S. HRG. 111–1214

LEGISLATIVE HEARING ON S. 1733, CLEAN ENERGY JOBS AND AMERICAN POWER ACT

HEARING

BEFORE THE

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS UNITED STATES SENATE

ONE HUNDRED ELEVENTH CONGRESS

FIRST SESSION

OCTOBER 27, 2009

Printed for the use of the Committee on Environment and Public Works

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ONE HUNDRED ELEVENTH CONGRESS
FIRST SESSION

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LEGISLATIVE HEARING ON S. 1733, CLEAN ENERGY JOBS AND AMERICAN POWER ACT

TUESDAY, OCTOBER 27, 2009

U.S. SENATE,
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS,
Washington, DC.

The committee met, pursuant to notice, at 9:33 a.m. in room 406, Dirksen Senate Office Building, Hon. Barbara Boxer (chair of the committee) presiding.

Present: Senators Boxer, Inhofe, Baucus, Lautenberg, Cardin, Sanders, Klobuchar, Whitehouse, Udall, Merkley, Gillibrand, Specter, Voinovich, Vitter, Barrasso, Crapo, Alexander, and Bond.

OPENING STATEMENT OF HON. BARBARA BOXER, U.S. SENATOR FROM THE STATE OF CALIFORNIA

Senator BOXER. The committee will come to order.

Before I start my 5-minute statement, everyone is going to have 5 minutes, and we are doing the early bird rule. Senator Inhofe and I have agreed that if we are in the middle of a panel and a Senator arrives, we are going to just have them have to delay their opening statement so we can keep the flow of this going. We do expect a very good attendance on both sides of the aisle.

Senators, this is the first legislative hearing on S. 1733, the Clean Energy Jobs and American Power Act. Over the next 3 days, we will hear from 54 witnesses on 9 separate panels. Today I want to welcome my partner in writing this bill, Senator John Kerry, and our distinguished Obama administration witnesses. I greatly appreciate the President's strong leadership on this issue.

As promised, the Chairman's mark was made public on Friday, and we released and posted EPA's economic analysis of the bill. Committee rules provide that this document be circulated 3 days before the markup. We have done this at least 10 days before the markup.

The Kerry-Boxer bill was based on the successful legislation in the House, the Waxman-Markey bill. Our bill is straightforward, as you can see on the chart. After outlining the findings, goals and targets, Division A lays out a series of authorizations, and Division B sets up the pollution reduction and investment program.

EPA's economic modeling found that the Kerry-Boxer bill will carry modest costs for America's families, the overall impact being 22 cents to 30 cents a day. Let's talk about that for a minute. What will America's families get for 30 cents a day?

For 30 cents a day, we will put America in control of our own energy future and take a stand for home grown American energy,

rather than foreign oil from countries who don't like us. For 30 cents a day, we will protect our kids from dangerous pollution. For 30 cents a day, we will send a signal that sparks billions of dollars of private investment in job creation. For 30 cents a day, we will be the world's leader in clean energy technology.

No climate bill has ever had this level of review, and the Obama administration stands behind this analysis. EPA spent 5 weeks analyzing the Waxman-Markey bill and another 2 weeks analyzing our version. Scientists in the Obama and Bush administrations and the National Academy of Sciences and the U.N. IPCC tell us that we have a narrow window of time in which to avert the ravages of global warming. They tell us about frequent and intense storms, wildfires in the west, heat waves across the Nation, increased droughts and flooding, threats to agriculture, global conflict, refugees and food shortages.

In 2005, Hurricane Katrina took an estimated 1,700 lives, displaced a million people and cost well over $100 billion. Four years later, there is still suffering, and it will take billions to protect the coast in that region. Katrina provides a window into the kind of world we can expect if we fail to act.

S. 1733 is our best insurance against a dangerous future. It is a responsible approach that sets attainable goals for gradual reductions in carbon emissions. And it protects consumers, businesses and workers as we move toward clean energy.

Let me give the warmest of thank yous to John Kerry and his staff, as well as to all majority members of this committee and their dedicated staffs. Their hard work is reflected in the Chairman's mark.

I also want to thank Senator Carper for agreeing to take the helm of the Coal Working Group and for working with Senators on and off the committee to produce a positive outcome. Of course, I am disappointed that since John Warner retired, I don't have a Republican partner on the committee. But I am appreciative for the productive conversations I have had with Senator Alexander about nuclear energy and for the wide ranging conversations and meetings I had with Senator Voinovich and his staff.

We have been helped by environmental organizations, business and workers, religious experts, and I thank all of them.

Ladies and gentlemen, here is where we are. Since the Supreme Court ruled that greenhouse gas pollution is covered under the Clean Air Act, the EPA must move forward to meet its responsibilities under the law. Our bill is the best way to proceed. It provides flexibility to businesses and powerful incentives to drive innovation. It helps consumers, workers, agriculture, transportation, energy efficiency, wildlife. It helps cities and counties. It will launch an economic transformation, and it is deficit neutral, and may even have a surplus at the end of the day.

Over the past four decades, this committee has been at the center of our Nation's landmark environmental laws. They were written right here in this room. And those who sat in these chairs before us never ran from a challenge. Global warming is our challenge now, and I am very pleased that today is an important milestone on our road to action.

Members of the committee, I am going to call on Senator Inhofe. We are then going to hear from Senator Kerry, who must go to a committee hearing. And then we are going to go with the early bird rule and we will let all of you know your place on that.

Senator Inhofe.

OPENING STATEMENT OF HON. JAMES M. INHOFE, U.S. SENATOR FROM THE STATE OF OKLAHOMA

Senator INHOFE. Thank you, Madam Chairman. We are here today to discuss a 923-page bill to fundamentally redesign our $14 trillion economy. The bill is no doubt ambitious, but it is also extremely costly. I won't argue on the 30 cents a day; it is going to be very similar to the other efforts on cap-and-trade. It is going to be very, very expensive.

I do want to congratulate you, Madam Chairman, because I watched your YouTube this morning. It is the first one I have seen. And the fact that you are using the term global warming again is—I appreciate that. People have been running from that term ever since we went out of that natural warming cycle about 9 years ago.

Now, I won't go into a lot of details on the request that we have had for a narrative on this thing from the Environmental Protection Agency. I will have some questions for the Director. But I will let Senator Voinovich talk about that, since we have made these requests together over a period of time.

Now, getting the analysis will help cut through a lot of the catch words. It will bring into focus the words of Representative John Dingell from Michigan, who said cap-and-trade is "a tax, and a great big one." The Kerry-Boxer is a tax, and it will mean more economic pain and suffering and fewer jobs.

When President Obama signed the $780 billion stimulus bill into law, he promised to save or create 3.5 million jobs. Since then, we have lost 3 million jobs. And the number keeps growing. Today the Administration will argue that cap-and-trade creates jobs. But it won't.

The Senate Energy Committee recently had a hearing about the cost of cap-and-trade. Here are some of the headlines that follow. The Washington Post: "Cap-and-Trade Will Slow the Economy, CBO Chief Says." The Wall Street Journal: "Congressional Budget Chief Says Climate Bill Would Cost Jobs." In the Guardian: "The Obama Climate Change Bill Would Hurt the U.S. Economy."

Let us recount a telling moment of that hearing. That is when Senator Sessions asked the Government witnesses—now, we have some overlap here, Ms. Jackson, you are one of them; they had the CBO, EPA, EIA and the CRS. He asked them whether anyone disagreed with the finding that the net effect of cap-and-trade would be a reduction in jobs. None did. Cap-and-trade supporters acknowledge job loss. They acknowledge the transition to a green economy. I am not sure what that means. The CBO director provided some help. They said, transition will be painful. The victims of cap-and-trade can't just move on and get new green jobs. The transition will mean leaving high paying jobs, moving away from hometowns and significant reductions in lifetime earnings. Now, that's the CBO that stated that.

Now the majority will say that Kerry-Boxer has provisions to soften the transition. This raises two points. First, it is an implicit acknowledgment that the bill will destroy jobs. We have a provision in the bill that says we are going to try to have worker training, because people will be losing jobs.

Second, I am sure the worker in the cement plant, when he loses his job, won't find it very much consolation in the green welfare programs. Even the job killing impacts of cap-and-trade become clear. We now hear of a grand climate compromise. It entails greater support for nuclear plants and more offshore and gas drilling. These are sensible policy goals. But why attach them to an energy tax that destroys jobs? And can you really try to drive fossil fuels into extinction on one hand and increase them on the other? It doesn't work.

This apparent compromise will also entail a massive expansion of Government bureaucracy. Senator Webb, a Democrat from Virginia, compared it to "the old Soviet Union." Consider that in 2003, the Climate Stewardship Act—this is interesting, because we have addressed this five different times in the Senate. That had 58 pages. The next version in 2005 had 63 pages. The Lieberman-Warner bill had 344 pages. And the Kerry-Boxer has 923 pages. Waxman-Markey was 1,428 pages.

So if we are talking about a deal, let's focus on nuclear and oil and gas drilling; keep taxes and bureaucracy out of it.

In his speech last week, President Obama dismissed opponents of cap-and-trade as cynical and pessimistic. I wonder if that applies to the 44 Democrats who voted against the Waxman-Markey bill. I think differently. They object to a policy that would destroy jobs and radically increase the size and scope of Government.

I think if you just look at this in light of the Kyoto Treaty, then the 2003 bill, the 2005 bill, the 2008 bill, the one thing they have in common is cap-and-trade is very expensive. We are talking about somewhere between $300 billion and $400 billion a year. That is something the American people can't tolerate, and I don't believe they will.

Thank you, Madam Chairman.

[The prepared statement of Senator Inhofe follows:]

STATEMENT OF HON. JAMES M. INHOFE,
U.S. SENATOR FROM THE STATE OF OKLAHOMA

We are here today to discuss a 923-page bill to fundamentally redesign our $14 trillion economy. The bill is no doubt ambitious, but it's also extremely costly and ineffective. It is a massive new tax on consumers that will have virtually no effect on climate.

This bill necessarily will raise the price of gasoline, electricity, food, and just about everything else. So we need a comprehensive economic analysis to understand the bill's impacts. But we don't have it. We have instead a 38-page narrative from the Environmental Protection Agency, the gist of which is, "This bill is a lot like Waxman-Markey, so go see our analysis of Waxman-Markey." I did read the analysis of Waxman-Markey. It's flawed and incomplete. So what do we have here? Not much.

While I have serious problems with EPA's analysis of Waxman-Markey and its 38-page "meta-analysis" of Kerry-Boxer, the latter was not entirely EPA's fault. In its drive to ram S. 1733 through the legislative process, the majority didn't provide EPA enough time to do a serious analysis. Why would the majority ram through a 923-page bill to overturn the existing economic order? The question answers itself. The public deserves more than just a 38-page description of how much S. 1733 resembles another energy tax passed by the House.

We were told EPA's work contains "everything that you ever wanted to know." Yet EPA glosses over and minimizes key issues. Moreover, EPA's analysis of Waxman-Markey lacks the real world assumptions that Senator Voinovich and I asked for in July. EPA rejected our request—we were told to go and find rigorous analysis somewhere else. At this point, I hope we can work with EPA to sort this out, or else our ability to have a markup will be in jeopardy.

Getting the analysis will help us cut through the catchwords. It will bring into focus the words of Representative John Dingell (D–Mich.), who said cap-and-trade is "a tax, and a great big one." Kerry-Boxer is a tax, and it will mean more economic pain and suffering and fewer jobs.

When President Obama signed the $787 billion stimulus bill into law, he promised to "save or create" 3.5 million jobs. Since then, we have lost 3 million jobs, and the number keeps growing. Today the Administration will argue that cap-and-trade creates jobs. With all due respect, there is a credibility problem here.

The Senate Energy Committee recently had a hearing about the costs of cap-and-trade. Here are some of the headlines that followed—the Washington Post: "Cap-and-Trade Would Slow Economy, CBO Chief Says"; the Wall Street Journal: "Congressional Budget Chief Says Climate Bill Would Cost Jobs"; and the Guardian: "Obama climate change bill could hurt U.S. economy, panel told."

Let me recount a telling moment in that hearing. Senator Sessions asked the Government witnesses—and they were CBO, EPA, EIA, and CRS—whether anyone disagreed with the finding that the net effect of cap-and-trade would be a reduction in jobs. None did.

Cap-and-trade supporters acknowledge some job loss. They acknowledge a "transition" to the green economy. I'm not sure what that means. The CBO director provided some help. He said the "transition" will be painful—the victims of cap-and-trade can't just move on and get a new green job. The "transition" will mean leaving high paying jobs, moving away from hometowns, and "significant reductions in lifetime earnings."

Now the majority will say Kerry-Boxer has provisions to soften the "transition." This raises two points: first, it's an implicit acknowledgement that the bill will destroy jobs; and second, I'm sure the worker at a cement plant, when he loses his job, won't find much consolation in green welfare programs.

Even as the job killing impacts of cap-and-trade become clear, we now hear of a grand climate compromise. It entails greater support for new nuclear power plants and more offshore oil and gas drilling. These are sensible policy goals, but why attach them to an energy tax that destroys jobs? And can you really try to drive fossil fuels to extinction on the one hand and increase them on the other?

This apparent compromise will also entail a massive expansion of Government bureaucracy. Senator Webb (D–Va.) compared it to "the old Soviet Union." Consider that in 2003, the Climate Stewardship Act was 58 pages; the updated version in 2005 was 63 pages; the Lieberman-Warner bill in 2008 was 344 pages; in 2009, Kerry-Boxer is 923 pages and Waxman-Markey is 1,428 pages. So if we're talking about a deal, let's focus on nuclear and oil and gas drilling; keep taxes and bureaucracy out of it.

In his speech last week, President Obama dismissed opponents of cap-and-trade as "cynical" and "pessimistic." I wonder if that applies to the 44 Democrats who voted against Waxman-Markey. I think differently: they object to a policy that will destroy jobs and radically increase the size and scope of Government.

This is about prudence and common sense. And it's about a fundamental difference in vision for the country. We have the approach to tax and destroy versus the approach to expand and create. The American people prefer the latter. And so do I. Thank you.

Senator BOXER. Thank you very much, Senator.

Our first witness is the author of the Kerry-Boxer bill, and we are very happy you could be here, Senator. We know you have many other obligations, but we will be very interested in hearing what you have to say in as long as you need to take to say it.

OPENING STATEMENT OF HON. JOHN KERRY, U.S. SENATOR FROM THE STATE OF MASSACHUSETTS

Senator KERRY. Well, Madam Chairman, thank you very, very much. Thanks for the privilege of appearing before this committee, Senator Inhofe, and all the members of the committee, many of

whom I have met with individuals talking about this, and all of whom I really want to sit down with and talk about this. Because we need to find the path forward.

I listened carefully, Senator Inhofe, to your comments, and I will address some of them as I go along, and I would like to.

But I want to thank Chairman Boxer, first of all, for her passionate, determined, inspirational leadership on this issue. She has been a gracious and invaluable collaborator in this effort. I am personally grateful to her, as are many people, for her effort to push this along. And you may disagree with her, but she is determined to try to put America in the right place on this issue. And I hope in the course of these hearings we will all understand how we are doing that.

Today we begin the formal legislative process to lead the world in rolling back the urgent threat of climate change. I believe, and the vast majority, overwhelming numbers of scientists and peer reviewed studies across the globe, leaders of countries across the globe, presidents, prime ministers, finance ministers, environment ministers, all across the planet, have all determined that we need to move forward to deal with climate change, and that in doing so, Senator Inhofe, we will actually improve every sector of our energy economy, from coal to nuclear, to wind and solar. We will take crucial strides toward energy independence, which strengthens America's national security. And critically, we will create millions of jobs, new jobs and entire new industries will stay in the United States of America.

We will create jobs that cannot be exported, because we will create our energy here at home, which makes America stronger and which in fact strengthens our competitive posture. It is no surprise that somebody like Jim Rogers, who runs a multi-billion dollar company, a CEO of a Fortune 500 company, Duke Energy, is one of the leaders, he is the chairman of America's Competitiveness Council. He is responsible in that capacity for creating jobs and for making America more competitive. And he is one of the leaders in saying that we need to set a fixed target of pollution reduction in order to challenge our economy and in order to grow our economy for the future and remain competitive.

Now, we are not going to do these things if we don't pass an aggressive, forward looking climate and energy combined piece of legislation. Let me share with you very quickly—I am not going to spend much time on this, but I do want to share with you why there is an urgency to this. Senator Inhofe, you just talked about the costs of doing some of this. Are there some costs? Yes, sir. There are some costs. But almost every study that looks at the costs does not factor in the impact of energy efficiency or the impact of new technology or what the impact is of becoming more energy independent.

And most importantly, they none of them factor in the cost of doing nothing. That is far more expensive for your folks in Oklahoma or for your folks in any of the other States represented on this panel.

So we need to be honest and realistic as we assess how we in fact best protect the interests of our country. There is a reason that the leaders of the G20 in Italy recently affirmed that we cannot let

the temperature of the planet rise more than 2 degree Centigrade. And the reason is that all of our best scientists in peer-reviewed studies tell us that if it goes over 2 degrees Centigrade, we risk catastrophic changes to the climate, to our crops, to our water supply, to the ocean currents, to the ecosystems that we depend on.

And I will say to you, the science, Senators, is more definitive than ever. The science is screaming at us to take action. A few years ago, the scientists told us that the Arctic ice would be melted perhaps by 2030. It is now going to be summer, ice-free, by 2013. And already Russia has gone ahead and planted a flag underneath the ocean to say, we have the right to take these minerals out of here, because they have an ability, because it is ice-free, to be able to go up there and do that.

There are huge conflicts that will come out of what we are allowing to happen without addressing it adequately.

In the 21 years that we have had hearings on this in the Senate, Al Gore and I shared the privilege of having the first hearings on this in 1988, when Jim Hanson first told us that it was happening. And the evidence is now clearer than ever before that a voluntary approach just doesn't work.

We went down to Rio with President George Herbert Walker Bush, a Republican Administration, with the efforts of John Sununu and Bill Reilly, put in place a voluntary framework for a global effort to reduce emissions. Because in 1992, we determined that we needed to do this.

What happened? In every country in the world, emissions have gone up faster than is allowable to meet the 2 degrees Centigrade standard. And it is because voluntary doesn't work. Everybody is waiting for the next person to move. Nobody wants to sort of curb in their economy, as you have said, Senator Inhofe, because they are afraid they will be non-competitive.

But the consequences of that are really traumatic. The best experts tell us that the last 10 years have been the hottest decade on record, since we have kept records of temperature. Our oceans have become 30 percent more acidic. And that has a profound impact on the spawning grounds and on the krill that feed the whales and on the cycle of the oceans.

Pine beetles have destroyed 6.5 million acres of forest land in the western States. I recently listened to Governor Ritter from Colorado come in and tell us how in Colorado alone they have lost a million acres because beetles that used to die off because it got cold now don't die off. So the cycle has changed.

A hundred and eighty Alaskan villages are losing permafrost, literally melting the ground beneath their homes and feet. The citizens of Newtok, Alaska—ask Lisa Murkowski, ask Mark Begich, they will tell you what is happening in Alaska. The citizens of Newtok, Alaska, recently voted to move their village inland because of the rise of sea level and the lack of sea ice in the winter. That is at a cost of some $400 million.

The fact is that there is enormous melt-off of our glaciers in the western part of our country. Water supply is already at issue. The principal supply to American agriculture is at issue. And the rivers around the world are at issue.

The Chinese have taken enormous note of this. I was in China 2 months ago. They are fearful that the great rivers of China, the Yangtze, the Yellow River, are going to dry up, the Mekong. And that affects a billion people and the agriculture of their nation.

Southwestern States in our country are projected now to experience permanent drought conditions by mid-century. And the area that is burned by western wildfires is projected to nearly triple. The fact is that the Siberian ice shelf study, which just came out this last year, shows that because the permafrost lid is melting, because the oceans are getting warmer, we have columns of methane rising now in the ocean. And if you were to stand at the place where those bubbles of methane actually burst out into the open air and light a match, it would ignite.

Methane is 20 times more dangerous and damaging than carbon dioxide, than CO_2. So we have an enormous challenge facing us in order to be able to do this. And all of the scientists who, in these peer-reviewed studies are telling us that these changes may well be irreversible for a thousand years.

An organization as innocent as the Audubon Society has reported that there is now a 100-mile swath wide belt in the United States where there is a transformation in what plants and flowers and bushes and shrubs and so forth will grow in America. There is already a migration that has been predicted by many scientists. So that is why, Madam Chairman, the countries of the world, and there are many other impacts, I am not going to go into all of them here now, but that is why the countries of the world, including India, China and the United States, have agreed to limit this global rise to 2 degrees Celsius.

Now, why is that so critical? Because the current warming level of Earth, scientists tell us, is already at about .8 degrees since the Industrial Revolution. And what is already up there in the atmosphere, which we can't get out, has a half-life, that is, it will continue to do the damage it is doing today for another thousand years perhaps.

That means that what we have put up there that has done the damage that has raised the temperature the .8 degrees is guaranteed to raise it at least another .8 degrees. That means we are going to be at almost certainly 1.6 degrees Centigrade before we even do anything, Madam Chairman. And that gives us a cushion of about .4 degrees before you reach the 2 degrees, which they say could result in catastrophe.

Now, I can't tell you that it absolutely is. I can't sit here and tell you with certainty that I know the answer to that. But I can tell you as a public person that if the best scientific minds we have in the world in peer-reviewed studies are all in unity telling us this is the potential consequence, I think as public people we have a responsibility to try to respond. And if we are wrong, we will have created more jobs, become more energy independent, moved to the point of having better health in America and increased the security of the United States. If we are right and someone else is wrong and we haven't done anything, the results are obviously absolutely catastrophic. That is the balance here.

Now, I believe there is a workable mechanism to get this done, Madam Chairman. If you look at our legislation, we ask America

to do our part, and we have to work, obviously, to convince others to do theirs. Let me make it clear that by putting this target in place, I believe we will attract private investment and spur a new industrial revolution in America. We had the great movement of wealth, if you will, in the 1990s, when we moved to the tech economy. That is an economy that was about a trillion dollars large, and it had about a billion users. What we are looking at now is an economy where most estimates say it is a $6 trillion economy with 6 billion users. Energy economy is the mother of all economies. And right now, the United States of America is watching China, watching Germany, watching India and other countries race to this marketplace at the expense of the jobs of our Nation.

I believe that the pollution reduction measures that are in this bill are very tightly focused for maximum impact. And I want to emphasize that some people argue the effect on the economy. Senator Inhofe, you have raised this, U.S. unemployment, et cetera, why kill more jobs. I have a report here, it is a compilation of reports, different reports by the Center for American Progress, by the U.S. Conference of Mayors, by the American Council for an Energy Efficient Economy, by the College of Natural Resources at the University of California Berkeley. Every single one of these analyses, we have done them for each of your States, for every one of you on this committee, and we will do them for everybody on the Senate. They show net creation of jobs in every one of your States. They show net increase of investment and money moving into your States.

In Idaho, for instance, 7,000 to 14,000 jobs net, according to the University of California Berkeley. According to the American Council for Energy, by 2020, 200,200 jobs created from energy efficient measures, a savings of $226, by 2030, 2,900 jobs created, $700 million, according to the Center for American Progress, $700 million will come into Idaho alone, creating 8,000 jobs. There is a variation here.

But there isn't one of these that doesn't suggest an increase of jobs, an increase of investment. We are going to create the equivalent of 5 or 10 Google equivalents that are going to drive the economy of our country. That is why people like DuPont, Dow Chemical, American Power, the Florida Power and Light, Duke Energy, Cisco Systems, some of the largest companies in America are all saying, do this. Give us a market certainty on the price of carbon. Give us a system where you will help us to transition.

Now, I want to just say a word about that if I can. Senator Inhofe, this is not economy-wide. Only 7,500 entities in the United States of America are covered by this legislation. Ninety-eight percent of America's small business is exempt. Agriculture is exempt. Transportation is exempt. Small business is exempt. So you may say to yourself, well, what do you do with that other 2 percent? Well, the fact is that that 2 percent represents three-quarters of America's greenhouse gas emissions. We are only talking about creating a marketplace between entities that pollute more than 25,000 tons of carbon dioxide a year. That is the equivalent of the output of 2,300 homes, or 4,600 automobiles, or 130 railway cars full of coal.

It exempts office buildings, apartment, homes, malls, stadiums, small firms. We have to be able to find it in our capacity to reduce pollution from 2 percent of America's businesses that represent 75 percent of America's pollution.

Now, let me say another reason we need to do this. Climate change and our dependence on foreign oil are a significant threat to our national security. There is nothing conservative about remaining indebted to hostile regimes for our energy. Doubters often talk about the cost of taking action. But I have to tell you, every analysis shows that the cost of not taking action is more expensive. If we think that it is good for America to send $400 billion a year to other countries so we can put stuff up into the atmosphere that costs us even more to fix, we are crazy. We would be far better off moving more rapidly toward the creation of that energy here at home.

Eleven former admirals and high ranking generals issued a seminal report warning that climate change is a "threat multiplier" with the potential to create sustained natural and humanitarian disasters on a scale far beyond those we see today. And John Warner, who will testify, our former colleague, there is no greater security advocate for the United States, speaks eloquently about this, as have others. General Zinni, former CentCom commander, said this is going to cost us lives. It is going to cost us the deployment of the American military because of the crises that will ensue as a consequence of allowing this to go unaddressed.

It threatens to bring more famine and drought, worse pandemics, more natural disasters, more resource scarcity and human displacement on a staggering scale. And the result is, we risk fanning the flames of failed stateism. Madam Chairman, you can see this today in Africa. Right now, there is fighting between tribes in the Sudan because they have been forced to move because of the lack of water and the desertification that has taken place. So they move into another area, fight for water, fight for location, and the result is conflict and the destabilization of a whole region.

In an interconnected world, that threatens all of us. I think you will hear this from Senator Warner. Let me quote Anthony Zinni directly. He said "We will pay the price later in military terms. And that will involve human lives. There will be a human toll."

Fourth issue, Madam Chairman. America's leadership is significantly on the line here. Brazil, Mexico, South Korea, the European community, Japan, Australia, have all committed to significant emissions reductions. Last month, Chinese President Hu Jintao pledged to reduce China's emissions below projected levels.

India is working on its own domestic legislation to reduce pollution. It is a myth that China and India have been sitting on the sidelines. I was just in China. Let me tell you, they have tripled their wind goals and targets. They have determined to be the world's leader in electric automobiles. They are now the world's leader in solar production and in battery storage, et cetera. They have moved to put transportation restrictions on their automobiles, more strict than the ones that we have in this country. And they have put them in place faster. And the fact is that they are coming to the negotiating table with an agreement that they will be a constructive and positive force at Copenhagen.

Fifth, the economic opportunities that stare us in the face are enormous. There are millions of jobs, major improvements to every sector of our economy. But I am telling you, Madam Chairman, if we hang back, you can tell what is happening. Today, of the five top 30 companies of the world in solar, wind and advanced batteries, only five are based in the United States of America. We invented solar. We invented wind. And we pulled back and we allowed those technologies to be developed and taken from laboratory to shelf by other countries.

Germany now has created 280,000 new renewable energy jobs and actually employs more people in its renewable energy sector than in the legendary German auto industry. That is the future. Wind energy alone can bring tremendous benefits.

I will give you an example, the State of North Dakota. I have talked to Byron Dorgan about this. The State of North Dakota is ranked by the Wind Power Energy Association as No. 1 wind potential in the United States of America. It is currently number 24 in terms of its production. Though its regular economy has grown by about 2 percent over the course of the last few years, its renewable energy sector has grown by about 19 percent. That represents the kind of growth in each of your States, if you will take a look at the analysis of these studies.

In Montana, there is a plan to build a $25 million wind turbine manufacturing plant in Butte with scientists who are trained at Montana Tech. In Pennsylvania, the wind turbine manufacturer, Gamesa, has invested over $175 million and put over 1,100 Pennsylvanians to work. In Norman, Oklahoma, there is a 30-year-old family owned company that has become the third largest manufacturer of small wind turbines in the world, with installations in all 50 States and over 100 countries. That business can grow and compete with the Chinese.

And that is just a few examples from what comes from a clean energy sector.

Now, I understand there is some concern in the Senate that the process is moving too quickly. I will put aside my own feelings that a process that began over 20 years ago is actually moving too quickly. That could happen only by Senate standards, frankly.

But within the constraints of the Senate, what is happening here in this committee is just one step. There are five other committees. They are all working. The Energy Committee has done part. The Foreign Relations Committee, the Agriculture Committee, et cetera. By the time this gets to the floor, a comprehensive energy and climate bill will include the inputs from six Senate committees. And the foundation of all that work has to come through this committee first.

I will just close. You have been very generous in allowing me the time here. Let me just close and say, OK, why put a target that is mandatory on the reduction of emissions? Some people argue it would be cleaner to have a carbon tax. Well, it might be cleaner. But I don't believe that you will change behavior with a tax at the level that you might under some miracle be able to pass in the Senate. I doubt that there are enough people here who would vote for a tax of any kind.

And therefore, to say you are going to change behavior, you are going to have to have a tax that is high enough to force companies to be able to reduce emissions, because they are going to say, whoops, this is too costly, we have to go find a different way to behave, and we are going to invest in the different technologies.

So I don't think this is going to work, which is why companies that are big companies have decided to support the idea of a targeted pollution reduction, mandatory reduction. Because it allows them, if they have been good performers and they have reduced their emissions, they can take the difference between where they are at and the emissions target and sell it to another company that can't yet meet the target or wants to be able to continue its current practices.

That is the marketplace, folks. That is classic American capitalism. It is classic marketplace capacity. There isn't a dime of public dollar in that. There is not one tax dollar in that. It is not a Government-run program. It is a private company deciding that it wants to behave this way or that way. And depending which way it decides to behave, it gets an asset that is worth something, or it sells the asset; it can buy it and continue to pollute for a period of time while it transitions to a place where they are willing to invest to meet the target.

So I would just say to all of my colleagues, I respect the passion on this committee. I am happy to answer any questions.

I think we have to believe in America's technology ability. I do. We saw this in 1990 with the Clean Air Act.

I will just end on this note. I sat in that room and negotiated with John Sununu and President Bush and Bill Reilly. And we heard the same arguments. Everybody said it is going to cost $8 billion, and you are going to bankrupt us, and you will make us noncompetitive, and we can't do it. The environment community came in and said, no, no, no, that is just those studies that sort of exaggerate things. It is going to cost $4 billion, and it will take 4 years, and we can do it.

To the credit of George Herbert Walker Bush, he decided to do it. And guess what? We achieved our goals within about a year and a half to 2 years at a cost of about a billion and a half to $2 billion. Why? Because nobody has the ability to predict what happens when you set a target and American ingenuity and genius begins to move to create the technologies and find the solutions to meet that target.

I believe that is exactly what is going to happen here if we will have the courage to set the goal and lead the world. And if we do that, I believe we are going to, in 10, 15 years, not only see that we have met the challenge of climate change, but we have improved the health in America, we have created more jobs, we have strengthened American security, we have met our environment responsibility, and we are more energy independent. Tell me a public policy choice where you get five benefits for one choice. There are very, very few of them.

Thank you, Madam Chairman.

[The prepared statement of Senator Kerry follows:]

STATEMENT OF HON. JOHN KERRY,
U.S. SENATOR FROM THE STATE OF MASSACHUSETTS

Thank you, Chairman Boxer and Senator Inhofe, for the opportunity to discuss a set of issues as important as any we face. Chairman Boxer has been a passionate, determined, and inspirational leader on environmental issues for as long as I've known her—and an invaluable and gracious collaborator on this bill.

Today, we have an opportunity to lead the world in rolling back the urgent threat of climate change. We can protect the air our children breathe and the water they drink. We can improve every sector of our energy economy, from coal and nuclear to wind and solar; take crucial strides toward energy independence; and create millions of new jobs and entire new industries that will stay in America.

But we can't and we won't do those things if we don't pass aggressive, forward looking climate and energy legislation. And let me tell you why.

First, the science is more definitive than ever and more troubling than ever, and—21 years since first Senate hearings on climate change back in 1988—the evidence is now clearer than ever before that a voluntary approach won't get the job done.

NASA scientists—the best experts we have—tell us that the last 10 years have been the hottest decade on record. Our oceans have become 30 percent more acidic. Pine beetles have destroyed 6.5 million acres of forest land in the western States. 180 Alaskan villages are losing permafrost—literally melting the ground beneath their homes and their feet. Southwestern States are projected to experience permanent drought conditions by mid-century, and the area burned by western wildfires is projected to nearly triple. And worst of all, scientists say these changes may well be irreversible for 1,000 years.

That's why the countries of the world—including India, China and the United States—have agreed to limit the global rise in temperature to 2 degrees Celsius.

Second, there is a workable mechanism to get this done. For America to do our part and convince others to do theirs, we need to set a mandatory target to reduce the carbon pollution that causes climate change—and then we need to drive private investment to meet those goals as affordably and efficiently as possible.

The pollution reduction measures in this bill are tightly focused for maximum impact: Only companies emitting 25,000 tons of carbon each year are covered. These are big polluters—with an output equivalent to 2,300 homes, 4,600 automobiles, or 130 railway cars full of coal. Even as it exempts office buildings, apartments, homes, malls and stadiums, farmers, small firms, and over 98 percent of America's businesses, the bill still covers three-quarters of America's carbon pollution. So this is a smart way to start the ball rolling and transition America to clean energy.

Third, climate change and our dependence on foreign oil are a threat to our national security. There's nothing conservative about remaining indebted to hostile regimes for our energy. Doubters often talk about the costs of taking action. Let me tell you, the costs of inaction are larger, and frankly they become more staggering by the day.

Eleven former admirals and high ranking generals issued a seminal report warning that climate change is a "threat multiplier" with "the potential to create sustained natural and humanitarian disasters on a scale far beyond those we see today." Why? Because climate change injects a major new source of chaos, tension, and human insecurity into an already volatile world. It threatens to bring more famine and drought, worse pandemics, more natural disasters, more resource scarcity, and human displacement on a staggering scale. We risk fanning the flames of failed stateism and offering glaring opportunities to the worst actors in our international system. In an interconnected world, that endangers all of us. Senator Warner, a friend to many here, will speak eloquently to the national security case for preventing catastrophic climate change. General Anthony Zinni, former commander of our forces in the Middle East, warned that without action—and I quote—"we will pay the price later in military terms. And that will involve human lives. There will be a human toll."

Fourth, America's leadership is also on the line. While the Senate stands still, the world is racing ahead: Japan, Mexico, Brazil, South Korea, the EU, and Australia have committed to significant emissions cuts. Last month, Chinese President Hu Jintao pledged to reduce China's emissions below projected levels. India, for its part, is working on its own domestic legislation to reduce carbon pollution. So it is a myth that China and India have been sitting on the sidelines. The truth is, they've been coming to the negotiating table with concrete actions and commitments, and they're waiting for us to do the same!

Fifth, and as important as anything, if we act, the economic opportunities will be enormous: millions of new jobs and major improvements in every sector of the en-

ergy economy. But if we hang back, we know what will happen, because it is happening already. Today, only 5 of the top 30 companies in the world in solar, wind and advanced batteries are based in the United States. We invented solar and wind technology, but we let others master it first, and now Germany has created 280,000 renewable energy jobs and actually employs more people in its renewable energy sector than in the legendary German auto industry.

State by State, a smart energy bill can deliver growth and jobs. Wind energy alone can bring tremendous economic benefits. In Montana, there's a plan to build a $25 million wind turbine manufacturing plant in Butte, with scientists trained at Montana Tech. In Pennsylvania, the wind turbine manufacturer Gamesa has invested over $175 million and put over 1,100 Pennsylvanians to work. In Norman, Oklahoma, there's a 30-year-old family owned company that has become the third largest manufacturer of small wind turbines in the world, with installations in all 50 States and over 100 countries. And that's just a few examples from one clean energy sector! I understand that there is some concern inside the Senate that this process is moving too quickly. I'll put aside my own feeling that a process that began over 20 years ago is quick only by Senate standards. But within the constraints of the Senate, we know this is only one step—albeit a crucial one—in a broad, comprehensive, Senate-wide effort. By the time it gets to the floor, a comprehensive energy and climate bill will include inputs from six Senate committees. But the foundation for all of that work—a cap on carbon pollution—must come through this committee first.

I respect that there is a lot of passion on all sides of these issues. People are worried about jobs, about keeping energy affordable, and about economic competitiveness. These are real and legitimate subjects of concern. And we must address them as thoroughly and honestly as we can together. I am confident that the more people understand about what we are trying to accomplish here—not the politics, but the substance—the more they will be willing to join us. So to sum up, the science is more urgent than ever. We have a workable mechanism to address the challenge in a way that is affordable and efficient. Our security, our leadership, and our economic future are at stake.

And frankly, this body's leadership is at stake, too. America and the world are waiting to hear from the U.S. Senate. World leaders are waiting for a signal that we are serious before they make commitments at the Copenhagen climate talks 6 weeks from now. CEOs and business leaders are waiting for a signal from Washington that will give them market certainty.

Failure to act comes with another cost. If Congress does not pass legislation dealing with climate change, the Administration will use the Environmental Protection Agency to impose new regulations. Imposed regulations are likely to be tougher, and they certainly will not include the job protections and investment incentives we are proposing. Killing a Senate bill is not success; indeed, given the threat of agency regulation, those who have been content to make the legislative process grind to a halt might well later be demanding that Congress secure the kinds of incentives and investments we can and should simply pass today.

For all these reasons it's time for the Senate to lead—and with an eye toward our best traditions find common ground to move the country forward, keep our country safe and strong, and lay the groundwork for decades of economic growth to come.

Senator BOXER. Thank you, Senator Kerry. We so appreciate your expanding on why it is so important that we act. We thank you very much.

I want to say to the committee, we are going to now go to opening statements. And we are going to be tough on the clock. I do have a request from Senator Baucus, who is late for a health care meeting, he would like to go first, if it is OK with my side. He said he only needs 3 minutes. So if there is no objection, I think everyone knows what is on your shoulders. So go ahead.

OPENING STATEMENT OF HON. MAX BAUCUS, U.S. SENATOR FROM THE STATE OF MONTANA

Senator BAUCUS. Thank you. I am keeping Director Orszag and Director Summers waiting in my office for 12 minutes. I deeply apologize, I will be very, very brief, and I will thank the indulgence of my colleagues.

First, I want to thank the Senator from Massachusetts. Senator Kerry has worked so hard on climate change, and clearly, his statement today shows how hard he has worked. He has done a great job.

Madam Chairman, I want to thank you and thank Ranking Member Inhofe and our witnesses for being here today to discuss climate change. The legislation before us today is about protecting our outdoor heritage. We, I think all of us in the country, certainly those of us in Congress, when we leave this place, have a moral obligation to leave it in as good a shape or better shape than we found it. If uncontrolled, the impacts of climate change put this future at risk.

The legislation before us today is about our economy. Montana, with our resource-based agriculture and tourism economies, cannot afford the unmitigated impacts of climate change. But we also cannot afford the unmitigated effects of climate change legislation. That is why I support passing common sense climate legislation that reduces greenhouse gas emissions while protecting our economy. And the key word in that sentence is passing.

I have some concerns about the overall direction of the bill before us today and whether it will lead us closer to or further away from passing climate change legislation. For example, I have serious reservations about the depth of the mid-term reduction target in the bill and the lack of preemption of the Clean Air Act's authority to regulate greenhouse gas emissions.

We cannot afford a first step that takes us further away from an achievable consensus on common sense climate change. We could build that consensus here in this committee. If we don't, we risk wasting another month, another year, another Congress without taking a step forward into our future.

I look forward to working with my colleagues on both sides of the aisle in this committee prior to the markup to address these issues and other key issues. I think it is very important that we do.

Thank you, Madam Chairman.

Senator BOXER. Thank you very much, Senator.

Senator Alexander.

OPENING STATEMENT OF HON. LAMAR ALEXANDER, U.S. SENATOR FROM THE STATE OF TENNESSEE

Senator ALEXANDER. Madam Chairman, thank you.

I have no problem with the problem. My problem is with the solution. Eleven academies in industrialized countries say that climate change is real, humans have caused most of the recent warming. If fire chiefs of the same reputation told me my house was about to burn down, I would buy some fire insurance.

But I would buy insurance that worked, and I wouldn't buy insurance so expensive that I couldn't pay my mortgage or my hospital bill. That is my problem with this solution. It is going to make it harder for Americans to support their families. When it is all wrapped up and put together, it is going to be an economy-wide cap-and-trade, narrowly defined energy mandates, taxes, mandates and surprises.

My colleagues, I am sure, are going to point out the surprises and the things we know. At a time of 10 percent unemployment,

utility bills going up, manufacturing jobs going overseas, a new slush fund in Washington with corporations with their hands out. It will be ineffective against fuel, which produces 30 percent of carbon, because raising the price of gasoline doesn't change human behavior enough to change to reduce much carbon.

If it is like Waxman-Markey, which EPA says it mostly is, then according to President Obama's budget director, it is the largest corporate welfare program in history. According to CBO, it could reduce our gross domestic product by 3 and a half percent. Brookings says $300 billion a year, et cetera.

So the strategy is, taxes, expensive energy and mandates, and make 20 percent of our electricity from subsidized windmills. But our dream should be cheap energy, to create jobs and eliminate hardship. So before we embark deliberately on a program to send jobs overseas and make it hard to pay our bills, why don't we try a cheap energy strategy for clean energy?

One, build 100 new nuclear plants in 20 years. They are 70 percent of our carbon-free energy; wind is 4 percent of our carbon-free energy. Two, electrify half our cars and trucks in 20 years. We can do that without building one new power plant if we plug them in at night. Three, explore offshore for natural gas. It is low carbon. Four, launch four mini-Manhattan projects like the one we had in World War II. Secretary Chu calls them innovation hubs, to find ways to recapture carbon from coal plants, make solar costs competitive, make electric batteries better, recycle used nuclear fuel.

Instead, we have this plan for a national energy tax plus a national windmill policy. This windmill policy would require building 186,000 50-story wind turbines that would cover West Virginia, 19,000 new transmission lines, $170 billion in taxpayer subsidies, ridge tops and coastlines and treasured landscapes turned into junkyards in the sky, kill a million birds a year. And it still would work only a third of the time, and you would have to build natural gas or nuclear or coal plants to back them up.

What happened to nuclear? If we are going to war, and we had invented a nuclear navy 60 years ago, and it was doing exactly what we wanted, and thousands of sailors had lived safely on top of the reactors for 60 years, would we stop building nuclear ships and start building sailboats?

Building nuclear power plants, 100 of them in 20 years, is the fastest, cheapest, reliable way to reduce carbon from utilities, just as electrifying half our cars is the fastest way to reduce foreign oil. China is building 132 nuclear plants, France is 80 percent nuclear, it has the lowest electric rates, among the lowest carbon emission rates in Europe. Japan, Taiwan, India, the United Arab Republic, Russia, all building nuclear plants. We invented it, and we haven't started a new one in 30 years.

If we went full speed ahead, by 2030, nuclear would produce 40 percent of our electricity, natural gas 25 percent, hydroelectric 10, wind and solar 5. We would come close to meeting the Kyoto carbon emissions by 2030 just with nuclear plants and electric cars. And presidential leadership could do it, remove barriers, provide incentives, fund the Manhattan Projects. With presidential leadership, we could build 100 nuclear plants, electrify half our cars and trucks, find new low carbon natural gas, launch the Manhattan

Projects, meet our clean energy goals, all without a national energy tax and without running jobs overseas.

All 40 Republican Senators agree with this four-part agenda. So do many Democrats. Then why are we pursuing a high cost national energy tax and subsidizing 186,000 windmills, when we could agree on a low cost clean energy plan that would create good jobs and low electric fuel bills?

Thank you.

Senator BOXER. Thank you, Senator.

Senator Specter. Oh, I'm so sorry, Senator Klobuchar and then Senator Specter. Under the early bird rule.

OPENING STATEMENT OF HON. AMY KLOBUCHAR, U.S. SENATOR FROM THE STATE OF MINNESOTA

Senator KLOBUCHAR. Thank you.

Senator Boxer, I first want to thank you for moving proactively on this issue that is so important to our Nation's economy, security and environment. Your leadership on this issue is well recognized. And I appreciate your working with me and our staff on this bill to include provisions to better protect the middle class, to expand agriculture allocations and to work to provide a stable business environment for companies that make energy efficient technology.

I also appreciate how both you and Senator Kerry have worked across the aisle and people like Lindsey Graham and others. I hope that ultimately we will have a bi-partisan bill here.

I look forward to working with you, Senator Boxer, on key issues including ensuring that the bill further protects middle class families as well as businesses and manufacturers from fluctuating energy costs. We have done a lot in this area, but there is more to do. I look forward to working with my agriculture colleagues on further agriculture provisions in this bill.

And finally, I believe that ultimately this bill must include a strong renewable electricity standard.

Let me focus on why this legislation is important. This legislation is about putting America back in control of our energy supply. It is about our national security, and it is about investing in the farmers and the workers of the Midwest instead of the oil cartels of the Middle East.

This is about getting jobs right here in this country. Unlike the IT revolution, which was a great thing, but tended to bring jobs to certain places in the country, the ET revolution, the energy technology revolution, if done right, will mean jobs across the country and across demographic lines. In other words, the wind turbine manufacturing companies won't have signs outside that say, Ph.Ds. only apply.

Second, there are a wide variety of solutions to our energy dependence problem, as Senator Alexander has acknowledged. Some critical paths of this bill, which I support, will take years, like developing complex technology and building more nuclear plants, something that I believe we need to do. But some of the solutions, which this bill acknowledges, will be more achievable in the short term: energy efficiency, weatherization, using some of the existing technologies we have, like solar, wind, geothermal, biomass as quickly as possible.

Third, we need an energy bill, as Senator Kerry had so eloquently discussed, that can send clear market signals that both short-term and long-term investment in energy technologies will be rewarded, allowing businesses to plan to invest in new technologies and realize long-term development of new facilities and operations.

Finally, we want an energy bill that builds on the work being done at the State level. All over the country, we are witnessing improvements to our communities on the State level. Minnesota has one of the most aggressive renewable electricity standards in the country, 25 percent by 2025. Our biggest utility is Xcel. Its goal is 30 percent. I have talked to the CEO, Dick Kelly. He said they are going to make it, and they are going to make it without increasing rates.

When this legislation passed in Minnesota, it had Democratic and Republican support, farmers, environmentalists, traditional energy companies. It passed 123 to 10 in the House, 63 to 3 in our State Senate and was signed into law by a Republican Governor.

So while Minnesota and so many other States are already heading down the path toward a new energy economy, the Federal Government has not even made it to the trailhead. In a famous opinion, Justice Brandeis once wrote that States are truly the laboratories of democracy. He said that if one of the happy incidences of the Federal system could be that a single courageous State may, if its citizens choose, serve as a laboratory and try more social and economic experiments without risk to the rest of the country.

Well, he didn't mean by that statement that we should have inaction by the Federal Government. And that is what has been happening. This bill is an opportunity to put the courage and the entrepreneurship of the American people up front and center. It is about the thousands of people employed in biofuels plants throughout our State, dotting the countryside. It is about nine people in Starbuck, Minnesota, that had the courage to leave their jobs to go work for a solar panel factory. It is about a little phone company in Sebeka, Minnesota, that decided they wanted backup power for their customers and put together a wind and solar backup system.

And one guy who is 80 years old decided that he wanted to outfit his whole house that way. And they said, well, you know, you are not going to get your investment back, sir, for 10 years, and you are 80 years old. He said, that is OK, I want to go green.

You know, this, if the people of American have this kind of courage, this Congress should have this courage. That is why I believe we need to move forward on this legislation. I hope that eventually we will be doing it on a bi-partisan basis.

Thank you.

[The prepared statement of Senator Klobuchar follows:]

STATEMENT OF HON. AMY KLOBUCHAR,
U.S. SENATOR FROM THE STATE OF MINNESOTA

Senator Boxer, I want to thank you for moving proactively on an issue so important to our Nation's economy, security, and environment. Your leadership on this issue is well recognized, and I appreciate your working with me and my staff on this bill to include provisions to protect the middle class, expand agriculture allocations, and provide a stable business environment for companies that make energy efficient technology. I also appreciate how both you and Senator Kerry have reached out across the aisle on this issue to Lindsey Graham and others. I believe this will

be key to getting the bill passed—at least that's how we got energy legislation passed in my State.

I look forward to working with you further on key issues including ensuring that the bill further protects middle class families as well as businesses and manufacturers from fluctuating energy costs. We've done a lot in this area, but there's still more work to be done.

As a member of the Agriculture Committee, I'm also looking forward to working with my Ag colleagues on additional agricultural provisions.

Finally, the ultimate bill must have a strong renewable electricity standard.

Let me first focus on why this legislation is so important. This legislation is about putting America back in control of our energy supply. It's about investing in the farmers and workers of the Midwest instead of the oil cartels of the Mideast. Renewable energy—coming from our wind, sun, ground and bio products is by its nature going to involve jobs right here in our country. Unlike the IT revolution which tended to focus the jobs in certain places in our country, the ET revolution, if done right, will mean jobs across this country and across demographic lines. In other words, the wind turbine manufacturing companies won't have signs outside that say Ph.D.s only apply.

Second, as acknowledged in the bill, there are a wide variety of solutions to our energy dependence problem. Some things will take years—like developing complex technology and building more nuclear plants. But some of the solutions are more achievable in the short term—conservation, weatherization and using some of the existing technologies—solar, wind, geothermal, biomass, as quickly as possible.

Third, we need an energy bill so that we send clear market signals that both short-term and long-term investment energy technologies will be rewarded, allowing businesses to plan to invest in new technologies and realize long-term development of new facilities and operations.

Finally, we want an energy bill that builds on the work being done at the State level. All over the country, we are witnessing improvements to our communities through renewable energy projects, facilities, and products, as well as a focus on increased energy efficiency.

For renewable electricity, for instance, I note that Minnesota is further down the path than any other State.

By the year 2025, the State's energy companies are required to generate 25 percent of their electricity from renewable sources such as wind, water, solar, and biomass. The standard is even higher for the State's largest utility, Xcel Energy, which must reach 30 percent by 2020. CEO Dick Kelly has been in my office and said it is going to be tough, but they are going to make it, and they'll meet this goal without raising rates.

When this legislation passed in Minnesota, it wasn't a partisan issue. It was supported by both Democrats and Republicans—as well as the farmers and environmentalists, traditional energy companies and new renewable energy companies. It passed overwhelmingly in the Minnesota legislature: 123–10 in the House and 63–3 in the Senate, and was signed into law by a Republican Governor.

But while Minnesota and so many are States are already heading down the path toward the new energy economy, Federal legislation has not even made it to the trail head.

In a famous opinion Justice Brandeis once wrote that States are truly the "laboratories of democracy." He went on to describe the special role of States when it comes to experimenting with new policies in our Federal system.

States are where new ideas emerge, where policymakers can experiment, where innovative proposals can be tested.

Brandeis wrote over 70 years ago, "It is one of the happy incidents of the Federal system that a single courageous State may, if its citizens choose, serve as a laboratory; and try novel social and economic experiments without risk to the rest of the country."

Yet he did not in any way mean for State action—which has been precipitated so often in the energy area this decade as a result of Federal inaction—he did not mean for State action to serve as an excuse for inaction by the Federal Government. Good ideas and successful innovations are supposed to emerge from the laboratory and serve as a model for national policy and action. That is now our responsibility in Congress.

When we do this, we need to put the courage and entrepreneurship of the American people front and center. People in my State believe in this new energy future.

Or the solar panel factory in Starbuck, Minnesota, where nine people left their jobs to go work for this little company.

Or the story of the little phone company in Sebeka, Minnesota, with back-up power. Will take you 10 years. He was 80. I want to go green.

By being part of something bigger than themselves, by actually seeing this new homegrown energy in their own communities, it makes it a lot easier for people to support energy legislation, to see it as part of the greater good.

If you ever visit our office in Washington, you will see a picture on the wall, and it's the picture of an angel placing the world in some outstretched hands, and the words read, "The angel shrugged. She placed the world in the palms of our hands, and she said, 'If we fail this time, it will be a failure of imagination.'"

Well, I don't believe we are going to fail; we can't. If nine people in a solar panel factory in Starbuck, Minnesota, have the courage and imagination to see a new energy future and the world of opportunity before us, Congress can, too.

Thank you.

Senator BOXER. Thank you so much.

Now, we do have a lot of speakers. We know that Secretary Salazar must leave by noon. So it is my intention to get where we are going, and at that point, if we are really slow, we will get to at least Secretary Salazar and go back to our plan.

So here is the list. It is Bond, then Specter, Crapo then Sanders.

Senator Bond.

OPENING STATEMENT OF HON. CHRISTOPHER S. BOND, U.S. SENATOR FROM THE STATE OF MISSOURI

Senator BOND. Thank you, Madam Chair, for holding the hearing.

Unfortunately, this latest cap-and-trade bill was just released late Friday night. That is why the EPA discussion paper is nothing more than a political document requested by advocates and acquiesced by politicians. Career EPA experts would usually take about 6 weeks to conduct a thorough economic analysis. EPA's analysis of Bingaman-Specter ran 252 pages, Lieberman-Warner 193, Waxman-Markey 160. But for Kerry-Boxer, EPA slapped together a mere 38 pages of excuses and analogies.

Left unsaid by EPA is how Kerry-Boxer provides less consumer protection against higher prices. The businesses that will be hit with this high carbon tax will pass along these higher prices, which are disguised taxes, to every family, every small business, every farm, in the United States. If you think about it, a smaller pie produces smaller slices. In the case of Kerry-Boxer, their bill has a more stringent 20 percent target in 2020, instead of 17 percent in Waxman-Markey. It means it will distribute 1.46 billion fewer allowances between 2012 and 2030. And while most of Kerry-Boxer and Waxman-Markey's allocation percentages are the same, the Kerry-Boxer allocates smaller. Smaller pie, smaller slices, which mean less relief from the burdensome taxes. This means, by my calculations, electric consumers will receive nearly $16 billion less from Kerry-Boxer in protection against higher energy prices.

Since consumers and workers in coal dependent States like the Midwest will bear the brunt of this multi-million dollar shortfall, we deserve to know how much less it will protect gas consumers and trade exposed workers. Another gaping hole is the plight of farmers, a major concern in the Midwest and South. Cap-and-trade threatens farmers and livestock producers with higher production costs, from fuel to run their machinery to fertilizer to drying costs to the cost of shipping their goods to market. It is as if the Kerry-Boxer bill is telling farmers and the ag communities, you are not important. It took away the USDA's offset role, negotiated in the House, removed the 5-year pause in EPA's indirect land use rule.

It proposes uncertain potential for ag offsets. It proposes higher production costs for farmers. And their bill will result in ag lands taken out of production. That means higher food prices for all of us.

The last dynamic is a result of farmers reacting to a carbon offset program by taking land out of production. Higher food prices, more pain at the grocery checkout for families. I don't know if EPA even understands, or else they chose not to discuss in their discussion paper these land production dynamics and the regional disparities in crop and production cost estimates. America deserves better. America's families, farmers, and workers deserve to know how Kerry-Boxer will impose trillions of dollars in higher energy taxes, kill millions of jobs and treat unfairly entire regions of the country such as the Midwest, South and Great Plains.

The analysis discussed about new green jobs did not mention the tremendous costs to existing jobs of this carbon tax to be passed throughout our economy. Independent organizations not swayed by the Administration's influence, such as the Congressional Budget Office, say the same thing, cap-and-trade will hurt the economy and cost jobs.

Now, we can make this country, including the North American continent, energy independent in 15 years, if we have some leadership to start developing in an environmentally friendly, efficient way to tap the energy resources that we have. Producing more of the energy we need here, using significantly more nuclear power, using energy conservation, using electric cars. These will generate more good jobs, produce more revenue, instead of costing the tremendous amount of taxpayer subsidies for wind and solar. And we can do that without costing jobs that are higher pay, existing jobs throughout the economy.

We want to see changes. But we want to make them smart, energy efficient, not kill jobs, not put burdens on families, small businesses and farmers.

I thank the Chair.

Senator BOXER. Thank you very much.

Senator Specter.

OPENING STATEMENT OF HON. ARLEN SPECTER, U.S. SENATOR FROM THE STATE OF PENNSYLVANIA

Senator SPECTER. Thank you, Madam Chairwoman.

I think it is not too much to say that what we are doing today may really turn out to be historic, as we grapple with very critical objectives. The objective of providing energy for our country, to take care of us and our economy in the future, to deal with climate change and to protect the planet from global warming, and to free ourselves from dependence on OPEC and Venezuelan oil.

I compliment you, Madam Chairwoman, for your prodigious work here, and both you and Senator Kerry for producing the legislation we are looking toward today. I note, as everyone must, the very heavy political overtone at the start of these hearings. It is my hope that we will listen to the witnesses. We all are concerned about job loss.

My State, Pennsylvania, is a microcosm. It has been built upon coal and steel. And it is critical that any legislation take into ac-

count those factors. My State has a great deal of natural gas with the new Marcellus Shale, opening clean fuel for the future. My State is a leader on green jobs. A week ago today, I held a hearing in Pittsburgh on the potential of green jobs. But at the same time, concerned as to what would happen in southwestern Pennsylvania in the coal mines.

Now, we are building on Lieberman-Warner, and in the 109th Congress I worked with Senator Bingaman to try to craft a moderate bill which got support from many of the environmental groups, got support from the power plants and got support from the United Mine Workers. Now, for a Pennsylvania Senator, support from those facets, especially the mine workers, is very, very important.

We are open for business for people who have problems and ideas. Yesterday, I met with the Building Trades Council in Pennsylvania. And they brought to my attention, as it had been before, the refinery problem. Well, our refineries are not up to date. And there are problems with them. But there are thousands of jobs in Philadelphia on the Sunoco refinery and on the Conoco Phillips refinery. So when I hear comments about loss of jobs and higher costs for consumers, I am very, very much concerned with that.

We have dedicated some $80 billion in the stimulus package to wind and hydro power. So we are moving ahead. So it is complicated. I have been in the Senate a while, and I haven't seen two mammoth legislative problems like health care and climate control, which we are facing now. But it would be my hope that we will finally get to the witnesses, and then we will have other witnesses. And the people who have raised objections, I respect them, have worked with them for a long time. We will bring their witnesses in, and let's be fact oriented, and let's look for public policy. We all have the same objectives and the same goals. It would be very refreshing in America today if we could find a bi-partisan answer.

Thank you, Madam Chairwoman.

Senator BOXER. Thank you so much, Senator.

Let's see, next is Senator Sanders, who isn't here, so we will go—I am sorry.

Senator Crapo.

OPENING STATEMENT OF HON. MIKE CRAPO, U.S. SENATOR FROM THE STATE OF IDAHO

Senator CRAPO. Thank you very much, Madam Chairman.

I want to comment on a few things like process and a few aspects of the bill that I want to highlight, and then conclude discussing the policy issues that a number of my colleagues have already addressed.

With regard to process, Madam Chairman, I want to congratulate you for having some bill language for us to evaluate, although we just barely got it. I just went through the process in the Finance Committee of having to actually go through an entire 2-week markup and vote on a bill that didn't exist. In fact, I am not sure it ever did get fully drafted, because then it was redrafted as it was merged with the Health Committee bill. That process was flawed.

I appreciate the fact that we have bill language. I would hope that as we move through the hearing process here that we will also

take the time to get a thorough EPA analysis and to get a thorough CBO score before we would go to any kind of a markup. And let the American public, as well as this committee, to truly vet this legislation and understand what the exact wording in the bill means and does for us.

Second, I appreciate our witnesses begin here today. I work with all of them and appreciate the relationship I have with them and look forward to hearing what they have to say. I do wish that the Secretary of Agriculture was here. In fact, Madam Chairman, I wish that the legislation gave the Secretary of Agriculture a greater role.

Senator BOXER. Senator, if you would yield without losing any time, we do have a statement. He is traveling in China. But he has a wonderful statement which I will quote from later.

Senator CRAPO. All right, good. I appreciate that. And actually, the legislation as it is now structured puts the EPA in charge of the offset programs for farmers and foresters, as I understand it; is that not correct?

Senator BOXER. That is not correct. Again, without losing his time, we leave it up, we say the White House will, it is a place holder for the Ag Committee, which Chairman Lincoln understands. And she is planning to fill it in. So as we have a place holder for Finance, we have a place holder for Ag. And in the bill, it just says right now that the White House will determine who would be in charge of it.

Senator CRAPO. All right, very good. This just shows the importance of us being able to have the time to know what is in the bill and to vet it adequately. But I really do hope that when we get to that point and we get it finalized that we have the Department of Agriculture in charge of managing the offsets in any bill that we might pass dealing with farmers and foresters.

I want to move now to the policy issues that we are all discussing. I really don't believe there is a huge disagreement between us on the need for us to move forward and develop a very robust and meaningful national energy policy that will help us to dramatically remove or reduce our dependence on carbon-based forms of energy. I personally think that our country is far too dependent on petroleum as a form of energy. Not that we shouldn't recognize the need for petroleum and develop our own resources, because frankly, we are also far too dependent on foreign sources of that energy. And as Senator Kerry indicated, that creates a threat not only to our national security in a defense context, it creates a threat to our economy, as we have most of our eggs in just one or two baskets, so to speak.

So I strongly support developing a national energy policy that will help us to become more diversified. I often analogize it to an investment portfolio, and very few people would invest all of their assets or resources in one place or just a couple places. A diversified investment portfolio is clearly a better way to approach our energy policy, just like it would be in managing one's own financial circumstances.

Because of that, I am a very strong advocate for wind and solar and geothermal and nuclear, which I am going to talk a little bit more about, and a number of other kinds of energy. My point,

though, is very similar to that made by Senator Alexander. And that is that as we move to new, strong, robust energy policy in our country, we should do so in a way that does not devastate the economy. I am concerned that the provisions of this legislation would have the impact that many of my colleagues have already identified. We can do things like focus on conservation aggressively and find tremendous reductions of consumption just in the conservation arena. In fact, every bit of energy that we conserve is the equivalent, in my opinion, to energy generated.

Second, nuclear power. And I wish the bill did more for nuclear power. Reading from the text of the bill itself, which does have a nuclear section, it talks about how nuclear energy is the largest provider of clean, low carbon electricity, almost eight times larger than all renewable power production combined, excluding hydroelectric power. This is from the bill itself.

Senator BOXER. [Remarks off microphone.]

Senator CRAPO. I appreciate that. My problem is that we continue, in different contexts, to hear positive support with regard to nuclear, but the specific serious details that the committee needs to be getting into with regard to nuclear, in terms of the loan guaranty programs, the financial commitments to construction of new sites, the effort to address the incredible regulatory burdens and delays that are stopping us from being able to move forward aggressively. Those kinds of very robust energy policies in the nuclear context need to be put in the bill, rather than just the findings about how important nuclear is.

So I appreciate the fact that the Chairman has put this in the legislation and I hope to work with her. We are already working with many members of the committee to address this issue and get a robust energy title.

Senator BOXER. Thank you very much.

Senator Sanders isn't here, so we will skip over him until he gets back and go to Senator Udall.

OPENING STATEMENT OF HON. TOM UDALL, U.S. SENATOR FROM THE STATE OF NEW MEXICO

Senator UDALL. Thank you very much, Chairman Boxer. Thank you for your leadership. I have said a number of times here that you have weighed in in such a way that has been very persuasive, and I think Senator Kerry joining us in these Tuesday group sessions has been very, very helpful.

Today we are facing a narrow window of opportunity on three fronts: our economy, our environment and our national security. Every recent economic downturn in our country has been preceded by a major spike in energy prices, and 2008 was no exception. With world oil production flat, we are likely going to see worse than $4 gasoline when the world economy turns around and demand returns. Nobody wants to see that, but I am afraid that is where we are headed.

Our legislation here today offers a way out of that economic trap. We can loosen our dependence on foreign oil supplies, which are limited and restricted, and create jobs and home grown energy.

This legislation takes a do it all, do it right approach to energy policy. The bill today provides powerful incentives for plentiful, af-

fordable, renewable energy like wind and solar. The bill will create tens of thousands of jobs that save hundreds of billions of dollars in energy efficiency. The bill provides critical resources to increase the safety and security of our nuclear energy power plants. The bill provides incentives to tap our abundant low carbon supplies of American natural gas, which have increase by 40 percent in just the last 2 years.

The bill improves upon the already substantial investments in carbon capture and sequestration for coal power that were made in the House legislation. And the bill provides strong incentives to capture CO_2 for enhanced domestic oil recovery, which can increase our domestic oil supplies by four times, enough supply for a decade or more.

The bill improves the renewable fuel standard by creating a technology neutral standard, which is important for new, innovative sources of biofuel like algae. The incentives in this legislation are based on a fundamental principle: the polluter pays. There should be a fee for permits to pollute, since pollution is a cost imposed by a profit making entity on society.

If polluters do not have to consider the costs of their actions, then society will face the costs of global warming: increased droughts, wildfires, crop loss and flooding. Society at large will pay the cost instead.

Finally, we must find new sources of energy to preserve our national security and independence. Two-thirds of the world's oil supplies lie in six Middle Eastern nations and Russia, which do not, do not operate based on market principles. Future Presidents will face national security decisions if we enact this legislation and move rapidly toward energy independence.

And I am going to yield back my time now, because I anxiously await the testimony of our excellent panel and look forward to hearing Secretary Salazar and the others here. Thank you.

Senator BOXER. Thank you, Senator Udall.

Senator Voinovich.

OPENING STATEMENT OF HON. GEORGE V. VOINOVICH, U.S. SENATOR FROM THE STATE OF OHIO

Senator VOINOVICH. Thank you, Madam Chairwoman.

Climate change, I think we know, is a serious and complex issue that deserves our full attention. I think that Senator Alexander did a very good of eloquently stating that there are alternatives to this legislation, and I think that Senator Bond did a very good job of outlining the impact that this legislation would have on the economy of our country.

This may be the most single significant piece of legislation that has come before this committee, touching every section of the economy and having an immense energy, economic, environmental and national security consequences. Yet despite our requests of earlier this year, the committee plans no legislative hearings on specific bill texts. Rather, we will proceed with conceptual hearings only. And now I am told we will proceed to a markup and final vote on November 3.

I note that on legislation of significant importance the Senate has a history of expending the time and consideration necessary to

achieve broad bi-partisan support before reporting legislation out of committee. For example, when considering the American Clean Energy Leadership Act, the Senate Energy Committee held 19 formal hearings and 11 open business meetings over a span of 5 and a half months before favorably reporting out a bill, a bi-partisan bill.

Following a similar process during consideration of this legislation is important, because we cannot afford to get it wrong. At this point, we do not fully understand how this legislation will impact GDP or the price, supply and reliability of electricity, gasoline and other commodities that millions of Americans are going to have to pay. What is more, we don't know if the bill will have any appreciable impact on climate change. EPA's recent economic analysis of the bill fails to provide answers to these questions. Instead, it compares and contrasts various provisions of 1733 with the Waxman-Markey bill.

First, a credible legislative process on Kerry-Boxer cannot be supported by a piecemeal analysis based on estimates from the House bill. Second, EPA did not model all the Waxman-Markey provisions and include in their assessment assumptions concerning the timing and availability of clean energy technologies, CCS, nuclear and offsets that defy technological, practical and political realities.

We do have a comprehensive analysis from various outside groups on the possible impacts. For example, the American Council for Capital Formation has concluded by 2020, the House bill could reduce household income in my State of over $261 per year, increase energy costs up to 20 percent, and result in the net loss of more than 100,000 jobs.

I have been working with the EPA for a number of months to correct these deficiencies. While we made progress on that front, we now face a hurried political agenda. At this stage of the game, I think the most important thing is that we get a comprehensive analysis on this bill before we proceed to markup.

And only the Chairman of this committee and the Administration can make this possible. I recall when I had the Clear Skies legislation before this committee that the members on the other side of the aisle insisted that they have analysis of their prospective bills before we marked up the Clear Skies legislation. They delayed the markup on three occasions, it was over a 2- or 3-month period, in spite of the fact that we provided 10,000 pages of analysis.

Madam Chairman, I made the point the last time around, and that was that we needed the EPA to do the analysis, complete analysis before this bill went to the floor. I think you realize what a disaster it was when it hit the floor because of the few number of the members of the U.S. Senate that actually supported it.

In closing, I reference an October 21, 2009, New York Times article by John Broder, which states in regard to Copenhagen, "The United States and many other countries have concluded that it is more useful to take incremental steps toward a global agreement rather than try to jam it down through a treaty." The article goes on to say, "U.S. officials and congressional leaders have said that final legislative action on a climate bill would not occur before the first half of next year."

So Madam Chairman, the question I have for you and Senator Kerry and the other members of this committee, why are we trying to jam down this legislation now? Wouldn't it be smarter—wouldn't it be smarter to take our time and do it right, like we didn't do it the last time around that we had this legislation before us?

[The prepared statement of Senator Voinovich follows:]

STATEMENT OF HON. GEORGE V. VOINOVICH,
U.S. SENATOR FROM THE STATE OF OHIO

Madam Chairwoman, climate change is a serious and complex issue that deserves our full attention. I acknowledge your commitment to timely legislation, but the abbreviated process by which this legislation is moving is not conducive to thoughtful, bipartisan climate change legislation.

This may be the single most significant piece of legislation that has ever come before this committee, touching every sector of the economy and having immense energy, economic, environmental and national security consequences. Yet despite our requests of earlier this year, the committee plans no legislative hearings on specific bill text; rather, we will proceed with conceptual hearings only. Now, I am told that we will proceed to a markup, and a final vote, on November 3.

