national security fortunes in the 21st century. The challenge we face is nothing short of the conversion of an economy sustained by high-carbon energy—putting both our national security and the health of our planet at serious risk—to one based on low-carbon, sustainable sources of energy. The scale of this undertaking is immense and its potential enormous.

The urgency of this issue demands a president willing to make the low-carbon energy challenge a top priority in the White House—a centerpiece not only of his or her energy policy but also of his or her economic program—to produce broad-based growth and sustain American economic leadership in the 21st century. This task is so encompassing it will demand that the incoming president in 2009 reorganize the mission and responsibility of all relevant government agencies—economic, national security, and environmental.

As part of this reorganization, the incoming president should create a new National Energy Council in the White House led by a National Energy Advisor whose missions will be the energy transformation of our economy and the promotion of these same steps abroad. Our challenge is huge, full of opportunity and risk. And time is working against us. So the president will need the kind of single-minded attention that a fully empowered National Energy Advisor can bring.

Our traditional understanding of energy security has been largely limited to assuring adequate supplies of energy to fuel our economy. That will remain a necessary concern, of course, but not a sufficient one. Going forward our leaders will have to act on an understanding of energy security that turns not just on the supply but on the carbon content of the energy we use. Otherwise, we will consign ourselves long-term to the mercy of international markets and an increasingly variable climate. We must act now

and act boldly to put ourselves on a sustainable footing, in the interest of our national, economic, environmental, and energy security. Simply put, energy will rapidly transform the world for good or ill. The question for the United States is whether we will participate as a leader in the global energy revolution.

This paper insists the United States must lead this revolution. Ours is a vision of an economy in which highly efficient vehicles dominate the roadways, service stations pump large quantities of low-carbon alternative fuels, incandescent light bulbs are entirely replaced by compact fluorescents, and all buildings employ day lighting, solar heating and cooling, as well as highly efficient appliances and air conditioning. In this economy, utility companies will increase their profits when customers *save* energy and draw more than a quarter of their feed stock from renewable sources of energy; coal-fired power plants will be built to capture CO_2 and pump it through a national network of pipelines for geologic storage; and businesses of all kinds will have to factor the cost of carbon into their bottom-line calculations and aggressively pursue low-energy options.

The scale of the change we need is daunting but achievable. In their well-known "wedges" analysis on how to stabilize atmospheric CO_2 at non-dangerous levels, Stephen Pacala and Robert Socolow of Princeton University describe 15 major energy initiatives, any 7 of which would allow us to bring emissions down to an acceptable level during the next 50 years—avoiding about a third of the total CO_2 emissions that would otherwise be released. Each of these wedges is formidable, including, for example, increasing the fuel efficiency of 2 billion cars from 30 miles per gallon to 60 mpg (the worldwide fleet of cars is currently 800 million, but that number is rapidly rising). Other wedges include improving the efficiency of buildings and appliances enough to cut their CO_2 emissions by 25 percent; increasing the efficiency of coal-fired power plants by 50 percent; introducing so-called carbon capture-and-storage capabilities at the equivalent of 1,600 large (500 megawatt) power plants; and dramatically increasing the use of renewables like wind, solar, and biomass in producing electricity.

Taking such action is not just good for our environment. Actions like these can provide a powerful charge to the economy. Our vision of a low-carbon economy includes vigorous private and public research pushing the envelope on technologies that will not only stabilize

U.S. Losing Competitive Edge in Green Technologies

Our foreign competitors are racing ahead of us in key environmental and energy technologies, in large part because of concerted government efforts abroad. Notably

- Companies in the European Union control 70 percent of the world's production of wind turbines.
- Japan and Germany are world leaders in solar cell production.
- Brazil is the global leader in ethanol production for alternative automotive fuel.

U.S. Business and Finance Leaders Recognize Green Opportunities

While venture capitalists pour money into new energy technologies, corporate business leaders are also demanding environmental protection. As evidence

- Venture capitalists invested $2.4 billion in energy technologies in 2006 alone.
- Solar energy companies accounted for the three largest initial public offerings in 2005.
- The annual revenue of solar, wind, biofuels, and photovoltaic cell companies hit $55.4 billion in 2006, up nearly 39 percent over the total revenue in 2005.
- The U.S. Climate Action Partnership, which includes diverse business membership such as General Electric Co., Duke Energy, Alcoa Inc., and DuPont, has embraced mandatory cuts in greenhouse gases of 60 percent to 80 percent below current levels by 2050.

emissions at livable levels during the next 50 years but also create the clean-powered world that our grandchildren and their children will see at the dawn of the next century. Developing, deploying, and building at this scale recalls other great economic transformations in America's past, like the laying of our railroads and the construction of the interstate highway system. But in many ways our new challenge is even more complex since energy powers every part of the economy. Yet that's exactly why these advancements will drive economic growth and American leadership in a competitive global economy well into the 21st century.

The good news is that the technology we need to begin the transformation to a low-carbon economy exists and the investment dollars are available if the policy ground rules are properly established. A great deal of investment and effort will be needed to make this vision real, but the hard work of ushering it in can become a powerful engine for growth, competitive advantage and jobs.

Our competitors are figuring this out, while our national leaders have been asleep at the switch. Over the past 10 years, for example, our market share in producing solar cells has plummeted, while Japan, relying on government R&D and consumer subsidies, has become the world leader.[1] Germany, not known for its sunshine, has also become a solar leader, thanks to some well-placed incentives. European companies have also captured a dominant share, approximately 70 percent, of the world market for wind turbines.[2] And Brazil has vastly reduced its dependence on oil by ramping up its production of ethanol and transforming its auto fleet to run on such fuel.

Our nation has always thrived on its creativity, entrepreneurial character, flexible economic structure, resourcefulness, and can-do spirit. Over and over, in the face of large and difficult challenges—cleaning our air and water, repairing the ozone layer, making cars go farther on a gallon of gas (which we did 30 years ago before reversing direction)—the gloomy chorus has complained that we couldn't succeed, that the economy would fail, that jobs would disappear, that America's competitive edge would be blunted. Every time the naysayers have been proven wrong, and this will happen again when we rise to meet our new energy challenge.

Policies That Are Closer To Home

Voters across the country are empowering their state and local representatives to take action in their communities and in regional initiatives to combat global warming.

- As of the end of September 2007, 691 Mayors had signed the U.S. Conference of Mayors Climate Protection Agreement, in which cities agree to encourage federal and state-level action, in addition to committing to efforts to reduce their greenhouse gas emissions according to the Kyoto Protocol's targets—a 7 percent reduction below 1990 levels by 2012.
- In 2006 California passed the California Global Warming Solutions Act and became the first state to legally bind itself to a set of reduction targets, which aim to achieve 1990 emissions levels by 2020, or 25 percent below what is forecasted. While the state is still in the process of developing the specifics, the California Air Resources Board has released early action steps that will take effect in 2010, if not earlier, and soon the state will mandate emissions reporting.
- In April 2007, Maryland joined at least eight other Northeastern and Mid-Atlantic states in formal discussions on how to design and implement a regional cap-and-trade carbon emissions credit program, known as the Regional Greenhouse Gas Initiative. As part of the agreement, several states have adopted climate strategies and action plans, and set tangible, statewide reduction targets.
- In February 2007, Arizona, California, New Mexico, Oregon, and Washington formed the Western Climate Initiative and were shortly thereafter joined by British Columbia, Utah, Manitoba, and several observers. Together, the region has agreed to a 15 percent emissions reduction below 2005 levels by 2020 and committed to reporting their emissions every two years.
- In September 2007, Minnesota Gov. Tim Pawlenty, currently chair of the National Governors Association, launched the initiative "Securing a Clean Energy Future," which made climate change and energy a central issue for the governors association and created a task force to unify all governors on a path to clean, secure energy.

At a gathering pace, Americans are recognizing and embracing this challenge. Chief executives, venture capitalists, state and local leaders, the general public—everyone, it seems, but the federal government, which keeps running far behind the curve—are taking action. A group of CEOs of major companies including General Electric Co., Duke Energy Corp., Alcoa Inc. and DuPont joined with major environmental groups, under the umbrella of the United States Climate Action Partnership, to call for a far-reaching, mandatory program to cut greenhouse gas emissions by 60 percent to 80 percent below current levels by 2050.

Venture capital has started pouring into clean energy. Solar-energy companies accounted for the three largest technology IPOs of 2005. In 2006, venture capital investments in energy technology tripled to $2.4 billion. Annual revenue for solar power, wind power, biofuels and fuel cells rose from $40 billion in 2005 to $55.4 billion in 2006, nearly a 39 percent increase in one year.[3] John Doerr, the leading Silicon Valley venture capitalist who helped finance Google Inc., Amazon.com, Inc., and Sun Microsystems, Inc., among many others, calls clean energy "the largest economic opportunity of the 21st century."[4] Another leading Silicon Valley financier, Vinod Khosla, is now betting heavily on biofuels and solar thermal.

Meanwhile, states, including long-time leader California and 10 Northeastern states that are implementing a regional carbon cap-and-trade program to cut CO_2 emissions, are also charging forward to produce low-carbon energy, unwilling to wait for our temporizing leaders in Washington. And they are doing this on a bi-

AMERICANS SUPPORT CLEAN ENERGY PROPOSALS DESPITE ATTACKS FROM CRITICS

	PERCENT FAVORING	PERCENT OPPOSING
Provide tax credits to people who use solar and wind energy and companies who produce alternative sources of energy to expand the use of these new sources. Critics say it will end up increasing taxes for average Americans. [500 respondents]	71%	27%
Raise mileage standards for new cars and SUVs over the next ten years to 40 miles per gallon, instead of the current 24 miles per gallon. Critics say it would lead automakers to produce smaller and more expensive cars. [500 respondents]	66%	31%
Require 25 percent of all electricity in the U.S. to come from alternative sources by 2025. Critics say this will raise electricity rates. [500 respondents]	65%	32%
Cap the amount of carbon emissions from power plants and industry to reduce carbon emissions by 2 percent every year. Critics say it will reduce America's economic growth and lead to job losses. [500 respondents]	58%	37%

Notes: This survey of 1000 registered voters was conducted March 19–22 by Greenberg Quinlan Rosner Research.
The sample has a margin of error of approximately + 3.1 percentage points at the 95 percent confidence level.

partisan basis, led by Republicans, such as Governors Arnold Schwarzenegger (CA), Charlie Crist (FL), and Tim Pawlenty (MN), and Democrats such as Governors Bill Richardson (NM), Eliot Spitzer (NY), Christine Gregoire (WA), and Edward Rendell (PA). In addition, under the auspices of the Clinton Foundation, 16 of the world's largest cities, including New York, Chicago, and Houston, have recently agreed to participate in an aggressive program to retrofit buildings—the source of 40 percent of CO_2 emissions—to lower their carbon footprint.

The general public, unsurprisingly, gets it. A recent Greenberg Quinlan Rosner poll, conducted for the Center for American Progress, asked respondents to choose between two alternative perspectives: that the country needs to tackle global warming even if it will cost businesses more to meet stronger regulations on pollution; or that we should not address global warming by putting more regulations on businesses that will cost us jobs and increase prices for consumers. Respondents favored the first by 65 percent to 32 percent.[5] Similarly, by a 79 percent to 17 percent margin, respondents endorsed the view that shifting to new, alternative energy production will help America's economy and create jobs, rather than costing America jobs and weakening the economy.

What has been missing to date is the political will in Washington to seize the energy moment, put in place a series of tough, mandatory rules of the road, back them up with targeted government investments, and begin the work of transforming our economy. The old way of addressing environmental issues apart from the main workings of the economy—as "externalities" or "amenities" in the language of economics—no longer applies. We are confronted now with an issue that is paramount to the preservation of our environment and the sustainability of our eco-

AMERICANS READY TO MOVE AWAY FROM OIL AND COAL AS FUEL SOURCES

	MOVE TO ALTERNATIVE FUELS	CONTINUE TO USE OIL
We should move from oil to alternative fuels for our vehicles because it will cause less pollution, stop global warming and make us more energy independent.	74%	
We should continue to use oil as our main source of fuel for vehicles because other sources for fuel are unreliable, less efficient and will cost consumers more.		23%

	EXPAND CLEAN, ALTERNATIVE ENERGY	EXPAND OIL/COAL PRODUCTION
The most important thing we should do is move quickly to expand the production of clean, alternative energy and reduce our use of oil and coal.	71%	
The most important thing we should do is expand our production of oil and coal. [367 respondents]		27%

Notes: This survey of 1000 registered voters was conducted March 19–22 by Greenberg Quinlan Rosner Research. The sample has a margin of error of approximately + 3.1 percentage points at the 95 percent confidence level.

systems as well as critical to our national security and central to our hope for a new era of economic growth and prosperity.

In this report, we will look at the urgent reasons why we need to make this low-carbon energy transformation—climate change and oil dependency—and then discuss the building blocks (see box on pages 8–9) of a low-carbon economy as well as some of the policy instruments we will need to put those building blocks in place. Specifically, this report will examine the five steps necessary to create this new energy opportunity:

- Implementing an economy-wide cap-and-trade program for greenhouse gases
- Transforming our transportation network by
  - Increasing vehicle fuel efficiency
  - Boosting the production and availability of low-carbon alternative fuels
  - Investing in a low-carbon transportation infrastructure
- Overhauling our electricity industry by
  - Improving the efficiency of energy production and use
  - Increasing production and consumption of renewable energy
  - Promoting the use of "advanced coal" through carbon capture-and-storage systems
- Requiring the federal government, coordinated by a new White House National Energy Council, to manage the energy transformation and structure its own operations to reduce global warming and create a low-carbon economy
- Advancing international global warming policies

A word about the international dimension is necessary. This report's focus is on what we must do at home to transform the energy foundation of our economy, and so the complex issues involved in devising global solutions are largely beyond its scope. But a few short points are in order.

All major carbon-emitting nations, including key developing countries such as China and India, will have to be part of the solution. In fact, most of the future emissions growth will be generated by developing countries who collectively will account for over 75 percent of global emissions growth by 2030.[6]

But far-reaching, mandatory U.S. action has to come first. Without that, the United States will have no credibility to argue for broader global participation.

American action will spur developing world action in two separate ways. First, the policy changes needed to cut carbon emissions in the United States are job-producing and growth-generating actions. Other countries will emulate them, just as China, Russia, Brazil, and other countries have adopted building energy codes and appliance efficiency standards based on U.S. models.

Second, the technologies needed to promote low-carbon economies are increasingly produced and sold in a global market. When America buys compact fluorescent lamps, most of them are made in China, so China automatically develops the manufacturing technology to use them domestically. When America requires that computers and TVs become more efficient, it affects the market in India and Africa. And conversely, when America lags in efficiency or renewable energy technology, either the rest of the world also lags or else other developed countries grab the market and control the export sales to the developing world.

Clearly there are many reasons why the United States needs to capture the energy opportunity by creating a low-carbon economy. So, too, do the rest of the nations of the world. American leadership is paramount, both at home and abroad.

The National Energy Council

Managing the Transition to a Low-Carbon Economy

Capturing the energy opportunity and making the rapid transition to a low-carbon economy will require fully committed presidential leadership and a reorganization of the missions and responsibilities of the economic, national security, and environmental agencies throughout the government.

To this end, the incoming president should create a new National Energy Council of all relevant Cabinet Agency heads, lead by a National Energy Advisor reporting directly to the president. The Council's mission will be to coordinate the relevant policy of all the agencies of the federal government, outreach with states, localities, and the private sector, and U.S. leadership and partnership in international efforts to reduce global emissions.

The Council's first task should be to support the president in preparing energy legislation for delivery to Capitol Hill within 60 days of the inauguration. Within 120 days, the Council should advise the president on an enhanced research and development program in consultation with the Energy Innovation Council, as well as on developing an international agenda for global reductions in carbon emissions. The president should promise on Inauguration Day to convene the Council personally each quarter for the first year to ensure that all of the president's cabinet understands the importance the president puts on this effort. Each agency also shall be charged with developing and reporting on its own plan for helping to achieve the national goals.

10 Steps to a Low-Carbon Economy

The Center for American Progress presents ten broad policy steps to limit temperatures to 3.6˚F (2˚C) above pre-industrial levels—the threshold at which scientists agree humanity can weather the affects of global warming. By pursuing these steps we will create new jobs and new technologies that will boost job growth, productivity, and innovation, restoring our global leadership in key 21st century industries.

Create an economy-wide, greenhouse-gas-emissions cap-and-trade program

Market-based trading of properly priced carbon emission permits will lead businesses, consumers, and governments alike to price the cost of greenhouse gases into their work-a-day world and link the United States to an already emerging global marketplace in carbon credits. We propose to auction 100 percent of these credits, allocating 10 percent of the revenue to businesses operating in energy-intensive sectors. Half of the remaining 90 percent of the revenue will be allocated to low- and moderate-income Americans to help offset energy-related price increases. The remaining half would go to spur science and technology innovation across the board and to drive our transition to a low-carbon economy by funding RD&D projects, tax incentives, and other initiatives described here.

Eliminate Federal tax breaks and subsidies for oil and gas

The federal government currently invests billions of dollars annually in tax breaks and other subsidies to the oil and gas industry. Given the high price of oil, oil companies are making record profits and do not need this government assistance. It is time to shift this investment away from high-carbon dirty sources of energy to the clean energy necessary to power a low-carbon economy. Redirecting this investment to help fund the low-carbon energy policies outlined here will help transform our economy and capture the energy opportunity this transformation provides.

Increase vehicle fuel economy

To create low-carbon transportation across our country we propose a rapid increase in the fuel economy of our vehicle fleet to 40 mpg by 2020 and at least 55 mpg by 2030. This goal is readily achievable through the swift development of existing fuel-efficient technologies, including hybrid and electric technologies as well as more efficient engines that can run on low-carbon biofuels, and through the dedicated research and development to deploy new technologies. Providing incentives to U.S. auto manufacturers to retool their automotive fleets and consumer tax credits for the purchase of more fuel efficient vehicles will also help pave the way for clean transportation in this country.

Increase production and availability of alternative low-carbon fuels

Reducing our nation's dependence on carbon-based fossil fuels requires a dramatic increase in the production and use of bio-based fuels including E85 (85 percent ethanol/15 percent gasoline) and a swift shift to even cleaner cellulosic biofuels and electricity. To achieve these goals, we propose that low-carbon alternative fuels, including electricity, supply 25 percent of our nation's transportation fuels by 2025. We propose two measures to ensure these alternative fuels, over their lifecycle of production to consumption, generate fewer greenhouse gas emissions and are sustainably produced: a low-carbon fuel standard to reduce lifecycle emissions from transportation fuels by 10 percent by 2020; and a renewable fuels certification program with transparent sustainability labeling. To ensure the fueling infrastructure is in place to accommodate this change, we propose a pump-or-plug mandate that requires 15 percent of fuel "pumps" (including dedicated electricity charging stations for plug-in hybrid vehicles) provide low-carbon alternative fuels in any county in the U.S. where 15 percent of vehicles can run on these alternative fuels.

Invest in low-carbon transportation infrastructure

Less fuel-intensive transportation options means less greenhouse gases. To boost greater use of alternative low-carbon transportation we propose new investment in more diverse and inter-modal transportation networks such as local mass-transit networks, regional and interstate long-distance high-speed rail systems, and green city programs to encourage the redevelopment of urban areas and reduce long commutes and suburban sprawl.

Improve efficiency in energy generation, transmission and consumption

Energy efficiency is the cheapest, fastest way to reduce the carbon intensity of our economy. The United States currently uses nearly twice as much energy per dollar of GNP than other industrialized countries, so there is much we can do to reduce the inefficiencies of our energy generation, transmission, and consumption. To this end, we propose a National Energy Efficient Resource Standard to require electricity and natural gas distributors to meet a 10 percent energy savings threshold through efficiency upgrades by 2020, and a major upgrade of the U.S. electricity grid to increase energy and national security, encourage distributed generation, and increase the efficiency of transmission. Additional significant gains in efficiency can be made by requiring efficiency upgrades for our appliances and private, commercial, and federal buildings.

Increase the production of renewable electricity

We can lower the amount of greenhouses gases produced by electric power, which now generates 36 percent of our carbon emissions and will grow dramatically as the demand for electricity increases unless we significantly change the way we produce power through new investments in renewable energy sources and advanced-coal energy production. Specifically, we propose a new national renewable electricity standard to require 25 percent of energy produced in the United States to come from renewable sources by 2025, increasing distributed renewable electricity generation and facilitating investment in renewable energy by improving the structure of production tax credits and low interest loans.

Use carbon capture-and-storage systems to capture and bury the carbon emissions from burning coal

The United States boasts 27 percent of the world's coal reserves, enough to last over 200 years, but coal-fired power plants today account for 80 percent of all carbon emissions from power plants. Our answer is the deployment of new carbon capture-and-storage technologies that allow power plants to burn coal for energy while sequestering carbon emissions in underground geologic reserves across the country. We recommend the establishment of an emission performance standard for all new coal-fired facilities equivalent to the best available capture-and-store technology, and the provision of federal funds to help offset additional costs of implementing carbon capture-and-storage technology.

Create a White House National Energy Council and make the Federal government a low-carbon leader

The federal government must first create a White House National Energy Council to lead all other agencies in making energy and global warming top administration priorities. The new Council will ensure that the U.S. government leads the way on all of these fronts, not just by enacting these proposals but also by wielding the purchasing power of the federal government to promote low-carbon technologies, implementing new tax policies, and creating dedicated federal agencies to address global warming. The federal government must ensure that taxpayer investments reduce and withstand the effects of global warming. It must also create an Energy Innovation Council to spur interagency alternative energy-related research and development, an Energy Technology Corporation to demonstrate the efficacy of these new clean technologies, a Clean Energy Investment Administration to ensure these technologies make it to the marketplace, and a Clean Energy Jobs Corp to promote new "green collar" jobs in a new clean economy. We must also more than double currently existing federal investment in low-carbon energy RD&D.

Lead efforts to advance international global warming policies

Global warming is obviously an international problem that requires concerted action by all countries. The United States needs to reclaim the lead in global efforts to combat climate change by getting our own house in order while simultaneously joining current international efforts to reduce greenhouse gas emissions. This means creating an E-8 of nations comprised of leading developed and developing countries devoted to addressing global ecological and resource issues. And it means taking the lead once again in the U.N. Framework Convention for Climate Change, where the Kyoto Protocol of 1997 on reducing greenhouse gas emissions was first enacted—without U.S. support. As a component of these efforts, the United States must also invest in the energy, environment, and infrastructure sectors in developing nations to alleviate energy poverty with low-carbon energy systems and to help these nations adapt to the effects of climate change.

Capturing the Energy Opportunity

The Urgent Need for a Low-Carbon Energy Transformation

Overview

There is no longer any real question that global warming is occurring as the result of the rapid build-up of greenhouse gases primarily caused by human activities. We are on a trajectory for global warming to become much more intense unless we begin a concerted, rapid shift toward a low-carbon economy. And the danger is increasingly clear and present. As Rajendra Pachauri, chairman of the Intergovernmental Panel on Climate Change and recipient of the 2007 Nobel Peace Prize, has said, "If there's no action before 2012, that's too late. What we do in the next two to three years will determine our future. This is the defining moment."

The Earth's average temperature has already increased by 0.8ºC (about 1.4ºF) over pre-industrial levels, increasing at a rate of 0.2ºC per decade since 1975, and without changing our course, we will lock several more degrees of change into the system.[7] Such temperature shifts may sound small, but they are not. During the last ice age, average global temperature was only about 5.4°C (9.7°F) colder that it is now.[8]

Many of our leading climate scientists have warned that if we exceed 2.0ºC (3.6ºF) above pre-industrial times, we will enter a dangerous, uncharted territory. No one knows at what precise temperature the effects of global warming become intolerably large, whether as a result of gradual worsening of droughts, floods, hurricanes, and heat waves or as a result of abrupt, catastrophic change, such as the collapse of the Greenland or West Antarctic ice sheets and the accompanying global swell in sea levels. But we are conducting a dangerous uncontrolled experiment with the only home we have. This is why young people in increasing numbers are starting to see climate change as the challenge of their generation.

The Washington Post reported in April that, "For many children and young adults, global warming is the atomic bomb of today. Fears of an environmental crisis are defining their generation in ways that the Depression, World War II, Vietnam and the Cold War's lingering 'War Games' etched souls in the 20th century."[9]

Some of the dire projections may not occur, but in light of the warnings from our best scientists, it would be beyond irresponsible to take that bet. Scientists are telling us if we

do not take action soon, it will be too late to avoid the most serious consequences of global warming.

Environmental Costs

The projected environmental consequences of climate change are well known. The only thing that keeps changing, with the steady drumbeat of new and better scientific data and analysis, is that the picture gets more and more serious. In the words of Harvard's John Holdren, one of our leading science policy thinkers, global climate change is the most dangerous of all environmental problems because climate represents the envelope within which all our natural systems operate. By badly disrupting that envelope, we "adversely affect every dimension of human well-being that is tied to the environment."[10]

The Fourth Assessment Report on Climate Change Impacts released in April 2007 by the IPCC, the official body of over 2,000 scientists acting under the auspices of the United Nations, presents

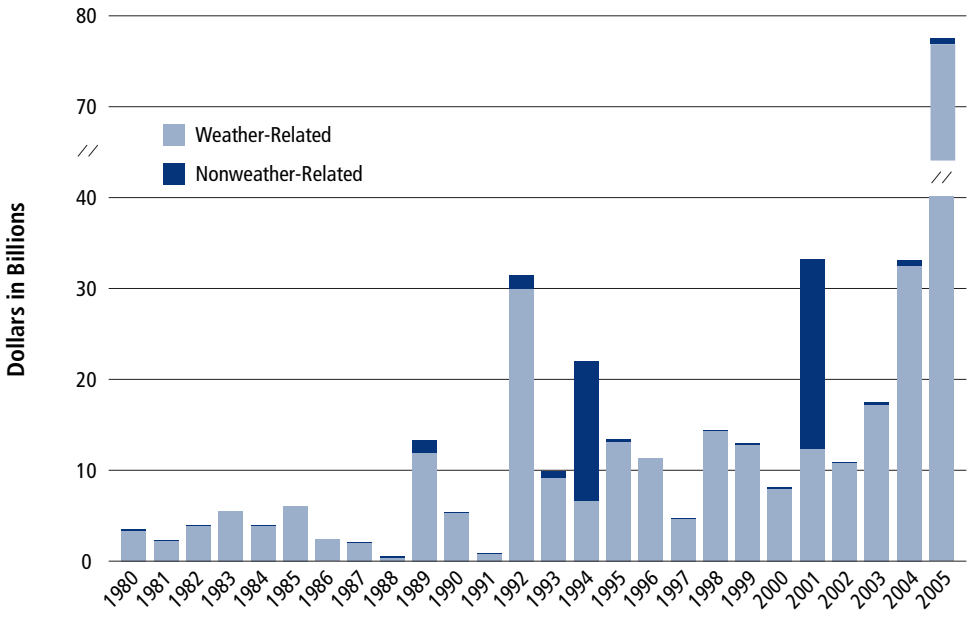
DAMAGE FROM EXTREME WEATHER EVENTS

Clockwise from top left: flooding in Texas, July 2007; remnants of a drought-damaged crop in Minnesota; destruction from Hurricane Wilma as it hit Playa del Carmen, Mexico, October 2005; the result of two weeks of monsoon rain in Bangladesh, August 2007; flooded New Orleans following Hurricane Katrina, August 2005; floodwaters in Topeka, Kansas after six inches of rain fell overnight, May 2007. (AP)

a stark picture. The IPCC report says that "human induced climate change is already affecting physical and biological processes on all continents and some oceans." Among other impacts, the report warns of:

- Extreme weather events such as drought, floods, and severe storms, including hurricanes, becoming more intense and inflicting greater damage to life and property.
- Increasing hurricane intensity. (Other recent scientific findings suggest that not just the intensity but also the frequency of hurricanes is increasing with rising sea-surface temperatures).[11]
- Rising sea levels threatening the mega-delta regions of Asia, coastal cities in Europe, low-lying areas in North and Latin America, and small islands. The melting of the Greenland ice sheet alone could lead to a sea-level rise of seven meters.
- Increased water scarcity facing 1 billion to 2 billion people.
- Increased risk of heat- and flood-related mortality and of water- and food-borne diseases.
- Declining crop yields and increased hunger in some regions, including parts of Africa and Asia.
- Degrading fisheries.
- Declining coral reef systems.
- Extinction facing 20 percent to 30 percent of global plant and animal life.

ANNUAL WEATHER- AND NONWEATHER-RELATED INSURED LOSSES



Source: GAO analysis of PCS, NFIP, and FCIC data.

Key Facts about Global Warming

The projected effects of climate change on our environment, economy, national security, and energy security are serious. Here's a short breakdown of only a few of these consequences:

Our Environment

- The average global temperature is likely to increase by 3.6°F to 5.4°F (2°C to 3°C) above 2000 temperatures by the end of this century—an increase not seen in 3 million years.
- Anywhere from 20 percent to 30 percent of all animal and plant life on earth may go extinct from climate change.
- Islands and coastal communities, including large parts of Bangladesh and the state of Florida, face a serious threat from sea level rise.
- The IPCC predicts declining crop yields, increasing hunger in the dry tropics, and worsening water scarcity problems for 1 billion to 2 billion people.
- Already scientists have concluded that global warming, which is increasing sea surface temperatures, is also increasing the intensity of severe storms and hurricanes. Some studies have even found a correlation between warmer temperatures and hurricane frequency.

Our Economy

- We face increased costs of damage from extreme weather events such as floods, droughts, hurricanes, heat waves, and major storms, and the risk that such events will affect global financial markets
- Between the 1960s and the 1990s, the economic costs of major weather disasters jumped seven-fold and insured losses increased 11-fold. In the future, insurers say that costs, aggravated by climate change, could double from current levels to $150 billion a year in 10 years.
- Environmental and human health as well as economic growth and productivity will suffer under the weight of degrading environmental conditions.
- Oil and gas prices are becoming more volatile, harming consumers, business, and economic growth.

Our National Security

- According to a recent report by 11 former Army generals and Navy admirals, climate change is a "threat multiplier for instability" in volatile parts of the world.
- Coastal cities worldwide are vulnerable to sea level rise, even in the near future. For example, the IPCC identifies Nigeria's capital, Lagos, as one of the African coastal megacities at risk as soon as 2015. These conditions, coupled with rapid population growth projections, are likely to force significant human migration, precipitate economic collapse, and contribute to regional political and economic turmoil.
- In Darfur and elsewhere in Sudan, Ethiopia, and Kenya, water shortages have already led to the desertification of large tracts of farmland and grassland. Fierce competition between farmers and herdsmen over the remaining arable land, combined with simmering ethnic and religious tensions, helped ignite the first genocide of the 21st century.

Our Energy Security

- Our foreign oil deficit of $270.9 billion in 2006 accounted for 33 percent of our nation's total trade deficit.
- Nearly 40 percent of our foreign oil imports come from potentially unstable or hostile countries.
- Other nations are importing more oil from these same countries; world oil consumption is estimated to rise from 83 million barrels a day in 2004 to 118 million barrels a day in 2030, with North America and the developing nations of Asia, including China and India, accounting for the largest increases in consumption over this time period.

Economic Costs

There is substantial uncertainty about the precise economic costs of climate change, but if we continue on our current path there is little doubt that overall they would be very large. A look at trend lines from the insurance industry gives a hint of the kind of rising magnitude of damage we might see from just one projected effect of global warming—extreme weather events.

At the meeting of the U.N. Framework Convention on Climate Change in Morocco in 2001, large reinsurance companies (which offer insurance to other insurers) such as Swiss Re and Munich Re warned of the increase in extreme weather events. According to Munich Re, "The number of really big weather disasters has increased four-fold if we compare the last decade to the 1960s. The economic losses have leaped seven-fold and the insured losses are 11 times greater."[12] In 2004, Swiss Re warned in a report that the costs of natural disasters, aggravated by climate change, threatened to double to $150 billion a year in 10 years.[13]

More systematically, the much discussed Stern Review of the Economics of Climate Change, commissioned by the British government and authored by Sir Nicholas Stern, former Chief Economist for the World Bank, concludes that economic damages from climate change could be seismic:

> Our actions over the coming few decades could create risks of major disruption to economic and social activity, later in this century and in the next, on a scale similar to those associated with the great wars and economic depression of the first half of the twentieth century. And it will be difficult or impossible to reverse these changes.[14]

Stern sees the threat of this major disruption coming from a number of factors, including the increased costs of damage from extreme weather events such as floods, droughts, hurricanes, heat waves, and major storms; the risk that such events affect global financial markets through higher or more volatile insurance costs; and the risk of abrupt and large-scale climate change. Stern also points to the consequences of climate change on the environment and on human health as economic growth and productivity suffer under the weight of degrading environmental conditions.

National Security and Foreign Policy Challenges[15]

Climate change presents the United States with multiple foreign policy challenges quite apart from those directly connected to our nation's deepening dependence on imported oil, which we will detail shortly. These challenges include, for example, increased border stress resulting from the impact of climate change-induced storms and droughts in Mexico and the Caribbean. Or consider the complications posed by ever-scarcer water supplies to political progress in the Middle East.

Perhaps the greatest climate change-induced geopolitical challenge in the short-term, though, will arise in the developing countries in the earth's low latitudes. In these countries, even a relatively small climatic shift can trigger or exacerbate food shortages, water scarcity, the spread of disease, and natural resource competition. Such conditions fuel political turmoil, drive already weak states toward collapse, and threaten regional stability. According

to a recent report by 11 former Army generals and Navy admirals, climate change is a "threat multiplier for instability" in volatile parts of the world.[16]

Nigeria and East Africa pose particularly acute challenges. Nigeria, Africa's most populous country, will confront intense drought, desertification, and sea-level rise in the coming years. Already, approximately 1,350 square miles of Nigerian land turns to desert each year, forcing both farmers and herdsmen to abandon their homes.[17] Lagos, the largest Nigerian city, is one of the West African coastal megacities that the IPCC identifies as at risk from sea-level rise by 2015.[18] These conditions, coupled with rapid population growth projections, are likely to force significant human migration and contribute to regional political and economic turmoil.

The threat of regional turmoil is higher yet in East Africa because of the concentration of weak or failing states, numerous unresolved political conflicts, and the severe effects of climate change. Climate change will likely create large fluctuations in the amount of rainfall in East Africa during the next 30 years—a 5 percent to 20 percent increase in rainfall during the winter months would cause flooding and soil erosion, while a 5 percent to 10 percent decrease in the summer months would cause severe droughts.[19] Such volatility will jeopardize the livelihoods of millions of people and the economic capacity of the region: Agriculture constitutes some 40 percent of East Africa's GDP and employs 80 percent of the population.[20]

In Darfur and elsewhere in Sudan, Ethiopia, and Kenya, water shortages have already led to the desertification of large tracts of farmland and grassland. Fierce competition between farmers and herdsmen over the remaining arable land, combined with simmering ethnic and religious tensions, helped ignite the first genocide of the 21st century.[21] This conflict has now spilled into Chad and the Central African Republic. Meanwhile, the entire Horn of Africa remains threatened by a failed Somalia and other weak states.

Beyond Africa, the IPCC warns that "coastal areas, especially heavily populated mega-delta regions in South, East and Southeast Asia, will be at greatest risk due to increased flooding from the sea and, in some mega-deltas, flooding from the rivers."[22] In South Asia, this will generate political tension as displaced people traverse the region's many contested borders and territories, such as those between Bangladesh, India, Pakistan, and China. In Bangladesh, for example, the combination of deteriorating socioeconomic conditions, radical Islamic political groups, and dire environmental insecurity brought on by climate change could prove a volatile mix, one with severe regional and potentially global consequences.[23]

Climate change will also pose a growing political and economic challenge to China, which could have significant national security implications for the United States. Unless China's pattern of energy consumption is altered, its carbon emissions will reinforce or accelerate several existing domestic environmental challenges—ranging from desertification to water shortages to unhealthy air in urban areas.

In the last few years, concerns over environmental issues have provoked tens of thousands of Chinese to demonstrate across the country. In April 2005, as many as 60,000 people rioted in Huaxi Village in Zhejiang Province over the pollution from a chemical plant, and just three months later, 15,000 people rioted for three days in the eastern fac-

AMERICANS WANT IMMEDIATE ACTION ON CLEAN, ALTERNATIVE ENERGY

	ACT IMMEDIATELY	ACT CAUTIOUSLY
Some people say that America needs to act immediately to make our country less dependent on oil and move to cleaner, alternative energy sources. Other people say that America needs to become less dependent on oil and move to cleaner, alternative energy sources, but we should do so cautiously and take our time.	64%	35%

Notes: This survey of 1000 registered voters was conducted March 19–22 by Greenberg Quinlan Rosner Research. The sample has a margin of error of approximately + 3.1 percentage points at the 95 percent confidence level.

tory town of Xinchang (just 180 miles south of Shanghai) over the pollution from a pharmaceutical factory.[24] China's future—and U.S. foreign policy—will be shaped by how its leadership reacts to intensifying domestic and international pressure to address these challenges.

Oil Dependence and Energy Security Costs

The United States uses over 20 million barrels of oil a day, importing nearly 13 million of these barrels.[25] Our economy's dependence on oil, independent of whether it is domestic or imported, contributes significantly not just to global warming but also to our vulnerability to price shocks. If oil prices spike because of events in Saudi Arabia, Iran, or Venezuela, they will spike for oil pumped in West Texas or off the Louisiana coast as well as for oil pumped in an Arabian desert.

The oil market upheavals of the last 30 years (such as the 1973 Arab oil embargo) have cost the U.S. economy some $8 trillion.[26]

Then there are the economic consequences of our nation's rising dependence on imported oil. In 2006, the U.S. petroleum deficit reached $270.9 billion, an 18 percent increase over 2005, comprising 33 percent of our overall trade deficit.[27] In addition, nearly 40 percent of oil imports come from potentially hostile or unstable regimes,[28] and 92 percent of conventional oil reserves are in these nations.[29]

Oil and gas price volatility can hit low- and middle-income families and small businesses especially hard. Over 79 percent of American workers drive themselves to work, and most of these people cannot switch jobs, telecommute, or buy a new more fuel-efficient car to handle a spike in gas prices.[30] Americans with the lowest incomes spend at least 9 percent of their total income on gasoline.[31] Price volatility makes it impossible for many families to plan accurately for future expenditures.

The combination of oil imported from a number of potentially unstable countries and rising demand, especially from China, makes the prospect of future price shocks all too real. The so-called "reference projection" of the Department of Energy's Energy Information Agency for 2030 shows world oil consumption rising from 83 million barrels a day in 2004 to 118 million barrels a day in 2030, with North America and the developing nations of Asia, including China and India, accounting for the largest increases in consumption over this time period.[32]

Beyond the macroeconomic risk of price shocks, there are two other risks that flow from our reliance on imported oil. First, as noted, oil represents a large chunk of our balance of payments deficit. Second, our dependence on oil-producing countries inevitably affects the conduct of our foreign policy—both our perceived need to use military force to protect our access to overseas oil supplies and the freedom of action with which we pursue our foreign policy objectives. There is little doubt, for example, that the appetite of the international community to press Iran to forego its nuclear ambitions is tempered by the fear that if Iran withheld its oil supplies to retaliate, world oil prices could soar to well over $100 per barrel.

Building a Low-Carbon Economy

The Objective

To design policies aimed at creating a low-carbon economy, we need to understand first the extent to which global average temperatures can rise without triggering the dangerous consequences of global warming detailed in the first section of this report and, second, how low we need to keep the atmospheric concentration of greenhouse gases in order to stay within that temperature limit. Both of these questions (the temperature limit and the concentration limit) must be answered based on scientific analysis of historic climate data and projections of future conditions, and state-of-the-art computer models paint a stark picture of what is to come.

As noted, global mean temperature is about 0.8ºC (1.4°F) above pre-industrial levels, and another 0.6ºC (1.1°F) of further warming is probably built into the system already. Even if we cut off emissions tomorrow, the concentration of greenhouse gases in the atmosphere would continue rising since these gases persist in the atmosphere for a very long time—from decades to thousands of years after they are first emitted depending on the specific type of greenhouse gas.

The evidence is mounting for the need to maintain global average temperatures at no more than approximately 2.0ºC (3.6ºF) above pre-industrial levels, a level the Center for American Progress and others called for in 2005 in "Meeting the Climate Challenge," the report of the International Climate Change Task Force that was chaired by Sen. Olympia Snowe (R-ME) and U.K. Member of Parliament Stephen Byers. As John Holdren has discussed, the scientific view of an appropriate temperature target has evolved recently downward:

> Until a few years ago many analysts and groups were suggesting that stabilization of atmospheric concentrations at a level corresponding to a 3ºC increase was in fact a suitable target…The last few years of accumulating evidence about impacts already being encountered at only 0.8ºC above the pre-industrial average temperature, however, have led many analysts to argue for a more ambitious target, with some (including the European Union) settling on 2ºC.[33]

If a temperature target in this range is not maintained, the planet faces serious risks. In a February 2007 statement to U.N. Secretary-General Ban Ki-moon, and the U.N. Commission on Sustainable Development, Holdren said:

> If the build-up of greenhouse gases pushes the global average surface temperature past 2–2.5°C above the

> pre-industrial level, the danger of intolerable and unmanageable impacts of climate change on human well-being becomes very high.[34]

Dr. James Hansen, the noted climate scientist at NASA's Goddard Institute for Space Studies, has issued similar warnings:

> We conclude that global warming of more than about 1°C, relative to 2000, will constitute "dangerous" climate change as judged from likely effects on sea level and extermination of species.[35]

The IPCC, in its Fourth Assessment Report on Mitigation of Climate Change, published in May 2007, analyzes the concentration levels that correspond to estimated increases in the global mean average temperature above pre-industrial levels. According to this analysis, keeping average temperature to an increase in the range of 2.0°C to 2.4°C would require a CO_2 equivalent concentration—or CO_2e, which is a measurement that expresses the global warming potential of all greenhouse gases compared to CO_2—in the range of 445 parts per million to 490 parts per million, a highly ambitious target.[36]

The challenge before us, then, is clear, and nothing is gained by delay. If we ignore the risks of climate change and oil dependence, or fail to mobilize the political will needed to address them, then we will ultimately be forced into a much more costly and much less effective crash program down the road. A short-sighted, business-as-usual approach to climate change will make it more difficult to cope with increased disaster-related damage in the future and force us to abandon existing infrastructure and equipment and any new physical capital we improvidently deploy without regard to global warming.

Moreover, we would incur a very large opportunity cost, having lost out on the chance to become the economic leader in developing alternative and more efficient uses of energy. Instead, we should seize the moment of challenge and opportunity now to start building the low-carbon economy.

Low-Carbon Economic Policies

To limit global temperature increase to approximately 2.0°C (3.6°F) above pre-industrial levels, we will need to put in

PROJECTED WORLD-WIDE CO_2 EMISSION INCREASES WITHOUT EMISSION CONTROLS (1990–2030), IN METRIC TONS OF CO_2

	1990	2004	2010	2015	2030	2004–2030*
Power Generation	6,955	10,587	12,818	14,209	17,680	2.0%
Industry	4,474	4,742	5,679	6,213	7,255	1.6%
Transport	3,885	5,289	5,900	6,543	8,246	1.7%
Residential and Services**	3,353	3,297	3,573	3,815	4,298	1.0%
Other***	1,796	2,165	2,396	2,552	2,942	1.2%
Total	**20,463**	**26,079**	**30,367**	**33,333**	**40,420**	**1.7%**

* Average annual growth rate. ** Includes agriculture and public sector.
*** Includes international marine bunkers, other transformation and non-energy use.
Source: Int'l Energy Agency, *World Energy Outlook 2006*.

place both a broad, economy-wide policy to limit carbon emissions and, because markets do not operate perfectly, a set of complementary policies to require emission reductions in all sectors of the economy, including such measures as performance standards, tax incentives, and targeted research, development, and demonstration, or RD&D projects. Our core emission-reduction focus should be on the transportation sector, which is powered almost entirely by oil, and the electric power sector, where over 80 percent of CO_2 emissions come from coal. Together, these sectors account for 72 percent of U.S. CO_2 emissions from energy.[37]

Economy-wide Greenhouse Gas Emissions Cap-and-Trade Program

Markets are essential to creating a low-carbon economy. Once businesses have to factor the cost of emitting CO_2 (and other greenhouse gases) into their bottom lines, the power of the marketplace will start to push toward efficiency, low-carbon fuels, renewable energy, and so-called carbon-capture-and-storage technologies for coal-fired power. Market-based pricing is a critical part of the equation but won't work to rapidly transform our economy to a low-carbon model without accompanying complementary policy mandates.

There are two ways to regulate carbon across the broad economy—through a cap-and-trade program and through a carbon tax. Both approaches can work, if designed correctly. Both are cost-effective, market-based mechanisms and both could be imposed at the same point in the supply chain, for example at the mine or refinery.

The distinct advantage of a cap-and-trade program, however, is that it provides greater certainty with respect to the objective of limiting emissions. Designing a carbon tax would require policymakers to make an educated guess about the tax rate needed to hold emissions to the desired level. And factors such as the rate of economic growth would affect how successful the tax was in meeting its objective.