I note that, on legislation of significant importance, the Senate has a history of expending the time and consideration necessary to achieve broad, bipartisan support before reporting legislation out of committee. For example, when considering the American Clean Energy Leadership Act (ACELA), the Senate Energy Committee held 19 formal hearings and 11 open business meetings over a span of 5 and a half months before favorably reporting a bill with bipartisan support.

Following a similar process during consideration of this legislation is important because we cannot afford to get this wrong.

At this point we do not fully understand how this legislation will impact GDP or the price, supply and reliability of electricity, gasoline and other commodities that millions of Americans depend upon every day. What's more, we don't know if the bill will have any appreciable impact on climate change.

EPA's recent economic analysis of the Kerry-Boxer climate bill fails to provide answers to these questions. Instead, it compares and contrasts various provisions of S. 1733 with Waxman-Markey bill.

First, a credible legislative process on Kerry-Boxer cannot be supported by a piecemeal analysis based upon estimates from the House bill. Second, EPA did not model all of Waxman-Markey's major provisions and included in their assessment assumptions concerning the timing and availability of clean energy technologies (e.g. CCS and nuclear) and offsets that defy technological, practical and political realities.

We do have comprehensive analyses from various outside groups on the possible impacts of Waxman-Markey. For example, the American Council for Capital Formation has concluded that by 2020 the House bill could reduce household income in my home State of Ohio by up to $261 per year on average, increase energy costs by up to 20 percent, and result in a net loss of more than 100,000 jobs. But this is no substitute for EPA's providing a comprehensive, unbiased assessment of the bill.

I have been working with EPA for a number of months to correct these deficiencies. And while we have made progress on that front, we now face a hurried political agenda. At this stage of the game, I would be willing to release my hold on Robert Perciasepe if EPA is given the time necessary to provide a comprehensive analysis on the bill before we proceed to mark up.

Last year's bill—the Lieberman-Warner proposal—saw a miserable showing on the Senate floor. It gathered only 32 votes on the Senate floor—and subsequent to the vote, 9 of the Senators voting to limit debate sent Senator Reid a letter saying they wouldn't have votes for the bill on final passage. I predict that if we rush this bill through committee without a considered, thoughtful amendment process, we will have a similar result.

Madam Chairwoman, when this committee was considering the Clear Skies Act—legislation that was far less complicated or far reaching—several analyses were completed as we considered legislative text. I recall that Senators Baucus, Carper, Chaffee and Obama were adamant that we have an EPA analysis on their alternative proposals before moving forward. In fact, even after the Administration gave them 10,000 pages of analyses, they delayed the mark up three times. I insist that similar consideration be afforded to us in this process.

In closing, I reference an October 21, 2009, New York Times article, which states in regard to Copenhagen, "the United States and many other . . . countries have con-

cluded that it is more useful to take incremental . . . steps toward a global agreement rather than to try to jam through a treaty." The article goes on to say: "[U.S.] officials and congressional leaders have said that final legislative action on a climate bill would not occur before the first half of next year."

So Madam Chairwoman, the question I have for you and Senator Kerry is, why are you trying to jam this legislation through committee when it is unlikely we will move legislation or that a treaty will be ratified this year?

Senator BOXER. Thank you, Senator. I am going to answer a couple of things you said, I think it is important.

No. 1, in terms of process, the committee rules say you have to have a bill out for 3 days before markup. Ours will be out for 10 days. And I appreciate Senator Crapo's comments about that.

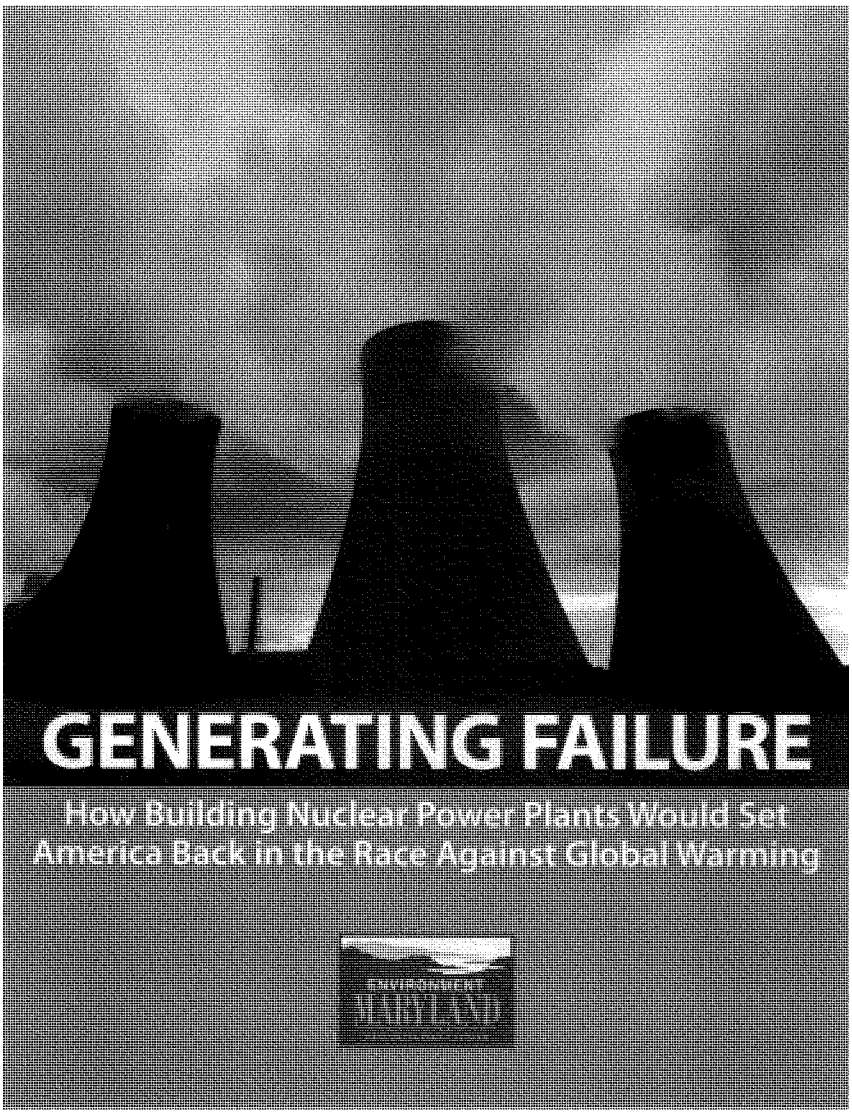
No. 2, this need for bi-partisanship—believe me, I would give anything if I had a John Warner still sitting here. We don't have it. Climate change, global warming, isn't waiting for who is a Democrat and who is a Republican. Either we are going to deal with this problem or we are not. That is No. 2.

And as was stated before, we are going to be in negotiations with both sides, with members on and off this committee.

The last point I am going to put in the record, a study that shows that Senator Alexander's plan to build 100 nuclear plants by 2030 would cost $800 billion, all paid for by ratepayers. And most of us on this side of the aisle believe a better way to go is our legislation, because putting a price on carbon will make the nuclear field way more competitive and will result in 200 plants being built.

So I think that is part of the debate we are going to have. Very last point I am going to put in the record, John Kerry's good staff work here, analysis of jobs in every State showing that, these are net jobs created in Ohio, 35,000 to 61,000 jobs. These are studies that were done over a great period of time. So put all that in record and call on Senator Lautenberg.

[The referenced information follows:]


GENERATING FAILURE
How Building Nuclear Power Plants Would Set America Back in the Race Against Global Warming
ENVIRONMENT
MARYLAND

Generating Failure

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Executive Summary

Far from being a solution to global warming, nuclear power will actually set America back in the race to reduce pollution. Nuclear power is too slow and too expensive to make enough of a difference in the next two decades. Moreover, nuclear power is not necessary to provide clean, carbon-free electricity for the long haul.

The up-front capital investment required to build 100 new nuclear reactors could prevent twice as much pollution over the next 20 years if invested in energy efficiency and clean, renewable energy instead. Taking into account the ongoing costs of running the nuclear plants, a clean energy path would deliver as much as five times more progress for the money.

Early action matters in the fight against global warming.

- The more total carbon dioxide pollution that humanity emits into the atmosphere, the greater the warming – and consequent damage. Earlier action allows us more flexibility to respond to an evolving understanding of humanity's role in shaping the climate.
- According to current science, humanity as a whole can emit no more than 1 trillion metric tons of carbon dioxide from 2000 through 2050 in order to have a 75 percent chance of limiting the global temperature increase to 3.6° F above the pre-industrial era – a target the international community has set to limit the severity of global warming impacts. This 1 trillion metric tons is our "carbon budget."
- To facilitate keeping total emissions within this budget, a panel of distinguished Nobel Prize-winning scientists have called on developed nations to reduce their emissions of global warming pollution by 25 to 40 percent below 1990 levels by 2020.
- Reducing emissions from power plants holds large potential for early progress. The share of the U.S. emissions budget available to electric power plants could be as little as 34 billion metric tons of carbon dioxide (CO_2) from 2010 cumulatively through 2050.

New nuclear reactors would be built too slowly to reduce global warming pollution in the near term, and would actually increase the scale of action required in the future.

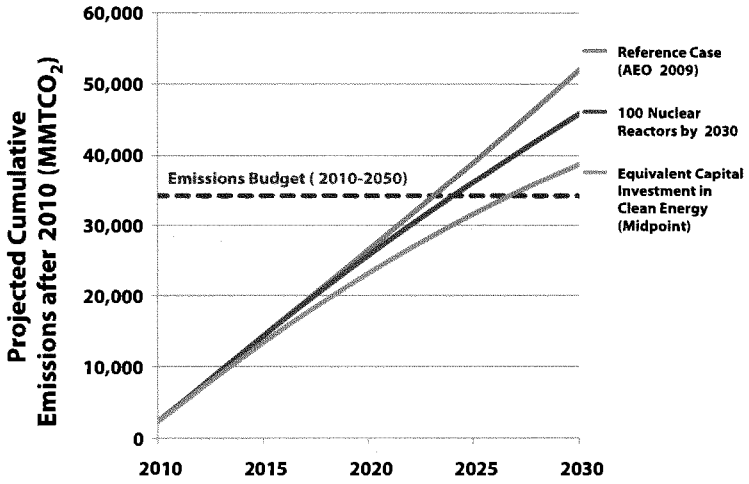
- No new reactors are now under construction in the United States. The nuclear industry will not complete the first new reactor until at least 2016, optimistically assuming construction will take four years after regulatory approval.
- However, it is likely that no new nuclear reactors could be online until 2018 or later. During the last wave of nuclear construction in the United States, the average reactor took nine years to build. New reactors are likely to experience similar delays. For example, a new reactor now under construction in Finland is at least three years behind schedule after a series of quality control failures.
- The American nuclear industry is not ready to move quickly. No American power company has ordered a new nuclear power plant since 1978, and all reactors ordered after the fall of 1973 ended up cancelled. As a result, domestic manufacturing capability for nuclear reactor parts has withered and trained personnel are scarce.
- Even if the nuclear industry managed to complete 100 new reactors in the United

States by 2030 – the level of construction advocated by supporters of nuclear power – new nuclear power plants could still only reduce cumulative power plant emissions by 12 percent over the next two decades, leading to a higher and later peak in pollution. As a result, America would burn through its 40-year electric sector carbon budget in just 15 years. (See Figure ES-1.)

In contrast, energy efficiency and renewable energy sources can make an immediate contribution toward reducing global warming pollution.

- Clean energy can begin cutting emissions immediately. Energy efficiency programs are already reducing electricity consumption by 1-2 percent below forecast levels annually in leading states, and the U.S. wind industry is already building the equivalent of three nuclear reactors per year in wind farms, and growing rapidly.

Figure ES-1: Projected Cumulative Electric Sector Emissions of Global Warming Pollution after 2010 with No Action, 100 New Reactors Built by 2030, or an Equivalent Capital Investment in Clean Energy



Nuclear reactors are too slow to cut enough pollution in the next two decades. With the up-front capital investment required to build 100 new nuclear reactors, America could achieve twice as much by investing in clean energy instead.

- With the up-front capital investment required to build 100 new nuclear reactors, America could prevent twice as much pollution in the next 20 years by investing in clean energy instead. (Midpoint estimate, see Figure ES-1 and page 21 for more details.)

- However, even this level of investment in clean energy would not be enough to keep U.S. power plant emissions within budget. (See Figure ES-1.) America should cut power plant emissions on the order of 50 percent within the next decade to limit the worst consequences of global warming.

Nuclear power is expensive and will divert resources from more cost-effective energy strategies.

- Building 100 new nuclear reactors would require an up-front capital investment on the order of $600 billion (with a possible range of $250 billion to $1 trillion), diverting money away from cleaner and cheaper solutions.

- Any up-front investment in nuclear power would lock in additional expenditures over time. Over the life of a new reactor, the electricity it produces could cost in the range of 12 to 20 cents per kilowatt-hour, or more. In contrast, a capital investment in energy efficiency actually *pays us back* several times over with ongoing savings on electricity bills, and an investment in renewable power can deliver electricity for much less cost.

- Per dollar spent over the lifetime of the technology, energy efficiency and biomass co-firing are five times more effective at preventing carbon dioxide pollution, and combined heat and power (in which a power plant generates both electricity and heat for a building or industrial application) is greater than three times more effective. In 2018, biomass and land-based wind energy will be more than twice as effective, and offshore wind power will be on the order of 30 percent more effective per dollar of investment, even without the benefit of the renewable energy production tax credit. (See Figure ES-2.)

- By 2018, and possibly sooner, solar photovoltaic power should be comparable to a new nuclear reactor in terms of its per-dollar ability to prevent global warming pollution. Some analyses imply that thin film solar photovoltaic power is already more cost-effective than a new reactor. And solar power is rapidly growing cheaper, while nuclear costs are not likely to decline.

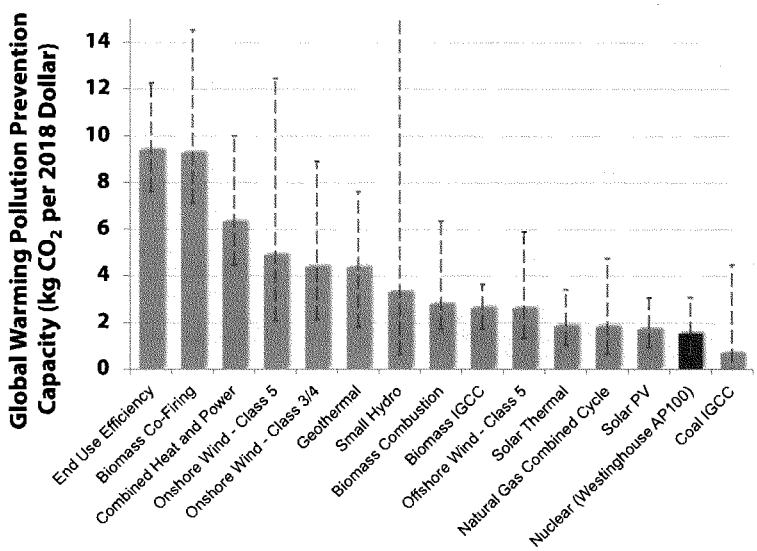
Nuclear power is not needed to provide reliable, low-carbon electricity for the future.

- Nuclear power proponents argue that nuclear plants are needed to produce low-carbon "base-load" power. However, the need for base-load power is exaggerated and small-scale clean energy solutions can actually enhance the reliability of the electric grid.

- Many clean power sources – including energy efficiency improvements, combined heat-and-power technologies and renewable energy sources such as biomass, geothermal energy and solar thermal power with heat storage – are available at any time, just like nuclear power. Others, including wind and solar photovoltaic power, are predictable with about 80-90 percent accuracy a day in advance. With proper planning and investments in a "smart grid" to facilitate wise use of resources, clean energy solutions could supply the vast bulk of America's electricity needs.

- Over-reliance on base-load power plants such as nuclear reactors can harm the reliability of the grid. Because nuclear reactors provide power in massive, inflexible, all-or-nothing blocks, they often produce large amounts of power at times when few people need it. Moreover, when a reactor fails, it can have dramatic and widespread consequences for the availability of electricity. For example,

Figure ES-2: Comparative Ability of Electricity Technologies to Prevent Global Warming Pollution, per 2018 Dollar Spent over Technology Lifetime – Online in 2018, Merchant Financing Terms



By 2018, a reasonable estimate for the first date a new reactor could be online, nuclear power will be among the least cost-effective options for reducing global warming pollution. Source: see discussion on page 29 and Methodology on page 39.

when a power line failure triggered the shutdown of two nuclear reactors at Turkey Point in southern Florida in February 2008, more than 3 million customers in the Miami area lost power for up to five hours – causing traffic jams, stranding people in elevators, and widely disrupting business.

To address global warming, U.S. policy should focus on improving energy efficiency and generating electricity from clean sources that never run out – such as wind, solar, biomass and geothermal power. State and federal leaders should:

- **Oppose additional subsidies for nuclear power.** Nuclear power has already benefited from more than $140 billion in federal subsidies over the last half-century, from liability protection to loan guarantees. The federal government should not further subsidize new nuclear power plants. Any subsidies for low-carbon energy alternatives must be judged based on their relative short-term and long-term costs and environmental advantages.
- **Reduce the nation's emissions deeply enough to prevent dangerous impacts from global warming, guided by the latest scientific understanding.** The United States should reduce its emissions of global warming pollution 35 percent below 2005 levels, with the vast majority of emissions coming domestically, and reduce emissions by more than 80 percent by 2050. Polluters should pay for any right to use the atmosphere, and any revenues should support investments in clean energy and benefit consumers. The United States should also work with other nations to achieve an international agreement to do what it takes to prevent the worst impacts of global warming.
- **Require the nation to reduce overall electricity use by 15 percent by 2020 and to obtain at least 25 percent of its electricity from clean, renewable sources of energy that never run out, such as wind and solar power, by 2025.** States should also enact similar policies or expand existing targets.
- **Strengthen energy efficiency standards and codes for appliances and buildings** with the goal of reducing energy consumption in new buildings by 50 percent by 2020 and ensuring that all new buildings use zero net energy by 2030. Advanced states should go further, aiming for all new buildings to achieve net-zero energy performance by 2020.
- **Invest in electric grid modernization** to maximize our potential to take advantage of a diverse range of energy efficiency opportunities and clean power sources.

Introduction

People around the world are growing increasingly alarmed about global warming – and for good reason. Every day, it seems, scientists announce a new finding that points toward grave peril for our civilization.[1]

The damaging impacts of warming – from the acidification of the world's oceans to melting glaciers and rising sea levels – are happening even faster than the most eye-opening predictions made by the United Nations' Intergovernmental Panel on Climate Change just two years ago.[2] Scientists are becoming increasingly concerned that critical thresholds are a matter of years or a few decades away – beyond which lay dramatic and irreversible changes to our world and our way of life.[3]

Given the pollution that humans have already produced, some impacts, such as the melting of mountain glaciers and the resulting disruption of water supplies, will be unavoidable and irreversible.[4] However, with immediate, swift and decisive action at all levels of government – local, state, national and international – we still have a chance to avoid many of the most catastrophic impacts of global warming.

Given the scale of the threat, we should put every possible solution on the table, except for the status quo. We should carefully consider all sources of carbon-free energy – even nuclear power – to make sure that we choose the approach most likely to deliver success.

The nuclear industry has worked tirelessly over the last decade to position itself as a solution to global warming.[5] On the surface, the case looks reasonable. Nuclear power is capable of producing large amounts of electricity while emitting little to none of the heat-trapping gases that cause global warming.[6] Nuclear power advocates have coalesced around a vision of building 100 new reactors in the United States by 2030, doubling the current fleet of reactors and moving America's economy away from its dependence on polluting fossil fuels.[7]

This report takes a closer look at how new nuclear power could contribute to the fight against global warming. The report focuses on the need for solutions that deliver rapid and substantial progress in reducing America's emissions of global warming pollution within the next 10 to 20 years; cut pollution in a cost-effective way compared to other strategies; and maintain reliable electricity service.

By these measures, nuclear power simply isn't up to the job. Putting aside the unresolved problem of how to safely dispose of nuclear waste, the environmental impacts of mining and processing uranium, the risk of nuclear weapons proliferation, and the potential consequences of an accident or terrorist attack at a nuclear power plant, the nuclear industry simply cannot build new reactors fast enough to deliver the progress we need on a time scale that will make enough of a difference. Moreover, new nuclear reactors are far more expensive than other forms of emission-free electricity. Investing in a new generation of nuclear reactors would actually delay needed progress and divert critical investment dollars away from better solutions.

Despite billions in government subsidies made available through the Energy Policy Act of 2005, and a streamlined permitting process at the Nuclear Regulatory Commission, no new nuclear reactors are yet under construction. Looking at the state of the industry in 2009, nuclear industry experts at the Massachusetts

Institute of Technology warn that without more government action to support the technology, "nuclear power will diminish as a practical and timely option for" reducing the odds of catastrophic global warming.[8]

This report concludes that government action to address global warming would be better focused on the wide range of other technologies that can deliver emission reductions more quickly and cheaply than nuclear power while also providing reliable electricity service. Despite decades of generous federal subsidies to the nuclear industry, nuclear power is not now ready to address the challenge of global warming – especially on the short timeline required for meaningful action. Piling additional subsidies or policy preferences upon the previous largesse extended toward the nuclear industry would only serve as a dangerous distraction in the fight to prevent the worst impacts of global warming.

Fueled by global warming, a mountain pine beetle infestation has killed 6.5 million acres of forest in the western United States. Preventing the most catastrophic impacts of global warming will require rapid and substantial cuts in global warming pollution over the next 10 to 20 years. The nuclear industry simply cannot build new reactors fast enough to deliver the progress we need. Investing in a new era of nuclear power would divert money from more effective solutions. And nuclear power is not necessary for reliable electricity service.

Photo: iStockPhoto.

America Must Act Quickly to Limit the Consequences of Global Warming

"We are faced with the fact that tomorrow is today. We are confronted with the fierce urgency of now. In this unfolding conundrum of life and history, there is such a thing as being too late. Procrastination is still the thief of time. Life often leaves us standing bare, naked and dejected with a lost opportunity. The "tide in the affairs of men" does not remain at the flood; it also ebbs. We may cry out desperately for time to pause in her passage, but time is deaf to every plea and rushes on. Over the bleached bones and jumbled residue of numerous civilizations are written the pathetic words: 'Too late'."

– Martin Luther King, April, 4, 1967, at Riverside Church in New York City

Global warming is rapidly changing America's climate, driven largely by combustion of fossil fuels for energy.[9] The country is becoming hotter.[10] Sea level is rising.[11] Rainstorms and hurricanes are becoming more intense.[12] Landscapes are changing – from Western forests ravaged by drought, bark beetles and fires, to the degradation of coral reefs along the Florida Keys, to shifts in the timing of seasons and in the habitable ranges of plant and animal species across the country.[13]

Should our emissions of global warming pollutants continue unchecked, America and the world face catastrophic consequences. Global average temperatures could increase by as much as 11.5° F by the year 2100 (depending on the pace of the emissions increase).[14] Sea level could rise by as much as 6.5 feet by the end of the century, causing extensive coastal flooding.[15] Hurricanes could become more severe.[16] And America could experience extended periods of hot weather and drought, punctuated by heavy downpours, interfering with water supplies and agriculture and exacerbating smog pollution.[17]

To limit the impacts of global warming, America must rapidly and substantially reduce its emissions of global warming pollution. The more global warming pollution that humanity emits into the atmosphere, the greater the warming – and the damage – that will become unavoidable. Early action will help prevent the worst impacts while also allowing greater flexibility to respond to an already changing climate, and help lead the world toward preserving a livable future. It is in this context that we must evaluate potential approaches to mitigate global warming and focus on those approaches with the greatest odds of success.

Global Warming Threatens the Health and Well-Being of All Americans

Global warming poses a serious threat to the health and well-being of people across America and around the world. Global warming is already changing America's climate. And if we do not act quickly to limit emissions of global warming pollution, the consequences could be catastrophic.

Global Warming Is Rapidly Changing America's Climate

According to the United Nations' Intergovernmental Panel on Climate Change, the evidence that humans are altering the earth's climate is "unequivocal."[18] For example:

- Worldwide, temperatures have increased by more than 1.4° F since pre-industrial times.[19]
- The oceans have absorbed 80 percent of the extra heat in the climate system, causing the water to expand.[20] Coupled with melting glaciers, this has caused sea levels to rise by about eight inches – with the rate of increase accelerating.[21]
- Hurricanes have become more intense, and the frequency of extreme rain and snowstorms has increased.[22]
- At the same time, droughts in many parts of the world have become longer and more severe, especially in the tropics and subtropics.[23]

These changes are also affecting the United States.

- Rising temperatures are changing the timing of the seasons and shifting the habitable area for plant and animal species northward and higher in altitude across the country.[24]
- Levels of carbon dioxide are increasing in the air as well as the ocean, causing ocean waters to become more acidic and contributing to the decline of ocean ecosystems, including a 50 to 80 percent decline in coral on reefs along the Florida Keys.[25]
- Western forests are being ravaged by drought and pine beetles. From the Rockies to the Cascades, the pine beetle has killed 6.5 million acres of forest.[26] Milder winters linked to global warming have increased winter beetle survival from 10 percent to 80 percent, allowing the beetle population to rise dramatically.[27] Simultaneously, hotter summers have weakened the trees' ability to fight off beetles.[28]

If Emissions Continue to Increase, the Consequences Will Be Catastrophic

The more global warming pollution that humanity emits, the more serious the consequences. And the changes will be largely irreversible for a thousand years after emissions stop.[29]

On our current emissions path, humanity risks increasing the average global temperature by 10° F or more (above the pre-industrial era) by the end of this century.[30] Warming on this scale would have catastrophic consequences, including:[31]

- Extinction of as much as 70 percent of all species on earth.[32]
- Acidic "dead zones" in the ocean that could endure for thousands of years.[33]
- The loss of unique ecosystems such as the Amazon rainforest.[34]
- Sea level rise of as much as 6.5 feet in the next century, causing extensive coastal inundation in areas such as south Florida and Louisiana and increasing the risk of storm surge flooding in major coastal cities.[35]
- Continuing sea level rise marching on for thousands of years. The Greenland and West Antarctic ice sheets could melt, raising sea level by 30-40 feet.[36] Ultimately, sea level could increase 250 feet, reaching levels associated

with the climate at the end of the Eocene era, 34 million years ago.[37]

- Widespread drought across as much as a third of the globe, straining water supplies and agriculture.[38] By mid-century, the U.S. southwest could fall into permanent drought exceeding even the severity of the Dust Bowl era.[39]
- Extreme heat waves. Peak temperatures greater than 120° F could threaten most of the central, southern, and western United States by the end of the century.[40]
- More intense hurricanes, driven by warming seas. The number of severe category 4 and 5 hurricanes could increase from 13 to 17 worldwide per year by 2050.[41]
- More intense wildfires. By the end of the century, wildfires in the West could be five times as severe as they are today.[42] Each degree in temperature rise could increase the area burned in a typical fire by 300 percent, and more than double the costs of protecting homes.[43]

Additionally, the more pollution humanity emits, the greater the risk that we will cross a critical "tipping point," accelerating climate change beyond human control. For example, melting permafrost threatens to release massive quantities of methane, a potent global warming gas, from decaying material now frozen underground. Or, changes such as the current pine beetle infestation in Western forests could transform an ecosystem from one that absorbs carbon from the atmosphere to one that emits carbon.[44] In other words, the risk that global warming will cause severe, unforeseen and uncontrollable impacts increases with every pound of coal or gallon of gas that humans burn.

To Limit the Consequences of Global Warming, America Must Swiftly and Substantially Cut Emissions of Global Warming Pollution

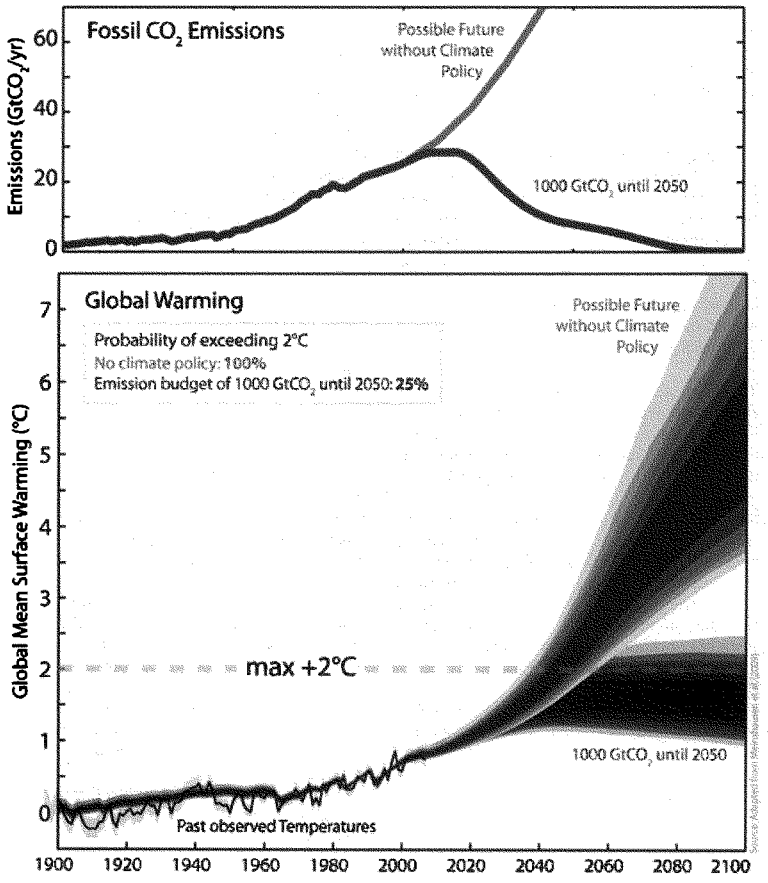
In order to minimize the impacts of global warming, America must quickly and dramatically cut its emissions of global warming pollution.

The international community has agreed to work to limit global warming to 3.6° F (or 2° C) above temperatures in the pre-industrial era.[45] According to current scientific understanding, to have even odds of meeting this target, the concentration of carbon dioxide in the atmosphere must not rise above roughly 450 parts per million (ppm) – and perhaps substantially less.[46] (Current concentrations are already greater than 380 ppm.[47]) Additional limits must be placed on other types of heat-trapping gases.

This means that humanity can only emit so much global warming pollution into the atmosphere before the odds of limiting the temperature increase to 3.6° F become increasingly unlikely. This amount is our "carbon budget," or ultimate limit on allowable pollution.

Science makes two critical points clear. The faster we cut our emissions, the easier it will be to stay within our carbon budget and the less risk we face. Early action allows more flexibility to respond to an evolving understanding of humanity's role in shaping the climate, making a wider variety of options available. Correspondingly, the higher and later the peak in emissions, the harder we will have to work to keep emissions within budget, the higher the potential costs, and the greater the risk that our options will run out.

Figure 1: Limiting Total Global Emissions of Carbon Dioxide to 1 Trillion Metric Tons From 2000 to 2050 Would Yield a 75 Percent Chance of Limiting Warming to 3.6° F (2° C) or Below[51]



Total Emissions Must Not Exceed Our "Carbon Budget"

According to current scientific understanding, humanity as a whole can emit no more than a total of 3.7 trillion metric tons of carbon dioxide from the beginning of our history onward through the next 500 years in order to have a 50-50 chance at limiting global warming to an average temperature increase of no more than 3.6° F (2° C) above the pre-industrial era.[48]

Humanity has already emitted more than 1.8 trillion metric tons of carbon dioxide pollution so far. From now (2009) through 2050, we must emit less than that same amount again in order to have even odds at meeting the international target for mitigating climate change. At current emission rates, the world is on pace to exceed this "carbon budget" in less than four decades – at which time we will have committed the world to a future of dangerous global warming.[49]

To increase the odds to 75 percent that we will be able to limit warming to 3.6° F or below, we will have to accept a global carbon budget of 1 trillion metric tons of carbon dioxide emissions during the first half of this century.[50] (See Figure 1.)

Scientists note that the target may need to be substantially lower, given the likelihood that our understanding of human influence on the climate will continue to evolve. And even warming of 3.6° F carries significant consequences and major risks for human civilization.[52] Leading climate scientists, including Dr. James Hansen of NASA, have called for reducing atmospheric carbon dioxide below current levels, which would require reducing our fossil fuel emissions to zero as quickly as possible. Then, we would have to develop and deploy methods of removing pollution from the atmosphere.[53] In this view, we have already exceeded our carbon budget and must act with even greater speed.

Early Action Matters

The most important thing we can do to address global warming, then, is to cut our emissions of global warming pollution as quickly and sharply as we can, while laying the groundwork for future reductions in the years to come. The more rapidly we reduce emissions, the less risk we assume, and the more room we leave to maneuver in later years.

Recognizing the necessity of swift action, the chief of the Intergovernmental Panel on Climate Change, Rajendra Pachauri, has called on developed nations to ensure that global emissions peak no later than 2015.[54] Emissions must then fall rapidly thereafter. A large panel of top United Nations scientists and Nobel Prize winners has called on developed nations to reduce emissions of global warming pollution by 25 to 40 percent below 1990 levels by 2020.[55]

The world must then continue to slash emissions rapidly, achieving cuts of at least 50 percent by mid-century, and perhaps substantially more.[56] Developed countries with the largest capacity to act will need to reduce emissions by 80 to more than 95 percent.[57] Afterwards, the world must then embark on a program to zero out all emissions of global warming pollution, and very possibly deploy technologies to remove carbon dioxide from the atmosphere.[58]

Because carbon dioxide can persist in the atmosphere for well over 100 years, the timing of emissions is less important than keeping overall emissions within the carbon budget.[59] As a consequence, if the world is unable to achieve deep cuts in global warming emissions by 2020, then the world will have to work harder and make deeper and faster cuts in emissions before 2050.

Early action increases the odds that keeping emissions within the overall budget will be politically and technologically feasible.

Setting a Carbon Budget for the United States

Setting a carbon budget for the world, and allocating responsibility for emission reductions among the world's countries, is a difficult political decision that the international community will have to grapple with.

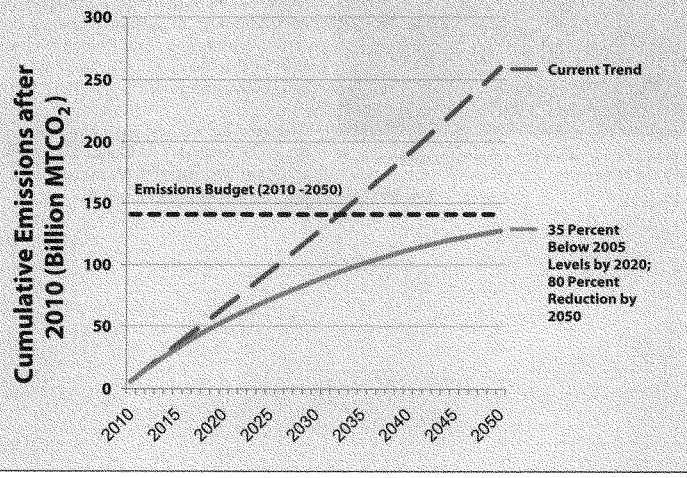
For the purposes of elucidating the argument in this report, we assume a world carbon budget of 1 trillion metric tons of carbon dioxide from 2000 through 2050. Limiting emissions to this amount will give the world about a 3 in 4 chance of keeping the global average temperature from rising higher than 3.6° F above the pre-industrial era.[66]

We assign 20 percent of this budget, or 200 billion metric tons, to the United States, which is approximately our share of cumulative emissions by mid-century under a simplified scenario in which all countries work toward equalizing per-capita emissions of global warming pollution at about 800 kilograms per person per year.[67] By the end of 2009, we will have already used up 30 percent of this budget, leaving just 140 billion metric tons of allowable emissions for the next 40 years.[68]

Keeping emissions below this overall limit would require reducing U.S. carbon dioxide emissions by 35 percent below 2005 levels by 2020 and 80 percent by 2050, while having the United States make a significant contribution to emission reductions in other nations. (See Figure 2.)

Most early progress is likely to come through reducing emissions from electricity generation. As a result, the United States may need to limit emissions from electricity generation to 34 billion metric tons of CO_2 from 2010 cumulatively through 2050, or less.[69] This figure is a rough guide to what the U.S. electric sector must accomplish to do its part to limit the consequences of global warming.

Figure 2: Keeping Cumulative Emissions Below Our 2050 Carbon Budget Will Require Cutting Annual Emissions 35 Percent by 2020 and 80 Percent in Four Decades

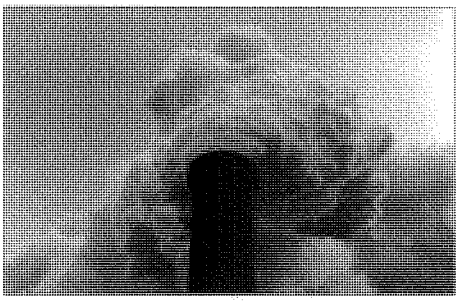


The United States Plays a Critical Role

Because the U.S. is responsible for far more of the global warming pollution now in the atmosphere than any other country, the degree of emission reductions required here will be greater than in less-developed countries.[60]

Early Progress Is Most Likely to Come from the U.S. Electricity System

To meet our goals for limiting the consequences of global warming, we must achieve rapid, deep and sustained cuts in emissions from the U.S. electricity system. For this reason former Vice President Al Gore has challenged the United States to switch its entire electricity system to run on clean energy instead of fossil fuels by 2018, and to ultimately reduce emissions of global warming pollution 90 percent by mid-century.[61]



Displacing coal-fired power from the U.S. electricity system is one of the most likely sources of early cuts in global warming pollution.
Photo: Kenn Kiser.

The U.S. electricity system is one of the most likely sources of early cuts in global warming pollution. About 40 percent of total U.S. carbon dioxide emissions come from the generation of electricity.[62] About 80 percent of these emissions come from coal – despite the fact that coal provides just under half of U.S. electricity.[63] Preventing the construction of any new coal-fired power plants and phasing out the use of coal in existing power plants would cut emissions substantially. Furthermore, relative to the transportation sector with its millions of gasoline-powered engines, cuts in the electricity sector will be easier and cheaper to obtain in the near term, and may set the stage for transitions such as shifting vehicle fuel from gasoline to electricity.[64]

There are many low-carbon options for electricity generation and broad public consensus on shifting America away from its dependence on fossil fuels.[65] Resources with the potential to deliver emission cuts span the spectrum from nuclear power to energy efficiency and from carbon capture and sequestration to clean energy sources that never run out, such as wind, solar and geothermal power.

Given the importance of quick and effective action to reduce America's emissions of global warming pollution, it is crucial that we invest in the options likely to deliver the best results.

Nuclear Power Is Not a Solution to Global Warming

Nuclear power is not necessary to provide reliable, low-carbon electricity for the future. Far from being a solution to global warming, a major national investment in nuclear power would actually set America back in its efforts to reduce pollution. Even building 100 nuclear reactors by 2030 would be too slow to make enough of a difference, and too expensive compared to other sources of clean, emission-free electricity. And that investment – which would likely run into the trillions of dollars – would foreclose opportunities to invest in other clean technologies with the potential to deliver greater emission reductions, faster.

Nuclear Power Is Too Slow to Reduce Global Warming Pollution in the Near-Term

Building 100 new nuclear reactors would happen too slowly to reduce global warming pollution in the near-term, and would actually increase the scale of emission cuts required in the future.

At best, the nuclear industry could have a new reactor up and running by 2016, assuming that construction could be completed in four years. This pace would be faster than 80 to 95 percent of all reactors completed during the last wave of reactor construction in the United States.[70] If construction follows historical patterns, it could take nine years after a license is issued before the first reactor is up and running – into the 2020s.

Under this very plausible scenario, new nuclear power could make **no** contribution toward reducing U.S. emissions of global warming pollution by 2020 – despite the investment of hundreds of billions of dollars for the construction of nuclear power plants. And even if the industry completed 100 new reactors by 2030, which is highly unlikely, these reactors would reduce cumulative power plant emissions of carbon dioxide over the next two decades by only 12 percent below business as usual, when a reduction of more than 70 percent is called for. In other words, 100 new nuclear reactors would be too little, too late to successfully meet our goals for limiting the severity of global warming.

At Best, No New Reactors Could Be Completed Until 2016

No new reactors are now under construction in the United States. The nuclear industry will not complete the first new reactor until 2016, optimistically assuming construction will take four years after regulatory approval.

From application development to operation, the nuclear industry expects that a new nuclear reactor would take 10 years to build.[71]

- Construction cannot begin on any new reactors until the U.S. Nuclear Regulatory Commission (NRC) approves a reactor design and issues a license. This is not likely to happen before 2011 or 2012.
- To date, reactor manufacturers have submitted plans for three new types of nuclear reactor designs for certification. The NRC expects official hearings around the suitability of these designs to begin in 2010 or 2011, with decisions arriving later.[72] One type of reactor is already certified through 2012, but then must be re-certified.[73]
- Power companies have submitted applications to build and operate 26 new reactors, with as many as eight more expected.[74] As of

Delays are Already Mounting in the Nuclear Renaissance

Companies seeking to build new nuclear power plants are already suffering delays. In October 2009, the NRC rejected the certification of a new reactor design over concerns that a key component could not survive an earthquake – a setback for as many as 14 planned reactors.[74] Since the end of 2008, nine reactor license applications have been canceled or indefinitely suspended, and the Tennessee Valley Authority has canceled plans to finish a partially built reactor.[75] Plans for another 10 to 12 reactors have been delayed or are failing to find adequate business partners to share the risk.[76] Such developments increase the odds that the nuclear industry will not achieve much expansion, if any, over the next decade – and underscore the danger of depending on nuclear power to deliver urgently needed progress in reducing global warming emissions.

October 2009, the NRC is actively reviewing applications for 22 of these reactors.[75] The nuclear industry expects this process to take up to four years for the first reactors, followed by public hearings and a rulemaking.[76] Later reactors may take two to three years.[77]

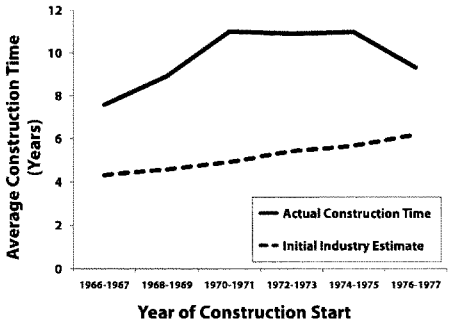
The nuclear industry estimates that construction work on a new reactor could be completed in four years.[78] If the NRC begins to issue licenses in 2012, that would imply that as many as three new reactors could be online by 2016, with two more by 2018.[79]

However, this schedule could very well be too optimistic.

The Nuclear Industry Has Consistently Overestimated How Fast Reactors Can Be Built

During the last wave of nuclear power plant construction in the United States (from the late 1960s into the early 1990s), the nuclear industry predicted that reactors could be built in 4-6 years. However, the average reactor ended up taking nine years to complete.[83] In other words, actual construction times were almost double projections – consistently – across several decades of reactor construction work. (See Figure 3.)

Figure 3: Construction Times Were Consistently Underestimated During the Last Wave of U.S. Nuclear Reactor Deployment [87]



Also notable is the fact that later reactors tended to take longer to complete than the first reactors. (See Figure 4.) This pattern is the opposite of a typical learning curve, where later units often can be completed faster and for less cost as an industry gains efficiency and economies of scale – especially with simple products manufactured in high volumes.[84] Nuclear reactors are big, complex, and difficult to manufacture in high volumes. In addition, many reactor projects suffered from unanticipated quality control problems during construction.[85]

Today, the nuclear industry promises that new, standardized designs and technological advances will enable reactor construction to proceed quickly, without the mistakes of the past.[86] However, recent experience with reactor construction in Finland and France – two of the only active nuclear construction projects in the Western world – raise the very real possibility that nothing has fundamentally changed.

A New Generation of U.S. Nuclear Reactors Would Likely Experience Construction Delays

A new generation of nuclear reactors in the United States would likely face delays that could push construction times well beyond four years.

A reactor now under construction in Finland exemplifies this risk. The reactor is now at least three years behind schedule after a series of quality control failures, and its builder, a French government-owned nuclear developer called Areva, is no longer committing to a specific target date for completion.[89]

The reactor is the first of its kind in the world, incorporating advanced design features the industry had hoped would facilitate rapid completion and keep costs in check.[90] However, the project has suffered from delays and cost overruns, much like past nuclear reactor projects.

Areva and its contractors have made a variety of costly mistakes during construction. Welds for the reactor's steel liner were flawed, and had to be redone. Water coolant pipes were revealed as unusable. And concrete poured in the foundation was suspect, with too much moisture content to meet safety requirements.[91]

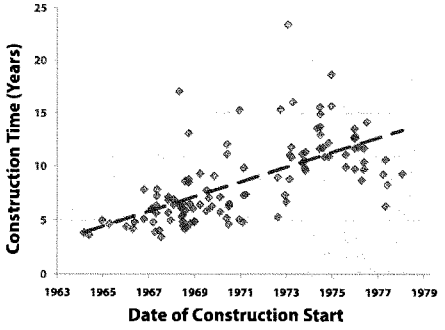
While the project was initially scheduled for completion in summer 2009 (a four-year construction time), Areva has scrapped the timeline.[92]

As of September 2009, the project is $3.3 billion over budget.[93] Areva and the Finnish utility TVO are locked in a dispute over who will be responsible for the cost overruns.[94] Meanwhile, a coalition of Finnish industries estimates that the delays will indirectly cost electricity users $4 billion in higher power bills.[95]

The Finnish reactor is not the only nuclear project behind schedule. A second Areva reactor being built in France is at least nine months behind schedule.[96] Project coordinators admitted in late 2008 that the project was 20 percent over budget.[97] The last four reactors built in France took an average of 10.5 years to complete.[98]

If a new generation of U.S. nuclear reactors faces delays approaching this scale, it is possible that no new reactors could be up and running before 2020. While new reactors are under construction, the United States would continue to operate existing dirty power plants, making it impossible for the nation to meet near-term targets for reducing global warming pollution.

Figure 4: During the Last Wave of U.S. Reactor Deployment, Construction Duration Tended to Escalate Over Time[88]

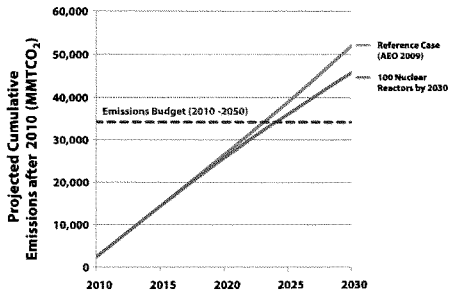


The American Nuclear Industry Is Not Ready to Move Quickly

No American power company has ordered a new nuclear power plant since 1978, and all reactors ordered after the fall of 1973 ended up cancelled.[99] As a result, domestic manufacturing capability for nuclear reactor parts has withered and trained personnel are scarce.[100] While the United States had 900 certified nuclear component suppliers two decades ago, today there are fewer than 300.[101] In addition, only two metal foundries in the world today are capable of forging heavy nuclear reactor vessels – and they are located in Japan and France.[102] Only the facility in Japan has the capability to forge vessels larger than 500 tons.[103] The nuclear industry must compete with the petrochemical industry for access to these facilities.[104]

The industry is not capable of taking on a large number of new reactor construction projects without time to re-establish a trained workforce and a resilient supply chain – a probable source of delay. While new reactor component factories opening as early as 2011 could ease this situation somewhat, the industry could have as many as 30 to 70 active reactor construction projects at any one time on a sustained trajectory to build 100 new reactors by 2030.[105]

Figure 5: Projected Cumulative Electric Sector Emissions of Global Warming Pollution after 2010 with No Action or 100 New Reactors Built by 2030



Nuclear power is too slow to deliver enough pollution cuts in the next two decades. Even if the nuclear industry managed to complete 100 new reactors in the United States by 2030, nuclear power could still only reduce total electric sector emissions 12 percent below forecast levels by 2030, leading to a higher and later peak in emissions. As a result, America would exceed its 2010-2050 power plant emissions budget by 2025 – 25 years too early to meet our goals for reducing the severity of global warming.

Even Without Delays, the Nuclear Path Is Too Slow to Keep Global Warming Emissions Within Budget

Even with generous assumptions about speed and effectiveness, building 100 new reactors in the United States by 2030 will not reduce global warming pollution fast enough to keep our carbon emissions within budget – and therefore not fast enough to meet our goals for limiting the consequences of global warming.

First, assume that the nuclear industry can deliver on its ambitious timelines and successfully complete 100 new reactors (about 100 gigawatts of generation capacity) in two decades. Then, assume that every kilowatt-hour of nuclear power would displace coal, the largest source of carbon-intensive power generation. Finally, assume that next-generation nuclear reactors operate at an average of 90 percent of full capacity – an upper-bound estimate from a group of nuclear technology experts.[106] Under these best-case conditions, building 100 active nuclear reactors could prevent more than 750 million metric tons of carbon dioxide ($MMTCO_2$) pollution in 2030. Overall power plant emissions would be 20 percent below 2005 levels.

However, these nuclear reactors would not be able to reduce emissions while they are under construction. In other words, the nuclear path delivers a late start in cutting pollution. As a result, building 100 new reactors could only reduce cumulative power plant emissions of global warming pollution by 12 percent over the next two decades compared to doing nothing. (See Figure 5.) On this path, America would still exceed its 2010-2050 electric power emissions budget by 2025 – 25years too soon. (See "Setting a Carbon Budget for the United States" on page 13 for a brief explanation of the source of the budget line represented in Figure 5.)

In conclusion, building 100 new nuclear reactors by 2030 would be too little, too late when it comes to preventing global warming pollution. By leading to a higher and later peak in emissions, using nuclear power as a primary strategy to address global warming would ensure that the United States exceeds its 2010-2050 power plant emissions budget. As a result the nuclear path would cut into what little margin of error we have, increasing the risk of catastrophic global warming.

Clean Energy Solutions Can Reduce Pollution Much Faster Than 100 New Reactors

Clean energy solutions have a significant advantage over nuclear power when it comes to reducing global warming pollution. Individual clean energy measures are small – as simple as installing a new light bulb in a home or erecting a single wind turbine. Small means fast. Millions of individual workers could participate in a clean energy transition at the same time. And many individual clean energy measures can add up to a rapid, large-scale cut in emissions.

Energy Efficiency and Clean Energy Measures Can Be Deployed Quickly

Individual energy efficiency and clean energy measures can be implemented in a matter of minutes to just a few years. Each individual measure delivers results right away. For example:

- Designing and building a super energy-efficient building requires little to no extra time compared to the effort required to build and design a standard building. Simple changes in design and construction can yield homes, institutions, and commercial buildings that use 70 percent less energy than standard structures.[107] Adding small-scale clean energy systems – solar photovoltaic panels or small wind turbines, for instance – can yield buildings that produce as much energy as they consume over the course of an entire year.
- Retrofitting an existing structure to achieve higher energy performance can take a matter of days to months to a few years. Contractors can weatherize an existing home in an average of three days.[108] Installing a home solar photovoltaic system typically takes less than a week.[109] Larger businesses or institutions can upgrade lighting, heating and cooling equipment, or mechanical systems in a matter of months to just a few years.[110]
- With available transmission infrastructure, today's power companies can build a utility-scale wind farm in as little as one year, and a concentrating solar thermal power plant in as little as two to three years after groundbreaking.[111] The components of these systems are largely modular. Making a bigger wind farm simply requires installing more wind turbines, and making a larger solar power plant basically requires installing more mirrors or more steam turbines. The modular and scalable nature of construction makes projects simple relative to traditional coal-fired or nuclear power plants, and better able to take advantage of economies of scale. Wind, concentrating solar thermal, and geothermal energy, however, must be integrated into the transmission grid. Projects that require major new power lines to be built could take longer to complete. (See "The Importance of Grid Modernization" on page 20.)
- Production of large amounts of energy efficient products and renewable energy technologies

The Importance of Grid Modernization

A rapid and massive expansion of renewable electricity generation through wind, concentrating solar thermal, geothermal, and related energy sources will require investments to modernize the U.S. electricity grid. Needed steps may include expanding transmission infrastructure into areas with large amounts of renewable electricity resources, such as the windy plains of North Dakota or the sun-soaked desert Southwest. Grid modernization may also require investments to improve the integration of distributed sources of electricity, such as rooftop solar panels.

While these costs are real, and should not be underestimated, they will be relatively small. For example, the U.S. Department of Energy estimates that generating 20 percent of America's electricity supply from wind power by 2030, including necessary transmission upgrades, would cost the average household just 50 cents per month compared to sticking with coal- and gas-fired power.[111] And this estimate excludes the benefits of cleaner air, conserved water and less global warming. Moreover, the U.S. electricity grid would require upgrading to accommodate a massive deployment of nuclear power as well.

That said, in order for the majority of America's electricity to come from renewable sources of power, electricity system planners must plan ahead. Building major new transmission lines can require five years or more. To the extent that necessary investments in grid modernization are delayed, it could limit the speed of a transition to a renewable electricity system.

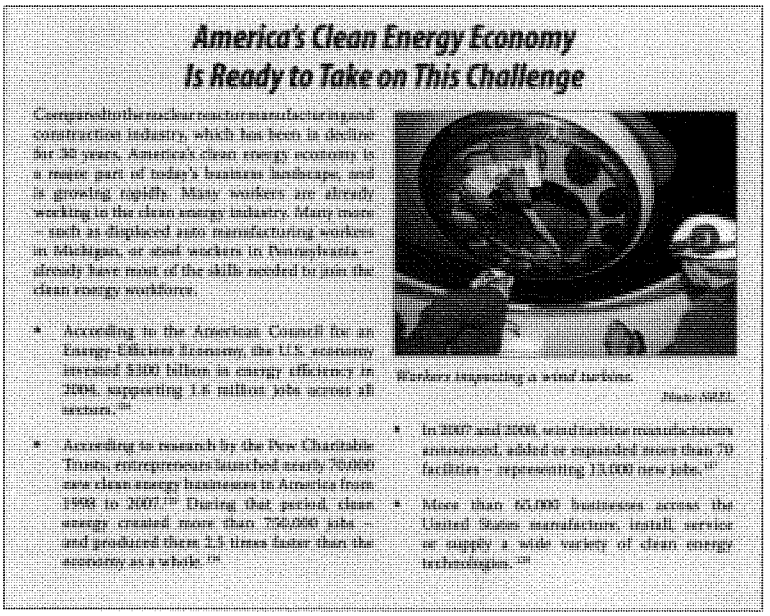
Fortunately, many clean energy sources – such as energy efficiency, combined heat and power, and solar photovoltaic panels – can make a difference right away, with no added transmission capacity. These energy sources are located at or near where the energy will be used and do not require the addition of massive new power lines. These energy sources alone can provide the energy equivalent of well over 150 new nuclear reactors in the U.S. over the next two decades. (See discussion on page 24 and 55.) The deployment of massive amounts of energy efficiency measures and distributed generation can also ease pressure on existing transmission infrastructure and enable more wind farms and concentrating solar thermal plants to contribute than would otherwise be possible.

can be ramped up quickly. For example, worldwide capacity for solar panel production nearly doubled in 2008 alone and has increased by roughly five-fold since 2004.[112]

Individual Clean Energy Measures Quickly Add Up to Substantial Results

Clean energy measures are individually small and modular, but massed together, they can deliver substantial emissions reductions within just a few years.

- Energy efficiency programs active now in states such as California, Oregon, Connecticut, Vermont and New York are supplying most new electricity needs – cutting electricity consumption by 1-2 percent below forecast levels per year.[114] Reducing electricity consumption by 1.2 percent per year (below a no additional action forecast) across America as a whole, starting in 2010, could deliver the same amount of energy as building more than 30 nuclear reactors by 2016 – the earliest possible date the U.S. could have even three new reactors up and running.[115]
- In 2008, the wind industry brought 8,500 MW of wind energy generation capacity online, with another 4,000 MW in the first half of 2009.[116] The installations increased U.S. wind energy capacity by more than 50 percent – two years ahead of schedule on a trajectory to supply 20 percent of America's electricity by 2030, as mapped out by the U.S. Department of Energy.[117] Wind accounted for almost half of all new generation capacity completed in 2008.[118] In energy equivalent terms, these new wind turbines are equal to more than



America's Clean Energy Economy Is Ready to Take on This Challenge

Compared to the nuclear reactor manufacturing and construction industry, which has been in decline for 30 years, America's clean energy economy is a major part of today's business landscape, and is growing rapidly. Many workers are already working in the clean energy industry. Many more – such as displaced auto manufacturing workers in Michigan, or steel workers in Pennsylvania – already have most of the skills needed to join the clean energy workforce.

- According to the American Council for an Energy-Efficient Economy, the U.S. economy invested $300 billion in energy efficiency in 2006, supporting 1.6 million jobs across all sectors.[116]
- According to research by the Pew Charitable Trusts, entrepreneurs launched nearly 70,000 new clean energy businesses in America from 1998 to 2007.[117] During that period, clean energy created more than 770,000 jobs – and produced them 2.5 times faster than the economy as a whole.[118]

Workers inspecting a wind turbine.

Photo: NREL

- In 2007 and 2008, wind turbine manufacturers announced, added or expanded more than 70 facilities – representing 13,000 new jobs.[119]
- More than 60,000 businesses across the United States manufacture, install, service or supply a wide variety of clean energy technologies.[120]

three new nuclear reactors.[119] Wind energy experts predict that wind will become the dominant source of new electric generating capacity in 2009-2012, with 36,000 to 40,000 MW installed (the energy equivalent of 10-12 new nuclear reactors).[120]

- The concentrating solar power industry is actively installing facilities in the southwestern United States, with 8,500 MW of generating capacity expected to be online by 2014.[121] This capacity is the rough energy equivalent of two to three nuclear reactors.[122] Rooftop solar photovoltaic panels are booming as well, with California alone on pace to install 3,000 MW by 2017.[123]

With the Capital Investment Required to Build 100 Nuclear Reactors in the Next Two Decades, Clean Energy Could Deliver Double the Impact

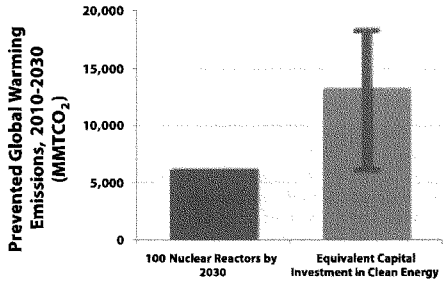
Through 2030, investing in clean energy could deliver double the impact of a comparable investment in nuclear power. The speed at which small, modular clean energy measures can be deployed means that capital invested in clean energy can begin preventing pollution right away, making a bigger overall difference in the next two decades.

Cost estimates for new nuclear reactors vary widely, since none have been built in the U.S. in more than 30 years.[129] The U.S. Department of

Energy has put forward one of the most optimistic forecasts of possible nuclear reactor costs over the next two decades, projecting that the capital cost of reactor construction could be as low as $2,400 per kilowatt (kW) by 2030 (in 2007 dollars).[130] (Many independent experts find this estimate implausible.[131]) However, even if building a nuclear reactor turns out to be this inexpensive and quick, 100 new nuclear reactors by 2030 could – at best – prevent the same amount of pollution as investing that same capital into clean energy solutions such as energy efficiency. (See Figures 6 and 7.)

On the other hand, if building a new nuclear reactor turns out to be an expensive and time-consuming endeavor, like many reactors built in the 1970s, reactors could cost as much as $10,000 per kW (2008 dollars).[132] Putting that level of capital investment into energy efficiency and renewable energy technologies instead would prevent three times as much pollution by 2030. (See Figures 6 and 7.)

Figure 6: Potential Reduction in Total Electric Sector Emissions of Global Warming Pollution, 2010-2030, from 100 New Reactors Built by 2030 vs. an Equivalent Capital Investment in Clean Energy



Investing in clean energy can deliver greater progress, faster, than a comparable investment in nuclear power. Building 100 new nuclear reactors by 2030 could prevent about 6 billion metric tons of carbon dioxide pollution. However, putting that same capital investment into clean energy solutions instead would prevent 6 to 18 billion metric tons of pollution (with the range representing uncertainty over how much a new nuclear reactor would cost, since none have been built in the United States in more than 30 years).

Comparing Nuclear Cost Estimates

Cost estimates from different sources are notoriously difficult to compare directly. Estimates often rely on different assumptions (such as the duration of construction) and they can exclude important costs (such as finance). The figures cited on page 22 are meant to give a plausible range of the up-front capital investment needed to build 100 new nuclear reactors.

For a direct comparison of the cost of nuclear generated electricity with other sources of power, averaged over the entire lifetime of each technology to enable meaningful comparison, see page 28.

At a mid-range reactor cost estimate of $6,250 per kW (2008 dollars), putting an equivalent investment into energy efficiency and renewable energy would prevent twice as much pollution by 2030 as building 100 new reactors.[133] (See Figures 6 and 7.) (See the Methodology section for more details.)

To Keep Power Plant Emissions Within Budget, America Will Have to Do Much More

Power plant emissions are on pace to exceed the U.S. power sector emission budget by 2024 with no further action. To keep emissions from exceeding this budget, the nation must respond swiftly and decisively.

In the next two decades, clean energy deployment equal to the capital investment in 100 new nuclear reactors could reduce global

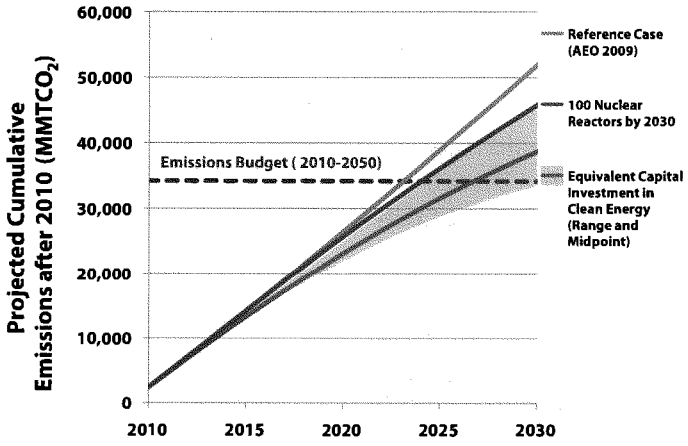
warming pollution by 6 billion to 18 billion metric tons of carbon dioxide – 11 to 35 percent below forecast levels. However, even this level of clean energy deployment that would not be enough to keep U.S. power plant emissions within budget. (See Figure 7.) America will have to do much more to reduce power plant emissions within the next 20 years to limit the worst consequences of global warming.

Keeping power plant emissions within this budget would require reducing emissions by more than half in the next 10 years, and then reducing emissions by 95 percent by mid-century. Achieving progress on this scale will require a level of effort approaching that called for by Al Gore when he challenged the nation to end its dependence on fossil fuels for electricity generation within a decade.[134]

Quick Action Through Clean Energy Can Demonstrate International Leadership

If the United States chooses nuclear power as its primary strategy to reduce emissions of global

Figure 7: Projected Cumulative Electric Sector Emissions of Global Warming Pollution after 2010 with No Action, 100 New Reactors Built by 2030 or an Equivalent Capital Investment in Clean Energy



Clean energy solutions can deliver results faster than nuclear power. With the up-front capital investment required to build 100 new nuclear reactors, America could achieve twice as much by investing in clean energy instead. (Given the wide range of uncertainty over the cost of a new nuclear reactor, clean energy could at least equal the performance of new nuclear power by 2030, and at most perform three times better. See the shaded wedge in the figure above.) However, even this level of clean energy deployment would not be enough to keep U.S. power plant emissions within budget. America will have to do much more to reduce power plant emissions within the next 20 years to limit the worst consequences of global warming.

warming pollution, it is likely that the nation would have *little or nothing* to show for it in terms of real emission reductions from the electric power sector in the next 10 years. The failure of the United States to demonstrate real emission reductions would erode U.S. leadership in addressing global warming and likely reduce the international community's appetite for action.

We need other countries across the world to act rapidly and forcefully alongside the United States in order to have a chance at limiting global warming to 3.6° F above the pre-industrial era – thus controlling the severity of global warming impacts.

Showing a commitment to urgent action by adopting a clean energy path, however, could demonstrate more U.S. leadership, bringing the international community closer to achieving an ambitious, binding and firm agreement to fight global warming. Urgent action to deploy clean energy can also help America take a leadership role in building a clean technology and clean energy economy.[135]

Choosing to Build New Reactors Would Divert Resources from More Cost-Effective Strategies

Choosing to build new reactors would divert resources from more cost-effective strategies. Building 100 new nuclear reactors could have an up-front cost on the order of $600 billion (with a possible range of $250 billion to $1 trillion).[136] Investing this money in reactor deployment would foreclose opportunities to pursue cheaper and faster options.

New nuclear reactors would be far more costly than other forms of emission-free electricity. Even the most optimistic estimates for the average cost of power from a new nuclear reactor are 300 percent higher than the cost of energy efficiency or the cost of co-firing biomass in an existing power plant, and well above renewable technologies like wind power. Moreover, any new nuclear reactors won't be operational until well into the next decade, whereas clean energy sources can be deployed now.

The cost advantages that clean energy has over nuclear power are likely to become even more pronounced over time, while we wait for the nuclear industry to finish its first new reactor. According to Moody's Investor Service, "...nuclear generation has a fixed design where construction costs are rising rapidly, while other renewable technologies are still experiencing significant advancements in terms of energy conversion efficiency and cost reductions."[137]

Building 100 New Nuclear Reactors Would Divert Resources from Cheaper and More Effective Solutions

If both nuclear power and clean energy technologies such as renewable energy and energy efficiency improvements can reduce global warming pollution, why can't we just pursue both paths – reducing emissions now through clean energy and in the future with nuclear?

In a world of unlimited resources, such a path would be conceivable. But in the real world of public policy, governments must make choices about how to allocate limited resources. Moreover, to retain public support for efforts to reduce global warming pollution, government will need to demonstrate that it is acting in ways that minimize the costs of emission reductions and deliver the greatest benefit for the smallest expenditure.

Recent estimates for the up-front cost of building a new nuclear reactor suggest that building 100 of them could require an up-front investment on the order of $600 billion.[138]

However, the capital cost of a new nuclear plant is only part of the full story. Any up-front investment in nuclear power would lock in additional expenditures across decades. Once a plant is

built, the price of the electricity it generates will reflect the ongoing need to pay off debt; the cost of operating and maintaining the plant; the cost of fueling the plant with uranium; the cost of decommissioning the plant and disposing of the waste; and the cost of transmitting and distributing the electricity to consumers. For 100 reactors, these costs would add up to additional trillions over a period of decades.

An investment in energy efficiency would deliver vastly superior results. Investing in energy efficiency actually *pays us back* with ongoing savings on electricity bills. Efficiency measures are almost always cheaper even than operating existing power plants. For example, analysts at the consulting firm McKinsey & Company estimate that investing $520 billion in energy efficiency measures would eliminate $1.2 trillion in waste from the U.S. economy, saving citizens and businesses nearly $700 billion (in net present value terms).[139] In other words, energy efficiency could provide the same level of impact as building 160 nuclear reactors in the next ten years – at net savings.[140]

An investment in renewable sources of power can deliver carbon-free electricity for much less cost than nuclear power. Many types of renewable energy have the advantage of zero fuel costs, since wind and sunlight and the earth's heat are free. Other types of clean energy, such as solar photovoltaic panels, have the advantage of being located near where the energy will be used, minimizing the cost of transmitting and distributing electricity. And these technologies require no special waste handling or decommissioning.

Compared to clean energy solutions, nuclear power is extremely expensive. The total extra cost to the U.S. economy of building 100 new nuclear reactors, above and beyond a least-cost clean energy approach, could fall in the range of $1.9 to $4.4 trillion over the entire lifetime of the reactors.[141]

"The failure of the U.S. nuclear power program ranks as the largest managerial disaster in business history, a disaster on a monumental scale. The utility industry has already invested $125 billion in nuclear power, with an additional $140 billion to come before the decade is out, and only the blind, or the biased, can now think that the money has been well spent. It is a defeat for the U.S. consumer and for the competitiveness of U.S. industry, for the utilities that undertook the program and for the private enterprise system that made it possible."

"Nuclear Follies," a cover story in Forbes Magazine, February 11, 1985.

Cost Estimates for Nuclear Power Continue to Rise

In 2003, experts at the Massachusetts Institute of Technology and Harvard concluded that "today, nuclear power is not an economically competitive choice."[142] The researchers predicted that without subsidies and financial support for the nuclear industry, "nuclear power faces stagnation and decline."[143] The U.S. Congress responded by streamlining the permitting process at the Nuclear Regulatory Commission and authorizing billions in new subsidies through the 2005 Energy Policy Act. However, in 2009, the MIT researchers took another look at the nuclear industry and found that despite the new support, "increased deployment of nuclear power has been slow both in the United States and globally ..."[144]

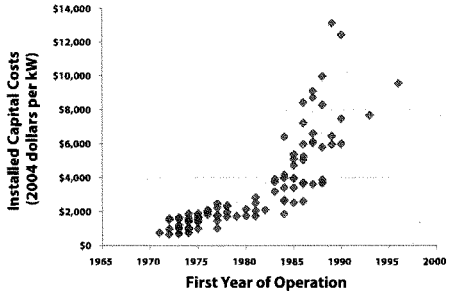
High costs are a major obstacle in the way of building new reactors. In the past decade, cost estimates for new nuclear power plants have only escalated.

In the early 2000s, nuclear industry executives estimated that construction costs for building a new nuclear reactor could approach $1,500 per kW of power generating capacity, plus finance costs.[145] They said the lower costs would make nuclear power competitive with coal and natural gas.