In contrast, a cap-and-trade system would identify the necessary level of carbon reductions, and then allow the marketplace to price the cost of those emissions. Uncertainty about the price of carbon credits can be reduced through provisions that allow companies to borrow emissions permits from later years or "bank" permits they didn't need in a given year, giving businesses more flexibility in meeting low-carbon emission requirements. And, employment of new low- and zero-carbon technologies will help reduce the overall cost of this energy transformation.

Moreover, the cap-and-trade market model boasts a great track record in reducing acid rain. In fact, the United States actually "wrote the book" on cap and trade, creating the oldest and arguably most successful emissions trading system for sulfur dioxide under the acid rain program of the 1990 Clean Air Act Amendments, which has reduced SO_2 emissions at a fraction of anticipated costs and engendered health benefits exceeding program costs by more than 40 to 1.[38] U.S. financial markets are starting to develop nascent carbon markets, too. The voluntary Chicago Climate Exchange came online in 2003 and is currently North America's only greenhouse gas emission registry, reduction, and trading system.

Further, by adopting a market-based model for reducing greenhouse gas emissions, the United States can link up with the rapidly growing international marketplace for carbon credits. Partly for this reason, some of the world's leading banks, including Morgan Stanley, Citigroup, Lehman Brothers Holdings, Credit Suisse, and others are urging the United States and other industrialized nations to adopt cap-and-trade programs rather than enacting carbon taxes. These institutions also warn against over-allocating carbon credits—giving too many credits away for free to carbon-intensive industries rather than requiring those companies to purchase the credits on the open market. The over-allocation of carbon credits can lead to price volatility in the marketplace, as Europe has experienced over the past year and a half.[39]

Since February of 2005, when the Kyoto Protocol came into effect and set carbon caps in participating industrialized countries, carbon markets have taken off at a brisk pace, especially in Europe. In 2006, the carbon market tripled in value to reach $30 billion after the European Union Emissions Trading Scheme came online in early 2005.[40] The EU's cap-and-trade program, which includes all of its 27 member countries and accounts for roughly 45 percent of total EU CO_2 emissions,[41] experienced immediate price volatility as the European Union worked out its credit allocation parameters—a complex process that initially resulted in too many free credits (with immediate market value) being given away.

The United States can learn from these growing pains in the European carbon market in the design of our cap-and-trade system. First, auctioning 100 percent of the carbon credits will avoid windfall profits for polluting industries. Second, ensuring that the number of carbon credits available in the marketplace is linked to a strict emissions cap will help avoid carbon permit price volatility and achieve real emission reductions. And once the United States enacts its own carbon cap, without which a true trading system cannot develop, our cap-and-trade marketplace will integrate more fully into the emerging global marketplace, providing much more liquidity and allowing our highly competitive derivatives exchanges to deploy their proven trading prowess in a new and critical global marketplace for carbon credits.

There are other gains to be achieved with an internationally-linked carbon market. For instance, the demand for international carbon offsets will bring critical finance to developing countries by encouraging investment flows into their energy and environment sectors. In impoverished countries across Africa, Asia, and South America, faltering economies are put at a disadvantage today by antiquated fossil-based energy infrastructures and environmental degradation.

These problems will be exacerbated by climate change over the next 50 years. Through carefully tailored international offset provisions, a carbon market could work hand-in-hand with the U.S. international development agenda to address these problems and help build strong, resilient economies abroad.

The threshold question in constructing a cap-and-trade system is determining how tight the cap should be. We support setting the cap to limit the increase in average global temperature to approximately 2.0°C (3.6°F) above pre-industrial levels. With that objective in mind, legislation

such as that introduced by Rep. Henry Waxman (D-CA) and Sens. Barbara Boxer (D-CA) and Bernie Sanders (I-VT) would require a steadily declining cap on emissions that reaches 80 percent below 1990 levels by 2050.

The IPCC estimates that to meet a goal of keeping the average temperature increase in the range of 2.0 to 2.4°C, global emissions in 2050 would need to be between 50 percent and 85 percent lower than 2000 levels. Moreover, under the IPCC estimate, the global peak in emissions would have to occur very soon—by 2015—and then start to decline.[42]

Under a cap-and-trade plan, businesses would have to obtain permits entitling them to emit a certain quantity of CO_2 or its equivalent in other greenhouse gases. Companies unable to meet their emissions quotas could purchase permits from the federal government or on the open market from other companies which have acquired more permits than they need to account for their emissions.

We recommend auctioning all the carbon permits available under the cap-and-trade system, and allocating approximately 10 percent of the revenue to businesses operating in energy intensive sectors to compensate shareholders, employees, and communities in those sectors. More than that would lead to windfall profits, because companies would recoup most of their additional cost by passing it on to their consumers, as was observed in the first phase of the European Union Emissions Trading Scheme.[43]

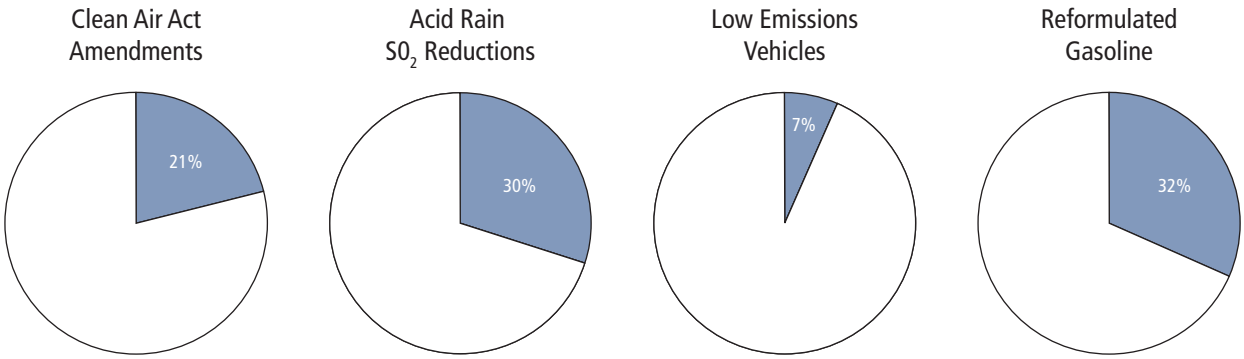
Based on studies that calculate projected auction revenue under different cap-and-trade legislative proposals, we estimate that an economy-wide cap-and-trade program would generate at least $75 billion per year, with the price of emissions permits in the near term likely to fall in the range of $10 to $15 per metric ton of CO_2e.[44] Thus, allocation of auction revenue involves a transfer of substantial wealth and must be handled wisely to ensure equitable and efficient distribution.

Consequently, we would devote half of the remaining revenues, after the initial 10 percent allocation to carbon-intensive companies, to low- and moderate-income Americans in order to help offset any energy price increases that may occur as a result of the transition to low-carbon energy sources. Distributing these revenues to low- and middle-income Americans efficiently will involve formulating ways in which to distribute revenue to all low- and middle-income Americans, including those with the lowest incomes who do not file tax returns.

Distributing these revenues would also require that the distribution system does not contain perverse incentives discouraging greater energy conservation and efficiency. Such an allocation of auction revenue will ensure that the average American consumer does not bear the brunt of paying for the transition to low-carbon energy sources.

We would then devote the other half of the revenue to spur science and technology innovation across the board and to drive our transition to a low-carbon economy by funding RD&D projects, tax incentives, and other initiatives. This entire effort would be self-financed, supported by the revenues generated by the cap-and-trade auction process and the elimination of federal tax breaks, subsidies, and other handouts to the oil and gas industry.

ACTUAL COSTS OF AIR POLLUTION REGULATION IN THE U.S. PROVED TO BE MUCH CHEAPER THAN ANTICIPATED



Source: Environmental Defense, "Air quality measures consistently cost less than predicted."

Eliminating Federal Tax Breaks and Subsidies for Oil and Gas

The federal government currently invests billions of dollars annually in tax breaks and other subsidies for oil and gas, including royalty relief, research and development subsidies, and "accounting gimmicks".[45] Given the high price of oil, oil companies are making record profits and do not need this government assistance. It is time to shift this federal investment—more than $6 billion per year—away from high-carbon dirty sources of energy and towards the clean energy necessary to power a low-carbon economy. Redirecting this investment towards policies to promote low-carbon energy alternatives will help the transform our economy and capture the energy opportunity this transformation provides.

The Costs of Mitigation

The doubters have long said that we cannot afford to tackle climate change, but the truth is we cannot afford not to. There will certainly be real costs involved in shifting to a low-carbon economy, but those costs should be altogether manageable. The price of gasoline and electricity will rise in the near term as the result of an economy-wide cap-and-trade program—putting a price on carbon is, after all, a key device for driving businesses and consumers toward greater efficiency and the use of low-carbon energy.

But the overall economics of transitioning to a low-carbon future are quite promising. As the Stern Review reports, "Tackling climate change is the pro-growth strategy for the longer term, and it can be done in a way that does not cap the aspirations for growth of rich or poor countries. The earlier effective action is taken, the less costly it will be."[46]

First, take a look at some relevant numbers from recent reports. For instance, The Stern Review estimates that a robust set of policies aimed at holding greenhouse gas concentrations to around 550

parts per million of CO_2e are likely to cost about 1 percent of global GDP per year by 2050. But the Review also makes clear that the economic costs of failing to act are likely to be many times higher.

Focusing in on the U.S. economy, the Energy Information Administration performed an analysis of legislation introduced by Sens. Joseph Lieberman (I-CT) and John McCain (R-AZ). S. 280, which calls for an economy-wide cap-and-trade program with gradually tightening caps so that, by 2050, emissions would be one-third of year 2000 levels. This analysis found that, under S. 280, GDP would be 0.3 percent to 0.5 percent lower than it otherwise would have been in 2030, or approximately 0.02 percentage points lower per year.[47]

The Environmental Protection Agency also recently published detailed results based on modeling the impact of the Lieberman-McCain bill. EPA estimates that overall U.S. emissions under S. 280, including both sources covered by the bill and those that were not, would be 44 percent lower than EPA's business-as-usual reference case in 2050.[48]

EPA considered a number of scenarios, making different assumptions about such variables as: the availability of domestic offsets and international credits; the extent of reductions by other countries, both developed and developing; and the extent to which carbon-capture-and-storage and nuclear technologies are available. Different assumptions about these variables obviously affect projected costs, but the base case EPA considered—its so-called S. 280 scenario—provides a useful indicator.[49] EPA used two economy-wide "general equilibrium" models to estimate the cost of carbon credits, the cost of gas and electricity prices, and the cost to GDP growth under its business-as-usual and S. 280 scenarios:[50]

- Carbon credits. One of the models shows carbon credit prices per ton of CO_2e at $13 in 2015, moving up to $27 in 2030 and $70 in 2050; the other model shows prices for the same years were $15, $32, $85.

- Gas and electricity prices. The models indicate that electricity prices would be 22 percent higher in 2030 and 25 percent higher in 2050 than in the business-as-usual case. The models indicate that gas prices would be about 26 cents a gallon more in 2030 than in the business-as-usual case.

- GDP. In the business-as-usual case, GDP is projected to increase 112 percent between 2005 and 2030, and 238 percent between 2005 and 2050. Under the S. 280 scenario, GDP is projected to be between 0.6 percent ($146 billion) and 1.6 percent ($419 billion) lower in 2030, and between 1.1 percent ($457 billion) and 3.2 percent ($1,332 billion) lower in 2050. What this means is that, in the worst case, GDP in 2030 would be 110.4 percent higher than 2005 rather than 112 percent and that GDP in 2050 would be 234.8 percent higher than 2005 rather than 238 percent higher.

Understood this way, it is hard to argue that we can't afford to do what it takes to avoid the serious and potentially catastrophic risks of climate change. These and other studies suggest that the cost of making the large changes needed to shift to a low-carbon economy is moderate.

But the news on cost is actually better than that for several reasons. First, studies like this do not account for complementary policies beyond the basic cap-and-trade

program itself. If supporting policies are implemented simultaneously, the modest negative economic effects are reduced or eliminated. As noted, for example, we would commit half the revenues derived from auctioning carbon credits under a cap-and-trade system to offset increases in energy prices as a result of the transition to a low-carbon economy for low- and moderate-income families.

In addition, the federal government should support "green collar" training to help supply displaced workers with the specialized skills needed to install, operate, and maintain new clean technology.

Beyond such direct assistance, supporting policies are likely to have positive effects on income growth in the longer term. For example, projections for job growth under a renewable electricity standard are sizeable.[51]

Greater efficiency and increased availability of alternative, low-carbon fuels and electricity are also likely to reduce the growth of energy prices over time. And the savings for consumers from efficiency and lower energy prices tend to be sufficient to defray the costs of the initial investments. For example, according to the Union of Concerned Scientists, higher vehicle mileage standards would result in more efficient engine technology, and these efficiency gains could provide consumers enough fuel savings to cover the higher costs of the new technology over the life of a car.[52]

Second, analyses such as those conducted by Energy Information Agency and EPA do not consider the supplemental benefits of reducing emissions. Those benefits are likely to include reduced health care costs and fewer sick days for employees due to respiratory illnesses linked to pollution. Economic benefits would also arise from avoiding the catastrophic and incremental costs of climate change, such as those analyzed in the Stern Report, and from growth in domestic low-carbon energy, fuel, and manufacturing sectors.

Finally, the example of the United States' first emissions trading system—to control acid rain—demonstrated that once the right rules were put in place, the results were better and the costs lower than anyone had predicted. Specifically, the annual cost of reducing sulfur dioxide only reached one-third to one-half of what was projected in 1990 by EPA and the Edison Electric Institute.[53] If we can get the right rules, complementary policies, and leadership in place, there is every reason to believe that American ingenuity and hard work will leave the model results in the dust.

Complementary Low-Carbon Economic Policies

Some economists argue that if we set the right price in a cap-and-trade system (or through a carbon tax), then we could dispense with a wide range of complementary policies such as vehicle fuel economy standards and emission performance standards for all new coal power facilities, since price signals are more economically efficient. That argument may be right in theory, but it is flawed in practice.

Because the energy component of overall cost is often not that high, the carbon price signal required to spur many of the changes we need—whether rapid market penetration of hybrid cars, the purchase of highly efficient appliances, or the development of a workable carbon-cap-

ture-and-storage system for our coal-fired power plants, would be too high as a matter of political reality. That's why we need an energy program that puts a price on carbon and then is accompanied by other complementary environmental and economic policies.

Transportation

To create a low-carbon transportation sector, we need to do three big things, and we need to do them simultaneously and in tandem with the introduction of a carbon cap-and-trade program. We must rapidly increase the fuel economy of our fleet of vehicles. We must push the development of low-carbon, alternative fuels alongside the requisite refueling infrastructure. And we must improve our public transportation infrastructure and city planning to reduce the number of miles we drive.

Highly efficient hybrid cars are becoming well-established and increasingly popular in the United States. J.D. Power and Associates estimates that in the first six months of 2007, hybrid vehicles accounted for 2.3 percent of all new vehicle sales, and projects that by the end of 2007, sales of hybrids will be up 36 percent over sales in 2006 (a record 256,000 hybrids were sold in 2006).[54] Transportation policy should now be aimed at delivering the right incentives to more consumers and especially to our domestic manufacturers in order to increase dramatically the penetration of these and other fuel-efficient vehicles in the U.S. fleet. Even more significant gains in creating a low-carbon fleet of vehicles will come as the next generation of hybrid cars, so-called plug-in hybrids, becomes widely available. Robust government incentives should be deployed to hurry these clean cars onto our roads and highways.

Clean fuels also offer great potential to reduce carbon. Here federal policy should require the rapid increase in the production and market availability of such fuels through both government mandates and intensive government-funded R&D needed to move our clean fuel mix from mostly corn-based to mostly cellulosic biofuels, which would vastly increase our biofuel stock. At the same time, we need to encourage through our transport policy the development of the service station infrastructure required to make alternative low-carbon fuels widely available.

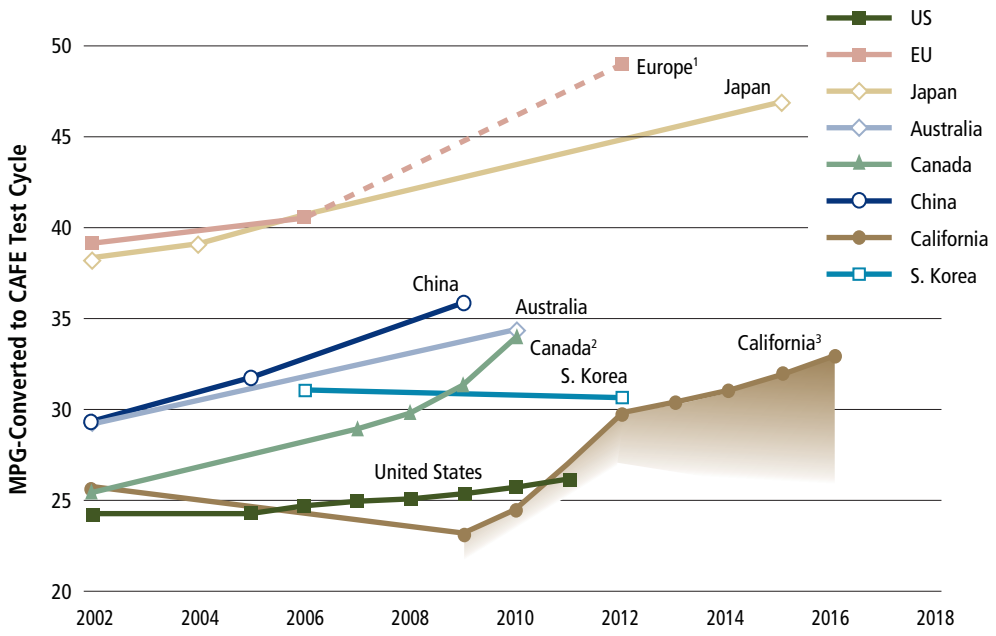
In addition, we must reduce the miles we travel in vehicles through smart transportation and land-use policy that seeks to improve accessibility and increase consumer choice in housing to reduce commuting miles, reduce congestion, and provide new, expanded transit, bus, and rail facilities, both intra- and inter-city.

Together, these steps will increase the number of low-carbon transportation choices available to Americans, reduce our dependence on oil, dramatically cut greenhouse gas emissions and other associated pollutants from this sector, invigorate the creation of new green transportation jobs, and strengthen the competitiveness of U.S. auto manufacturers in the global marketplace. But these critical environmental and economic gains will not happen unless the detailed transportation policies outlined below become part and parcel of overall U.S. low-carbon economic policy.

Increasing Vehicle Fuel Economy

The potential to reduce transportation emissions is large, precisely because the

ACTUAL AND PROJECTED FUEL ECONOMY FOR NEW PASSENGER VEHICLES BY COUNTRY, 2002–2018



Source: International Council on Clean Transportation, *Passenger Vehicle Greenhouse Gas and Fuel Economy Standards: A Global Update*, July 2007.

1 The relative stringency of Europe's CO_2-based standards is enhanced under a fuel economy standard because diesel vehicles achieve a boost in fuel economy ratings due to the higher energy content of diesel fuel.

2 For Canada, the program includes in-use vehicles. The resulting uncertainty of this impact on new vehicle emissions was not qualified.

3 Shaded areas under the California trend line represents the uncertain amount of non-fuel economy related GHG reductions (N_20, CH_4, HFCs, and upstream emissions related to fuel production) that manufacturers will generate from measures such as low-leak, high efficiency air conditioners, alternative fuel vehicles, and plug-in hybrid electric vehicles.

U.S. auto industry has so scandalously underperformed in the past 20 years. In the aftermath of the 1973 to 1974 Arab oil embargo, Corporate Average Fuel Economy, or CAFE, standards were established to reduce U.S. oil consumption. Although our automakers warned of the dire economic impact of CAFE standards, they succeeded in substantially improving the efficiency of the entire motor vehicle fleet (including passenger vehicles and light trucks). These actions helped reduce U.S. oil consumption by 17 percent from 1977 to 1985, even as GDP grew over those years by 27 percent.[55]

By model-year 1985, new passenger vehicles and light trucks were required to meet fuel efficiency standards of 27.5 miles per gallon and 19.5 mpg, respectively.[56] But as fuel prices began falling after 1984, consumers became less interested in fuel economy and automakers started turning their focus from passenger vehicles to light-duty trucks, including minivans and, especially, sport utility vehicles. This undermined overall fuel economy, given the lower standard for light trucks.

Moreover, vehicles heavier than 8,500 pounds were exempted from CAFE standards altogether. And making matters worse, the government, under pressure from the auto industry, found itself unable to agree on any further increases in fuel economy standards, facilitating Detroit's love affair with the

2007 AUTO MANUFACTURER PROFITS ($ MILLIONS)	
U.S.	
General Motors	-1,978.00
Ford	-12,613.00
Daimler Chrysler	4,048.80
JAPANESE	
Toyota	14,055.80
Nissan	3,939.60
Honda	5,064.10
EUROPEAN	
Volkswagen	3,449.00
Volvo	2,205.50
Fiat	1,336.20
BMW	3,598.30
2007 PROFIT RANKING (HIGHEST TO LOWEST)	
Toyota Motor (Japan)	14,055.80
Honda (Japan)	5,064.10
Daimler Chrysler (U.S.)	4,048.80
Nissan (Japan)	3,939.60
BMW (Europe)	3,598.30
Volkswagen (Europe)	3,449.00
Volvo (Europe)	2,205.50
Fiat (Europe)	1,336.20
General Motors (U.S.)	-1,978.00
Ford Motor (U.S.)	-12,613.00

Source: FORTUNE Global 500 Revenue/Profit listings: http://money.cnn.com/magazines/fortune/global500/2007/full_list/index.html. Auto Industry alone: http://money.cnn.com/magazines/fortune/global500/2007/industries/19/1.html

SUV. By 2005, light trucks (including SUVs) accounted for 52 percent of all motor vehicles sold in the United States, a huge increase from their 26 percent market share in 1985.[57]

Since then, CAFE standards for passenger vehicles have not changed, and light truck CAFE standards have increased a mere 2.7 mpg over the last 22 years.[58] Fleet-wide fuel efficiency actually dropped from 25.4 mpg in 1985 to a low of 24.5 mpg in 1999 and 2001.[59] It rebounded a bit in 2005 and 2006 to 25.4 mpg as a result of non-mandated fuel-efficiency improvements, especially in passenger vehicles.