However, these early estimates have turned out to be overly optimistic. Recent estimates for the average cost of electricity from a new nuclear plant over its entire lifetime are four times higher than this initial projection that promoters of a "nuclear renaissance" put forward in the early part of the decade.[146]

No nuclear companies have signed a contract guaranteeing a price for a new nuclear reactor. When Canada asked for guaranteed cost bids to build two new reactors, the results blew far past expectations. The only company willing to guarantee its work quoted a price of $26 billion to build two new reactors – or $10,800 per kW – more than seven times higher than cost estimates from early in the decade.[147] Areva offered its technology for $23 billion – or $7,400 per kW – but its bid was deemed non-compliant, likely because it would not guarantee the price.[148] Both of these quotes were more than double the threshold for competitiveness.[149]

Figure 8: Actual Capital Costs of Completed U.S. Nuclear Reactors (in 2004 Dollars)[153]



Nuclear Reactors Tend to Run Aground on Skyrocketing Construction Costs

High and escalating bids for new nuclear reactor projects should not be a surprise. Nuclear reactor construction projects in the U.S. have regularly run aground on skyrocketing construction costs. Of 75 nuclear reactors completed between 1966 and 1986, the average reactor cost more than triple its original construction budget.[150] Later-built reactors came in as much as 1,200 percent over budget.[151]

Economists commonly expect that new products and technologies become cheaper over time, as companies gain experience and develop economies of scale. However, in the case of the last generation of nuclear power in the United States, the opposite proved to be true. The first nuclear reactors ever built were among the least expensive, while costs spiraled wildly out of control in the final decades of reactor construction. (See Figure 8.) For plants beginning operation in the late 1970s and onward, inflation-adjusted capital costs escalated from just under $2,000 per kW to more than $10,000 per kW (in 2004 dollars).[152]

Seen through the lens of history, nuclear industry predictions that new designs and modular construction techniques will bring costs down appear overconfident.[154] Developing new nuclear power plants will likely remain prone to high cost "surprises" and increased financial risk for power companies and their customers.[155] Due to the large amount of money required to build an individual reactor, the investment ratings firm Moody's calls nuclear construction a "bet the farm risk" for a typical utility.[156]

Nuclear Power Is More Costly than Other Forms of Emission-Free Electricity

Power from a new nuclear reactor would be more costly than other forms of emission-free electricity. Recent estimates for the average cost of electricity from a new nuclear power plant over its entire lifetime range from a low of 8 cents to a high of 30 cents per kilowatt-hour (kWh), with the bulk of estimates falling between 12 and 20 cents per kWh.[157] For many of these estimates, add another 2 cents per kWh to transmit and distribute the electricity from the nuclear plant to the customer.

Vast amounts of clean energy are available – now – at far less cost.[158]

- Energy from a new nuclear reactor would be two to six times more expensive than saving electricity through efficiency – including utility and consumer investment. Across the country, the average utility cost of saved energy is 2.5 cents per kWh, three to four times cheaper than building any kind of new power plant.[159] Including consumer contributions to efficiency measures, the average total resource cost of efficiency is around 4.6 cents per kWh.[160] Analyses of future energy efficiency potential typically find vast available resources with average utility lifetime costs of around 4 cents per kWh in the residential sector and 2 cents per kWh or less in the commercial and industrial sectors.[161] Moreover, as the scale and scope of energy efficiency programs increase, they tend to become even more cost effective.[162]

- Combined heat and power and recycled energy technologies are also extremely cost-effective sources of electricity. Recycled energy technologies can generate electricity for about 3 cents per kWh.[163] Combined cycle industrial heat and power installations can generally produce power for 4.5 to 5.5 cents per kWh, including credit for the value of useful heat that the generators also produce.[164] And smaller building-scale CHP technology can deliver electricity for less than 6 cents per kWh, again counting the value of the useful heat also produced by the generator.[165]

- Energy efficiency, distributed solar power, and combined heat and power have the added advantage of saving or generating energy near where it will be used, avoiding transmission and distribution costs. In addition, saving or generating energy locally minimizes electricity losses that can occur while transporting electricity from a distant power plant.

Large potential supplies of clean energy from wind, solar, biomass and geothermal sources are also available – now – at costs well below estimates for new nuclear power. For example:

- America's entire electricity needs could be met by the wind blowing across the Great Plains or the sunlight falling on a 100 mile square patch of the desert Southwest, or a tiny fraction of the natural heat just beneath the surface of the earth anywhere across the country.[166] Diverse, locally-based resources are available in every state. Even the southeastern United States has enough biomass, wind, and low-impact hydroelectric resources to meet 25 percent of its electricity needs within the next two decades.[167]

- The U.S. Department of Energy (DOE) estimates that wind energy resources across the U.S. as a whole could produce more than 1.5 million GWh per year for between 6 and 10 cents per kWh (2006 dollars).[168] (This price includes estimated transmission costs, assuming that the existing grid has 10 percent spare capacity that could be used for wind, and that appropriate planning will allow new lines to be constructed as needed.) This amount of wind would be the energy equivalent of 190 nuclear reactors.[169] DOE estimates that generating 20 percent of America's electricity supply with wind by 2030 would cost the

average household just 50 cents per month more compared to sticking with coal- and gas-fired power – and excluding the benefits of cleaner air and conserved water.[170]

- The California Public Utilities Commission estimates that in the western United States:[171]
  - Nearly 200,000 GWh per year of renewable electricity could be delivered locally for 9 cents per kWh or less;
  - An additional 200,000 GWh per year of renewable electricity could be locally delivered at costs of 10 cents per kWh or less; and
  - Well over 500,000 GWh per year of additional renewable electricity could be delivered locally at a cost of 12 cents per kWh or less.

Electricity from these renewable resources – the energy equivalent of more than 110 nuclear reactors – would be available at 8 to 12 cents per kWh delivered, half to two-thirds of a mid-range estimate for the cost of power from a new nuclear power plant.[172] Developing U.S. renewable energy and energy efficiency resources could save Americans more than $200 billion on energy bills by 2020.[173]

Per Dollar Spent, Clean Energy Is More Effective at Preventing Pollution than New Nuclear Power

In at least the next six years, new nuclear power cannot be obtained in the United States at any price. However, many other energy technologies are available now that can deliver cost-effective reductions in pollution. Recent estimates for the cost of a new nuclear power plant place it well above many alternatives, including energy efficiency, combined heat and power, wind power (on land and off shore), biomass, landfill gas, geothermal, some types of solar thermal power and natural gas combined cycle power.[174]

Research done for the California Energy Commission (CEC) in 2009 provides a relatively recent, apples-to-apples comparison of the estimated costs of different generation technologies with an in-service date of 2018, a decent guess as to when the first nuclear reactors might become available.[175] The estimates are partially specific to western states, and include the effects of some tax and incentive policies now authorized through that year (but not the renewable energy production tax credit, which is currently set to expire by 2013). These factors aside, the research gives a general idea of how generation technologies stack up. Many additional studies, using different starting assumptions, support the conclusion that energy efficiency and many forms of renewable power are expected to be substantially more cost-effective than nuclear power.[176]

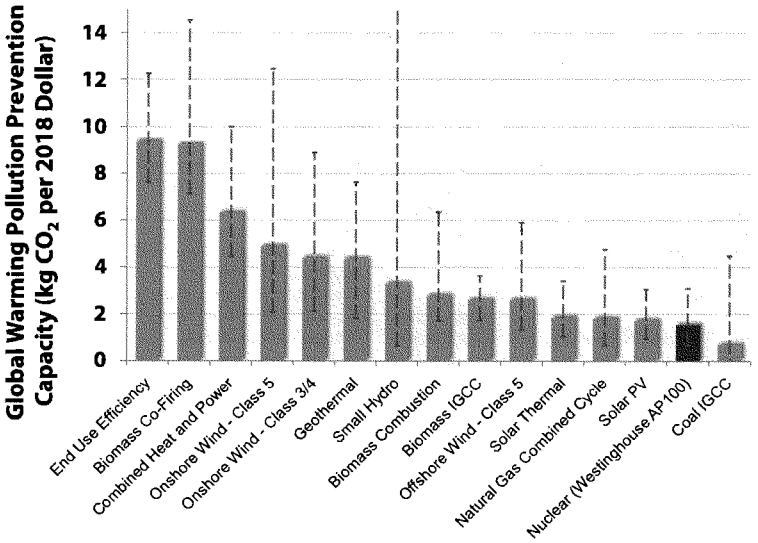
The CEC figures also exclude solutions like energy efficiency, biomass co-firing and combined heat and power, so this report draws on other sources to include them. Finally, this report does not consider possible intermediate solutions such as replacing coal-fired power with greater utilization of existing natural gas-fired power plants, which are also likely to be more cost-effective ways to prevent carbon emissions than building new nuclear plants.

In 2018, the CEC projects that new nuclear power will be more costly than most other forms of low-emission electricity, whether financed by a public utility, an investor-owned utility, or a merchant generator.[177] Under investor-owned utility financing, per dollar spent (over the lifetime of the technology), energy efficiency would be five times more effective at preventing global warming pollution, and combined heat and power (in which a power plant generates both electricity and heat for a building or industrial application) would be greater than three times more effective. (See Figure 9.) Even without the benefit of the production tax credit in 2018, biomass, geothermal and land-based wind energy will be

more than twice as effective, and offshore wind will be on the order of 40 percent more effective. Under merchant financing terms, nuclear fares even more poorly, with CEC expecting both solar thermal and solar photovoltaic power to be more cost-effective ways to reduce pollution.

By 2018, solar photovoltaic power should be comparable to a new nuclear reactor in terms of its per-dollar ability to prevent global warming pollution. However, solar power is falling in price far faster than any other generation technology. Solar prices have fallen by more than 80 percent

Figure 9: Comparative Ability of Electricity Technologies to Prevent Global Warming Pollution, per 2018 Dollar Spent over Technology Lifetime– Online in 2018, Merchant Financing Terms [178]



By 2018, a reasonable estimate for the first date a new reactor could be online, nuclear power will be among the least cost-effective options for reducing global warming pollution. Per dollar spent, nuclear power would be less effective than other low- or zero-emission energy solutions. Efficiency, combined heat and power, wind power, geothermal energy, biomass combustion, small scale hydropower and offshore wind all outperform nuclear. (For simplicity, this figure assumes that power from these new sources at scale would displace an average unit of electricity from the existing U.S. electricity grid. Error bars represent a possible range of values for each technology, given the range of resource quality and location, and uncertainty around cost estimates. See the Methodology section for more details.)

since 1980.[179] And prices continue to decline as public policies encourage growth in capacity for solar panel manufacturing, distribution and installation.[180] Recent cost improvement is apparent in utility decisions to build nearly 1,000 MW of large-scale solar photovoltaic power plants in Florida and California – 10 times bigger than any now in service across the world.[181]

In fact, recent analysis by the investment firm Lazard implies that thin-film solar photovoltaic and solar thermal power technologies, with existing incentives, are already competitive with and even ahead of nuclear power.[182] Lazard also highlights biomass co-firing – in which an existing coal-fired power plant replaces up to 15 percent of its typical fuel with plant matter – and landfill gas as additional cost-effective options.[183]

The fact that clean energy is more cost-effective than new nuclear reactors is reflected in the conclusion of a recent report by the European Renewable Energy Council, the German Aerospace Center and Greenpeace, which shows that currently available clean energy technology could be deployed in the United States to deliver massive reductions in global warming pollution – at half the cost and with twice the job creation as an equivalent amount of nuclear and coal-fired power. Similarly, the non-profit Nuclear Policy Research Institute and the Institute for Energy and Environmental Research have published a report demonstrating how the United States can create an economy with zero emissions of global warming carbon dioxide pollution within 30 to 50 years at a reasonable cost, without nuclear power.[184]

What Could an Equivalent Capital Investment in Clean Energy Achieve?

Investing $600 billion could potentially get us 100 new nuclear reactors by 2030. Alternatively, if we invested that money in clean energy solutions, we could get the double the impact, without the drag on the economy that the high cost of nuclear power would impose.

At an optimistic reactor cost forecast used by the Energy Information Administration of around $2,500 per kW of capacity (see page 22), building 100 new reactors would cost $250 billion up-front. Investing that same amount of capital in energy efficiency could reduce America's electricity consumption by about 12 percent below the reference case by 2030.[185] This level of investment in energy efficiency would deliver emission reductions equal to building 100 new nuclear reactors by 2030, but unlike nuclear, pollution prevented through efficiency would come at net savings, since energy efficiency is so much more cost-effective than building new reactors.

At mid-range costs of around $6,500 per kW, near those forecast by Moody's and comparable to recently proposed reactors, building 100 nuclear reactors would cost $650 billion.[186] Directing $590 billion of this capital investment to efficiency measures could capture a large fraction of America's identified potential for electric energy efficiency, reducing electricity consumption by 25 percent below business as usual by 2030. The remaining money could purchase enough wind turbines and other renewable energy equipment to generate an additional 130 billion kWh by 2030.[187] Altogether, this package of clean energy would yield as much energy as more than 170 nuclear reactors in 2030.[188] This package of clean energy would reduce twice as much pollution as nuclear through 2030, with net savings on electricity costs – which nuclear power cannot offer.

Should the highest cost forecasts for nuclear power come true, building 100 new reactors could cost $1 trillion. This level of investment in clean energy solutions could yield as much electricity as more than 270 new nuclear reactors in the year 2030.[189] This package of clean energy would reduce three times as much pollution as nuclear through 2030, for far less total cost.

Nuclear Power Is Not Needed to Provide Reliable, Low-Carbon Electricity for the Future

Proponents of nuclear power often make the claim that nuclear reactors are necessary because they are a source of emission-free "base-load" electricity which "must run uninterrupted night and day" in order to ensure the reliability of electric service.[191]

Patrick Moore, a public relations consultant working on behalf of the nuclear industry, summed up the argument, writing in the *Washington Post* in 2006:[192]

> "Nuclear energy is the only large-scale, cost-effective energy source that can reduce [global warming] emissions while continuing to satisfy a growing demand for power... Wind and solar power have their place, but because they are intermittent and unpredictable they simply can't replace big base-load plants such as coal, nuclear and hydroelectric. Natural gas, a fossil fuel, is too expensive already, and its price is too volatile to risk building big base-load plants. Given that hydroelectric resources are built pretty much to capacity, nuclear is, by elimination, the only viable substitute for coal. It's that simple... Every responsible environmentalist should support [nuclear power]."

Were nuclear power to be "the only viable substitute for coal," it would indeed be difficult for any "responsible environmentalist" to oppose it – even with the astronomical cost, the long timelines for construction, the risks posed by weapons proliferation and accidents, the environmental impacts of uranium mining and nuclear plant operation, and the still unresolved dilemma of how to safely and responsibly transport and manage the highly radioactive waste over millennia.

"I think base-load capacity is going to become an anachronism." ... "We may not need any [new nuclear or coal plants], ever."

- Jon Wellinghoff, Chair of the Federal Energy Regulatory Commission, speaking to reporters at a U.S. Energy Association forum, April 22, 2009.[190]

But nuclear power is not an indispensible source of carbon-free electricity. It is not needed to meet "growing power demand" in a world where cost-effective energy efficiency opportunities abound. "Large scale" power plants are as much of a curse as they are a blessing in running a well-functioning electric grid. And alternative clean energy sources are fully capable of replacing coal-fired power plants – particularly if we make necessary investments to improve the electric grid.

The Myth: Nuclear Plants Are Needed to Produce Base-Load Power

Nuclear power proponents often argue that nuclear power is among the only practical sources of low-carbon "base-load" power, giving it a supposedly irreplaceable role in a low-carbon future. In other words, nuclear power may cost more and may be considered less desirable by the public than clean energy technologies, but we must accept it in order to keep the lights on in the future without triggering dangerous global warming.

To understand why these claims do not hold water, it is necessary to take a step back and look at how we produce and use power in the United States. Demand for electricity varies a great deal from hour to hour and from season to season. In the Mid-Atlantic region in 2008, for example, the amount of electricity required at 5 p.m. on a hot June afternoon was nearly three times greater

Bigger Isn't Always Better: The Failure of a Nuclear Reactor Can Have Dramatic Consequences for the Reliability of Electricity Service

Nuclear reactors produce electricity in huge, all-or-nothing blocks of power, and are incapable of reacting nimbly to changes in electricity demand. From a reliability viewpoint, this aspect of nuclear power is actually a disadvantage. In fact, when power is supplied in huge blocks by large central station power plants, the failure of any individual power plant or power line carries a great risk of widespread electricity supply disruption.

Existing nuclear power plants, particularly in recent years, have had a decent record of reliability. But when a nuclear reactor does shut down – even if such an event happens relatively infrequently – it can wreak havoc on the electric grid. For example, when two reactors at Turkey Point in southern Florida shut down in February 2008 because of a power line failure, the resulting power outage cut off electricity to more than 3 million customers in the Miami area for up to five hours – causing traffic jams, stranding people in elevators, and widely disrupting business.[29]

Nuclear plants have a history of unanticipated failures, which sometimes lead to unplanned outages.

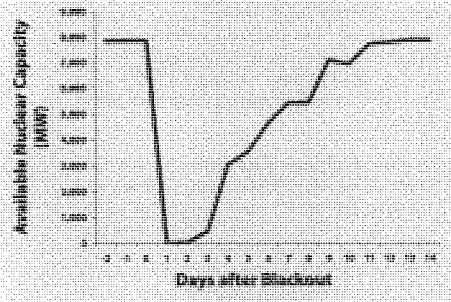
Of all 132 nuclear reactors ever built in the United States, 29 shut down prematurely because of cost or reliability problems, or in the case of Three Mile Island Unit 2, a near-meltdown.[30] Problems at another 35 reactors resulted in two or more outages of at least one year.[31]

In addition, it can take days or weeks for a nuclear reactor to return to full output after an emergency shutdown. For example, nine nuclear reactors shut down automatically during the wide-ranging Northeast electric blackout that occurred on August 14, 2003. Nearly two weeks elapsed before these reactors regained full generation capacity.[32] (See Figure 10.) Prolonged deactivation of nuclear reactors in Canada threatened to cause another blackout in the days after the event. Government officials asked Ontario citizens to cut their electricity consumption in half to keep the system online.[33] A large amount of backup generation capacity had to be mobilized at high prices to restore electric service in the absence of the nuclear reactors.

An electricity system made up of millions of small clean energy resources would yield a more flexible, more reliable electricity system compared to a new generation of nuclear power plants. In contrast to a single large power generating station, it is unlikely that all of the pieces of a diverse portfolio of clean energy resources will fail at the same time. The transient removal of any single small, clean generation unit or even group of units has little to no effect on the overall system. This will be especially true in a "smart grid," where the electricity system operator will have the ability to manage electricity demand at the same time as supply.

Moreover, distributed clean energy technologies – such as energy efficiency, rooftop solar panels and combined heat and power systems – are located near where the energy will be used, reducing the need for power to travel over transmission lines. These resources insulate individual customers from wider electricity disruptions. And since nearly all power failures originate in the transmission system, energy resources that bypass power lines can reduce the opportunity for grid failures in the first place.[34]

Figure 10: Available Capacity of Nine Affected Nuclear Power Plants after the Northeast Electric Blackout in August 2003[35]



than the amount of electricity used at 5 a.m. on a temperate May morning.[193]

Base load, therefore, is that slice of power demand that must be satisfied day or night, across all the seasons.

Power is supplied to the grid by a variety of different generating technologies, each with its own characteristics. Nuclear and coal-fired power plants have typically been assigned to meet the base load – in part because they have been the cheapest to run (and will therefore always be the first plants dispatched to the grid) and in part because they are physically unable to be turned on and off at the flick of a switch. Restarting a nuclear plant, for example, is a days-long process. Because of these characteristics, nuclear and coal-fired power plants are often called *base-load power plants.*

There is no iron clad rule, however, that base load must be met by a traditional base-load power plant. Electricity is electricity, after all, and as long as enough power is generated – from any source – to balance demand, the lights will stay on. And as long as grid operators can predict and control the flow of power to the system, the lights will stay on reliably.

It is not necessary, therefore, for society or electricity consumers to build unnecessarily expensive nuclear power plants *solely* because they have low costs of operation or generate power constantly. Indeed, other approaches can satisfy the need for base-load power and electricity at all times of day, using clean and cost-effective energy resources.

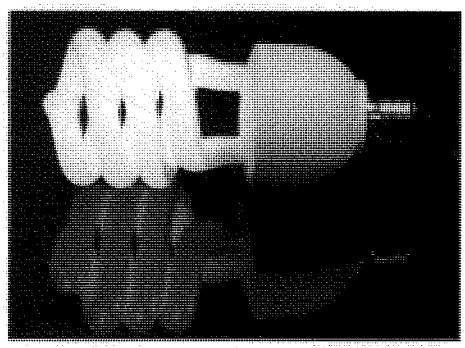
Building a Reliable Grid with Clean Energy

Expending vast amounts of ratepayer money on huge, central station power plants – such as nuclear power plants – may have been the way utilities safeguarded the reliability of the grid in the past, but it doesn't have to be the way we do it in the future. By intelligently investing our resources and engaging in sound planning, America can dramatically increase its use of clean energy technologies while safeguarding the reliability of the electric grid.

Step 1: Reduce Demand Through Energy Efficiency

Nuclear power advocates often argue that nuclear is necessary to "satisfy a growing demand for power."[201] However, our electricity system wastes a great deal of energy. By eliminating that waste through energy efficiency programs, we can get much more work done with the same – or even less – electricity.

Altogether, experts at the American Council for an Energy-Efficient Economy estimate that the United States could cost-effectively reduce its overall energy consumption by 25 to 30 percent or more over the next 20 to 25 years – ensuring that America uses less energy several decades from now than we do today, even as our economy grows.[202] Reducing electricity consumption by 25 percent below forecast levels by 2030 would save more than 1.2 trillion kilowatt-hours of electricity



America could reduce its energy consumption by 25 to 30 percent over the next 20 years through energy efficiency.

Photo: Eric Delmar.

in that year – equivalent to the output of more than 150 new nuclear reactors.[203]

Energy efficiency improvements reduce demand at all parts of the day. Energy efficiency efforts targeted at particular sources of base load power demand – such as refrigerators, "stand-by" power consumption from appliances, and industrial facilities – can address the specific slice of electricity demand currently met by "base load" generators with low operating costs. Moreover, energy efficiency programs can save America trillions on energy costs. From a societal perspective, efficiency is almost always cheaper than operating existing power plants.

Step 2: Use Renewable and Efficient "Base-Load" Power Sources

Nuclear power proponents tend to equate "clean energy" with "intermittent energy." While it is true that two large sources of clean energy – wind and solar power – are intermittent, many are not. These sources could be used to directly supplant existing traditional base-load power plants, such as coal plants. Geothermal energy, biomass and landfill gas power plants, as well as concentrating solar power plants outfitted with thermal storage, are just as capable of producing consistent electricity as existing coal, nuclear and hydroelectric plants. In the future, other renewable technologies that are capable of delivering consistent, always-on power, such as ocean current turbines, could also be deployed.

Concentrating solar thermal power with heat storage can provide reliable electricity even when the sun isn't shining.

Photo: eSolar.

Additionally, combined heat and power units – which capture waste heat from buildings or industrial operations to generate electricity – can operate on demand, greatly reducing emissions compared to traditional coal- or natural gas-fired power plants. Hospitals and other large institutions often use combined heat and power to guarantee that power will be available, even when the larger electricity grid fails. Combined heat and power can offer similar reliability benefits for many types of buildings and industries.

Step 3: Integrate Predictable, Intermittent Forms of Clean Energy

Solar and wind energy are both intermittent forms of generation, generating power only when the sun is shining or the wind is blowing. But that does not mean that they cannot provide a sizeable share of America's electricity – especially when integrated over large areas and coupled with other clean power technologies. For example, Denmark already generates more than 20 percent of its electricity from wind power alone, and has studied the possibility of deploying wind power at penetrations as high as 100 percent.[204]

Studies of the electricity system have shown that, with effective planning, the system can accommodate the integration of large amounts of wind and solar power, without the need for additional backup power sources and with minimal cost.[205] At penetrations of up to 20 percent wind power, the U.S. Department of Energy estimates that the cost of integrating wind power will be no more than 10 percent of the wholesale value of the power – which would result in the cost of wind power continuing to be much less that of a nuclear power plant.[206]

Intermittent resources can be more effectively integrated into the system with improved forecasts of power output, and by increasing the number and geographic dispersion of generators. With today's technology, wind power output over a large region can now be forecast with 80 to 90 percent accuracy a day in advance, and with 90 to greater than 95 percent accuracy an hour in advance.[207] Similarly, solar power output can be forecast using models predicting solar intensity throughout the day, taking into account the angle of the sun and anticipated cloud cover.

Increasing the number of wind turbines, solar panels, and other clean energy resources in a system – especially if they are linked with effective transmission and distributed over a wide area – can smooth power output levels and increase predictability.[208] For example, researchers at the Rocky Mountain Institute and the University of Colorado found that an optimized portfolio of wind and solar power, in as few as six locations, can reduce the variability of overall power output by more than half.[209] The larger the system, the more likely that some part of it will be generating electricity at any given time, even if the wind stops blowing or a cloud drifts over in some areas.

To achieve even higher penetration, wind, solar and other types of clean energy power plants could be hybridized with biogas or natural gas turbines, much like a gasoline-electric hybrid car. Other types of hybrid plants could be possible, including offshore wind coupled with ocean wave or ocean current turbines.

One of the more promising ideas for a hybrid power plant involves combining solar with biogas or natural gas. Plant economics are improved by using a single steam-driven turbine, with heat coming from either the sun, or from natural gas or biogas, depending on conditions.[210] This design avoids duplicating infrastructure such as transmission lines compared to having a fully separate backup power plant. Solar systems could even be added as a new source of heat to existing power plants, in areas with appropriate conditions.[211]

Wind power in America could provide more energy than 190 new nuclear reactors, with power output predictable with 80 to 90 percent accuracy a day in advance.

Photo: NREL.

Step 4: Build a Smarter Grid

The reliability of electric service and the flexibility of the system can be increased through smart grid technology. America's current electricity grid is designed to be a one-way street, with centrally generated power distributed to meet demand. While "smart grid" is used to refer to a variety of measures, ultimately this technology is meant to use the power of modern computer networks to make the electricity system into a two-way street, which can accommodate power generated in many locations and exert control over load, supply and even energy storage.

Widely deployed, well-designed smart grid technology could help the electricity system to respond dynamically to stress, exert fine control over energy uses to maintain reliability, accommodate the addition of large amounts of diverse sources of renewable electricity – from wind farms to neighborhood solar panels, and integrate energy storage technologies such as a network of batteries in plug-in electric or hybrid electric cars.[212]

As a result of the Obama administration's economic recovery package, $1.2 billion in

smart grid test projects are now or will soon be underway.[213] For example,

- Southern California Edison is working on systems to combine customer control over home energy usage in response to system-wide electrical demand, solar panel output, home energy storage, and plug-in electric vehicle need.[214]
- IBM and a North Carolina technology company called Consert have deployed a smart grid pilot project that allows the utility to "cycle appliances on and off" based on customer profiles detailing home preferences such as ideal home temperature and daily schedule.[215] A test run cut average energy consumption by 20 percent, with one household achieving a 50 percent cut.[216]

In October 2009, the Obama administration injected another $3.4 billion into electric grid modernization, as a further part of the economic recovery package.[217] Private companies are contributing an additional $4.7 billion to the effort.[218] This level of investment will purchase 18 million smart electricity meters – covering more than 10 percent of all electricity customers in the country.[219]

Step 5: Integrate Storage into the Electric System

Energy storage technologies could ultimately enable America's electricity system to rely completely on clean sources of electricity that never run out, breaking free entirely from fossil fuels and nuclear power. Promising energy storage technologies include compressed air storage, pumped water storage, heat storage, and batteries – such as those found in a plug-in electric or hybrid electric car.

Compressed air storage uses underground caverns or aquifers to hold pressurized air, which can be released later to drive a turbine and generate electricity.[220] These facilities can store hundreds of hours of energy, and the technology is proven at large scale. A 280 MW facility has been operating in Germany since 1978, and a 110 MW facility has served in Alabama since 1991.[221] The natural gas industry currently uses underground caverns like these to store much of the nation's natural gas supplies.[222]

Pumped water storage involves pumping water from a downhill reservoir to an uphill one, then releasing the water to generate electricity when necessary.[223] The U.S. already uses more than 20,000 MW of this technology.[224] Pumped storage may even be possible without traditional dams. A company called Riverbank Power is actively testing a plan to drill deep holes in the ground near a river, with the potential to generate as much as 1,000 MW of power for six hours before pumping the water back up to the surface. The company is testing the technology at the former site of the Maine Yankee nuclear power plant, decommissioned more than a decade ago.[225]

Solar developers are now building concentrating solar thermal power plants in the desert Southwest that incorporate molten salt tanks, which can store the sun's heat with greater than 99 percent efficiency. The heat can be used to generate power when needed, even at night or when the sun isn't shining.[226]

Finally, companies are developing batteries that can directly store electrical energy.[227] Some of these batteries are large and stationary. Another promising idea combines smart grid technology with an electric or hybrid-electric vehicle system, in which every parked vehicle becomes a storage device to hold and dispatch clean power.[228]

Policy Recommendations

Nuclear power is not the best available solution we have in the fight against global warming. In fact, it is a dead end. Putting aside the unresolved problem of how to safely dispose of nuclear waste and the risk of nuclear weapons proliferation, the nuclear industry simply cannot build new reactors fast enough to deliver the progress we need on a time scale that will make enough of a difference. Moreover, new nuclear reactors are far more expensive than other forms of emission-free electricity. Investing in a new generation of nuclear reactors would actually delay needed progress and divert critical investment dollars away from better solutions.

As a matter of public policy, America should focus on improving energy efficiency and generating electricity from clean sources that never run out – such as wind, solar, biomass and geothermal power. These clean energy solutions can deliver more emission reductions for our money – faster – than nuclear power. Integrated in a "smart grid," clean energy resources can ensure a reliable, safe, secure and affordable supply of electricity, while rapidly and substantially cutting global warming pollution.

Accordingly, state and federal leaders should:

Refrain from directing new subsidies to the nuclear industry.

- Nuclear power is already the most heavily supported form of electric power in America. From 1950 to 1999, the federal government subsidized nuclear power to the tune of $145 billion.[229] The value of all the subsidies currently on offer to the nuclear industry is substantial – reaching as high as $13 billion for a single new reactor.[230] However, the nuclear industry is asking for more than $120 billion in loan guarantees for proposed new reactors, far in excess of the $18.5 billion that Congress has thus far appropriated.[231] Applied to 34 possible new reactors, Physicians for Social Responsibility calculate that the nuclear industry could need as much as $170 to $320 billion in loan guarantees.[232] The Congressional Budget Office considers the risk of default on nuclear loan guarantees as well above 50 percent, primarily because nuclear is not cost-competitive with other generation sources.[233] In addition to expanded loan guarantees, the nuclear industry wish list includes a variety of tax incentives and favorable regulatory treatment.[234]
- The federal government should not further subsidize new nuclear power plants. Any subsidies for low-carbon energy alternatives must be judged based on their relative short-term and long-term costs and environmental advantages.[235]

Reduce the nation's emissions enough to prevent the worst impacts of global warming, guided by the latest scientific understanding.

- The United States should work in concert with other nations to keep cumulative world emissions from exceeding 1 trillion metric tons of carbon dioxide, or equivalent, from 2000 to 2050. Progress on this scale is necessary to give the world a 75 percent chance of limiting global warming to 3.6° F above the pre-industrial era – a target the international community has set to limit the severity of global warming impacts.
- In order to make this goal possible, the U.S. should commit to reducing emissions by at least 35 percent below 2005 levels by 2020. The

nation should then aim to reduce emissions by 80 percent or more by 2050.

- Any policy designed to reduce America's emissions of global warming pollution should ensure that polluters pay for any right to use the atmosphere, and direct resulting revenues into accelerating the transition to clean energy sources and easing the impact on consumers. Additionally, the policy should include strict rules for the integrity of any carbon "offsets" to ensure that efforts to reduce emissions are successful.

Require America to obtain at least 25 percent of its electricity from clean, sustainable energy sources such as wind and solar power by 2025.

- States with renewable electricity standards (RES) are leading the nation in taking advantage of America's ample clean energy potential.[236] The United States should set a national renewable electricity standard that requires that at least 25 percent of America's electricity come from new renewable energy sources by 2025. Achieving that target would put the nation well on its way to dramatic cuts in emissions of global warming pollution. Individual states should go further.

Require America to reduce overall electricity use 15 percent by 2020.

- America has vast potential to use energy more efficiently. To take advantage of that potential, the nation should adopt an energy efficiency resource standard (EERS) similar to those adopted by leading states across the country. Such a standard would set a concrete goal for improved energy efficiency and unleash the resources needed to achieve that goal. A federal EERS should seek to reduce electricity demand by 15 percent by 2020 and natural gas demand by 10 percent, with more ambitious goals in later years.

- Combining energy efficiency and renewable energy with a national effort to limit emissions of global warming pollution enhances the benefit of these policies to America's economy. For example, the Union of Concerned Scientists has found that combining an EERS and RES with a cap on global warming pollution would deliver $1.6 trillion in consumer savings through 2030 compared to continuing on our current path.[237]

Strengthen energy efficiency standards and codes for appliances and buildings.

- America should ensure that all buildings and appliances use energy efficiently. New codes should aim to reduce energy consumption in new buildings by 50 percent by 2020 and ensure that all new buildings use zero net energy by 2030. Individual states should go further.

Invest in electric grid modernization.

- America should upgrade its electricity transmission and distribution system to maximize our potential to take advantage of a diverse range of energy efficiency opportunities and clean power sources.

Methodology

The starting point for modeling the policies and technologies evaluated in this report was the Energy Information Administration's (EIA) *Annual Energy Outlook 2009*, updated reference case.[238] The "no additional action" scenario in this report matches the levels of power generation, fuel consumption and carbon dioxide emissions forecast by the EIA. We model the emissions impact of building 100 new nuclear reactors, or deploying clean energy measures with an equivalent capital investment, relative to this initial forecast.

Calculating a Carbon Budget for the United States

This report accepts a world carbon budget of 1 trillion metric tons – the limit on allowable emissions from 2000 to 2050 to have a 75 percent chance of meeting international goals for limiting the severity of global warming. We assign 20 percent of this budget, or 200 billion metric tons, to the United States, which is approximately the U.S. share of cumulative emissions by mid-century under a simplified scenario in which all countries work toward equalizing per-capita emissions of global warming pollution at about 800 kilograms per person per year.[239] By the end of 2009, 140 billion metric tons of allowable emissions will remain for the next 40 years, due to pollution already emitted this decade.[240]

We calculate that the U.S. must reduce emissions of carbon dioxide 35 percent below 2005 levels by 2020 and 80 percent by 2050 to stay within this budget.

Given this emissions trajectory, we assume that two-thirds of the reductions through 2020 and half of the total required reductions overall come from the electricity sector. This is equivalent to reducing electric sector emissions by 55 percent below 2005 levels in the next 10 years, and then reducing emissions by 95 percent by mid-century.

The early emission reductions required are comparable in magnitude to those described by the EIA in modeling the impact of the American Clean Energy and Security Act, in a scenario with no international offsets and limited availability of nuclear or carbon capture and sequestration technology.[241] Under these conditions, U.S. power plant emissions could fall 37 percent by 2015.

Given these parameters, we estimate that U.S. power plants must keep cumulative emissions below 34 billion metric tons from 2010 through 2050 to enable the nation to do its part in limiting the consequences of global warming.

Modeling the Emissions Impact of Building 100 New Nuclear Reactors by 2030

Starting with the power generation and emissions pathway described in the *Annual Energy Outlook 2009*, we model the impact of building 100 new nuclear power plants, using the following key assumptions:

- The nuclear reactors will have an average size of 1,000 MW.
- The reactors will operate with an average capacity factor of 90 percent, an upper bound estimate of the Keystone study.[242]
- Electricity generated by the reactors will 100 percent displace average coal-fired power from the U.S. electricity grid – a best case assumption.

- The first reactors will come online in 2016 and construction will proceed evenly with 100 reactors operational by 2030.
- Nuclear power has zero emissions of global warming pollution.
- Total electricity demand, generation by fuel for all sources other than nuclear and coal, and emission rates by fuel proceed as forecast in *Annual Energy Outlook 2009*.

Developing a Clean Energy Scenario Based on the Capital Investment Needed to Build 100 New Nuclear Reactors

Starting with the range of overnight capital investment required to build 100 new reactors – $250 billion to $1 trillion, with a mid-point of around $650 billion – we created a mid-, lower- and upper-bound scenario of clean energy deployment that could be achieved with the same level of up-front investment.

With the lower bound investment of $250 billion, energy efficiency could reduce America's electricity consumption by about 12 percent below the reference case by 2030, assuming an average program plus customer cost of 4.6 cents per kWh. We assume that all of the costs of efficiency measures are up-front capital costs, and we specifically exclude all resulting consumer and utility savings when comparing nuclear capital investment with efficiency. This assumption therefore significantly understates the actual advantages of energy efficiency compared to nuclear and is highly conservative.

At mid-range costs, building 100 nuclear reactors would cost around $650 billion. $590 billion of this could be used to capture a large fraction of America's identified potential for electric energy efficiency, reducing electricity consumption by 25 percent below business as usual by 2030. Since energy efficiency is the most cost-effective clean energy resource, we maximize its use. Based on reference case assumptions for the capital cost and performance of various renewable electricity technologies outlined in *Assumptions to the Annual Energy Outlook 2009*, the remaining $70 billion could purchase enough wind turbines and other renewable energy equipment to generate an additional 130 billion kWh by 2030, assuming an even rate of investment from 2013 to 2030.[243]

For the upper margin, we assume a nuclear capital investment of $1 trillion and low-end renewable capital costs from *Assumptions to the Annual Energy Outlook 2009*. In addition to the energy efficiency measures described in the mid-range case, this level of investment could drive the installation of enough infrastructure to generate about 900 billion additional kWh of renewable energy by 2030, assuming an even rate of investment from 2013 to 2030.[244]

Modeling the Emissions Impact of Clean Energy

In modeling the emissions impact of clean energy, we assume that a unit of energy efficiency displaces an average unit of coal-fired electricity. Additionally, we assume that a unit of renewable electricity displaces half a unit of natural gas and half a unit of petroleum or coal. Additionally, we assume that efficiency and renewable power have zero emissions of global warming pollution, and that emissions rates by fuel progress over time as described in the *Annual Energy Outlook 2009*.

Calculating the Per-Dollar Capability of Energy Technologies to Prevent Global Warming Pollution

We compare all technologies, assuming for simplicity that each displaces an average unit of power from the U.S. electricity system, with an average emission rate per *Annual Energy Outlook 2009.*

We use lifecycle carbon dioxide emission rates per kWh for a variety of renewable technologies and new nuclear reactors from a 2008 report by Stanford scientist Mark Jacobson.[245] We supplement these figures with lifecycle emission data for combined heat and power and traditional technologies from a range of additional sources.[246]

We use levelized cost estimates for an in-service date of 2018, using merchant financing, from the California Energy Commission for the following technologies:[247]

- Onshore Wind - Class 5
- Onshore Wind - Class 3/4
- Geothermal
- Biomass Combustion
- Hydro - Small Scale and Developed Sites
- Biomass IGCC (Integrated Gasification Combined Cycle)
- Offshore Wind - Class 5
- Nuclear (Westinghouse AP100)
- Solar Thermal
- Solar Photovoltaics[248]
- Natural Gas Combined Cycle
- Natural Gas Simple Cycle
- Coal IGCC

We supplement these figures with additional technologies, including:

- End Use Efficiency, based on estimates by the American Council for an Energy Efficient Economy of 4.6 cents per kWh total resource cost, inflated to 2018 dollars assuming a 3 percent per year inflation rate, and with a 25 percent plus or minus uncertainty factor applied;[249]
- Combined heat and power (CHP), derived from estimates for recovered heat industrial CHP, combined cycle industrial CHP, and building-scale CHP by the Rocky Mountain Institute, with a 3 percent per year inflator applied to approximate 2018 cost;[250] and
- Biomass co-firing cost estimates from the investment firm Lazard, with a 3 percent per year inflator applied to approximate 2018 cost.[251]

With this information, we calculated the ability of each technology to displace carbon emissions based on the average emission rate of the U.S. electricity grid, taking into account each technology's lifecycle carbon emissions. Error bars in the resulting figure represent high and low bounds of pollution reduction cost-effectiveness, given a range of available resources, locations, and uncertainty in cost estimates.

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187 Assuming an even rate of investment from 2013 to 2030, and based on reference case assumptions for the capital cost and performance of various renewable electricity technologies outlined in: U.S. Department of Energy, Energy Information Administration, *Assumptions to the Annual Energy Outlook 2009*, Report DOE/EIA-0554, March 2009. All wind or a mix of landfill gas, biomass co-firing, geothermal and wind would have a similar capital cost.

188 Compared to nuclear output per note 119.

189 In addition to the energy efficiency measures described in the mid-range case, this level of investment could drive the installation of enough infrastructure to generate about 900 billion additional kWh of renewable energy by 2030. All wind or a mix of landfill gas, biomass co-firing, geothermal and wind would have a similar capital cost. See note 187. Compared to nuclear energy output per note 119.

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203 1.2 trillion: calculated based on the reference forecast in: U.S. Department of Energy, Energy Information Administration, *An Updated Annual Energy Outlook 2009 Reference Case Reflecting Provisions of the American Recovery and Reinvestment Act and Recent Changes in the Economic Outlook*, Table 8, SR/OIAF/2009-03, April 2009; 150 reactors: compared to nuclear output on an energy-equivalent basis per note 119.

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205 See note 113 and American Wind Energy Association, *Groundbreaking Minnesota Wind Integration Study Finds up to 25 Percent Wind Can Be Incorporated into Electric Power System* (press release), 13 December 2006. Wind industry analysts suggest it is possible to have up to 40 percent wind power as part of a smoothly functioning electricity grid. See, for example, Randall S. Swisher, "Bringing Wind Energy Up to 'Code'," *Public Utilities Fortnightly*, June 2004. Swisher, executive director of the American Wind Energy Association, a wind industry trade group, contends that the technical limits to the integration of wind into electricity grids is approximately 40 percent of annual energy use.

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239 See note 67.

240 See note 68.

241 This scenario delivers more than 90 percent of the emission cuts called for by our electricity sector carbon budget through 2030. See note 69.

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248 This calculation assumes 100 percent of the cost of installing a solar PV system is born by the utility as in the case of a utility-built project. However, when solar PV systems are simply subsidized by ratepayers through feed-in-tariffs or rebates, the per unit of energy cost of solar PV to the utility/ratepayer, dramatically falls making distributed solar power much more cost effective from a utility perspective than this analysis shows.

249 See note 159.

250 See note 165.

251 See note 182.

Clean-Energy Investments Create Jobs in Ohio

By Robert Pollin, James Heintz, and Heidi Garrett-Peltier

Investments in a clean-energy economy will generate major employment benefits for Ohio and the rest of the U.S. economy. Our research finds that Ohio could see a net increase of about $5.6 billion in investment revenue and 67,000 jobs based on its share of a total of $150 billion in clean-energy investments annually across the country. This is even after assuming a reduction in fossil fuel spending equivalent to the increase in clean-energy investments.

Adding 67,000 jobs to the Ohio labor market in 2008 would have brought the state's unemployment rate down to 5.4 percent from its actual 2008 level of 6.5 percent.

Clean energy creates jobs across the economy

Clean-energy investments create 16.7 jobs for every $1 million in spending. Spending on fossil fuels, by contrast, generates 5.3 jobs per $1 million in spending.

Most of the jobs created through clean-energy investments will be in the same areas that people work in today. Constructing wind farms creates jobs for sheet metal workers, machinists, and truck drivers. Increasing buildings' energy efficiency through retrofitting requires roofers, insulators, and building inspectors. Expanding mass transit systems employs civil engineers, electricians, and dispatchers.

Relative to spending on fossil fuels, clean-energy investments create 2.6 times more jobs for people with college degrees or above, 3 times more jobs for people with some college, and 3.6 times more jobs for people with high school degrees or less.

Legislation encourages private investment

Most of the $150 billion per year in new clean energy investments would come from private businesses. The American Recovery and Reinvesment Act encourages private investors through a wide range of subsidies, incentives, and regulations. The American Clean Energy and Security Act—currently being debated in Congress—includes a range of measures that would substantially strengthen these clean-energy investment incentives for private businesses.

Policies such as the ACESA will have significant economic benefits in addition to their environmental contributions. Most importantly, a clean-energy investment program will be an engine for expanding employment opportunities in Ohio and throughout the country.

Investment promotes efficiency and renewable energy

The largest share of clean-energy investments will go toward energy efficiency, including funds for building retrofits, public transportation, and a smart grid electrical transmission system. Important new investments will also be devoted to developing renewable energy sources, including wind, solar, biomass, and geothermal power.

The overall clean-energy investment program will provide a major boost to the construction and manufacturing sectors, in Ohio and throughout the United States.

Robert Pollin is professor of economics and co-director of the Political Economy Research Institute at the University of Massachusetts-Amherst. James Heintz is associate research professor and associate director for PERI. Heidi Garrett-Peltier is a PERI research fellow.

NAM National Association of Manufacturers

ACCF AMERICAN COUNCIL FOR CAPITAL FORMATION

Ohio

Economic Impact on the State from the Waxman-Markey Bill, H.R. 2454
Proposed Legislation to Reduce Greenhouse Gas Emissions

This study analyzes the Waxman-Markey bill under low and high cost cases with respect to a baseline that projects the future in the absence of the bill.[1,2] W/M sets targets that would reduce GHG emissions to 17% below 2005 levels by 2020; 42% below 2005 levels by 2030; and 83% below 2005 levels by 2050 (Figure 1). The price of carbon permits (what companies must pay to emit CO_2) could reach between $48 and $61 per metric ton of CO_2 (MT) by 2020 and could increase to between $123/MT and $159/MT by 2030.[3]

Impact on Jobs

The jobs impact of W/M is delayed by the free allocation of permits and generous carbon offsets. By 2030, as emission reduction targets tighten and other W/M provisions phase out, Ohio jobs decline by 79,700 under low cost case and by 108,600 under high cost case (Figure 2). The primary cause of job losses would be lower industrial output due to higher energy prices, the high cost of complying with required emissions cuts, and greater competition from overseas manufacturers with lower energy costs.

Decrease in Disposable Household Income

Higher energy prices would have ripple impacts on prices throughout the economy and would impose a financial cost on households. Ohio would see disposable household income reduced by $133 to $261 per year by 2020 and $873 to $1,419 by 2030 (Figure 3).

W/M's Impact on Energy Prices

Most energy prices would rise under W/M, particularly coal, oil and natural gas. By 2015, gasoline would increase between 6% and 8%, electricity between 2% and 5% and natural gas between 17% and 26%. By 2030, gasoline prices increase between 20% and 26% while electricity prices increase by up to 60% and natural gas by up to 79%. Table 1 shows the increase in energy prices faced by a typical Ohio household compared to national household increases over the 2020-2030 period.

Factors Contributing to Higher Electricity Prices

W/M would reduce GHG emissions from all sectors of the economy (transportation, residential, commercial, and industry); however, as the largest emitter of GHGs, the primary impact would fall on the electric sector. W/M would result in the electric industry shutting down most carbon-based generation and/or using expensive, as yet unproven technology, to capture and store CO_2. To meet the stringent goals of W/M, the electric industry would also have to substitute high cost technologies, such as biomass and wind, for conventional generation.

Figure 1. US GHG Emissions and H.R. 2454 Targets

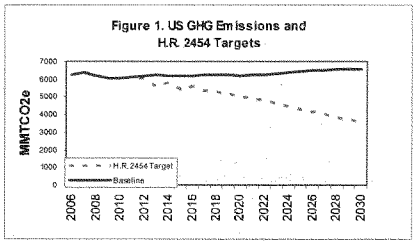


Figure 2. Loss in Employment by 2030

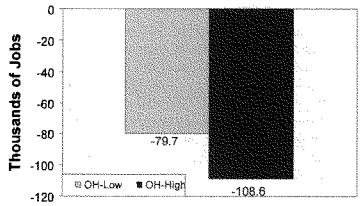
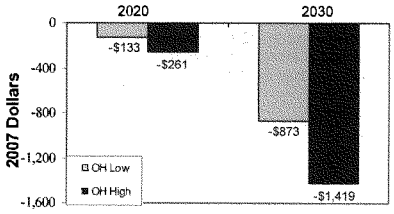


Figure 3. Loss of Disposable Income per Household



[1]The study used NEMS/ACCF-NAM 2, the version of the National Energy Modeling System (NEMS) used in this project, and assumptions provided by ACCF and NAM for this analysis. It was performed independent of EIA which uses the NEMS model for energy forecasting and policy analysis. (See the full report for all assumptions).

Impact on Economic Growth

High energy prices, fewer jobs, and loss of industrial output are estimated to reduce Ohio's gross state product (GSP) by between $1.3 and $2.3 billion per year by 2020 and $13.9 and $18.9 billion by 2030 (Figure 4).

Impact on Industry

Ohio's major economic sectors will be affected by emission caps (Figure 5).[4] The current two largest sectors, chemical manufacturing and transportation manufacturing, show decreases in output of 6.1% to 6.7% and 8.0% to 8.5%, respectively in 2030. All manufacturing sectors will suffer output losses of between 5.4% and 6.0% by 2030, while output from energy intensive sectors falls between 10.7% and 11.7%. Ohio's coal production would fall between 70.5% and 76.8% and electricity production would fall by 15.1% to 18.6% by 2030 (Figure 6). These continued losses will have a lasting effect on the economic base of Ohio.

Impact on Low Income Families[5]

The impacts of W/M will be felt especially by the poor, who spend a greater share of their income on energy and other goods than other income brackets. By 2030, higher energy prices mean that low income families in Ohio (with average incomes of $13,725) will spend between 18.9% and 20.1% of their income on energy under W/M compared to a projected 15.9% without W/M. Others on fixed incomes such as the elderly will also suffer disproportionately.

Impact on State Budgets[6]

The increases in Ohio's energy costs under W/M will impact expenditures throughout the state. Specifically, Ohio's 5,204 schools and universities and 241 hospitals will likely experience a 28.2% to 42.0% increase in energy expenditures by 2030. For government entities, costs for services, including public transportation and vehicle fleets, such as school buses, will also rise under W/M.

Table 1: Change in Energy Prices at Household Level (% change from baseline)

		Ohio		US	
Sector	Year	Low	High	Low	High
Electricity (Residential)	2020	0.9%	5.2%	5.0%	7.9%
	2025	-1.3%	-1.6%	4.9%	11.5%
	2030	37.5%	59.7%	31.4%	50.0%
Gasoline	2020	8.4%	11.3%	8.3%	11.1%
	2025	12.0%	15.9%	12.0%	16.0%
	2030	19.9%	26.1%	20.0%	26.1%
Natural Gas (Residential)	2020	-3.5%	0.3%	-3.3%	0.1%
	2025	5.3%	11.1%	4.8%	10.1%
	2030	60.6%	78.8%	56.3%	73.5%

Figure 4. Loss in Gross State Product For Ohio

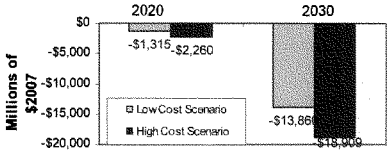


Figure 5. Percent Change in Output by Industry in 2030

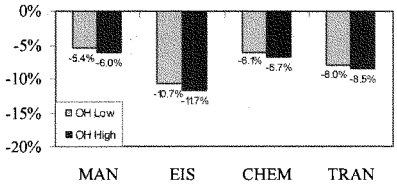
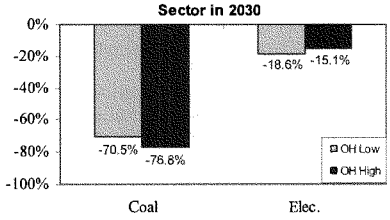


Figure 6. Percent Change in Production by Sector in 2030



[2] "Low" refers to the Low Cost Case, which assumes higher nuclear capacity, fewer constraints on new generating technologies, etc. "High" refers to the High Cost Case, which assumes low nuclear additions and constrained new generation technologies, etc. (See the full report for all assumptions).
[3] All dollar figures in this report are presented in constant 2007 dollars.
[4] MAN = manufacturing industries, EIS = energy intensive industries; CHEM = chemical manufacturing; TRAN = transportation manufacturing.
[5] These projections assume that the energy expenditures by income quintile in the state are the same as the average for the census division, since there is insufficient data to accurately calculate this quantity on the state level.
[6] These projections assume that the expenditures on schools and hospitals are the same as the average for the census region, since there is insufficient data to accurately calculate these quantities on the state level.

Senator ALEXANDER. Madam Chairman.

Senator BOXER. Yes.

Senator ALEXANDER. May I ask permission, since you mentioned my comment, to put in the record a comparison of nuclear and wind power that has a Department of Energy estimate that shows the cost of building 186,000 wind turbines is approximately the same as building 100 nuclear plants, that it would cover 25,000 square miles instead of 100, and that it would cost 10 times as much in Federal subsidies and 19,000 more miles of new transmission lines, which are not part of that calculation?

Senator BOXER. We will put that in the record and make a point, I am not supporting having ratepayers pay for those windmills outside of this bill either. So I think what you do is, if you do this cap-and-trade, all of these have a level playing field and you don't pick a winner, because they are all going to be winners if they don't emit carbon.

[The referenced information follows:]

Two Options to Make Another 20% of U.S. Carbon-Free Electricity

	Nuclear	Wind
New Plant Needs	100 new reactors	180,000 1.5-megawatt turbines
Current Percentage of U.S. Electricity [1]	20%	1.3%
Type of Power	Baseload	Intermittent - can't be more than 20% of total generation
Actual Operating Availability (Capacity Factor)	90%	33%
Additional Infrastructure	Little - Mostly built on existing sites	Thousands of miles of new transmission lines
Subsidy Cost [2]	Up to $17.5 billion (over 10 years) including nuclear production tax credit	$170 billion (over 10 years)
Direct Jobs [1]	250,000 construction	73,000 construction
	70,000 permanent	77,000 permanent
Plant Lifetime	80 years	20 years
Levelized Cost per KWh [3]	$0.06-0.13 - includes financing and spent fuel disposal	$0.04-0.10 - does not include transmission or backup power
Visual Impact	100 square miles	25,000 square miles - covers an area the size of West Virginia

[1] Department of Energy

[2] Nuclear Subsidy: $100 billion loan guarantees scored at 10%, and nuclear production tax credit. Wind Subsidy: renewable production tax credit extended to 20% U.S. electricity production.

[3] The National Academies: America's Energy Future, July 2009.

Senator INHOFE. Madam Chairman.

Senator BOXER. We are going to move on.

Senator INHOFE. Well, Madam Chairman, let me ask procedurally, if you are going to come through and refute things that each member on this side says afterwards, I think that is not a good policy unless we get a chance to participate in that.

Senator BOXER. Right, I only do it——

Senator INHOFE. I sat here for 25 minutes listening to Senator Kerry talk about me, and I didn't have a chance to respond. I will, however.

Senator BOXER. I so appreciate it. And I just have to say, when somebody says the Chairman isn't being fair and that we don't have the bill out there, I need to respond to that. But we will all have time later.

Senator Lautenberg.

OPENING STATEMENT OF HON. FRANK R. LAUTENBERG, U.S. SENATOR FROM THE STATE OF NEW JERSEY

Senator LAUTENBERG. Thanks very much, Madam Chairman. We are all indebted to John Kerry for his presentation.

Even though one could disagree, I don't know whether it is in a substantial fact disagreement or political, but the fact is, he offered us a view of where we are at that cannot be ignored. We are all grateful to him. Along the way, I think we ought to have a vote on whether his speech made any sense or not.

But I feel like we are developing an unreality show here. The whole thing to me is unreal, I must tell you, friends. We are now looking at the number of pages of paper that determine whether or not this bill has veracity. I didn't know there was such an interest in protecting the trees here. But we hear protests about 900 pages.

The fact of the matter is that we have a very good friend on the other side, distinguished Senator, Senator Voinovich; he was very proud of his work on Clean Skies and talked about producing 10,000 pages worth of information that could be viewed and judged.

Senator VOINOVICH. It was the analysis, Senator, just the analysis of it.

Senator LAUTENBERG. So what we are now hearing is that, heaven forbid that there are too many pages in this thing. We ought to have in our audience a bunch of children, 6 to 10, 6 to 11 years old, and explain to them why it is that we want to fight about this. Do we see any risk to them? Do we see any danger? When we look at the evidence in front of us, whether it is our physical security or whether it is security for good health and long lives.

There is a film produced on ocean acidification. Thirty percent of the carbon dioxide has been typically absorbed in oceans. That has increased markedly since the Industrial Revolution. The increase is a hundred times faster than any change in acidity experienced by marine organism for at least 20 million years. Ocean acidification affects shellfish, primarily by impairing their ability to develop protective shells. Carbon dioxide continues to be released into our atmosphere. Ocean acidification could harm commercially important shellfish, lobster, crabs and mussel.

And yes, it would be important to hear from the farmers. It would be equally important to hear from the fishermen. It would be equally important to hear from those who are concerned about what is happening with asthma in our society. The same things that increase global warming increase temperatures also increase susceptibility to asthma. One in 10 Americans today is asthmatic. And I wish that we could look into the faces of the children and explain in their simple terms, I have 10 grandchildren, my oldest 16 years old, just turned, has asthma. One of my younger granddaughters has diabetes.

What would I pay in taxes, what would any American spend in taxes if we could reverse the damage of an illness that they might carry through their lives? What does that cost? Is that cost realistic in terms of what we are talking about? No, listen. Job loss is a terrible calamity. My father lost his job many times during the Depression years, and it was catastrophic in our family. But what is the final cost? That is the thing that we have to look at.

And Madam Chairman, please accept the full presentation of my speech into the record. But I do want to commend you for getting this hearing going, for moving the process along, for saying, we have had enough, we are sounding the alarm, America, wake up, wake up, your kids are in danger, your families are in danger. And let's get to work putting out that fire.

Thank you.

[The prepared statement of Senator Lautenberg follows:]

STATEMENT OF HON. FRANK R. LAUTENBERG,
U.S. SENATOR FROM THE STATE OF NEW JERSEY

Madam Chairman, global warming is threatening the future of our planet. It is harming our health. It is destroying our ecosystems. And it is threatening our security.

In 2007, 11 former admirals and high ranking generals warned that climate change could "create sustained natural and humanitarian disasters on a scale far beyond those we see today."

Testifying before this committee, Retired Vice Admiral Dennis McGinn said, "Without bold action now to significantly reduce our dependence on fossil fuels, our national security will be at greater risk."

According to the CIA's National Intelligence Council, as many as 800 million more people will face water or cropland scarcity in the next 15 years.

Too many people fighting for too few resources breeds conflict, terrorism and war.

The military itself could be affected by global warming. Major U.S. bases in Norfolk, Virginia, and Diego Garcia in the Indian Ocean could be overrun with water if sea levels rise just a fraction of what scientists are predicting.

Our dependence on oil causes global warming, but it also distorts our foreign policy, leaving us at the mercy of the few countries that control most of the world's oil—and putting the national security of our country at risk.

It is up to us to leave the planet and our economy in better shape for generations to come.

The world's eyes are now on this committee to see if we will fulfill our duty—to pass a bill that addresses the greatest environmental challenge of our time.

We must begin by setting a science-based target for reducing global warming pollution—and this bill gets that done.

This legislation would reduce emissions in the U.S. by 20 percent by 2020. That's a modest goal, but one rooted in science—and one that promotes clean energy today, not years down the road.

We must invest in our transportation system—because cars, trucks, buses and other forms of transportation represent about one-third of the greenhouse gases generated in the United States.

This bill is a good start—but we've got to do a lot more to support cleaner and more efficient transportation like transit and rail. And we must invest in research

and development to create jobs in the short-term and give our country the tools to compete in the long-term.

Investing in new technologies turns factories that are now dark into vibrant centers of industry, building components like wind turbines and solar panels. In fact, from 1998 to 2007, the number of jobs in America's emerging clean energy economy grew nearly two and a half times faster than overall jobs, and these jobs have remained strong during otherwise difficult economic times.

In New Jersey alone, more than 2,000 clean energy companies employ more than 25,000 people.

I am proud to say that this bill increases funding for clean energy research and development by billions of dollars over the life of the bill.

Madam, Chairman, every generation has a duty. Fighting climate change is ours. Nothing less than the security of our country, the future of our economy, the health of our families, and the survival of our planet are at stake.

Senator BOXER. Thank you so much, Senator.

Senator Barrasso.

OPENING STATEMENT OF HON. JOHN BARRASSO, U.S. SENATOR FROM THE STATE OF WYOMING

Senator BARRASSO. Thank you so much, Madam Chairman.

Madam Chairman, I have very serious concerns about American job losses under this Administration. We must view the promises of green job creation made by the President and the authors of this bill with legitimate skepticism. The Administration and experts told the American public and members in Congress that their economic stimulus bill would create millions of jobs across America. The economic stimulus package has failed to deliver on that promise. In fact, the opposite has occurred.

Jobs in western States have spiraled downward. In my home State of Wyoming, 8,000 jobs were projected to be created; instead, 10,500 have been lost since the stimulus passed. Throughout the West, thousands of jobs have been lost in every western State. In fact, over 2.7 million jobs have disappeared nationwide since the stimulus package was passed. The situation is only getting worse. The $800 billion stimulus bill is not going to save the day.

The Chair of the President's Council on Economic Advisors, Christina Romer, testified last Thursday before the Congressional Joint Economic Committee. She stated the stimulus package's impact on the economy will weaken from here on. She stated, most analysts predict that the fiscal stimulus will have its greatest impact on growth in the second and third quarters of 2009. By mid-2010, fiscal stimulus will likely be contributing little to growth.

This is a stark admission by the Administration that we have already seen the best we are going to see in terms of job growth from the President's stimulus. This energy tax bill will be an American job killer as well. It is the next attempt by the Administration to promise jobs for all, create some for a few and let the rest of us fend for ourselves.

The west and the fossil fuel reliant States in the South and the Midwest face a different future than the coastal States under this bill. The Director of the Congressional Budget Office, Dr. Douglas Elmendorf, gave America a glimpse of that future in a recent testimony before the Senate Energy and Natural Resources Committee. Dr. Elmendorf stated that the fossil fuel sector would mirror the massive job losses experienced by the manufacturing industry since the 1970s. He also stated that the fact that jobs turn up some-

where else for some people does not mean that there are not substantial costs borne by people, by communities and by firms in affected industries and affected areas. You saw this in manufacturing, and we will see this in response to the changes that this legislation will produce.

The 1970s were not a happy time in the Rust Belt manufacturing States. No region of this country should have to suffer that again. So why are we setting up whole regions of the country to have a replay of that era?

There is a lot of talk about green job creation in this energy tax bill to replace lost jobs. The few jobs created will not benefit the most affected. Once the jobs have been driven away from the towns and cities that rely on the fossil fuel industry, chain reactions will occur for the folks who live there. The people of Wyoming will not accept this outcome. So I urge my colleagues to consider what has already been stated by the non-partisan Congressional Budget Office. This massive energy tax is a job killer for States that produce the red, white and blue energy that our Nation relies upon, and all of those people who depend upon fossil fuels.

Thank you, Madam Chairman.

Senator BOXER. Thank you very much, Senator.

Senator Merkley.

OPENING STATEMENT OF HON. JEFF MERKLEY, U.S. SENATOR FROM THE STATE OF OREGON

Senator MERKLEY. Thank you very much, Madam Chair. I appreciate your leadership and Senator Kerry's leadership and deliberations that have led us to this point to have a bill ready to debate and consider in detail in public. Certainly, these many months of intensive efforts, both last year and this year, have prepared to this point.

But there is a moment when you need to lay out a bill before the public and have the full conversation. I appreciate that you all have taken us forward to that point today.

Many say that this bill is very complicated, and indeed, energy touches virtually every aspect of our economy. But this bill can be reduced to a series of fairly clear choices. It is a choice between clean air or dirty air. It is a choice between investing a billion dollars a day in red, white and blue American-made energy or sending that billion dollars a day overseas to countries like Venezuela and Saudi Arabia and other countries that don't always share our national interests.

This bill is a choice of creating jobs for Americans or sending those jobs overseas. It is a choice between a strong, secure energy independent America or a weaker, oil addicted America. It is a choice between planetary stewardship that serves our ecosystems and human civilization well or a rise in the Earth's temperature that is devastating for ecosystems and for human civilization.

This bill represents a choice between a forward looking American leadership that repositions our energy economy to make America an economic powerhouse in the future or backward looking American policies that protect and sustain an inefficient energy status quo that will undermine our success in the coming generation.

Here in this building, we often wrestle with short-term choices versus long-term vision. But our children get this. Every university I have been to, when I ask the students what their top concern is, they always weigh in that we need to act on climate change. They get it because they have seen the science. We simply have to look at the Arctic ice, the Antarctic ice, the amount of carbon dioxide and the acidification of the ocean. Our glaciers, our permafrost, the rate of carbon dioxide buildup in the environment. Each one of these clear, significant factors can only be missed if you shut your eyes or put your head in a hole in the ground.

Now, some say that this bill moves too fast. The aim is 20 percent reduction below 2005 carbon dioxide levels by 2020. We are already closing on in 9 percent below 2005 levels. That means this bill is saying, let's move 11 percent more over the next 11 years. That is just 1 percent per year. That is not an overly aggressive goal for us to undertake as a Nation.

In fact, you could argue that this bill is not moving fast enough. The Intergovernmental Panel on Climate Change said that to limit the probability of reaching a temperature increase over 2 percent, developing countries should reduce their CO_2 by 2020 by 25 percent below the 1990 level. Well, to compare apples to apples, this bill will put us at 7 percent below 1990 by 2020, not 25 to 40 percent.

We are taking and setting up a framework that moves us forward on a vision of reducing carbon dioxide, but few could argue that this bill is overly aggressive. We need to understand today what our children already understand, that this is a debate about the security of our Nation, about how clean our air is, about whether we create American jobs, about whether we have a strong economy in the future, and about whether we are good stewards of our planet for the benefit of our ecosystems and human civilization. I hope we in this committee can make the right decision.

Thank you, Madam Chair.

Senator BOXER. Thank you, Senator.

Next we will hear from Senator Vitter, and then Whitehouse, Gillibrand if she returns, and Cardin. And then we will get to the panel.

Senator Vitter.

OPENING STATEMENT OF HON. DAVID VITTER, U.S. SENATOR FROM THE STATE OF LOUISIANA

Senator VITTER. Thank you very much, Madam Chair.

Like all the members on this side of the dais, I also support an aggressive national energy policy that looks to dramatically decrease our dependence on foreign sources and aggressively get us beyond high carbon fuels. And like other members here, I think that needs to focus on conservation, nuclear, natural gas and new technologies like electric cars and many other advancing new technologies. I think that sort of approach, that sort of national energy strategy, would have broad based support of the American people and bipartisan support from Congress.

Unfortunately, that is not what we are talking about today. I think what we are talking about today, this sort of cap-and-trade proposal is very different and doesn't have that broad based sup-

port. I believe this cap-and-trade concept is a bad idea in any climate, and is a particularly horrible idea in this deep recession, as unemployment continues to grow and hover around 10 percent.

I want to mention four concerns in particular with this and similar legislation. First of all, something about the science. I believe there is certainly one thing that the science is absolutely clear on, and it is beyond debate. And that is, if countries like China and India and Russia are not part of a carbon reduction global program, that it does not matter what we do. And that the only effective actions like this will be to dramatically harm our economy.

If there is any suggestion in the science to the contrary, I would love to hear it, and I would love to hear forecasts from our Administration witnesses regarding scenarios where China, India, Russia and similar powers do not reduce carbon emissions. It has been made perfectly clear by them, directly from their mouths, that they have no plans to join such a global regime. And all three are aggressively pursuing natural resource assets around the world and dramatically increasing energy production from fossil fuels.

Secretary Chu mentions in his testimony that China is spending $9 billion a month on clean energy. The other side of that coin, the bigger side of that coin is that they are building two coal-fired power plants a month and securing oil resources around the globe.

Point No. 2 is the cost of all this. I think it is very significant that the Obama administration Treasury Department developed a cost estimate. And their cost estimate, not a Republican one, not a Heritage Foundation one, but their cost estimate is that the cost of cap-and-trade would be over $1,700 a year per household. This would roughly be the equivalent of hiking income taxes by 15 percent. Certainly a little more than a postage stamp a day. And Treasury stated specifically that "Economic costs will likely be on the order of 1 percent of GDP, making them equal in scale to all existing environmental regulation."

Others have agreed with this, including the President on the campaign trail: "Under my plan of a cap-and-trade system, electricity rates would necessarily skyrocket. Whatever the plants were, whatever the industry was, they would have to retrofit their operations. That will cost money. They will pass that money on to consumers." "Cap-and-trade would increase the cost of energy." From Secretary Tim Geithner. "Under a cap-and-trade program, firms will not ultimately bear most of the cost of the allowances, but instead would pass them along to their customer in the form of higher prices." That is Peter Orszag, as Director of CBO. Of course, he is now the Obama administration head of OMB.

"Cap-and-trade is a tax, and it's a great big one." John Dingell. And Charlie Rangel, "Whether you call it a tax, everyone agrees that it's going to increase the cost to the consumer."

Point No. 3 is putting points No. 1 and two together. Foreign competition does nothing like this. We dramatically increase taxes and costs. And obviously, that significantly hurts jobs and pushes jobs overseas.

Thank you, Madam Chairman.

[The prepared statement of Senator Vitter follows:]

STATEMENT OF HON. DAVID VITTER,
U.S. SENATOR FROM THE STATE OF LOUISIANA

Thank you, Chairman Boxer; and I would like to thank the Administration witnesses for their testimony here today and their candor in this most important debate.

As a recently obtained Treasury Department analysis of cap-and-trade stated, "Economic costs will likely be on the order of 1 percent of GDP, making them equal in scale to all existing environmental regulation." As unemployment is headed upward of 10 percent the impact of further job losses by a massive new regulatory program could not be overstated.

"Cap-and-trade" is potentially a new stealth tax in the order of magnitude of more than $1,700 per American household annually. American families can look forward to an increase in their electricity bills, their gas bills, their food bills and their utility bills. It is clear that most Americans' standard of living will be reduced.

It doesn't matter if the study is done by the Energy Information Administration, the Congressional Budget Office, the National Black Chamber of Commerce, the National Association of Manufacturers, the Brookings Institute or the Heritage Foundation—every legitimate economic analysis says that this is a bad idea. The human impact of these new regulations, job losses, and the increased price of energy should never be marginalized or ignored.

Senator Gillibrand wrote an insightful op-ed last week in the Wall Street Journal titled "Cap and Trade Could Be a Boon to New York." This article provided important insight into who will make money and how much. The Senator from New York stated that "carbon permits could quickly become the world's largest commodities market, growing to as much as $3 trillion by 2020." That is $3 trillion that has to be generated by the work of America's farmers, refiners, miners, small businesses and manufacturers and then redistributed to Wall Street. It will perhaps be the greatest transfer of wealth in U.S. history. And it may very well be the greatest scam ever thrust on the people of the United States. This program would be the equivalent of TARP in perpetuity for a handful of financial institutions that have already been bailed out once. And you don't need a Republican to tell you that.

Senator Dorgan recently stated that "I know the Wall Street crowd can't wait to sink their teeth into a new trillion-dollar trading market in which hedge funds and investment banks would trade and speculate on carbon credits and securities. In no time they'll create derivatives, swaps and more in that new market. In fact, most of the investment banks have already created carbon trading departments. They are ready to go. I'm not." Senator Dorgan further stated that "For those who like the wild price swings in the oil futures market, the unseemly speculation in mortgage-backed securities, or the exotic and risky financial products like credit default swaps that pushed our economy into the ditch, this cap-and-trade plan will be the answer to their prayers."

I look forward to hearing from the Administration on what programs they plan on cutting to pay for a transfer in our economy from energy jobs that generate massive amounts of wealth to energy jobs that require massive amounts of subsidies. I also look forward to the Administration discussing China's purchase of mineral resources around the world, including rare earth minerals. As well, I am not aware of any solar project or wind mill that doesn't require mined or refined materials or inputs that are derivatives from oil and natural gas.

The CBO has stated that mining and refining jobs will be among the most impacted by the proposed cap-and-trade program. However, nearly every product made, farmed, built, and manufactured requires some derivative from oil and natural gas or other minerals. How in the world can it be strategically beneficial for the United States to become more dependent on mined and refined products from foreign countries?

Secretary Chu mentions in his testimony the International Energy Agency in his support for renewable energy technologies. I wonder why he fails to mention that the same agency has recommended that Germany end its solar subsidies that will total $115.5 billion by 2013. If the U.S. were to take the same approach as Germany, U.S. consumers could expect their electricity bills to increase by 100 percent. The Administration's contention is that a cap-and-trade system along with significant subsidies will create a new industry and a lot of high tech jobs. Yet Germany's solar producers are now scaling back as they are crowded out by Chinese manufacturers.

A critical point in this whole debate is that China, India and Russia have made unequivocally clear that they have no intention of agreeing to a cap on carbon emissions. As well, all three are aggressively pursuing natural resource assets around the world and increasing energy production from fossil fuels. It is silly to think that

U.S. businesses will be able to compete on the international level when they are subject to carbon caps and regulation, increased energy costs and an easily manipulated market scheme. Secretary Chu mentions in his testimony that China is spending $9 billion a month on clean energy. They are also building two coal-fired power plants a month, are increasing nuclear power generation and are securing oil resources across the globe.

Secretary Chu also mentions Denmark as an example, a country where electricity prices are more than 200 percent higher than they are in the United States. One recent study shows that each wind related job in Denmark is taxpayer subsidized at the rate of $90,000 to $140,000 per job. In fact, the Danes pay more for their power than anyone in the European Union.

Despite my concerns with the idea of a cap-and-trade program, I do support investment and research in renewable technologies. I do believe a robust plan for investment should be in place, but to do so we must not be borrowing money from China or stealing money from American families under the guise of "global warming." The greatest opportunity for investment in new technologies is revenue generated from increased domestic energy production. Recent analysis suggests that increased domestic resource production could represent $8 trillion in GDP, $2.2 trillion in incremental tax receipts, and perhaps 2 million jobs or more. All without borrowing a dime or increasing taxes even a penny.

Finally, there are significant issues that need to be raised and questions that need to be answered in regard to this program. Some of those questions include:

(1) Who are the winners and losers under cap-and-trade?

(2) What States benefit, and what States are adversely impacted?

(3) How does it affect the U.S. strategically to be importing more refined mineral products and refining less domestically?

(4) How are Federal and State treasuries affected by moving from industries that generate massive amounts of wealth to industries that require massive amounts of subsidies?

(5) Given that reliable low cost energy is one of the greatest equalizers in the history of mankind, how are families impacted by dramatically increasing costs?

(6) Who are the benefactors of any "third party" certifying provisions, and how much money are they anticipating receiving?

(7) Why are Administration officials claiming that "we must reduce our carbon emissions by 80 percent by mid-century to stabilize atmospheric greenhouse gas concentrations" when there are no models or studies to support such statements, especially without similar reductions from China, India or Russia?

(8) Who are the major investors in the Chicago Climate Exchange, and in what countries are the assets held?

(9) Why not a single one of the computer models predicted the stabilizing, if not cooling, atmospheric temperatures the world has experienced over the last 10 years?

(10) If the United States is to sign a binding international agreement, what freedoms and pillars of the democratic process are we asking American citizens to cede to an international body?

Thank you, and I look forward to asking questions of these witnesses.

Senator BOXER. Thank you very much, Senator.

Senator Whitehouse.

OPENING STATEMENT OF HON. SHELDON WHITEHOUSE, U.S. SENATOR FROM THE STATE OF RHODE ISLAND

Senator WHITEHOUSE. Thank you, Madam Chairman.

President Obama said last week at MIT, everyone in America should have a stake in legislation that can transform our energy system into one that is far more efficient, far cleaner and provides energy independence for America. The letters and phone calls I received from constituents in Rhode Island overwhelmingly support clean energy legislation and demonstrate the momentum growing behind this effort.

Rhode Islanders and Americans across our Nation acutely understand the benefits of becoming the world's leader in clean energy technology and the risks of failing in that endeavor. Some States, like Rhode Island, transitioned at their own expense to cleaner energy years ago. Other regions of the country are new to this en-

deavor. But there is emerging a shared sense of purpose across the country. Even my colleagues from our coal States, on and off this committee, are seriously engaged in this discussion for the first time.

Americans are brought together by our common understanding that our current fossil fuel energy habit is not sustainable and by our common recognition that America can and should lead the world to move to a clean energy economy.

The United States has always been at the forefront of technological and economic advancement, from Slater Mill at Pawtucket to the world's first automobile and airplane, to air conditioning and the light bulb. We put the hand of man on the Moon, on Mars and on Venus and opened the computer era with the invention of the microprocessor and the Internet. It is in America's DNA to innovate.

The next great economic revolution is the race to clean energy. Yet America continues to rely today on the same fuels and energy sources that fed the manufacturing centers and steam engines of the Industrial Revolution over a century ago. Oil still accounts for approximately 40 percent of our total energy needs, and 70 percent of this oil is imported from foreign countries, many of whom, to put it mildly, are not committed to our best interests.

But we fed the flow to the oil cartel of hundreds of billions of dollars rather than step forward into the clean energy economy that beckons, promising clean, abundant, renewable American energy sources. Millions of hard working Americans could be back on the job, building and servicing an American clean energy infrastructure.

In the last 10 years, jobs in the clean energy sector have grown at a rate nearly two and a half times faster than overall jobs. And these jobs can be created anywhere in the country, including States like my own State of Rhode Island, where jobs are now most scarce. We have only begun to scratch the surface. There is strong and growing domestic demand for wind turbines, solar panels and advanced batteries. Yet almost half our turbines are imported. Only 1 of the top 10 solar component manufacturers calls the United States home. And China, Japan and Korea are taking the lead in battery research.

As John Doerr testified before this committee, if you list today's top 30 companies in solar, wind and advanced batteries, American companies hold only 6 spots. The Clean Energy Jobs and American Power Act is key to unshackling America from implicit subsidies to dirty foreign fuels and putting us on the path toward prosperity and world economic leadership.

History has stood us at this point of choice. Winston Churchill described those small agate points on which the balance of the world turns. We are at one now. We can reach to the clean energy future that beckons, pave the way for jobs and energy independence at home and show leadership in the world economy abroad. Or we can sit idle, beguiled by the money and spin of polluting industries, and let destiny's moment pass. The right choice is clear, and I am confident that we will make it, perhaps ultimately in bipartisan fashion.

I hope we can act soon, and I for one have not lost hope that buoyed by a success on health care reform, we can turn swiftly and with optimism to meeting our responsibilities on this front. I concur with Senator Kerry that we are not moving too quickly. By all reasonable measures we are all moving, and for a long time have been moving too slowly.

Thank you, in particular, Madam Chairman, for your inspirational, collegial, passionate and determined leadership. I yield the remainder of my time.

Senator BOXER. Thank you so very much.

Senator Sanders has come back to join us. We welcome you back, and then you will speak now and then Senator Cardin, and then we will get to our panel.

OPENING STATEMENT OF HON. BERNARD SANDERS, U.S. SENATOR FROM THE STATE OF VERMONT

Senator SANDERS. Thank you, Madam Chair. Let me just echo what Senator Whitehouse has just said. This has been an extraordinary process, and I thank you and Senator Kerry for the openness of that process.

The issue that we are dealing with today is very different than many of the other issues that we deal with. Do you know why? Because what we are dealing with is not a political compromise, it is not just trying to get votes. You are dealing with science. And at the end of the day, we can have a bill passed and have a great celebration in the White House, and it may not be good enough. Because as you know, Madam Chair, what we are hearing from virtually all of the scientists that come before this committee, what are they telling us? What they are telling us is that, we told you in the past that the problem was serious, but we underestimated the problem. That if we do not act aggressively, the planet that we are leaving to our children and grandchildren will be a planet severely damaged in terms of drought, in terms of disease, in terms of flood, in terms of extreme weather disturbances. According to the CIA, in terms of national security issues.

And the question is, do we have the brains and the courage to address that crisis? And at the same time understand that in terms of our economy, what we are doing is preventing hundreds and hundreds of billions of dollars of damage a year while, as we go forward, we create millions of good paying jobs. That seems to me a no-brainer.

So the opportunity that we have right now in terms of energy efficiency, in my State of Vermont right now, under normal economic circumstances, we consume less electricity now than we did in the past, because we have been smart on energy efficiency. And you know what? We are creating jobs. The Department of Energy gave a small company in Vermont a grant for capacitors as part of hybrid cars. We are creating new jobs doing that, and we thank you for that grant.

There is a windmill company in the State of Vermont making wind turbines on the cusp of massive growth providing wind turbines to Alaska and other remote areas. We are creating jobs. Our rail system today is behind Europe, behind Japan. How many new

jobs do we create as we rebuild our rail system and build the trains that we need right here in the United States of America?

Secretary Salazar has told us that we can produce almost 29 percent of the electricity in this country from solar thermal plants in the southwestern part of this country. How many thousands of new construction jobs do we create? We are importing hundreds of billions of dollars of oil every single year from foreign countries, hundreds of billions of dollars. How many new jobs do we create where we invest those hundreds of billions of dollars in the United States, creating a new energy system?

This, my friends, is a no-brainer. The science is there, the economics is there, the job creation is there. And if we do not seize this moment to do the right thing, history will look back at us, and our children and our grandchildren will say, where were you as this planet undergoes catastrophic damage? We can do it, and I do not accept the argument of those on the other side who say this is a negative for the economy. This is a positive for the economy.

So Madam Chair, I want to thank you, I want to thank Senator Kerry for your very hard work. And we are going to make this happen. Thank you.

Senator BOXER. Senator, thank you so very much.

Senator Cardin.

OPENING STATEMENT OF HON. BENJAMIN L. CARDIN, U.S. SENATOR FROM THE STATE OF MARYLAND

Senator CARDIN. Madam Chair, let me also add my congratulations, and thanks for your leadership and Senator Kerry's leadership. All of us want to make sure we get it right.

But I just hope my colleagues understand the urgency of this issue. We have to act. We can't just talk about this. We have to act. My friend from Ohio and I were together at a meeting with our European friends. They talked about the urgency in a term that you don't hear often hear about climate migrants, people who are being forced to leave their homes because of drought and flooding, causing stability issues in Africa and Asia and Europe.

Now, I can take you right here to Maryland, to Smith Island, Maryland, and you are going to see potential climate migrants there, as their island is disappearing because of sea level increases due to global climate change. And of course, we can all give examples of why it is urgent for us to act in our own individual States. I talk to our watermen who tell me that with the rising temperatures in the Bay, it is become more and more difficult for juvenile crabs to survive.

So it is urgent that we act. I think my colleagues understand the urgency from a national security point of view. We are dependent upon imported oil, which jeopardizes the security of America. I think we all understand the economic threats that we go through. We are held hostage to oil, which affects our economy.

So it is urgent that we get this right. My friend from Vermont makes a very compelling point about the economic impact of this legislation. It is going to be positive on jobs. I look at White Marsh, Maryland, where they are doing the new battery technology with a grant that the Department of Energy just recently awarded. I

thank the Secretary for that innovation, where we are going to lead in the creation of alternative ways to fuel our automobiles.

Madam Chair, I just really want to take issue from my friend from Wyoming, as he used his numbers. I am going to ask unanimous consent that the congressional research on job loss and infrastructure job creation on the stimulus be made part of our record. I just want to quote from one report on that. It says, "Based on two different estimating procedures, it found that the American Recovery and Reinvestment Act may have added some 1 million jobs to employers' payroll in August, 2009, compared to what employment would have been in the absence of the legislation."

And my point is this: if we didn't act, we don't know how many jobs we would have lost in our economy. We do know that job losses have been reduced dramatically. Economists tell us the stimulus package worked.

So on this bill, when we are dealing with energy policies, we know that American ingenuity will create jobs if given the right incentive. And that is what this bill does: it gives the right incentive. It unleashes what America does best, and that is the economic ingenuity of its people in solving the problems of energy security, of dealing with the economic impact of energy and dealing with our environment.

I just want to applaud the Chairman and Senator Kerry for the framework of this legislation. Because it provides a way in which we can deal with alternative and renewable energy sources. It recognizes nuclear power. By having a friendly carbon footprint it is given priority in this legislation. And it allows us to invest in lifestyles that are going to be important for America.

All we need to do is visit any European capital and know we could do much better on transit here in America. Transportation represents 30 percent of the emissions of greenhouse gases, 70 percent of our oil use. We can do much better. And thank you, Madam Chair, because your bill gives us the opportunity to invest in that type of America that will make us more competitive in the future. You provide the resources to help consumers and energy intense industries so we make the transition to polluter pays. Polluter should pay. But we want to make sure the consumers are protected.

And I just want to mention one more aspect of this bill. It is deficit neutral. You have provided to make sure that we are not going to burden our children and grandchildren by additional debt. Look, I hope we all can work together, Democrats and Republicans. This is an issue that America is asking us to solve. I think we have the blueprint to do it. Let's get down to work.

[The prepared statement of Senator Cardin follows:]

STATEMENT OF HON. BENJAMIN L. CARDIN,
U.S. SENATOR FROM THE STATE OF MARYLAND

Madam Chairman, thank you for your hard work and commitment to working with your committee members to draft the legislation we are considering today. And to our partners in the Obama administration, thank you for your guidance and commitment to stemming climate change. I look forward to your testimony.

Madam Chairman, we've all heard the saying, "necessity is the mother of invention." Well it applies to the United States of America right now. At this critical juncture in our Nation's history, we face an economic crisis, an energy security crisis, and a global climate crisis.

The good news is that the solutions to these problems are intertwined with one another. And those solutions will come from new American ideas, new American industries, and a careful approach to maintaining the health of our planet.

I am confident that the work my colleagues and I have put into the legislation we are considering today will provide the legal framework, business incentives and consumer protections necessary to move America toward a more prosperous, secure, clean energy future.

The bill sets ambitious yet essential targets for greenhouse gas emission reductions. Through the expanded use of existing technologies, particularly in the area of energy efficiency, we can reach these near-term goals.

The investments this bill makes in renewable and alternative energy sources over the life of the bill will help us achieve energy security, leave our grandkids a healthy planet and generate millions of new, well paying jobs in the clean energy and transportation sector.

How? Well, for one, it will provide the regulatory certainty and incentives that the energy sector desperately needs to plan and develop the power generation and delivery systems for the future. This bill will create an environment that will spur innovation to develop greater domestic energy sources that are clean and affordable.

I am very pleased that this bill makes a significant investment in transportation infrastructure efficiency and access to transit. The transportation sector is responsible for 30 percent of the United States' greenhouse gas emissions and 70 percent of our oil use.

This bill recognizes the role transit will play in reducing vehicle emissions. According to the American Public Transportation Association, public transit currently saves 37 million metric tons of carbon dioxide emissions per year. If we are going to reach our targets for cleaner air and a cooler planet, we must invest in public transportation in this country. I fought hard to make sure this bill would boost funding for transit so that we can put more people on clean, efficient and convenient buses, trolleys, subways and rail systems.

The bill helps also helps keep consumer costs low by mitigating cost increases to ratepayers and providing incentives for energy efficiency. The bill recognizes the need to provide for a smooth transition period as we move toward a clean energy economy. This means providing ratepayer cost protections against energy price increases while the energy sector works to shift toward cleaner energy production and more efficient energy technologies.

The bill pays close attention to the needs of America's agriculture sector. Farmers will play an essential role in meeting our emissions targets by developing offsets that they can sell to help capped carbon emitters meet their compliance requirements. Additionally, the manager's mark increases funding for supplemental agriculture programs for farmers to participate in and receive financial benefits from when they engage in activities that help mitigate greenhouse gases, even if these activities or projects are not eligible as official offset projects.

The threats climate change brings to our way of life are not theoretical to many Marylanders. Ask the people of Smith Island who are watching their island vanish under rising sea levels. Ask Maryland's watermen whose way of life is disappearing as rising temperatures destroy the habitat the Chesapeake Bay's fish, crabs, and oysters depend on.

Their struggles are mirrored in communities around the globe where droughts, floods and other natural disasters are already destroying local economies and forcing people to change their way of life and even leave their homes. Dislocation, struggles over scarce resources: our Nation's top national security minds tell us that climate change is a real threat to our national security.

This bill allocates critical funds to make sure our wild places and our wildlife do not disappear. It sets aside money to help States protect their residents against the impacts of climate change including protecting water supply, defending against sea level rise, and repairing infrastructure from the damage these changed conditions will create. It will allow us to invest in third world countries to protect their way of life and prevent the dislocation that could impact our own safety here, thousands of miles away.

Congress has taken far too long to address our economic, energy security and climate crises. This bill will address all three. I am proud of the effort that has gone into this bill to build consensus. I look forward to working with the Chairman to advance this bill through committee and eventually to the floor. Let's get back to work!

[The referenced information follows:]

Job Loss and Infrastructure Job Creation Spending During the Recession

Linda Levine
Specialist in Labor Economics

October 2, 2009

Congressional Research Service
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www.crs.gov
R40080

CRS Report for Congress
Prepared for Members and Committees of Congress

Summary

After the long economic expansion that characterized much of the current decade, the nation entered its eleventh postwar recession in December 2007. The unemployment rate, which is a lagging economic indicator, did not start to rise until May 2008 when it jumped 0.5 percentage points to 5.5%. By December 2008, the unemployment rate exceeded 7.0% and well over 600,000 jobs were lost—the biggest monthly decrease since December 1974, when another deep recession was taking place. These labor market indicators and comments equating the latest recession to the Great Depression intensified congressional interest in passage of legislation early in 2009 aimed at encouraging creation of new jobs and warding off further loss of jobs. (See CRS Report R40655, *The Labor Market During the Great Depression and the Current Recession.*)

To mitigate all but one recession since the 1960s, Congress chose to increase federal spending on infrastructure. (See CRS Report 92-939, *Countercyclical Job Creation Programs.*) But, there are a number of issues associated with using expenditures on public works to quickly create jobs in times of recession. (See CRS Report R40107, *The Role of Public Works Infrastructure in Economic Stimulus.*)

Public works expenditures traditionally have gone chiefly to construction activities (e.g., building highways and bridges, dams and flood control structures) which indirectly increase demand in industries that supply their products to construction firms (e.g., manufacturing). Today, the definition of infrastructure has been expanded to include green jobs, which include those in industries that utilize renewable resources (e.g., electricity generated by wind), produce energy-efficient goods and services (e.g., mass transit), and install energy-conserving products (e.g., retrofitting buildings with thermal-pane windows).

A question that typically arises during congressional consideration of economic stimulus legislation is which approach produces the most bang for the buck. In the instant case, this means how many jobs might be supported by federal expenditures on traditional and green infrastructure projects. Once stimulus legislation is signed into law, the focus of Congress customarily turns to estimates of the number of jobs that result as federal funds are allocated to specific activities. Therefore, after briefly examining the trend in employment and unemployment since the recession's onset, the report turns to an in-depth look at estimates of job creation, including the limitations of the methodology often used to derive them and the difficulties associated with developing job estimates for green infrastructure in particular. The report closes with a review of what is known to date about the number of jobs supported by infrastructure spending among other provisions in the American Recovery and Reinvestment Act (ARRA, P.L. 111-5). Section 1512 requires entities that receive ARRA appropriations from federal agencies, totaling approximately $271 billion, to include in quarterly reports the number of jobs created or maintained as a result. Section 1513 requires the Council of Economic Advisors to report quarterly on the effect of ARRA provisions on employment and other economic indicators.

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After the long economic expansion that characterized much of the current decade, the nation entered its eleventh postwar recession in December 2007. The unemployment rate, which is a lagging economic indicator, did not start to rise until May 2008 when it jumped 0.5 percentage points to 5.5%. By December 2008, it exceeded 7.0% according to data from the U.S. Bureau of Labor Statistics (BLS). Well over 600,000 jobs were lost in December 2008—the biggest monthly decrease recorded by the BLS Current Employment Statistics program (CES) since December 1974, when another deep recession was taking place.

The Business Cycle Dating Committee of the National Bureau of Economic Research, the official arbiter of peaks and troughs in the business cycle, announced at the end of November 2008 that a substantial and widespread decline in economic activity had begun a year earlier. December 2007 marks both the end of the 73-month economic expansion that began in March 2001, and the beginning of the latest recession. As part of its announcement, the committee noted that it "views the payroll employment measure, which is based on a large survey of employers, as the most reliable comprehensive estimate of employment. This series [the CES] reached a peak in December 2007 and has declined every month since then."

The committee's announcement intensified congressional interest in passage of legislation aimed at encouraging creation of new jobs and warding off further loss of jobs. So, too, did comments equating the recession to the Great Depression. (See CRS Report R40655, *The Labor Market During the Great Depression and the Current Recession.*)

To mitigate all but one recession since the 1960s, Congress chose to increase federal expenditures on infrastructure (public works), thereby directly raising demand for goods and services to offset the reduced demand of consumers. (See CRS Report 92-939, *Countercyclical Job Creation Programs.*) But, there are a number of issues associated with using spending on public works to quickly create jobs during a recession. (See CRS Report R40107, *The Role of Public Works Infrastructure in Economic Stimulus.*)

When Congress considers spending on infrastructure to help stimulate a flagging economy, "how many jobs are created" is a commonly asked question. After first briefly examining trends in job loss since the latest recession began, this report focuses on job creation estimates associated with increased spending on traditional and so-called green infrastructure, placing a heavy emphasis on explaining the methodology often used to derive them and the difficulties associated with developing estimates for green infrastructure in particular.

Once stimulus legislation is signed into law, the focus of Congress customarily turns to estimates of the number of jobs that result as federal funds are allocated to specific activities. In the case of the American Recovery and Reinvestment Act (ARRA, P.L. 111-5), Congress included language requiring entities that receive ARRA appropriations from federal agencies to report the number of jobs created or maintained as a result and requiring the Council of Economic Advisors to report on the employment and other economic effects of ARRA provisions. The report closes with a review of what is known to date about the number of jobs associated with the stimulus act.

Employment and Unemployment Through Job Loss

As shown in **Table 1**, employment on nonfarm payrolls has steadily declined since December 2007. The number of job cutbacks intensified starting in late 2008. Of the 7.2 million jobs lost since the recession's onset, the majority have disappeared since November 2008.

Table 1. Payroll Jobs at Nonfarm Employers

(seasonally adjusted employment in thousands)

Year by Month	Total Employment	Private Sector Employment
2007		
December	138,152	115,783
2008		
January	138,080	115,689
February	137,936	115,515
March	137,814	115,373
April	137,654	115,203
May	137,517	114,029
June	137,356	114,834
July	137,228	115,691
August	137,053	114,497
September	136,732	114,197
October	136,352	113,813
November	135,755	113,212
December	135,074	112,542
2009		
January	134,333	111,793
February	133,652	111,105
March	133,000	110,457
April	132,481	109,865
May	132,178	109,573
June	131,715	109,182
July	131,411	108,936
August	131,210(p)	108,754
September	130,947(p)	108,544

Source: U.S. Bureau of Labor Statistics, data from the Current Employment Statistics program.

Notes: (p) = preliminary.

As is typical during economic downturns, employees in the goods-producing sector have been the most adversely affected. They saw their ranks shrink by almost 3.6 million between December 2007 and September 2009. (See **Table 2.**) Workers in the sector's construction industry began experiencing job losses before the economy-wide downturn began. Nonetheless, between the recession's onset and September 2009, construction firms cut almost 1.5 million jobs. Across all manufacturing industries, employment fell by 2.1 million as well. Although manufacturing job losses have been widespread, two industries that produce durable goods—fabricated metal products (e.g., hardware, wire, and screws) and transportation equipment (e.g., motor vehicles and parts)—have been particularly hard hit.

Table 2. Number of Payroll Jobs by Industry

(seasonally adjusted employment in thousands)

Industry by Sector	Employment, December 2007	Employment, September 2009 (p)
Goods-producing sector	22,043	18,465
Mining and logging	743	708
Construction	7,523	6,038
Manufacturing	13,777	11,719
Service-providing sector	116,109	112,482
Trade, transportation and utilities	26,725	25,092
Wholesale trade	6,045	5,649
Retail trade	15,568	14,700
Transportation and warehousing	4,555	4,178
Utilities	557	565
Information	3,025	2,826
Financial activities	8,243	7,702
Professional and business services	18,109	16,597
Education and health services	18,570	19,311
Leisure and hospitality	13,551	13,154
Other services	5,517	5,397
Government	22,369	22,403

Source: U.S. Bureau of Labor Statistics, data from the Current Employment Statistics program.

Notes: (p)=preliminary.

Employment in the service-providing sector most recently peaked in December 2007, when the recession began. Although some service-providing industries have continued to grow—utilities, education and health services—cutbacks elsewhere have far outweighed their gains. As shown in **Table 2**, these industries reported higher employment in September 2009 than at the start of the recession. In contrast, the financial activities industry began to lose jobs before the advent of the economy-wide downturn. This mirrors the above-mentioned trend in construction employment in part because real estate is a component of financial activities and it, like construction, has been hurt by the collapse of the housing market. Other components of financial activities, such as brokerage firms that packaged high-risk mortgages and the investors (e.g., banks) that purchased them, have been negatively affected by the housing market downturn as well.

Despite a marked slowdown in the pace of job loss in recent months and the widely expressed belief that the recession ended this summer, the prospect of steady job growth beginning in the near term looks dim according to a CRS analysis of employment trends after the end of the prior ten recessions. In all but one instance,

> "the number of jobs on employer payrolls fluctuated for months.... Sustained job growth occurred within three to five months of the start of seven recoveries. In sharp contrast, steady job growth did not commence until March 1992—12 months after the July 1990-March 1991 recession ended—and not until September 2003—22 months after the March-November 2001 recession ended."[1]

The unemployment rate in September 2009 rose to 9.8% from 5.0% in December 2007, according to BLS data derived from the Current Population Survey.[2] The Blue Chip Economic Indicators reported that the latest consensus forecast among the nation's leading business economists is that the unemployment rate will continue to rise to 10% or higher and "recede from that level only grudgingly" during the last six months of 2010. Most of these economists think it will not "be until the second half of 2012, or later, before the unemployment rate falls below 7 percent on a sustained basis."[3]

Infrastructure Spending and Job Creation Estimates

When in response to a recession Congress has acted to create jobs by raising demand for goods and services through increased federal spending, it often has chosen to direct the funds to infrastructure (public works) activities. Other means of direct countercyclical job creation—employment tax credits, state revenue-sharing, and public service employment—have been relied on much less often.[4]

A more expansive definition of infrastructure than was used in the past is now under consideration. Historically, public works has been synonymous with heavy and civil construction activities (e.g., road and bridge building, flood control structures and dam building). Today, it includes so-called green jobs. Although numerous studies on the emerging green economy have been released in the last several years, no consistent definition of green jobs exists at present. Green jobs seemingly are those in and related to industries that utilize renewable resources to produce their outputs (e.g., energy generated by wind, solar, and geothermal technologies) and jobs in and related to industries that produce energy-efficient goods (e.g., Energy Star appliances and equipment) and services (e.g., intra- and inter-city mass transit).[5] For this reason, the following discussion focuses on what is known about the job-generating impact of infrastructure spending broadly defined.

The section below begins with an in-depth examination of how job creation estimates usually are developed. The focus then narrows to look at two models that can be used to calculate the number of jobs nationwide dependent upon demand in the construction industry among other industries, and one model that can be used to calculate the number of jobs by state dependent on the construction industry among other industries. The section ends by reviewing the difficulties that researchers encounter in estimating the number of jobs supported by expenditures on green

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[1] CRS Report R40798, *Unemployment and Employment Trends Before and After the End of Recessions*, by Linda Levine.

[2] Data from the Current Population Survey of households is available at http://stats.bls.gov/cps.

[3] "Recession Finished, Say Blue Chip Analysts," *Daily Labor Report*, September 10, 2009.

[4] CRS Report 92-939, *Countercyclical Job Creation Programs*, by Linda Levine.

[5] Related jobs include, for example, those in industries that manufacture wind turbines and install thermal-pane windows.

infrastructure and the consequent caution that should be taken when utilizing these estimates in particular.

Job Creation Estimates: What Are They?

Interest in how many jobs are created by a particular type of economic activity has surfaced when the economy is in a downturn and policymakers seek to compare the relative advantages of different stimulus options. It also has arisen when policymakers want to know the impact of shifting expenditures from one federal budget category to another (e.g., away from defense and towards social services programs). Unless there is an increase in total spending, however, the number of jobs in the labor market would remain largely unchanged.[6]

Although there are other bases upon which to develop estimates of the number of jobs created by a given economic activity, an input-output (I-O) model of the economy often is utilized due to its cost-effectiveness.[7] An I-O model describes the interrelationships between industries in the production process, showing how the dollar value of a sale is distributed across industries at a particular point in time. It thus reflects how much of the purchased product comes from final and supplier industries. An I-O table might show, for example, the dollar value of roof trusses produced by the veneer, plywood, and engineered wood products manufacturing industry and the dollar value of bricks produced by the clay product and refractory manufacturing industry used by the construction industry to erect residential buildings.

The output requirements from each industry must then be converted to employment requirements. Employment requirements are derived from productivity estimates for each industry at a particular point in time. The total employment requirement associated with a given type of final demand (e.g., a water reuse program) is the employment in the industry producing the final product or service and in the supplier industries. In other words, it is an approximation of both the direct and indirect employment dependent upon/supported by the economic activity. It commonly is expressed as the number of jobs per billion dollars of expenditures valued in a particular year's dollars.

Like an I-O table, an employment requirements table is a matrix of hundreds of columns and rows. Each column displays the number of jobs supported in each of the industry rows by an expenditure of one billion dollars in the column industry. For example, one billion dollars spent in the construction industry supports (direct) employment in the various components of that industry (e.g., residential and commercial building, highway and bridge building) and (indirect) employment in the many industries that supply their goods and services to the construction industry (e.g., asphalt shingle manufacturing, fabricated metal bridge section manufacturing). An employment requirements table thus permits estimation of the varying impact of an expenditure on different industries and the varying impact of different kinds of expenditures.

[6] Small differences in the total number of jobs could occur at the same spending levels if the economic activities to (from) which funds were being shifted were more (less) capital-intensive, for example.

[7] Another basis for estimating the impact of policy and other changes on the economy is conducting surveys. According to the U.S. Bureau of Economic Analysis (BEA), the advantage of the I-O approach to making impact estimates is the accessibility of the data sources required to develop the I-O model.

Some Caveats

I-O models freeze technology and productivity at a particular point in time. Thus, the job-generating potential of an economic activity undertaken today could differ from that of an earlier period if there were technological and productivity improvements in the intervening years. Similarly, the estimates often are stated in terms of the number of jobs created for every billion dollars of expenditures, but a billion dollars spent in one year could buy less (more) than a billion dollars spent in another year depending on changes in price levels over time.

There also could be differences in estimated versus actual job creation because I-O models assume that resources are unlimited. If, for example, the economy was performing at a fairly high level with plants operating near full capacity and with fairly few workers unemployed, the actual number of new jobs might fall short of the estimate due to capital and labor constraints. This is less likely to matter during a broad-based economic downturn.

Further, I-O tables do not necessarily differentiate between imported and domestically produced goods. As a consequence, the domestic employment impact of expenditures might be overstated to the extent that inputs are imported. Similarly, I-O tables typically do not express employment in terms of full-time equivalents (i.e., both full-time and part-time jobs are counted equally). Thus, programs which draw upon industries that rely relatively more on part-time workers (e.g., retail trade) might appear to create more jobs than programs that draw to a greater extent on industries employing relatively more full-time workers (e.g., manufacturing).

The Multiplier Effect

A more comprehensive estimate of the number of jobs created by a particular type of economic activity has three components, namely,

- the number of jobs directly attributable to the activity,
- the number of jobs indirectly attributable to the activity, and
- the number of jobs induced throughout the economy as a result of the activity.

Induced jobs are those dependent upon the purchases of persons in direct and indirect jobs. For example, workers who are directly or indirectly employed as the result of a highway construction program might spend some portion of their wages in their communities at grocery stores, auto repair shops, and movie theaters.

Estimates of induced jobs or the multiplier are considered tenuous. To calculate the multiplier effect, one must estimate how much of the additional money earned by directly and indirectly employed workers will likely be spent versus saved. The actual number of jobs created by this added spending will further depend on economic conditions (e.g., the availability of labor, the inflation rate). As a result, there are widely varying estimates of the multiplier effect and those job creation studies that include induced employment utilize different multipliers.

Job Estimates and Construction Spending

The Federal Highway Administration

Perhaps the most widely known estimate of the employment impact of federal spending on our nation's roads comes from the Federal Highway Administration (FHWA). Although the FHWA twice updated its 1997 analysis, which estimated that $1 billion of federal-aid highway expenditures plus a $250 million state match supported 47,575 jobs, some proponents of stimulating job growth through increased federal spending on infrastructure continue to use this figure. The most recent update by the FHWA to 2007 indicates that a $1.25 billion expenditure on highway construction consisting of $1 billion from the federal government and $250 million from state government could support 34,779 jobs. If a state match is not required, "then $1 billion in Federal funds supports 27,800 jobs."[8] The jobs number has decreased over time in part because of increases in the price of inputs, such as asphalt and diesel fuel.

The FHWA breaks down the estimate of 27,822 jobs per billion dollars of federal spending on highways as follows:

- 9,536 construction-oriented jobs (i.e., jobs at construction companies working on the projects and at businesses that provide direct inputs to the projects such as asphalt, concrete, and guard rails);
- 4,324 jobs in supporting industries (i.e., employment at firms that provide inputs to the industries directly providing the materials and equipment utilized in highway construction such as producers of sheet metal who supply the manufacturers of guard rails); and
- 13,962 induced jobs (i.e., jobs throughout the economy dependent upon consumer expenditures from the wages of workers in "construction-oriented" and "industry-supporting" jobs).

Thus, the multiplier effect accounts for one-half of the total estimate.

The FHWA notes one caveat about I-O analysis in addition to those mentioned above, that is, the job estimate "utilizes the national average mix of construction materials and labor inputs. Specific projects and local utilization ratios will alter the estimated number of jobs supported."[9] For example, a different combination of materials and number of workers might be required for road resurfacing projects compared to bridge building or commuter rail projects.

The FHWA also states that

> [t]he employment figures have recently been used as a justification for including highway spending in an economic stimulus package. But with the exception of short-term resurfacing

[8] U.S. Department of Transportation, Federal Highway Administration, *Employment Impacts of Highway Infrastructure Investment*, p. 1, http://www.fhwa.dot.gov/policy/otps/publications.htm.

[9] U.S. Department of Transportation, Federal Highway Administration, *Employment Impacts of Highway Infrastructure Investment*, p. 2, http://www.fhwa.dot.gov/policy/otps/publications.htm.

and preservation projects, highway funds spend out slowly, with only 27% of a project, on average, outlaying in the first year.[10]

BLS Employment Requirements Table

In recognition of the fact that "people want to assess the impact on employment of different policies or actions," the U.S. Bureau of Labor Statistics (BLS) makes available electronically free-of-charge to the public the employment requirements tables it develops as part of its employment projections program.[11] I-O and employment requirements tables developed and utilized by others often are proprietary and not made widely available.

The employment requirements tables are based on the official I-O tables for the nation that the U.S. Bureau of Economic Analysis (BEA) develops every five years. BLS takes the latest national I-O table available from BEA – in this case, 1997 – and updates it to reflect more recent production and distribution technologies. It then utilizes the updated I-O table and recent labor productivity data to develop an employment requirements table. Because the base year for the most recently published employment projections is 2006, the latest employment requirements table reflects 2006 technologies of production and distribution as well as labor productivity.

The BLS employment requirements table provides information for the construction industry as a whole. The construction industry, according to the North American Industry Classification System, is composed of three major subdivisions:

- construction of buildings (residential and nonresidential),
- heavy and civil engineering construction (highway, street, and bridge construction; utility system construction; construction of flood control structures, dams, and hydroelectric power generation facilities), and
- specialty trade contractors (foundation, structure, and building exterior contractors; building equipment contractors; building finishing contractors).

The BLS employment requirements table shows 11,768 jobs directly and indirectly dependent upon $1 billion of spending on construction. A majority of the jobs are in the construction industry itself (i.e., 6,925 direct jobs).

The figure from the BLS employment requirements table for construction expenditures (11,768) is somewhat lower than the direct and indirect jobs figure for highway expenditures from the FHWA (13,860). Potential explanations for the disparity include differences in industry definition, data sources, method of updating the model, and time period.

The employment requirements available from BLS do not break out other types of construction that have been discussed as part of a federal job creation package (e.g., public school construction). BLS formerly conducted surveys to estimate full-time year-long employment associated with a variety of different construction activities, including new schools, hospitals,

[10] U.S., *Employment Impacts of Highway Infrastructure Investment*, U.S. Department of Transportation, Federal Highway Administration, p. 2, http://www.fhwa.dot.gov/policy/otps/publications.htm.

[11] U.S. Bureau of Labor Statistics, *Layout and Description for 201-order Employment Requirements Tables*, Washington, D.C., December 2007, p. 3, http://stats.bls.gov/emp/empind4.htm.

water and sewer facilities, roads, mass transit, and maintenance and repair construction. The survey information was last updated a few decades ago, however.

BEA's Regional Input-Output Modeling System (RIMS II)

From its Regional Input-Output Modeling System (RIMS II), the BEA produces estimates by geographic area of the employment, earnings, and output dependent on additional spending in hundreds of different industries.[12] For a fee to most parties, BEA currently utilizes either the 1997 benchmark I-O for the nation or the 2006 annual I-O for the nation adjusted by 2006 data from its regional economic accounts to provide these estimates at the subnational level.[13]

As shown in **Table 3**, the number of jobs directly and indirectly supported by an expenditure of $1 billion in the construction industry in a given state ranges widely. The main reason for the disparity in job creation estimates is that each state has a different mix of industries within its borders. As a consequence, one state varies from the next in its capacity to supply all the intermediate goods needed to carry out construction projects. A secondary explanation is that earnings vary by state.

Table 3. Number of Direct and Indirect Jobs by State Dependent on an Expenditure of $1 Billion in the Construction Industry

State	Number of Jobs	State	Number of Jobs
Alabama	15,851	Montana	16,127
Alaska	11,009	Nebraska	13,946
Arizona	12,238	Nevada	11,459
Arkansas	15,306	New Hampshire	12,374
California	12,289	New Jersey	11,118
Colorado	12,575	New Mexico	14,279
Connecticut	10,709	New York	10,106
Delaware	9,518	North Carolina	15,555
District of Columbia	1,874	North Dakota	13,500
Florida	13,127	Ohio	14,391
Georgia	14,224	Oklahoma	16,232
Hawaii	11,614	Oregon	13,184
Idaho	15,860	Pennsylvania	12,390
Illinois	11,916	Rhode Island	10,767
Indiana	13,747	South Carolina	15,319

[12] For additional information on RIMS II see BEA, *Regional Multipliers: A User Handbook for the Regional Input-Output Modeling System*, http://www.bea.gov/scb/pdf/regional/perinc/meth/rims2.pdf.

[13] More specific detail by industry is available from the 1997 benchmark I-O than from the annual I-O. Therefore, Table 1 (Number of Direct and Indirect Jobs Per $1 Million of Output Produced by the Water, Sewage and Other Systems Industry) in CRS Report R40107, *The Role of Public Works Infrastructure in Economic Stimulus*, was drawn from the 1997 benchmark I-O because the 2006 annual I-O provides data only for the utilities industry as a whole.

State	Number of Jobs	State	Number of Jobs
Iowa	14,330	South Dakota	15,316
Kansas	13,625	Tennessee	14,556
Kentucky	15,039	Texas	12,985
Louisiana	13,731	Utah	14,692
Maine	15,988	Vermont	14,883
Maryland	10,687	Virginia	12,085
Massachusetts	10,714	Washington	12,171
Michigan	13,354	West Virginia	13,834
Minnesota	12,998	Wisconsin	13,673
Mississippi	15,357	Wyoming	13,091
Missouri	13,241	United States	14,315

Source: Prepared by CRS from RIMS II estimates supplied by the BEA Regional Product Division.

Job Estimates and Green Infrastructure Spending

Estimating the number of jobs dependent upon green infrastructure activities presents a greater challenge than estimates related to infrastructure projects as traditionally defined. The basis for most data collection by U.S. statistical agencies is the North American Industry Classification System (NAICS). It currently does not identify separately so-called green industries (e.g., those that utilize renewable resources to produce their outputs, those that manufacture goods which minimize energy use). For example, the NAICS disaggregates the electric utility industry into hydroelectric, fossil fuel, nuclear, and other power generation, transmission, and distribution. Such renewable sources of energy production as wind, solar, and biomass are not uniquely recognized; they are included in the "other" category. If harnessing the wind to produce electricity and plant material to produce biofuel requires a substantially different mix of inputs than relying on coal and gasoline, for example, the conventional I-O model does not seem well-suited as a basis for estimating the number of jobs supported by these green activities. Similarly, within NAICS, the construction industry does not have a unique category for retrofitting (e.g., installing additional insulation, fluorescent lighting, or energy-efficient heating and air-conditioning systems). Retrofitting likely requires a combination of inputs from supplier industries that differs from the mix for the top-to-bottom construction of buildings, once again making use of conventional I-O models problematic.

This recognized difficulty generally is either not mentioned, or how it is dealt with is not described, in the analyses of green job creation. One study, commissioned by the Center for American Progress that is discussed in more detail below, does address the problem. The researchers explain that because "the U.S. government surveys and accounts that are used to construct the input-output tables do not specifically recognize wind, solar, biomass, building retrofitting, or new mass transit as industries in their own right," they created synthetic industries by combining parts of industries for which data are available. The researchers provided an example in the case of the biomass "industry:" they constructed it by combining farming, forestry,

wood products, and refining industries; then they "assigned relative weights to each of these industries in terms of their contributions to producing biomass products."[14]

Further complicating the matter is the context and manner in which estimates of green jobs generally are presented. Studies often develop employment projections based on differing sets of assumptions and time horizons. For example, the number of direct and indirect jobs some 10 or more years in the future supported by an assumed increase in the demand for energy that is met by an assumed shift during the projection period from coal to wind and geothermal power generation. Some reports also include induced employment, but this is not always made clear. In addition, some analyses relate to a particular state. Their results may not be generalizeable to other areas because state economy's have different mixes of industries and may not be able to provide any or all of the inputs for a particular green output. Additionally, the assumptions and methodologies underlying the job creation estimates often are not clearly articulated, which makes thoughtful review of the results very difficult.

It should be noted that many of the studies by green economy proponents that were available when Congress was crafting stimulus legislation had not been conceived for the purpose of quickly stabilizing or increasing the number of jobs in the nation or in industries particularly hard hit by the recession. Job creation estimates from two organizations that proposed broad-based green economy strategies intended in part to stimulate the deteriorating labor market are briefly described below.

- The September 2008 report, *Green Recovery: A Program to Create Jobs and Start Building a Low-Carbon Economy*, was commissioned by the Center for American Progress (a research and educational institute). It represents an acceleration of a 10-year program included in a 2007 report (*Capturing the Energy Opportunity: Creating a Low-Carbon Economy*). The 2008 report's authors at the Department of Economics and Political Economy Research Institute (University of Massachusetts – Amherst), who relied on I-O analysis, estimate that almost 2 million jobs (935,200 direct jobs, 586,000 indirect jobs, and 496,000 induced jobs) could be created or preserved by a two-year $100 billion "green economic recovery program." Of the $100 billion total, $46 billion would be in the form of federal spending for such activities as public building retrofits, mass transit and freight rail expansion, and smart electrical grid development. Much of the remainder would be in the form of tax credits to encourage businesses and homeowners to retrofit commercial and residential buildings. The authors acknowledge that not all of the green activities

  > can contribute equally to a short-term green economic recovery program. Some ... strategies are clearly capable of delivering within a year, while others will require as long as two years to be implemented.[15]

- In December 2008, the Apollo Alliance (a coalition of labor, environmental, business and community leaders) proposed *The Apollo Economic Recovery Act.*

[14] Robert Pollin, Heidi Garrett-Peltier, and James Heintz, et al., *Green Recovery: A Program to Create Good Jobs and Start Building a Low-Carbon Economy*, Center for American Progress, Washington, D.C., September 2008, p. 20, http://www.americanprogress.org.

[15] Robert Pollin, Heidi Garrett-Peltier, and James Heintz, et al., *Green Recovery: A Program to Create Good Jobs and Start Building a Low-Carbon Economy*, Center for American Progress, Washington, D.C., September 2008, p. 5, http://www.americanprogress.org.

It is an initial step toward achievement of a 10-year $500 billion program to create 5 million green-collar jobs, which had been released in September 2008. The new initiative calls for federal spending of about $50 billion to create or maintain more than 650,000 direct jobs and 1.3 million indirect jobs. The derivation of these job creation figures is not always clear, appearing to rely much of the time on spending-to-jobs relationships estimated by other organizations. The proposed allocation of federal funds and associated job estimates include $10 billion to improve the efficiency and reliability of the electric transmission grid (131,000 direct and indirect jobs), $8 billion to repair roads and bridges (278,000 direct and indirect jobs), and $8 billion to encourage localities to replace aging buses and trains with U.S.-made clean-energy vehicles (37,600 direct jobs in vehicle manufacturing and 167,000 indirect jobs).

Measuring Jobs Supported by Spending Provisions in the American Recovery and Reinvestment Act

While crafting the American Recovery and Reinvestment Act (ARRA), Congress was concerned about timely tracking of the number of jobs whose creation or maintenance results from the legislation. The 111th Congress therefore addressed this matter in bill language much more than prior Congresses had in countercyclical job creation legislation. At Title XV—Accountability and Transparency of Division A—Appropriations Provisions, P.L. 111-5 requires entities that receive ARRA appropriations from federal agencies (e.g., grant, loan, or contract recipients; states) to include in their quarterly reports to the agencies estimates of the number of direct jobs created and retained by infrastructure projects, for example. Recipients of recovery funds must make their first submission of the required information in October 2009, and the agencies must post the contents of the reports on websites 30 days after the end of each calendar quarter. The Office of Management and Budget (OMB) is directed to provide guidance to help recipients prepare the reports, including the development of job estimates.[16] The act further charges the Congressional Budget Office and the Government Accountability Office with commenting on the job estimates contained in the reports within 45 days after they have been submitted to federal agencies.

P.L. 111-5 additionally tasks the Council on Economic Advisers (CEA) with submitting quarterly reports to the Committees on Appropriations on the effect of ARRA-provisions on employment and other economic indicators. The CEA's mandate thus extends well beyond the above-described reporting requirements, which apply only to $271 billion in direct government investment spending out of a total of $787 billion.[17] Accordingly, as well as utilizing the direct job estimates provided by recipients of investment spending under ARRA, the CEA anticipates incorporating into its macroeconomic model the data the Treasury and the OMB are collecting weekly on tax cuts and other spending.

[16] Office of Management and Budget, *Implementing Guidance for the Reports on Use of Funds Pursuant to the American Recovery and Reinvestment Act of 2009*, M-09-21, Washington, D.C., June 22, 2009.

[17] The remaining ARRA funds fall into five categories, as the Council of Economic Advisors states in *Estimates of Job Creation from the American Recovery and Reinvestment Act of 2009* (May 2009, p. 2): "individual income tax cuts; a two-year patch to the alternative minimum tax; investment incentives; aid to people directly hurt by the recession; and state fiscal relief."

The first quarterly report of the CEA was issued in September 2009. Based on two different estimating procedures, it found that ARRA might have added some one million jobs to employer payrolls in August 2009 compared to what employment would have been in the absence of the legislation. The CEA focused on the impact of the state fiscal relief contained in ARRA because $38.4 billion had been provided to the states by August, which "represents almost half of outlays and one-quarter of total ARRA stimulus (that is, outlays plus tax reductions)."[18] A positive relationship was estimated between the fiscal relief thus far provided to states and employment in state and local government as well as in the education and health care industries.

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[18] Council of Economic Advisers, *The Economic Impact of the American Recovery and Reinvestment Act of 2009*, First Quarterly Report, Washington, DC, September 10, 2009, p. 33.

Economic Stimulus: Issues and Policies

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Summary

Recent policies have sought to contain damages spilling over from housing and financial markets to the broader economy, including monetary policy, which is the responsibility of the Federal Reserve, and fiscal policy, including a tax cut in February 2008 of $150 billion and two extensions of unemployment compensation in June and November of 2008.

In 2008 and early 2009, the government intervened in specific financial markets, including financial assistance to troubled firms and legislation granting authority to the Treasury Department to purchase $700 billion in assets. The broad intervention into the financial markets has been passed to avoid the spread of financial instability into the broader market but there are disadvantages, including leaving the government holding large amounts of mortgage debt.

With the worsening performance of the economy beginning in September 2008, Congress passed and President Obama signed a much larger stimulus package composed of spending and tax cuts. The American Recovery and Reinvestment Act of 2009 (ARRA, P.L. 111-5), a $787 billion package with $286 billion in tax cuts and the remainder in spending, was signed into law on February 17, 2009. It includes spending for infrastructure, unemployment benefits, and food stamps, revenue sharing with the states, middle class tax cuts, and business tax cuts.

The need for additional fiscal stimulus depends on the state of the economy. The National Bureau of Economic Research (NBER), in December 2008, declared the economy in recession since December 2007. Growth rates, after two strong quarters, were 2.1% in the fourth quarter of 2007, slightly negative in the first quarter of 2008, positive in the second quarter, a negative 2.7% in the third quarter, and a negative 5.4% in the fourth quarter. Estimates put growth at a negative 6.4% for the first quarter of 2009, the worst since 1982; estimates indicate negative growth of 0.7% in the second quarter of 2009. According to one data series, employment fell in every month of 2008. The unemployment rate, which rose slightly in the last half of 2007, declined in January and February of 2008, but began rising in March 2008 and in September 2009 stood at 9.8%. Some forecasters believe that the ongoing financial turmoil will result in a recession that is deeper and longer than average.

Fiscal policy temporarily stimulates the economy through an increase in the budget deficit, which leads to an increase in total spending in the economy, either through direct spending by the government or spending by the recipients of tax cuts or government transfers. There is a consensus that certain proposals—ones that result in more spending, can be implemented quickly, and leave no long-term effect on the budget deficit—would increase the benefits and reduce the costs of fiscal stimulus relative to other proposals. Economists generally agree that spending proposals are somewhat more stimulative than tax cuts because part of a tax cut may be saved by the recipients. The most important determinant of the effect on the economy is the stimulus' size. The 2008 stimulus package increased the deficit by about 1% of GDP. The ARRA would increase the budget deficit by about 1.3% in 2009 and an additional 2.2% (or 3.5% overall) in 2010. The Congressional Budget Office (CBO) projects that the ARRA would raise GDP by a range of 1.4% to 3.8% in 2009 compared with what it otherwise would have been.

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Introduction

The National Bureau of Economic Research (NBER) has declared the U.S. economy to be in recession since December of 2007. With the worsening performance of the economy, congressional leaders and President Obama proposed much larger stimulus packages. The American Recovery and Reinvestment Act of 2009 (ARRA), an $820 billion package with $275 billion in tax cuts (offset by a $7 billion gain from the treatment of built in losses) and the remainder in spending, was passed by the House on January 28 (H.R. 1). It contained infrastructure spending, revenue sharing with the states, middle class tax cuts, business tax cuts, unemployment benefits, and food stamps. Similar legislation was passed in the Senate on February 10 (a substitute for H.R. 1) and would cost $838 billion, with $292 billion in tax cuts. The version of the bill signed into law on February 17, 2009 (P.L. 111-5), was a $787 billion package with $286 billion in tax cuts and the remainder in spending.

Numerous actions have already been taken to contain damages spilling over from housing and financial markets to the broader economy. These policies include traditional monetary and fiscal policy, as well as federal interventions into the financial sector. In February 2008, in response to weaker economic growth, an economic stimulus package of approximately $150 billion was adopted.[1] A provision that was considered (but not enacted) in the February stimulus bill was a 26-week extension of unemployment benefits; this extension was eventually enacted.[2]

A number of financial interventions have also been undertaken, before and after financial market conditions worsened significantly in September 2008. The Federal Reserve (Fed) has reduced short-term interest rates to zero and introduced a number of facilities, providing direct assistance to the financial system that would eventually surpass $1 trillion. In October 2008, legislation granting the Treasury Department authority to purchase up to $700 billion in assets through the Troubled Assets Relief Program (TARP) was adopted.[3] On March 18, 2009, the Federal Reserve announced plans to purchase more than $1 trillion in assets, including $750 billion in mortgage-backed securities and $300 billion in long-term Treasury debt. On March 23, 2009, the Treasury announced a plan for a public-private partnership to purchase troubled assets, including one part that uses the Federal Deposit Insurance Corporation (FDIC) to insure loans and another part that would allow access to the Federal Reserve's Term Asset-Backed Securities Loan Facility (TALF).[4]

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[1] A second stimulus plan (H.R. 7110) passed the House on September 26, but was not passed by the Senate. It included $36.9 billion on infrastructure ($12.8 billion highway and bridge, $7.5 billion water and sewer, $5 billion Corps of Engineers); $6.5 billion in extended unemployment compensation; $14.5 billion in Medicaid; and $2.7 billion in food stamp and nutrition programs.

[2] For a discussion of the tax, housing, and unemployment legislation adopted in the 110th Congress, see CRS Report RS22850, *Tax Provisions of the 2008 Economic Stimulus Package*, coordinated by Jane G. Gravelle; CRS Report RS22172, *The Conforming Loan Limit*, by N. Eric Weiss and Mark Jickling; and CRS Report RS22915, *Temporary Extension of Unemployment Benefits: Emergency Unemployment Compensation (EUC08)*, by Julie M. Whittaker and Alison M. Shelton.

[3] See CRS Report RL34427, *Financial Turmoil: Federal Reserve Policy Responses*, by Marc Labonte, for a discussion of Federal Reserve Policy and CRS Report RL34730, *Troubled Asset Relief Program: Legislation and Treasury Implementation*, by Baird Webel and Edward V. Murphy.

[4] For further discussion see CRS Report RL34730, *Troubled Asset Relief Program: Legislation and Treasury Implementation*, by Baird Webel and Edward V. Murphy.

This report first discusses the current state of the economy, including measures that have already been taken by the monetary authorities. The next section reviews the economic stimulus package. The following section assesses the need for, magnitude of, design of, and potential consequences of fiscal stimulus. The final section of the report discusses recent and proposed financial interventions.

The Current State of the Economy[5]

The need for fiscal stimulus depends, by definition, on the state of the economy. According to the NBER, the official arbiter of the business cycle, the economy has been in recession since December 2007. It defines a recession as a "significant decline in economic activity spread across the economy, lasting more than a few months" based on a number of economic indicators, with an emphasis on trends in employment and income.[6]

Economic growth rose by 2.1% in the fourth quarter of 2007 and then fell by 0.7% in the first quarter of 2008; it increased by 1.5% in the second quarter of 2008. Real GDP decreased by 2.7% in the third quarter of 2008 and by 5.4% in the fourth quarter. Estimates indicate that output fell by 6.4% in the first quarter of 2009, the worst since 1982, and by 0.7% in the second quarter. The latest consensus forecast predicts that GDP will contract until the second half of 2009, with output falling by 2.6% for 2009 with the annual unemployment reaching a 9.2% in 2009 and 9.8% in 2010.[7] This recession is the longest and deepest in the period since the Great Depression, although it is still expected to end in 2009.

According to one data series, employment fell in every month of 2008. The deepening of the downturn following September can also be seen in the movement of the unemployment rate. The unemployment rate, which was 4.8% in February 2008, rose to 6.1% in August and September, and has steadily risen since, reaching 9.7% in June 2009; it declined slightly to 9.4% in July 2009 and rose to 9.8% in September 2009.

After a long and unprecedented housing boom, house prices fell 12% from peak to trough,[8] and residential investment has fallen by more than half. This marked possibly the first year of falling house prices since the Great Depression, according to one organization that compiles the data.[9] The decline in residential investment has acted as a drag on overall GDP growth, whereas the other components of GDP grew at more healthy rates until the third quarter of 2008. Many economists argued that the housing boom was not fully caused by improvements in economic fundamentals (such as rising incomes and lower mortgage rates), and instead represented a housing *bubble*—a situation where prices were being pushed up by "irrational exuberance."[10]

[5] This section was prepared by Marc Labonte of the Government and Finance Division.

[6] National Bureau of Economic Research, *The NBER's Recession Dating Procedure*, January 7, 2008.

[7] Blue Chip, *Economic Indicators*, vol. 34, no.9, September 10, 2009.

[8] Based on the Federal Housing Finance Administration's Purchase-Only House Price Index, a national measure of single-family houses with conforming mortgages based on resale data.

[9] Michael Grynbaum, "Home Prices Sank in 2007, and Buyers Hid," *New York Times*, January 25, 2008. Prices are compiled by the National Association of Realtors.

[10] For more information, see CRS Report RL34244, *Would a Housing Crash Cause a Recession?*, by Marc Labonte.

Most economists believed that a housing downturn alone would not be enough to singlehandedly cause a recession.[11] But in August 2007, the housing downturn spilled over to widespread financial turmoil.[12] Triggered by a dramatic decline in the price of subprime mortgage-backed securities and collateralized debt obligations, large losses and a decline in liquidity spread throughout the financial system. Although the real production of goods and services showed unexpected resilience until the fourth quarter of 2008, the ability of private borrowers to access credit markets remained restricted throughout the year. Evidence of a credit crunch was seen in the persistence of wide spreads between the interest rates that private borrowers paid for credit and the yields on Treasury securities of comparable maturity.

The Fed was forced to create unusually large amounts of liquidity to keep short-term interest rates from rising in August 2007, and has since reduced interest rates significantly. The Fed has gradually reduced the federal funds target rate from 5.25% to a range of 0 to 0.25%, as of December 16, 2008. In addition, the Fed has lent directly to financial institutions through an array of new facilities, and the amounts of loans outstanding has at times exceeded a trillion dollars.[13] A reduction in lending by financial institutions in response to uncertainty or financial losses is another channel through which the economy entered a recession.

To date, financial markets remain volatile, new losses have been announced at major financial institutions, and responses outside traditional monetary policy have been undertaken. Last March, the financial firm Bear Stearns encountered liquidity problems, was purchased, after a plummet in stock value, by JPMorgan Chase with financial assistance from the Fed. Then in July, the government-sponsored enterprises (GSEs) Fannie Mae and Freddie Mac experienced rapidly falling equity prices in response to concerns about the value of their mortgage-backed securities assets. In July, Congress authorized Treasury to extend the GSEs an unlimited credit line (which has not been utilized to date) in the Housing and Economic Recovery Act of 2008 (P.L. 110-289) because of concern that the failure of a GSE would cause a systemic financial crisis. The federal government took control of Fannie Mae and Freddie Mac in early September.

According to news reports in the fall of 2008, government officials decided not to intervene on behalf of Lehman Brothers and Merrill Lynch;[14] on September 14, Bank of America took over Merrill Lynch without federal intervention, and on September 15, Lehman Brothers filed for bankruptcy. The Treasury and Federal Reserve were trying to engineer a private bailout of the nation's largest insurance company, AIG, but on September 16 seized control with an $85 billion emergency loan, which would later be increased.[15]

On September 18, Administration and Federal Reserve officials, with the bipartisan support of the congressional leadership, announced a massive intervention in the financial markets.[16] The

[11] See, for example, Frederic Mishkin, "Housing and the Monetary Transmission Mechanism," working paper presented at the Federal Reserve Bank of Kansas City symposium, August 2007.

[12] See CRS Report RL34182, *Financial Crisis? The Liquidity Crunch of August 2007*, by Darryl E. Getter et al.

[13] See CRS Report RL34427, *Financial Turmoil: Federal Reserve Policy Responses*, by Marc Labonte.

[14] David Cho and Neil Irwin, "No Bailout: Feds Made New Policy Clear in One Intense Weekend," *Washington Post*, September 16, 2008, pp. A1, A6-A7.

[15] Glenn Kessler and David S. Hilzenrath, "AIG at Risk; $700 Billion in Shareholder Value Vanishes," *Washington Post*, September 16, 2008; U.S. Seizes Control of AIG With $85 Billion Emergency Loan, *Washington Post*, September 17, 2008, pp. A1, A8.

[16] See CRS Report RL34730, *Troubled Asset Relief Program: Legislation and Treasury Implementation*, by Baird Webel and Edward V. Murphy.

proposal asked for authority to purchase up to $700 billion in assets over the next two years. The Treasury had also provided insurance for money market funds, where withdrawals have been significant. These proposals suggested that government economists see problems with the transmission of traditional monetary stimulus into the financial sector and ultimately into the broader economy, where a significant contraction of credit could significantly reduce aggregate demand. Although the legislation passed with some delay, the stock market fell significantly. The original proposal had discussed buying mortgage related assets, particularly mortgage-backed securities, but the Treasury indicated it will spend the initial $250 billion on preferred stock in financial institutions. The Fed has also announced purchases of commercial paper, $200 billion of asset-backed securities, and $600 billion of mortgage-related securities; the government has also announced a plan to guarantee certain assets of Citigroup and Bank of America. On March 18, the Fed announced plans to purchase more than $1 trillion in assets, including $750 billion in mortgage-backed securities and $300 billion in long-term Treasury debt. On March 23, 2009, the Treasury announced a plan for a public-private partnership to purchase troubled assets, including one part that uses the Federal Deposit Insurance Corporation (FDIC) to insure loans and another part that would allow access to the Federal Reserve's Term Asset-Backed Securities Loan Facility (TALF).[17]

As the economy and financial sector had been grappling with the housing downturn, energy prices had risen significantly, from $48 per barrel in January 2007 to $115 dollars on April 30, 2008, and $144 as of July 2, 2008. After that, oil prices began a downward trend, and had fallen below $70 by October and $60 by the end of November. The price reached $43 per barrel on December 10, but has since increased to about $70 per barrel. Most recessions since World War II, including the most recent, have been preceded by an increase in energy prices.[18] Energy prices had gone up almost continuously in the current expansion, however, without causing a recession, which may point to the relative decline in importance of energy consumption to production. Although a housing downturn, financial turmoil, or an energy shock might not be enough to cause a recession in isolation, the combination was sufficient.

The 2009 Stimulus Package[19]

Preliminary Discussions

On December 15, House Speaker Pelosi suggested a $600 billion package with $400 billion of spending and $200 billion in tax cuts as a starting point for discussion. It was reported that the package would include infrastructure spending, aid to the states, unemployment compensation, and food stamps. Earlier, on December 11, Finance Committee Chairman Baucus suggested that half of an expected $700 billion plan might be in tax cuts; he mentioned child tax credits, state and local property tax deductions, the R&D tax credit, the marriage penalty, tax exempt bonds and energy incentives. House Republican Leader Boehner proposed a tax package that included increases in the child tax credit, suspending the capital gains tax on newly acquired assets,

[17] For further discussion, see CRS Report RL34730, *Troubled Asset Relief Program: Legislation and Treasury Implementation*, by Baird Webel and Edward V. Murphy.

[18] For more information, see CRS Report RL31608, *The Effects of Oil Shocks on the Economy: A Review of the Empirical Evidence*, by Marc Labonte.

[19] This section was prepared by Jane Gravelle and Thomas Hungerford, Government and Finance Division.

increasing expensing, extending bonus depreciation and raising the share of costs expensed from 50% to 75%, extending net operating loss carrybacks to three years, lowering the corporate tax rate from 35% to 25%, and expanding energy subsidies.

Reports on December 29 suggested that President-elect Obama would propose a package of $670 billion to $770 billion, but that additions in Congress might raise the total to $850 billion. The package was reported to include $100 billion in aid to the states to fund Medicaid, possibly with additional grants, and at least $350 billion for public works, alternative energy, health care and school modernization, and expanding unemployment insurance and food stamp benefits. The package would also include middle class tax cuts, possibly including changes to the child credit, state and local property taxes, marriage penalties, the R&D tax credit and tax exempt bonds.

Following a meeting between President-elect Obama and congressional leaders on January 5, news reports indicated that the share of the package directed at tax cuts would increase to about 40%, perhaps $300 billion. President-elect Obama suggested a credit for working families of up to $1,000 for couples and $500 for singles. Business provisions that were discussed included extensions of the bonus depreciation and small business expensing enacted in February 2008 that expired at the end of 2008 as well as an extended net operating loss carryback provision that was discussed but not enacted in 2008. Also discussed was an expansion of the first-time homebuyers credit adopted in the 2008 housing legislation and expanding renewable energy incentives. A payroll tax holiday was also discussed.

News reports on January 9 indicated some resistance of congressional lawmakers to two provisions in President-elect Obama's plan: a $3,000 tax credit for employers who hire new workers and the working families credit which provides for a credit of 6.2% of earnings up to a ceiling of $500 for individuals and $1,000 for married couples. Some were concerned that the employer tax credit would not benefit distressed firms and will be difficult to administer. There were also concerns about the effects of a tax benefit of small magnitude having an effect if reflected in withholding, although many economists suggest that a larger fraction of income received in small increments is spent.

House Proposal

The House proposal of the American Recovery and Reinvestment Act (H.R. 1) was composed of both spending and tax cuts. The spending proposals, which total $518.7 billion, include the following:

- $54 billion for energy efficiency ($32 billion to improve the energy grid and encourage renewable energy, $16 billion to repair and retrofit public housing; $6 billion to weatherize modest income homes);
- $16 billion for science and technology ($10 billion for research, $6 billion to expand broadband access in rural and underserved areas);
- $90 billion for infrastructure ($30 billion for highways, $31 billion for public infrastructure that leads to energy cost savings, $19 billion for clean water, flood control and environmental infrastructure, $10 billion for transit and rail);
- $141.6 billion for education ($41 billion to local school districts dedicated to specific purposes, $79 billion to prevent cutbacks in state and local services including $39 billion to local school districts and public colleges and universities

distributed through existing formulas, $15 billion to states for meeting performance measures, $25 billion to states for other needs, $15.6 billion to increase the Pell grant by $500, $6 billion for higher education modernization);

- $24.1 billion for health ($20 billion in health information technology and $4.1 billion for preventive care);
- $102 billion for transfer payments ($43 billion for unemployment benefits and job transit benefits, $39 billion to cover health care for unemployed workers, $20 billion for food stamps); and
- $91 billion to the States ($87 billion in general revenues by temporarily increasing the Medicaid matching rate and $4 billion for law enforcement).