The experience in the rest of the world makes it clear that the technology currently exists to vastly improve the efficiency of our cars, trucks, and SUVs. A recent comparison of passenger-vehicle fuel efficiency around the world found that, in 2006, Europe and Japan led the world with passenger vehicle fuel efficiencies of about 40 mpg while the United States came in last at below 25 mpg.[60]

Competitively, the U.S. auto industry finds itself in difficult straits. It made a bad long-term bet by ignoring fuel efficiency and held onto that bet too long, allowing its competitors in Japan to steal the march on developing and producing highly

efficient hybrid cars, whose market share is rising rapidly. Beginning in 1999, when fuel prices started to climb, U.S. automakers increasingly found it more difficult to sell the high numbers of profitable light trucks that were so important to their bottom lines, leading to significant job losses amid lackluster efforts by senior management to roll out more fuel-efficient cars Americans would want to buy. While high fuel prices and an excessive reliance on light trucks are not the only causes of Detroit's current difficulties, they are clearly significant contributors.[61]

With oil prices projected to remain high, U.S. automakers face a fundamental policy decision with regard to fuel economy. Either they can continue to lobby against fuel economy increases and, even if successful, watch their market share, profits, and jobs dwindle as consumers vote with their feet by purchasing cars that save them money at the pump. Or they can accept higher fuel economy standards and embrace the challenge of competing in the fuel-efficient market, seeking government help to develop the manufacturing capacity they need. The choice should be clear.

For policymakers, the choice should also be clear. We need to implement an aggressive program to revise and ramp up fuel economy standards to save jobs, increase consumer savings, lower our oil consumption, and possibly reduce the U.S. current account deficit. Smart policies that link mandated increases in fuel efficiency with manufacturer and consumer incentives will help Detroit build the production capacity it needs to compete and stimulate consumer purchases of highly fuel-efficient cars.

Fuel Economy Standards

First, we support increasing our nation's fleet-wide vehicle efficiency to 40 mpg by 2020 and at least 55 mpg by 2030.

Corporate Average Fuel Economy Standards

We must vastly improve the fuel efficiency of our nation's vehicle fleet

The U.S. government currently employs separate fuel economy standards for two different vehicle classes: passenger vehicles (27.5 mpg); and light trucks including SUVs less than 8,500 pounds (22.2 mpg). This two-standard system led to a fleet-wide fuel economy of 25.4 mpg in 2006.

We can do much better than 25 mpg. In fact, we should increase our nation's fleet-wide vehicle efficiency to 40 mpg by 2020, with continued improvements to reach at least 55 mpg by 2030. A 2005 Union of Concerned Scientists memo to the National Highway Traffic Safety Administration found that a fleet average fuel economy of 40 mpg is achievable within 10 years, even when only using existing (non-hybrid, gasoline) technologies.[62] *Imagine what is possible using more advanced technologies such as plug-in hybrid vehicles—for example, the Chevy Volt will reach the marketplace in 2010 and could achieve 150 mpg.*

In addition, the Union of Concerned Scientists has also recommended ways in which to close existing CAFE standard "loopholes," which decrease the overall efficiency of our vehicle fleet.[63] SUVs and minivans should be classified as passenger vehicles rather than light trucks. Fuel economy standards should be applied to vehicles over 8,500 pounds. Tax deductions for business purchases of luxury SUVs weighing over 6,000 lbs should be eliminated. And alternative fuel CAFE credits, so called "dual-fuel" credits, should be tied to actual low-carbon alternative fuel usage rather than the mere ability to run on alternative fuels as well as traditional gasoline.

Increasing the efficiency of our vehicle fleet will not only dramatically reduce our consumption of oil and greenhouse gas emissions, but will also create jobs and save consumers money—more efficient vehicles could save their owners a net of more than $2,000 over the life of the vehicle.[64]

Establishing a fleet-wide fuel-efficiency standard would ensure that every vehicle on the road is contributing to a low-carbon economy. Such a fleet-wide average would be overseen by the National Highway Traffic Safety Administration, which would translate the mandated fleet-wide average into different corporate standards for U.S. auto manufacturers based on their current vehicle production fleet.

One current component of the CAFE system that should be preserved is a rule that requires manufacturers to separately average the fuel economy of their imported and domestically produced fleets to meet CAFE standards. This rule has ensured that the production of smaller, more fuel-efficient vehicles and advanced technology vehicles has remained in the United States. Without this measure, it is likely that a number of domestic plants manufacturing more efficient vehicles would be closed and the jobs moved off shore to cut labor costs. We should ensure that our system for guaranteeing greater fuel economy remains sensitive to the need to preserve a strong domestic manufacturing base in next-generation automotive technology.

Increasing vehicle fuel efficiency will sharply cut emissions while saving jobs. According to a report by the Union of Concerned Scientists, raising fleet-wide fuel efficiency to 35 miles per gallon in 2018 (based on a bill introduced by Rep. Edward Markey (D-MA)) would cut oil consumption by up to 1.6 million barrels per day (more than we currently import from Saudi Arabia) and reduce CO_2 emissions 260 million metric tons per year, akin to taking nearly 40 million of today's average cars and trucks off the road in 2020. Such increases would also save as many as 241,000 jobs, and save consumers $37 billion after accounting for the expenditures on new technology in the year 2020.[65]

Feebates

We should also establish a feebate program for all new passenger vehicles sold in the United States. Feebates levy a surcharge on fuel-inefficient vehicles and allocate the money toward incentives or rebates for more efficient vehicles from the same class. They are a revenue-neutral means to spur the purchase of more efficient vehicles.

Manufacturer retooling incentives

Building a low-carbon transportation sector can and will make our domestic auto industry stronger and more competitive with the industry's more fuel-efficient Japanese and European rivals (See table, page 27). The University of Michigan Transportation Research Institute estimates that at gasoline prices between $2.00 and $3.10 per gallon, the profits of domestic automakers would rise considerably if they substantially increased the fuel economy of their cars.

Because a strong manufacturing economy has been a bedrock of the American middle class for generations, we should provide a variety of manufacturer incentives to give U.S. companies the capital they need to retool their production lines and become more globally competitive. This will become increasingly important in coming years, as the market for automobiles booms in countries such as China and India. Indeed, China already has higher fuel economy standards than the United States. If we hope to serve these growing global markets, we must begin immediately to retool our production.

The federal government should provide financial support for U.S. auto manufacturers to invest in new, more efficient vehicle technologies and vehicle assembly infrastructure. (AP Photo/Carlos Osorio)

The government should provide strong financial incentives and support for U.S. automakers manufacturing in the United States to invest in new, more efficient vehicle technologies and vehicle assembly infrastructure. Specifically, we need to create a federal revolving loan fund for manufacturer investments in efficiency or a facilities conversion investment tax credit.

In 2004, the University of Michigan Transportation Research Institute estimated that a facilities conversion investment tax credit of 67 percent to spur production of highly fuel-efficient vehicles in the United States would cost just under $1.1 billion from 2005 to 2009, and lead to switching half of all power trains and 25 percent of vehicle imports to U.S. production. Such a shift could provide the Treasury with over $7 billion in new tax revenues and preserve 59,500 jobs that would otherwise be lost over a 10 year period.[66]

Health Care for Hybrids

Because the private sector provides the bulk of health insurance in the United States, U.S. companies, and especially auto manufacturers, bear a large financial burden not shared by foreign competitors. In fact, U.S. car companies in recent years have spent more money on health care than they have on steel. Current labor negotiations are now resulting in the creation of private health care trust funds called Voluntary Employee Beneficiary Associations, which will help reduce the long-term cost of employee health care at the Big Three automakers. Yet U.S. companies still remain at a competitive disadvantage with foreign producers because of the magnitude of health care and legacy cost burdens, which divert significant capital away from new technology investments.

To boost production of more fuel-efficient vehicles, including but not limited

to hybrids, the federal government could offer relief for legacy health care costs and improved certainty in the long term stability of benefits for retirees—provided that the auto industry reinvests a large share of their financial savings in energy-efficient technology. Such a "Health Care for Hybrids" plan would free up capital for automakers to retool their R&D operations, their automotive designs and their assembly lines to produce highly efficient vehicles like hybrid cars and advanced diesels. The gains for the overall U.S. economy would be huge. We would burn over 1 million barrels of oil a day *fewer* in our automobiles while improving the competitiveness of the U.S. auto industry and the security of American workers.[67]

Fuel Efficiency Tax Credits

Tax credits for purchasing hybrid or other highly efficient vehicles can play an important role in rapidly transforming our nation's vehicles into a more efficient fleet. To encourage purchase of hybrid vehicles, current law provides a tax credit ranging between $250 and $3,400, depending on hybrid vehicle weight, technology, and fuel economy, with more fuel-efficient hybrids receiving higher tax credits.[68] This law should be strengthened in three ways. First, to make the most fuel-efficient vehicles more affordable, the tax credit should be increased to $4,000 per vehicle—the amount now available for vehicles powered by compressed natural gas—and this tax credit should be made refundable.

Second, the tax credit should be made available for the most fuel-efficient vehicles, regardless of vehicle technology. Some of the vehicles that qualify for the current hybrid tax credit are actually not very fuel efficient—the Chevy Silverado hybrid, for example—while others, such as the Ford Escape hybrid and the Toyota Prius, boast meaningful fuel-efficiency capabilities.

Third, the fuel efficiency tax credit should not phase out once a manufacturer has sold 60,000 eligible units, as is now the case with the hybrid tax credit. Under current policy, the credit is reduced 50 percent beginning in the second calendar quarter after the 60,000 limit is reached, reduced again to 25 percent of the initial credit in the fourth calendar quarter, and eventually terminates in the sixth calendar quarter after the limit is reached.

Toyota has already hit this ceiling due to the popularity of its hybrid Prius, which gets up to 60 mpg. Because of the current policy, Americans who chose to purchase a new Prius between April 1 and September 30, 2007, received a tax credit of only $787 compared with the $3,150 credit available before Toyota reached the 60,000 vehicle limit. This limit is an obstacle to achieving higher market penetration for the most efficient vehicles.

Incentives for Advanced Plug-In Hybrids

Plug-in hybrid vehicles hold particular promise for increasing vehicle efficiency, increasing the use of electricity to power our automobile fleet, and acting as a type of networked electricity storage system for our nation's larger power grid, by charging at night when the demand for power is lower and providing power back into the grid during peak power demand. New batteries are capable of powering a vehicle 20 miles to 60 miles on a single electric charge. Since a great many trips on America's roads are 25 miles a day or less, a plug-in with a minimum 25-mile battery range could

completely eliminate gasoline use in the daily commute of millions of Americans. A plug-in hybrid able to drive 20 miles on a single charge would get the equivalent of about 70 mpg on average; a plug-in capable of a 40-mile drive on a single charge would get the equivalent of about 134 mpg.[69]

Moreover, the cost of these "electric gallons" is dramatically less than the cost of actual gasoline. At an average cost of 9 cents per kilowatt-hour and on the assumption that the U.S. average fleet-wide fuel economy is 25 mpg, an "electric gallon" costs 75 cents compared with current average gasoline prices of approximately $3.00 per gallon.[70] Since plug-in vehicles are often charged at night when electricity rates are cheaper, the cost of an "electric gallon" of gas can be even less expensive.

Our electricity system could readily handle a large-scale addition of plug-in hybrids across the country. Overall electricity demand has been estimated to increase only 4 percent to 7 percent even if plug-ins made up half the fleet.[71] And because most cars would be recharged at night, consumers would be taking advantage of a large surplus of "off-peak" excess electric capacity in the grid that is cheaper than "peak-load" energy. The Pacific Northwest National Laboratory reports that idle capacity in the existing electric power grid could charge 84 percent of the 198 million-strong U.S. light-vehicle fleet if these vehicles were plug-in hybrid-electric vehicles.[72]

What's more, there are nationwide low-carbon gains because the production of electricity is more efficient than internal combustion, which in turn means that a plug-in hybrid produces fewer emissions than a gasoline-powered vehicle even if the electricity comes from coal. When the electricity is produced using low- or zero-carbon sources such as wind or solar, the CO_2 savings are even greater.

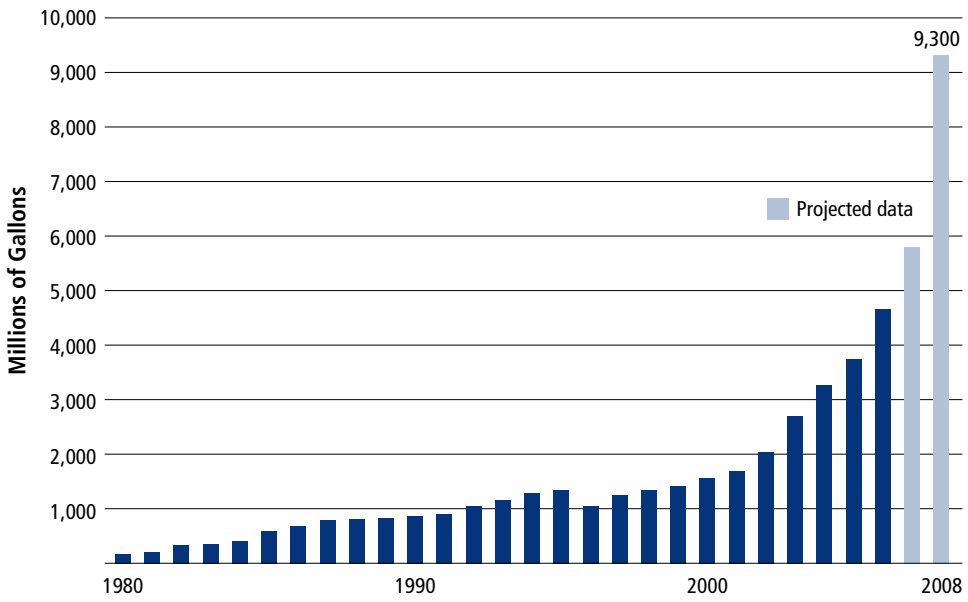
Spurring demand for plug-in hybrid vehicles will also give battery and vehicle manufacturers the market stability necessary for them to make investments in increased production capacity, which will ultimately facilitate economies of scale that will bring down the cost of the batteries needed to power plug-in hybrids and thus lower the retail cost of the vehicles for consumers. The Chevrolet Volt, a flex fuel plug-in hybrid, is predicted to reach the market in 2010. We recommend a refundable federal tax credit of $8,000 to purchasers of the first million plug-in hybrids to dramatically accelerate the production of these vehicles by all of our automakers.[73]

Additionally, plug-in hybrid vehicles would benefit enormously from our proposed feebate system. The reason: Revenue from feebates levied on gas guzzlers would be available in the form of rebates for consumers purchasing new plug-in hybrids, which initially will sport higher sticker prices because of the higher production costs of advanced battery technologies.

Increasing Production and Market Availability of Alternative Low-Carbon Fuels

Increasing our nation's use of low-carbon bio-based fuels, such as E85 (a mix of 85 percent ethanol and 15 percent gasoline), will play a large role in cutting greenhouse gas emissions and our consumption of oil. There are already 4.3 million flexible fuel vehicles on the road that can run on E85.[74] The number

HISTORIC U.S. FUEL ETHANOL PRODUCTION



Source: U.S. Energy Information Administration/Renewable Fuels Association; U.S. Department of Agriculture.

of vehicles that can run on E85 and other low-carbon alternative fuels, including electricity, should grow rapidly, which will require sustained federal support.

Brazil is a test case for what can be accomplished through the use of biofuels, the rapid introduction of FFVs, and the associated refueling infrastructure needed to create a marketplace for these vehicles. Brazil now relies on sugar-based ethanol for 40 percent of its transportation fuel.[75] In 2004, only 30 percent of its new car sales were FFVs.[76] Through the use of smart tax incentives, mandates for government vehicles, investments in distribution infrastructure, and sugar subsidies, Brazil transformed its auto fleet so that, by the end of 2005, 71 percent of its total vehicle sales were FFVs.[77]

The key for the United States to meet aggressive biofuel goals is to move from corn-based biofuels to cellulosic biofuels, the latter of which is produced from agricultural plant waste, such as rice straw or corn stover, or dedicated crops such as switchgrass, a fast-growing, drought-resistant perennial grass, or algae. Cellulosic feedstocks can potentially provide much greater quantities of biofuel with lower "lifecycle" CO_2 emissions—meaning the amount of CO_2 emitted during the production and transportation of the biofuel as well as during its use in automobiles—than corn-based ethanol. In addition, diversified sources of cellulosic ethanol would compete with corn-based ethanol in the marketplace, helping to stabilize the cost of corn as a key source of food and feed. Two early generation cellulosic ethanol plants are currently under construction in Georgia[78] and Louisiana,[79] signaling that this technology is making strides.

A recent University of Minnesota study suggests that mixed grasses grown on marginal land without fertilizers or pesticides would produce 51 percent more en-

LOWER CARBON BIOFUEL ALTERNATIVES COMPARED TO GASOLINE

	GASOLINE	BIODIESEL	CORN-DERIVED ETHANOL	CELLULOSIC ETHANOL
	BAD	GOOD	TRANSITIONAL	POTENTIALLY GREAT
Description	A non-renewable fossil fuel produced by refining crude oil; emits large quantities of CO_2 upon combustion.	A renewable alternative to petroleum diesel produced from animal fat or vegetable oil.	The main source of ethanol in the U.S. But growing corn is energy-intensive and requires large amounts of fertilizer made with fossil fuel.	Production results in the same ethanol that corn produces, but the feedstocks, especially switchgrass, are inexpensive and easy to grow and the process of refining them is environmentally friendly.
Net Energy Balance *	n/a	3.20	1.34	2.62
Reduction in Greenhouse Gas Emissions	None (1 gallon produces 19 lbs of CO_2)	67.7%	21.8%	91%
Cost (per gallon)	$3.10	$2.90 average	$2.55 (E85)	$2.55 (E85)
Gallons/Acre	n/a	Varies by feedstock Rapeseed: 127	328	Varies by feedstock Switchgrass: 1000
Current U.S. Production (gallons/year)	79 billion	75 million	4.9 billion	(no current production at commercial scale)
Availability	114,974 stations	1,485 stations	1,133 (E85)	1,133 (E85)

ergy per acre than corn grown on fertile land.[80] And fewer greenhouse gases are emitted during the cultivation of dedicated energy crops for cellulosic biofuel production because less petroleum-based fuel is used than in the cultivation of traditional crops.

Moreover, dedicated energy crops themselves can absorb CO_2 emissions through photosynthesis; perennial grasses can absorb 14 times the CO_2 that they produce after a decade of growth.[81] Additionally, a portion of the waste products generated during the production of the biofuel can become the biomass fuel needed to power biorefineries, further reducing emissions compared with coal-based power generation.

Nor is ethanol the only renewable biofuel. Biodiesel, produced from agricultural crops such as soybeans as well as waste cooking oils, currently comprises less than 1 percent of the transportation fuel consumed by Americans,[82] but it has the great advantage of requiring virtually no modifications to our automotive technology or fueling infrastructure to be used. A different experimental fuel, biobutanol, is attractive because it has an energy content almost as high as gasoline (ethanol contains only 67 percent of the energy content of gasoline per unit volume[83]) and because, unlike ethanol, biobutanol can be transported through the same fuel pipeline distribution infrastructure that currently transports gasoline.

The increased production and consumption of biofuels will provide a boon to our rural economy. Revenue earned from selling energy biomass and saved from not having to dispose of agricultural residue will remain in local rural communities. And rural bio-refineries will provide jobs in plant construction, operations, and maintenance.

The Renewable Fuels Association reports that in 2005, the ethanol industry created over 150,000 U.S. jobs, increasing household income by $5.7 billion and contributing about $3.5 billion in tax revenues at the local, state, and federal levels.[84] Given new goals to vastly increase renewable alternative fuel production over 2005 levels, these job and income numbers are likely to rise dramatically.

Biofuels and other types of bio-based energy will not solve all of the world's energy challenges. Nonetheless, as the recent increase in bioenergy investment worldwide suggests, in appropriate regions and with effective regulatory safeguards, bioenergy has a direct role to play in diversifying energy sources and contributing to economic growth and development, particularly in rural communities in both the developed and developing worlds.

As mentioned earlier (see page 31), advances in plug-in electric-hybrid vehicle technology point to electricity as another increasingly viable low-carbon alternative fuel. Our electricity system could readily handle a large-scale addition of plug-in hybrids to the fleet.

Finally, the development of hydrogen as an alternative fuel is also gaining ground, thanks in large degree to the major emphasis the Bush administration has placed on this technology. The use of hydrogen fuel cells as distributed sources of energy to power buildings and military installations is becoming more common. However, although hydrogen-powered vehicles are under development by a number of domestic and international auto manufacturers as well as the U.S. military, they currently are less efficient on a lifecycle basis than hybrid vehicles and are too expensive for commercial sales.[85] The majority of hydrogen produced today is made using fossil fuels, such as natural gas.[86] So, although the tailpipe emissions of a hydrogen vehicle consist of water vapor rather than CO_2, the lifecycle greenhouse gas emissions still remain large. Research into low-carbon means of producing hydrogen, such as through the use of solar energy to split water remains promising and should continue.

To boost low-carbon, alternative fuels, we should take the following steps:

Alternative Fuel Standard

First, we should significantly ramp up U.S. production of alternative low-carbon fuels with an aggressive alternative fuel standard: low-carbon, alternative fuels, including electricity, should supply 25 percent of our transportation fuels by 2025. Current legislative efforts are a good start but do not go far enough to ensure necessary quantities of sustainably produced alternative low-carbon fuels. Renewable fuel standards such as those recently called for by President Bush and the U.S. Senate focus on increasing the volume of domestic biofuel production. The president called for 35 billion gallons per year of renewable and alternative fuels by 2017 in his 2007 State of the Union Address. The recently passed Senate Energy Bill requires an increase in renewable and alternative fuel production to 36 billion gallons per year by 2022, with two-thirds of this volume produced from something other than corn.