The proposal also contained $275 billion in tax cuts, which was reduced by a small revenue gain from limits on built-in losses. The tax elements included the following:

- Temporary income tax cuts for individuals included the Making Work Pay tax credit—a 6.2% credit for earnings with a maximum of $500 for singles and $1,000 for couples, phased out for taxpayers with incomes over $75,000 ($150,000 for joint returns)—with a $145.3 billion 10-year cost, $4.7 billion for a temporary increase in the earned income credit, $18.3 billion to make the child credit fully refundable, $13.7 billion to expand higher education tax credits and make them 40% refundable (the refundability feature accounts for $3.5 billion).
- Tax provisions for business, which would have lost revenue in FY2009-FY2010 and gain revenue thereafter, included $37.8 billion for extending bonus depreciation, $59.1 billion for a temporary five year loss carryback for 2008 and 2009 (except for recipients of TARP funds; and electing firms would reduce losses by 10%), and $1.1 billion for extending small business expensing.
- A series of provisions related to tax exempt bonds aimed at aiding state and local governments, which would have cost $1.3 billion for FY2009-FY2010, but $37.3 billion from FY2009-FY2019. Almost half the revenue loss would have arisen from allowing taxable bond options which to make bonds attractive to tax exempt investors. Other major provisions measured by dollar cost were qualified school construction bonds, recovery zone bonds, and provisions to allow financial institutes more freedom to buy tax exempt bonds.
- A permanent provision would have repealed the 3% withholding for government contractors, which would not have lost revenue until 2011 and would have cost $10.9 billion for FY2009-FY2019.
- Energy provisions, some permanent and some temporary, would have totaled $5.4 billion in FY2009-FY2011 and $20.0 billion in FY2009-FY2019. There was also a provision substituting grants for credits for certain energy projects which would have shifted benefits to the present.
- The proposal also included a provision to eliminate the requirement for paying back credit for first-time homebuyers unless they sell their homes within three years ($2.5 billion for 2009-2019). There was also a substitution of grants for the low income housing credit, which would have shifted benefits to the current year ($3 billion).

- A minor provision ($208 million for FY2009-2019) would have provided incentives for hiring unemployed veterans and disconnected youth.
- Repeal (prospectively) a Treasury ruling made in 2008 that allowed financial institutions to carry over losses in an acquisition (gains $7 billion for FY2009-FY2010).

The bill passed the House on January 28, with an additional of $3.7 billion, primarily for transit funds, bringing the total cost to $820 billion.

Senate Proposal

The Senate passed a bill (a substitute for H.R. 1) with $838 billion in spending and tax cuts. The higher cost was primarily due to the addition of the Alternative Minimum Tax (AMT) "patch" (see below).

The tax provisions were similar to the House tax bill in many respects. The bill, however, did not fully refund the child credit and made 30% of tuition credits refundable, but allowed an exclusion of up to $2,400 of unemployment benefits. The Senate bill also included a $15,000 homeownership tax credit at a 10-year cost of $35 billion and an above-the-deduction for certain costs of a new automobile purchase ($11 billion 10-year cost). It would not have required net operating losses to be reduced, as in the House bill. It added provisions for businesses including an election to accelerate alternative minimum tax and research and experimentation credits in lieu of bonus depreciation, a deferral of tax on income from cancellation of indebtedness, an increase in the exclusion for small business stock. It also altered the size and mix of tax exempt bond provisions, with the total cost of $22.6 billion, and changed some energy provisions. The bill also included a $300 per adult payment to individuals eligible for Social Security, Railroad Retirement, Veterans benefits, and Supplemental Security Income, at a cost of $17 billion, and provided a one year increase in the ATM "patch" exemption, at a cost of $70 billion. Overall, the tax cuts were $368.4 billion. The measure also included $87 billion in Medicaid funding for the states, $20 billion to provide health insurance for unemployed workers, and $16 billion to provide for health information technology.

The details of the spending provisions amounted to $290 billion in discretionary spending and $260 billion in direct spending.[20] One category of provisions would have provided $116 billion for infrastructure and science, including $5.9 billion for the Department of Homeland Security and border stations, $7 billion for broadband technology, provisions in infrastructure and science for a variety of federal programs (e.g., $4.6 billion for the corps of engineers, $9.3 billion for defense and veterans), $27 billion for highways, $8.4 billion for mass transit, $10.9 billion for grants and other transportation, $8.6 billion for public housing, $15 billion for environmental programs, and $4.3 billion for science. The bill would have provided $84 billion for education and training, with the majority, $79 billion, in grants to states and localities, and also included $13 billion in Title 1, and $3.9 billion in Pell grants. Energy programs accounted for $43 billion; $23 billion would have been provided for nutrition, early childhood, and similar programs; and $14 billion for health. The Senate bill also contained a limit on executive compensation at firms receiving assistance from TARP.

[20] The direct spending also includes $83.7 billion in the refundable portion of tax credits.

The American Recovery and Reinvestment Act of 2009

The American Recovery and Reinvestment Act of 2009 (P.L. 111-5) was signed by President Obama on February 17, 2009. The version of the act signed into law has several provisions similar to the House and Senate proposals. The total 10-year cost, at $787 billion, is lower than both versions initially passed by the House and Senate, however. The spending parts of the act account for 63.7% of the total cost ($501.6 billion) and the tax provisions account for 36.3% ($285.6 billion). The act includes the $70 billion AMT "patch" and an executive compensation limitation for TARP recipients.

Many of the tax and spending provisions of the act were scaled down from the House and Senate proposals. The Making Work Pay tax credit was scaled back to $116.2 billion between FY2009 and FY2011 and provides a tax credit of up to $400 for a single taxpayer and $800 of joint taxpayers. The temporary increase in the earned income credit is projected to cost $4.7 billion over 10 years and the child tax credit is projected to cost $14.8 billion. The act also includes a $8,000 first-time homebuyer credit with a 10-year cost of $6.6 billion, an above-the-line deduction for sales tax on a new automotive purchase ($1.7 billion), a $2,400 exclusion of unemployment compensation benefits ($4.7 billion), and a $250 payment to recipients of Social Security, SSI, Railroad Retirement benefits, and certain veterans benefits ($14.2 billion).[21]

The business tax provisions are projected to lose $75.9 billion in revenues for FY2009 and FY2010, but gain revenue in the future; the total 10-year revenue loss is projected to be $6.2 billion. Other business tax provisions include an extension of bonus depreciation ($5.1 billion revenue loss), a five-year carryback of net operating losses for small businesses ($0.9 billion), delayed recognition of certain cancellation of debt income ($1.6 billion), an increase in the small business capital gains exclusion from 50% to 75% ($0.8 billion), and incentives to hire unemployed veterans and disconnected youth ($0.2 billion).

The energy tax provisions amount to $20 billion over 10 years and $3.4 billion for FY2009-FY2011. The major energy provision is a long-term extension and modification of renewable energy production tax credits ($13.1 billion over 10 years). The act alters the size and mix of tax-exempt bond provisions with a total 10-year cost of $25 billion.

The discretionary appropriations provisions of the act provide $311 billion in appropriations between FY2009 and FY2019. Investments in infrastructure and science account for $120 billion and education and training programs are to receive $106 billion. Health programs are set to receive $14.2 billion, the Supplemental Nutrition Assistance Program (formerly food stamps) will receive $20 billion, Head Start $2.1 billion, and $2 billion for the child care development block grant. Almost $40 billion will be used for investments in energy infrastructure and programs. Increases for direct spending programs include $57.3 billion for assistance to unemployed workers and struggling families, $25.1 billion for health insurance assistance, $20.8 billion for health information technology, and $90.0 billion for state fiscal relief.

[21] There is also a $250 tax credit for federal and state pensioners not eligible for Social Security with a $218 million 10-year cost.

Discussion

Fiscal stimulus is only effective when the policy options increase aggregate demand. Many economists view fiscal policy as less effective than monetary policy in an open economy. As mentioned earlier in this report, however, several monetary policy options have already been employed for several months.

Fiscal stimulus can involve tax cuts, spending, or a combination of both. Tax cuts may be less effective than spending because some of the tax cut may be saved, which diminishes the effectiveness of the stimulus. Some argue that tax cuts that are temporary, that appear in a lump sum rather than in withholding, or that are aimed at higher income individuals are more likely to be saved. Some evidence suggests that two-thirds of the 2001 tax rebate was spent within two quarters.

The challenge to spending programs is that there may be a lag time for planning and administration before the money is spent. For that reason, infrastructure spending is often discussed in the context of "ready-to-go" projects where all of the planning is in place and the only missing factor is funding. The U.S. Conference of Mayors has identified $73 billion of these projects and urged some funds to be given directly to localities; the American Association of State Highway and Transportation Officials has identified $64 billion of these projects; the National Association of Counties has identified $9.9 billion. Some analysts suggest that aid to state and local governments may be more quickly spent because these governments are likely to cut back on spending in downturns due to balanced budget requirements, and the aid may forestall these cuts.[22] The Congressional Budget Office (CBO) score for the spending (discretionary and direct) portion of the act estimates that about 21% will be spent in FY2009, and 38% in FY2010.[23] Overall, about 74% of the spending and tax provisions are estimated to reach the public by the end of FY2010. However, if the AMT "patch" is omitted then about 70% is estimated to reach the public by the end of FY2010.

The receipt of tax cuts can also be delayed.[24] For example, according to Joint Committee on Taxation estimates of the Making Work Pay credit revenue losses, 17% of the total would be received in FY2009.[25] The benefit is provided in the form of withholding; since the measure was not in place on January 1, some benefit would be delayed until tax returns are filed. Close to 50% would be received in FY2009 if a rebate mechanism were used (based on estimates of a similar provision considered in 2008 at about the same time of the year, 93% of the rebate was projected to be received in the current fiscal year). There is some limited evidence that periodic payments are more likely to be spent than lump sum payments, but that evidence is subject to uncertainty and is not of a magnitude that the withholding approach would result in a larger short run stimulus than a rebate.[26] In the second year, 57% would be received.

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[22] See CRS Report R40107, *The Role of Public Works Infrastructure in Economic Stimulus*, coordinated by Claudia Copeland, and CRS Report 92-939, *Countercyclical Job Creation Programs*, by Linda Levine.

[23] CBO, Letter to the Honorable Nancy Pelosi, Estimated Budget Impact of the Conference Agreement for H.R. 1, February 13, 2009.

[24] The progress of spending is tracked at http://www.recovery.gov/.

[25] http://www.house.gov/jct/x-19-09.pdf.

[26] This issue does not address the difference between temporary and permanent tax cuts; economists expect the latter to have more effect on consumption, but a permanent tax cut would result in budget pressures after recovery. Alan S. Blinder, "Temporary Income Taxes and Consumer Spending" *The Journal of Political Economy*, Vol. 89, February (continued...)

Several studies have estimated the effects of the proposed package on the economy. Romer and Bernstein estimate an increase of 3.7 million jobs by the fourth quarter of 2010; Zandi estimates 3.3 million in 2010.[27] The Romer-Bernstein estimates were criticized by Cogan et al. as being too large.[28] Citing uncertainty surrounding the effects of fiscal stimulus, CBO projects that the ARRA would boost GDP in 2009 by a range of 1.4% to 3.8% and employment by a range of 0.8 million to 2.3 million compared with what it otherwise would have been. In 2010, CBO projects that the ARRA would boost GDP by 1.1% to 3.3% and employment by 1.2 million to 3.6 million in 2010 compared with what it otherwise would have been. Starting in 2014, CBO projects that the ARRA would cause GDP to be slightly lower than it otherwise would have been due to "crowding out" effects described in the section titled "Long-Term Effects." The Council of Economic Advisors (CEA) is charged with providing a quarterly report on the effects of the legislation; that report estimates that the stimulus increased GDP growth by 2-3 percentage points in the second and third quarters and increased employment by 600,000 to 1.1 million jobs in the third quarter.[29]

(...continued)

1981, pp. 26-53, found the rebate 38% as effective as a permanent change and a withholding approach 50%, suggesting that the rebate would be 75% as effective as withholding. James M. Poterba, "Are Consumers Forward Looking?" *American Economic Review*, Vol. 78, (May 1988), pp. 413-418 found only 20% spent. Many economists have reservations about estimates using aggregate data, however, because of the difficulties of determining the counterfactual. For that reason, many researchers turned to comparisons of households with different amounts of tax cuts. Two studies of spending out of refunds (lump sum receipts) and spending out of withholding in the first Reagan tax cut found that 35% to 60% of refunds were spent but 60% to 90% of the withholding was spent (See Nicholas Souleles, "The Response of Household Consumption to Income Tax Refunds," *American Economic Review*, vol. 89 (September 1999), pp. 947-958; and Nicholas Souleles, "Consumer Response to the Reagan Tax Cuts," *Journal of Public Economics*, Vol. 85, pp. 99-120.). This research suggests a significant fraction of a temporary tax cut is spent, but that the lump sum has an effect that is about two thirds of the effect of withholding. This comparison is, however, somewhat clouded by the possibility that individuals may use tax refunds as a method of forced savings and not intend to spend them. In both cases, however, there is evidence of an effect for temporary tax cuts. Research on the 2001 rebate also indicates a significant amount was spent: David S. Johnson, Jonathan A. Parker, and Nicholas S. Souleles, Household Expenditures and the Income Tax Rebate of 2001,"*American Economic Review*, Vol. 96, December 2006, pp. 1589-1610 find over two thirds spent within two quarters. For other research see CRS Report RS21126, *Tax Cuts and Economic Stimulus: How Effective Are the Alternatives?*, by Jane G. Gravelle. Not included in that discussion are survey data asking individuals about their spending, as individuals themselves may not know what they spent. A preliminary study of the 2008 rebate also found significant spending: Christian Broda and Jonathan Parker, "The Impact of the 2008 Tax Rebates on Consumer Spending: Preliminary Evidence," Mimeo, University of Chicago and Northwestern University, July 29,2008: http://online.wsj.com/public/resources/documents/WSJ-2008StimulusStudy.pdf.

[27] Christina Romer and Jared Bernstein, "The Job impact of the American Recovery and Reinvestment Plan, Chair, Nominee Designate Council of Economic Advisors and Office of the Vice President Elect, January 9, 2009, http://otrans.3cdn.net/45593e8ecbd339d074_13m6bt1te.pdf; Mark Zandi, "The Economic Impact of the American Recovery and Reinvestment Act," January 21, 2009, http://www.economy.com/mark-zandi/documents/Economic_Stimulus_House_Plan_012109.pdf.

[28] John Cogan et al., *New Keynesian vs. Old Keynesian Government Spending Multipliers*, National Bureau of Economic Research, Working Paper 4782, March 2009.

[29] Council of Economic Advisors, The Economic Impact of the American Recovery and Reinvestment Act of 2009, September 10, 2009, http://www.whitehouse.gov/assets/documents/CEA_ARRA_Report_Final.pdf.

Issues Surrounding Fiscal Stimulus[30]

The Magnitude of a Stimulus

The most important determinant of a stimulus' macroeconomic effect is its size. The 2008 stimulus package (P.L. 110-185) increased the budget deficit by about 1% of gross domestic product (GDP). In a healthy year, GDP grows about 3%. In the moderate recessions that the United States experienced in 1990-1991 and 2001, GDP contracted in some quarters by 0.5% to 3%. (The U.S. economy has not experienced contraction in a full calendar year since 1991.) Thus, a swing from expansion to recession would result in a change in GDP growth equal to at least 3.5 percentage points. A stimulus package of 1% of GDP could be expected to increase total spending by about 1%.[31] To the extent that spending begets new spending, there could be a multiplier effect that makes the total increase in spending larger than the increase in the deficit. Offsetting the multiplier effect, the increase in spending could be neutralized if it results in crowding out of investment spending, a larger trade deficit, or higher inflation. The extent to which the increase in spending would be offset by these three factors depends on how quickly the economy is growing at the time of the stimulus—an increase in the budget deficit would lead to less of an increase in spending if the economy were growing faster.

Thus, if the recession is mild, additional stimulus may not be necessary for the economy to revive. If, on the other hand, the economy has entered a deeper, prolonged recession, as some economists believe to be likely, then fiscal stimulus may not be powerful enough to avoid it. Since the current recession has already lasted longer than the historical average, it may end before further fiscal stimulus can be enacted. Economic forecasts are notoriously inaccurate due to the highly complex and changing nature of the economy, so there is significant uncertainty as to how deep the downturn will be, and how much fiscal stimulus would be an appropriate response.

The American Recovery and Reinvestment Act of 2009 will increase the budget deficit by about 1.3% in 2009 and an additional 2.2% (or 3.5% overall) in 2010. Some believe that circumstances warrant a larger stimulus—GDP in FY2009 is expected to contract by more than size of the stimulus in 2009. Others have expressed reservations that the deficit is already too large and, at least with respect to spending, it would be difficult to spend such large amounts without financing wasteful projects. Although the act authorizes $379 billion of spending in 2009, CBO estimates a outlays of only $120 billion because it does not project that executive agencies can spend the total amount authorized in this fiscal year.

Bang for the Buck

In terms of first-order effects, any stimulus proposal that is deficit financed would increase total spending in the economy.[32] For second-order effects, different proposals could get modestly more "bang for the buck" than others if they result in more total spending. If the goal of stimulus is to

[30] This section was prepared by Marc Labonte, Government and Finance Division.

[31] See, for example, "Options for Responding to Short-term Economic Weakness," Testimony of CBO Director Peter Orszag before the Committee on Finance, January 22, 2008.

[32] There may be a few proposals that would not increase spending. For example, increasing tax incentives to save would probably not increase spending significantly. These examples are arguably exceptions that prove the rule.

maximize the boost to total spending while minimizing the increase in the budget deficit (in order to minimize the deleterious effects of "crowding out"), then maximum bang for the buck would be desirable. The primary way to achieve the most bang for the buck is by choosing policies that result in spending, not saving.[33] Direct government spending on goods and services would therefore lead to the most bang for the buck since none of it would be saved. The largest categories of direct federal spending are national defense, health, infrastructure, public order and safety, and natural resources.[34]

Higher government transfer payments, such as extended unemployment compensation benefits or increased food stamps, or tax cuts could theoretically be spent or saved by their recipients.[35] Although there is no way to be certain how to target a stimulus package toward recipients who would spend it, many economists have reasoned that higher income recipients would save more than lower income recipients because U.S. saving is highly correlated with income. For example, two-thirds of families in the bottom 20% of the income distribution did not save at all in 2004, whereas only one-fifth of families in the top 10% of the income distribution did not save.[36] Presumably, recipients in economic distress, such as those receiving unemployment benefits, would be even more likely to spend a transfer or tax cut than a typical family.

The effectiveness of tax cuts also depends on their nature. As discussed above, tax cuts received by lower income individuals are more likely to be spent. Some economists have also argued that temporary individual tax cuts, such as the 2001 and 2008 rebates, are more likely to be saved; however, evidence on the 2001 tax rebate suggests most was eventually spent, and debate continues on the effect of the 2008 rebate. Most evidence does not suggest that business tax cuts would provide significant short-term stimulus. Investment incentives are attractive, if they work, because increasing investment does not trade off short term stimulus benefits for a reduction in capital formation, as do provisions stimulating consumption. Nevertheless, most evidence does not suggest these provisions work very well to induce short-term spending. This lack of effectiveness may occur because of planning lags or because stimulus is generally provided during economic slowdowns when excess capacity may already exist. Of business tax provisions, investment subsidies are more effective than rate cuts, but there is little evidence to support much stimulus effect. Temporary bonus depreciation is likely to be most effective in stimulating investment, more effective than a much costlier permanent investment incentive because it encourages the speed-up of investment. Although there is some dispute, most evidence on bonus depreciation enacted in 2002 nevertheless suggests that it had little effect in stimulating investment and that even if the effects were pronounced, the benefit was too small to have an appreciable effect on the economy. The likelihood of the remaining provisions having much of an incentive effect is even smaller. Firms may, for example, benefit from the small business expensing, but it actually discourages investment in the (expanded) phase out range.[37] Net

[33] Policies that result in more bang for the buck also result in more crowding out of investment spending, which could reduce the long-term size of the economy (unless the policy change increases public investment or induces private investment).

[34] For the purpose of this discussion, government transfer payments, such as entitlement benefits, are not classified as government spending.

[35] Food stamps cannot be directly saved since they can only be used on qualifying purchases, but a recipient could theoretically keep their overall consumption constant by increasing their other saving.

[36] Brian Bucks et al., "Recent Changes in U.S. Family Finances: Evidence from the 2001 and 2004 Survey of Consumer Finances," *Federal Reserve Bulletin*, vol. 92, February 2006, pp. A1-A38.

[37] For more information, see CRS Report RS21136, *Government Spending or Tax Reduction: Which Might Add More Stimulus to the Economy?*, by Marc Labonte; CRS Report RS21126, *Tax Cuts and Economic Stimulus: How Effective* (continued...)

operating losses carrybacks do not increase incentives to spend, but do target cash to troubled businesses.

Mark Zandi of *Moody's Economy.com* has estimated multiplier effects for several different policy options, as shown in **Table 1**.[38] The multiplier estimates the increase in total spending in the economy that would result from a dollar spent on a given policy option. Zandi does not explain how these multipliers were estimated, other than to say that they were calculated using his firm's macroeconomic model. Therefore, it is difficult to offer a thorough analysis of the estimates. In general, many of the assumptions that would be needed to calculate these estimates are widely disputed (notably, the difference in marginal propensity to consume among different recipients and the size of multipliers in general), and no macroeconomic model has a highly successful track record predicting economic activity. Thus, the range of values that other economists would assign to these estimates is probably large. Qualitatively, most economists would likely agree with the general thrust of his estimates, however—spending provisions have higher multipliers because tax cuts are partially saved, and some types of tax cuts are more likely to be saved by their recipients than others. As discussed above, a noticeable increase in consumption spending has not yet accompanied the receipt of the rebates from the first stimulus package. (Note, however, that these effects do not account for the possibility of extensive delay in direct spending taking place.)

The CBO rankings of multipliers are similar to Zandi's.[39] For government purchases and transfers to state and local governments for infrastructure, their multipliers are 1.0 in the low scenario and 2.5 in the high. For transfers to state and local governments not for infrastructure, the multipliers are 0.7 and 1.9. CBO sets the multipliers for transfers at 0.8 to 2.2, for temporary individual tax cuts at 0.5 to 1.7, and the tax loss carryback at 0 to 0.4. As with Zandi, these effects do not incorporate differentials in the rate of spending, however. In particular, they note that infrastructure spending will likely be delayed, while transfers would occur very quickly. Unlike Zandi, CBO emphasizes the broad uncertainty inherent in estimating multipliers.

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Are the Alternatives?, by Jane G. Gravelle; CRS Report RL31134, *Using Business Tax Cuts to Stimulate the Economy*, coordinated by Jane G. Gravelle; and CRS Report RS22790, *Tax Cuts for Short-Run Economic Stimulus: Recent Experiences*, coordinated by Jane G. Gravelle. Also see *Fiscal Policy for the Crisis*, IMF Staff Position Note, December 29, 2008, SPN/08/01 http://www.imf.org/external/np/pp/eng/2008/122308.pdf.

[38] Mark Zandi, "Washington Throws the Economy a Rope," *Dismal Scientist*, Moody's Economy.com, January 22, 2008.

[39] Congressional Budget Office, "The State of the Economy and Issues in Developing an Effective Policy Response," Testimony of Douglas W. Elmendorf, Director, House Budget Committee, January 27, 2009.

Table 1. Zandi's Estimates of the Multiplier Effect for Various Policy Proposals

Policy Proposal	One-year change in real GDP for a given policy change per dollar
Tax Provisions	
Non-refundable rebate	1.02
Refundable rebate	1.26
Payroll tax holiday	1.29
Across the board tax cut	1.03
Accelerated depreciation	0.27
Extend alternative minimum tax patch	0.48
Make income tax cuts expiring in 2010 permanent	0.29
Make expiring dividend and capital gains tax cuts permanent	0.37
Reduce corporate tax rates	0.30
Spending Provisions	
Extend unemployment compensation benefits	1.64
Temporary increase in food stamps	1.73
Revenue transfers to state governments	1.36
Increase infrastructure spending	1.59

Source: Mark Zandi, Moody's Economy.com.

Timeliness

Timeliness is another criterion by which different stimulus proposals have been evaluated. There are lags before a policy change affects spending. As a result, stimulus could be delivered after the economy has already entered a recession or a recession has already ended. First, there is a legislative process lag that applies to all policy proposals—a stimulus package cannot take effect until bills are passed by the House and Senate, both chambers can reconcile differences between their bills, and the President signs the bill. Many bills get delayed at some step in this process. As seen in **Table 2**, many past stimulus bills have not become law until a recession was already underway or finished.[40]

[40] The International Monetary Fund recently analyzed the "timeliness, temporariness, and targeting" of U.S. tax cuts from 1970 to 2008 in International Monetary Fund, *World Economic Outlook*, Washington, DC, October 2008, p. 172.

Table 2.Timing of Past Recessions and Stimulus Legislation

Beginning of Recession	End of Recession	Stimulus Legislation Enacted
November 1948	October 1949	October 1949
August 1957	April 1958	April 1958, July 1958
April 1960	February 1961	May 1961, September 1962
December 1969	November 1970	Aug. 1971
November 1973	March 1975	March 1975, July 1976, May 1977
July 1981	November 1982	January 1983, March 1983
July 1990	March 1991	December 1991, April 1993
March 2001	November 2001	June 2001

Source: Bruce Bartlett, "Maybe Too Little, Always Too Late," *New York Times*, January 23, 2008.

Second, there is an administrative delay between the enactment of legislation and the implementation of the policy change. For example, although the 2008 stimulus package was signed into law in February, the first rebate checks were not sent out until the end of April, and the last rebate checks were not sent out until July. When the emergency unemployment compensation (EUC08) program began in July 2008, there was about a three week lag between enactment and the first payments of the new EUC08 benefit. Many economists have argued that new government spending on infrastructure could not be implemented quickly enough to stimulate the economy in time since infrastructure projects require significant planning. (Others have argued that this problem has been exaggerated because existing plans or routine maintenance could be implemented more quickly.) Others have argued that although federal spending cannot be implemented quickly enough, fiscal transfers to state and local governments would be spent quickly because many states currently face budgetary shortfalls, and fiscal transfers would allow them to avoid cutting spending.[41] ARRA granted $379 billion of budget authority in 2009, but CBO projects that only $120 billion will be outlayed in 2009.[42]

Finally, there is a behavioral lag because time elapses before recipient of a transfer or tax cut increases its spending. For example, the initial reaction to the receipt of rebate checks was a large spike in the personal saving rate (see above). It is unclear how to target recipients that would spend most quickly, although presumably liquidity-constrained households (i.e., those with limited access to credit) would spend more quickly than others. In this regard, the advantage to direct government spending is that there is no analogous lag. Although monetary policy changes have no legislative or administrative lags, research suggests they do face longer behavioral lags than fiscal policy changes because households and business generally respond more slowly to interest rate changes than tax or transfer changes.

[41] Transfers to state and local governments could be less stimulative than direct federal spending because state and local governments could, in theory, increase their total spending by less than the amount of the transfer. (For example, some of the money that would have been spent in the absence of the transfer could now be diverted to the state's budget reserves.) But if states are facing budgetary shortfalls, many would argue that in practice spending would increase by as much as the transfer.

[42] Congressional Budget Office, *Cost Estimate for the Conference Agreement for H.R. 1*, Letter to Honorable Nancy Pelosi, February 13, 2009.

Long-Term Effects

A main factor in another round of fiscal stimulus may be the size of the current budget deficit. The 2009 stimulus package is relatively large, and CBO projects the deficit will already exceed $1 trillion in 2009. Deficits of this magnitude would set a peacetime record relative to GDP. Although current government borrowing rates are extremely low (because of the financial turmoil), there is a fear that a deficit of this size could become burdensome to service when interest rates return to normal. A larger deficit could eventually crowd out private investment, act as a drag on economic growth, and increase reliance on foreign borrowing (which would result in a larger trade deficit). By doing so, the deficit places a burden on future generations, and could further complicate the task of coping with long-term budgetary pressures caused by the aging of the population.[43] In the highly unlikely, worst case scenario, if too much pressure is placed on the deficit through competing policy priorities, then investors could lose faith in the government's ability to service the debt, and borrowing rates could spike.

Many of these issues could be minimized if the elements of the stimulus package are temporary—an increase in the budget deficit for one year would lead to significantly less crowding out over time than a permanent increase in the deficit. There is often pressure later to extend policies beyond their original expiration date, however. Among policy options, increases in public investment spending would minimize any negative effects on long-run GDP because decreases in the private capital stock would be offset by additions to the public capital stock. Also, tax incentives to increase business investment would offset the crowding out effect since the increase in aggregate spending was occurring via business investment.

The direct effect of the American Recovery and Reinvestment Act on the budget deficit is relatively small after 2011, although it leads to a permanent increase in interest payments on the national debt if not offset by future policy changes.

Should Stimulus be Targeted?

It is clear that the slowdown has been concentrated in housing and financial markets to date. Some economists have argued that as long as problems remain in these depressed sectors, then generalized stimulus will only postpone the inevitable downturn. For example, as long as financial intermediation remains impaired, access to credit markets will be limited and it will be difficult for stimulus to lead to sustained growth. (As noted above, separate legislation to support housing and financial markets was enacted in 2008.) If so, fiscal stimulus may, at most, provide a temporary boost as long as those problems are outstanding, but cannot singlehandedly shift the economy to a sustainable path of expansion. For example, the first stimulus package, enacted in the first quarter of 2008, did not prevent the economy from deteriorating further in the third quarter of 2008. Other economists argue that if the current housing bust is being caused by the unwinding of a bubble, then the government could be unable to reverse unavoidable market adjustment that is bringing those markets back to equilibrium. But some would argue that the best way to help a troubled sector is by boosting overall demand.

[43] See CRS Report RL32747, *The Economic Implications of the Long-Term Federal Budget Outlook*, by Marc Labonte.

Is Additional Fiscal Stimulus Needed?

The economy naturally experiences a boom and bust pattern called the business cycle. A recession can be characterized as a situation where total spending in the economy (*aggregate demand*) is too low to match the economy's potential output (*aggregate supply*). As a result, some of the economy's labor and capital resources lay idle, causing unemployment and a low capacity utilization rate, respectively. Recessions generally are short-term in nature—eventually, markets adjust and bring spending and output back in line, even in the absence of policy intervention.[44]

Policymakers may prefer to use stimulative policy to attempt to hasten that adjustment process, in order to avoid the detrimental effects of cyclical unemployment. By definition, a stimulus proposal can be judged by its effectiveness at boosting total spending in the economy. Total spending includes personal consumption, business investment in plant and equipment, residential investment, net exports (exports less imports), and government spending. Effective stimulus could boost spending in any of these categories.

Fiscal stimulus can take the form of higher government spending (direct spending or transfer payments) or tax reductions, but generally it can boost spending only through a larger budget deficit, as is the case with ARRA. A deficit-financed increase in government spending directly boosts spending by borrowing to finance higher government spending or transfer payments to households. A deficit-financed tax cut indirectly boosts spending if the recipient uses the tax cut to increase his spending. If an increase in spending or a tax cut is financed through a decrease in other spending or increase in other taxes, the economy would not be stimulated since the deficit-increasing and deficit-decreasing provisions would cancel each other out.

How much additional spending can stimulate economic activity depends on the state of the economy at that time. When the economy is in a recession, fiscal stimulus could mitigate the decline in GDP growth by bringing idle labor and capital resources back into use. When the economy is already robust, a boost in spending could be largely inflationary—since there would be no idle resources to bring back into production when spending is boosted, the boost would instead bid up the prices of those resources, eventually causing all prices to rise. The recession appears to have deepened in the fourth quarter of 2008. By historical standards, the recession would be expected to end before fiscal stimulus could be delivered, but forecasters are predicting this recession will be longer than usual. Most of the stimulus provided by ARRA will be delivered by 2011, and CBO is projecting that there will still be a significant output gap at that point.

Because total spending can be boosted only temporarily, stimulus has no long-term benefits, and may have long-term costs. Most notably, the increase in the budget deficit "crowds out" private investment spending because both must be financed out of the same finite pool of national saving, with the greater demand for saving pushing up interest rates.[45] To the extent that private investment is crowded out by a larger deficit, it would reduce the future size of the economy since the economy would operate with a smaller capital stock in the long run. In recent years, the U.S. economy has become highly dependent on foreign capital to finance business investment and

[44] For more information, see CRS Report RL34072, *Economic Growth and the Business Cycle: Characteristics, Causes, and Policy Implications*, by Marc Labonte.

[45] Crowding out is likely to be less of a concern when the economy is in recession since recessions are typically characterized by falling business investment.

budget deficits.[46] Because foreign capital can come to the United States only in the form of a trade deficit, a higher budget deficit could result in a higher trade deficit, in which case the higher trade deficit could dissipate the boost in spending as consumers purchase imported goods. Indeed, conventional economic theory predicts that fiscal policy has no stimulative effect in an economy with perfectly mobile capital flows.[47] Some economists argue that these costs outweigh the benefits of fiscal stimulus.

Policies Previously Adopted

Stimulus has also been delivered from other fiscal changes and monetary policy. First, the federal budget has *automatic stabilizers* that cause the budget deficit to automatically increase (and thereby stimulate the economy) during a downturn in the absence of policy changes. When the economy slows, entitlement spending on programs such as unemployment compensation benefits automatically increases as program participation rates rise and the growth in tax revenues automatically declines as the recession causes the growth in taxable income to decline.

Second, any consideration for additional stimulus has to include the effects of stimulus previously enacted. According to CBO, the total deficit in FY2008 was $455 billion, or 3.2% of gross domestic product, sharply higher than the FY2007 deficit of $162 billion. In January 2008, CBO had projected that under current policy the budget deficit would increase by $56 billion in 2008 compared with 2007. When the cost of the February 2008 stimulus package and part of the cost of financial market intervention in the fall of 2008 is added, the increase in the deficit for one year rose by nearly $300 billion. CBO projects the deficit will increase further in 2009, to $1.2 trillion or 8.3% of GDP, in the absence of additional stimulus. These increases in the deficit would also be expected to have a stimulative effect on aggregate spending.

Third, the Federal Reserve has already delivered a large monetary stimulus. By the end of April 2008, the Fed had reduced overnight interest rates to 2% from 5.25% in September 2007.[48] On December 16, the interest rate was lowered to a targeted range of 0% to 0.25%. Typically, lower interest rates stimulate the economy by increasing the demand for interest-sensitive spending, which includes investment spending, residential housing, and consumer durables such as automobiles. Yet, the potential for stimulus caused by lower interest rates can be limited if tight credit markets constrain borrowing. In addition, lower interest rates can stimulate the economy by reducing the value of the dollar, all else equal, which would lead to higher exports and lower imports.[49]

It could be viewed that the Federal Reserve has chosen a monetary policy that it believes will best achieve a recovery given the actions already taken. If it has chosen that policy correctly, an argument can be made that an additional fiscal stimulus is unnecessary since the economy is already receiving the correct boost in spending through lower interest rates and through the first

[46] If foreign borrowing prevents crowding out, the future size of the economy will not decrease but capital income will accrue to foreigners instead of Americans.

[47] For more information, see CRS Report RS21409, *The Budget Deficit and the Trade Deficit: What Is Their Relationship?*, by Marc Labonte and Gail E. Makinen.

[48] For interest rate changes see CRS Report 98-856, *Federal Reserve Interest Rate Changes: 2001-2009*, by Marc Labonte.

[49] For more information, see CRS Report RL30354, *Monetary Policy and the Federal Reserve: Current Policy and Conditions*, by Marc Labonte.

stimulus package. In this light, additional fiscal stimulus would be useful only if monetary policy is unable to adequately boost spending—either because the Fed has chosen an incorrect policy or because the Fed cannot boost spending enough through lower interest rates and direct assistance to the financial sector to spark a recovery, and direct intervention in financial markets is not adequate. [50] (Now that interest rates have fallen to zero, the Fed can no longer reduce rates to stimulate the economy, but it can increase—and has increased—its direct assistance to the financial sector.)

Interventions for Financial Firms and Markets

A number of direct interventions in the economy occurred in 2008 that could be seen as a type of stimulus, in part because of credit problems. One indication of restricted credit despite stimulative Federal Reserve monetary policy was the failure of mortgage rates to fall significantly. Instead, the spread between Treasury and GSE bonds remained elevated over the summer. The newly created Federal Housing Finance Agency (FHFA) cited the persistence of this wide spread as a major factor in its decision to place the GSEs in conservatorship in September. During the week of September 15-19, financial markets were further disturbed by the bankruptcy of investment bank Lehman Brothers and Federal Reserve intervention on behalf of the insurer AIG. These actions eroded market confidence further, resulting in a sudden spike of the commercial paper rate spread from just under 90 basis points to 280 basis points, a spike that in times past might have been called a panic. If financial market confidence is not restored and private market spreads remain elevated, the broader economy could slow more due to difficulties in financing consumer durables, business investment, college education, and other big-ticket items.

In September 2008, Administration and Federal Reserve officials with the bipartisan support of the congressional leadership, announced a massive intervention in the financial markets, requesting authority to purchase up to $700 billion in assets over the next two years. The Treasury had also provided insurance for money market funds, where withdrawals have been significant. Congressional leaders and other Members raised a number of issues and made some additional proposals, which included setting up an oversight mechanism, restrictions on executive compensation of firms from which assets are purchased, acquiring equity stakes in the participating firms, and allowing judges to reduce mortgage debt in bankruptcies (not included in the final act).

Later, in October 2008, legislation (P.L. 110-343) was enacted to allow an initial $250 billion of financing with an additional $100 billion upon certification of need, with Congress allowed 30 days to object to the final $350 billion. The plan has oversight by an Inspector General, audit by the Government Accountability Office, setting standards of appropriate compensation, and providing for equity positions in all participating companies. The final package also added an expansion of deposit insurance coverage. There remained, however, concerns about how to price acquired assets in a way that balances protection of taxpayers with providing adequate assistance to firms. The Treasury had indicated use of a reverse auction mechanism to purchase mortgage

[50] Fed Chairman Ben Bernanke may have hinted at the latter case when he testified that "fiscal action could be helpful in principle, as fiscal and monetary stimulus together may provide broader support for the economy than monetary policy actions alone." Quoted in Ben Bernanke, "The Economic Outlook," testimony before the House Committee on the Budget, January 17, 2008.

backed securities, where companies will bid to sell their assets. It is not clear how well such an auction would work with heterogeneous assets.[51]

The Treasury subsequently announced that it would use the first $250 billion authorized to purchase preferred stock in financial institutions and has now indicated it will use subsequent funds for capital injections, consumer credit (such as auto loans, student loans, small business loans, and credit cards) and mortgage assistance.[52] Congressional leaders urged Treasury to provide $25 billion in aid to U.S. auto manufacturers.[53] On November 10, a restructuring of government assistance to AIG was announced which increased the amount at risk from $143.7 billion to $173.4 billion, extended the loan length and reduced the interest rate. The Fed also announced on October 14 that it would begin purchasing commercial paper.[54] News reports indicated the FDIC had a plan, supported by many congressional Democrats, to offer financial incentives to companies that agree to reduce monthly mortgage payments, but that this plan was opposed by the Bush Administration.[55] On November 23, the government announced a plan to assist Citicorp, and on November 25 the Fed revealed plans to purchase $200 billion in asset-backed securities through the Term Asset-Backed Securities Loan Facility (TALF); these securities are based on auto, credit card, student and small business loans.

Much of the intervention up to this point had been in the financial markets. However, the Detroit automakers (GM, Ford, and Chrysler) asked for $34 billion in loans to forestall bankruptcy. After Congress did not adopt an emergency loan of $14 billion in a special post-election session in December 2008, the Administration announced, on December 19, that it would provide $17.4 billion from TARP: $9.4 billion to GM and $4 million to Chrysler. An additional $4 billion would be made available for GM if the remaining $350 billion in TARP funds is approved. On December 30, $6 billion in TARP funds were provided for GMAC, the auto financing company.

The Fed has also announced purchases of commercial paper, $200 billion of asset backed securities, and $600 billion of mortgage-related securities; the government has also announced a plan to guarantee certain assets of Citigroup and Bank of America. On March 18, the Fed announced plans to purchase more than $1 trillion in assets, including $750 billion in mortgage backed securities and $300 billion in long-term Treasury debt. On March 23, 2009, the Treasury announced a plan for a public-private partnership to purchase troubled assets, including one part that uses the FDIC to insure loans and another part that would allow access to the Federal Reserve's TALF.[56]

Legislation has been introduced (H.R. 384) by the chairman of the Financial Services Committee to regulate the spending of the final $350 billion, but many of the provisions could also be achieved through an agreement between Congress and the Administration. There is interest in directing some of the funds to directly aid mortgage holders to avoid foreclosure and small

[51] See CRS Report RL34707, *Auction Basics: Background for Assessing Proposed Treasury Purchases of Mortgage-Backed Securities*, by D. Andrew Austin.

[52] Testimony of Interim Assistant Secretary for Financial Stability Neel Kashkari before the House Committee on Oversight and Government Reform, Subcommittee on Domestic Policy, November 14, 2008.

[53] David M. Herszenhiorn, "Chances Dwindle on Bailout Plan for Automakers," *New York Times*, November 14, p. A1.

[54] Federal Reserve Board Press Release, October 14, 2008.

[55] Buinyamin Appelbaum, FDIC Details Plan to Alter Mortgages, Washington Post, November 14, 2008, p. A1.

[56] For further discussion, see CRS Report RL34730, *Troubled Asset Relief Program: Legislation and Treasury Implementation*, by Baird Webel and Edward V. Murphy.

business loans, as well as considering oversight issues. Congress could have enacted legislation to disallow the release. However, on January 15, the Senate defeated a proposal to block the spending of the additional funds.

Among the issues of concern with financial interventions is whether an ad hoc, case-by-case intervention is likely to be a successful strategy. A case-by-case strategy can create uncertainty and also moral hazard (causing firms to undertake too much risk if they expect to be rescued). The creation of TARP represents a shift to a more broad-based approach. The approach of a broad-based intervention could take the form of the purchase of troubled assets (as originally proposed or through a "bad bank") or the injection of capital (such as the Treasury's decision to purchase preferred stock).[57]

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[57] These issues are discussed in more detail in CRS Report RL34730, *Troubled Asset Relief Program: Legislation and Treasury Implementation*, by Baird Webel and Edward V. Murphy.

Senator BOXER. Thank you.

We are going to ask our witnesses to please take their seats right now. Our witnesses, in this order of speaking, unless Secretary Salazar is going to work with his colleagues, this is what I have. Hon. Steven Chu, Hon. Ray LaHood, Hon. Ken Salazar, Hon. Lisa Jackson, Hon. Jon Wellinghoff. That is the array that we have.

Senator Voinovich.

Senator VOINOVICH. I just would like to have the article that I referred to in the New York Times put in the record after my statement, along with the analysis of the job loss by the American Council for Capital Formation.

Senator BOXER. Absolutely, and we will also place in the record a number of studies cited by Senator Kerry that shows the opposite, so everybody sees it.

While you are all getting ready, we were asked about Secretary Vilsack. I explained that he is traveling. But for that he would have been here. And I am going to place, ask unanimous consent now to place his statement in the record. I am going to quote from two sentences. He says "The cost of inaction will have a significant effect on our farmers, ranchers and rural communities. While farmers and ranchers and forest land owners have a lot at stake if we fail to act, they have much to gain if we address climate change quickly and wisely. And there are significant opportunities for landowners in a cap-and-trade program that can help revitalize rural America." And it talks about wealth creation.

[The referenced statement follows:]

Statement of

Thomas J. Vilsack
Secretary of Agriculture

Before the
Committee on Environment and Public Works
United States Senate

October 27, 2009

Madame Chairwoman, Ranking Member Inhofe, and members of the Committee, I apologize for not being able to be with you today. Unfortunately, I am out of the country but I appreciate the opportunity to submit testimony today on the critical role of and potential impact on agriculture and forestry in climate change legislation.

The United States, along with the rest of the world, is facing a crisis. Climate change is a serious threat to our economy and national security. This legislation is an important opportunity for the US to show international leadership on climate change. I want to commend Senators Kerry and Boxer for the introduction of their legislation, which provides an important first step towards the passage of comprehensive energy and climate legislation in the Senate. The USDA looks forward to continuing to work with the Senate on this monumental challenge.

Farmers, ranchers, and forest landowners are at the crux of the climate change debate. The U.S. Climate Change Science Program and Subcommittee on Global Climate Change Research reported that forest landowners are already seeing the impacts of climate change on the health and productivity of our forests. Drought, catastrophic weather events, and disease outbreaks are just some of the potential effects of a warming climate. In addition, there continues to be a growing concern that crop yields will suffer due to changing weather patterns. Clearly, the cost of inaction will have a significant effect on our farmers, ranchers, and rural communities.

While farmers, ranchers and forest landowners have a lot at stake if we fail to act, they also have much to gain if we address climate change quickly and wisely. I believe there are significant opportunities for landowners in a cap and trade program that can help revitalize rural America. Rural America has an unprecedented potential for economic development and job growth through new energy technologies. The anaerobic digesters and wind will provide landowners with new sources of revenue and wealth creation.

A robust carbon offsets market will provide farmers, ranchers and forest landowners with the potential for new sources of income. Rural communities may have new opportunities for growth and competiveness as we enter a new 21st century economy. To be effective, the market will require an infrastructure of people and agencies that can encourage landowner participation, provide information to landowners, manage data and resources,

and maintain records and registries. I believe that USDA, EPA, DOI, DOE, and other Federal agencies can meet this need. We must also ensure that agricultural and forest offsets provide real, additional, and verifiable greenhouse gas reductions. This is critical not only to addressing climate change but to maintaining public confidence in the carbon offset program, as well.

However, we understand the concerns of many in the agricultural and forestry community about the potential costs of climate change legislation. I know many of you are hearing the same concerns from the farmers, ranchers and forest landowners in your states.

In order to address these concerns, USDA has analyzed costs and benefits of the House-passed climate legislation for agriculture. While there are differences between the Waxman-Markey legislation and the Kerry-Boxer bill, it is our expectation that the impact in agriculture will be similar. Our preliminary analysis demonstrates that economic opportunities for farmers and ranchers can outpace – perhaps significantly – the costs from climate legislation.

Let's first look at the cost side. Agriculture is an energy intensive sector with row crop production particularly affected by energy price increases. For example, fertilizer and fuel costs account for 50 to 60 percent of variable costs of production for corn. While most of the direct energy price increases would be felt immediately by the agricultural sector, fertilizer costs would likely be unaffected until 2025 due to provisions in HR 2454 that would distribute specific quantities of emissions allowances to "energy- intensive, trade exposed entities" (EITE). In absence of the EITE provisions, higher fertilizer prices could lead to an average annual increase in crop production expenses of $1.4 billion in real 2005 dollars over 2012-18.

Increases in fuel prices are expected to raise overall annual average farm expenses by about $700 million between 2012 and 2018, or about 0.3%. Annual net farm income as a result of these higher energy prices is expected to fall by about 1 percent. These estimates are conservative, for example they assume that in the short term farmers are unable to make changes in input mix in response to higher fuel prices—so they likely overestimate the costs to farmers. Over longer time frames, the estimated impacts of HR 2454 are modest and suggest a decline of annual net farm income of $2.4 billion, or 3.5%, in 2030 and $4.9 billion, or 7.2%, in 2048. These estimates are likely an upper bound on the costs, because they fail to account for farmers' proven ability to innovate in response to changes in market conditions.

The medium to long term analyses are conservative given the observation that energy use per unit of output has declined significantly over the past several decades. Because of this, our estimates are likely an upper bound estimate on the costs because they fail to account for farmers' ability to fully respond to changes in market conditions. Our analysis is also conservative because it doesn't account for revenues to farmers from biomass production for bioenergy. A number of studies have examined the effects of

higher energy costs with models that allow for expected changes in production management practices and switching to bioenergy crops.[1] Based on the analysis of Schneider and McCarl, for example, allowing for changes in input mix and revenues from biomass production - but without accounting for income from offsets -, it is estimated that annual net farm income would increase in 2030 by about $0.6 billion or less than 1 percent. By 2045, annual net farm income is estimated to increase by more than $2 billion or 2.9%.

The creation of an offset market will create new opportunities for the agricultural sector. In particular, our analysis indicates that annual returns to farmers and ranchers range from about $1 billion per year in 2015-20 to almost $15-20 billion in 2040-50, not accounting for the costs of implementing offset practices. In the short term, the economic benefits to agriculture from cap-and-trade legislation will likely outweigh the costs. In the long term, the economic benefits from offsets markets easily trump increased input costs from cap-and-trade legislation. Let me also note that we believe these figures are conservative because we aren't able to model the types of technological change that are very likely to help farmers produce more crops and livestock with fewer inputs. Second, the analysis doesn't take into account the higher commodity prices that farmers will very likely receive as a result of enhanced renewable energy markets and retirement of environmentally sensitive lands domestically and abroad. Of course, any economic analysis such as ours has limitations. But, again, we believe our analysis is conservative – it's quite possible farmers will actually do better. None of this analysis includes the potential benefit arising from new energy jobs that will come from constructing, operating, and maintaining new infrastructure for renewable energy.

We recognize that climate legislation will affect different landowners in different ways. USDA can help smooth this transition by using our Farm Bill conservation and renewable energy programs to assist landowners in adopting new technologies and stewardship practices.

I want to thank the Committee for its interest and involvement on climate change. The leadership you provide will help farmers, ranchers and forest landowners participate in and benefit from climate legislation. The participation of rural landowners is, I believe, vitally important to the success of any cap and trade program. USDA looks forward to working with you as we move forward in building a stronger rural America.

Senator BOXER. So we are going to place this, and we are proud to have Secretary Vilsack's support for a good climate change bill.

We are honored to have this array of experts with us from the Administration, and we thank you for your patience. Sometimes I know it seems interminable, but I think it is also important for you to hear from each of us, so you know exactly the issues that we are all dealing with.

So is there any change in the order? Or we can stick with it? OK. The Honorable Steven Chu, Secretary, United States Department of Energy. Welcome.

STATEMENT OF HON. STEVEN CHU, SECRETARY, U.S. DEPARTMENT OF ENERGY

Mr. CHU. Thank you, Chairman Boxer, Ranking Member Inhofe, members of the committee. Thank you for the opportunity to testify today.

When I appeared before you in July, I focused on the energy challenge and the grave threat from climate change. The Intergovernmental Panel on Climate Change found in 2007 that the best estimate for the rise in the average global temperature by the end of this century would be more than 7 degrees Fahrenheit if we continued on a high growth fossil fuel intensive course.

A 2009 MIT study found a 50 percent chance of a 9 degree rise in the century and a 17 percent chance of a nearly 11 degree increase. Eleven degrees might not sound like much, but during the last Ice Age, when Canada and much of the United States were covered all year in a glacier, the world was only about 11 degrees colder. A world 11 degrees warmer would be very different as well.

Today I want to focus on the other half of the energy equation, the energy opportunity. The world now realizes that its current level of greenhouse gas emissions is unsustainable. In the coming years, there will be a vigorous effort to limit carbon pollution that will require a massive deployment of clean energy technologies. The only question is, which countries will invent, manufacture and export these clean technologies, and which countries will become dependent on foreign products?

The Energy Information Administration, an independent statistical agency within the Department of Energy, recently estimated the market for a few clean energy technologies. It based its analysis on a scenario derived by the International Energy Agency that could prevent the worst changes to our climate. The EIA found globally the cumulative investment in wind turbines and solar photovoltaic panels from now to 2030 could be $2.1 trillion and $1.5 trillion respectively. The policy decisions we make today will determine the U.S. share of this market. And many additional dollars, jobs and opportunities are at stake in other clean energy economies.

China has already made its choice. China is spending about $9 billion a month on clean energy. It is also investing $44 billion by 2012 and $88 billion by 2020 in ultra-high voltage transmission lines. These lines will allow China to transmit power from huge wind and solar farms far in the western part of China to its cities on the eastern coast.

While every country's transmission needs are different, this is a clear sign of China's commitment to developing renewable energy.

The United States, meanwhile, has fallen behind. The world's largest turbine manufacturing company is headquartered in Denmark. Ninety-nine percent of the batteries that power America's hybrid cars are made in Japan. We manufactured more than 40 percent of the world's solar cells as recently as the mid-1990s. Today we produce only 7 percent.

When the gun sounded on the clean energy race, the United States stumbled. But I remain confident that we can make up ground. When we gear up our research and production of clean energy technologies, we can still surpass any other country.

This work began in earnest with the American Recovery and Reinvestment Act. That Act includes $80 billion to put tens of thousands of Americans to work, developing new battery technologies for hybrid vehicles, making our homes and businesses more energy efficient, doubling our capacity to generate renewable electricity, and modernizing the grid.

In fact, today, President Obama will announce an investment of more than $3.4 billion in smart grid projects across the country. This is a major down payment on a more robust, more flexible electricity transmission and distribution system.

However, to truly seize the opportunity, we must enact comprehensive energy and climate legislation. I commend Chairman Boxer and Senator Kerry for bringing forward this legislation. The most important element of this bill is that it puts a cap on carbon emissions that ratchets down over time. That critical step will drive investment decisions for clean energy.

Imagine, for example, you own a power company and are considering building more generating capacity. You can build a new coal-fired plant or a new nuclear plant. These are serious, multi-billion dollar investments, and they will last 60 years. If you knew that carbon emissions had to decrease, would you build a coal plant without carbon capture and storage technology? Would a nuclear power plant look more attractive? Would you consider investing in wind and solar?

On-again and off-again incentives will not drive the level of clean energy investment we need. A cap on carbon will give the energy industry the long-term direction and certainty that it needs to make appropriate technology and capital investment decisions.

To achieve our long-term goals in a cost effective way, we will also need a sustained commitment to research and development. Only R&D will deliver a new generation of clean technologies. Much of this work is underway at the Department of Energy using resources provided in the Recovery Act. However, continued investment will be needed.

S. 1733 would continue portions of this work, and the legislation reported by Chairman Bingaman's committee would also bolster these efforts. I applaud you for holding this hearing and look forward to working with this committee and the full Senate to swiftly pass comprehensive clean energy and climate legislation. Thank you.

[The prepared statement of Mr. Chu follows:]

Statement of

Steven Chu
Secretary of Energy

Before the
Committee on Environment and Public Works
United States Senate
Washington, D.C.

October 27, 2009

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When I appeared before you in July, I focused on the energy challenge and the grave threat from climate change. The Intergovernmental Panel on Climate Change found in 2007 that the best estimate for the rise in average global temperature by the end of this century would be more than 7 degrees Fahrenheit if we continued on a high growth, fossil fuel intensive course. A 2009 MIT study found a fifty percent chance of a 9 degree rise in this century and a 17 percent chance of a nearly 11 degree increase. Eleven degrees may not sound like much, but, during the last ice age, when Canada and much of the United States were covered all year in a glacier, the world was only about 11 degrees colder. A world 11 degrees warmer will be very different as well.

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The Energy Information Administration – an independent statistical agency within the Department of Energy – recently estimated the market for a few key clean technologies. It based its analysis on a scenario derived by the International Energy Agency that could prevent the worst changes to our climate.

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When the starting gun sounded on the clean energy race, the United States stumbled. But I remain confident that we can make up the ground. When we gear up our research and production of clean energy technologies, we can still surpass any other country.

This work began in earnest with the American Recovery and Reinvestment Act. The Recovery Act includes $80 billion to put tens of thousands of Americans to work developing new battery technologies for hybrid vehicles, making our homes and businesses more energy efficient, doubling our capacity to generate renewable electricity, and modernizing the electric grid. In fact, today, President Obama will announce an investment of more than $3.4 billion in smart grid projects across the country. This is a major down payment on a more robust, more flexible electricity transmission and distribution system.

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The most important element of this bill is that it puts a cap on carbon emissions that ratchets down over time. That critical step will drive investment decisions toward clean energy.

Imagine, for example, that you own a power company and are considering building more generating capacity. Building a new coal-fired power plant or a new nuclear plant is a serious, multi-billion dollar investment. And these investments could last at least 60 years. If you knew that carbon emissions had to decrease, would you build a coal plant without carbon capture and storage technology? Would the nuclear plant look more attractive? Would you consider investing in wind and solar?

On-again, off-again incentives will not drive the level of clean energy investment we need. A cap on carbon will give the energy industry the long-term direction and the certainty it needs to make appropriate technology and capital investment decisions.

To achieve our long-term goals in a cost-effective way, we will also need a sustained commitment to research and development. Only R & D can deliver a new generation of clean technologies.

Much of this work is underway at the Department of Energy using the resources provided in the Recovery Act. However, continued investment will be needed. S. 1733 would continue portions of this work, and the legislation reported by Chairman Bingaman's committee would also bolster these efforts.

I applaud you for holding this hearing and look forward to working with this committee and the full Senate to swiftly pass comprehensive clean energy and climate change legislation. Thank you.

Environment and Public Works Committee Hearing
October 27, 2009
Follow-Up Questions for Written Submission
Questions for Chu
Questions from:

Senator Frank R. Lautenberg

1. **I have worked with Chairman Boxer and other members of the Committee to increase the amount of funding for researching and developing the next generation of clean energy technology, which will fundamentally shift the way we use energy, while creating jobs and stimulating the economy. Can the U.S. successfully transition to a clean energy economy-and create the jobs that come along with it-if we fail to provide a significant investment in research and development by our most promising scientists and engineers?**

We have many low-carbon technologies available to us today, and we should put in place stable policies including comprehensive energy and climate legislation to deploy them and thereby reduce our carbon emissions.

Much of the current R&D activities underway at the Department of Energy using the resources provided in the Recovery Act work toward a successful transition. However, continued investment will be needed.

Senator James M. Inhofe

1. **Do you agree that the worker adjustment assistance provisions in Title 3, Part 2, sections 311 through 313 in Kerry-Boxer are needed because this bill will cost jobs?**

No. As I stated in my testimony, I believe that passing legislation that sets long-term carbon targets will send a signal to American industry that will result in innovation and new jobs. However, there will be some shifts in employment among various sectors during the transition to a low-carbon economy, and the provision you refer to is intended to address this.

2. **I understand new legislation usually entails new programs. But Sen. Webb compared the bureaucracy in Lieberman-Warner to "the old Soviet Union. Lieberman-Warner was 344 pages. Kerry-Boxer is 923 pages. Waxman-Markey is 1,400 pages. How would you describe the bureaucracy and mandates in this bill? And if this a market-based approach, why is all of this necessary?**

As I stated in my testimony, I believe the most important element of this bill is that it puts a cap on carbon emissions that ratchets down over time. That critical step will drive investment decisions toward clean energy. I do not have a view as to what is the appropriate number of pages for comprehensive clean energy and climate change legislation, but I am ready to work with you and other members of this committee and the Senate to craft a bill that moves us to a low-carbon, clean energy economy in the most efficient and effective way.

3. **Traditionally, DOE has focused its efforts on supporting RD&D related to development and early demonstrations of advanced unproven energy technologies. But in today's economic and financial markets there is a substantial gap, often called the "valley of death", in moving from development and demonstration to first-of-a-kind commercial-scale deployment of clean energy and CCS technologies. *Would* you agree that we face a "valley of death" problem with CCS technology deployment? If so, how can it be addressed?**

Through the Recovery Act and other measures, DOE is currently investing more than $4 billion in CCS projects. This investment is being leveraged by contributions from the private sector that reach almost $7 billion, indicative of the role DOE plays in mitigating the risks associated with early deployment of new technologies and helping to minimize the time required to deploy. In addition, advanced technology for Enhanced Oil Recovery using CO2 injection, which is included in some Recovery Act projects, can stimulate development of the CCS transportation infrastructure that will facilitate CCS deployment. There are a number of mechanisms that could be used to build on this work, some of which are included in the Kerry-Boxer bill.

4. **Given the recognized importance of avoiding "carbon leakage" for energy-intensive trade-exposed industries and the early deployment opportunities for industrial with CCS, shouldn't industrial projects be included in the first tranche of CeS deployment bonus allowances under the K,;,B (first 10 GW tranche now allocated solely to utilities)?**

DOE is investing more $4 billion in CCS, which will be matched by up to almost $7 billion more from U.S. industry. Of the $4 billion, approximately $1.3 billion of this amount will support an additional five to seven industrial scale demonstration projects retrofitting existing industrial facilities with innovative new carbon capture technologies.

5. **With, and without, a unilateral "carbon price signal," how do you envision the timeline and scope of CCS commercial deployment, industrials and power?**

I believe we must make it our goal to advance carbon capture and storage technology to the point where widespread, affordable deployment can begin in 8 to 10 years. I am convinced that this timeline can be achieved, but it will require sustained investment. DOE is investing more than $4 billion in CCS, which will be matched by up to almost $7 billion more from U.S. industry. I am also encouraged by the commitments other countries have made, and the international partnerships that are forming to drive this technology forward.

6. **What other commercialization program elements need to be in place? Given current limitations in private capital formation or mobilization, how can DOE successfully manage CCS technology to assure near-term commercial deployment?**

As noted above, I believe that the most important element of this bill is that it puts a cap on carbon emissions that ratchets down over time. That critical step will drive investment decisions towards clean energy, including CCS technology. DOE's applied R&D will also help to increase efficiency and reduce costs of CCS technologies.

7. **Is there urgency to better "rationalize" the full array of CCS technology RDD&D? How could this leverage the potential for deployment acceleration and the cost savings opportunities of non-utility industrials?**

As noted above, through the Recovery Act and other measures, DOE is currently investing more than $4 billion in CCS projects. These funds and programs will support research and development across a range of CCS applications. Secretary Chu has recently stated the goal of having CCS technology to the point widespread, affordable deployment can begin in 8 to 10 years.

8. **I read the proposal out of the Vice President's office that your department uses Recovery Act funding for a home energy labeling program that is still pending in legislation before Congress. Last I checked it's up to Congress to**

authorize programs and administrative agencies to implement them. Do you think that's wise to move forward with the home energy labeling program before Congress has had a chance to finish discussing it?

DOE has existing authorities to support the program you refer to, though DOE of course stands ready to work with Congress on pending legislation.

9. **Your own inspector general concluded in a recent audit, reported by the New York Times, that the Department is failing to properly track whether manufacturers that give their appliances an Energy Star label have met the required specifications for energy efficiency. Now you're proposing to energy star label every home in America. If you are not able to offer the American public confidence in the energy efficiency of a simple household appliance, how are you going to do that when it comes to existing homes, where there are so many more variables to account for?**

DOE is taking aggressive action to address the findings of the IG audit. DOE is pursuing the home labeling program you refer to because home energy use and bills can be substantial, and we believe that American consumers will reap substantial benefits from having access to robust, reliable information about home energy performance. DOE is also increasing its focus on enforcement in this area and has recently announced the creation of an enforcement team in the office of the general counsel.

10. **The "Recovery Through Retrofit" Report, released by the Office of the Vice President on October 19, 2009, proposes creation of an "Energy Performance Label and Measure" for existing homes. Please describe:**

a) the specific statutory authorities and exactly how funding under the Recovery Act (Public Law 111-5) will be used to develop and implement this proposal. And will use of these home energy labels and measures become a condition for state governments to receive funding for any state energy program, energy efficiency and conservation block grants or any other energy efficiency/conservation program?

This proposal will be implemented pursuant to the Energy Conservation Standards for New Buildings Act of 1976, the Department of Energy Organization Act of 1977, and the Energy Policy and Conservation Act of 1975, as amended. Funding under the Recovery Act will be used only in accordance with the provisions thereof. Funding for the State Energy Program and the Energy Efficiency and Conservation Block Grant Program will be provided consistent with the statutory and regulatory provisions governing those programs.

b) the opportunities that will be provided for stakeholders and the general public to provide their input on the impacts this proposal could have on the current housing market; and

Building labels will be created pursuant to the normal labeling process, which includes a substantial opportunity for public comment and participation.

c) the process and procedures by which the DOE, EPA or both will assure that an home's energy label accurately characterizes and adequately captures the variability in the designed and achieved performance of existing homes and that existing homes that receive an Energy Star label under the Administration's proposal will in fact, meet the specifications of that label.

DOE is developing testing protocols that will validate the labels by benchmarking them against the homes' actual electric and gas consumption. We intend to continue this sampling process indefinitely as we continuously improve the software and methodology for creating the label. Labels will only be generated by individuals certified to do so using methods approved by DOE and EPA. We expect that the label ratings will be based on an appropriate computer simulation of the building's energy use. The labels will advise the consumer that actual energy use will vary depending on how the building is operated.

11. **Section 163 would require the EPA Administrator, or other agency head or heads designated by the President, to promulgate regulations establishing building code energy efficiency targets by January 1, 2014. Which agency is best equipped to establish national energy efficiency building targets, the DOE or the EPA?**

DOE and EPA work closely on a range of energy efficiency programs. Traditionally, DOE has taken the lead on building codes; in addition, DOE is the lead for building efficiency standards under a recently signed EPA-DOE Memorandum of Understanding.

12. **Under current law, the DOE is charged with making determinations on national model energy codes and participates in the development of those codes. Does Section 163 conflict with the DOE's current responsibilities?**

Section 163 appears to create a binding, national energy code. Such a code does not exist under current law.

13. **When will loan guarantees for new nuclear plants be issued?**

As I stated at the hearing, DOE is working hard to finalize and make conditional awards. I remain hopeful that the first conditional awards will be made in the coming months.

14. **In the 2009 Omnibus Appropriations Act, Congress directed DOE to provide a report describing the development of the credit risk subsidy model and the economic assumptions used for the energy markets and technologies under consideration to receive loan guarantees. When will you submit that report?**

We will provide you a copy of the report, which was recently submitted to Congress.

15. If Yucca Mountain is not an option, when do you anticipate ceasing payments from the Nuclear Waste Fund to the State of Nevada?

This is an issue that will be addressed in future year budgets, and I am unable to provide information about such budgets at this time.

16. Since the Administration currently has no plan for the disposal of nuclear waste and spent nuclear fuel and no corresponding cost estimate, please provide a detailed justification for why the one mil fee shouldn't be adjusted commensurate with spending on the Yucca Mountain program.

The federal government retains the responsibility for the permanent disposal of spent nuclear fuel. The fees to which you refer will be used to fund that permanent solution. The Department of Energy has consistently determined, as required by the Nuclear Waste Policy Act, that the current fee of 1/10-cent per kilowatt hour is adequate to cover the total system life cycle costs of disposing of commercial spent nuclear fuel and high-level radioactive waste, using the assumptions in place at the time; and, in accordance with the Act, the fee will continue to be reviewed annually.

17. When will the blue ribbon commission on nuclear waste be established?

The details about the commission will be announced soon.

18. Will the blue ribbon commission consider Yucca Mountain as a potential site for a repository? If not, will the panel propose alternative locations or recommend a site selection process?

The details about the commission will be announced soon.

19. In what time frame do you ultimately foresee the Federal Government disposing of nuclear waste and spent nuclear fuel?

DOE will meet its obligations to permanently dispose of spent nuclear fuel and high-level waste. With respect to spent nuclear fuel, I believe it would be premature to set a deadline at this time. I am confident that, as the NRC has also indicated, spent nuclear fuel is safe in current dry storage facilities for many decades. I also look forward to the Blue Ribbon Commission's recommendations regarding nuclear waste storage, reprocessing and disposal of spent nuclear fuel.

Senator George V. Voinovich

1) Secretary Chu - Mr. Secretary, thank you for being here. As I am sure you are aware, language included in the Energy and Water Appropriations Bill expected you to suspend collection of payments to the Nuclear Waste Fund, because electric customers are paying for something they aren't getting - a permanent site to store spent nuclear fuel. I would like to know, given the Administration's decision to terminate the Yucca Mountain repository program what is your specific strategy to execute the statutory obligations of managing nuclear waste consistent with the Nuclear Waste Policy Act? As a possible alternative, would DOE cooperate with private entities that are interested in developing NRC licensed, private storage facilities - with DOE accepting the used fuel at the nuclear power plants, transporting the fuel to the private facility and contracting with the facility for storage services? As another alternative, would DOE provide storage for spent fuel at unused DOE facilities?

DOE will meet its obligations to dispose of spent nuclear fuel and high-level waste. The fees to which you refer will be used to fund that permanent solution. Your question also identifies several interim strategies for meeting these obligations. I expect that the Blue Ribbon Commission that will soon be announced will examine these and other options. I look forward to receiving those recommendations and working with Congress to set a new path forward.

2) Secretary Chu - Mr. Secretary, can you explain your vision for the Blue Ribbon Commission on Nuclear Waste. What is your schedule for putting this Commission together - and what is the time frame for their final recommendations? Do you believe this Commission will shed new light on a problem that DOE has extensively researched for the past 30 years?

The details about the commission will be announced very soon, and yes, I am very optimistic that new light can be shed on the problem of nuclear waste. I look forward to the commission's recommendations regarding nuclear waste storage, reprocessing and disposal of spent nuclear fuel.

3) Secretary Chu - I know that environmental groups have been placing pressure on you to deny loan guarantees for nuclear power plants if the NRC has questions regarding their design certifications. Does this factor into your decision for providing loan guarantees for nuclear plants? When can we expect a decision for the leading four nuclear power plant applications?

As I stated at the hearing, DOE is working hard to finalize and make conditional awards. I remain hopeful that the first conditional awards will be made in the coming months.

4) Secretary Chu - If carbon emissions are to be reduced by 83 percent by 2050, most energy technologies we use today will be obsolete. In Ohio, where more than 87 percent of electricity comes from coal, I am very interested in new technologies

being developed to utilize this abundant resource in cleaner, more efficient ways so as to generate the needed energy for Ohioans. What do you see as the Federal government's role in making sure that adequate technologies such as Carbon Capture and Sequestration exist, especially as it relates to coal? Is the federal government and/or private industry currently investing enough in energy research and development to allow the US to incorporate the technologies that will allow us to reach our midterm and long term emission reduction goals?

I believe we must make it our goal to advance carbon capture and storage technology to the point where widespread, affordable deployment can begin in 8 to 10 years. Through the Recovery Act and other measures, DOE is currently investing more than $4 billion in CCS projects. This investment is being leveraged by contributions from the private sector that reach almost $7 billion, indicative of the role DOE plays in mitigating the risks associated with early deployment of new technologies and helping to minimize the time required to deploy. In addition, advanced technology for Enhanced Oil Recovery using CO2 injection, which is included in some Recovery Act projects, can stimulate development of the CCS transportation infrastructure that will facilitate CCS deployment. I am convinced that this timeline can be achieved, but it will require rapid adoption of clear and stable enabling policies.

5) Secretary Chu - President Obama in his address to a joint session of Congress earlier this year called for 15 percent of cap and trade revenues to be used for research and deployment, yet the research component of the House ACES legislation allocations was only about one percent. The Boxer-Kerry draft increases this investment slightly, but not nearly to the amount called for by the President. What are the consequences of having such limited support for energy research?

We have many low-carbon technologies available to us today, and we should deploy them to reduce or carbon emissions. Our investment in energy R & D helps develop new technologies that may help enable us to meet our long-term emissions targets even more cost-effectively than we can today.

6) Secretary Chu - As I am sure you are aware, several Ohio institutions and businesses were successful in winning funding through the first round of ARP A-E awards. I wish I could take credit, but it is our outstanding scientists and engineers that really deserve the accolades. Is ARP A-E the best way to fund "high-risk, high-reward" research that has the best chance of commercialization? What do you think it will take to commercially develop viable carbon capture and storage technology?

I believe we must make it our goal to advance carbon capture and storage technology to the point where widespread, affordable deployment can begin in 8 to 10 years. I am convinced that this timeline can be achieved, but it will require sustained investment. DOE is investing more than $4 billion in CCS, which will be matched by up to almost $7 billion more from U.S. industry. I am also encouraged by the commitments other countries have made, and the international partnerships that are forming to drive this

technology forward.With respect to ARPA-E, I do not have a definitive answer at this time. However, I know that the recently-confirmed ARPA-E director will be looking across the energy technology portfolio to determine which technologies have technical barriers that could be addressed by this important program.

7) Secretary Chu -In your statement you mention DOE's investment of more than $3.4 billion in smart grid projects across the country. Can you give this committee a sense of the total investment that will be needed to create the electricity and transmission distribution system that will be necessary to more fully utilize solar and wind technologies (estimates vary from $60 billion to $100 billion). With the funding how long would it take to upgrade the grid? What hurdles would need to be overcome? Are there provisions in Kerry-Boxer to address those hurdles?

As you point out, the cost estimates for upgrading our electricity transmission and distribution system vary, but there is no question that the total price tag is in the tens and hundreds of billions of dollars. As I noted in my testimony, I believe the most important element of this bill is that it puts a cap on carbon emissions that ratchets down over time. That critical step will drive investment decisions toward clean energy, including investments in transmission. However, the bill includes a number of other provisions that focus on research, development and deployment of clean energy technologies. Finally, there are issues around siting that need to be addressed.

8) Secretary Chu - You have said in the short term, energy efficiency will be our most effective tool for reducing our carbon emissions. How close will today's marketplace energy efficiency technologies get us to our energy efficiency goals for 2020, 2030, and 2050? What specifically will Kerry-Boxer to help get us the rest of the way?

As I noted in my testimony, I believe the most important element of this bill is that it puts a cap on carbon emissions that ratchets down over time. That critical step will drive investment decisions toward clean energy, including investments in transmission. I believe that there are a number of policies to drive investments in energy efficiency. Minimum energy performance standards for appliances will continue to be important. Finding ways to more efficiently deliver and finance energy efficiency services to American families will be important. Aligning incentives for utilities to make deployment of energy efficiency will be important. The potential for energy efficiency is very substantial, but a range of tools and a sustained effort will be needed to realize the potential.

9) Secretary Chu - What do you believe is a credible estimate for the number of reactors that could be constructed in the U.S. with and without a climate bill by 2020? What about 2030 and 2050? How is the DOE engaged in developing a stronger nuclear industry in the U.S.? Do you believe existing designs for small, modular reactors are currently technologically feasible? Would you agree that having a domestic capability for manufacturing the entire reactor in the U.S. (including large forgings for existing Oen III and Oen III+ reactors, and smaller

forgings for small and medium reactors) would be the best approach for growing and maintaining a strong domestic nuclear industry?

I do not have an estimate for how many reactors can be built within the specific timeframes that you mention, but I would observe that the current fleet of reactors was built during a similar length of time. DOE is working hard to finalize and make conditional loan guarantee awards. I remain hopeful that the first conditional awards will be made in coming months. In addition, DOE's current research and development program includes work on advanced reactor systems that could provide improved economic performance, safety, and proliferation-resistance. Finally, the bill sets carbon emissions targets that ratchet down over time, which will favor nuclear and other low-carbon energy technologies. Indeed, EIA and EPA analyses of cap-and-trade proposals have predicted a significant expansion of nuclear power under cap-and-trade proposals similar to Kerry-Boxer.

Senator David Vitter

1. Mr. Secretary on October 8, 2009 you responded to a question about a few corporations leaving the Chamber by exclaiming "I think it's wonderful."
a. Would you please tell me what facts about the Chamber you relied upon to support the statement that the departures were "wonderful"?
b. In arriving at your position about the Chamber would you please tell me what Chamber documents you reviewed in formulating your position?
c. In formulating your position about the Chamber, did you have any discussions with any of the White House staff? What was the substance of the discussion?
d. In formulating your position about the Chamber, please tell me what environmental organizations you had conversations with about the Chamber and its position on climate change?
e. In formulating your position about the Chamber please tell me what corporations or individuals you had conversations with about the Chamber?

My comments about the Chamber reflect my belief, as stated in my testimony, that comprehensive clean energy and climate change legislation is essential to American economic competiveness in the future. A growing number of businesses agree.

2. On the same day, according to press reports, you stated: "I think companies like that-Exelon, for example, others-are saying that we have to recognize the reality: In order to position the United States in an economically competitive place, and also to minimize the dangers of significant climate change for our children and grandchildren, we have got to go in this direction."
a. Mr. Secretary, according to Bernstein Research, Exelon's CEO John Rowe told investors that if the climate legislation being proposed is passed Exelon will initially receive $700 to $750 million in annual revenues for every $10 per metric ton increase in the price of C02 allowances. Mr. Rowe estimates that climate legislation will contribute 67 to 72 cents per share in 2012 and as the price of allocations rise Exelon will receive $1 to $1.30 cents per share, courtesy of the U.S. taxpayers. My question is: Does the Obama administration support giving tens of billions of taxpayers' dollars to a corporation just because the corporation supported the administration's policy objectives?

My comments about Exelon reflect my belief, as stated in my testimony, that comprehensive clean energy and climate change legislation is essential to American economic competiveness in the future. I also believe that the legislation will create powerful incentives for energy companies to invest in the development and deployment of the technologies what we need to meet our energy and climate challenges.

3. Mr. Secretary, you said on April 23, 2007, that "Coal is my worst nightmare." Yet this bill that we are being asked to consider places a great deal of responsibility in your hands for the future of coal, including but not limited to the formation of a national strategy for carbon capture and sequestration deployment. How will you reconcile your obvious dislike of coal as an energy technology for this massive new

responsibility not only to get CCS deployed, but get it deployed as quickly as possible?

I have been consistent in my statements that because the U.S. has enormous coal reserves, and because other countries will continue to rely on coal for electricity, we are aggressively moving CCS technology towards widespread commercial deployment.

4. Mr. Secretary, earlier this year you killed funding for hydrogen-fueled vehicles, saying in an article the technology needs four "miracles" before it can become widely adopted, but "saints only need three." The Congress has voted to restore most of the funding in appropriations bills we are sending to the President.

a. Will you advise the President not to sign the Department's appropriations bill given that the hydrogen car program has been restored?

b. Given the relative uncertainty of our low-carbon technology options in the face of sharp C02 cuts in a bill like this, don't you think that all technologies should be given a chance to succeed? Are you in the business of picking energy winners and losers?

I have consistently stated that we need a portfolio approach to developing and deploying low-carbon energy technologies.

5. On October 20, you said that the U.S. should enact C02 limits without a border tariff, saying that it "does no one good." I do not disagree with you, but realize also that this still leaves us the problem of international competitiveness to deal with. If we enact this bill and nobody else does, we are making our industrial manufacturing more expensive in the U.S. and giving manufacturers in China, India and others an advantage. What do you propose in the alternative to a border tariff?

I believe there are a number of approaches that can be used to address legitimate concerns about competitiveness impacts on energy-intensive, trade-exposed industries and the carbon leakage that could result as a consequence. The Administration believes that the most effective approach to address concerns with carbon leakage and competitiveness is to negotiate a new international climate change agreement that ensures that all the major emitters take significant actions to reduce their greenhouse gas emissions. To complement this effort, we have pursued actions in other international for a to ensure a level playing field that can maximize the environmental benefits of our policies without risking competitiveness and leakage problems, including the G20 initiative spearheaded by the President to phase-out fossil fuel subsidies and our joint proposal with Canada and Mexico to phase-down emissions of HFCs, a potent greenhouse gas, in developed and developing countries under the Montreal Protocol. The Administration will weigh various options in the context of our international commitments, as well as our domestic policy goals. I would also note that China and other countries are investing heavily in clean energy technologies. We are already falling behind in technologies that we pioneered. The greatest risk we face is from skipping the clean energy race, not from joining it.

Senator John Barrasso

1) You recently announced a goal for deployment of carbon capture and sequestration technology in 8 to 10 years. You also said that coal is likely to be a major and growing source of electricity generation for the foreseeable future. I agree that coal will be an integral part of our energy future. We cannot turn our backs on coal. Coal is affordable, abundant, and reliable. America has the tools and the brains to make carbon sequestration a reality. Unfortunately, there is little discussion about the legal framework for long-term carbon storage.
Do you think carbon capture and sequestration can become a reality without first putting the legal framework in place?
Will companies proceed with long-term storage without certainty regarding liability or who owns the pore space?
Do you think building the legal infrastructure for long-term carbon storage should be a part of legislation aimed at reducing greenhouse emissions?

I agree that having a legal framework in place is a critical component of rapid development and deployment of CCS technology. In July, 2008, EPA proposed a rule to regulate the injection of CO2 into geological formations. EPA has proposed this rule under the authority of the Safe Drinking Water Act's Underground Injection Control Program. DOE has been working very closely with EPA in the development of this rule. The final rule is currently expected next year. Several states also have passed or have pending legislation to address CO2 injection into geological formations. I do not have a view at this time as to whether additional legislation is required, though I would be glad to work with you to explore this issue further.

Senator Lamar Alexander

You have been very supportive of nuclear power and made recent statements that we should increase loan guarantee levels and that we need to be building nuclear power.

1. You say that a utility might consider wind or solar in building new capacity. Under current technologies, can wind or solar provide reliable base-load day-in, day-out power to utilities?

I believe that we will need a mix of power sources, including both renewables and traditional sources like nuclear. The extent to which renewables can provide base-load power depends in large part on energy storage technologies, and we should certainly use renewable energy to meet peak loads when it is economical to do so. We have some viable energy storage solutions today, and I am optimistic that we will develop even better ones in the coming years.

2. You say in your testimony that EIA found, globally, the cumulative investment in wind turbines and solar photovoltaic panels from now through 2030 could be $2.1 trillion and $1.5 trillion. Was there a comparable figure for nuclear and coal with carbon capture?

I do not have comparable estimates for the size of these other markets, though I believe that they will also be substantial markets that offer major economic opportunities for the United States.

3. What do you think is holding back industry from building new nuclear reactors? How would you propose to address such barriers?

One barrier is financing, and we are working to address that now by moving to make conditional awards using the $18.5 billion of nuclear loan guarantee authority that DOE already has.

4. What does S. 1733, the Kerry-Boxer bill do to expand the deployment of nuclear power?

This bill sets carbon emissions targets that ratchet down over time, which will favor nuclear and other low-carbon energy technologies. Indeed, EIA and EPA analyses of cap-and-trade proposals have predicted a significant expansion of nuclear power under cap-and-trade proposals similar to Kerry-Boxer.

5. Do you think American nuclear power plants are safe?

Yes, our nuclear plants generally have excellent safety records. However, I believe that safety must continue to be at the top of the list for industry and the NRC alike as we move to restart the nuclear industry in the United States.

6. Can we store used nuclear fuel safely for 40, 60, or even 80 years?

The NRC has said that we can safely store spent nuclear fuel in dry casks over these time frames, and I agree with this assessment.

7. Do you believe we are likely to find a way, with the next 10 or 20 years, to recycle used nuclear fuel that:
a. doesn't isolate plutonium?
b. we can end up with a waste that's not dangerous for more than 300 years?
c. limits the volume of waste to 10%,5%, or even 3% of its current volume?

I am hesitant to provide specific benchmarks. However, DOE's current program includes research on advanced, proliferation-resistant nuclear fuel cycle and waste management technologies that can minimize wastes, and research and development of advanced reactor systems that could provide improved economic performance, safety, and proliferation-resistance. I look forward to the Blue Ribbon Commission's recommendations on this and other issues regarding storage, reprocessing and disposal of spent nuclear fuel.

8. Is isolating plutonium the most likely root of nuclear proliferation or is it more likely that North Korea will produce its own enriched uranium?

There are a range of nuclear proliferation risks. Whether enrichment or reprocessing presents the greater proliferation risk depends on the technology paths available to any potential proliferating nation. However, with respect to today's technologies for reprocessing spent nuclear fuel, separation of plutonium is only one drawback. These technologies are also uneconomic and do not sufficiently address the waste problem. For these reasons, we continue to pursue R & D on more promising technologies.

9. Secretary Chu, in your testimony you said, "The only question is which countries will invent, manufacture and export these clean technologies and which countries will become dependent on foreign products?"
a. Is it possible that nuclear power is another technology where we might become dependent on foreign innovation, technology, and products? Is there anything we might do to regain our lead?

I agree that nuclear power offers a great opportunity for the U.S. and nuclear will need to be part of our energy mix. DOE is working hard to finalize and make conditional loan guarantee awards. I remain hopeful that the first conditional awards will be made in coming months. In addition, DOE's current research and development program includes work on advanced reactor systems that could provide improved economic performance, safety, and proliferation-resistance.

10. In recent weeks you have been quoted as saying we should double loan guarantees for nuclear power to build an additional 4-5 plants. Do you believe it would be a good idea to increase loan guarantees for all carbon free electricity?

As I have noted, the $18.5 billion in nuclear loan authority currently available to the DOE will enable the Department to guarantee loans for 3-4 projects in the pipeline to build new reactors. I remain hopeful that the first conditional awards will be made in the coming months.

11. Current proposals in the House and Senate would require a "Renewable Electricity Standard" that up to 20% of our electricity to come from a narrowly defined list of sources - mostly wind and solar. Shouldn't our goal be to encourage any carbon free production of electricity rather than picking specific technologies to achieve that goal? Why not, instead, propose a "Carbon-Free" or "Reduced Carbon" Electricity Standard?

I believe that nuclear power must continue to be a part of our energy mix, and that the clean energy and climate bill passed by the Senate should reflect and contribute to achieving that goal. I would be pleased to work with you to further develop this legislation.

Senator BOXER. Thank you very much.

The Honorable Ray LaHood, Secretary, U.S. Department of Transportation.

STATEMENT OF HON. RAY LAHOOD, SECRETARY, U.S. DEPARTMENT OF TRANSPORTATION

Mr. LAHOOD. Chairman Boxer, Ranking Member Inhofe and members of the committee, thank you for inviting me to discuss the Clean Energy Jobs and American Power Act. I appreciate the challenge you and your colleagues have undertaken in this important bill.

President Obama's Administration and the Department of Transportation believe that making the transition to a clean energy environment and combating climate change are major priorities, and the time to act is now. We also understand that transportation contributes to and is affected by climate change, and therefore our transportation policy must be a part of the solution.

To that end, transportation will play a vital role in helping to reduce greenhouse gas emissions, decrease our reliance on oil, create more livable, sustainable communities and generate green jobs. Let me review some of the actions already underway.

In recent months, DOT has teamed up with the Department of Housing and Urban Development and the Environmental Protection Agency to better direct Federal investments in transportation, housing, improved air quality and water infrastructure across the country. Our agencies support coordinated infrastructure investments and economic development as a means of creating more livable neighborhoods while residents in urban, suburban or rural communities can get to work, school, the doctor or the grocery store without having to get into an automobile.

We know that in the U.S., shifting just 10 percent of its new housing starts to livable communities over the next decade, Americans would save nearly 5 billion gallons of gasoline. And people who live in walkable communities served by transit have a much smaller carbon footprint than those in car dependent communities and spend less on transportation as well.

To move this agenda forward, our agencies would like to partner with Congress to align our programs to ensure Federal spending is effectively leveraged with other public and private investments. We are consulting on performance measures that could be used to determine outcomes, and we are developing an affordable index and other tools to help achieve our goals. We are also providing joint technical assistance through EPA to communities interested in coordinating these types of investments right now. And we are collaborating on implementing sustainable community grants through HUD, if they are funded in the 2010 appropriations bill.

Through the American Recovery and Reinvestment Act, DOT is making significant investments in transportation-related projects that reflect our livable and sustainable priorities. Liveability for instance, is given significant weight as part of the $1.5 billion TIGER grants, and applications are currently under review. As you know, we are also investing $8 billion for high speed rail corridors and other inter-city rail passenger service. The Federal Railroad Administration's long-term plans seek to build upon this initial in-

vestment with a national network of passenger rail corridors that improve mobility, service, convenience, safety and efficiency, all of which contribute to developing livable, sustainable communities.

In pursuit of our climate change goals, we are planning to work with EPA to develop and implement fuel economy and greenhouse gas emissions standards for medium and heavy trucks. This follows our successful collaboration to propose harmonized national fuel economy and emissions standards for light duty vehicles and trucks. We are greatly encouraged by our ability to work together to achieve the best possible regulations without imposing undue hardships on industry. We believe this intergovernmental approach can serve as a model for future Government action in this area.

We look forward to working with Congress to support robust transportation planning techniques and target investments toward projects that reduce emissions and fuel consumption. We understand that State DOTs and metropolitan planning organizations will need new tools, technical assistance, capacity building and resources to determine which investments generate the best outcomes.

There are many, many other promising initiatives underway throughout DOT, too numerous to discuss. I will mention just a few. The Federal Highway Administration is developing cost effective strategies and performance measures to determine progress in reducing emissions. The Federal Aviation Administration is conducting research to improve our scientific understanding of the impact of aviation emissions on climate and working with domestic and international stakeholders to develop appropriate strategies to develop a global impact of climate change.

And finally, the Federal Transit Administration is working to expand access to public transportation, support transit-oriented development and conduct research to help public transportation agencies operate more efficiently.

We are delighted to be here, and we look forward to your questions.

[The prepared statement of Mr. LaHood follows:]

STATEMENT OF
THE HONORABLE RAY LAHOOD
SECRETARY OF TRANSPORTATION
BEFORE THE

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS
U.S. SENATE

HEARING ON

CLEAN ENERGY JOBS AND AMERICAN POWER ACT OF 2009

OCTOBER 27, 2009

Chairwoman Boxer, Ranking Minority Member Inhofe, and Members of the Committee:

Thank you for the opportunity to discuss the Clean Energy Jobs and American Power Act. I congratulate you on the difficult work you and your colleagues have undertaken on this bill and your efforts to improve America's economic competitiveness and prosperity, reduce the Nation's impact on climate change, and ensure America's energy security.

Transportation will play a key role in achieving clean energy and climate objectives. I look forward to continued discussions to ensure that comprehensive legislation is passed that advances our clean energy goals, protects our environment for this and future generations, and ensure economic prosperity for all Americans.

The Obama Administration and the Department of Transportation (DOT) consider transition to a clean energy environment and combating climate change a major priority, and the time to act is now. We are committed to generating green jobs, decreasing our reliance on oil, reducing pollution, and creating more livable, sustainable communities. And we are already taking aggressive steps to act on these priorities. For instance, the Administration -- with the full support and involvement of DOT -- is dramatically improving the fuel economy of automobiles, intensifying energy efficiency and renewable energy efforts through the American Reinvestment and Recovery Act of 2009 (Recovery Act), and working through interagency partnerships to build livable and less energy intensive communities.

Transportation both contributes to and is affected by climate change, and I am committed to ensuring that transportation is part of the solution. The Department is focused on substantially reducing transportation's contributions to greenhouse gas (GHG) emissions and adapting to potential impacts on transportation infrastructure. This work includes improving vehicle fuel economy, developing alternative fuels, improving system efficiency and encouraging more sustainable transportation choices, as well as understanding climate impacts and protecting transportation infrastructure. And we are working with other Federal agencies, as well as State and local governments and our transportation stakeholders, to accomplish this critical work.

Because this committee has jurisdiction over both the climate change legislation and surface transportation reauthorization, you will be at the forefront of ensuring that comprehensive climate legislation works in concert with Federal transportation policies and investments. I look forward to working with you on this effort.

We recognize that government leadership at all levels will be needed to transform our transportation system into one that allows Americans to get to work, school, the doctor, the grocery store, or the park without being required to get into a car. To achieve this goal, we will need the most effective tools and strategies possible.

We have much more to do, but we are not waiting to begin taking aggressive and meaningful actions. I am particularly pleased with one of our efforts. In recent months, DOT has been working with the Department of Housing and Urban Development (HUD) and the Environmental Protection Agency (EPA) in an interagency partnership for sustainable communities to develop Federal policies that could help support and shape State and local land use decisions and infrastructure investments to develop livable communities where people have the option to drive less. The promise is that this approach might lower the climate impact from the transportation sector, while also saving American families money and increasing their mobility. Currently, American adults travel a total of 25 million miles a day in trips of a half-mile or less and nearly 60 percent of these are motor vehicle trips. DOT, HUD, and EPA are working together to support the building of more livable neighborhoods with "complete" streets that increase safety and mobility for all users by giving Americans –whether they live in urban, suburban or rural communities--the choice of walking, biking, or riding transit instead of driving motor vehicles. If the presence of these alternatives promotes less driving, then that will reduce road congestion, reduce pollutants and greenhouse gases, and use land more efficiently.

Reducing GHG emissions may be achieved through changing local transportation and land use patterns. For instance, assuming that more travel options and supporting land use would reduce vehicle miles traveled, an EPA analysis found that shifting 10 percent of new housing starts to livable communities over the next 10 years would save Americans roughly 4.95 billion gallons of gasoline. Minneapolis-St. Paul is a good example of the benefits of adopting livability strategies. More walkable and bikeable neighborhoods in the area have the potential to deliver estimated GHG savings from walking and biking equal to the benefits from a shift of 12 percent of vehicles to hybrids. The recently released *Moving Cooler* study, funded by a number of diverse stakeholders, also recognizes the substantial environmental and energy benefits resulting from livable communities. It found that compact development, complemented with pricing strategies and support for alternative transportation modes, could reduce CO_2 emissions by up to 15 percent by 2050. These studies suggest that promoting mixed-use, connected communities has the potential to reduce vehicle miles traveled, and thereby significantly contribute to U.S. carbon dioxide emissions reductions.

DOT, HUD, and EPA are identifying ways to align our agencies' programs to ensure that our spending is effective and leveraged with other public and private investment. We are

consulting with each other on performance measures that will be used to determine the results we can expect from these efforts. We are jointly identifying Federal barriers that impede performance of our programs and will seek to have them removed. We are providing joint technical assistance through EPA's Smart Growth Implementation Assistance Program competition and will collaborate on the implementation of HUD's Sustainable Communities Grants if they are funded in the FY 2010 Appropriations bill. We are also working to enhance the skills of transportation and housing planners, and to develop tools such as an affordability index.

DOT has worked to ensure that livability and sustainability objectives are given significant weight in the new discretionary spending of the Department as part of the Recovery Act. The Transportation Investment Generating Economic Recovery (TIGER) team is currently in the process of awarding $1.5 billion worth of competitive grants for State and local governments for projects with significant long-term impact for the nation, metropolitan area, or region. Criteria for selection include the project's contribution to sustainability and livability.

Additionally, the Recovery Act provided $8.4 billion for transit to support projects in bus and rail car manufacturing, operation and maintenance, fixed guideway improvements, and work that supports the operation of high efficiency buses, among other sustainable transit needs. Selections have been made for $100 million in discretionary grants through the Transit Investments for Greenhouse Gas and Energy Reduction (TIGGER) program with livability and sustainability goals included as project funding criteria.

The Recovery Act also provides $8 billion for high-speed rail corridors and other intercity passenger rail services. The high-speed rail initiative developed by the Federal Railroad Administration seeks to fund a long term program to plan and build a national network of passenger rail corridors. Preferred projects will improve mobility, options, service, convenience, safety, and efficiency, and contribute to economic recovery and development, as well as support environmental equality and livable communities.

Through the Clean Energy Jobs and American Power Act, Congress can help to foster partnerships, encourage cross agency collaboration, and better ensure that livability is institutionalized as a part of transportation decision making.

We also look forward to partnering with EPA, as our agencies work to develop and implement fuel economy and GHG emission standards for medium and heavy trucks. DOT and EPA each have expertise in developing harmonized standards that recognize the dual objectives of reducing consumption of fossil fuels and GHG emissions. DOT and EPA each bring unique expertise that, through collaboration, is likely to result in more rigorous yet achievable standards. And our recent cooperation in proposing harmonized national fuel economy and GHG emission standards for light-duty vehicles and trucks is an example of how the two agencies can successfully coordinate to deliver substantial fuel economy and environmental benefits. Such collaboration can contribute to produce the best possible regulation of mobile sources without imposing undue or conflicting burdens on industry.

Our past success argues for continued cooperation. On May 19, 2009, President Obama announced a historic national policy to reduce GHG emissions and improve fuel economy for all new cars and light duty trucks sold in the U.S. On September 15, DOT and EPA announced a joint proposed rulemaking that would set fuel economy and tailpipe carbon dioxide emissions standards for passenger cars, light-duty trucks, and medium-duty passenger vehicles, covering model years 2012 through 2016. The standards, taken together, would deliver a fleetwide fuel economy standard of 35.5 miles per gallon by 2016. According to EPA's preliminary analysis, the standards, if finalized, are projected to reduce GHGs by approximately 950 million metric tons and save 1.8 billion barrels of oil over the life of the program. The program would reduce GHG emissions from the U.S. light-duty fleet by 19 percent by 2030.

Another way to achieve our clean energy and climate goals is through more effective transportation planning. We would like to work with Congress to support robust transportation planning techniques to target investments to projects that reduce GHG emissions and fuel consumption. One strategy for reducing transportation-related GHG emissions is by integrating transportation planning with housing, land use and water infrastructure planning. As new or additional development is contemplated, considering where people will be located, where they will need to go, and how they should be able to get there, can promote better efficiencies, system performance and lower carbon emissions.

DOT's experience and statutory jurisdiction to implement transportation planning regulations lends itself well to accomplish the transportation planning goals contemplated in the bill. A key mechanism by which DOT can have an impact on climate change is through our role in financing infrastructure and promoting effective transportation planning across the United States, including highways, airports, transit systems, and multi-modal facilities. We have a unique opportunity to shape the transportation infrastructure of the future to promote livability and to reduce the environmental impact of transportation.

State DOTs and metropolitan planning organizations (MPOs) have limited experience with the kind of planning promoted in this legislation. Consequently, we need to make sure the program does not become unnecessarily complex and does provide the most efficient and effective route to reduce emissions. DOT, along with our partners at HUD and EPA, are excited to work with Congress to find the best way to invest infrastructure dollars to decrease GHG emissions and increase mobility and economic vitality – three areas that are inexorably linked.

The Department is already taking a number of other steps to address transportation-related GHG emissions.

DOT's Center for Climate Change and Environmental Forecasting sets priorities for climate change policy analysis and research. One example of the Center's work is *The Impacts of Climate Variability and Change on Transportation Systems and*

Infrastructure. This case study of the Gulf Coast was designed to understand and address the possible effects of climate change on transportation infrastructure and aid transportation decision makers in determining how to account for potential impacts in the transportation planning process. Phase I of the study was completed in 2008 and studied how changes in climate over the next 50 to 100 years could affect transportation systems in the U.S. central Gulf Coast region. Phase II, which was just launched, will explore more detailed information about impacts at the local level. Phase II will be completed in about three years, and will develop guides for transportation planners, including a risk assessment tool to allow decision makers to understand vulnerability to climate change. This important work has already gained considerable interest within the transportation community about planning for transportation investments.

The Center is overseeing preparation of a report to Congress on the impact of the Nation's transportation system on climate change, and solutions to mitigate climate change by reducing GHG emissions from the transportation sector. The report, mandated by the Energy Independence and Security Act of 2007, will identify national policy approaches, evaluate pros and cons, and estimate magnitudes of emission reductions. This research will allow DOT to evaluate the implications of various approaches on other transportation goals. The report results will compare strategic options to reduce transportation emissions and will inform future research and policy development.

The Center's Transportation and Climate Clearinghouse was launched in early 2009 and includes information on GHG inventories, analytic methods and tools, GHG reduction strategies, potential impacts of climate change on transportation infrastructure, and approaches for integrating climate change considerations into transportation decision making.

Additional efforts are underway throughout DOT's operating administrations. The Federal Highway Administration (FHWA) climate efforts include mitigation and adaptation work on improvements to system efficiency, land use, and planning. FHWA is working to evaluate how land use, transportation infrastructure, and policy changes would affect travel activity and GHG emissions. FHWA is also working to develop cost-effective strategies and performance for measuring progress in reducing emissions. FHWA is working with State DOTs and MPOs around the country to address climate change in transportation planning decisions.

FHWA is also developing a strategy to address climate adaptation issues, and a draft framework for conducting risk-based assessments and transportation infrastructure. Guidelines will be developed for consideration of climate change impacts and adaptation in project development and environmental review under the National Environmental Policy Act.

In addition, FHWA has several programs underway to enhance system efficiency by developing and implementing innovative solutions to reduce traffic congestion and its effects on the environment, including: enhanced design and implementation of work zones; quicker response to traffic incidents; improved timing of traffic signals and other

traffic management strategies; provision of information to allow travelers to make informed decisions en route, mode and timing of trips; highway design improvements to remove bottlenecks; and better balancing of supply and demand through congestion pricing where appropriate.

The Federal Aviation Administration (FAA) leads the transformation to the Next Generation Air Transportation System (NextGen). One key NextGen environmental goal is to limit or reduce the impact of aviation GHG emissions on the global climate. To achieve this, a key approach is to more efficiently use the Nation's airspace, which will lead to less fuel use and therefore have a positive GHG and air quality impact. In an effort to reduce fuel burn and other emissions, FAA is developing and improving environmentally friendly procedures covering gate-to-gate, terminal, and surface operations.

FAA is leading work to improve scientific understanding of the impacts of aviation emissions on climate. With participation from the National Aeronautics and Space Administration, the National Oceanic and Atmospheric Administration, and EPA, FAA launched the Aviation Climate Change Research Initiative (ACCRI) to accelerate scientific understanding that will inform policy decisions on mitigation. FAA also launched the Continuous Lower Energy Emissions and Noise Program (CLEEN) to advance maturing engine and aircraft technologies for quick deployment into the fleet in order to increase fuel efficiency and reduce emissions. FAA helped form—and is an active participant in—the Commercial Aviation Alternative Fuels Initiative (CAAFI). CAAFI is a broad public-private collaboration that seeks to develop and deploy alternative jet fuels for commercial aviation which offer reductions in life cycle emissions.

In addition, FAA is conducting research to inform Administration decisions about potential impacts on domestic and international aviation of possible policies and their impacts on the climate change. These policies include aircraft carbon emissions standards, emissions cap and trade, and carbon taxes on aviation emissions.
The unique nature of the aviation sector means that its environmental impacts are not only domestic, but international in scope. To that end, the FAA has also been working with other Federal agencies, including EPA and the Department of State, within the context of ongoing negotiations in the International Civil Aviation Organization to develop a global framework to mitigate aviation's impact on climate change.

The Federal Transit Administration's (FTA) work on climate change falls into two main areas: (1) catalyzing expanded public transportation service and transit-oriented development to reduce overall transportation emissions while providing convenient and economic mobility options; and (2) technology research and deployment that will enable local public transportation agencies to provide their already relatively energy efficient service in an even more efficient manner.

FTA's grants, technical assistance, research, and policy leadership all play a role in the agency's efforts to address climate change. FTA funds public transportation through the

agency's grant programs. FTA also provides technical assistance in planning and transit-oriented development. Combining investment in public transportation with compact, mixed-use development around transit stations creates synergies that amplify the greenhouse gas reductions of each strategy and enhance overall livability and sustainability goals of the Department. FTA's research on alternative fuels and high efficiency vehicles has yielded the introduction of hybrid-electric buses, hydrogen fuel cell buses, and other low emissions technologies. Transit vehicles make ideal demonstration vehicles because of their high visibility and centralized maintenance.

FTA is funding a new synthesis on GHG emission savings from transit through the Transit Cooperative Research Program. FTA is developing a handbook for transit agency managers of low carbon practices and also offers environmental management systems (EMS) training. FTA also has sustainability partnership projects with the American Public Transportation Association and the Association of Metropolitan Planning Organizations.

The Research and Innovative Technology Administration (RITA) coordinates the majority of the Department's surface transportation research on alternative fuels, alternative vehicles, hydrogen fuels and fuel cells, and advanced vehicle technology, all of which address climate change concerns. RITA also works on multiple research projects regarding hydrogen, including finding safe and effective storage materials, testing hydrogen fuel cell vehicles, and training emergency responders on hazardous characteristics of hydrogen.

DOT, in partnership with EPA, will analyze ways to reduce transportation-related GHG emissions while continuing to support efforts to attain air quality and water quality standards, learn more about harm from air toxics related to transportation, and maintain noise reductions. Our climate change research will help us identify the potential co-benefits of mitigation strategies, such as reductions in criteria air pollutants, as well as potential unintended consequences of mitigation strategies, such as increased risks to public health.

DOT is fully committed to reducing energy consumption and greenhouse gas emissions from across the transportation sector. DOT will continue to work with the White House Office on Energy and Climate Change Policy, the other Federal agencies, State and local governments, and the transportation community to identify and pursue the most critical climate change priorities.

DOT is also committed to working with Congress to ensure the passage of comprehensive clean energy and climate change legislation that provides the most valuable tools to achieve the most effective emissions reductions while supporting economic growth and prosperity.

In closing, I applaud your efforts to further the debate and move us much closer to comprehensive and effective solutions. Thank you, and I look forward to answering your questions.

Environmental and Public Works Committee Hearing
October 27, 2009
Follow-Up Questions for Written Submission

Questions for Secretary LaHood

Questions from:

Senator James M. Inhofe

1. Do you agree that the worker adjustment assistance provisions in Title 3, Part 2, sections 311 through 313 in Kerry-Boxer are needed because this bill will cost jobs?

The Department of Transportation (DOT) is confident that the bill will create green jobs in the transportation sector in the effort to transition to a clean and sustainable transportation system.

2. I understand new legislation usually entails new programs. But Sen. Webb compared the bureaucracy in Lieberman-Warner to "the old Soviet Union." Lieberman-Warner was 344 pages. Kerry-Boxer is 923 pages. Waxman-Markey is 1,400 pages. How would you describe the bureaucracy and mandates in this bill? And if this is a market-based approach, why is all of this necessary?

The cap-and-trade provisions of the various comprehensive bills actually account for only a fraction of the content of the bills, and certainly only a fraction of the total pages. We look forward to working with Congress to implement comprehensive energy legislation that achieves its objectives at the minimum cost to the U.S. economy.

3. Secretary LaHood, when you appeared before this Committee back in July, I asked you to explain the contradiction between the Administration's opposition to paying for a transportation bill by increasing the federal gas tax—a position I support, by the way—and the Administration's support for a cap-and-trade proposal, which by design will increase the cost of gasoline. Estimates show the increase due to cap-and-trade to be at least 20 cents per gallon, effectively doubling the current federal gas tax. Many estimates show the increase to be even higher. Could you please explain this contradiction in the Obama Administration's position on increasing consumer costs?

Most of the climate bills before the Congress create mechanisms that cushion the impact of allowance prices on the American public. In any case, EPA's analysis of the costs of the Waxman-Markey Bill, which EPA believes is broadly applicable to the Boxer-Kerry Bill as well, suggest that the cost per household in 2020 will be less than $0.50 per day.

4. Your written testimony references the *Moving Cooler* report to argue that changing transportation and land use policies can reduce greenhouse gas emissions. According to that report, the 15 percent reduction you cite would require enacting a growth boundary on all cities of more than 50 thousand people; taking local land use decisions away from local governments and giving them to Metropolitan Planning Organizations; requiring that at least 90 percent of new development be only multifamily homes or on lots of 1/8th an acre; and increasing annual transit, bike and pedestrian spending by 500 percent. The pricing strategies your testimony refers to include increasing the gas tax to $2.71 a gallon—a fifteen hundred percent increase over the current 18 cents a gallon tax, adding a national Vehicle Miles Traveled tax on top of this higher gas tax, tolling the entire interstate, charging a fee to drive into the downtown areas of all metro areas of more than 50 thousand people, and charging a minimum of $200 a year to park in front of their own homes.

a. Do you support any of these measures, including the ones seemingly endorsed in your written testimony?

The *Moving Cooler* report analyzed an array of actions that can be taken to reduce greenhouse gas emissions from transportation. The analysis combined groups of actions that together might achieve significant reductions in emissions. The *Moving Cooler* "packages" of strategies could assist State and metropolitan transportation planners in evaluating which strategies might be most appropriate for a particular area or state, in cooperation with land use, housing and environmental planners. DOT testimony stated that *Moving Cooler* and other studies suggest that promoting mixed use, connected communities reduces vehicle travel and contribute to carbon dioxide reductions. The Department has not endorsed any particular package of strategies analyzed in the study or the predicted benefits.

b. Are these the types of measures you would fund under the discretionary grant program included in the Kerry-Boxer bill?

The Department continues to review the Manager's Amendment and has not yet developed a position on each section of the recently released Manager's Amendment. Our understanding of section 113 is that it could provide funds for developing and updating transportation GHG reduction targets and strategies. It could also fund implementation of those strategies included in statewide and metropolitan transportation plans that meet performance requirements and comply with other Federal laws. These planning efforts could consider the types of strategies described in section 112 of the Manager's Amendment. Strategies for meeting transportation and environmental objectives through the transportation planning process could also be considered as the Administration works with Congress in reauthorizing Federal surface transportation programs.

5. This bill would require all States and all metropolitan planning organizations (MPOs) serving transportation management areas to use scenario analysis when formulating transportation plans.

a. What percentage of States and covered MPOs currently use scenario analysis as defined in the Kerry-Boxer bill?

The Federal Highway Administration (FHWA) estimates that approximately 10 percent of MPOs, as defined in the Kerry-Boxer Bill, currently use scenario analysis. However, the majority of scenario analysis to date has not been focused on reducing greenhouse gas emissions.

b. How much money would it take for an individual State or MPO to make the switch to such a scenario analysis?

The cost of a scenario analysis depends on the level of sophistication of the analysis. FHWA estimates that the low end of the range could be approximately $50,000. The use of more sophisticated software and tools, along with the assistance of a consultant, could cost from $60,000 to $100,000.

c. How long would it take for a State or MPO to make the change to using scenario analysis?

This is dependent on the current modeling capabilities of the MPO, whether it has in-house modeling expertise, and the accessibility of modeling consultants.

6. Section 113 of the chairman's mark establishes a discretionary grant program to be administered by the Secretary of Transportation. The language, however, is not consistent as to whether awards are to be made to implement transportation plans, the new requirements for greenhouse gas emissions targets and strategies, or individual projects. At which level of specificity would you anticipate awarding grants under this language?

DOT will gladly work with the Senate to determine the best possible strategy to award grants under the bill's language. We are proud of our experience with implementing the discretionary spending as part of the American Recovery and Reinvestment Act (ARRA). Our Transportation Investment Generation Economic Recovery Team (TIGER) is currently in the process of reviewing applications for $1.5 billion worth of competitive grants for state and local governments for projects with significant long-term impact for the nation, metropolitan area, or region. Sustainability and livability are infused into our selection process for these grants. While TIGER is focused on individual projects, we could utilize this experience to fit any discretionary grant program Congress decides to fund though this bill.

7. The discretionary grant program in section 113 of the bill seems to allow, but does not require, DOT to use up to 10 percent of the funds made available to help metropolitan planning organizations meet the new planning requirements, but no money is set aside for States for planning purposes. Additionally, the remainder of the money seems to be geared towards grants for implementing, not developing, the new strategies.

a. Do you agree with that reading of the bill?

The language of the bill can be interpreted in this manner.

b. Do you think it makes sense not to provide funding to States to comply with these new planning requirements?

DOT continues to review the proposed legislation and currently does not have a position on these provisions of the bill. But we intend to work with Congress to ensure that adequate funding and resources are provided to accomplish the clean energy and climate change objectives embodied in the legislation.

8. This language also states that "The Secretary shall have the discretion to designate the specific modal requirements that shall apply to a project," (page 76). Does that mean that you could choose to provide grants only to certain modes of transportation, regardless of the overall targets and strategies developed by the States and MPOs?

DOT continues to review the proposed legislation and currently does not have a position as to how this language should or would be interpreted. However, we look forward to working with Congress to ensure that the clean energy and climate change objectives embodied in the legislation are achieved in the most cost-effective manner.

9. During a recent briefing for my staff, staff from the Transportation Research Board indicated that there are major information gaps with respect to attempting to address climate goals through transportation planning. These gaps include not just insufficient models, but also a lack of knowledge about the assumptions and actual behavioral research to be used in models.

a. In your opinion, does the Kerry-Boxer bill direct any funding to addressing these information gaps?

The planning provision of the Kerry-Boxer bill provides support for addressing the information gaps with respect to addressing climate change. This could be an improvement over current planning funds provided to MPOs.

b. If not, how would you plan to address these information gaps so that States and MPOs are not required to take action without having the tools necessary to make reasoned decisions?

The Department has a Center for Climate Change that is pursuing research such as the impending report to Congress on the mitigation of greenhouse gases from the transportation sector. This report will help address some of the information gaps and thus help inform transportation planning. In addition, DOT will continue to identify information and modeling gaps that may inhibit solid and effective MPO planning and address them through cooperative efforts with appropriate Departments of the U.S. Government and internally as our resources allow. Planners have experience using the best available data to inform the public and decision makers, understand the uncertainties and risks, promote community discussion and make decisions. While climate change presents additional challenges due to the need for additional research, data and understanding, DOT will continue to provide the best available tools and technical assistance to DOTs and MPOs as they incorporate GHG reduction strategies into the long-range planning process.

10. In the DOT's planning for a response to the impacts of climate change, have you considered that spending funds to address this Country's existing deteriorating infrastructure rather than on Climate Change?

DOT recognizes the many pressing needs of the country's aging infrastructure including maintaining the existing infrastructure. At the same time, we expect that there will be impacts on transportation infrastructure - whether new or older - from climate change in the coming years, and we believe it is necessary to begin to plan for this scenario.

a. How do you differentiate between climate change and those from weather variability?

By working now to understand the state of repair of our current infrastructure and to understand the anticipated future impacts of climate change, we can help States and MPOs understand the types of changes to the infrastructure system needed to maintain our transportation networks into the future, regardless of whether the impacts are attributable to climate change or weather variability. Some of these changes may be included in routine or regularly scheduled infrastructure management activities; some may require entirely new efforts.

11. I noticed you mentioned the GHG emissions savings making neighborhoods more walkable and bikeable, that is making more livable cities. What happens to freedom of choice, property rights subject restrictions on urban sprawl? Do you believe the public should be fully informed of the impacts and lifestyle changes associated with livability, sustainability and complex legislation like S.1733?

We look forward to a full dialogue with the public on these issues. Our goal is for the public and local governments to make more informed decisions about investing in infrastructure. Ultimately we are confident that the public will enjoy the benefits of more

walkable and bikeable neighborhoods, and we will be able to reduce energy consumption and pollution.

Senator John Barrasso

1. There are several proposals with new planning requirements that would compel states to reduce emissions. Wyoming is very rural in nature and there is only so much we can do to cost effectively promote walking, bicycling, and transit ridership.

These proposals may be viable options in metropolitan areas, but due to our low population density, great distances, and harsh winters, they are not practical transportation options for rural states like ours. Wyoming generates very little emissions from transportation compared to other states.

Would you be open to drafting an exemption for low population density states?

Livability in rural areas is about access. Rural communities, especially those located in remote areas, face special challenges related to livability. Lack of access to necessities like medical facilities without use of a personal automobile can force seniors out of their homes or even an entire community. For example, past transportation policies resulted in the town centers of many rural communities being bypassed by the interstate highway system, contributing to the decline of once-vibrant business centers. Many rural communities close to urban areas are struggling with the loss of farm land and open space as a result of dispersed patterns of development from urban growth. Also, transportation costs are often significantly higher for residents of rural communities. We will specifically address rural communities and small towns in our any livability program.

We are developing new, unprecedented approaches to incentivize the use of federal funds toward investments in existing infrastructure and existing communities that will benefit rural as well as urban communities.

Senator BOXER. Thank you so much, Mr. Secretary.

And now, Secretary Salazar, of the United States Department of the Interior. Welcome, Mr. Secretary.

STATEMENT OF HON. KEN SALAZAR, SECRETARY, U.S. DEPARTMENT OF THE INTERIOR

Mr. SALAZAR. Thank you very much, Chairman Boxer and Senator Inhofe and the distinguished members and friends who are on this committee.

This issue is an imperative issue of our time. President Obama has made it clear from day one that we will succeed on this effort. It is driven by the imperatives, many of which have come out here today.

First, we need to get our country to a point of greater energy independence. Second, we need to create millions of new energy jobs here at home. And third, we need to make sure that we are protecting our children and our planet from the dangers of pollution. That, frankly, is what this is all about. And I hear the conversation and the presentations by the Senators, trying to address those issues. Our hope is that in fact, at the end of the day, as this U.S. Senate works its way, that there will be a way in which Democrats and Republicans can join in terms of getting a climate change and energy bill that will finally be one that this country can be very proud of.

Let me say I am proud of my colleagues as well. We work together as a team, as a team under the Obama administration helping us to forge a new energy future for our country. We have not let the absence of this legislation keep us from moving forward with a number of different initiatives. I want to speak briefly about some of the work that we are doing at Interior, because it ties into some of the work that this committee will be doing in the days and weeks ahead.

First, at the Department of Interior, we see ourselves and our mission to be the stewards of America's natural and cultural resources. We have an energy and climate change role as an energy supplier for this Nation in many ways. We are the carbon catchers of this country in terms of carbon sequestration, both biologically as well as geologically. We are also a primary agent of adaptation programs for this country based on the resources that we have. And we are a science provider, through the scientists we have at the U.S. Geological Survey, as well as the Fish and Wildlife Service.

Let me very quickly just say a word about the assets that we have to fulfill these roles. The United States Fish and Wildlife Service oversees 550 wildlife refuges and 150 million acres of fish and wildlife refuges around the country. The Bureau of Land Management, 253 million acres. The National Park Service, 84 million acres. Tribal lands, which we hold in trust for American native peoples, 56 million acres. And in the Outer Continental Shelf, and I know many of you are interested in that, we oversee 1.75 billion acres of the Outer Continental Shelf.

We have educational assets that we bring to the table on the energy and climate change agenda, because we have about 500 million people that will come to visit our icons, from the Statue of Lib-

erty to Yellowstone to the Everglades every year. And we have personnel, some 70,000 people, which includes the scientists that are some of the premier scientists in America in the USGS and Fish and Wildlife.

On the energy supplier side, Madam Chairman, the conventional fuels that we produce through the Department of Interior include approximately 30 percent of the oil for this country from our public lands and the submerged lands, about 30 percent of our natural gas and 40 percent of the coal that is used in this country. That is what we have been doing, and we continue to work on that agenda.

But exciting for all of us in the Department of Interior also is the new energy frontier. And from the beginning of this year, we have stood up the renewable energy world in the Department of the Interior. We moved fast forward with solar energy where we have set aside 1,000 square miles for the development of solar energy. As Senator Sanders said earlier, our estimates are that the solar energy potential just on those lands alone is about 100,000 megawatts, which would power 29 million homes or provide about 29 percent of the energy equivalent needed for the households of America today.

We also are moving fast forward, because this is not pie in the sky; we don't want to have people thinking about whether or not we can do it in 4 or 5 years. So we are fast tracking applications in Arizona and California and Nevada and New Mexico, where we hope to be able to permit by the end of next year 4,500 megawatts of solar power. The 4,500 megawatts is the equivalent of close to 14 or 15 coal-fired power plants.

But we are not stopping with the Sun. We are also doing everything we can to capture the power of the wind, both onshore as well as offshore. On the onshore, we hope on the same time line by the end of next year to have 800 megawatts of power stood up with respect to wind energy. And our belief and our estimates are that there is huge potential, especially in the Atlantic seaboard, because the Governors in those States are very excited about what we can do with respect to offshore wind.

We have great potential with hydro power, using existing facilities and not creating new dams, but using our facilities that we currently have and moving forward with the hydro renewable energy agenda. Geothermal is big. Transmission, we are working together as a Cabinet group to move forward with transmission. We are fast tracking transmission facilities in the West as well.

Two quick points before my time runs out here. As a carbon catcher, I want this committee, who oversees the Fish and Wildlife Service, to recognize the great importance of what we can do in terms of our climate change and energy agenda. Through our refuges and through the facilities that we oversee along the Nation's coastlines, national wildlife refuges alone and the National Park Service alone, we have 160 wildlife refuges and 74 national parks along the coastlines of America. And what we can do in terms of biological sequestration there is no different than what we are proposing in this bill to do in places like Brazil, Indonesia and other places. So the deforestation aspects of this legislation are something also that we need to deal with here at home.

We are excited, and would be delighted at some point, Madam Chairman, to talk about the landscape conservation cooperatives, which we are moving forward with in the Department, that can help us essentially create carbon sinks within the United States of America.

And finally, the USGS has moved fast forward with the creation of protocols for carbon sequestration for coal. We are excited about that agenda.

And in conclusion, what I will say, we can do a lot on adaptation with water, with wildlife, with migration corridors, because we are really at the front line in terms of seeing the consequences of climate change. And our science providers at USGS and U.S. Fish and Wildlife will be key to moving forward with this agenda.

We at Interior and in the Obama administration, under President Obama's leadership, very much look forward to working with this committee on both sides of the aisle, as well as the rest of the U.S. Senate, to finally, once and for all, address the signature issue of our times, energy and climate change.

[The prepared statement of Mr. Salazar follows:]

STATEMENT OF KEN SALAZAR
SECRETARY OF THE INTERIOR
ON
S. 1733,
THE CLEAN ENERGY JOBS AND AMERICAN POWER ACT
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS
UNITED STATES SENATE

October 27, 2009

Chairman Boxer, Ranking Member Inhofe and Members of the Committee, I am pleased to appear before you today to discuss S. 1733, The Clean Energy Jobs and American Power Act, and the Department of the Interior's role in building a new energy future. Let me first thank you for your time, interest, and leadership on the important issues of energy security and climate.

The Administration supports enactment of comprehensive legislation that will make America more energy independent, create clean energy jobs here at home, and protect our children and planet from the dangers of pollution. Under President Obama's leadership, the Department of the Interior is committed to helping our country build a comprehensive energy and climate change plan.

Introduction
The Department of the Interior serves as the steward of the nation's resources, heritage, and cultures.

We have jurisdiction over 20 percent of the land mass of the United States and 1.75 billion acres of the Outer Continental Shelf (OCS). Interior-managed public lands and the Outer Continental Shelf account for nearly 30 percent of domestic natural gas production, over 30 percent of our oil production, and over 40 percent of our coal production.

Through Interior's Bureau of Reclamation we provide water to farmers, power to homes and businesses from hydroelectric facilities, and recreational opportunities to boaters, anglers, and others who love the outdoors.

The Fish and Wildlife Service – also under Interior - manages over 550 wildlife refuges and other units of the Refuge System, encompassing more than 150 million acres of important wildlife habitat, shorelines, and wetlands.

The National Park Service oversees our 391 National Parks, 84 million acres of treasured landscapes and historic places, and introduces 300 million visitors each year to the wonders and joys of America's natural and cultural legacies.

The Bureau of Land Management manages approximately 258 million acres of public lands, from the Arctic tundra and coastal forests to the vast mountains, deserts, and rangelands of the American West. These lands provide water resources, wildlife habitat, recreational opportunities, forest products, livestock forage, and mineral and energy resources.

Moreover, the Department, through the Bureau of Indian Affairs, manages over 56 million acres of tribal land and land owned by individual Indians. These lands, held in trust, are managed for farming, grazing, and energy production. Some of these lands are a rich source of conventional fossil fuels, and many have major renewable energy potential.

The breadth of the Department's responsibilities are perhaps most visible in Alaska, where we manage tens of millions of acres of public land, parks, and refuges. But the truth is, Interior has responsibilities in all 50 states, in insular areas, and with tribal nations. The resources we manage are economic engines for communities everywhere. As a nation, we must recognize how vital the wise stewardship of our landscapes is to our economic well-being.

Creating Energy Independence

But just as our landscapes and outdoor amenities create jobs and fuel local economies, the energy potential on our public lands offers great promise for a clean energy economy.

Every year, we spend hundreds of billions of dollars to import much of the oil we need to power our country. We have fallen behind the world in developing many of the energy technologies that will shape our economic future. The rising costs of the failed energy policies of the past have been unchecked for too long. As the President has said, there is a choice before us: we can remain the world's leading importer of oil, or we can become the world's leading exporter of clean energy technology.

As part of our comprehensive energy strategy, the Department of the Interior is proceeding with oil, gas and coal development in a thoughtful, responsible way that allows for development and also protects the environment. We reject the notion that every piece of land or submerged lands should be explored or developed for oil and gas. But we embrace the reality that oil, gas, and coal are part of our energy portfolio.

A comprehensive energy strategy cannot be limited to conventional energy sources alone. America, after all, has vast clean, renewable energy potential on our public lands. Interior oversees lands with great solar potential in the Southwest; wind potential in the Atlantic, on the Great Plains and in the West; and geothermal potential in the West.

The great promise of these resources has led us at the Department of the Interior to change how we do business. In the last nine months, we have used existing authorities to launch a new renewable energy frontier for America that embraces environmentally responsible renewable energy projects on public lands.

Since coming into office, we have prioritized the development of renewable energy on our public lands and our offshore waters. American business is responding. Companies are investing in solar facilities in the Southwest, wind farms off the Atlantic seacoast, and geothermal energy projects throughout the west. These new energy sources produce no greenhouse gases and, once installed, they harness abundant, renewable energy that nature itself provides.

With regard to solar energy development, we have set aside 1,000 square miles of public lands in twenty-four "Solar Energy Study Areas" and are evaluating these for environmentally appropriate solar energy development across the West. These two dozen areas have the technical potential to generate nearly 100,000 megawatts of solar electricity, enough to power millions of American homes. We believe that of the solar projects currently proposed, more than 4,500 megawatts of new capacity – mostly in California, Arizona, and New Mexico - will be permitted for construction by the end of 2010. If all of these projects came to fruition, they could potentially generate enough energy to power roughly 1.4 million homes.

In that same timeframe, we believe that more than 800 megawatts of new capacity will be available from wind energy projects currently proposed on BLM lands. If this capacity is realized, these projects could provide enough energy to power around 240,000 homes. According to a recent Department of Energy report, "20% Wind Energy by 2030," it is feasible that wind could generate as much as 20 percent of the Nation's electricity by 2030.

We are creating Renewable Energy Coordination Offices in our western states to help speed completion of reviews on the most ready-to-go solar, wind, geothermal, and biomass projects on public lands.

We also recognize the continued value of hydropower. It is a low cost source of energy that emits a fraction of the greenhouse gases generated by fossil-based energy sources. It constitutes approximately 70 percent of the current total portfolio of renewable energy generation. The Bureau of Reclamation's 58 hydroelectric power plants provide enough energy to meet the residential needs of 3.6 million households, the equivalent of 80 million barrels of oil. Reclamation is the nation's second largest hydropower producer. Reclamation is evaluating new capacity and efficiency increases at existing projects that could help realize undeveloped power potential.

Interior's vast land ownership also gives us an important role in siting the new transmission lines needed to build a transmission grid for the 21st Century and bring stranded domestic renewable energy assets to load centers and to American homes and businesses. Working with the Department of Energy, the Department of Agriculture, the Federal Energy Regulatory Commission, and the Council on Environmental Quality we are helping to develop a coordinated permitting process that can review and approve permit applications that cross federal agency jurisdictions, and we are also and mapping out electric transmission corridors that meet the needs of this new energy economy. We

are also working to improve coordination on transmission with Indian tribes on their lands, which carry great energy potential.

Climate Impacts
At the Department of the Interior, we recognize first hand that greenhouse gas emissions are affecting our climate. The change in climate is impacting water supplies for cities, towns, and farms; leading to more severe droughts, hurricanes, and floods; contributing to more intense forest fires; putting coastal communities at risk; and shifting wildlife habitat and migration patterns.

Our land and wildlife managers are already confronting the impacts of climate change. Reduced snowpack – particularly in the Northwest and Mountain-West – is leading to decreased recharge of groundwater systems, increasing stress on public water systems and reducing river flows that impact temperature, depth, and other characteristics of spawning environments for fish. Our Arctic parks and refuges are seeing some of the earliest impacts of possible climate change – melting sea ice threatens marine mammals as well as coastal communities, while thawing permafrost can destabilize buildings, roads, and facilities and disrupt the structural basis of large regions of interior lands.

The BLM is seeing increased desertification of public lands, the result of an increase in the frequency and duration of drought. Vegetation in some places has converted to more drought-hardy species and, in some instances, species numbers have been reduced or lost.

Our scientists are also noting changes in abundance and distribution of species, including changes to migration patterns; the expansion of pests and invasive species; increased vulnerability to wildland fire and erosion; and an overall reduction in carrying capacity. Many of the iconic wildlife species that the Department manages from the Arctic to the Everglades will see their habitat threatened by global climate change.

Other significant changes associated with increased warming include rising sea levels and water temperatures that pose threats to marine habitats, coastal wetlands, and estuaries which are part of more than 74 units of the National Park System and 160 National Wildlife Refuges managed along the Nation's coastline.

The Department's 70,000 employees – with their scientific and land management expertise -- are already documenting these impacts and developing systems to respond to them across the Nation. The development of successful adaptation and mitigation strategies that address the impacts of climate change will be critical to the health of the land, water, and wildlife resources we manage.

The Department's developing experience with adaptive management strategies for resource management can provide a template for future efforts. U.S. Geological Survey stream gages, for example, are showing snowpack declines and earlier annual peaks in river run-off in the Northwest and Mountain-West. As a result, land managers are analyzing potentially substantial changes in management requirements for fish and wildlife and water resources.

Interior managers are also learning to be strategic in rebuilding facilities that are lost to natural disasters like Hurricanes Katrina and Rita. The Fish and Wildlife Service has repaired or replaced dozens of facilities at refuges along the coast damaged by these storms. In the process of rebuilding facilities across the region, the Service decided not to replace some facilities judged to be too vulnerable and relocated others to more secure locations.

In all of these activities, the Department is putting a premium on integrating our dual science and land management roles. Scientists at the USGS, the Fish and Wildlife Service, Bureau of Reclamation, the Bureau of Land Management, and the National Park Service are working hand-in-glove with our land, wildlife, and water managers who are responsible for the more than 500 million acres of public lands and the water that the Department oversees. The focus is to ensure that our scientists are collecting and analyzing data that provide relevant scientific information about natural resource conditions, issues, and problems to decision-makers in the Department, at all levels of government, and to the general public.

Realizing this vision is an interactive process, as our land, wildlife and water managers work with our scientists and help focus the nature of their research and analysis on the reality of on-the-ground changes. In this context, the information they provide – baseline natural resources scientific information, trends detection, modeling and forecasting, together with the effective dissemination of information and decision support tools – is key to understanding and addressing climate change and its effects.
Given its scientific expertise, the Department also plays a role in the development of domestic carbon offset programs. For example, for the past 10 years the Fish and Wildlife Service has been working with partners in its Southeast Region to increase biological sequestration – through reforestation with native hardwoods – in refuges there. Under authority provided in the Energy Independence and Security Act of 2007, USGS is developing methodology to assess carbon sequestration and will use this methodology to conduct national assessments on geological and biological carbon sequestration.

Conclusion
Problems as complex as climate change and as large-scale as the development of a real new energy economy demand the coordinated efforts of the executive and legislative branches of our government and all the governments of the world. I look forward to working with you and the United States Senate as we move toward enactment of comprehensive legislation. The Department and its bureaus stand ready with our shoulder to the wheel to contribute our experiences, successes, and expertise to this effort.

Thank you. I look forward to answering your questions.

Environment and Public Works Committee Hearing
October 27, 2009
Follow-Up Questions for Secretary Salazar

Senator James M. Inhofe

1. The bill has over a dozen different programs and provisions relating to adaptation to climate change. Undoubtedly, the Department of Interior will be participating in, and even potentially implementing, those programs. I am already troubled by the inefficiencies created by litigation under the Endangered Species Act. Despite over 30 years of effort, thousands of man-hours, and millions, perhaps billions, of direct and indirect costs, the U.S. Fish and Wildlife Service reports that only about 2% of ESA-listed species have been "delisted" - very few of those were delisted because the species actually recovered. **Given that the Department still has a long way to go in implementing the most significant laws it currently manages, how will the agencies within the Department will be able handle such a tremendous new workload under this bill?**

Response: Addressing the observed impacts of climate change, several of which I noted in my testimony, is an ongoing activity at the Department stemming from our responsibility as stewards of our natural resources. As reported by the Intergovernmental Panel on Climate Change, "[a]daptation will be necessary to address impacts resulting from the warming which is already unavoidable due to past emissions." (Contribution of Working Group II to the Fourth Assessment Report of the IPCC, 2007.) I am committed to working within the Administration and with Congress to ensure that we have the necessary authority and funding to deal with the impacts to land, water, wildlife and people caused by climate change.

2. Both you and Deputy Secretary Strickland have previously stated that you did NOT believe that laws like the Endangered Species Act should be used to regulate greenhouse gases. **How will the provisions in S. 1733 affect whether the Department considers global warming when implementing and enforcing laws like the ESA?**

Response: Based on our initial review of the bill, it does not appear that S. 1733 will affect the Department of the Interior's obligations and authorities to implement and enforce the Endangered Species Act (ESA).

3. **What do you envision the Department's role being in implementing programs aimed at helping species and resources adapt to climatic changes? Will the Department focus only on perceived impacts from manmade global warming or will you also consider ecological impacts from naturally-occurring changes in climate? Please elaborate on how you will deal with both man-made and naturally occurring climate impacts.**

Response: In order to fulfill our broad responsibilities with regard to the land, water, marine, fish and wildlife, tribal, and cultural resources for which the Department has

stewardship and management responsibilities, the Department would consider all of the impacts to resources and species from changes in climate, regardless of whether the causes of climate change are natural, anthropogenic, or not determinable.

4. You mention that DOI has been assisting with many renewable energy projects including wind, solar, and geothermal. **How many of those projects did not receive any federal subsidy? For those projects that did receive federal subsidies, what was the amount and percent of total project costs for federal subsidy received for the average wind project? The average solar project? The average geothermal project?**

Response: It is important to understand the role of federal subsidies in promoting new energy technologies. A recent Environmental Law Institute report, titled "Estimating U.S. Government Subsidies to Energy Sources: 2002-2008", September 2009, may provide useful information.

5. Environmentalists in West Virginia recently filed a law suit under the Endangered Species Act, claiming that the Wind Turbines could threaten the Indiana bat. In California's Mojave Desert, development of solar and wind facilities has been delayed due to concern over the region's tortoise population. Lawsuits and similar scenarios have pitted ESA duties against the importance of renewable energy, two goals that DOI shares. **As DOI works to build transmission lines and increase these renewable sources of power, how will it balance the needs to reduce global warming with endangered species protection?**

Response: As we augment transmission infrastructure and increase energy production from renewable sources, the Department will carefully balance our energy needs with our responsibilities under the Endangered Species Act. In this regard, on October 29th the Administration announced a Memorandum of Understanding that relates to the permitting of new transmission lines. The agreement specifically recognizes the Department's role in ensuring that siting of transmission lines is carried out in a way that protects our natural resources, and it contains specific provisions that relate to work under the National Environmental Policy Act and consultation under the Endangered Species Act.

6. **How does DOI plan to balance the needs of species adaptation and water with the needs of water users, such as food producers, agriculture and towns who depend on BLM water for their existence?**

Response: The Department is committed to processes that provide interested stakeholders the opportunity to comment on proposed Federal actions. In this manner, the needs of interested stakeholders will be appropriately considered.

7. In your testimony you mentioned the "failed energy policies of the past" as noted that oil, gas, and coal are "part of our energy portfolio." According to EIA, fossil fuels account for 84% of the primary energy consumed in the United States and a recent report from Congressional Research Service found that the US endowment of recoverable oil

was 167 billion barrels. This figure is considerably larger than the 21 billion often cited by a number of my colleagues across the aisle, and is the equivalent of replacing America's current imports from OPEC countries for more than 75 years.

A. Do you think, without damaging our economy or energy stability, we could successfully and quickly turn a great portion of that 84% to renewable low carbon energy sources?

Response: Time and resources are essential elements of responsible and economical energy development, whether it is based on renewable or fossil fuel sources. While there is no quick fix to meeting our nation's energy challenges, the Department of the Interior is committed to managing America's public lands for balanced oil, natural gas, and coal development, and to facilitating environmentally responsible renewable energy projects that can help power President Obama's vision for a clean energy future and greater energy independence.

B. Considering the massive oil and natural gas reserves in the US, do you think that part of our "failed" past energy policies include not tapping further into these valuable resources? Would you be opposed to further exploration and utilization of these resources to help lessen our foreign oil dependency during what could be a slow transition to other energy sources?

Response: Our Nation needs a balanced and comprehensive energy policy, which includes further exploration and development of domestic oil, coal, and natural gas. As we transition to a clean, renewable-based energy economy, oil, gas, and coal are and will continue to be a part of our energy mix.

8. **Has DOI worked with any organizations or researched on its own the possible effects of wind turbines on local climate and weather patterns? Has DOI done any studies or worked with any organizations to investigate how wind energy development impacts critical military radar systems, a concern of many of my colleagues along the eastern seaboard and throughout the country.**

Response: I am not aware of any specific research at the Department related to the impacts of turbines on weather patterns. In those instances where wind development takes place on lands or in waters under the Department's jurisdiction and may have an impact on radar systems, the requirements of the National Environmental Policy Act would ensure that appropriate federal agencies, including the Federal Aviation Administration, the Department of Defense, or the National Oceanic and Atmospheric Administration are involved in the permitting of any wind energy project.

9. According to your testimony, the Bureau of Reclamation has 58 hydroelectric power plants that provide for the residential energy needs of 3.6 million households. The same number of households could be powered by only 3 large coal or nuclear power plants. **Noting this inefficiency, as well as the importance of our nation's waters, are these hydroelectric plants the best use, especially when taking into account these plants'**

potential to obstruct fish passage to spawning grounds or to the ocean, to degrade both aquatic and streamside habitats, and to impact water quality by lowering the amount of dissolved oxygen in the water?

Response: While I am not familiar with costs associated with bringing additional nuclear power online, I share your concern that we must manage our energy resources in environmentally responsible ways. At facilities under its jurisdiction, the Department funds activities related to Endangered Species Act compliance and habitat restoration. Many of these projects are located at sites that provide water for irrigation, infrastructure for flood control, or other benefits. In this context, hydropower is a low cost source of energy that emits a fraction of the greenhouse gases generated by fossil-based energy sources.

10. **Given the fact that DOI has 70,000 employees with "scientific and land management expertise" that are already addressing adaptation problems with climate change throughout the nation, how does this bill benefit the DOI other than by with a windfall of extra money taken from the revenues of a national energy tax? What specific language or areas in the bill will give DOI a greater ability to address climate change?**

Response: Global climate change is a complex challenge that requires leadership and new and innovative solutions and incentives. This legislation highlights the lead role of the Department of the Interior as the steward of America's public lands and natural resources.

11. Section 362 on page 345 of the Chairman's Mark, states the following:
"It is the policy of the Federal Government, in cooperation with State and local governments, Indian tribes, and other interested stakeholders, to use all practicable means to protect, restore, and conserve natural resources so that natural resources become more resilient, adapt to, and withstand the ongoing and expected impacts of Climate change, including, where applicable, ocean acidification, drought, flooding, and wildfire. "

Further on Section 363 defines the term natural resources as: *"Fish, wildlife, plants, habitats, and terrestrial, freshwater, estuarine, and marine ecosystems of the United States."*

The Chairman's mark would create more than 50 pages of new federal law establishing a new national obligation to use *"all practical means"* to protect fish and wildlife from climate change, but the proposal doesn't contain even a single a paragraph about safeguarding our ability to feed ourselves. **Does this seem like a good idea to you?**

Response: The health of the environment and our ability to feed ourselves are inextricably linked. Ensuring well-functioning ecosystems promotes healthy lands, fish, and wildlife. As we work to address this challenge, we are working to ensure a healthy planet and the continued ability of our lands and waters to provide sustenance.