But according to an Energy Information Agency reference-case projection, the Senate's 36 billion gallon renewable fuel mandate would be equivalent to only 13 percent of fuel consumption in 2025. EIA's projection, however, assumes very

WHAT DOES IT DO?	ENVIRONMENTAL BENEFITS	ECONOMIC/JOB BENEFITS
ECONOMY-WIDE GREENHOUSE GAS EMISSIONS CAP-AND-TRADE PROGRAM		
• Cap U.S. greenhouse gas emissions to achieve an 80% reduction in emissions by 2050. • Auction 100% of carbon permits	• Works to stabilize global average temperatures at no more than 3.6 degrees F above pre-industrial temperatures, avoiding the worst projected impacts of global warming.	• Generates at least $75 billion annually in auction revenue, for the first 10 years of the program. • Stimulates investment in RD&D, consumption of low-carbon technologies, and creates green jobs. • Helps offset energy costs for low- and middle-income Americans during the transition to a low-carbon economy.
ELIMINATE FEDERAL TAX BREAKS AND SUBSIDIES FOR OIL AND GAS		
• Eliminate tax breaks, royalty relief, research and development subsidies, and accounting "gimmicks" for the oil and gas industry.	• Shifts federal investment in oil and gas toward low-carbon energy alternatives.	• Generates more than $6 billion annually over 10 years for investment in the low-carbon policies described below.
TRANSPORTATION		
Increasing Vehicle Fuel Economy		
• Mandate an increase our nation's fleet-wide fuel efficiency to 40 mpg by 2020, and at least 55 mpg by 2030. • Establish a feebate program for all new passenger vehicles sold in the U.S.to levy a surcharge on fuel inefficient vehicles and allocate the money towards incentives or rebates for more efficient vehicles in the same class. • Provide manufacturer retooling incentives to support the production more fuel efficient vehicles. • Establish a "Healthcare for Hybrids" program where the federal government offers relief for legacy health care costs in return for auto industry investment in and production of more fuel-efficient vehicles. • Establish federal fuel efficiency tax credit of $4,000 per vehicle for the most fuel efficient vehicles, regardless of vehicle technology. • Create a refundable federal $8,000 tax credit to purchasers of the first 1 million plug-in electric hybrid vehicles.	• Cuts gasoline consumption and reduces tailpipe CO_2 emissions by driving the marketplace towards more fuel efficient vehicles. • Reduces greenhouse gas emissions through adoption of plug-in hybrid vehicle technology because production of electricity is more efficient than internal combustion, even if the electricity is produced by dirty coal.	• Drives consumer demand for more fuel efficient vehicles. • Creates more low-carbon technology auto manufacturing jobs. • Improves the competitiveness of U.S. auto industry in the global marketplace and improves the security of American workers.
Increasing Production and Availability of Alternative Low-Carbon Fuels		
• Establish an Alternative Fuel Standard to require low-carbon alternative fuels (including electricity) supply 25% of our transportation fuels by 2025. • Update the Volumetric Ethanol Excise Tax Credit (VEETC) by making it a variable credit, based on the price of oil. • Establish a Low-Carbon Fuel Standard to reduce the lifecycle emissions from transportation fuels by 10% by 2020 to ensure investment in alternative fuels serves both to enhance energy independence and combat global warming. • Establish a Renewable Fuels Certification Program to ensure the sustainable production of these fuels though a transparent certification and labeling program. • Mandate that 15% of fuel "pumps" (including dedicated electricity charging stations for plug-in electric hybrid vehicles) provide low-carbon alternative fuels in any county in the U.S. where 15% of vehicles can run on these alternative fuels.	• Spurs investment in low-carbon alternative fuels, reducing gasoline consumption and reducing greenhouse gas emissions. • Helps avoid sharp increases in food and feed prices. • Ensures sustainable biofuel production methods that maximize lifecycle greenhouse gas reductions, conserve land and water resources, maintain biodiversity, and avoid the introduction of invasive species.	• Helps ensure stable a stable marketplace and supply of low-carbon alternative fuels. • Creates more jobs in the low-carbon fuel industry.
Investing Low-Carbon Transportation Infrastructure		
• Invest in a wide range of federal policies and incentives to improve public transportation and reduce the number of miles Americans drive in personal vehicles, including investing in smart growth, promoting mass transit ridership, and investing in high-speed rail corridors.	• Cuts gasoline consumption and reduces CO_2 emissions through decreasing the need for Americans to drive personal vehicles on a daily basis.	• Increases investment and green job growth in land-use planning and transit construction.

WHAT DOES IT DO?	ENVIRONMENTAL BENEFITS	ECONOMIC/JOB BENEFITS
ELECTRICITY		
Improving Energy Efficiency		
• Create a National Energy Efficient Resource Standard to require electricity and natural gas distributors meet a 10% energy savings through efficiency upgrades by 2020. • Decouple utility sales from profits to make it easier for utilities to make efficiency upgrades. • Upgrade the U.S. electricity grid to increase energy security, encourage distributed generation, and increase the efficiency of transmission. • Require appliance energy efficiency improvements. • Increase building efficiency through improving building codes, retrofitting public buildings to higher standards, incentivizing deployment of distributed energy technology, and providing energy efficient housing energy grants and mortgages.	• Reduces greenhouse gas emissions by increasing efficiency of electricity production and transmission, decreasing electricity consumption, and reducing projected growth in electricity and natural gas sales.	• Saves consumers and businesses money through efficiency and conservation measures. • Increases investment in energy efficient technologies and green construction and increases job growth in these sectors.
Increasing Production and Consumption of Renewable Electricity		
• Establish a Renewable Electricity Standard to require 25% of electricity produced in the U.S. to come from renewable sources including distributed sources by 2025. • Improve the structure of production tax credits and low interest loans to facilitate investment in renewable energy generation.	• Increases the proportion of electricity produced from low and zero carbon sources and increases the efficiency of electricity distribution, reducing greenhouse gas emissions.	• Increases investment in the renewable electricity sector and creates jobs in this sector.
Using Carbon Capture-and-Storage Systems to Capture and Bury the Carbon Emissions from Burning Coal		
• Invest in commercial demonstration projects that include CO_2 sequestration, transport through pipelines and storage in different geologic settings. • Require all new coal fired facilities to meet an emission performance standard equivalent to the best available control technology, and provide federal funds to help offset additional costs of implementing carbon capture and storage technology.	• Reduces greenhouse gas emissions from the power sector by preventing emissions from coal-fired electricity facilities from reaching the atmosphere.	• Provides certainty for future investments in new coal fired power plants, and creates jobs in this sector.
CREATE A WHITE HOUSE NATIONAL ENERGY COUNCIL AND MAKE THE FEDERAL GOVERNMENT A LOW-CARBON LEADER		
• Fully deploy the purchasing power of the federal government to help spur the market for fuel efficient vehicles, alternative low-carbon fuels, energy efficiency, and renewable energy. • Ensure that taxpayer investments reduce and withstand the effects of global warming. • Require the federal government to work in partnership with state and local governments, businesses, non-profit organizations, and other community members to develop adaptation strategies to climate change. • Establish a White House National Energy Council to prioritize energy and global warming as top Administration priorities. • Create a new interagency group, the Energy Innovation Council, responsible for developing a multi-year National Energy RD&D Strategy for the U.S. • Create an Energy Technology Corporation to finance and execute large-scale, commercially credible demonstration projects. • Create a Clean Energy Investment Administration to reduce investment risk in clean energy projects with loan guarantees. • Create a Clean Energy Jobs Corps to provide training for "green collar" workers in clean energy industries. • More than double currently existing federal investment in low-carbon energy RD&D.	• Reduces fuel consumption, increases energy efficiency, and reduces emissions across the Executive Branch. • Ensures smart federal investments in projects in the lowest-greenhouse gas emitting projects that are the most resilient to the projected impacts of climate change. • Provides for better hazard preparedness and disaster response and recovery plans to help U.S. communities and our natural environment adapt to a changing climate. • Reduces emissions and improves energy security across all sectors of the economy.	• Provides a large market for and increases investment in low-carbon energy technologies. • Increases green job growth in low-carbon sectors. • The mission of these new federal agencies and entities and the goal of increased investment in federal low-carbon RD&D will be the energy transformation of our economy.
ADVANCING INTERNATIONAL GLOBAL WARMING POLICY		
• Create an E-8 (modeled after the G-8, but comprised of the world's leading developed and developing countries) devoted to the key ecological and resource issues confronting the world. • Invest in the energy and environment sectors in developing nations to alleviate energy poverty with low-carbon energy systems and to adapt to the effects of climate change.	• Devotes specific international attention to solving key ecological and resource issues. • Reduces emissions and growth in emissions globally by investing in low-carbon international assistance. • Improves global resiliency of communities and ecosystems to climate change through investment in adaptation measures.	• Spurs the global market for low-carbon and energy efficient technologies and increases green job growth.

Misplaced Enthusiasm

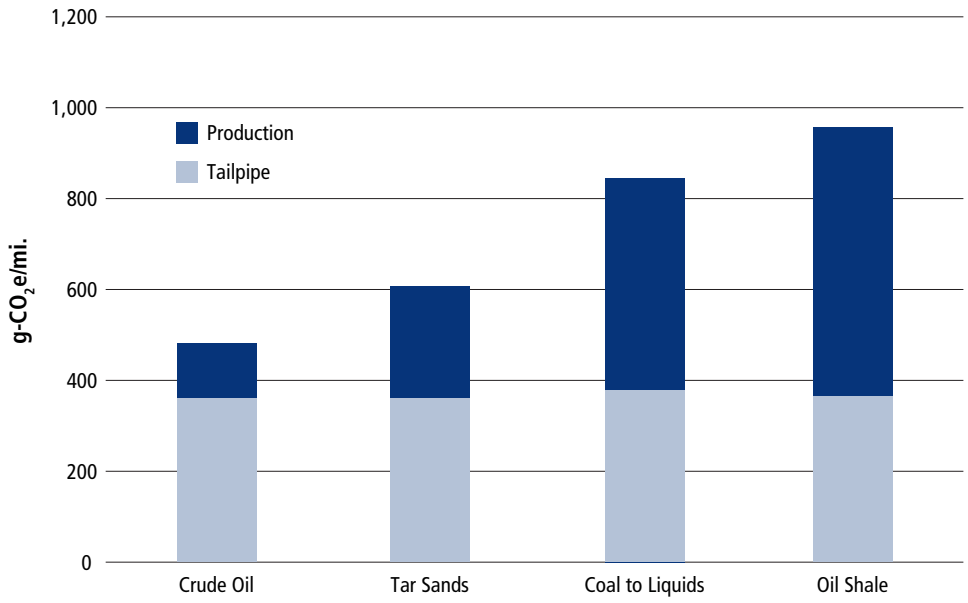
Coal-to-liquid technology is no alternative

The enthusiasm surrounding coal-to-liquid technology is misplaced. If carbon capture-and-storage technologies (see page 54 for the details) are developed and widely commercialized, then coal will be able to continue playing a large role in the production of electricity, but not in transportation. At worst, coal-to-liquid fuels produce twice as many global warming emissions as gasoline. Even if the carbon associated with liquid coal production is captured and stored, liquid coal produces 4 percent to 8 percent greater global warming emissions than gasoline. We need to be encouraging the production of cleaner alternative fuels, not taking a step backward to produce fuels that are dirtier than the status quo.

modest improvements in fuel efficiency and little impact on projected increases in consumer demand for fuel. If the United States moves to significantly improve the fuel efficiency of our fleet, as we call for, then fuel consumption will decline, and the Senate mandate would represent a greater percentage of this future consumption.

That's why we need to ensure that the sustainable production of alternative transportation fuels, including electricity for plug-in hybrids, lowers the lifecycle

HIGH-POLLUTION FUEL ALTERNATIVES ARE NOT THE ANSWER
Lifecycle GHG Emissions



Note: Values shown are averages and ignore considerable uncertainties in some cases.
Source: Natural Resources Defense Council, *Driving It Home: Choosing the Right Path for Fueling North America's Transportation Future*, 2007.

greenhouse gas footprint of the entire transportation sector. Some policy measures to achieve this end have already been detailed, and others follow below.

Updating the Volumetric Ethanol Excise Tax Credit

Because the alternative fuel standard described above will provide more market certainty and increase investment in production of biofuels, we recommend extending and updating the existing volumetric ethanol excise tax credit, or VEETC. The current VEETC is a flat $0.51 per gallon of ethanol and is set to expire in 2010. As the volume of ethanol used as transportation fuel increases and greater investment certainty is established, we should ensure that the cost of this tax credit to the federal government remains acceptable. How? By making the VEETC variable, based on the price of oil; the VEETC would increase as the price of oil decreases, and vice versa.

Low-Carbon Fuel Standard

Our pursuit of alternative fuels must serve both to enhance energy independence and to combat global warming. Not all alternative fuels are created equal in terms of their lifecycle greenhouse gas emissions or other effects on the environment. That's why it is important to couple any alternative fuel standard with a low-carbon fuel standard that requires reductions in the lifecycle emissions of the fuels sold in the United States so that we are encouraging the production of the cleanest fuels possible moving forward.

Alternative fuels that reduce our dependence on oil but worsen climate change, such as coal-to-liquid technology (see sidebar, page 38), are a fool's bargain.

But truly sound alternative fuel standards are imperative. That's why we support legislative proposals in the House and Senate that would replicate California's low-carbon fuel standard nationwide, requiring fuel providers to reduce by 10 percent the lifecycle emissions from the transportation fuels they refine and sell by 2020. On a national scale, this low-carbon fuel standard could cut greenhouse gas emissions by 265 million metric tons by 2020.[87] This low-carbon fuel standard, however, should not "pick winners" or specify which alternative fuels may be used to meet this mandate. It should instead allow the marketplace and fuel providers to drive the choice of alternative low-carbon fuels.

Renewable Fuels Certification Program

Some have raised concerns about the potentially negative consequences of intensive biofuel production, such as the increased conversion of land for energy-producing crop production. Clearly, we must be careful that pursuing biofuel production does not create competition that would sharply boost food and feed prices. Many preliminary studies are encouraging. For example, one study indicated that a 50 percent increase in crop production in Africa is possible without incurring trade-offs between food and energy.[88]

But we will need to take great care to develop an appropriate regulatory framework to ensure that increased biofuel production does not compete with food production or lead to widespread deforestation and excessive use of water. We must also ensure the use of sustainable biofuel production methods that maximize lifecycle greenhouse gas reduction methods, maintain biodiversity, and avoid the introduction of invasive species.

Example of low-carbon alternative fuel pump. There are currently only 1,133 public service stations that sell E85—this number must be dramatically increased. (Charles Bensinger and Renewable Energy Partners of New Mexico, DOE/NREL)

Consequently, we propose a voluntary Renewable Fuels Certification Program to establish transparent certification and labeling criteria in order to encourage sustainable production of biofuels. Such a program will allow farmers to grow a "green" renewable biofuel crop according to broad-based and widely accepted standards and verified by an independent third-party certifier. With such a program, we can encourage sustainable biofuel production and at the same time promote local farmer-owned biorefineries and processing facilities, and give farmers the opportunity to contribute their know-how and resources to combat climate change.

Pump or Plug Mandate

Shifting to a low-carbon transportation system requires not just the alternative low-carbon fuels and the vehicles that can run on these fuels, but also a new refueling infrastructure. Drivers of highly fuel-efficient vehicles have to be able to fill up at accessible, convenient service stations. However, of the 4.3 million vehicles currently on the road that can run on E85, 99 percent run on regular gasoline because E85 is rarely available to the everyday driving public.[89] The National Ethanol Vehicle Coalition reports that there are only 1,133 public service stations that sell E85, out of 170,000 service stations—and more than one-third of these stations are in Illinois and Minnesota.[90]

To correct this problem, we should institute a low-carbon alternative fuel "pump or plug mandate" to ensure that low-carbon alternative fuel pumps and dedicated electricity sources for plug-in hybrids are built where there is demand. Specifically, in any counties in the nation where 15 percent of registered vehicles can run on low-carbon alternative fuels, we should require that 15 percent of pumps provide such fuels. To protect locally owned "mom and pop" gas stations without the capital necessary to fund the conversion, the 15 percent pump requirement should be limited only to owners of 10 or more gas stations.

Investing in Low-Carbon Transportation Infrastructure

Besides investing in more fuel-efficient vehicles and low-carbon alternative fuels, the third way to reduce greenhouse gas emissions from the transportation sector is simply to drive less, reducing the number of vehicle miles that American commuters travel. Like energy efficiency, the fuel we avoid burning to meet our transportation needs is the cheapest and cleanest alternative available.

In addition to reducing our carbon emissions, investing in new infrastructure for smart growth and transportation

FLEX-FUEL VEHICLES AND PUBLIC E85 STATIONS IN EACH STATE

STATE	# FLEX FUEL CARS/ STATE	# OF PUBLIC E85 STATIONS
Alabama	91,984	0
Alaska	9,542	0
Arizona	77,169	7
Arkansas	55,251	4
California	257,318	2
Colorado	63,725	22
Connecticut	33,708	0
Delaware	16,491	1
Florida	307,093	2
Georgia	165,608	5
Hawaii	14,993	0
Idaho	16,595	2
Illinois	207,483	146
Indiana	105,495	86
Iowa	58,049	65
Kansas	48,519	18
Kentucky	56,802	3
Louisiana	92,631	0
Maine	14,974	0
Maryland	90,411	3
Massachusetts	69,834	1
Michigan	243,668	44
Minnesota	105,728	308
Mississippi	39,848	0
Missouri	107,888	72
Montana	13,386	0
Nebraska	36,859	31
Nevada	24,031	7
New Hampshire	15,967	0
New Jersey	116,512	0
New Mexico	32,209	3
New York	173,229	2
North Carolina	121,547	12
North Dakota	15,165	23
Ohio	205,658	39
Oklahoma	55,549	0
Oregon	47,563	3
Pennsylvania	174,943	9
Rhode Island	11,066	0
South Carolina	68,303	41
South Dakota	18,813	61
Tennessee	93,698	6
Texas	415,207	31
Utah	31,227	4
Vermont	8,753	0
Virginia	112,368	1
Washington	64,453	2
Washington DC	2,476	0
West Virginia	27,392	1
Wisconsin	116,054	63
Wyoming	10,008	3

alternatives has many spin-off benefits, increasing property values (especially near transit networks), creating high-skill construction jobs, providing real transportation choices for commuters, investing in more livable communities, and increasing job access for low-income workers. Investing in a more diverse and inter-modal transportation network is a long-term strategy for meeting climate challenges and a critical part of an integrated approach to reducing our nation's carbon footprint.

A wide range of federal policies and incentives shape America's transportation and land-use decisions. Chief among these is the federal transportation bill, which has long placed undue emphasis on highway construction as the primary investment in the mobility of our citizens. As we face the challenge of building a robust economy in a carbon-constrained world, we will by necessity build a more diverse, efficient, and inter-modal transportation network. This will be driven by a host of mutually reinforcing policies.

VOLUNTARY RENEWABLE FUELS CERTIFICATION PROGRAM

How It Works

STEP 1
Growing Crops with Standards

When a farmer decides to grow a crop to sell as a "green" renewable energy crop, he or she must follow standards to attain certification that ensures the biofuels are being grown in a sustainable manner.

STEP 2
Certification

As the crop is grown, the farmer has the crop inspected by an independent third-party certifier. If the crop passes the tests conducted by the inspector, the crop will be certified and the appropriate documentation will be issued to the farmer.

STEP 3
Delivery and Payment

The farmer takes the crop to a nearby biorefinery or processing facility along with the crop's certification and other documentation. The farmer is paid a contract rate plus an agreed-upon premium for the crop.

STEP 4
Processing

The biorefinery processes the "green" energy crop and blends it with conventionally grown biofuel according to a specific formula. Over time, the proportion of "green" crop to conventional crop should be increased to create a more sustainable biofuel.

STEP 5
Sale

The resulting product is sold as a premium "green" product.

First of all, we must dedicate more funds for mass transit: for new construction, for the expansion of existing services, and for operation and maintenance. Currently, demand for federal funds to initiate mass transit construction projects far outstrips federal budget allocations. We must help our cities meet smart growth demands. We can also increase incentives for communities to build better and more effective transit systems by increasing the percentage of the federal match for new mass transit rail networks and high speed bus systems, and by strengthening federal programs that promote mass transit ridership through workplace and other incentives. At the state and regional level, we can also have great impact on reducing long-distance automobile travel by promoting the construction of new high-speed rail corridors in the Midwest, South, and West Coast, and by upgrading the already successful rail projects in the Northeast.

In our cities, too, we can promote denser, more desirable, and pedestrian-friendly neighborhoods by funding programs that redevelop abandoned and polluted urban lands close to transit networks—specifically by funding the expansion of the highly successful Brownfields program, which has brought much blighted urban land into vibrant and productive use. The low-carbon benefits of restructuring our cities are both short- and long-term. For example, if we construct over a million new homes every year based on new green home building standards, then the carbon impact could be profoundly long-lasting. Additionally, a recent study found that two-thirds of the development in the United States by 2050—homes, offices, and other non-residential buildings—will be built between now and then.[91] If 60 percent of this new growth were built using new compact land development patterns, this would reduce the need to drive by 30 percent and could save 85 million metric tons of CO_2 annually by 2030.[92] Rebuilding our metropolitan regions to promote new modes of transportation that in turn promote shorter commutes is ultimately a critical step toward creating a low-carbon economy.

Transportation Research, Development, & Deployment

To create the most fuel-efficient transportation solutions, we recommend that overall federal funding for low-carbon energy research should be more than doubled over what we currently spend. Alongside research, development, and deployment incentives for low-carbon vehicles and transportation infrastructure, the federal government must ramp up funding for RD&D of advanced battery technologies. The benefit of these technologies is that they have multiple applications outside the automotive sector—from space exploration to military operations—and thus represent a valuable investment for federal research dollars.

Federal research programs should not only increase support for the development of vehicles built to run on low-carbon alternative fuels but also the development of low-emitting fuels. We already are experienced in producing and marketing ethanol made from corn. Now, we should direct federal research dollars toward scientific breakthroughs to enable large-scale, cost-effective production of cellulosic ethanol, biodiesel, and other low-carbon fuels. Greater resources must also be dedicated toward the development of drought-resistant, non-invasive energy crops that produce more energy on an energy-input, water-input, and land-acreage basis.

The Nuclear Non-Alternative

The uncertainties remain problematic

Existing nuclear power provides a valuable low-carbon energy source; yet nuclear waste storage, and the dangers of proliferation remain serious unsolved concerns. Nuclear power is expensive and likely to remain so if we ever try to construct enough new capacity fast enough to make a difference in carbon emissions. For these reasons, our low-carbon economic policies call for investment in renewable energy sources and advanced coal rather than new nuclear facilities.

Electricity

Electricity powers our homes, offices, and factories.[93] Electricity for all purposes accounts for 36 percent of U.S. CO_2 emissions.[94] Burning coal produces 50 percent of our overall electricity, but 82 percent of CO_2 emissions from electricity. Natural gas and petroleum combustion account for the remaining 18 percent of emissions from electricity production.

As in the case of transportation, the road to low-carbon electricity is conceptually clear and consists of three basic elements: efficiency, renewable energy, and advanced coal technologies. While none of these steps is easy to implement, they also represent great opportunities for our economy and are far safer that another source of "clean" energy: nuclear power (see sidebar above).