12. What provisions of the Chairman's mark ensure that farmers and ranchers will *"become more resilient, adapt to, and withstand the ongoing and expected impacts of climate change?"*

Response: I believe that any actions that we take that benefit the health of the public rangelands under the Department's jurisdiction that are available for grazing will ultimately benefit the ranchers and farmers who utilize those lands.

13. If this bill became law, could the mandate to employ *"all practical means" [sic]* to protect fish and wildlife be used in litigation to undermine federal and state laws, agreements and contracts governing the allocation of water resources and the use of public lands?

Response: It would not be appropriate for me to speculate about potential litigation that could arise under this yet-to-be enacted legislation. Climate change is a complex challenge that requires leadership and new and innovative solutions and incentives. We stand ready to work with the Committee to ensure that the necessary authorities are in place to help us address the resulting resource challenges.

14. Could this mandate to employ *"all practical means"[sic]* to protect fish and wildlife be used to justify involuntary re-allocations of water, land and other resources away from current users in order to protect fish and wildlife?

Response: As noted previously, it would not be appropriate for me to speculate about potential litigation that could arise under this yet-to-be enacted legislation.

15. Should the bill put safeguards for domestic agriculture on an equal footing with safeguards for fish and wildlife?

Response: While we defer to the Department of Agriculture for any substantive responses related to the domestic agriculture sector, any actions taken for the benefit of the health of our public lands will also benefit the ranchers and farmers who utilize those lands.

Environment and Public Works Committee Hearing
October 27, 2009
Follow-Up Questions for Secretary Salazar

Senator John Barrasso

1. Communities in coal country have tried to develop renewable energy such as wind, which could lead to job growth.

Unfortunately, they are running into some obstacles. There was a recent article in the *Washington Post* entitled "Tiny bat pits green against green."

The sub-headline is "Wind farm could cut carbon, but could it also kill endangered species?" The article is about a Chicago company trying to build wind turbines in West Virginia to generate clean energy and jobs in the region. Environmentalists apparently think the turbines might hurt an endangered bat and are suing to block the construction of the turbines under the Endangered Species Act.

In my home State of Wyoming we have run into the same problem, where environmental groups are blocking wind production across large areas of my home State because of the sage grouse. **How can we build green renewable energy if we do not provide regulatory relief in any climate change bill to allow such projects to move forward without all the red tape?**

In addition, how can we say that green jobs are going to replace lost jobs in coal country if all attempts to do so are being blocked by environmentalists?

Response: The Administration is moving forward – successfully – on a number of energy fronts, including development of both conventional and renewable resources. The Department has taken a number of steps over the past months to ensure that this development occurs responsibly and in a more coordinated fashion. For example, the Department:

- created the first-ever framework for offshore renewable energy development;
- clarified the relationship between the Federal Energy Regulatory Commission and the Department with respect to potential offshore renewable projects;
- funded and staffed Renewable Energy Coordination Offices in western states to help complete reviews on the most ready-to-go solar, wind, geothermal, and biomass projects on public lands;
- set aside 1,000 square miles of public lands in 24 "Solar Energy Study Areas" that BLM is evaluating for environmentally appropriate solar energy development across the West; and
- entered into MOUs with –
    - the State of California to more efficiently and effectively permit renewable energy projects on Department lands in California;

- The Western Governors' Association, DOE and USDA for identification and uniform mapping of wildlife corridors and crucial habitats; and
- Eight other federal agencies to better coordinate the process of permitting transmission infrastructure across federal lands.

These actions demonstrate our commitment to development of our energy resources in a thoughtful, responsible way that allows for development and also protects the environment.

2. I recently introduced a bill that determines the ownership of the pore space below federal lands. This issue must be determined before long-term carbon storage projects will occur, particularly in the West where so much of our land is federal land.

Do you believe the federal government should own the pore space below federal lands?

Response: We recognize the importance of this issue. Here in the Department, the U.S. Geological Survey has been developing a methodology to assess the volume of pore space in subsurface rocks that is able to store carbon dioxide for tens of thousand of years. As we move forward with actions like this that are intended to facilitate the large-scale development of geologic carbon sequestration, the issue of pore space ownership must be resolved. Congressional action may be necessary to accomplish this.

Senator BOXER. Thank you very much.
And EPA Administrator, Lisa Jackson, welcome.

STATEMENT OF HON. LISA P. JACKSON, ADMINISTRATOR, U.S. ENVIRONMENTAL PROTECTION AGENCY

Ms. JACKSON. Thank you, Chairman Boxer, thank you to Ranking Minority Member Inhofe and members of the committee for inviting me to testify about the Clean Energy Jobs and American Power Act. It is always a good day when I join my colleagues from the Administration here and EPA's authorizing committee.

I last appeared before this committee on July 7th. Since then, this Administration has, under President Obama's leadership, taken unprecedented steps to decrease America's dependence on oil, put our Nation in the lead of the 21st century energy economy and reduce the greenhouse gas pollution that threatens our children and grandchildren.

On September 15th, for example, as you have already heard, Secretary LaHood and I jointly announced coordinated DOT and EPA rulemakings to increase fuel efficiency and reduce greenhouse gas emissions of cars and light trucks through the year 2016. The joint DOT/EPA rules will reduce the lifetime oil consumption of those vehicles by 1.8 billion barrels. That will mean eliminating more than a billion barrels of imported oil, assuming the current ratio of domestic production to imports does not improve.

At today's oil prices, we are talking about saving $78 billion of the dollars that America would otherwise give to other countries for their oil. In the process, the rules will avoid nearly a billion metric tons of greenhouse gas pollution. And we have heard each of my colleagues here describe other steps that the Administration has already taken to make America's economy stronger by getting it running on clean energy.

Even as the President and members of his Cabinet move forward under existing authority, we continue urging Congress to pass a new clean energy law. Only new legislation can bring about the comprehensive and integrated changes that are needed to restore America's economic health and keep the Nation secure over the long term. This committee held its July 7th hearing shortly after the House of Representatives had passed the American Clean Energy and Security Act. So I took the opportunity to echo President Obama's request that the Senate demonstrate the same commitment that we had seen in the House to building a clean energy foundation for a strong American economy.

While the introduction of the Clean Energy Jobs and American Power Act on September 30th shows that the Senate is responding to the President's call to action, and I commend you, Madam Chair, and Senators Kerry and Kirk, for introducing that bill. I applaud the many Senators, including members of this committee, who have contributed meaningfully to the Chairman's mark, and I thank Senator Graham for joining with Senator Kerry in a recent statement that reminds all of us that giving America control over its energy future can and should be a bipartisan mission.

Earlier this year, EPA ran the major provisions of the House Clean Energy legislation through several economic computer models. When it comes to the specifications that the models are de-

signed to detect, the Clean Energy Jobs and American Power Act is very similar to the House legislation. Nevertheless, EPA has examined the ways in which the Senate bill is different and has determined which of the conclusions reached about the House passed bill can confidently be said to apply to the Senate bill as well.

EPA delivered the results of that inquiry to the committee last Friday, and the members can review the report in detail. But let me just state some of the key projections about the House bill that EPA feels confident also apply to the Clean Energy Jobs and American Power Act.

First, the legislation would transform the American economy from one that is relatively energy inefficient and dependent on high polluting energy to one that is highly energy efficient and powered by advanced, cleaner and more domestically sourced energy. Second, the legislation would bring about that transformation at a cost well below 50 cents per day per American household in 2020.

Third, the region by region cost differences would be small. Finally, if the U.S. adopted the legislation, then the world could avoid a 2 degree Celsius rise in temperature over pre-industrial levels without assuming international action any more ambitious than the goals agreed to at the July 9th major economies forum. That is good news, because as the U.S. global climate change research program reported in June, a 2 degree Celsius rise would subject the American people to unacceptable risk from catastrophic harm, from intensified droughts, wildfires, spring floods, heat stress to livestock and much more.

Madam Chairman, the American people have waited decades while our Nation has become increasingly dependent on foreign energy sources, while our global competitors create the clean energy jobs of tomorrow, and while we fail to safeguard the well-being of our children and our grandchildren. I think Americans are tired of listening to the same corporate interest groups that vastly exaggerated the cost of reducing acid rain pollution and of reformulating gasoline. I think Americans want reform that harnesses the country's can-do spirit. I think they want to fuel long-term economic recovery with a wise investment that sparks a clean energy transformation and protects our children and grandchildren.

The Clean Energy Jobs and American Power Act is a significant milestone on that road. There of course remains the road ahead. There are many Senators on and off this committee who have tremendous value to add. Thank you for your continuing work, and thank you for inviting me to testify today.

[The prepared statement of Ms. Jackson follows:]

Statement of Lisa P. Jackson
Administrator, U.S. Environmental Protection Agency
Senate Committee on Environment and Public Works
Legislative Hearing on S. 1733, the Clean Energy Jobs and American Power Act
October 27, 2009

Chairman Boxer, Ranking Minority Member Inhofe, and members of the Committee, thank you for inviting me to testify about the Clean Energy Jobs and American Power Act.

I last appeared before this Committee on July 7. Since then, this Administration has, under President Obama's leadership, taken unprecedented steps to decrease America's dependence on oil, put our nation in the lead of the 21st Century energy economy, and reduce the greenhouse-gas pollution that threatens our children and grandchildren.

On September 15, for example, Secretary LaHood and I jointly announced coordinated Department of Transportation and Environmental Protection Agency rulemakings to increase the fuel efficiency and reduce the greenhouse-gas emissions of cars and light-duty trucks of model years 2012 through 2016. The rules will reduce the lifetime oil consumption of those vehicles by 1.8 billion barrels. That will mean eliminating more than a billion barrels of imported oil, assuming the current ratio of domestic production to imports does not improve. At today's oil prices, we are talking about saving 78 billion dollars on buying oil from other countries. In the process, the rules will eliminate nearly a billion metric tons of greenhouse-gas pollution.

Each of my colleagues here can describe other steps that this Administration has already taken to make America's economy stronger by getting it running on clean energy.

Even as the President and the members of his Cabinet move forward under existing authority, we continue urging Congress to pass a new clean-energy law. Only new legislation can bring about the comprehensive and integrated changes that are needed to restore America's economic health and keep the nation secure over the long term.

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can detect, the Clean Energy Jobs and American Power Act is very similar to the House legislation. Nevertheless, EPA has examined the ways in which the Senate bill is different and determined which of the conclusions reached about the House-passed bill can confidently be said to apply to the Senate bill as well.

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First, the legislation would transform the American economy from one that is relatively energy inefficient and dependent on highly-polluting energy production to one that is highly energy efficient and powered by advanced, cleaner, and more domestically-sourced energy.

Second, the legislation would bring about that transformation at a cost of less than 50 cents per day per American household in 2020.

Third, the finding that regional cost differences would be small applies to the Senate bill just as it did to the House legislation.

The American people have waited decades while our nation has become increasingly dependent on foreign energy sources; while our global competitors create the clean energy jobs of tomorrow; and while we fail to safeguard the wellbeing our children and grandchildren.

I think Americans want reform that harnesses the country's can-do spirit. I think they want to fuel long-term economic recovery with a wise investment that sparks a clean-energy transformation in our economy and that protects our children and grandchildren.

The Clean Energy Jobs and American Power Act is a significant milestone on the road to that reform. There of course remains road ahead, and there are many Senators on and off this Committee who have tremendous value to add. Thank you for your continuing work, and for inviting me to testify today.

Environment and Public Works Committee Hearing
October 27, 2009
Follow-Up Questions for Written Submission

Senator Tom Udall

1. As currently drafted the legislation puts the point of regulation (POR) for natural gas liquids (NGLs) at the point of fractionation, and requires the owner of the NGLs to acquire an allowance for those products, even though a large percentage of these NGLs will not be combusted and therefore will be non-emissive because they will be used as building blocks for petrochemical and plastic products. The legislation contemplates that the owner of the NGLs will be compensated for the cost of those allowances when the NGLs are sold to the end use customer—most likely a petrochemical or refining facility. The owners of those facilities will, in turn, are able to obtain "compensatory" allowances for their non-emissive, feedstock use of those products. I have some questions about the efficiency of this arrangement and would greatly appreciate EPA's technical advice on how to improve it.

- Since petrochemical facilities use the vast majority of their NGL's as a feedstock in the manufacturing of plastics and refiners who use NGLs for blending with motor fuels are already covered facilities that must present allowances to EPA for their emissions under the bill, would it be simpler from a regulatory standpoint to put the responsibility for acquisition of the allowance on the small portion of NGL's being actually used as a fuel?

  Administrator Jackson Response:

  EPA staff stands ready to provide your office with technical assistance in determining whether the approach you describe would be simpler and at least as effective.

- Under the proposed draft is there an opportunity for regulated entities to take advantage of incomplete pass-through of allowance costs in the transaction between the owner at fractionation and the ultimate consumer, thus creating an opportunity to create windfalls through the compensatory allowance structure? If so, what steps could be taken to prevent any windfalls?

  Administrator Jackson Response:

  EPA staff stands ready to provide your office with technical assistance in identifying whether any such risk exists and, if so, designing appropriate steps to eliminate it.

- Is EPA prepared to institute a regulatory program to ensure that all costs incurred by the owner at fractionation are fully recovered and windfalls are avoided and if so, how would such a regulatory program potentially work?

Administrator Jackson Response:

If legislation like S.1733 were enacted, EPA would, under the authorization contained in the statute, begin immediately to prepare to institute such a program in time to begin the emissions allowance allocation system and emissions cap established by the statute.

Senator James M. Inhofe

1. Administrator Jackson, Sen. Barrasso and I sent you letters on the endangerment finding in August and September, and heard no response. We finally got a stack of documents yesterday evening. It seems the only time I get responses from you is the night before you testify before the committee. I am very disappointed with this, especially since you said in your nomination hearing that you would treat requests from the minority the same as those from the majority. This has become a pattern and practice. Will this continue, or can you commit to me to respond to my requests in a timely and transparent fashion?

Administrator Jackson Response:

EPA has responded to your requests in a timely fashion in light of the scope of the requests, and we will continue to respond in a timely and transparent manner.

2. Administrator Jackson, Michigan and California have both tried to create green jobs and move to a so-called "green economy." Yet, California has a 12.2 percent unemployment rate, the nation's 4th highest; Michigan's is 15.3 percent, the nation's highest. These are far higher than the national rate of 9.8 percent. In light of your considerable experience with green jobs, can you explain what is happening in those states? How would putting a price on carbon help those states, when we know, according to CBO, that cap-and-trade results in a net loss of jobs?

Administrator Jackson Response:

The economic challenges facing our states are the result of a number of circumstances which vary to some extent by state. What is clear is that states and the nation as a whole cannot stay competitive if we don't move to a 21st century economy powered by low-carbon energy while China and other major economies do. I applaud the efforts of California and Michigan to position their economies to take advantage of the move to clean energy and green jobs. Putting a price on carbon will help those states and others make further progress by providing a strong price signal for the development and deployment of clean energy that will provide the foundation for our country's economy going forward.

3. EPA concedes on page 3 of its analysis that Kerry-Boxer's mandates and standards restrict the way sources can meet the cap, which will increase the cost without delivering additional emissions reductions. Can you explain this for me?

Administrator Jackson Response:

As stated in EPA's analysis of S. 1733, a cap-and-trade policy "assures that the cap is met at the cheapest possible cost to covered sources while inducing long-term innovation and change in the production and consumption of energy-intensive goods in related markets." This section of the analysis also states that, "Standards that impose restrictions on the way in which a particular subset of sources meet the cap will reduce this flexibility and, if binding, likely increase the costs without delivering additional emission reductions." This statement was intended to contrast a cap-and-trade policy with generic command-and-control policies, and does not refer to specific provisions of H.R. 2454 or S. 1733.

4. Do you agree that the worker adjustment assistance provisions in Title 3, Part 2, sections 311 through 313 in Kerry-Boxer are needed because this bill will cost jobs?

Administrator Jackson Response:

No. I believe the bill will create good, clean energy jobs that cannot be moved overseas. As we build a workforce trained in the skills needed for a clean energy economy, we will not only be putting Americans to work, but we will be making changes that reduce energy costs. For example, homes across America can be weatherized and made more energy-efficient, creating jobs that can't be outsourced while saving families hundreds of dollars a year.

5. I understand that new legislation usually entails new programs. But Sen. Webb compared the bureaucracy in Lieberman-Warner to "the old Soviet Union." Lieberman-Warner was 344 pages. Kerry-Boxer is 923 pages. Waxman-Markey is 1,400 pages. How would you describe the bureaucracy and mandates in this bill? And if this a market-based approach, why is all of this necessary?

Administrator Jackson Response:

The cap and trade program in the Kerry-Boxer and Waxman-Markey bills would provide a streamlined, highly efficient mechanism for obtaining the deep reductions in greenhouse gases that are needed to address the threat of climate change. But we also know that the price signal the cap and trade program would establish may not be strong enough in the early years to spur the technological changes needed for the nation's transition to a clean energy economy. Market barriers can also lessen the impact of the price signal the cap and trade program would provide. The bills deploy a number of complementary measures to address these well-recognized issues.

6. I note that you mentioned the joint EPA/DOT regulation to set auto emission standards and fuel economy standards for motor vehicles. Both standards are for the 2012-2016 model years. As I understand it, DOT has to provide a certain amount of lead time to permit manufacturers to tool-up. EPA has the same problem, but only because it has proposed to issue a positive endangerment finding which would require the setting of motor vehicle emission standards to address GHG pollutants. Now I know that EPA's regulations will get some nitrous

oxide and methane emissions reductions, but the bulk of its reductions will be in carbon dioxide emissions. I believe that as far as CO2 is concerned EPA and DOT will get roughly the same amount of emissions reductions. Therefore I have two questions: is there a court imposed deadline to get the EPA portions of this rule out? Did you weigh the cost-benefits of not making carbon dioxide a regulated pollutant, suffering the emission reductions not achieved, against the costs of putting many small sources in legal jeopardy of having to decide to get or not get construction permits for new construction and significant modifications?

Administrator Jackson Response:

EPA has issued its proposed light-duty vehicle standards as part of its efforts to expeditiously respond to the Supreme Court's now 2 ½ -year-old ruling that greenhouse gases are air pollutants under the Clean Air Act and that EPA must answer the endangerment question posed by a now 10-year-old rulemaking petition for vehicle greenhouse gas standards under section 202(a) of the Act. While there is not a court-ordered deadline for EPA to issue the proposed standards, I take very seriously the obligation to respond to the Supreme Court's decision. We note that the Supreme Court directly addressed the issue of whether DOT regulations are sufficient to absolve EPA of its mandate; specifically the court finding stated *"that DOT sets mileage standards in no way licenses EPA to shirk its environmental responsibilities. EPA has been charged with protecting the public's "health" and "welfare," 42 U. S. C. §7521(a)(1), a statutory obligation wholly independent of DOT's mandate to promote energy efficiency."*

It is also important to remember that if EPA were to further delay this proposal, there could be separate federal and state regimes independently regulating light-duty vehicles to reduce fuel consumption and GHG emissions: NHTSA's CAFE standards, and the GHG standards applicable in California and other states adopting the California standards. The joint EPA-NHTSA proposal would allow automakers to meet both the NHTSA and EPA requirements with a single national fleet. In addition, California's commitment to defer to the federal program is also conditioned on EPA adopting GHG standards of this type.

For several reasons, the estimates of benefits and costs presented by EPA and NHTSA, while consistent, are not directly comparable and should not be expected to be identical. EPA estimates that the proposed GHG standards will result in a reduction of 947 million metric tons of CO2 from the 2012-2016 vehicles over their lifetime. DOT has estimated that the CAFE program alone will result in a reduction of 639 million metric tons of CO2. In response to your second question, EPA is addressing concerns over PSD permitting by a proposed rule on PSD permitting requirements, which is discussed further in the answer to question #30.

7. Many think the PSD tailoring rule is legally suspect and if the rule is overturned everyone that followed your regulation would be in legal jeopardy. You may leave them alone, but can EPA protect them from citizen suits? I know you have some legal theory about judges keeping an illegal rule effective until EPA makes corrections.

Administrator Jackson Response:

I believe the proposed PSD tailoring rule is legally sound. It would focus state permitting efforts on the largest sources of greenhouse gas emissions for at least five years and describes a process for evaluating future regulation of additional sources. In the case of a citizen suit, should the final rule remain as proposed, the court would have a solid basis for rejecting the challenge because of the rule's legal foundation, which is described at length in the preamble to the proposed rule. See, in particular, 74 Fed. 55292, 55303-55320 (October 27, 2009). EPA will, of course, carefully consider the comments it receives in response to the proposal.

a. Why do you think that will work when I am told you have tried to get the Act to work first by proposing streamlined permitting for small sources?

Administrator Jackson Response:

I believe the proposed rule's legal foundation will provide a court with a solid basis for upholding it. As we develop the final rule, we will take into account the public comments we receive, and I am confident the rule will be stronger as a result. The proposed rule includes a discussion of EPA's intention to develop streamlining techniques for smaller sources to the extent feasible.

b. Again, what is the rush? I have been told you are pressuring Congress to pass climate change legislation. Is that true? Or do you really think this path to chaos is prudent regulatory behavior?

Administrator Jackson Response:

The President and I have repeatedly asked Congress to pass comprehensive climate change legislation. As time passes, however, I am compelled to address pending legal obligations concerning greenhouse gases, and to address the task that the Supreme Court laid out for us. The need to address climate change is also urgent. The Agency has applied sound science, available technological information and common sense in developing its responses to those obligations to date.

8. Along with Sen. Voinovich, I asked for an analysis of H.R. 2454 with what I believed were realistic assumptions about the availability of international offsets, the ability to only construct a modest number of additional new nuclear plants above those that had to be replaced, and finally the lack of carbon capture and sequestration (CCS) availability. Our request was not granted. I have no analysis as to what many believe are realistic scenarios for the future. Doubly troubling is the fact that your S.1733 analysis is believed by your experts to be "close" to the H.R. 2454 analysis. During this committee's consideration of the Lieberman-Warner bill, I received a comprehensive technical analysis after the bill had passed out of committee. I have some questions regarding your analysis of S. 1733:

What scenario did EPA use for its base case for S.1733 (or herein after "Chair's Mark")? What sensitivity analyses did you perform on S.1733?

Administrator Jackson Response:

As stated in our analysis of S. 1733 "EPA synthesized the results of a significant volume of modeling analysis on economy-wide climate policy performed by the Agency. This effort drew from the nearly 50 modeling scenarios of five bills over the past two years, with particular focus on the two economic analyses of the Waxman-Markey bill this year."

a. Please describe how EPA synthesized the results of various modeling exercises?

Administrator Jackson Response:

EPA assessed how the differences between H.R. 2454 and S. 1733 would likely impact modeled costs. Many of the differences between the bills had previously been examined in sensitivity scenarios included in previous EPA analyses. EPA also presented some of the modeled costs from the core scenario (scenario 2) of EPA's analysis of H.R. 2454 for comparison. EPA discussed additional sensitivity cases that were run for previous bills that would also be applicable for S. 1733.

b. In modeling the market stability reserve, under which scenario or sensitivity run did the reserve run out of allowances, and what was the resultant allowance price?

Administrator Jackson Response:

EPA did not explicitly model the market stability reserve. The discussion of the reserve running out was simply based on the amount of allowances that were initially placed in the reserve and the amount of allowances that are allowed to be auctioned from the reserve in each year. This discussion did not require any modeling.

c. Under S.1733, if the Administrator does not determine that sufficient CCS has been commercially deployed, NSPS is not triggered. Do you model the impact this may have on the development of new coal fired power plants? Without CCS, what control technology and at what cost in $/kw do you project to be available?

Administrator Jackson Response:

EPA modeling shows that new *conventional* coal plants (without CCS) are not built in the presence of a carbon price, whether CCS is available or not. Thus, EPA has not specifically analyzed this provision. In the absence of CCS, there are many low-emitting power technologies that are available to meet emission reduction targets.

The cost assumptions for these technologies are taken from EIA's AEO 2009 (April update). For the coal-fired facilities, emission reduction options (excluding CCS) include biomass co-firing, plant efficiency improvements, or changes to utilization.

9. Your models are deficit neutral, but since S.1733 is unlikely to pass without being scored as deficit neutral, did you model the impacts of the Deficit Reduction Fund? What were the impacts on allowance prices as a result of the smaller number of allowances allocated to utilities?

Administrator Jackson Response:

As stated in our analysis of S. 1733, "EPA synthesized the results of a significant volume of modeling analysis on economy-wide climate policy performed by the Agency. This effort drew from the nearly 50 modeling scenarios of five bills over the past two years, with particular focus on the two economic analyses of the Waxman-Markey bill this year." EPA has not included a scenario that varies the deficit reduction fund in the analyses it has conducted of climate legislation for the House or in prior Congresses.

10. Table 5 of your discussion lists a number of small or slight increases as well as a slight decrease in the difference between S. 1733 and H.R. 2454. What are the sum of the increases, and the result of the sum of the decreases, minus the decrease?

Administrator Jackson Response:

We have not estimated a sum total of the differences between S. 1733 and H.R. 2454 but are confident that the economic impacts of S. 1733 are very similar to H.R. 2454.

11. In your discussion of emissions and resulting carbon dioxide concentration increases over time, what formula, equation or mathematical relationship between emissions, carbon dioxide concentration, and temperature did you use? What was the source of this relationship?

Administrator Jackson Response:

As stated in EPA's October 23 report, the agency evaluated the impact of policies like S. 1733, combined with actions by other governments, on global CO_2-equivalent concentration levels and global average temperature rise. On pages 25-28 of EPA's October 23 report, we noted that we used the MiniCAM and MAGICC models to assess global emissions, concentrations, and temperature rise through 2100. We used a climate sensitivity of 3.0, which was deemed the "best estimate" by the IPCC Working Group I in their 2007 report.

12. At what point in time and under what scenario or sensitivity run did the strategic reserve run out of allowances? What were the consequences for allowance prices and impacts on consumers?

Administrator Jackson Response:

As stated in our analysis of S. 1733, "EPA synthesized the results of a significant volume of modeling analysis on economy-wide climate policy performed by the Agency. This effort drew from the nearly 50 modeling scenarios of five bills over the past two years, with particular focus on the two economic analyses of the Waxman-Markey bill this year." EPA has not run a scenario or sensitivity run in any of its publically available modeling where the strategic reserve runs out of allowances.

13. Did you analyze the sensitivity of your model to the case where there were no international offsets available? If so, please provide your results.

Administrator Jackson Response:

We included a sensitivity of no international offsets in our H.R. 2454 modeling. See Scenario 7, slide 40 of the H.R. 2454 analysis for the results.

14. Did you analyze the sensitivity of your model where no new nuclear power plants were constructed? If so, please provide your results.

Administrator Jackson Response:

We included a sensitivity of no new nuclear generation growth beyond the reference case in our H.R. 2454 modeling. See Scenario 5, Slide 17 of the H.R. 2454 analysis for the results.

15. Did you analyze the sensitivity of your model where CCS does not become commercially available until 2030, or is never available? If so, please provide your results.

Administrator Jackson Response:

EPA has not included this scenario in the analyses it has conducted of climate legislation in the House or in prior Congresses. However, EPA's analysis of S. 2191 included a scenario constraining nuclear, biomass, and CCS. The results of this scenario are available in our analysis of S. 2191.

16. Did you analyze the sensitivity of your model to the case where there are no new nuclear plants being constructed, CCS is not available, and there are no international offsets?

Administrator Jackson Response:

EPA has not included this scenario in the analyses it has conducted of climate legislation in the House or in prior Congresses. However, EPA's analysis of S. 2191 included a scenario constraining nuclear, biomass, and CCS; and a scenario that did not allow offsets; but did not include a scenario combining these constraints. The results of this scenario are available in our analysis of S. 2191.

17. Please provide the amount of renewable energy that each scenario and/or sensitivity run projected to be built. Please break this down by type.

Administrator Jackson Response:

As stated in our analysis of S. 1733, "EPA synthesized the results of a significant volume of modeling analysis on economy-wide climate policy performed by the Agency. This effort drew from the nearly 50 modeling scenarios of five bills over the past two years, with particular focus on the two economic analyses of the Waxman-Markey bill this year." In EPA's analysis of H.R. 2454, the share of renewable electricity in the reference scenario is 6% of generation in 2015, 8% in 2020, and 10% in 2030. In "scenario 2 – H.R. 2454" the renewable generation share increases to 8% in 2015, 12% in 2020, and 20% in 2030 (other policy scenarios have similar renewable shares).

18. Please provide your analysis of the impact of carbon dioxide pipeline construction on the amount of expected CCS use within the series of analyses you performed.

Administrator Jackson Response:

EPA's analysis does not estimate specific pipeline construction needed for climate legislation. EPA assumes a cost of $15/ton of CO2 to reflect the costs of building, transporting, and storing CO2 underground.

19. In your discussion of energy efficiency provisions, you stated that S.1733 would have energy efficiency impacts of about half those calculated for H.R. 2454. Please provide your analytical methodology for this estimate and the actual amount of impact.

Administrator Jackson Response:

As discussed in our S. 1733 assessment, three areas of energy efficiency provisions were addressed within our analysis of H.R. 2454: building codes, energy efficiency-related allowance allocations, and the energy savings component of the Combined Efficiency and Renewable Electricity Standard (CERES). In our analysis of H.R. 2454 (p. 18 of 53), EPA indicated that the impact of these provisions on electricity demand was estimated to grow to 5% of reference case

demand by 2020 and increase to 5.6% of reference case demand in 2050. Each of the three areas contributed significantly to this total effect, roughly 1/3 over the entire period through 2050.

In S. 1733 there is no provision comparable to the CERES provision of H.R. 2454. Also, the allowance allocations for energy efficiency are lower in S. 1733 than H.R. 2454, ranging from approximately 11% lower through 2029 to approximately 25% lower in 2040 and later years. This has a proportional impact on our estimate for the effects of these provisions. In addition, the absence of an allowance mechanism for addressing non-compliance within the building codes provision lowers our estimate of the energy savings effects of this provision In total we estimate the aggregate impact of the energy efficiency provisions in S. 1733 to be approximately half of the comparable provisions within H.R. 2454.

20. Table 4 on page 17 of your discussion contains very useful information about H.R. 2454. Please provide a similar table for S.1733 and the back-up material.

Administrator Jackson Response:

EPA developed the S.1733 analysis based on synthesizing the results of nearly 50 modeling scenarios of five bills over the past two years. As we noted in the October 23rd paper, because of the many similarities between H.R. 2454 and S. 1733 and the relatively small differences between the two bills, we expect that S. 1733 would have economic impacts very similar to H.R. 2454, as depicted in Table 4.

21. Does your schedule that is posted on EPA's website accurately reflect your public meetings and administration meetings?

Administrator Jackson Response:

My office endeavors to keep the schedule posted on EPA's website accurate and up-to-date.

22. S. 1733 and H.R. 2454 will require the EPA to promulgate quite a few new rules and regulations before the contemplated trading scheme can start in 2012. However, the existing trading program for pollutants that are actually harmful to public health, Clean Air Interstate Rule (CAIR), was vacated by the DC Circuit Court of appeals on July 11, 2009 – almost 16 months ago – and still the EPA has failed to issue even a proposed replacement rule. Given the agency's historical record regarding the time required to promulgate new rules, is it even feasible for the agency to promulgate all the necessary regulations for a new cap and trade scheme before the 2012 start date?

Administrator Jackson Response:

The more appropriate comparison for developing and implementing regulations directed by legislation is EPA's experience with Clean Air Act Title IV, which established the Acid Rain

Program. Congress passed the Clean Air Act amendments that added Title IV in November 1990; Title IV required EPA to establish a program to reduce the adverse effects of acidic deposition in part through cap-and-trade. To implement that statutory mandate, EPA codified the Acid Rain Program requirements in seven regulations. In this case, EPA has already made substantial progress in establishing a system to collect and verify greenhouse gas emissions through promulgation of the Greenhouse Gas Mandatory Reporting Rule.

23. The EPA has a record of problems in administering the annual Sulfur Dioxide allowance auctions. Just last year, the agency initially reported erroneous results regarding the winning bidders of the annual Sulfur Dioxide allowance auction. Currently, it is contemplated that the EPA would have authority over both the supply (via allocation, strategic reserve, determination of new emissions subject to regulation) and demand (through regulations around measurement and account true up) aspects of the trading scheme. From both an internal control perspective, and in an effort to better utilize the relative comparative capabilities of the various agencies of the federal government, would it not make more sense to have the Treasury Department administer the supply aspects of the scheme (including the auction and strategic reserve fund management) and leave the demand aspects (measurement, true up, etc) to the EPA?

Administrator Jackson Response:

EPA has a strong record of efficiently administering the Acid Rain program. In addition to allocating allowances to each generating unit, EPA has conducted small annual, revenue-neutral allowance auctions since 1993. Auctioned allowances are acquired by the EPA holding back approximately 2.8% of the allowances issued to each unit. Each unit in turn receives a pro rata share of the auction proceeds. The Chicago Board of Trade (CBOT) ran the auctions for the first 13 years and then decided not to run them any longer. EPA has successfully run the auctions since then .

During the 2009 auction EPA inadvertently posted the incorrect 7-Year Advance Auction results at 12:00 noon on March 24, 2009. The incorrect results were corrected as soon as possible on the same day and resulted from a typographical error on our part in entering data from a bid form submitted for the auction. EPA is improving the auction format and will use electronic bidding in the future, which should preclude data entry errors. EPA has not been using electronic bidding in auctions of Acid Rain Program allowances because the number of allowances auctioned and number of bids received (never exceeding about 200 bids) have been relatively small and manageable, using a manual system.

Ultimately, it is up to Congress to determine who should administer the auction under any future energy and climate legislation.

24. Both H.R. 2454 and S. 1733 do not give allowances "Property Rights" legal status, which would afford holders the same constitutional protections against a taking as all other property. The concept of not giving allowances property rights legal status is the same concept used under the existing Title IV allowance trading program implemented as part of the Amendments to the Clean Air Act of 1990. However, under that program, most allowances (approximately 98%) are

allocated at no cost to sources. Under the currently contemplated trading scheme, no cost allocation is quickly phased out over time and in the not too distant future sources will need to purchase allowances. Why are allowances not given property rights legal status? Isn't the program's success contingent on market participants' confidence in the government's continued commitment to the program? Does the lack of property rights impair the value of the allowance and/or provide sources with a disincentive to use allowances as part of their long term compliance plan?

Administrator Jackson Response:

Title IV of the existing Clean Air Act, like H.R. 2454 and S. 1733, specifies that allowances are not property rights. This provision was inserted to ensure that EPA can require additional, appropriate emission reductions without those actions being deemed "takings" as a matter of constitutional law.

25. Section 163 would require the EPA Administrator, or other agency head or heads designated by the President, to promulgate regulations establishing building code energy efficiency targets by January 1, 2014. Does the EPA have the resources and technical knowledge of residential and commercial energy codes necessary to meet this target date? Is the EPA prepared to take on the responsibility of establishing national energy efficiency building codes? Under current law, the DOE is charged with making determinations on national model energy codes and participates in the development of those codes. How does the EPA view the requirements of Section 163 interacting with the DOE's current responsibilities in the development of national model energy codes?

Administrator Jackson Response:

Section 163 of S. 1733 is similar to Waxman-Markey Title II, Subtitle A, Section 163, which directs EPA to establish building code energy efficiency targets for the national average percentage improvement of buildings' energy performance. A key difference between the S. 1733 and Waxman-Markey provisions is that the S. 1733 provisions direct EPA or such other agency head or heads as the President designates, to develop building code energy efficiency targets in consultation with NIST. In contrast, the Waxman-Markey provisions direct DOE to establish building energy codes.

EPA will take on the responsibilities it is assigned in any enacted statute. Both EPA and DOE have experience and expertise in advancing energy efficiency measures for buildings and promoting the adoption of building codes (currently building codes are established in a voluntary consensus-based process). I am confident that EPA and DOE would work together to implement effectively any responsibilities assigned to the respective agencies by statute. Both agencies also would consult with NIST, which works closely with standards code organizations to develop roadmaps and the standards that industry accepts through the voluntary consensus process.

26. Administrator Jackson, at the hearing today, you outlined three principles with regard to preemption of the federal Clean Air Act (CAA), suggesting that not all of the provisions of the Act should be preempted if comprehensive climate change legislation is enacted. Please provide a comprehensive list of those provisions of the CAA that you believe should be preempted in legislation such as S. 1733 and HR 2454 and those provisions that you believe should not be preempted.

Administrator Jackson Response:

I currently do not have a comprehensive list in mind. EPA has begun to take action under CAA Title II to set vehicle greenhouse gas standards, and both H.R. 2454 and S. 1733 call for EPA to set standards under existing Title II authorities for other types of transportation sources. It will be important to consider each Clean Air Act tool in turn in deciding whether and how these tools can make a useful and efficient contribution to greenhouse gas reductions in the context of climate change programs being crafted by Congress. Having said this, the President has made clear that the problem of climate change is best addressed through comprehensive energy and climate legislation, and he strongly supports passage of such a bill. I look forward to working with the Committee on these issues.

27. Do you support full preemption of other federal statutes, such as the Clean Water Act and the Endangered Species Act with regard to the potential regulation of GHG emissions due to the potential impacts on species and water quality from changes in climate, ocean acidification and coral bleaching?

Administrator Jackson Response:

I currently do not have a position on that issue. I understand the importance of considering the ongoing role of these statutes as Congress considers comprehensive climate change legislation, and would welcome discussing the issue with the Committee.

28. HR 2454 proposes to preempt several provisions of the CAA, including part C of title I, section 112, section 108, section 115, and Title V. On balance, these provision should reduce the cost of HR 2454 compared to S 1733. Please provide an estimate of the regulatory costs of proceeding with these CAA programs if no legislation is enacted. Please explain how the inclusion of provisions preempting these sections of the CAA would affect the overall cost of the legislation.

Administrator Jackson Response:

The regulatory cost of proceeding under the Clean Air Act authorities you reference would depend, among other things, on the particular provisions of any specific rules EPA issued pursuant to those authorities. EPA has proposed a rule under part C of title I and Title V to focus the permit programs those provisions establish on the largest sources of greenhouse gases. We

provided an economic analysis of the proposed rule in the draft regulatory impact statement accompanying the proposal. Since there are no EPA proposals under the other authorities you cite, we have not developed information concerning the possible regulatory costs of such programs.

29. Both HR 2454 or S 1733 propose to require oil refiners to purchase allowances for all GHG emitted at the refinery during production as well as all GHG emitted from combusting the fuel in vehicles. This will raise the cost of gasoline and diesel fuel. Neither HR 2454 nor S 1766 proposes to preempt preemption section 211(c) of the CAA that provides EPA with authority to regulate fuels. Please tell the Committee why the price signal created from the increased cost of fuel and the inclusion of GHG emissions from the combustion and process of fuel under the economy wide cap is not sufficient in of itself to force changes in the production and consumption of fuel in the most cost-effective manner possible.

Administrator Jackson Response:

EPA's recent analysis has shown that refiners' obligation under the cap would raise gasoline prices $0.25 in 2030 and $0.69 in 2050(in real 2005 dollars) -- increases smaller than the fluctuations in gasoline prices seen in recent years. This small, indirect price signal on transportation fuel from the cap alone may not achieve a large-scale transformation in the transportation system. Complementary policies, such as the proposed GHG rule for passenger vehicles, give greater impetus to ensure ongoing development of technological innovations for new vehicles, lower carbon fuels, improvements to the existing fleet, and VMT reductions. The benefits of such an approach go beyond climate change mitigation and offer energy security benefits as well

30. On September 15, 2009 EPA signed a proposal to reduce GHG emissions from motor vehicles under section 202 of the CAA. On October 27, 2009, EPA proposed a "Tailoring Rule" in an attempt to limit the impact of the final mobile source rule (based on EPA's interpretation) on triggering stationary source requirements for 40,000 sources under the PSD preconstruction permit program and 6 million sources under the title V permit program. In the proposed 202 rule, EPA omitted any full discussion of the potential stationary source regulations that will occur when the rule is finalized. Similarly, in the proposed Tailoring Rule, EPA notes that the rule "does not impose economic burdens" and should be viewed "as regulatory relief for smaller GHG emission sources when the light-duty vehicle rule is promulgated."

> a. Given EPA's view that the final section 202 motor vehicle rule will impose significant if not unworkable economic burdens on millions of stationary sources, why did EPA fail to present a full accounting of these stationary source impacts in the proposed light-duty motor vehicle rule when the Agency believes that the rule will automatically trigger these requirements?

Administrator Jackson Response:

In the notice of the proposed vehicle rule, EPA included all of the analysis that the Clean Air Act and Executive Orders direct EPA to include in such a proposal. EPA will carefully review all of the public comments it receives in response to the proposal.

b. Why did EPA fail to conduct a regulatory flexibility analysis as required under the Regulatory Flexibility Act knowing that a final rule would affect millions of smaller sources?

Administrator Jackson Response:

EPA addressed the requirements of the Regulatory Flexibility Act (RFA) with respect to the proposed section 202 rule in the preamble of the proposal. For the reasons stated there, the Agency concluded that no additional RFA analysis was needed.

In the 202 proposal, EPA also acknowledged that small entities might have concerns about the potential impacts of the statutory imposition of Prevention of Significant Deterioration (PSD) permit requirements that might occur given EPA's various GHG rulemaking efforts. As the potential burdens of such stationary source regulation are being addressed in the tailoring rule proposal, EPA explained that it was "using the discretion afforded to it under section 609(c) of the RFA to consult with OMB and SBA, with input from outreach to small entities, regarding the potential impacts of PSD regulatory requirements that might occur as EPA considers regulations of GHGs" as part of the tailoring rule package. EPA will continue to assess any potential PSD impacts on small entities as we consider comments from the various rulemaking packages and conduct our outreach.

c. Similarly, why did EPA fail to include the impacts on stationary sources when it submitted its benefit cost analysis required under Executive Order 12866?

Administrator Jackson Response:

EPA has taken the steps that Executive Order 12866 requires EPA to have taken by this point. For the proposed tailoring rule, EPA completed a regulatory impact analysis (RIA) that estimates the cost savings to sources and permitting authorities that would be achieved by the rule. The public has the opportunity to comment on this analysis along with the proposed rule itself, and we will carefully consider the comments we receive.

d. How can sources meaningfully participate and comment on impending regulatory requirements without the inclusion of a full analysis of the likely burdens and the underlying statutory and regulatory authorities triggering those requirements?

Administrator Jackson Response:

As noted above, the public has an opportunity to review and comment on the RIA that we prepared for the proposed tailoring rule. More generally, EPA has and will continue to provide potentially affected sources with an opportunity to comment on any rulemaking that EPA proposes, including outreach to small entities coordinated in consultation with SBA.

e. Given this gap and the likelihood that millions of sources will be impacted without ever having been afforded an opportunity to comment on a full analysis of the burden in the context of the rulemaking imposes this burden, shouldn't EPA withdraw the 202 proposal and reissue it with a full analysis of expected impacts as required by law.

Administrator Jackson Response:

I do not believe that EPA should withdraw the proposed section 202 proposal. The proposed tailoring rule addresses how sources might be impacted and provides the public with an opportunity to comment on focusing the application of the Clean Air Act permitting programs with respect to greenhouse gases on the largest sources of those pollutants. EPA will review and carefully consider any public comments filed on the proposals.

31. What portion of the proposed GHG emission reductions from the combined DOT and EPA rules would the EPA proposed section 202 produce compared to the reductions anticipated under the DOT rule?

Administrator Jackson Response:

For several reasons, the estimates of benefits and costs presented by EPA and NHTSA, while consistent, are not directly comparable and should not be expected to be identical. However, the CAA standards provide significant additional CO2 benefits. EPA estimates that the proposed GHG standards will result in a reduction of 947 million metric tons of CO2 from the 2012-2016 vehicles over their lifetime. DOT has estimated that the CAFE program alone will result in a reduction of 639 million metric tons of CO2.

a. Could EPA realize some of the expected GHG emission reductions from HFC control through Title VI authorities rather than section 202?

Administrator Jackson Response:

EPA views this proposed rule as complementing the Title VI programs, and not conflicting or overlapping with them. To the extent that manufacturers choose to

reduce refrigerant leakage in order to earn air conditioning leakage credits, this would dovetail with the Title VI section 609 standards which apply to the servicing of motor vehicle air conditioning systems (MVACs), and to end-of-vehicle life disposal. In fact, a benefit of the GHG rule's proposed A/C credit provisions is that there should be fewer and less impactive maintenance events for MVACs, since there will be less leakage. EPA also believes the menu of leak control technologies proposed in the GHG vehicle rule would complement the section 612 requirements (pertaining to EPA's review of substitutes for ozone depleting substances that reduce the overall risks to human health and the environment), because these control technologies would help ensure that R134a or other refrigerants would be used in a manner that further minimizes potential adverse effects on human health and the environment.

b. Isn't true that EPA is not under a court deadline to issue the 202 rule and has the discretion to hold back the section 202 rule and let the DOT rule go forward alone?

Administrator Jackson Response:

Proposal of the section 202 rule is part of EPA's effort to expeditiously respond to the Supreme Court's 2007 decision in *Massachusetts v. EPA*. We note that the Supreme Court directly addressed the issue of whether DOT regulations are sufficient to absolve EPA of its mandate; specifically the court finding stated "*that DOT sets mileage standards in no way licenses EPA to shirk its environmental responsibilities. EPA has been charged with protecting the public's "health" and "welfare," 42 U. S. C. §7521(a)(1), a statutory obligation wholly independent of DOT's mandate to promote energy efficiency.*" While EPA is not under a court deadline to issue the GHG vehicle proposal, the goals of the National Program rely on a joint EPA/NHTSA program. This joint proposal offers the prospect of important regulatory convergence and certainty to automobile companies. If EPA were to further delay its proposal, there could be separate federal and state regimes independently regulating light-duty vehicles to reduce fuel consumption and GHG emissions: NHTSA's CAFE standards, and the GHG standards applicable in California and other states adopting the California standards. This joint proposal would allow automakers to meet both the NHTSA and EPA requirements with a single national fleet, greatly simplifying the industry's technology, investment and compliance strategies. Many of the world's largest auto companies have stated their support for this joint proposal. In addition, California's commitment to defer to the federal program is also conditioned on EPA adopting GHG standards of this type.

c. Wouldn't at least a temporary delay in issuing the section 202 rule make sense given the state of the economy and the significant and immediate impact it is likely to have on stationary sources, job creation, and the economy? Wouldn't additional time make sense given the time needed for Congress to carefully deliberate on comprehensive GHG legislation?

Administrator Jackson Response:

Our response to your concerns about stationary source regulation is provided in answer to question 30 above. The benefits of the proposed section 202 rule are substantial. The proposed National Program would result in approximately 950 million metric tons of total carbon dioxide equivalent emissions reductions and approximately 1.8 billion barrels of oil savings over the lifetime of vehicles sold in model years 2012 through 2016. In total, the combined EPA and NHTSA 2012-2016 standards would reduce GHG emissions from the U.S. light-duty fleet by approximately 21 percent by 2030. The estimated benefits of the proposed National Program would total about $250 billion (at a 3% discount rate). In addition, the joint GHG/CAFE proposal has significant economic benefits for American consumers. Consumers would save more than $3,000 as a result of fuel savings over the lifetime of a model year 2016 vehicle. Finally, EPA believes that the proposed GHG vehicle standards would complement comprehensive climate legislation.

32. Many companies producing products have had to shut down facilities and production lines given the economic recession and the reduced demand. If at some later point, the economy recovers and these sources decide to restart production two years after stopping, would they trigger PSD if GHG emission levels increase above the proposed significance levels? If so, would these sources then have to wait 18 months if not longer to receive a permit and install BACT before beginning operation?

Administrator Jackson Response:

EPA has policies in place to handle these sorts of situations. These evaluations are done based on the individual circumstances of each case.

33. In issuing the proposed Tailoring Rule, EPA relies on the legal argument of administrative necessity in circumventing the statutory thresholds of 100 and 250 tons depending on source category.

a. What other agencies inside the Administration reviewed this legal theory? Please provide copies of their comments.

Administrator Jackson Response:

EPA has not proposed to circumvent any statutory requirements. As I stated earlier, I believe the proposed rule is legally sound. The proposed rule was subject to the interagency review process, so numerous agencies had an opportunity to review the rule, including its legal basis. As required by the Clean Air Act, EPA has included in the public docket for the proposed rule the comments submitted by other agencies during the interagency review process. The link to the electronic docket is

http://www.regulations.gov/search/Regs/home.html#home. When the page opens, please enter in the 'Enter Key Word" box docket # EPA-HQ-OAR-2009-0517.

b. Based on prior NSR rulemakings and legal precedents, if the Tailoring Rule is vacated, would the 100/250 ton statutory thresholds be retroactively applicable? Would a significance level of zero emission increase be retroactively applicable for modifications as well if the Tailoring Rule is vacated? Does this mean that any modification at facilities with a potential to emit of 100 or 250 tons would trigger PSD and BACT if it causes a net increase in GHG emissions?

Administrator Jackson Response:

While there is caselaw that suggests vacaturs can apply retroactively, a court may decide not to vacate a rule, and instead to remand it, in light of the potential impacts. In that case, the rule would remain on the books until revised. Moreover, in certain circumstances, even when vacating a rule, the court may retain the ability to fashion equitable relief, so that the vacatur would not apply retroactively. EPA believes that a reviewing court would find the tailoring rule, if adopted, legally sufficient, and that if the court held to the contrary, it would not find those numerical thresholds retroactively applicable in that situation.

34. Earlier this month, the press reported that Judge David Tatel of the U.S. Circuit Court of Appeals for the District of Columbia warned agencies that fail to follow federal statutes. He is quoted in the press as saying: "It looks for all the world like agencies choose their policy first and then later seek to defend its legality.....This gets it entirely backwards.....It's backwards because whether or not agencies value neutral principles of administrative law, courts do, and they will strike down agency action that violates those principles -- whatever the president's party, however popular the administration, and no matter how advisable the initiative." Do the Judge's comments and the sentiments expressed in those comments have any bearing on EPA's proposed legal argument with regard to the proposed Tailoring Rule?

Administrator Jackson Response:

The D.C. Circuit's decisions on EPA interpretation of the Clean Air Act obviously have a bearing on EPA's interpretation of the Clean Air Act regarding any rule that EPA issues under that statute. Presumably, Judge Tatel's remarks reflect cases in which he served on the judicial panel reviewing final EPA actions under the Clean Air Act. I am not aware that Judge Tatel has yet served on a judicial panel that has issued a decision on a final agency action that EPA has taken under the Clean Air Act during the current Administration.

a. If, as some suggest, reliance on the doctrine of Administrative Necessity is legally precarious given the emission threshold that are written in the statute, isn't EPA needlessly placing millions of small businesses at economic risk (for costly controls

and permit delays) by issuing a final section 202 rule when it has the discretion to wait?

Administrator Jackson Response:

I believe the proposed tailoring rule is legally sound. As explained in the preamble to the proposed rule, its legal foundation relies on two lines of cases, the absurd results cases and the administrative necessity cases. Both lines of cases include precedents by the D.C. Circuit. *See* 74 *Fed. Reg.* at 55,306 (absurd results caselaw), at 55,316 (administrative necessity caselaw). As a result, we do not believe that we are placing small businesses at risk.

35. Concerning your June 2009 analysis of the Waxman-Markey Bill, please answer the following:

a. Why does your data annex file ("HR.2454 EPA Data Annex – ADAGE & IGEM v.2.3.xls") not include figures from all 7 scenarios?

Administrator Jackson Response:

The data annex file "HR.2454 EPA Data Annex - ADAGE & IGEM v.2.3.xls" does include data from all 7 scenarios. It should be noted that the two models, ADAGE and IGEM, were not each run for each of the 7 scenarios. Data is provided from the ADAGE model for scenarios 1, 2, 3, 4, 5 and 6. Data is provided from the IGEM model for scenarios 1, 2, and 7.

b. Please provide figures for 1) electricity price, 2) gasoline price and 3) natural gas price under the reference and policy case scenarios (including scenario #7) for the years in the range of the program.

Administrator Jackson Response:

The data annex file "HR.2454 EPA Data Annex - ADAGE & IGEM v.2.3.xls" all relevant energy price information from the ADAGE model for scenarios 1 – 6. Scenario 7 was only run in the IGEM model, which does not produce this specific energy price information.

c. Please elaborate on why you include the net present value calculation for consumption loses (p. 13).

Administrator Jackson Response:

The net present value calculation for consumption losses is one of several different ways we present consumption loss impacts. The net present value consumption loss calculation is comparable to the net present value consumption loss calculation presented in MIT's analyses of climate policy.

d. Please respond with consumption losses for all scenarios, including scenario 7, in net present value and straight consumption loss per Household.

Administrator Jackson Response:

This information is presented on slide 62 of the appendix to EPA's analysis of H.R. 2454.

e. You report says the "average annual NPV cost per Household" is $80-$111. (p. 13) Does this figure represent how much money would need to be put aside today to meet an average year's obligation? If so, is it far to say a household would have to put aside $80 to $111 for each year of the program today in order to make up for consumption loses over the duration of the program?

Administrator Jackson Response:

The net present value of the consumption loss in a future period calculates the consumption loss today that would be equivalent to the consumption loss estimated for a future period. For example, as shown in table 4 of EPA's analysis of S. 1733, in 2020 H.R. 2454 would result in a consumption loss of $0.23 - $0.29 per day. The net present value of this loss in 2020 would be $0.13 - $0.16 per day. This means that a household would be indifferent between a consumption loss of $0.29 that happens in 2020 and a consumption loss of $0.16 that happens today.

f. Can you create a new "Consumption" slide that includes all scenarios, including scenario 7? (See p. 13 of your Waxman-Markey analysis.)

Administrator Jackson Response:

This information is presented on slide 62 of the appendix to EPA's analysis of H.R. 2454.

Senator George V. Voinovich

1. I have been working with you and your agency, to ensure that your analyses of these climate bills includes cases that provide a look at possible costs associated with this bill -

particularly if assumptions about technology adoption aren't as rosy and optimistic as some would hope. Given that the EPA has not yet performed this analysis, how is it possible to believe that "a postage stamp a day" is the true cost of implementing this legislation?

Administrator Jackson Response:

EPA stands behind the methodologies and assumptions that the agency uses in order to model the economic impacts of energy and climate policies. EPA has always been and will remain transparent about the methodologies and assumptions that the agency uses. In particular, we examined the core features of both the House and Senate bills and found that the per-household costs were likely to be similar (about 30 cents a day) because of the close similarities in the core features of the bills. In addition, we examined alternative scenarios in our analyses that vary assumptions about technology adoption and acknowledge that the consumption impacts would be different (e.g., if there was no nuclear generation growth or no international offsets).

2. The EPA's base analysis of the Waxman-Markey Climate Bill assumes a 150% increase in nuclear generating capacity by 2050. That's equivalent to bringing online about 150 new nuclear plants in the next 40 years. For someone who has been saying that "we can't get there from here without nuclear", I couldn't be happier to hear that. However, I have a problem with that assumption. Given the current constraints in capital financing, licensing, manufacturing, and skilled work force for engineering and construction, I believe bringing 150 new nuclear plants online in the next 40 years is simply unrealistic. Additionally, your analysis shows 25 Gigawatts of CCS online by 2020, and a tenfold increase in biomass generation by 2050. So, could you please discuss the level of optimism you have in terms of actually seeing this level of adoption for these technologies? Have you had these assumptions peer-reviewed by other knowledgeable people at other government agencies or private industries? Aren't there a host of environmental problems that would only be aggravated by a tenfold increase in biomass generation?

Administrator Jackson Response:

EPA's analysis of H.R. 2454 does not assume a 150-percent increase in nuclear generating capacity by 2050. Rather, EPA's analysis of H.R. 2454 projects a 150-percent increase in nuclear generating capacity by 2050, in response to the policies in H.R. 2454. In the longer term, we believe that nuclear power will be a cost-competitive source of emissions-free electricity under a cap and trade system. The 150-percent increase in nuclear generating capacity by 2050 is a restriction on the amount of new nuclear capacity that the model is allowed to build. These restrictions are designed to reflect the technical and political feasibility of building new nuclear power plants.

The assumed limitations on new nuclear capacity reflect the U.S. Climate Change Science Program Synthesis and Assessment Product 2.1a (MiniCAM Level 1 Scenario), and the EPRI analysis "The Power to Reduce CO_2 Emissions: The Full Portfolio" (August 2007). When it comes to the nuclear industry, EPA uses the assumptions about the costs of nuclear power used by the Energy Information Administration. All of the assumptions that EPA uses have been through repeated rounds of inter-agency review. The non-governmental peer review that EPA's

methodologies and assumptions have been through is described in slides 16 – 18 of the appendix to EPA's analysis of H.R. 2454.

EPA recognizes that the actual degree of future expansion of any of the electricity-generating technologies in question depends not just on the economic incentives created by a policy such as H.R. 2454 or S. 1733, but also on the presence or absence of constraints and incentives beyond the policy itself (administrative, political, etc.) that EPA's computer models are not designed to detect. For that reason, EPA's computer-modeling efforts include running the policy in question through the models under assumptions that the technologies in question do not deploy as much as would otherwise occur, irrespective of the economic incentives created by the policy under analysis. In that regard, my staff has made an offer to yours regarding additional scenarios with additional pessimistic assumptions that EPA could include in any future computer-modeling analysis of policies such as H.R. 2454 and S. 1733.

Senator David Vitter

1. Administrator Jackson, I want to thank you for your candor in answering my letter of July 15. As you said in your response EPA has no analysis of the plausible emissions scenarios for the G-5 developing countries and Russia. Neither do you have the global CO2 equivalent concentration scenarios necessary to evaluate the impact of S 1733.

Based on your comments I have approached Dr. Leon Clarke with the Joint Global Change Research Institute to see whether he had any data available from his studies. He seems to have the same problem responding that the Department of Energy has.

My request is that you provide detailed modeling of the plausible scenarios of emissions based on the cases I outlined in my letter of July 15 so that we have this information before we mark up this bill. This analysis should conform to the July 2013 requirements stipulated in Section 705. ***Can you ensure this modeling is prepared and submitted to Congress in a timely manner?***

"SEC. 705. REVIEW AND PROGRAM RECOMMENDATIONS. "(a) IN GENERAL.—The Administrator shall, in consultation with appropriate Federal agencies, submit to Congress a report not later than July 1, 2013, and every 4 years thereafter, that includes—

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"(2) whether United States actions, taking into account international actions, commitments, and trends, and considering the range of plausible emissions scenarios, are sufficient to avoid— "(A) atmospheric greenhouse gas concentrations above 450 parts per million carbon dioxide equivalent; "(B) global average surface temperature 3.6 degrees Fahrenheit (2 degrees Celsius) above the pre-industrial average, or such other temperature thresholds as the Administrator deems appropriate; and "(C) other temperature or greenhouse gas thresholds identified pursuant to subsection (c)(6)(B).

Administrator Jackson Response:

As stated in EPA's October 23 report, the agency does have a basis for evaluating the impact of policies like S. 1733, combined with actions by other governments, on global CO_2-equivalent concentration levels and global average temperature rise. Please see pages 25-28 of EPA's October 23 report.

2. I assume that you have read the bill. Section 707 suggests that by July 1, 2015 the President will direct all agencies to take additional actions to reduce emissions.

What additional actions could EPA take to further reduce emissions and under what authority?

Administrator Jackson Response:

It is premature to describe exactly what additional actions EPA may take until such an analysis is conducted. However, we note that EPA has had successes achieving emissions reductions through voluntary programs that could be applied to uncapped sources.

Wouldn't EPA have the authority to void any of the emissions credits under this provision?

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"SEC. 707. PRESIDENTIAL RESPONSE AND RECOMMENDATIONS.

"Not later than July 1, 2015, and every 4 years thereafter— "(1) the President shall direct relevant Federal agencies to use existing statutory authority to take appropriate actions identified in the reports submitted under sections 705 and 706 and to address any shortfalls identified in such reports;

Administrator Jackson Response:

No, that is not our interpretation. Section 707 refers only to use of existing authorities. Nothing in the language of section 707 establishes authority to void emission credits.

3. Section 744 indicates that EPA will allow international offsets only from countries that comply with certain guidelines. If a country has not taken on legally binding and verifiable commitments, then it appears that the offsets will be disallowed. If China and India have not entered into such agreements, I assume that any offsets from those countries would not be available. ***What assumptions did EPA make about offsets from specific countries in its analysis of S 1733/HR 2454?***

Sec 744 International Offset Credits. Page 564 (2) REQUIREMENTS FOR INTERNATIONAL OFFSET CREDITS.—The Administrator may issue international offset credits **only if**— "(A) the United States is a party to a bilateral or multilateral agreement or arrangement that includes the country in which the project or measure achieving the relevant greenhouse gas emission reduction or avoidance, or greenhouse gas sequestration, has occurred; "(B) such country is a developing country;

Administrator Jackson Response:

Pages 8 and 9 of EPA's S. 1733 analysis describe the construction of the international offset marginal abatement cost curves used in EPA's analysis of H.R. 2454. These assumptions are further detailed in the EPA's March 26, 2007 memo to EIA, "EPA S.280 mitigation cost schedules for capped sectors and domestic and international offsets," which is available as part of the data annexes of all of EPA's analyses of legislative climate proposals. EPA made differing assumptions about which sources are eligible to provide abatement to the international market depending on whether or not it was from a country with a binding cap on emissions. EPA did not make any assumptions about specific bilateral or multilateral agreements. Pages 20 – 21 of EPA's analysis of S. 1733 discuss the important sensitivities on international offset availability that have been run by EPA and others.

4. Administrator, on October 13th, I wrote to request the results of your continuing Section 321(a) evaluation of potential loss or shifts of employment which may result from the suite of regulations EPA has proposed or finalized that address greenhouse gases under provisions of the Clean Air Act, including threatened plant closures or reductions in employment that may result from the administration or enforcement of such regulations.

As you know, Section 321(a) of the Act (42 U.S.C. § 7621(a)) states:

Continuous evaluation of potential loss or shifts of employment. The Administrator shall conduct continuing evaluations of potential loss or shifts of employment which may result from the administration or enforcement of the provision of this chapter and applicable implementation plans, including, where appropriate, investigating threatened plant closures or reductions in employment allegedly resulting from such administration or enforcement.

I was wondering if you might tell me the status of your analysis per my request?

Administrator Jackson Response:

On October 26, 2009, EPA transmitted to your office the agency's response to your letter of October 13.

Senator John Barrasso

1. CBO Director Dr. Elmendorf stated that if we enacted this energy tax the fossil fuel sector would mirror the massive job losses experienced by the manufacturing industry since the 1970s.

    a. What part of the Boxer-Kerry bill do you believe avoids turning fossil fuel dependent communities of the West, Midwest and South from becoming the rust belt of the 21rst Century?

Administrator Jackson Response:

I do not believe that CBO Director Elmendorf's testimony included the statement that you attribute to him. I do read Director Elmendorf's testimony to make two points. First, over time, legislation like S. 1733 would shift a significant amount of US jobs from high-emitting industries – such as oil refineries and conventional coal-fired power plants – to low-emitting industries – such as cellulosic biorefineries and advanced coal plants with carbon capture and sequestration. This Administration does want to make clean energy the profitable kind of energy in this country. We want to promote US industry and jobs over the long term by putting those industries at the forefront of the burgeoning global marketplace in clean-energy technologies.

Director Elmendorf's second point was that if the shift occurs too abruptly, then high-emitting industries and their employees might not have enough time to adjust. That is the point the behind an emissions cap that starts now, at a modest level, and then declines smoothly and gradually over time. If we waited much longer to start, then the transition would be abrupt. We need to start now, so that the transition need not be abrupt. Preventing an abrupt transition could also be a rationale for some of the transitional free allowances – such as for energy-intensive industries, coal-fired utilities, and the like – that you see in S. 1733.

I believe that S. 1733 and H.R. 2454 have been crafted to avoid the negative outcome that you describe.

2. Do you believe it makes sense for Washington to pass a cap and trade bill to make everything American's buy more expensive, and increase energy costs for low and middle income folks, and then devise a government bureaucratic "food stamp" like system to monthly compensate these households for the higher costs that were imposed upon them?

Administrator Jackson Response:

Analyses of S. 1733 indicate that costs are modest. However, its important not to lose sight of the fact that the bill would create, for the first time, a system of incentives to make clean energy the profitable kind of energy. Furthermore, what the analysis does not provide is the economic losses that may be avoided by reducing the risk that we will experience the most catastrophic impacts of climate change.

Senator Lamar Alexander

1. I have looked through the EPA produced document entitled "Economic Impacts of S. 1733: The Clean Energy Jobs and American Power Act of 2009" that was released to the public last Friday evening.

    a. Can you tell me the number of jobs created or lost by this bill? Does this include information on which sectors or industries will gain or lose jobs due to this bill?

Administrator Jackson Response:

EPA's economic computer models are not designed to project precise numbers of jobs gained or lost, either in the aggregate or in particular industries. Data and model limitations make it very difficult to estimate any labor market changes that might occur with any degree of accuracy. This is especially true considering that labor markets are primarily influenced by factors including routine business cycles, changes in production technology, and the state of the economy overall. No modeled job-related outputs appear in any of the computer-modeling reports that EPA provided on the Lieberman-Warner bill, the Bingaman-Specter bill, or the Waxman-Markey bill. Therefore EPA's October 23 analysis does not describe any such outputs.

b. What is the effect of the bill on the nation's GDP?

Administrator Jackson Response:

GDP would continue to grow if S. 1733 were enacted. EPA's computer models actually overestimate the negative impact on US GDP growth of a policy such as S. 1733, because the models are not designed to project and reflect the beneficial impacts on GDP growth of avoiding catastrophic climate change. Even with that being the case, the models project that the rate at which US GDP would grow under a policy like S. 1733 would be imperceptibly slower than in the absence of the policy. Indeed, the difference in the projected growth rate is so small as to fall well within the historical margin of error in GDP growth projections.

c. What is the effect on the price of gasoline and diesel fuel?

Administrator Jackson Response:

EPA's computer models project that each dollar in the price of an emission allowance would cause the price of a gallon of gasoline or diesel to be approximately one cent higher than in the absence of the program, all else being equal.

2. The document states that the impacts of this bill would be "similar" to those estimated for the House-passed Waxman-Markey climate change bill. What exactly does that mean with reference to the costs to the average American family?

Administrator Jackson Response:

It means that the cost to consumption of the average American household would start out at just a few cents a day and would be up to only about 30 cents a day by 2020.

3. What does this document say about the mix of electricity sources we are likely to have in 2020, 2030, and 2050? How many new nuclear plants will be built? How many new

Administrator Jackson Response:

The analysis that EPA completed on October 23 indicates that the projections that EPA made for H.R. 2454 are applicable to S. 1733 as well. In short, the projections are that for each of the following electricity sources – nuclear power, wind power, solar power, and coal with carbon capture and sequestration – the percentage of total U.S. electricity generated by that source by 2020, by 2030, and by 2050 would be higher in the presence of a policy like H.R. 2454 and S. 1733 than in the absence of one. The percentage also gets larger with time (i.e., the percentage is larger in 2030 than in 2020 and much larger in 2050 than in 2030). The opposite is the case with respect to natural gas by the last two decades of the program.

4. If the EPA's best efforts to quantify the effect of this proposed legislation as the title of this document clearly implies... "Economic Impacts of S. 1733: The Clean Energy Jobs and American Power Act of 2009" can't actually answer any of these questions then what other analysis is required to find these answers? Is further analysis from the EPA required? What other experts, such as the CBO, would you recommend we consult?

Administrator Jackson Response:

As noted in the responses above, the analysis that EPA completed on October 23 does provide answers to questions you have posed. EPA developed the S.1733 analysis based on synthesizing the results of nearly 50 modeling scenarios of five bills over the past two years. As we noted in the October 23rd paper, because of the many similarities between H.R. 2454 and S. 1733 and the relatively small differences between the two bills, we expect that S. 1733 would have economic impacts very similar to H.R. 2454.

Senator BOXER. Thank you so much, Administrator Jackson.

And our last witness is Hon. Jon Wellinghoff, Chairman of the Federal Energy Regulatory Commission. Welcome.

STATEMENT OF HON. JON WELLINGHOFF, CHAIRMAN, FEDERAL ENERGY REGULATORY COMMISSION

Mr. WELLINGHOFF. Thank you, Madam Chairwoman Boxer, Ranking Member Inhofe and members of this committee. Thank you all for inviting me here today to speak about a very important subject.

First, I want to commend Chairwoman Boxer and Senator Kerry for this undertaking and offer the support and assistance of my agency to further your effort here today.

I would like to submit my prepared testimony for the record and I will highlight a few points of my testimony.

Senator BOXER. Without objection.

Mr. WELLINGHOFF. Thank you.

The Federal Energy Regulatory Commission seeks to assist energy consumers in obtaining reliable, efficient, sustainable energy services at a reasonable cost through appropriate regulatory and market means. Toward that end, the Commission is removing barriers to the use of low carbon renewable resources and encouraging greater efficiency in the electric energy system. These efforts and the efforts by many States are helping to reduce the emissions produced by the generation of electricity.

Our Nation, however, has the capability to reduce these emissions much, much more. A major reason why low carbon renewable resources and energy efficiency are not used more extensively is that the cost of greenhouse gas emissions is, in economic terms, an externality. In other words, the effects of these emissions is not reflected in the price of energy in the marketplace. S. 1733 would change the situation by recognizing in the energy marketplace the effect of greenhouse gases. And I would note that this concept of internalizing these external costs has bipartisan support at my Commission.