There are enormous opportunities to save energy through efficiency, with measures aimed at deploying the technology we have on the shelf as well as developing still better alternatives. Consider that in states where there has been a commitment to efficiency over the past 30 years, electricity use per capita has been cut by 40 percent compared to the national average without beginning to exhaust the potential and at a lower cost than constructing new conventional electricity resources. But also note that renewable energy boasts great potential right now, as is clear from the 11 percent of electricity produced in California from renewable energy resources, compared with 2 percent production levels nationwide, due to renewable energy policies in place in that state since 1980.[95, 96]

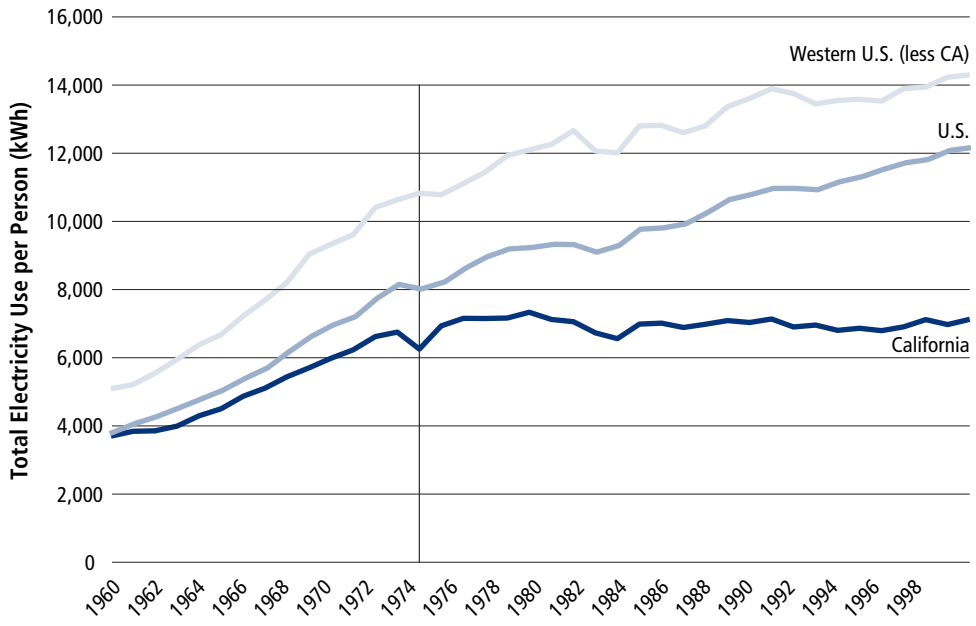
Advanced coal technology, including the capture, transport, and geologic storage of CO_2 from coal-fired power plants, is a much newer concept, but is absolutely vital. Scaling up an advanced coal system is an immense endeavor, requiring full-scale demonstration projects, the promulgation of new rules for geologic repositories, and RD&D to perfect the system. But unless we conquer the coal challenge—not only in the United States but globally, especially in China and India—our efforts to control global warming will likely fail.

Improving Energy Efficiency

Energy efficiency may seem unexciting, but it is the cheapest, fastest, and cleanest way to reduce the carbon intensity of the economy, and it has huge potential. In a May 2007 report on energy efficiency titled "Curbing Global Energy Demand: The Energy Productivity Opportunity," the McKinsey Global Institute says:

U.S. PER CAPITA ELECTRICITY USE

California Electricity Use Per Person Is Not Increasing Because of Efficiency Measures



Source: California Energy Commission, *2002–2012 Electricity Outlook Report*, February 2002.

A concerted global effort to boost energy productivity—or the level of output we achieve from the energy we consume—would have spectacular results. By capturing the potential available from existing technologies with an internal rate of return of 10 percent or more—an extremely robust rate—we could cut global energy demand growth by half or more over the next 15 years.

The easiest-saved ton of CO_2 emissions comes from the oil or coal you didn't burn in the first place because you were able to get the job done using less energy. The energy guru Amory Lovins has even coined a term for these savings, "negawatts." Efficiency works. It avoids emissions and saves money.

Look at what has occurred already. The total energy use per dollar of GNP in the United States has declined by nearly half since the 1970s.[97] Compared to a 1973 baseline, we save more energy than we produce from any single source. Appliance standards already have had a potent impact on reducing the demand for energy. For example, refrigerator efficiency more than quadrupled from 1972 to 2005, and dishwasher efficiency has doubled since 1998.

California has led the way. Since 1975, California's energy efficiency programs have kept the state's per capita energy consumption flat at around 7 megawatt hours per person, while the rest of the nation's energy consumption has increased by almost 50 percent.[98] During this same time period, California per

capita CO_2 emissions have decreased by 30 percent, while national per capita CO_2 emissions have remained level.

Moreover, implementing these energy efficiency programs has cost less than half what it would cost to increase electricity generation in the absence of such programs and has added over $4 billion to California's economy.[99]

As the McKinsey report says, there is enormous potential to do much more. The United States uses nearly twice as much energy per dollar of GNP as other industrialized countries.[100] More than two-thirds of the fossil fuels we burn in power plants is lost as waste heat.[101] Three of Pacala and Socolow's 15 "wedges" are based on efficiency, one for fuel efficiency in vehicles, but two more for efficiency in electricity generation or use: getting the efficiency of coal-fired plants up to 60 percent; and improving end-use efficiency in the building sector by 25 percent.

Our capacity to realize the potential of energy efficiency depends on smart and aggressive federal policy. Right now, because of anemic national policy, we are leaving enormous energy savings on the table. We are producing emissions and losing money. We need to reverse the equation—make money and lose the emissions. The following are the key steps we need to take.

National Energy Efficiency Resource Standard

Following the lead of states such as Texas, Hawaii, Nevada, Connecticut, and at least five others, we should establish a national energy efficiency resource standard. A national EERS would require utilities to meet energy savings targets, which they could do by offering efficiency programs to their customers, improving the efficiency of energy distribution, and implementing combined heat and power generation systems. Texas, for example, now requires utilities to offset 10 percent of their demand growth through end-use energy efficiency, or in plain English to improve the efficient use of energy in industry, agriculture, households, and other energy users.[102] A national EERS that required 10 percent efficiency savings for electricity and natural gas by 2020 would save approximately one-quarter of the projected growth in electricity sales by 2020.[103] What's more, a national EERS would save consumers and businesses $170 billion.

Decoupling Utility Sales from Profits

In order to effectively implement national energy efficiency upgrades, we must decouple utility sales from profits. As long as utilities make money based on how much electricity they sell, they have an obvious disincentive to promote end-use efficiency. Decoupling busts that disincentive. California, Idaho, and New York have shown leadership in decoupling this way, and six additional states are considering decoupling.

If we pursued decoupling and instituted a profit incentive to save rather than use energy (as demonstrated by these leading states) across the country, then we could make enormous efficiency improvements.

Grid Improvements

The Northeast Blackout of 2003 exposed the fragility of our electricity infrastructure. Passenger rail transportation shut

down, gas stations were unable to pump fuel, and airports were unable to carry out screenings, causing international and regional air transportation to cease.

The blackout revealed that our electrical grid is ill-equipped to deal with the large increases in congestion caused by high energy demand. We are relying on outdated, impractical, polluting technologies that impose both environmental risk and security liabilities on our nation. The Electric Power Research Institute estimates that outages and quality fluctuations cost U.S. businesses more than $120 billion a year. And as our demand for electricity increases, the problem will only get worse unless we take action.

Updating our electric grid can improve our economic and national security, even as it cuts carbon. A modern grid will increase efficiency and lower emissions by reducing congestion and making the best use of the energy we already produce. It will encourage distributed generation that not only improves reliability but increases the efficiency of transmission by reducing the waste of electrical line loss and generating energy close to the point of use. A modern grid will also encourage energy efficiency by improving the flow of information through strategies such as real-time pricing that establish strong market signals to promote conservation of electricity.

We need to provide incentives to create a smart grid, making it more efficient, reliable, and capable of drawing on sometimes intermittent renewable resources. To move toward deployment of a revamped, "smart" electricity grid, we support the recommendations of the non-partisan Energy Future Coalition, a group that seeks to change U.S. energy policy to address the economic, security, and environmental challenges related to the production and use of fossil fuels and to explore economic opportunities created by the transition to a low-carbon economy. The EFC recommendations would establish a set of national performance standards for future investments in the electricity grid. And they would create a "21st Century Electricity System Security and Modernization Fund" to support investments in smart grid technologies.[104]

Moreover, utilities already have planned expenditures in their capital project budget pipelines that, with the proper regulations and incentives, could be leveraged to finance smart grid technology. As Steven Pullins writes in the Smart Grid Newsletter, the projected costs of developing a smart grid should not be more than 6 percent above current business-as-usual capital projects budgets and may be a good deal less.[105]

Appliance Efficiency Standards

It is time to reinvigorate the process of setting efficiency standards for appliances. The Bush administration has dropped the ball here, not issuing any standards, despite the impressive record of appliance efficiency improvements in the 1980s and 1990s and the statutory deadlines for more than two dozen rules.

As a result of a recent court settlement in a case brought by a number of states and environmental groups, the Energy Department has finally agreed to issue 22 overdue appliance standards during the next four years. Congress needs to conduct vigilant oversight to make sure this commitment is addressed in a way that meets national policy goals as well as statutory requirements. At a minimum,

Congress needs to ensure the program is adequately funded and produces robust results. And if that fails, then Congress should shift the standards-setting responsibility to an agency that can better discharge it.

Upgrade Efficiency Standards for Residential, Commercial, and Federal Buildings

We need to boost efficiency in the building sector, which accounted for 39 percent of U.S. carbon emissions in 2005, approximately equivalent to the combined total emissions of Japan, France and the United Kingdom.[106] A combination of building codes, energy efficiency, and green building recognition programs such as Energy Star or Leadership in Energy and Environmental Design, or LEED, standards, financial incentives such as those offered by utilities, and tax incentives can accomplish this.

Once again, California has set the pace with a building code that has allowed the state to avoid building thousands of megawatts of new generating capacity. The federal Energy Policy Act of 2005 authorized $125 million over five years for states that adopt and implement energy-efficient building codes for both residential and commercial structures, but the money has never been appropriated. It should be, promptly. That same federal legislation also included tax incentives for efficient buildings and equipment. Legislation has been proposed to expand and extend those incentives, and that legislation makes good sense.

Global cities are also leading the way. The Clinton Foundation recently announced a pilot program through its Clinton Climate Initiative with 15 of the world's largest cities—from Johannesburg, Karachi, and Tokyo, to Houston, Chicago, and New York—that is designed to spur a massive increase in investment in energy efficiency retrofits of existing buildings. This public-private partnership brought together five of the world's largest banks, each pledging $1 billion toward energy efficiency retrofits.

Additionally, the four largest energy service companies in the world—Honeywell, Johnson Controls, Siemens, and Trane—will provide new financing and expanded capacity in the private sector to undertake energy audits, conduct building retrofit projects, and guarantee those energy savings that would result. This public-private partnership demonstrates clearly how political leadership with bold vision can create new markets and new investment, in this case literally doubling the market for energy efficiency in buildings overnight.

Sound policies that promote efficiency, encourage new markets, and foster both public and private investment in climate solutions can be a major source of economic growth. Such policies can include improved building codes, retrofitting public buildings to higher standards, establishing new incentives for deploying low-carbon, distributed energy technology, and for low-income and public housing, including energy efficiency housing grants, public housing vouchers, and energy-efficient home mortgages. All of these efforts, meanwhile, can create new industries and construction jobs for American workers.

RD&D on Energy Efficiency

Here, as in many other areas, we are hurt by a weak federal RD&D effort.

U.S. RENEWABLE ELECTRICITY GENERATION

SOURCE	ELECTRICITY GENERATING CAPACITY IN 2007 (GIGAWATTS)	% OF TOTAL ELECTRICITY GENERATING CAPACITY IN 2007
Conventional Hydropower	79.98	8.49
Geothermal	2.45	0.26
Wood and Other Biomass	2.22	0.24
Solar Thermal	0.53	0.06
Solar Photovoltaic	0.04	0.00
Wind	16.42	1.74
Total Non-Hydropower Renewable Electricity	**21.66**	**2.3**
Total Renewable Electric Power Sector	**101.64**	**10.79**

Source: Energy Information Administration.

The Bush administration energy efficiency request for 2008 is more than a third down from 2002 budget levels. More broadly, the federal government spent less than $2 billion on energy R&D last year, a third of what it spent 25 years ago.[107] During that period, government spending on medical research jumped almost 300 percent to $28 billion, and government military research climbed 250 percent to $75 billion.[108] When John F. Kennedy proposed to put a man on the moon and return him safely home again within the decade, he marshaled the resources of a nation to accomplish the task. At a minimum, expenditures on energy R&D must be more than doubled to respond to our current climate crisis.

Increasing Production and Consumption of Renewable Electricity

While non-hydro renewable energy is a very small part of our energy equation right now, providing only about 2 percent of total U.S. electricity capacity, it has great potential to play an important role in a low-carbon economy. The policy framework, however, is critical.

The Energy Information Agency reference case—essentially a business-as-usual projection that takes into account projected technology improvements, but not improvements that are the result of new policies—still shows non-hydro renewable energy accounting for only about 2 percent of electricity by 2030.[109] To move off that tepid path, we need a smart set of polices to propel the sector forward.

This makes sense for both environmental and economic reasons. Renewable sources such as wind, solar, biomass, and geothermal produce not just very few greenhouse gas emissions but more jobs, too. A 2007 analysis by the Union of Concerned Scientists suggests that a 20 percent national renewable electricity standard by 2020 would create 185,000 jobs, save consumers $10.5 billion on energy bills through 2020, and reduce CO_2 by 223 million metric tons a year.[110]

In the past decade, our competitors, using smart policies, have made great progress on renewable technologies, seizing leadership in both wind and solar technology. The United States has wind and solar sources far greater than those in Europe or Japan. The missing

KEY RENEWABLE ELECTRICITY SOURCES

WIND

Wind is an abundant resource in the United States, and is well distributed across the country. Wind farms on good sites can generate electricity at 3 cents to 5 cents per kilowatt hour, or about as cheaply as coal or natural gas at today's prices. Wind is also a job creator. Every 100 MW of new wind power has been estimated to create 200 construction jobs and as much as $1 million in local property taxes.

But wind is also a greatly underused resource and underdeveloped industry in this country. In Germany and in some parts of Spain and Denmark, wind supplies more than 20 percent of electricity, while in the United States, wind provides less than one percent. While U.S. government support for wind power has been erratic, marked by short-term extensions of the federal production tax credit, in other countries where wind power has taken off at a faster rate, renewable power producers get the benefit of long-term purchase agreements at adequate prices.

Wind power still faces challenges—it is an intermittent resource and some have protested over the aesthetics of wind farms and potential hazards posed to birds and bats—but these are challenges that can and should be met, given the cheap, plentiful and emission-free qualities of wind power.

SOLAR AND SOLAR-THERMAL ENERGY

Energy from the sun, converted by photovoltaic cells or by concentrated solar technologies such as parabolic trough technology, provides a very small share of our electricity, but is rapidly growing. Global production of solar cells increased by 500 percent between 2000 and 2005, and while costs are still substantially above those of fossil fuels, they have fallen by 90 percent since 1970 and are still dropping.

Solar-thermal technology—using solar energy to convert water into steam which turns turbines—is also gaining ground. A major benefit to this technology is that steam can be stored, allowing these facilities to provide power at all hours of the day, not just when the sun is out.

Once again, though, the United States is missing out where it could be capitalizing on opportunities. In the last 10 years, our market share in producing solar cells has dropped from 44 percent to 10 percent, while Japan and Germany have become solar leaders. German firms that make photovoltaic panels and other components now employ 40,000 people, and 15,000 more work in the solar thermal business, which makes systems for homes and businesses.

BIOMASS

Biomass is another encouraging source of renewable energy, and can generate electricity through various processes. The most common use of biomass for electricity production is through co-firing in power plants along with coal; over 100 such co-firing operations are up and running in the U.S. Co-firing provides a host of environmental benefits, including reducing sulfur and nitrogen oxides, key components of acid rain and smog, as well as reducing lifecycle CO_2 emissions.

Combusting methane captured from landfills, sewage treatment plants, and livestock operations is also a form of bio-power. Combusting methane converts it into carbon dioxide; this practice is doubly beneficial because it produces energy and keeps methane (a greenhouse gas 21 times more potent than CO_2) from reaching the atmosphere. Biomass gasification is yet another technique for converting biomass to electricity, and can be used in combined-cycle generation systems which reach efficiencies close to 60 percent. In comparison, modern supercritical coal-fired power plants currently achieve efficiencies around 40 percent.

Further deployment of biomass for energy is hindered by the same inconsistent policy framework that plagues other renewable energy technologies such as wind and solar. Long-term subsidies or tax incentives would allow the nascent industry to attract necessary new investments.

GEOTHERMAL

Geothermal energy is harvested from heat that percolates up from the Earth's mantle to the surface. It is a renewable zero-emission resource that holds enormous potential for deployment in the U.S. and internationally. Geothermal energy can be used both for electricity production and for home heating (through geothermal heat pumps). At the end of 2005, the U.S had 2,828 MW of grid-connected geothermal power, satisfying the electricity needs of roughly 4 million people. Furthermore, over 600,000 geothermal heat pump units are installed nationwide, and between 50,000 to 60,000 additional units are installed every year, which is the highest installation rate in the world.

Geothermal energy has a lot of untapped potential. The Geothermal Energy Association projects that by 2025 geothermal resources could provide 30,000 MW of electricity nationwide. The capacity to bring this promising renewable energy resource to market depends partially on continued federal R&D, but the administration's FY 2007 and FY 2008 DOE budget requests contained no money for geothermal R&D.

MARINE

Marine energy can be harvested from waves and tides. Wave energy is harvested from the sea surface, where moving water creates kinetic energy that is captured by floating buoys connected to pistons. Tidal power, in contrast, originates from the gravitational pull of the moon on the Earth's oceans, and can power underwater turbines. The Electric Power Research Institute estimates that wave resources alone could generate 2.3 trillion kWh of electricity per year, which is over eight times the output of current U.S. hydropower facilities.

While this technology is still being fine-tuned, it is close to commercialization, and a few pilot projects are already up and running, including a project in New York's East River. Additionally, Pacific Gas and Electric recently announced a $1.5 million research project to study the energy potential and associated costs of developing tidal energy in the San Francisco Bay.

To facilitate deployment of marine energy, the Federal government must increase funding for research and development, which up to this point has been negligible, and must streamline the regulatory process to allow private developers to test and ultimately install marine energy projects around U.S. coastlines.

ingredient here is willpower and a set of clear, predictable rules.

Wind Power

Wind is an abundant resource in the United States, well distributed across the country and with particular power in the Great Plains, a region that has been described as the "Persian Gulf" of wind power. Wind farms on good sites can generate electricity at 3 cents to 5 cents per kilowatt hour, or about as cheaply as coal or natural gas at today's prices.[111]

But wind is also a greatly underused resource and underdeveloped industry in this country. Europe currently controls approximately 70 percent of the world's market share of wind turbines.[112] In Germany and in some parts of Spain and Denmark, wind supplies more than 20 percent of electricity, while in the United States, wind provides less than 1 percent.[113]

A good part of that difference can be traced to government policy. In those countries, renewable power producers get the benefit of long-term purchase agreements at adequate prices. Here, by contrast, government support has been erratic, marked by short-term extensions of the federal production tax credit, often after substantial delays. This kind of approach obviously makes it very difficult for businesses to plan.

Wind power, however, still faces challenges. Because wind is an intermittent source, utility managers need to learn how to integrate it into their power grids. And some local residents have protested over the aesthetics of wind farms, while others have expressed concerns over the hazards posed to birds and bats. But these are challenges that can and should be met, given the cheap, plentiful, and emission-free qualities of wind power.

Moreover, wind is a job creator. Every 100 MW of new wind power has been estimated to create 200 construction jobs and as much as $1 million in local property taxes.[114]

Solar and Solar-thermal Energy

Energy from the sun, converted by photovoltaic cells or by concentrated solar technologies such as parabolic trough technology, provides a very small share of our electricity, but that share is rapidly growing. Global production of solar cells increased by 500 percent between 2000 and 2005.[115] Global grid-connected photovoltaic capacity increased by 55 percent in 2005, faster than any other source.[116] And while costs are still substantially above those of fossil fuels, they have fallen by 90 percent since 1970 and are still dropping.[117] Investors are voting with their wallets; the three largest technology IPOs of 2005 were for solar-energy companies.[118]

Solar-thermal technology—using solar energy to convert water into steam which turns turbines—is also gaining ground. A major benefit to this technology is that steam can be stored, allowing these facilities to provide power at all hours of the day, not just when the sun is out. Vinod Khosla has made solar-thermal energy one of the key technologies he is pursuing. And at the September 2007 Clinton Global Initiative meeting, Florida Power & Light officials unveiled plans to build Florida's first large-scale solar thermal power plant, a 500-megawatt facility.[119]

Once again, though, the United States is missing out where it could be capitalizing

on opportunities. In the last 10 years, our market share in producing solar cells has dropped from 44 percent to 10 percent, while Japan, relying on government R&D and consumer subsidies, has become the world leader.[120] Germany has also become a solar leader, thanks to some well-placed incentives. German firms that make photovoltaic panels and other components now employ 40,000 people, and 15,000 more work in the solar-thermal business, which makes systems for homes and businesses.[121]

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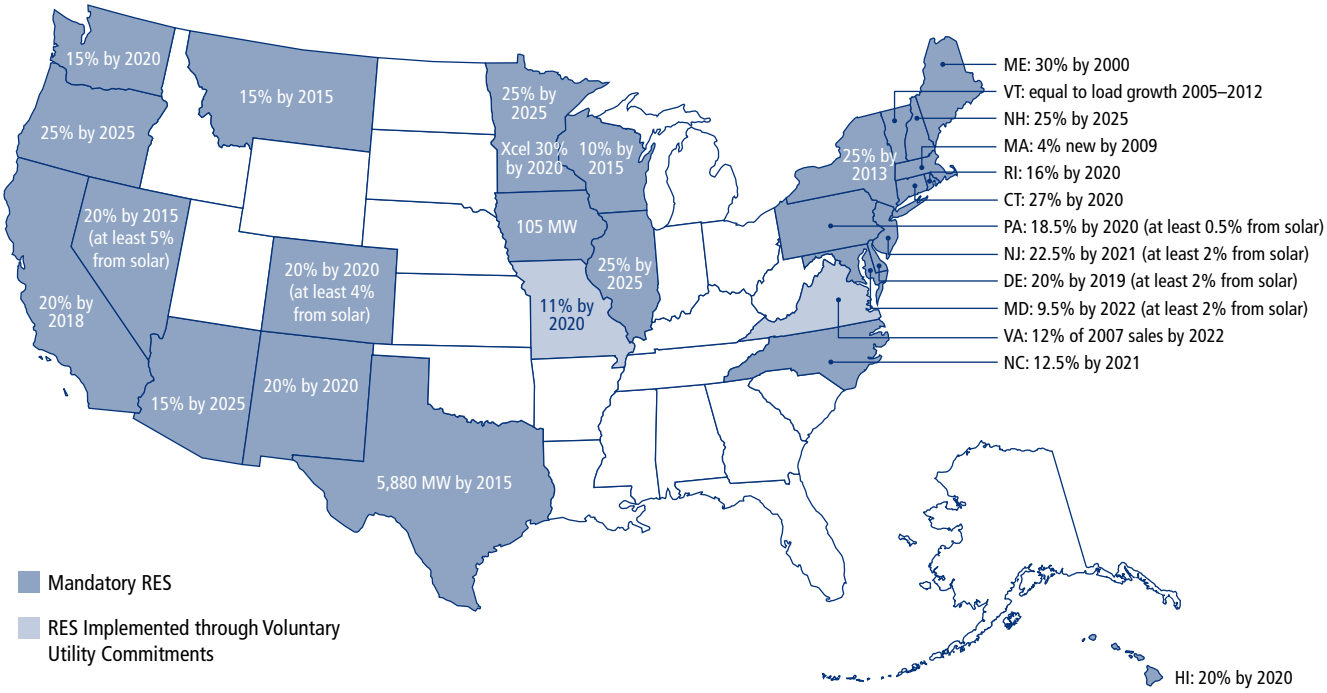
STATES WITH RENEWABLE ELECTRICITY STANDARDS



Source: Pew Center on Global Climate Change, August 2007.

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Renewable Electricity Standard

Twenty-five states and the District of Colombia require that electric utilities generate a specified amount of electricity

from renewable energy sources, including levels as high as 25 percent. The House-passed energy bill (H.R. 3221) would set a national renewable electricity standard of 15 percent by 2020, a good start. We support a more ambitious renewable electricity standard of 25 percent by 2025, but in addition call for a national standard that also includes so-called distributed electricity mandates. Distributed electricity is the creation of small amounts of energy close to where it is consumed, for example, by solar cells on roofs or hydrogen fuel cells.

Around the country, from New Jersey to Arizona, a number of states require that a portion of new renewable energy capacity that is brought online must come either specifically from solar energy or from other sources of distributed generation.

Requiring a certain percentage of renewable electricity to come from distributed sources would have several benefits. First, requiring more of our electricity to come from distributed sources would help prevent electricity disruptions. Our large centralized power plants and electricity transmission infrastructure makes our energy supply vulnerable to equipment failures, weather, and also acts of terrorism. For example, an analysis of the 2003 Northeast blackout suggested that distributed solar power generation representing just a small percentage of peak electricity, located at key spots in the region, would have significantly reduced the extent of the power outages.

Second, as our nation's demand for electricity grows, so does the demand to build more electricity generation and transmission infrastructure. Long-distance transmission of electricity from centralized facilities raises concerns over the citing of new transmission lines and efficiency concerns owing to the electricity line loss that results from long-distance power transportation. Distributed renewable energy would avoid both these concerns.

Finally, establishing a new distributed renewable energy infrastructure would ensure that the market for these new and innovative technologies grows in a rapid and cost-effective manner, bringing new technology, skills, and services to market to meet the demand. To make distributed energy production cost effective, however, the federal government needs to remove barriers to customer investments in distributed energy products.

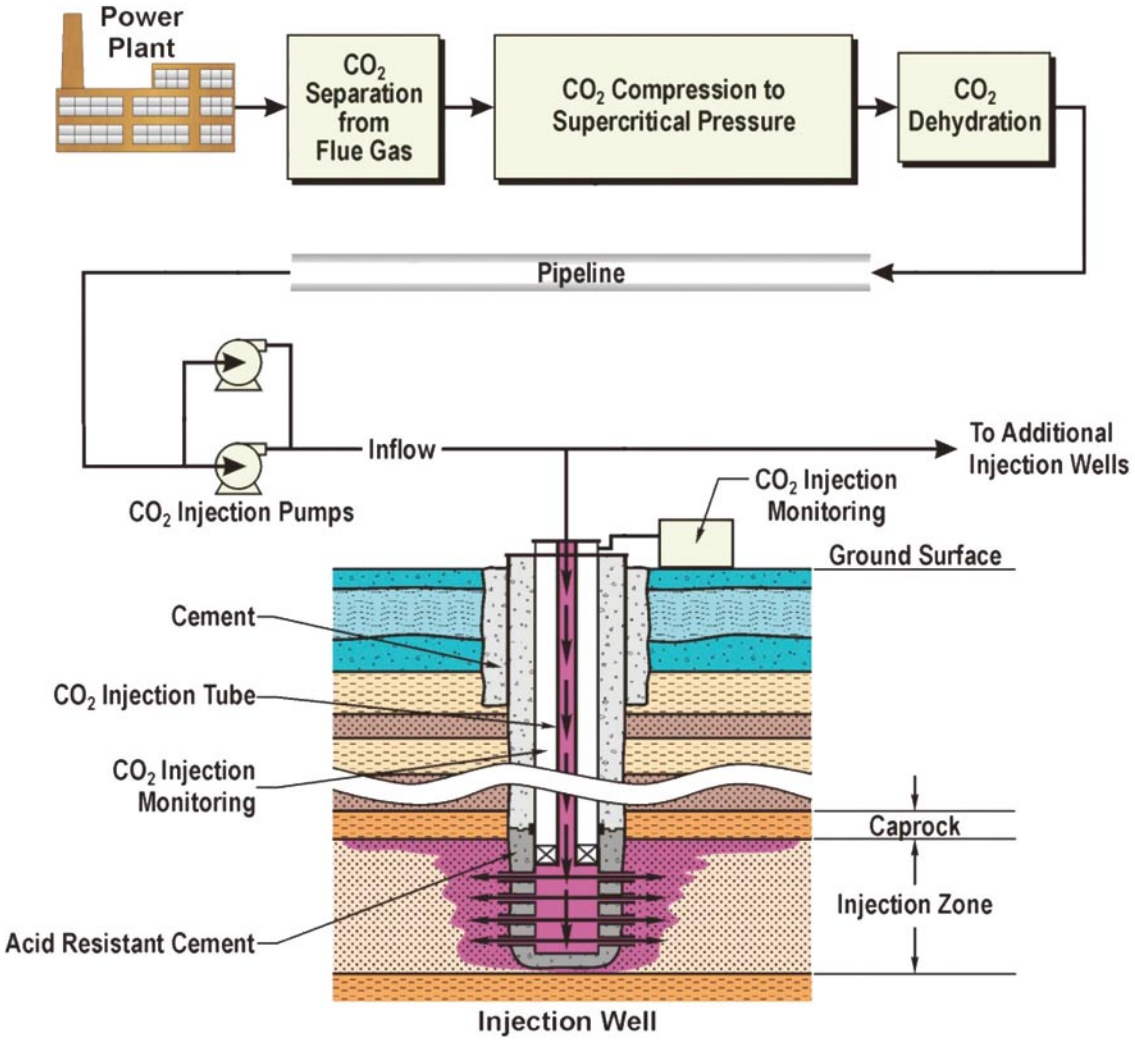
In states where distributed energy generation (including solar) has grown most effectively, four key policies have been put in place to facilitate consumer installations. First, net metering allows rate payers to supply energy back into the electrical grid when they are not using all of the energy they generate, actually running their electrical meters backwards. Second, fair rate design ensures that electricity pricing does not penalize homeowners who become producers of clean energy.

Third, establishing interconnection standards guarantees that renewable energy-generating customers can connect to the utility without undue delay and expense. And finally, long-term declining financial incentives stimulate near-term customer investment in renewable electricity, and help drive the price of technology down without establishing a permanent dependence on subsidy.

Tax Credits and Low-Interest Loans

We need to provide consistent, long-term production tax credits for renewable energy sources. Combined with state-level renewable energy standard regulation,

CARBON CAPTURE AND STORAGE: HOW IT WORKS



Source: Battelle Climate Research Institute, *Carbon Dioxide Capture and Geological Storage*, April 2006.

production tax credits have been a major driver of wind power development over the past six years.[127] However, lapses in federal production tax credits, occasional one- to two-year extensions, and uncertainty about the future of these credits have led to a "boom and bust" cycle in the development of wind power over the same time period.[128]

Thus, production tax credits for all types of renewable energy should last long enough so that businesses can make sound investment decisions. The Geothermal Energy Association, for example, states that geothermal production tax credits must last for at least three to five years to aid in the construction of these capital-intensive facilities, which can take several years to bring online even after securing all necessary permits.[129] The federal government should also provide financing assistance through mechanisms such as low-interest loans, loan guar-

antees, or bonds to help deal with high upfront costs and reduce investor risk.

Use carbon capture-and-storage systems to capture and bury the carbon emissions from burning coal

Coal represents a critical part of the challenge in building a low-carbon economy. Because it is cheap, plentiful, and widely distributed around the world, it plays a large role in the production of energy and is projected to continue doing so for decades. And the quantities of recoverable coal are enormous. The United States, with the world's largest reserves (27 percent of the world's total) has enough to last over 200 years at current production rates.[130] And sizable reserves can also be found in Russia, China, India, and Australia, among other places.

Coal accounts for 50 percent of U.S. electricity generation,[131] and that number is projected to rise slightly by 2030 according to the EIA."[132] Worldwide, coal accounted for about 41 percent of electricity supply in 2004, and that number is projected to increase to 45 percent in 2030.[133] According to the International Energy Agency, between now and 2030, 1400 gigawatts of new coal capacity will be added globally. China is adding the equivalent of more than one major coal plant per week—an added capacity equal to the entire U.K. power grid every year.[134]

Projections like these do not take into account the kind of new policies that can and should be put in place in the near future. But even assuming a substantial reduction in demand owing to new policies, coal is likely to play an important part in our energy mix for decades to come.

The trouble is that coal is also the most carbon-intensive of the fossil fuels. As noted earlier, coal accounts for over 80 percent of CO_2 emissions from electricity in the United States, nearly 36 percent of U.S. CO_2 emissions from energy, and some 37 percent of worldwide CO_2 emissions from energy. If the new capacity expected to be built by 2030 is built without CO_2 controls, it would produce about 8.4 billion tons of CO_2 per year, a 30 percent increase over *total* current worldwide CO_2 emissions from the consumption of fossil fuels.[135] Fareed Zakaria put it starkly in *Newsweek*: "Coal is the cheapest and dirtiest source of energy around and is being used in the world's fastest-growing countries. If we cannot get a handle on the coal problem, nothing else matters."[136]

Fortunately, there appears to be a way to reconcile coal's ongoing use as a major energy source with the imperative of cutting CO_2 emissions, namely carbon capture-and-storage technologies. CCS technologies capture the CO_2 emitted during coal combustion and then store this CO_2 underground in geologic reservoirs. Given the scale of existing and projected coal use and the scope of its carbon impact, a full-tilt effort to demonstrate and deploy CCS technology has to be a first-order priority for developing a low-carbon economy.

In fact, advancing the deployment of CCS technology will pave the way for coal to continue to be an important part of the electricity production mix in the new low-carbon economy. Without CCS, coal is far too carbon intensive to remain a viable energy source.

The components of CCS—carbon capture, transport via pipelines, and geologic storage—are all commercially in use. In the United States, 35 million metric

tons of CO_2 annually are captured and injected for enhanced oil recovery.[137] Still, this is small-scale compared to what would be needed to deploy full-scale CCS, which will be a huge undertaking. The largest of the existing projects injects only 1 million metric tons of CO_2 a year, while a single 500 MW power plant can produce around 3 million metric tons of CO_2 a year. The United States alone produces around 1.5 billion metric tons of CO_2 a year from coal-burning power plants.

According to the recent Massachusetts Institute of Technology report on "The Future of Coal," if 60 percent of the CO_2 from U.S. coal plants were captured and compressed to a liquid for geologic storage, its volume would equal the total U.S. daily consumption of oil, or about 20 million barrels a day.[138] Thus, capturing and sequestering the 1.5 billion metric tons of CO_2 produced annually by U.S. coal-burning power plants represents a substantial challenge.

There is already a high level of confidence that geologic storage of very large quantities of CO_2 is practical and will work. A 2005 report by the IPCC on *Carbon Dioxide Capture and Storage* concluded that, based on both actual observation and models, more than 99 percent of sequestered CO_2 would be retained in geologic reservoirs for over 1,000 years. And the MIT study said that "no knowledge gaps today appear to cast doubt on the fundamental likelihood of the feasibility of CCS. Our overall judgment is that the prospect for geologic CO_2 sequestration is excellent."[139]

The cost of CCS is significant. Estimates suggest it could add 40 percent to the production cost of coal. But the overall impact on electricity prices is likely to be modest for several reasons: production costs account for only 60 percent of the cost of electricity; coal accounts for only 50 percent of electricity; and CCS, even if rapidly adopted, will apply to only a fraction of U.S. coal capacity for a substantial period, since CCS is suitable for new plants, but not necessarily for retrofitting existing capacity.

Demonstration Projects

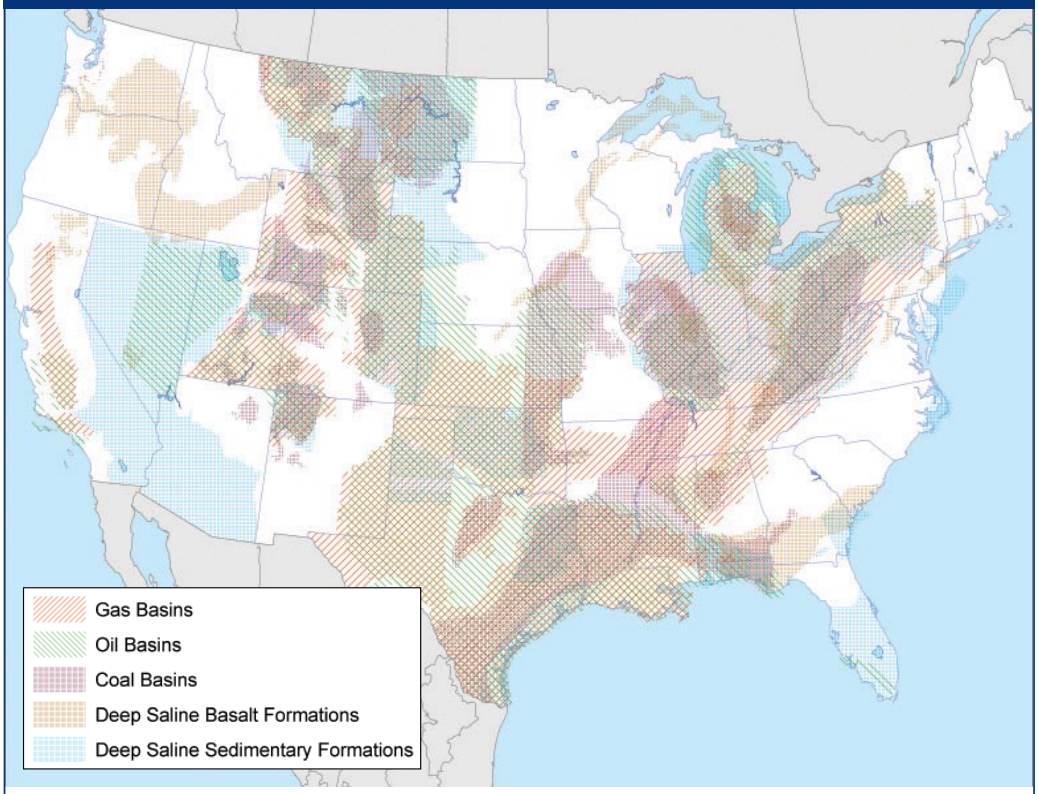
We need to provide significant government support for several full-scale, integrated commercial projects that include CO_2 sequestration, transport of CO_2 through pipelines, and storage in different geologic settings. These should not be conceived of in a sequential manner as projects that need to demonstrate feasibility before other aspects of the policy agenda move forward. Given how quickly new coal-fired power plants are being built and how long coal facilities last (50 years or more), we do not have the luxury to build demonstration plants first and enact a program later. Nor do we need to do that. We have existing knowledge to begin this process immediately.[140]

Emission Performance Standard

One approach to promoting the adoption of CCS would be to set tight cap-and-trade limits on CO_2 so that CO_2 emissions would be costly enough to make CCS an attractive alternative for power generators. A politically feasible cap-and-trade program, however, probably won't result right away in a high enough price for CO_2 credits (estimated to be around $30 per ton)[141] to spur the adoption of CCS. And the adverse consequences of constructing new coal plants without CCS are significant and long-lasting.

Two recent Center for American Progress and Center for American Progress Action Fund analyses, "Global Warming and

POTENTIAL GEOLOGIC CO_2 STORAGE RESERVOIRS IN THE U.S.



The United States is fortunate to have an abundance of theoretical CO_2 storage potential, well distributed across most of the country. Our preliminary and ongoing assessment of candidate geologic CO_2 storage formations reveals that the formations studied to date contain an estimated storage capacity of 3,900+ gigatons of CO_2 within some 230 candidate geologic CO_2 storage reservoirs.

- 2,730 gigatons in onshore deep saline formations, with perhaps close to another 900 gigatons of storage capacity in offshore deep saline formations
- 240 gigatons in onshore saline-filled basalt formations
- 35 gigatons in depleted gas fields
- 30 gigatons in deep unmineable coal seams with potential for enhanced coalbed methane recovery
- 12 gigatons in depleted oil fields with potential for enhanced oil recovery

Source: Battelle Climate Research Institute, *Carbon Dioxide Capture and Geological Storage*, April 2006.

the Future of Coal: The Path to Carbon Capture and Storage" and "The Path to Cleaner Coal: Performance Standard More Effective Than Bonus Allowances," indicate that the adoption of an emission performance standard for all new coal-fired electricity plants is the best policy tool to achieve accelerated adoption of CCS technologies. This emission performance standard would require, in effect, that new coal capacity be built to meet a CO_2 emissions standard achievable with the best available CCS technology.

Lead time of several years would have to be provided to permit utilities to learn from the operational experience of demonstration projects and to give the government time to establish the new regulatory framework that would be needed to

govern and monitor the whole system. But time is of the essence. Given how long power plants last, it is vital that they be built with the right, low-carbon technology. While all new coal-fired power would be subject to these emission performance standards, existing power plants would be subject to a declining cap on emissions under a cap-and-trade system that would create incentives for emission reductions through efficiency measures.

Congress should promptly pass legislation declaring that, going forward, no new coal plants would be grandfathered out of having to meet CCS obligations. Additionally, establishing a national CCS system will require not only large-scale R&D and demonstration projects, but also the development of new rules to govern design and operation of geologic repositories, a process that the EPA has only recently begun to explore.[142] Numerous issues will arise based on the need to ensure that the system is safe, that leaks are avoided, that sequestration sites are properly selected and monitored, and that liability is assigned, in the event that there are problems.

There will also be complicated issues with regard to property rights for pipelines and storage sites. This regulatory project should be commenced promptly so that by the time full-scale CCS deployment is ready to go, the legal and regulatory framework will be in place.

Requiring Federal Action to Reduce Global Warming

Led by the new White House National Energy Council, the federal government should play several roles in promoting energy efficiency and reducing greenhouse gas emissions. Not only should the government create policies to promote the development and adoption of energy-efficient and low-carbon technologies, it should also use its own purchasing power to spur consumption of low-carbon technologies and make sure that its own investments go only toward low-emitting projects. The federal government must start investing in our capacity to adapt to the climate change we will face even if we cut emissions dramatically.

Separately, the next presidential administration needs to create four new federal agencies and entities to help support the development and advancement of technologies to fund our nation's low-carbon energy future. These agencies and entities can speed the development of clean energy technology and provide financial and technical support to industries, workers, and consumers of the future.

Federal Purchasing Power

To show real leadership, national law makers should begin by fully deploying the purchasing power of the federal government to help spur the market for fuel efficient vehicles, alternative low-carbon fuels, energy efficiency, and renewable energy.

The government, and the Executive Branch in particular, operates an enormous fleet of vehicles. In 2000, President Clinton signed Executive Order 13149, which required federal agencies operating 20 or more motor vehicles in the United States to reduce their entire vehicle fleet's annual petroleum consumption—primarily through the use of alternative fuels and more fuel-efficient vehicles—by at least 20 percent below 1999 levels by the end of 2005.

On January 24, 2007, President Bush issued an executive order revoking

E.O. 13149 and several others issued by President Clinton that reduced federal petroleum use, increased federal energy efficiency, and reduced federal greenhouse gas emissions. President Bush's January executive order focuses on reducing energy intensity rather than meeting a specific emission reduction target and reducing petroleum consumption without mandating any increase in the fuel efficiency of the federal fleet.

The federal government needs to be moving forward, not backward. If the government made a commitment to require a percentage of all its vehicle purchases to be the most fuel-efficient vehicles available, including those that can run on alternative low-carbon fuels, then this would help boost demand for these vehicles, especially those in the early stages of technological development, such as plug-in hybrids.

The federal government is also an enormous electricity consumer and could take far more aggressive measures to reduce electricity consumption at its various facilities by updating federal building energy targets, adopting green building standards, and expanding the Federal Energy Management Program, which allows building managers to benefit from upfront energy efficiency investments. The General Services Administration is the largest landlord in the United States, owning and operating approximately 500,000 buildings. So the federal government's own management choices can play a major role in transforming the market for green and more energy-efficient construction practices.

President Bush's recent executive order also revoked President Clinton's E.O. 13123, which among other measures, required reductions in greenhouse gas emissions, improved energy efficiency, increased use of renewable energy, and reduced petroleum use in federally owned buildings. To achieve significant improvements in federal buildings, we need the government to adopt a serious plan to cut emissions and increase efficiency, not to revert to weak goals and reductions based on emissions intensity.

Ensuring Taxpayer Investments Reduce and Withstand the Effects of Global Warming

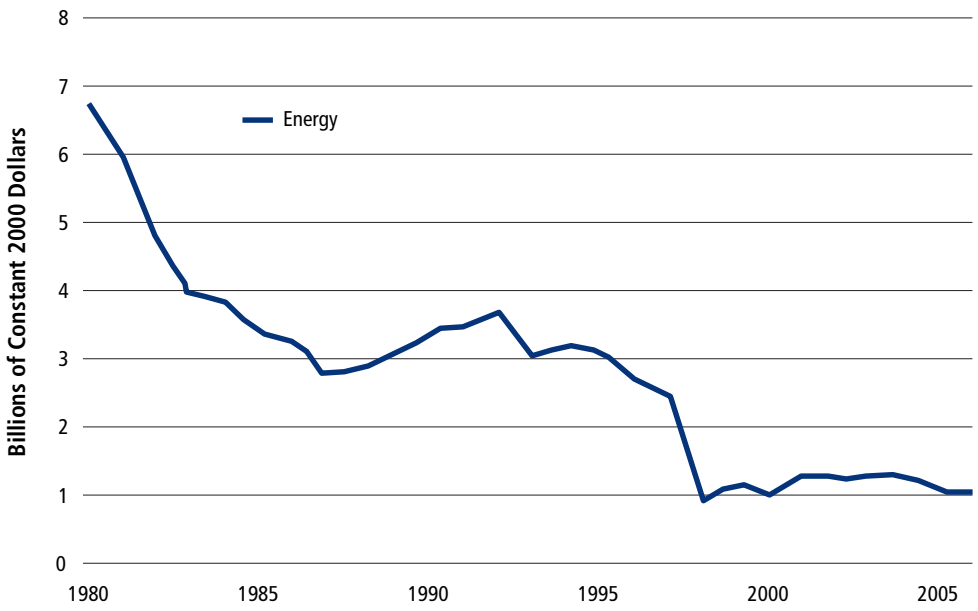
The federal government currently makes no systematic effort to evaluate emissions or performance risks associated with government-funded programs or projects. Without requiring these assessments, we do not know how federal spending affects U.S. emissions or how vulnerable taxpayer investments are to changing climatic conditions. American taxpayer dollars should only be funding projects and programs that take carbon emissions and resilience to climate change squarely into account.

Adaptation to the Effects of Global Warming

Even if all greenhouse gas emissions were eliminated today, the concentration of gases already in the atmosphere is high enough to produce the global warming effects we are now experiencing and will continue to experience for years to come.

As outlined in the CAP report, "Forecast: Storm Warning," the federal government must work in partnership with state and local governments, businesses, non-profit organizations, and other community members to develop adaptation strategies to climate change, including community-based hazard preparedness, coordinated disaster response, and post-disaster recovery plans.

FEDERAL NONDEFENSE ENERGY R&D, 1980–2006



Note that the sharp drop between FY1997 and FY1998 is due to a shift in accounting methodology that moved some energy R&D dollars to the General Science account.

Source: Science and Energy Indicators (2006).

The need for such planning in the face of the projected increase in the severity and number of hurricanes is especially important given current demographic shifts: Over 50 percent of the U.S. population currently lives on our coastlines.

It is not only our built environment that will need help in adapting to the effects of climate change; our natural ecosystems, including federal landholdings, will also require investments to ensure conservation of important ecosystem services and the preservation of biodiversity.

Energy Innovation Council[143]

The United States needs a fresh approach to energy RD&D that successfully integrates the efforts of the numerous departments and agencies that are engaged in energy-related work, including the Department of Energy, the U.S. Department of Agriculture, the Department of Commerce, the Department of Defense, the National Science Foundation, and the EPA. This new approach will need to address the shortcomings that have frequently plagued energy RD&D efforts, such as the practice of spending significant resources on demonstration projects that provide little useful information to the private sector.

The Apollo and Manhattan Projects are sometimes held up as models of innovation to be emulated, but the energy innovation challenge is fundamentally different because it requires the private sector to adopt new technologies that can succeed in the competitive marketplace. These were not considerations in

our country's efforts to put a man on the moon or to build a nuclear weapon.

Consequently, we recommend at least doubling the size of the federal energy RD&D budget and creating a new interagency group, the Energy Innovation Council, or EIC, that will be responsible for developing a multi-year National Energy RD&D Strategy for the United States. The mandate of the EIC would be to construct a plan that integrates the RD&D programs of the involved federal agencies over a multi-year period. The National Energy RD&D Strategy would provide direct expenditures to support technology development and demonstration and indirect financial incentives or regulations to promote new technology.

Energy Technology Corporation[144]

The government should also establish a quasi-public Energy Technology Corporation to manage large scale energy demonstration projects in alternative, low-carbon technologies. The ETC would finance and execute select large-scale, commercially-credible demonstration projects. This new organization would be governed by an independent board nominated by the President and confirmed by the Senate, composed of individuals with expertise in market forecasting and industry requirements.

Due to its quasi-public status, ETC projects would be free from the federal procurement regulations and mandated production targets that currently make it difficult to demonstrate the commercial viability of new technologies under real market conditions. In order to limit the influence that Congress and special interest groups would have on its decision-making, the ETC should be funded in a single appropriation.

Clean Energy Investment Administration

We support the Apollo Alliance recommendation to create a Clean Energy Investment Administration modeled on the Small Business Administration to reduce investment risk in clean energy projects with loan guarantees. The CEIA would provide up to $25 billion in federal loan guarantees over 10 years, directed toward both commercial prototypes and mass-market deployment of proven technologies. In addition, CEIA would authorize up to $2 billion to cover the high risks associated with commercialization projects. This entity would help create jobs, reduce emissions, and diversify production by fostering successful private commercial ventures that promote energy efficiency and renewable energy technologies.

Clean Energy Jobs Corps

The federal government should create a new Clean Energy Jobs Corps that can provide new pathways out of poverty, service learning, and support for training and apprenticeship programs to help workers move into "green collar" jobs and clean energy industries that provide family-supporting wages and benefits. To do this, the federal government should marshal the resources of agencies like the Corporation for National and Community Service that has run the highly successful AmeriCorps program, along with job training resources administered by the Department of Labor under the Workforce Investment Act. This new agency will ready a workforce with new skills and assist in the transition of any workers displaced from high-carbon industries.

A significant shift is needed in our workforce in order to transition to a low-carbon economy. Specialized skills will be

Green-collar worker assembles a wind turbine. (Warren Gretz, DOE/NREL)

needed to install, operate, and maintain many of the new clean technologies and advanced energy systems. A 2006 study by the National Renewable Energy Lab identified the shortage of skills and training as a leading non-technical barrier causing a bottleneck in the future growth of the renewable-energy and energy-efficiency industries.[145] This growing skills shortage is occurring even as the American Public Power Association reports that half of current utility workers will retire within the next decade. As a nation we are simply not training enough new workers to fill these jobs.

A workforce investment program in clean energy could increase funding for low-income home weatherization and couple it with a job-training program focused on energy efficiency and renewable energy trade skills. These newly trained workers could serve the growth industries of wind and solar power, with 26 percent and 40 percent annual growth, respectively. The trainees could include veterans and those displaced due to energy industry changes, among others.

This approach is currently being tried in pilot programs in a number of cities, but it is time for a national commitment to meeting the workforce needs of a low-carbon economy.

Federal agencies must also employ individuals who have the technical, financial, and management skills necessary for successful energy innovation.[146]

Creating this elite career service and a successful RD&D program will require integration of a number of energy innovation disciplines. A career service that provides the opportunity (or even the requirement) that an individual have experience working in a number of different agencies will strengthen the capability of the country to manage energy innovation successfully.

Advancing International Global Warming Policy

Climate change is a global phenomenon, and the shift to a low-carbon economy can serve America's interests at home and abroad. The focus of this report in the *Progressive Growth* series of economic policies has been on what the United States should do to hasten the advent of a low-carbon economy, and thus the complicated set of questions concerning the policies and diplomacy needed to

The Energy Transformation in Practice

How would our* Progressive Growth *energy and climate policies affect American businesses and individuals? Here are several hypothetical examples.

Oil Industry Worker

Upon enactment of a national cap-and-trade system for greenhouse gas emissions, executives at an aging oil refinery announce a phased closing of the plant, predicting that the costs of emissions permits will render their operation unprofitable in a matter of years. Shortly thereafter, an experienced pipeline technician and 22-year veteran of the company discovered that his job would be one of the first to go.

Several months earlier, however, the technician learned of a new federally-funded job retraining program for workers dislocated by the new low-carbon economic policies of the new presidential administration. This "Green Collar Jobs" program offered free vocational training to supply the burgeoning ethanol industry in the Midwest.

Transitioning from the oil industry to ethanol pipeline construction and maintenance required some moderate retraining, but the technician avoided severe economic dislocation. After the green jobs training, he found a new job at a local ethanol refinery that had better environmental working conditions and enormous opportunity for growth. After all, ethanol production had increased an average of 20 percent each year for the previous five years and was poised to increase even further under a new federal low-carbon alternative fuels standard and as cellulosic ethanol production came on line.

Yet the technician remained concerned about how increasing energy costs would affect his monthly utility bills. Soon, however, he discovered that he faced only minimal cost increases because of a new federal program designed to offset rising energy prices for low- and middle-income Americans. Funding for this new program came fro.m auctioning emissions permits under the cap-and-trade system, which is why the funds were available immediately.

Small Farm Owner

As the new presidential administration enacted a raft of low-carbon energy policies, a part-time graduate student came to inherit her parents' small farm, leaving her in sole custody of the family's now third-generation homestead. Yet her financial situation was tenuous as she struggled to make a living off the small farm amid agricultural price uncertainties due to the introduction of a new nationwide market-based cap-and-trade system.

During her coursework in natural resource policy, she had learned more about the opportunities that recently enacted renewable energy legislation had created for small farms. So she teamed up with her neighbors to form a local wind energy cooperative and secure a loan guarantee to cover the initial high start-up costs of purchasing, installing, and operating their own wind turbines. This new rural wind cooperative also took advantage of her state's recently initiated public-private partnership to increase energy security by extending transmission lines to tap renewable electricity resources, thus connecting her cooperative to the state electricity grid.

Moreover, investment was flowing into the state to finance cellulosic ethanol refineries to produce biofuel from her state's extensive supply of forestry and agricultural biomass. Once the nation committed to producing 25 percent of its transportation fuel from low-carbon alternatives by 2025, investors knew that risk would be greatly reduced—decreasing profit margins somewhat but also allowing many more prudent investors to participate.

Researching the types of feedstocks that a new cellulosic biofuel refinery was looking to purchase, she wisely invested in planting native switchgrass. Within five years, her small farm became a much more predictable source of income, allowing her to concentrate once again on more traditional farm concerns, like worrying about the weather.

Clean Energy Entrepreneurs

In the early 21st century, the outsourcing of jobs overseas became an increasingly common occurrence in high-tech manufacturing and information technology services, raising profound questions about the competitiveness of even highly skilled American workers amid rapid globalization. Compounding the problem was the unwillingness of venture capitalists to invest their risk capital outside the traditional high-tech centers on the East and West Coasts, which, alas, was not where two alternative energy entrepreneurs residing in a rust belt state had opted to launch their new start-up company.

With funding from friends and family and a few local investors, the two partners managed to launch their new thin-film solar photovoltaic manufacturing company, and within a few years they began to profit from a host of federal and state-level policies that

were creating new markets for energy efficiency and clean energy technologies. Soon, venture capitalists who had once shunned solar cell startups not located in Silicon Valley were eager to invest.

Why the change?

First, the combination of a nationwide cap-and-trade system and a newly mandated 25 percent renewable electricity standard by 2025 created immediate and dependable domestic market demand for clean energy technologies, goods, and services. Then international demand emerged as the United States exhibited long-awaited leadership in spearheading a new international global warming treaty, putting the planet on a cooperative path towards reduced greenhouse gas emissions.

In addition, venture capitalists looking out 10 to 20 years realized that a new federally supported innovation agenda would bear fruit. The new innovation programs dramatically increased research and development funds for clean technologies, providing startups with loan guarantees and other incentives to reduce investment risk, while also sustaining government and university research efforts for technologies that could later be commercialized by the private sector. The two solar entrepreneurs were suddenly in a venture capital "sweet spot."

State policy also contributed to the successful emergence of startup renewable energy companies such as theirs. First, the state passed legislation overhauling the utility industry and codifying the practice of net metering. This allowed households to sell surplus electricity (at retail prices) from their solar installations back to the grid. Tax policies favorable to clean energy companies also were a major reason start ups chose to set up shop in the state.

With demand growing for low-carbon products and services, the local economy in which the two entrepreneurs had staked their future began to reap the rewards. Statewide, 80,000 jobs were created in new clean technology industries over the next decade. Median household income registered a solid increase, as did the coffers of the state treasury. In all, after several decades of transition and adaptation, the state saw increased economic prosperity and quality of life for its residents through pragmatic policies and innovation in the low-carbon economy.

Mid-Sized City Commuter

The transition to a low-carbon economy in this mid-sized city created over 20,000 new jobs over the next decade as a new "Green Collar" workforce emerged out of new government training programs to fill positions in the rapidly growing, high-wage, clean-tech companies.

One negative consequence of this rapid economic growth, however, was an increase in population—and corresponding traffic congestion—which drastically increased the work commuting time for many of the city's drivers, including a financial operations officer at a national clean tech company headquartered downtown.

The city responded to the congestion problem over the next several years with progressive public transportation policies, such as the implementation of downtown congestion fees and increased funding to improve bus and rail service, thus incentivizing commuters to drive less. In tandem, federal funding that was part of the new administration's efforts to build more energy-efficient commuting options around the country resulted in a new and expanded mass transit network that allowed commuters to spend less time on the road and more time with their families.

Commuters like the financial operations officer could now get to work via light rail and bus systems. Additionally, indirect benefits from this shift in transportation infrastructure, including drastic improvements in air quality for the city, allowed him and his family to enjoy more days and evenings outside.

Manufacturing Company Executive

The chief operating officer of a one of America's best-known tractor manufacturers was confident her company could ensure its workers and shareholders that the future looked bright. After all, the company was a staple of America's farming communities, providing dependable, heavy-duty farm equipment at competitive prices to customers across the nation for 75 years. Its main factory has not changed locations since the company's founding, and it continued to source the majority of its components from manufacturers in the United States.

But soon she and others in the company's executive suite grew concerned about what effects the newly enacted federal cap-and-trade legislation in the United States would have on the profitability of their company. They knew, based on their European rival's experience under the EU Emissions Trading Scheme, that any flaws in the design and implementation of the U.S. cap-and-trade system would induce volatility in the prices of energy and emissions permits traded on the nascent market.

Volatility and uncertainty would make it difficult for the tractor company to plan for the future. But thankfully, U.S. officials charged with developing the cap-and-trade regime *did* learn lessons from the EU experience. They managed to design a system that was accurate and transparent, creating a stable and predictable carbon emissions market.

The Energy Transformation in Practice *(continued)*

Still, industrial emitters like the tractor company experienced growing pains under the new system. Costs of production rose slightly over the course of the next several years as energy generators and industrial carbon emitters began to internalize the costs of their greenhouse gas pollution. Profits slipped, followed by a round of layoffs.

Yet the COO noticed, after several tough years, that electricity and natural gas price volatility that had so bedeviled her in the first decade of the 21st century was declining as federal policies took hold that were designed to diversify the nation's sources of energy, specifically renewable and low-carbon alternatives, and to reward utilities that promoted efficiency and conservation.

Moreover, sustained federal investment in the research and development of energy-efficient industrial machinery helped commercialize a new line of efficient manufacturing equipment. Once installed, the energy intensity (goods per unit of energy) of the company's product line fell sharply, reducing the cost of production and improving its competitiveness in the marketplace.

Customer demand for the company's new line of energy-efficient farm equipment capable of running on biodiesel also picked up as farmers turned to cheaper low-carbon fuels produced locally or on-site, and as orders from abroad picked up as more nations moved toward climate-friendly policies. The layoffs and profit shrinkages that did occur during the few years of company contraction were more than offset by new hires and increased revenues as the company adapted and prospered in the new American low-carbon economy.

Union Electrician

The sub-prime mortgage crisis and housing market backslide continued to ripple throughout the building industry, hitting blue-collar trade workers particularly hard as the new administration enacted its package of low-carbon policies. One union electrician struggling to put two kids through college saw little connection between the government's new "Green Building" initiatives and her livelihood, in which demand for her services was decreasing steadily until she was struggling to make ends meet at the end of each month.

As the administration's new policies were enacted, however, the green building industry began to grow exponentially—and along with it demand for craftspeople knowledgeable of so-called Leadership in Energy and Environmental Design, or LEED standards, and skilled in the various components of energy and resource-efficient new construction and building retrofits. The electrician's union, seeking to capitalize on this growing market, offered job training seminars in electrical installation and retrofits for low-carbon and energy efficient technologies such as solar photovoltaic panels and lighting timers.

The union electricians participated in the training, which required only minor adjustments to her existing skill set, and immediately found herself at a competitive advantage for jobs in the green building industry. Soon, those end-of-the-month money crunches were a thing of the past. In fact, in time she was able to junk her gas-guzzling 1980s-era truck and with the help of a new federal tax incentive she purchased a highly efficient American flex-fuel pickup.

bring about a low-carbon economy globally are beyond its scope. But a few broad points should be made.

By taking the lead in transforming our own economy, we can lead in the creation of a global market that can benefit countries and communities around the world. Just as important, we can provide the global leadership that is desperately needed to manage the impact of climate change in the developing world—as a matter of principle, as a measure of our commitment to a more equitable world, and for practical reasons given the high costs and widespread instability that climate change will trigger in the world's poorest countries.

The solution to climate change must be a global one. The United States is a large part of the problem, with only 5 percent of the world's population yet responsible for 23 percent of worldwide emissions.[147] At the same time, most of the growth in emissions going forward will be generated by developing countries whose collective increase in emissions will account

for over 75 percent of global emissions growth by 2030.[148]

Indeed, in 2006 (well ahead of even recent forecasts) China surpassed the United States as the world's leading emitter of greenhouse gases, although U.S. per capita emissions remain higher than China's.[149] It is thus clear that rapidly industrializing countries—China chief among them—will have a big role to play in containing climate change.

The United States will simply have no credibility with other nations unless we have vigorously addressed the problem at home. As we are putting our own mandatory system in place, we will need to re-engage vigorously in the diplomatic arena. The principal forum for climate change negotiations to date has been the U.N. Framework Convention on Climate Change under which the Kyoto Protocol was negotiated. The UNFCCC process is the one that President Bush walked away from shortly after he took office. We must reverse course and reassert constructive U.S. leadership.

But we should also recognize that the UNFCCC process, with over 190 nations, is inevitably slow and bureaucratic. The Kyoto Protocol was first agreed to in 1997, but did not enter into force until 2005. The urgency of this problem means that the global community simply must pick up the pace. To this end, we support the formation of a small forum that we have previously described as an E-8 in which the leaders of key developed and developing nations can meet annually to seek agreement both on concrete actions within the group itself, which would account for around 70 percent of global emissions, and on the architecture of a new global agreement to succeed Kyoto.

We will also need to pay particular attention to the need to bring financial support and encourage investment flows to the energy and environment sectors of poor countries. In impoverished nations across Africa, Asia, and South America, faltering economies are already at a disadvantage on account of antiquated energy systems and environmental degradation, and these problems are likely to worsen as climate change takes its toll over the next 50 years, according to the IPCC's recent report. As a high priority, we will need to engage with our international partners and direct a portion of cap-and-trade auction revenue to help poor countries both alleviate energy poverty by developing modern, low-carbon energy systems and adapt to the effects of climate change that are already unavoidable.

Conclusion

The case for reestablishing the energy base of our economy on a low-carbon foundation could scarcely be more compelling. The failure to meet the energy challenge that is upon us will have severe—and potentially catastrophic—consequences for our environment, economy, and national security. Nothing short of nuclear war poses a greater long-term threat to civilization than the ecological dangers that confront us, and none of these ecological threats is as profound as climate change. The United States must either take upon itself the task of fundamentally transforming its approach to energy or endure the consequences.

On the opportunity side, the explosive innovation that the right set of low-carbon policies and rules could propel the United States and world economy to its next great leap forward.

And fortunately, there is still time to act; nothing stands in our way except a lack of political will.

The costs inherent in this economic transformation are real but entirely manageable. Recall the EPA worst-case economic projections based on the Lieberman-McCain bill: that in 2050 our economic growth compared with 2005 would be 234.8 percent, rather than 238 percent, higher. If the right policies and rules of the road are put in place, with business aggressively pursuing the new opportunity of low-carbon energy, the actual economy should leave worst-case scenarios like that in the dust and instead produce a virtuous cycle of invention, innovation, new business development, job creation, and economic growth.

At any rate, the idea that costs, even of the kind in the EPA scenario, would cause us to shrink from doing what manifestly needs to be done, as an insurance policy at the very least, is difficult to comprehend. It would testify to a profound failure to recognize our historical moment.

Every great change in the nature of economic or social arrangements produces great resistance, and this is sure to happen now as well. But that is the challenge of leadership—to mobilize the potent forces of change, to instruct and teach those who are prepared to help, to persuade those who are unsure, and to overcome those who are frozen in unyielding opposition.

The course ahead is clear, and the responsibility is upon us all to do our part.

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About the Authors

John Podesta

John Podesta is the President and Chief Executive Officer of the Center for American Progress. Podesta served as Chief of Staff to President William J. Clinton from October 1998 until January 2001, where he was responsible for directing, managing, and overseeing all policy development, daily operations, Congressional relations, and staff activities of the White House. Podesta is currently a Visiting Professor of Law on the faculty of the Georgetown University Law Center.

Podesta is a 1976 graduate of Georgetown University Law Center, and a 1971 graduate of Knox College.

Kit Batten

Kit Batten is the Managing Director for Energy and Environmental Policy at the Center for American Progress. Batten is a Ph.D. ecologist who worked in the office of Sen. Dianne Feinstein (D-CA) as a Legislative Assistant on climate change, energy, transportation, and agriculture policy. She also served as an American Association for the Advancement of Science Fellow in the office of Sen. Joseph Lieberman (I-CT) where she worked on climate change legislation, energy policy, land conservation and management, fisheries policy, and Endangered Species Act reauthorization.

Batten received a B.A. in chemistry from Oberlin College and a M.S. and Ph.D. in ecology from the University of California, Davis.

Todd Stern

Todd Stern is a Senior Fellow at the Center for American Progress, focusing on climate change and energy issues. He is also a partner at WilmerHale and Vice Chair of the firm's Public Policy and Strategy practice. As Assistant to the President and Staff Secretary in the White House from 1993–1998, Mr. Stern played a central role in preparing the key issues of domestic, economic and national security policy for the President's decision. Mr. Stern coordinated the Administration's initiative on global climate change from 1997 to 1999, acting as the senior White House negotiator at the Kyoto and Buenos Aires negotiations. After leaving the government, Stern served as an Adjunct Lecturer at Harvard's Kennedy School of Government.

Stern is a 1973 graduate of Dartmouth College and 1977 graduate of Harvard Law School. He is a Member of the Council on Foreign Relations.

Sarah Rosen Wartell, Project Director

Sarah Rosen Wartell is the *Progressive Growth* Project Director and an Executive Vice President at the Center for American Progress.

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Related Work by CAP Fellows and Staff

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A New Strategy to Spur Energy Innovation
To be published in *Issues in Science and Technology*
By John Podesta, John Deutch, and Peter Ogden (forthcoming 2007)

A Changing Climate: The Road Ahead for the United States
In *Washington Quarterly*
By Todd Stern and William Antholis (November 2007)

Rising-Tide Economics
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Center for American Progress
1333 H Street, NW, 10th Floor
Washington, DC 20005
Tel: 202.682.1611 • Fax: 202.682.1867
www.americanprogress.org