Renewable resources cannot only help reduce greenhouse gas emissions but also diversify the fuels used to generate electricity. Fuel diversity helps stabilize our electric supply against shortages or price spikes in particular fuel markets. Using domestic energy instead of foreign energy also strengthens our national security.

This month, I provided the Congress with the Commission's strategic plan for the next 5 years. In that document, we committed to take additional steps to address possible barriers to more extensive use of renewable energy resources and distributor resources in energy markets, thus allowing for markets to operate more efficiently, reduce carbon and reduce costs to consumers.

But a significant expansion of renewable resources in our electricity supply portfolio will require additional high voltage transmission facilities, network upgrades and feeder lines. I also note that the inter-regional transmission facilities necessary to deliver the output of certain renewable resources are unlikely to be constructed without additional Federal authority in areas of planning, citing and cost allocation.

Consumer energy use management, also called demand response, refers to consumers reducing their usage at certain times to improve grid efficiency. In June, at the direction of Congress, the Commission issued an assessment of the potential for consumer energy use management both nationally and for each State through 2019. The assessment found that the potential of peak electricity demand reductions across our country is 188 gigawatts, or up to 20 percent of the national peak demand. These savings, if realized, can significantly reduce the number of power plants needed to meet peak demand, and thereby reduce carbon emissions by as much as 1.2 billion tons annually.

As I indicated above, in the Commission's new strategic plan, we commit to continue our efforts to identify and eliminate barriers to participation by demand resources in the Nation's organized wholesale electric markets.

FERC is using its statutory authorities to aggressively eliminate barriers to renewable resources and distributor resources in wholesale electric markets and to encourage greater efficiency in the electric system and thereby reduce carbon emissions. For such efforts to increase reductions in carbon and improve efficiency, sound energy policies must get the price in the markets right to achieve both our environmental and our economic energy policy goals.

S. 1733 is the key to getting it right. I encourage you to pass this legislation.

Thank you again for the opportunity to testify here today. I will be happy to answer any questions that you may have.

[The prepared statement of Mr. Wellinghoff follows:]

Testimony of Jon Wellinghoff
Chairman, Federal Energy Regulatory Commission
Before the Committee on Environment and Public Works
United States Senate
October 27, 2009

Introduction

Chairman Boxer, Ranking Member Inhofe, and members of the Committee, thank you for the opportunity to speak here today. My name is Jon Wellinghoff, and I am the Chairman of the Federal Energy Regulatory Commission (FERC or Commission). My testimony addresses S. 1733, the Clean Energy Jobs and American Power Act, in the context of the energy industries. The Commission has regulatory authority over various aspects of these industries. The Commission seeks to assist energy consumers in obtaining reliable, efficient, and sustainable energy services at a reasonable cost through appropriate regulatory and market means.

The Commission has taken various steps to remove barriers to the use of "low carbon" renewable resources and to encourage greater efficiency in the electricity system. These efforts, as described below, and the similar efforts of many States are helping to reduce the emissions produced by the generation of electricity.

Our Nation, however, has the capability to reduce these emissions much more. For example, studies show a potential to develop hundreds of gigawatts of renewable energy resources by 2030, if we expand our infrastructure adequately. Similarly, a study issued this summer indicated that energy efficiency efforts by consumers could reduce our overall energy usage by nearly 25 percent. Moreover, this study did not consider the

significant potential for improved efficiency on the utility side of the meter including the transmission system infrastructure under the Commission's jurisdiction.

A major reason why "low carbon" renewable resources and energy efficiency are not used more extensively is that the cost of greenhouse gas emissions is, in economic terms, an "externality." In other words, the effect of these emissions is not reflected in the price of energy in the marketplace.

S. 1733 can change this situation. This legislation is a way to recognize, in the energy marketplace, the effect of greenhouse gases. Doing so will encourage more energy efficiency and use of "low carbon" renewable resources, allowing us to reduce our greenhouse gas emissions while maintaining our quality of life. We have extensive amounts of untapped renewable resources and large potential to use energy more efficiently. S. 1733 will remove a major impediment to using those tools to this end.

Renewable Resources

Renewable resources can not only help reduce greenhouse gas emissions, but also diversify the fuels used to generate electricity. Fuel diversity helps stabilize our electricity supply against shortages or price spikes in particular fuel markets. Using domestic energy instead of foreign energy also strengthens our national security and reduces our economy's vulnerability to the risk and volatility of imports.

FERC has taken a range of actions to reduce barriers to renewable energy development and deployment. For example, the Commission has reformed transmission rates to exempt wind generators and similarly variable resources from certain penalties for deviating from their scheduled output, since these resources have only limited ability

to control their output. FERC also recognized that its policy for allocating transmission interconnection costs can be a barrier to entry by location-constrained resources like many sources of renewable energy, so we allow variations from our historical policy for such resources. FERC also has approved incentives and other ratemaking policies to facilitate the development of transmission facilities needed for renewable resources, such as facilities to deliver wind power from the upper Midwest to consumers in Chicago and other cities, and from Montana and Wyoming to consumers in Nevada and other Southwestern states. In addition, the Commission is supporting efforts by regional transmission organizations (RTOs) and independent system operators (ISOs) to reduce their backlog of interconnection requests by planned generation projects, many of which are wind projects.

This month, I provided Congress with the Commission's Strategic Plan for FY2009-2014 and committed to take additional steps to address possible barriers to development of renewable resources. The Commission set a long-term goal of exploring and, as appropriate, implementing reforms to allow renewable resources to compete fairly in FERC-jurisdictional electric markets. These efforts could include, for example, changes to market rules, or the implementation of operational tools to support reliable integration of renewable resources. The Commission will seek input from the industry and the public and will change its regulations, as appropriate, to achieve this goal.

A significant expansion of renewable resources in our electricity supply portfolio will require additional high-voltage transmission facilities, network upgrades, and feeder lines. It is highly unlikely that the inter-regional transmission facilities necessary to

deliver the output of certain renewable resources will be constructed without additional federal planning, siting, and cost allocation authority.

As to transmission planning, the Commission has adopted rules to improve transmission planning processes, such as having public utilities open their planning processes to developers of renewable resources and others. Congress has recognized the need for additional improvements, authorizing $80 million earlier this year for the Department of Energy, after consultation with FERC, to facilitate inter-regional planning efforts. Several other bills have been proposed in Congress this year to encourage or require inter-regional planning, and this type of legislation would be a step to ensuring the success of these efforts.

As to transmission siting, I recognize and respect the long-standing role of the states in performing this function. Nonetheless, under limited and appropriate circumstances, transmission developers should have recourse to federal siting authority at the Commission. Such authority would be helpful even if limited to situations in which states have had an initial opportunity to address a proposal for transmission development and to transmission facilities that are primarily for moving renewable energy.

Finally, cost allocation is often a threshold consideration in the development of transmission facilities for delivering renewable energy. Legislation can help clarify the Commission's authority to allocate a project's costs reasonably among all of a project's beneficiaries. However, such legislation should avoid including unduly restrictive language on cost allocation, particularly language that would impose a requirement to

calculate the precise monetary benefits expected to accrue from a new transmission facility.

While these efforts on transmission issues are vital, we also should not lose sight of the critical role of local renewable energy. We must remove barriers to entry for local renewable resources. Developing and reliably delivering these local resources is important, but that effort must be made in concert with and not separate from developing the necessary transmission infrastructure. We need not choose between local and distant renewable resources; we need them both.

Consumer Energy Use Management

Consumer energy use management, also called demand response, refers to consumers reducing their usage at certain times that will result in improved grid efficiency. In June, the Commission issued an assessment of the potential for consumer energy use management both nationally and for each state, through 2019. The assessment found that the potential for peak electricity demand reductions across the country is 188 gigawatts, up to 20 percent of national peak demand. These savings, if realized, can reduce significantly the number of power plants needed to meet peak demand and thereby reduce carbon emissions by as much as 1.2 billion tons annually.

In its Strategic Plan for FY2009-2014, FERC commits to continue its efforts to identify and eliminate barriers to participation by demand resources in RTO and ISO markets. The Commission also will seek to identify best practices for demand response products and procedures and, if appropriate, initiate a proceeding to change existing market rules.

Smart Grid

Earlier this year, the Commission adopted a policy statement on the smart grid. The Commission identified several priorities for the development of standards for smart grid technologies, including standards needed for the integration into the power system of demand response resources, electricity storage facilities, and electric transportation systems. The Commission also adopted an "Interim Rate Policy," specifying the criteria that "early adopter" utilities must meet to recover their smart grid costs. The Department of Energy and the National Institute of Standards and Technology (NIST) also have major roles in the development of the smart grid, and FERC is working closely with those agencies and with States in collaboratively fostering deployment of smart grid technology. Later this year, NIST may file a number of proposed smart grid standards for FERC's review and adoption. If so, the Commission will solicit public comment and review the proposed standards expeditiously.

Renewable Portfolio Standard

While S. 1733 does not address Renewable Portfolio Standard (RPS) issues, a national RPS program is an important adjunct to climate change legislation. Many States have already adopted RPS requirements, and a properly-structured national RPS can add to the benefits achieved from the state requirements. A national RPS should be a "floor," not a "cap," on state programs. A national RPS also should encompass not only renewable resources but also distributed energy resources such as energy efficiency, consumer energy use management, combined heat and power facilities, and recycled energy (or waste heat recovery).

FERC is well-equipped to oversee implementation of a national RPS. Implementation of a national RPS needs to be coordinated with other energy policies significantly affecting the ability of renewable resources to obtain transmission services and make sales into wholesale energy markets. Many of those key policies are within FERC's jurisdiction. FERC not only has day-to-day knowledge of the electric industry, but also has extensive experience in implementing and enforcing regulatory requirements for electric utilities. If a national RPS is enacted, FERC is the most logical and appropriate agency to oversee, implement, and enforce such a national standard.

Carbon Market Assurance

Section 131 of S. 1733 focuses on the need for oversight of carbon markets. Section 131 states the sense of the Congress that there should be a single, integrated oversight program, and specifies a number of defining principles. Section 131 does not, however, establish the program or designate an agency to oversee it. I defer to Congress on which agency should oversee such a program, so long as any legislative language preserves the Commission's existing jurisdiction, including its exclusive jurisdiction over transactions pursuant to a FERC-approved tariff of an RTO or ISO. RTOs and ISOs are regulated comprehensively by FERC, and their services and products are designed to ensure an adequate supply of electricity at reasonable prices for consumers. The RTOs and ISOs also are required to have market monitors, and these entities assist the efforts of FERC staff in detecting and penalizing any manipulation of RTO and ISO markets.

Office of Consumer Advocacy

Section 151 of S. 1733 would establish an Office of Consumer Advocacy (OCA). To ensure its independence from FERC, OCA should be placed within another agency or created as a separate agency. Similar functions in State government are typically performed by State Attorneys General or by agencies outside of State Public Utility Commissions.

Also, section 151 allows OCA to "investigate independently" the rates and services of FERC-regulated companies. But, it is unclear why OCA's role should exceed the role of others advocating interests in Commission proceedings. Other advocates generally must request that FERC initiate an investigation, not initiate their own investigation. Additionally, the authority to independently investigate the same matters over which FERC has exclusive jurisdiction under the Federal Power Act or Natural Gas Act could create duplicative proceedings for regulated entities and disrupt ongoing FERC proceedings and investigations, including rate proceedings and market manipulation investigations.

Finally, Congress may want to consider funding the Office of Public Participation identified in section 319 of the Federal Power Act, in lieu of enacting section 151. While this Office was intended to, among other things, compensate participants in FERC cases for their litigation costs under certain circumstances, Congress has never funded this Office. Funding this Office may better fulfill the goals of section 151.

Conclusion

FERC is using its statutory authorities aggressively to eliminate barriers to renewable resources and consumer energy use management, and to encourage greater efficiency in the electricity system. As such, we are using the authority we have to implement regulations and policies to address greenhouse gas emissions. But those efforts and the efforts of other Federal and State agencies, while helpful, are not enough to efficiently stem the growing accumulation of greenhouse gases in our atmosphere. S. 1733 is the key to altering this trend. Congress should enact this legislation now.

Thank you again for the opportunity to testify today. I would be happy to answer any questions you may have.

Responses to October 27, 2009 Questions to Chairman Wellinghoff from Senator Sheldon Whitehouse

Question No. 1:

What is FERC's role in the licensing and siting of off-shore Liquefied Natural Gas facilities, and specifically, what is the suite of considerations FERC examines when approving a new LNG license application? I am concerned that FERC does not currently or adequately take into account a broad enough set of risks or burdens that an LNG facility may pose to a community, such as disruption of recreational activities and costs incurred by local emergency response teams. Please describe what FERC is legally required to consider in the licensing and siting process, and address any legal and resource constraints that may account for the oversight I have described.

Response:

The Energy Policy Act of 2005 provided FERC with the exclusive authority to approve or deny an application for the siting, construction, expansion, or operation of an LNG terminal located onshore or offshore in state waters. LNG terminals located offshore outside state waters are under the jurisdiction of the Maritime Administration under the Deepwater Port Act.

As lead Federal agency for the preparation of the environmental impact statement, FERC analyzes the impact of the entire project, including the proposed LNG terminal site, the LNG vessel transit to the site, and any related natural gas pipelines from the site to market areas. This analysis examines all public interest issues relating to a proposed project, including the impacts on environmental resources, land use and recreational activities; the safety of the LNG terminal facilities and vessel transit; and other issues raised throughout the extensive public scoping and comment process. In addition, the Commission is required to consult with states regarding the emergency response capabilities near the proposed LNG facility.

As a cooperating agency, the U.S. Coast Guard reviews a Waterway Suitability Assessment prepared by the applicant and validates it with port stakeholders to ensure the safe and secure transit of the LNG vessel to the terminal site. Measures to minimize the impact on commercial and recreational vessels that use the same waterway are also addressed. The results of the Coast Guard review are contained in a Letter of Recommendation to FERC which is subsequently incorporated into the draft environmental impact statement.

Regarding local costs for emergency response, the FERC requires LNG terminal operators to develop an Emergency Response Plan for the LNG terminal in consultation with the U.S. Coast Guard and state and local agencies. The plan is then submitted to the Commission for approval by the Commission prior to the Commission's granting any final authorization to begin construction. The Emergency Response Plan must include a Cost-Sharing Plan identifying any direct cost reimbursements the applicant agrees to provide to state and local agencies with responsibilities for security and safety of the LNG terminal and vessel transit. FERC reviews the plan to ensure that the economic burden on the community is minimized before authorizing construction.

Question No. 2 - Streamlining Multiple Use Permits for Small Dams

A. Rhode Island is home to approximately 600 dams, many of which are vestiges of Rhode Island's industrial past and are no longer in use. Of these 600 dams, nearly 100 are thought to be good potential candidates for micro hydro power. These dams are small, with mean annual water flows ranging from 12 to 791 cubic feet per second. (As a basis of comparison, over the first four months of 2000, water flows below the Hoover Dam ranged from 12,000 to 20,000 cubic feet per second.) Rhode Island has a proud history of harnessing its rivers to power manufacturing - the Blackstone River was literally the birthplace of the Industrial Revolution. Some of our cities and towns, such as those that lie along the Blackstone - Central Falls, Pawtucket, Cumberland, Lincoln, and Woonsocket - want to use these dams to produce local, low carbon energy.

However, it appears that FERC's one-size-fits all licensing requirements prove very burdensome for micro hydro projects (turbines with a capacity of 5 megawatts or less). There is a recognition in the law that there should be some common-sense exemptions from the usual licensing requirements under the Federal Power Act, such as the "conduit exemption" (where a hydro project on non-Federal land will use only the hydroelectric potential of a manmade conduit, which is operated for the distribution of water for municipal consumption and not primarily for the generation of electricity). In addition, the Federal Power Act has delegated micro hydro licensing of dams in Alaska to that state. But currently, if a small dam in Rhode Island wants to install a 5 megawatt turbine, it must undergo the same process as a dam on the scale of the Hoover Dam. For such a small project, this process is clearly overly complicated and burdensome. Does FERC current have a process in place or is working to establish a system to streamline the micro hydro application process for existing dams?

Response:

Yes, the Commission issues two types of exemptions: (1) Conduit Exemptions; and (2) 5-MW Exemptions.

As you point out, Conduit Exemptions are authorized for generating capacities 15 megawatts or less for non-municipal and 40 megawatts or less for a municipal project. The conduit has to have been constructed primarily for purposes other than power production and be located entirely on non-federal lands.

In addition to "Conduit Exemptions", the Commission issues "5-MW Exemptions" for projects that would have an installed capacity of 5 MW or less and be located at existing dams or that would utilize a "natural water feature" such as a stream without the need for a dam and propose to increase capacity.

Section 32 of the Federal Power Act (FPA) provides for the State of Alaska to assume licensing and regulatory authority over qualifying small hydroelectric projects ($\leq$5 MW) in the state. However, Alaska has not completed drafting the regulatory program that is a statutory prerequisite to the state beginning to regulate small hydro projects. It is Commission staff's impression that the costs and complexity of establishing a new state regulatory program have been matters of concern.

Licensing processes at FERC are designed to accommodate non-federal hydropower projects regardless of size; however, the amount of information that must be provided and the time to process a specific application are more dependent upon the project's environmental impacts than its size (installed capacity). For projects having no or minor environmental impacts, the amount of information needed is generally less and processing times can be significantly reduced. Here are some actions we can and have been taking for small projects having minor environmental impacts:

- Waive one or more pre-filing consultation stages if no objection from agencies/tribes
- Notify all parties of our intent to waive additional study requests in the tendering notice.
- Do paper scoping in lieu of a site visit and public meetings
- Forego formal scoping altogether and substitute the consultation that occurred during pre-filing
- Issue a combined tendering/acceptance/ready for environmental analysis notice

- Issue a single Environmental Assessment and address EA comments in the order
- Waive other parts of the regulations as appropriate

Some examples where we have successfully expedited authorizations are:

- Lower Turnbull Drop Project No. 12597 (5 MW), Upper Turnbull Drop Project No. 12598 (4.1 MW), and Mill Coulee Drops Project No. 12599 (1.05 MW) – licenses issued (07/28/06) 8 months from filing.
- Corriveau Project No. 12629 (350 kW) – exemption issued (10/24/06) 10 months from filing.
- City of Afton, Wyoming Culinary Water Project No. 13301 (225 kW) – license issued (10/09/09) 5 months from filing.

The keys to lessening the regulatory burden in licensing small hydropower projects are for the applicant to design a project and select a site that do not pose significant environmental issues, and for the applicant to work with other stakeholders to (1) establish a consensus that the project is meritorious, (2) reach agreement that little new environmental study needs to be performed, and (3) develop agreement as to what environmental measures will be needed. Where these matters are resolved, the Commission can act on an application quickly. To the extent that there is disagreement, licensing will take longer.

B. Rhode Islanders also want to make improvements to their dams, to facilitate the passage of fish and kayaks/canoes. What is FERC's role in overseeing or permitting these types of improvements? If these are explicit conditions of a micro hydro project, or if a Rhode Island project wants to incorporate these improvements, what other federal agencies are involved? Is there a way to coordinate the review of a multi-use application (to install power, and make environmental and recreational improvements, on an existing dam), to make the approval process easier for these smaller projects?

Response:

The Commission has jurisdiction to oversee these types of improvements only with respect to dams that are included in Commission-licensed hydropower projects. Where the improvements are proposed at Commission-licensed projects, the Commission can either require them during the licensing process or, if they are proposed during the license term, by amending the license.

Depending on the magnitude of the change and its environmental significance, the licensee could be required to consult with the appropriate Federal and state agencies. Federal agencies could include the U.S. Fish and Wildlife Service,

National Marine Fisheries Service, National Oceanic and Atmospheric Administration, and Corps of Engineers. In Rhode Island, the licensee would also need to contact the Department of Environmental Management, the Historic Preservation & Heritage Commission, and Water Resources Board.

During licensing, the Commission examines all public interest aspects of a proposed project. Thus, when the Commission examines a proposal to develop hydropower, it simultaneously analyses potential environmental and recreational enhancements.

C. Finally, would FERC be interested in launching a pilot project for streamlining micro hydro, with fish and recreational improvements? If so, could you do this using your existing regulatory authorities or would FERC need expanded statutory authority?

Response:

As described above in the answer to part A, the FERC is already taking steps within its authority to streamline the licensing and exemption processes for small hydro. In addition, FERC will hold a Commissioner-led technical conference on December 2, 2009, from 1:00 p.m. to 5:00 p.m. Eastern Time in the Commission Meeting Room at the Federal Energy Regulatory Commission, 888 First Street, NE, Washington, DC 20426. The purpose of this conference is to explore issues related to licensing small non-federal hydropower projects in the United States. Specifically, the participants will discuss the Commission's program for granting licenses and exemptions from licensing, including 5-megawatt and conduit exemptions. The conference will also provide an opportunity for industry, state and federal agencies, tribes, and other stakeholders to express their views and suggestions for processing applications for small hydropower projects. After the Commission reviews the matters discussed at the conference and public comments received thereafter, the Commission will assess whether further streamlining is appropriate and can be accomplished within its current regulatory authority.

Responses to October 27, 2009 Questions to Chairman Wellinghoff from Senator Tom Udall

Question No. 1:

It is my understanding that most FERC-jurisdictional interstate natural gas pipelines would be regulated as regulated industrial entities in this legislation, and therefore would be required to purchase emission allowances and incur other compliance costs.

Due to FERC rate regulation, interstate pipelines would not be able to unilaterally adjust the price of their product or service to reflect the cost of compliance. Instead, these pipelines must seek approval from the FERC to recover such costs in the rates charged for pipeline transportation service.

Would you agree that traditional rate case proceedings may be ill-suited to addressing these costs, because such costs are likely to be unpredictable and are likely to vary from year to year, and given the number of such cases that could be required?

Instead, would you and the FERC recommend a rate tracker or other mechanism for these greenhouse gas compliance costs, similar to current rate trackers for fuel costs?

Response:

Pursuant to the Natural Gas Act (NGA), the Commission must give interstate natural gas pipelines an opportunity to recover their prudently incurred costs of providing services subject to the Commission's jurisdiction, including an opportunity to earn a reasonable return on their investments. The Commission ordinarily requires pipelines to file a general rate case under NGA section 4 in order to recover any cost increases. Such a rate case allows the Commission to review all the pipeline's costs and revenues to develop just and reasonable rates. It may be determined that increases in some types of costs are offset by decreases in other types of costs. The Commission has also allowed pipelines to file more limited proposals under section 4 to establish separate rate tracking mechanisms to recover a particular type of cost, if those costs are more volatile than the pipeline's ordinary costs and thus are difficult to predict. For example, a number of interstate pipeline companies currently recover the costs of fuel through annual tracking mechanisms. Therefore, under existing law, pipelines may propose to recover any costs they may incur to comply with the proposed legislation in a tracking mechanism and the Commission can then consider whether such a recovery mechanism is just and reasonable.

There are some potential issues related to rate trackers that may not make them the best cost recovery option in this instance. First, if the rate tracking mechanism is crafted so that any costs passed through are presumed to be just and reasonable and prudent, there would be no opportunity to review the costs. Rather, such a mechanism essentially would guarantee full recovery of any costs incurred by the pipeline. Second, absent a revenue true-up mechanism or other revenue pass through provision, the tracker could become a profit center for the pipeline because it would be designed to recover costs, but not offset those costs by any revenues that may be received. Third, a rate tracker mechanism could remove any incentives for pipelines to seek efficiencies in greenhouse emissions because they will have a guaranteed full recovery of any costs incurred to purchase such emission allowances.

The question of whether a rate tracker is an appropriate mechanism is one that the Commission has addressed in the past. I believe the NGA currently gives FERC sufficient regulatory flexibility to apply its experience and decide whether a tracker is a fitting mechanism in this situation and, if so, the proper design of the tracker to address the issues discussed above. However, if Congress instead decides to propose a legislative rate tracker solution, such legislation should include a reasonable opportunity to review the costs flowed through the tracker, as well as potential revenues, to ensure that the pipelines remain revenue neutral. This may best be achieved by requiring a periodic review of the pipeline's overall rates.

Question No. 2:

It is also my understanding that many pipelines and their customers have negotiated rates or settlements wherein the pipeline has contractually agreed not to seek a rate adjustment for a certain number of years into the future, likely without contemplating the possibility of any new greenhouse gas compliance adjustment.

What options are available, either regulatory or statutory, to address such contractual situations to prevent economic disruption in the interstate natural gas pipeline market?

Response:

Unless Congress enacts provisions to the contrary, parties to negotiated rate or settlement agreements currently must file with the FERC for approval to amend or revise such agreements. The Commission's consideration of any proposed change

to these contracts depends on whether the parties have reserved for themselves the right to unilaterally change their agreement. If the parties have reserved that right in their agreement, then the Commission will approve or disapprove the requested change based upon a determination of whether the change is just and reasonable. If the parties have no such right in the agreement, then the Commission must determine whether the requested change or abrogation of the contract is in the public interest.

Senator BOXER. Thank you so much.

We will each have 5 minutes to question.

Secretary Salazar, how will this bill help to mitigate the impacts of unchecked global warming pollution on the Nation's most precious natural resources? And I know how strongly you feel about being the guardian of those for this time. So how will this bill help to mitigate if, if we are successful, and what would happen if we fail?

Mr. SALAZAR. It would have a dramatic and positive impact in terms of protecting the national icons of America. And you can see it in the way that I think many Americans would see it if they have the opportunity to sit in my chair, where you can go to a place like the Apostle Islands in Lake Superior in Wisconsin, and you can see the warming of the surface of Lake Superior by 5 degrees or flying across to the wildlife refuges of Minnesota and recognizing what is happening with wildlife and wildlife migration and their habitat because of the warming of those places.

Or perhaps even most graphically, in places like Glacier National Park, which we have now projected will have no more glaciers by the year 2020. And finally, in the Grand Canyon, where there was a compact with respect to water put together back in the 1920s, which we now are projecting that there will be perhaps as much as 20 percent less water available in the Colorado River basin, which will affect all of those States, including Southern California.

So the urgency of this bill is there. And I believe that one of our responsibilities is to be able to tell that story of urgency to America.

Senator BOXER. Thank you, and you do it so very well.

Administrator Jackson, a lot of people think that the trading program that we have in this bill is somehow brand new. Some of my colleagues call it a tax. All of them do, on the other side. They never called it a tax when it was in the Clean Air Act's acid rain program. So, they never called it a tax then.

So now, what I want to ask you is how successful has the Clean Air Act's Acid Rain Sulfur Dioxide trading program worked? And do you have optimism that a trading program around carbon will have a similar impact?

Ms. JACKSON. Thank you, Madam Chair.

The acid rain control program—the predictions at the time were that it would cost a lot of money and be ineffective. And EPA was very proud of the fact that it worked in a bi-partisan fashion back then with the first Bush administration to pass amendments that would actually prove that to be wrong and have indeed proven it to be wrong.

The acid rain costs, which were regarded at the time to be optimistic, even on behalf of the Bush administration, turned out to be lower than thought. In fact, the Administration estimated that the annualized compliance costs would be $4 billion a year. In fact, the costs are now estimated to be just $2 billion annually. So it is a lot cheaper, and emissions have been reduced.

It has also proven to harness the marketplace and the private sector, once they got the clear signal, once the market incentive was there, once they knew that SO_2 pollution had a cost, they were able to make business decisions. We saw the most cost effective re-

ductions come forward. And that is what I believe can happen here as well.

Senator BOXER. Thank you.

Secretary Chu, I see that Senator Specter is back. His focus was jobs. I have here a study by the Center for American Progress. It says, "Investments in a clean energy economy will generate major employment benefits for Pennsylvania and the rest of the U.S. economy." They go on to say, "Our research finds that Pennsylvania could see a net increase of about $6.1 billion in investment revenue and 72,000 jobs."

It points out that adding 72,000 jobs to the Pennsylvania labor market in 2008 would have brought the unemployment rate down to 4.3 percent from its actual level of 5.4.

The reason I am using Pennsylvania, I just happen to have this particular paper in front of me. We talked before, I think it was at a Democratic Caucus lunch, about the importance of letting the private sector put a price on carbon through this system. So my question is, the certainty of that kind of policy, how important is it to attracting the kind of venture capital that we need to get this economy rolling forward?

Mr. CHU. Well, as I said in my testimony, that long-term signal is incredibly important, because when companies make investments, for example, when power companies make investments, they are thinking this investment will last for 60 years. It could take anywhere from 5 to 10 years from the decision to go forward to the time it is really built. So you are really talking a 70-year time scale. In that time scale investment, you really need these long-term signals to say what is going to be happening in the next 50, 60, 70 years.

To the question about jobs, I should also say that not only are we talking about jobs today in the near-term future, we actually need to talk about jobs that will be sustaining 10 years, 20 years, 50 years from today. So these are going to be jobs that will continue to be jobs in the future. The rebuilding of the American infrastructure, the retrofitting of our buildings, the building of a clean new industry, the restarting of a nuclear industry in the United States and the building of those power plants, these are all jobs where, if we don't choose to lead in the development of this new technology, China and other countries will.

Senator BOXER. Thank you very much.

Senator Inhofe.

Senator INHOFE. Thank you, Madam Chairman.

I have been observing over the last 2 and a half hours or whatever it has been how quickly we forget here in these hallowed halls, the insulation of the U.S. Senate. It was only 60 days ago we came back from our August recess. And we have forgotten all about the outrage that is out there. Those people, many of them have been denigrated for not really expressing a sincere concern, but let me assure you, I say to my friends in the Senate, it is there.

And there are two issues, health care and then this thing we keep saying is not a tax, but what I consider to be the largest tax increase in history. And the people understood that.

Now, I also, I don't want any of the media to think just because I had to sit here and listen to our good friend, Senator Kerry, for

28 minutes, that I don't have responses to everything he said. I can assure you that over a period of time, I will be responding to such things as naming Duke Energy and other companies. We have already talked about this. There are clear winners and losers in this program. We had a hearing, and I outlined how much money each of those individuals from corporations would make if this thing becomes a reality. And they are out there. It will be huge amounts of money. So follow the money; it is there.

The carbon tax, he mentioned James Hanson. James Hanson, we all know, is the recipient of $250,000 from the Heinz Foundation. However, for the first time, I agreed with him, his statement, just the other day was, this James Hanson, cap-and-trade is a temple of doom, it would lock in disasters for our children and our grandchildren. He goes on and on talking about that.

And the reason he is doing that, I say to my friends in the panel, is that if you want to go about this honestly, go ahead, do a carbon tax, so everybody knows. But there is a good reason why we are not doing that. And that is, it can be so easily masqueraded by this very complicated tax in trade thing, or cap-and-trade thing that we are talking about.

Then I have to correct my fellow Senator, he is not here right now, but I understand he is returning, Vitter, when he said that China is cranking out two new coal-fired generating plants each month. It is really, according to the Chinese government, they are doing it each week, not each month. It goes on and on.

And on the science. The science is more definitive than ever. You keep saying that, because you want to believe it so much. And yet the same people, those scientists, I have a list, I say to my good friend, Secretary Salazar, of scientists who are on the other side of this issue, back during Kyoto and even back 6 or 7 years ago, and during the consideration of the 2005 bill, who are solidly on the other side right now. It is coming. It has already shifted. It is not shifting, it already has shifted.

And I would suggest to you that when we get on the floor and talk about this, I will say to my good friend, the Chairman of the committee, that I am going to do the same thing we did during the debate, if it comes to debate on the floor, during the Warner-Lieberman bill. And that is say, science is not settled, everyone knows it is not settled. But for the sake of this debate, let's assume it is. It is not, but let's assume it is so we can talk about the economic issues. And that is what we would be doing.

So quickly here, Administrator Jackson, first of all, I would just make one comment. I think you would have to agree with this. If not, let us know in writing for the record if you disagree, that we use this example of acid rain. In acid rain, there was a big difference. That is, technology was proven, and that is a huge difference from where we are today.

But I do want to ask you one question. Senator Barrasso and I sent you letters on the endangerment finding throughout August and September, and we didn't get any response until last night about 5 o'clock. I don't want to use up the remaining time, but if you just for the record would let me know, if you would try to stay with those things that you stated during your confirmation hear-

ing, that you would be responsive to our requests, I would appreciate that very much.

The second thing I would ask, a response for the record from each of the members, that is the worker adjusted assistance provision of this Act, if that doesn't presume that we are going to lose jobs in the Act.

But last, since Secretary Salazar, I know that you have a schedule, you might get up and leave, I want to give you the opportunity to respond to something that I feel is very significant. That is a report that just came out last week from the Congressional Research Service that says America's combined recoverable natural gas, oil and coal reserves is the largest in the world. We didn't used to be. It is now. And I agree with the three goals that you outlined at the beginning of your 5-minute statement. I would like to know if, should we develop these resources, and what can your department do to help do that.

Senator BOXER. Senator, you have gone over your time, but you want these in writing. So what I was going to suggest——

Senator INHOFE. That would be fine, for the record.

Senator BOXER [continuing]. As a way we have done it before. If you could get your questions in writing from your staff to ours by tonight——

Senator INHOFE. No, Madam Chairman, I have already stated them. I don't have to change them.

Senator BOXER. So you don't want to put them in. OK, then what we will do, with your permission, because I just want to make sure it is answered to your satisfaction, we will take your question from the record and we will put them in writing to Lisa Jackson. And we would ask all the panelists, please, to get your answer in by close of business tomorrow. Is that all right with everybody?

Senator INHOFE. Fair enough.

Mr. SALAZAR. Madam Chairman, if I may, I need to excuse myself for another meeting.

Senator INHOFE. You have to leave, yes.

Mr. SALAZAR. But I wanted to say two quick things. One is that I had a formal statement that I will submit for the record, and I am sure my colleagues as well, and hope that that can be accepted for the record.

Senator BOXER. Yes.

Mr. SALAZAR. And second, on behalf of my colleague, Tom Vilsack, who is not here, but he has been part of these meetings getting ready for this hearing, he would be here to tell the people of American that rural America is going to benefit significantly from this legislation.

Thank you very much.

Senator BOXER. Yes, and I have placed his statement in the record.

Thank you so much. We are so sorry that we ran a long time, but you know what, I think it is key for colleagues to have their chance.

With that, we will go to Senator Klobuchar.

Senator KLOBUCHAR. Thank you very much, Madam Chair, and thank you to all of you for your leadership. Thank you, Senator Salazar.

I wanted to clarify, in my opening statement I talked about how the Federal Government hadn't gotten to the trailhead. And I probably should have more likely said Federal legislation hasn't gotten to the trailhead, because I want to commend all of the Secretaries for the work that you have done with the legislation that you have. But I truly believe that we can bring more jobs and put America back in the driver's seat here by passing some forward thinking energy legislation.

The question I had, and I think, Secretary Chu, I have always enjoyed talking to you about these new technologies, and a more optimistic approach to this. To turn a phrase on Senator Inhofe, to sort of crawl out of this temple of gloom that gets created when we talk about this legislation. I really see some optimistic possibilities here.

When you look back, when President Kennedy talked about putting a man on the Moon, all the technologies that came out of that that weren't about the Moon, from GPS monitors to CT scans to satellite weather technology to the little chocolate space sticks that my family took on camping trips in the 1970s. Could you talk about the signal that this can provide to the private sector for investments, and explain that in a little detail? Because we have with this game of red light, green light that we have done in Congress with some of these tax incentives, we just haven't gotten to the place that other countries have gotten with investment.

Mr. CHU. Sure. I think going back to what we need are long-term signals, both on anything we do, whether it is a tax credit, subsidy of some kind, programs for it. On-again, off-again is disastrous if you do it every other year. It just doesn't work. Denmark and Europe and Germany developed their wind turbine industry. They took it away from us, because they gave a very long-term view to this.

Going back, those long-term signals, particularly a cap on carbon, and then you know what is going to happen in 2020, 2030, 2040, 2050, can actually stimulate a lot of stuff. Now, yesterday we just announced the first 37 selections for our ARPA-E program. We had nearly 3,700 applicants. So we had to winnow it down to the top 1 percent.

Some of those top 1 percent are truly spectacular. New batteries that could potentially scale up where you can store megawatt hours of energy, at a cost that perhaps is a factor of 10 or 20 cheaper than existing technology. And this is an old metal liquid battery that the positive and the negative side of the batteries are metal, and the electrolyte in between is a metal salt. And when you charge the battery up, it goes to pure metal and a little electrolyte is left over and you discharge it. It goes, all the metals go back into the salt.

So you can make a swimming pool sized battery, or you can make it this big. And so to see ideas like that, brilliant ideas that I am beginning to see on carbon capture, that could dramatically lower the cost, and when you see these things popping up, and most of what I see popping up has only appeared in the last 5 years.

Senator KLOBUCHAR. And your view is that if we don't put these kinds of clear market signals in place in legislation we may not get this investment.

Could we just switch to nuclear? Because I am in the group that believes this has to be part of our solution as well, and I know you have been positive about this. Just the timeframe for nuclear, as we know that this should be, for those of us that believe it should be part of the solution. If we only relied on nuclear, what would be the timeframe of that? I guess I am getting to the point of, we have to have a combination of things, some things that move quicker.

Mr. CHU. We are pressing very, very hard on getting the first of the nuclear loan guarantees. We have authorized $18.5 billion for nuclear loans. That is able to start three, maybe four, depending on foreign partners. Four nuclear reactors at most. So we are working very, very hard. Hopefully very soon we can announce the first of these, and hopefully by the end of the year the rest of them.

This is a beginning of the re-starting of the nuclear industry. Getting three or four going, I would say, doesn't really get it going. So I view that as the beginning. But we are also looking.

Senator KLOBUCHAR. So what is the timeframe on that, for when we will get that energy?

Mr. CHU. Those loans?

Senator KLOBUCHAR. Yes.

Mr. CHU. As I said, we are trying to move forward by the end of this year.

Senator KLOBUCHAR. No, but getting a nuclear power plant up and running.

Mr. CHU. Well, that depends. It depends on a lot of things. It depends on what the NRC does. The NRC is trying to streamline its review process of the power plants. And so one wants to decrease the time of approval. They are trying to make generic approvals of each type of power plant, instead of just doing one off each time. And then a much quicker approval at a particular site.

Senator KLOBUCHAR. But how about when we really get the energy from it? Nothing to do with delays and the Government process.

Mr. CHU. Ideally, it could be between 5 and 10 years from the time you say "go ahead" to the time you turn on the electricity.

Senator KLOBUCHAR. Thank you very much.

Senator BOXER. Senator Voinovich.

Senator VOINOVICH. Administrator Jackson, you and I and our staffs have had an ongoing disagreement about the thoroughness of your doing your analysis. In your report on the impacts of 1733, you state, "Because of these many similarities and the relatively small differences between the two bills, it is likely that a full analysis of 1733 would show economic impacts very similar to H.R. 2454." The fact is that you have not done a complete analysis, is that correct?

Ms. JACKSON. We have not run the full economic modeling, sir.

Senator VOINOVICH. How long would it take you to do that?

Ms. JACKSON. I believe we estimated 4 to 5 weeks. I think that was the estimate to run the full suite of modeling.

Senator VOINOVICH. So that we would actually have the numbers of a full analysis. And that is exactly what I have asked the Chairwoman that we have before we mark up this bill from this committee.

The other thing that we have talked about, I remember when we talked and you came in, you said that you would prefer that we deal with climate change through legislation rather than the Clean Air Act. I note in this legislation that it does not preempt the Clean Air Act. In other words, we would continue to have, we would have this legislation and we would also have the Clean Air Act to contend with.

Have you changed your position on that?

Ms. JACKSON. I have not changed my position. I have—my belief is that there is only one way to get economy-wide market incentives for reducing greenhouse gas emissions, and that is through new legislation. But I also firmly believe that the Clean Air Act has value and that there are common sense measures that can be taken under the Clean Air Act, either in the absence of or with new legislation.

Senator VOINOVICH. Well, my feeling is this. If we are going to have a comprehensive climate change piece of legislation pass that the people out there, that Dr. Chu referred to, that are going to be making decisions, ought to know that this is it. In other words, these are the rules that we are going to abide by and we can count on it, and they are not going to change the rules on us 5 or 10 years from now.

Dr. Chu, and by the way, the number in the Boxer-Kerry bill is 20 percent, Waxman-Markey is 17 percent. I can't believe that by increasing that percentage, that you are not going to have a larger impact on the economy, on the number of jobs and also on the rates that folks in Ohio are going to have to pay for electricity, for natural gas and pay for gasoline.

But Dr. Chu——

Senator BOXER. Do you want an answer to that?

Senator VOINOVICH. No, I just——

Senator BOXER. OK. Well, I would appreciate—can you freeze the time? I would appreciate your answering that in writing, because I know there is a very good answer to that. So if we could have that done as well. OK, go ahead.

Senator VOINOVICH. Dr. Chu, one of my problems with this legislation is that the caps are unrealistic in terms of the availability of technology. The real issue that we have here is by 2020, are we going to have the technology, for example, to, there is an assumption about how many clean coal plants we are going to have. Are we going to have enough money to do that technology so that we can capture and sequester carbon? For example, my concern is this. The Chinese are putting on two coal-fired per week. If they continue to do these emissions from coal, it is urgent that we get at this carbon capture and sequester issue, because it is not only going to affect the United States, but also China.

And I think that the President talked about 15 percent of this money, the bill money going to technology. And I think the Kerry-Boxer bill is a little better than Waxman, but not a whole lot better

in terms of available money to do technology. Could you comment on that?

Mr. CHU. Yes, I think that in the 2020 time scale, I see a couple things beginning to turn around. It is our goal, for example, to test, pilot a number of carbon sequestration things. I think in a reasonably optimistic analysis, these things could be done in 8, perhaps 10 years. So it is 2009 now, and then you begin to deploy on a more or less routine basis some things, so it begins to happen.

Nuclear power, I said ideally, 5 to 10 years. Let's put it a little bit further and say 10 years from today power plants start turning on.

So a lot of the things that will give us the much reduced carbon or completely clean things like that will take a scale of 10 years. We can grow the wind renewable aggressively, as we are doing now. Energy conservation, if we really think hard about how to implement that is, I believe, the lowest cost option to getting a lot of the carbon out of what we are doing. It is things like that. But it has to be done in a programmatic, very aggressive manner.

Senator VOINOVICH. Thank you.

Senator BOXER. Thank you.

Senator, there is, the question you raised is answered in the EPA modeling, because we have some offsets to that increase that deal with allowing landfill, coal mine and natural gas system methane sources as offsets. That is why it doesn't impact the cost.

Senator Specter.

Senator SPECTER. Thank you, Madam Chairman.

Administrator Jackson, the issue that Senator Voinovich has raised is a big one. One of the factors which has brought support to this legislation has been the provision in the House bill which does make the determination as to emissions on carbon dioxide. And the approach is to have to buy allowances, so you can't emit carbon dioxide unless you pay for it. Establishing that standard, that the Congress would, would have a tradeoff of not having EPA come in with additional regulation. And that is a big selling point for people who don't like the legislation.

Now, there are those who are very much in favor of keeping EPA with its regulatory authority. But we face a very practical situation, like your thinking, if it comes down to getting the votes so that we really deal with carbon dioxide, and deal with it in a pretty rugged fashion, 2020, 2017 or whatever we do, and these allowances are very expensive, and we make that kind of gigantic progress, would you concede a little on that issue?

Ms. JACKSON. Senator, I certainly understand the point. I would only make three points for consideration, because I believe the EPA authority question is one that will certainly be discussed in this committee and in broader venues.

The first is that there are—the cap in this bill is actually not entirely economy-wide. There are important carbon emission sources that could be addressed through Clean Air Act regulation. The transportation sector and the rules that Secretary LaHood and I cited are a good example of that. So obviously, not all Clean Air Act regulation is created equally.

Second, and quite important, is that the move to market incentives, we have heard from communities who say it is very impor-

tant that we also make sure that we don't inadvertently concentrate pollution in any one area. So part of the Clean Air Act New Source Review idea is that it allows for when significant investments are being made, or new sources are coming on, for us to reset the playing field, if you will, to say, no, listen, no matter what pollution allowances are calling for at that point, we need to think about the fact of whether we should be investing any more in a community. It does allow for equity concerns, if you will, across communities. And that is important.

And last, I will simply say that I think that your point about the fact that this is designed to address some places that there are overlapping authorities is a good one. It is certainly one I respect tremendously. I have already come out to say that I believe very strongly that the most cost effective way to put a price on carbon and move our market and transition our economy and build a clean energy economy is through cap-and-trade and though legislation of this type with this kind of model.

So I think the market incentive tradeoff with regulation is one that we are happy to continue to discuss with this committee.

Senator SPECTER. Well, I am glad to hear you like cap-and-trade and like the legislation. But in order to get the legislation, there may have to be a little give. But if there are new plants, they are subject to totally different standards. And you are dealing with carbon dioxide; you are not exactly dealing with a local problem. You are dealing with a general problem.

But if you have other ideas that you think there needs to be more flexibility, I would suggest you let us know what they are, and let us deal with them in legislation. Because if we come up with legislation which is finite and people know what to expect, you will get a lot more support out of western Pennsylvania and maybe from Arlen Specter or Bob Casey, although I don't want to speak for my colleague.

But if there are other things that you want, let us know what they are. And we will try to accommodate them. But there is a great deal to be gained by certainty, so people can make plans. That is what we want to legislate on. If the Administrator of EPA continues to have flexibility, people are going to say, we don't know where we are, we don't want to buy a pig in a poke. But as tough as it may be, through legislation, they may say OK.

I am almost out of time, so I just want to make two comments, one to Secretary LaHood, about CLEAN-TEA, the legislation which Senator Carper has championed and I have co-sponsored, the Carper-Specter bill, which the Chairwoman has graciously included in this legislation. That would provide for a reduction of vehicular oil burning or cars, for mass transit, for bicycles, for rail. And I would like to see us pursue that at the administrative level.

And a question for Chairman Wellinghoff to be answered for the record, I have introduced in the last two Congresses legislation, now in Senate Bill 32, which calls for hearings by FERC. And in my travels through Pennsylvania, 67 counties, I have a lot of complaints about transmission line and power lines and pipelines. My legislation would require a hearing. And a hearing is a very useful thing. Some hearings are not very useful, like my town meetings in August.

[Laughter.]

Senator SPECTER. But a hearing has great utility in allowing people to express themselves and to have some consideration, even if you don't find it. So I would appreciate it if you would take a look at Senate Bill 32, which Senator Casey and I are pursuing. I think it would take a lot of the steam off, if you come out and listen to people. I find it very helpful. And even if you can't agree with people, they like to have an opportunity to hear it.

Thank you, Madam Chair.

Senator BOXER. Thank you, Senator Specter, and you are absolutely right about certainty. That is what this legislation is all about. Without the certainty, you are not going to have the investments. Without the certainty, nobody is going to know what happens.

So we will work together to make sure that you have that certainty that you feel is necessary. As long as we protect clean air, that is what we are about.

Senator SPECTER. My constituents and I very much appreciate that assurance. Thank you.

Senator BOXER. Absolutely. Thank you, Senator.

Senator Sanders.

Senator SANDERS. Thank you, Madam Chair. Just a couple of questions for Secretary Chu and a question for Secretary LaHood.

The State of Vermont has, I believe, led the country in terms of energy efficiency. We are actually consuming less electricity now than we were a couple of years ago. And it is not like, the recession has hit us, but not any worse than it has hit other States.

Mr. Secretary, I understand you are announcing today a very significant funding for the "smart grid," and Vermont is going to do well by that. My understanding is that in previous studies, a home can reduce its electricity consumption by 15 or 20 percent with one of these smart grids. Can you take a moment to explain to the people what you hope to accomplish with this smart grid program?

Mr. CHU. Well, the first thing that will happen with a smart grid, especially with homeowners, is what you want to do is you want first to let the homeowners know sort of in real time how they are using electricity. And at times, as we transition to real costs, real time pricing of electricity, for example, it is not true in Vermont, but let's say in a place where there is a lot of air conditioning, and you are using energy, it costs a lot of money to provide power during those peak times.

We have about 5 percent, if you look at the power that we have, a lot of peakers, they are essentially idle except for maybe the last 5 percent of the time.

Senator SANDERS. The bottom line here, it will enable consumers of electricity to use that electricity much more cost effectively. Do you have any estimates as to what kind of savings we can see in that in terms of percentage of reduction of electricity in the average home?

Mr. CHU. Not off the top of my head. But I know globally, across the United States, if we just peak load shift that last 5 percent, which we can do without really any disruption or change in lifestyle, globally and in the United States, we are talking about over $100 billion per year.

Senator SANDERS. The other thing is, Mr. Secretary, I have a chart here, which deals with the cost to build new power plants in 2009. What it suggests is that the least expensive way forward is through wind, followed by biomass, followed by solar thin film, followed by geothermal, followed by solar thermal. Then we have coal gasification. And that number does not include coal sequestration, which makes that a lot more expensive. Then we have nuclear.

In other words, what this chart tells you, if you are serious about building more capacity in the United States, the most cost effective way to go forward is through the new sustainable energies. What does that chart tell you in terms of how this country has to invest into the future?

Mr. CHU. Unfortunately, my eyes are getting old.

[Laughter.]

Mr. CHU. I can read the axis, I can't say about the numbers. But certainly one of the things is that we are trying to, first, the first thing you do is you work very hard on energy conservation, so you don't build anything new. And you just save. If done correctly, that is a money maker. The investments in energy efficiency, the consumer actually keeps that money.

So that is the best thing you can do.

Senator SANDERS. My only point here is that the most expensive new electricity generation is nuclear and coal. Yet, I sit around this committee and all I hear is nuclear and coal. It seems to me that if we are smart, and we want to save taxpayers money, and we want to protect the environment, and we want to create jobs, maybe we should start looking at wind, biomass, solar and geothermal.

Let me ask Secretary LaHood a question. This is just a very general question. People come back from visits to Europe, they come back from visits to Japan, they come back from visits to China, and they say, wow, they have these fast, these high speed rails, zillions of people going to work on mass transportation. And we come back to the United States, we have trains that are going 25 miles an hour over rickety rail. Why is it that the United States today is so far behind other countries in terms not only of rail, but of public transportation in general? What are we going to do about it?

Mr. LAHOOD. Lack of investment. We have never made the investment. If President Eisenhower had signed the Passenger Rail Bill instead of the Interstate Bill, we would have state-of-the-art like they do in Spain, like they do in Europe, like they do in Asia. But we have a state-of-the-art interstate system. Second to none in the world.

But because of President Obama's vision, because of Vice President Biden's vision, high speed passenger rail, better passenger rail is coming to America. The down payment is $8 billion. That is not near enough. But there are companies from Europe and Asia in the United States right now ready to make investments in passenger rail. And we have some great proposals that have come into the Department. We are evaluating them for the use of our $8 billion. We need help from Congress to——

Senator SANDERS. But you will agree that $8 billion is a fairly paltry sum?

Mr. LAHOOD. It is a down payment. It is a very small amount. But it is $8 billion times more than we have ever had at the Department.

Senator SANDERS. All right. Let me ask you this, also. It is not just rail. I come from a rural State where people, in a vast majority of instances, can't get to work on public transportation. They have to use their car, period. What are we going to do about that?

Mr. LAHOOD. We are going to continue to work with you, Senator, and others that represent rural States on making sure there are good transit services for people that want to live in rural America. We owe it to them to do that. There are people that want to stay in small towns, but yet get to a larger area to go to a doctor or go to the grocery store or go to the drugstore. And we are going to work with you and other Senators from rural America to make sure these transit services are available.

Senator SANDERS. Madam Chair, I would just simply say that when we look at transportation, we have to have a special focus on rural transportation, which needs just an enormous amount of improvement. Thank you all very much, to all of the panelists.

Senator BOXER. Thank you, Senator.

Senator Udall.

Senator UDALL. Thank you, Madam Chair.

I don't want to neglect Chairman Wellinghoff, so I want to ask you a question. Your testimony here today discussed the need for a renewable electricity standard, and RES and the climate bill are intended to be complementary. We expect that with what the leadership has talked about them to be joined on the Senate floor. Several Senators have joined me in introducing legislation that would set a 25 percent renewable electricity standard by 2025. Based on the rapidly declining costs and the huge potential resource, especially in the West, do you believe that this standard is achievable, and what would its impact be on our climate goals?

Mr. WELLINGHOFF. Thank you, Senator Udall. I assure you, I don't feel neglected.

I do think it is achievable . In fact, I was one of the primary authors of the renewable portfolio standard in the State of Nevada and am very familiar with California's and Colorado's and your State's efforts in that area. We now have 31 States, in fact, in this country that have renewable, portfolio standards for renewable energy standards. But I think it is essential that we have a national standard. It is time that we have a national standard, and I think the goals that you set are very achievable.

Senator UDALL. Secretary Chu, recently the Potential Gas Committee found that the U.S. natural gas supply has increased 40 percent in just 2 years, and that some industry estimates are pointing to a 100-year supply of U.S. natural gas. I believe that natural gas is an overlooked resource and has great potential to replace oil in heavy truck transportation, create jobs in States like New Mexico. Does the Department of Energy believe that we are entering a time of abundance with natural gas that could make our climate goals much easier to reach, since it is a relatively low carbon fuel?

Mr. CHU. The short answer is yes. I have heard estimates considerably more optimistic than the one you just cited. And if you include Canada, it is considerably more. So we are beginning to look

at things, for example, in central locations where there is not an infrastructure problem. We are funding, piloting vehicles that are propelled by natural gas, delivery trucks, buses, go to the central station and then will always return to that station, to see if this is a viable thing.

Certainly in this century, because of the new technologies that can recover natural gas from shale, it is a lower carbon option.

Senator UDALL. And from everything your scientists tell you, these are pretty reliable estimates in terms of the increase and the potential out there?

Mr. CHU. They appear to be.

Senator UDALL. And talking about renewable energy here, from your perspective on renewable energy, are the costs per kilowatt coming down for solar and wind, and should we expect it to continue under this legislation? And are the innovation benefits in this area reflected in traditional economic analyses of climate legislation? Or is this an extra benefit that we should expect to see?

Mr. CHU. Well, the costs of wind and solar are coming down. They are steadily coming down. It is looking very good. Right now, the cost of the solar module, the retail cost, has just gone down below a dollar per watt. A decade ago, it was $5, $8 a watt. So it is remarkable. The things that we have to do in terms of photovoltaic solar, in particular, is to balance the system costs. It has to be coming down at that same rate, much cheaper inverters, much easier to install type of modules, things of that nature.

But I am optimistic that solar and wind, they are continuing to come down.

Senator UDALL. Secretary LaHood, you talked a little bit about railroads and bringing back the railroads. Is that an area where we could see significant savings in terms of energy efficiency and lower costs?

Mr. LAHOOD. Take a lot of cars off the road, take a lot of CO_2 out of the air. It is much cleaner burning transportation, whether it is light rail or whether it is passenger rail. We know that it is cleaner burning, and we know that when somebody gets on a train, they are out of their automobile. The benefit of it will be enormous in terms of taking CO_2 out of the air.

Senator UDALL. And it is a big priority for your Department?

Mr. LAHOOD. It is an $8 billion priority right now, and we hope with the help of all of you in the Senate and the House, we will continue to make it a priority. But it is President Obama's vision and Vice President Biden's vision. I want to give them the credit on this. Senator Sanders' question is very important. We haven't made the investments in America in passenger rail. But we are about to do it.

Senator UDALL. Thank you very much. Thank you, Madam Chair.

Senator BOXER. Thank you very much.

I just want to give us a little update on how we are proceeding. We are going to go down the list of everybody, and we are going to, therefore next call on Senators Lautenberg, then Merkley, Whitehouse and Cardin, of those who are here. We are not going to have any more rounds. So you should know that, because it is getting very late.

I also wanted to say, while colleagues are here, tomorrow we have panel one on jobs and economic opportunities, panel two on national security, and I guess is it two panels? Where is the third panel? Panel three on utility policies and panel four on adaptation. We have a very big agenda tomorrow. We start at 9:30. We are going to work throughout the day just taking a small lunch break. So I wanted to let colleagues know.

Next on the list, Senator Lautenberg.

Senator LAUTENBERG. Thanks, Madam Chairman.

I am struck by the fact that as we look at the placards here we see, why not? Those are the questions that are asked. Why not do something positive? Why doesn't it say, the reason that we want to do these things is a benefit to ourselves, to our families, to future generations, to the health and well-being of America? We don't see any placards up there that say that. We say, why not. Well, it is the wrong attitude, I think, and that is what has got us in the trouble that we have.

To Administrator Jackson and Secretary Chu, by the way, thank each one of you, you are a terrific panel, and a good start that we had, Madam Chairman, with John Kerry here.

The Intergovernmental Panel on Climate Change, based on the research of leading scientists around the world, says U.S. has got to cap emissions to at least 20 percent below 2005 levels by the year 2020. A recent study says that we can reduce our emissions by 17 percent by 2020 without adding to that cost using just energy efficiency.

Now, do either one of you, you first, Mr. Secretary, agree that we or doubt that we can't achieve a 20 percent emissions reduction by the year 2020?

Mr. CHU. Oh, it is achievable, but you have to look at every corner. And also, I forgot to mention, that would also include, in addition to efficiency, there are offsets: reforestation, agricultural, ways of changing agricultural practices. That is also part of the mixture. Some of the other technologies that I talked about, like nuclear and coal; it is going to take a while to get them on. But you can promote the renewables that we do have. The cost is going down. Wind is approaching parity with new power in terms of coal or gas.

So if you look at all the sectors and say, you can say, yes, we can do this. But you have to look across the board.

Ms. JACKSON. And Senator, the only thing I would add to my colleague here is that the clock is ticking. So every time we don't have legislation, every time we don't move forward, every time we don't have a price on carbon, we are losing precious time that might help us get to that 2020 goal. So we are actually racing against the clock. It doesn't help to start in 2015.

Senator LAUTENBERG. But you each agree that we can do this?

Ms. JACKSON. Yes, we have to.

Senator LAUTENBERG. And the Intergovernmental Panel and the Union of Concerned Scientists says that we need to be on that kind of a glide slope in order to get our long range objective, which is a longer time than I may be here. No? Thank you very much for that assurance.

[Laughter.]

Senator LAUTENBERG. Secretary LaHood, good to see you here. We have had a chance to get to know one another over the period of time that you are serving. You are getting really good at this job, I want to tell you.

So when we look at Amtrak, other forms of passenger rail, they have a need to be eligible to receive that funding. What is the role that passenger rail can play in lowering congestion? You described preventing pollution, reducing our dependence on oil. Do you have any kind of an estimate that tells us what we can achieve there?

Mr. LAHOOD. I will get you an answer for the record, because I would like to be specific on that. But we know every time you get someone out of their car, you reduce CO_2. The work that we have done with the EPA and the Administrator, Lisa Jackson, on getting to a much better gasoline standard for automobiles by 2012 and 2016 is enormous. Every time somebody uses mass transit, whether it is a bus or light rail or Amtrak, we know that they are out of their car, we know that car is not on the road.

But I will be happy to get you the statistics. And we know that we have some really good proposals coming in to us that are in the Department for passenger rail. And we are evaluating those and hopefully we will make some decisions on the $8 billion later this year.

[Mr. LaHood's response to the above question follows:]

Properly designed intercity passenger rail service can play an important and simultaneous role in all three—easing congestion, relieving pollution, and enhancing energy independence. Passenger rail can accomplish all this by offering competitive door-to-door travel times at affordable fares, thus diverting substantial traffic from the energy intensive air and automobile modes.

For example, the Department's commercial feasibility study (CFS) of high speed rail [1] showed that in California, a new high speed rail system (analogous to that currently proposed by the State) would generate 4.7 billion passenger-miles in 2020, of which 2.4 billion would be attracted from air and 0.9 billion from auto. These diversions would help to ease congestion at airports and on highways.

Furthermore, as discussed in the Department's Vision for High-Speed Rail in America, intercity rail consumes about 25 percent fewer BTUs per passenger-mile than travel by automobile, and about 18 percent fewer BTUs than air travel. [2] These differentials, when multiplied by the volume of traffic diverted, result in substantial emissions and energy savings. For instance, the CFS projected a present value of air and highway congestion delay savings and emissions reductions of some $13 billion (2009 dollars) from the California New HSR project alone.

As regards energy independence, while even diesel powered trains can economize on fuel consumption over other modes, electrified railways have the added potential of being completely oil independent. Already today, Amtrak's Northeast Corridor segment between New York and Washington obtains about 38 percent of its power from totally green and totally domestic hydroelectric power.

For all these reasons, intercity passenger rail offers great promise of achieving congestion relief, pollution abatement, and energy independence, all at the same time—even as it increases the options and mobility available to travelers.

Senator LAUTENBERG. Ms. Jackson, a lot about the cost of passing a global warming bill. But the report by a former chief economist at the World Bank found that the inaction on global warming could cost 10 times as much as transitioning to a clean energy economy, because of the increased risk of drought, flooding, water scarcity, rising sea levels, social disruption. How might our envi-

[1] High-Speed Ground Transportation for America (September 1997), the Department's most recent corridor-by-corridor analysis of the operating and economic potential of high speed rail.

[2] The source is the U.S. Department of Energy, Transportation Energy Data Book, Edition 26, May 2007.

ronment be affected and our economy as well if we—the question is too much, this is too easy for you, and I don't want to give you easy questions. You are better at the hard ones.

So with that, I say, thank you very much, each one of you for your service and your being here today. Thank you, Madam Chairman.

Senator BOXER. Thank you, Senator Lautenberg. I think this cost of doing nothing is a very important point to keep on making. It is huge. And it is not in any of the economic models. We have to keep remembering that.

Senators Merkley, Whitehouse and Cardin.

Senator MERKLEY. Thank you very much, Madam Chair.

The first question I wanted to address to Secretary Chu. The McKinsey study has laid out an analysis that we could achieve 17 percent reduction in our carbon dioxide through energy efficiency alone. It is very interesting to look at some of the numbers. For example, the Lazar energy consulting firm has laid out the cost per kilowatt in energy efficiency as between zero and $50, whereas the complete range is below any form of new production.

And in essence, because energy efficiency also reduces the power bills that folks pay, there is a real feedback that expands the purchasing power of citizens in our Nation.

So given this set of facts, the low cost of energy efficiency, the significant impact that energy efficiency alone could have on carbon dioxide, are we under-investing in energy efficiency, even in this bill? Do we need to go further? Should we have a separate energy efficiency standard and really push all the concepts that are cost effective in that realm?

Mr. CHU. Yes. The McKinsey study I know came out just this summer, said by 2020 you can actually decrease the energy consumption, the end use consumption by 23 percent of the aggregate consumption, which includes the generation of all those losses by 26 percent. If you only count those investments based on net present value, that would make money. So the report actually said $680 billion savings, and you get 26 percent reduction in energy.

However, there are many economists who differ on that statement. So we have actually been spending a lot of time digging into it, trying to understand. There are some barriers at work here. For example, if you want to retrofit your home, there are barriers, what economists would call market failures. Many people don't know what to do. It is inconvenient. There is inertia, and there is also a finance barrier.

So the short answer to your question is, if we overcome all those barriers, then we can start to recoup this. That was part of my earlier answer. Energy efficiency, you can't just say make it happen. You have to be very proactive because of these market failures.

Senator MERKLEY. Well, certainly I and many members of this committee would love to work with you as you dig deeper into those numbers and identify those barriers, how we might overcome them and go further in that effort. Because when you look at what you can do with energy efficiency alone, and give the fact that we are closing in on 9 percent below the 2005 levels already on carbon dioxide production, it starts to make it look like 20 percent by 2020. That is an additional 11 percent. Isn't that demanding? And

we could actually bridge that entire factor with energy efficiency alone if we really applied ourselves to it, a strategy that actually pays us back.

Mr. CHU. I agree. We are rolling out a couple of things. For example, on retrofitting, it costs a lot of money. If you did it in a mass produced sort of way, like you get one-half of the entire block to sign on, so the energy auditor goes from house to house to house to house, as a trusted, certified auditor, and then the truck that blows in the insulation goes to house to house to house, all in the same block, you can easily see where the price can come down by a factor of two or three.

And there is a trust, it is a social event, a block party. So we are going to be trying to pilot these things in the coming year to see if we can really bring down those costs.

Senator MERKLEY. Thank you.

Another aspect of energy efficiency is turning to electric vehicles. And my colleague, Lamar Alexander, noted that we could work to have 50 percent of our cars be electric over the next 20 years. I would reframe that a little bit differently in that I have read statistics that if we were to take and have the cars on our road all be able to go the first 30 miles on electricity, so they could potentially be hybrid cars rather than full electric, preserving additional range, but if all the cars could go 30 miles on electricity, we would reduce the carbon dioxide production, which is, assuming the electricity comes from renewable sources, by 80 percent from passenger vehicles. Should we be working more to really push the frontier on the conversion of the American auto fleet. I would open this up certainly to Secretary Jackson and Secretary LaHood and to yourself.

Mr. LAHOOD. Let me just say this. I was in Detroit recently and visited all three of the American automobile manufacturers. I drove the Volt. It is the wave of the future. It is the way that, talk about a company that is forward thinking, GM is forward thinking on this. And so it is coming. And they get it. Because they know this is what the American people want, because the American people get it. It is an amazing vehicle, and it will be here soon.

Senator MERKLEY. Thank you.

Senator BOXER. We are going to move on, because we are over our time.

Senator Whitehouse.

Senator WHITEHOUSE. Thank you, Madam Chair. First of all, I want to thank this very distinguished panel for being here. I know you are all very busy and have significant responsibilities. But I do think it is helpful for you to be up here, and I hope the fact that every single one right now of our Republican colleagues has departed, despite the fact that we have such a distinguished panel, including four Cabinet members here, helps give you a signal as to how difficult our lift is going to be on this issue with our colleagues.

A few quick points, the first, Secretary Chu, as you have heard from Senator Alexander and others, there is considerable interest in expanding our nuclear energy supply. The Navy does operate nuclear plants very safely. However, they do generate waste. And the waste is a considerable concern. I would urge that as you look at the nuclear component of our energy portfolio, you invest aggres-

sively in potential technologies that could take our existing nuclear waste and reconfigure it into fuel and turn it into value. I have heard estimates that the power contained in our nuclear waste, if properly reconfigured, could provide $2 trillion worth of energy, not only essentially free energy, but energy that actually comes at the savings of not having the disposal and national security risk costs of all of that.

So I urge you to look very much in that area, and I will certainly be far more comfortable with whatever the nuclear strategy is if it has that investment in the future. One day we should be burning this nuclear waste as fuel and not having it a continuing hazard for thousands of generations into the future.

Mr. CHU. I couldn't agree with you more. In fact we have started a detailed look at this. If you look at the uranium you dig out of the ground, and you ask how much of the energy content of that uranium is actually used in our current light water once pass through cycle, after you have enriched, there is energy content in uranium 238. It is about 1 percent. Only 1 percent of the energy content is used. The rest is either depleted uranium or——

Senator WHITEHOUSE. Let's work together on making sure we do that.

The next question is for Chairman Wellinghoff. FERC, I believe, has some oversight responsibility over the dispatch rules by which units are turned on and off. They are agreed by the local ISO, but they have to be filed and approved by FERC, if I am not mistaken.

Mr. WELLINGHOFF. Yes, to the extent that there are organized wholesale markets with independent system operators, those independent system operators, the regional transmission organizations, in fact do file their tariff rules with FERC as to how they do dispatch units within their footprint.

Senator WHITEHOUSE. It is my understanding that those dispatch rule do not take the environmental costs of the units into consideration whatsoever, and that all other things being equal, they would run a coal plant instead of a hydro plant because there is no adjustment for the pollution costs. And I would like to work with you to see what might be necessary to have FERC take a look at that. Because as we all know, those environmental costs truly are economic costs. And to ignore them is to give an unwarranted subsidy to certain industries at the expense of others and the public health.

Mr. WELLINGHOFF. We would very much like to work with you on that. In fact, I was in China 2 years ago, and they were talking about economic dispatch versus environmental dispatch, actually looking at environmental dispatch in China. So we were very interested in looking at the feasibility of that in this country and how it affects the economics of the overall system. We would like to do that very much.

Senator WHITEHOUSE. Good. Finally, Administrator Jackson, the last point that I would like to make with you regard to some of the comments that have been made about Clean Air Act enforcement. The perspective that I have on this is that for many years, corporate polluters in the Midwest have been ducking and dodging around the Clean Air Act. They have not met their responsibilities. What they have done is built smokestacks, higher and higher smokestacks, now reaching as high as 1,000 feet.

Now, a smokestack doesn't make the air any cleaner. What it does is it takes the poison, the pollution, and it exports it to other States. Right now, in Rhode Island, on a bright summer day, the radio in the morning could easily announce that today is a bad air day. And infants and the elderly and people with breathing disabilities should stay inside in the air conditioning. And it is not because of local emissions. It is because of what is being rained in on us by these power plants. It is not just my State, Senator Lautenberg's State is downwind, Senator Cardin's State is downwind, Senator Sanders' State is downwind, Senator Gillibrand's State is downwind.

So as we look at this Clean Air Act, there are a great number of us who believe, I should say, there are a great number of us who are in that geographic position. I very, very strongly believe it is time that these power plants were held to account. They have dodged around the law for too long. And their corporate lobbyists have won against our children's lungs. I for one am fed up with it.

So I hope you will stand firm on the Clean Air Act. I, at least, and I hope many of my colleagues, will support you on that.

Senator BOXER. Thank you so much, Senator.

Senator Cardin.

Senator CARDIN. Madam Chair, thank you very much.

I think each member of the committee has expressed our appreciation for you all being here. I am going to go a little bit further. I thank you for your public service, taking on the incredibly important jobs that you are taking on in the Obama administration and doing such an effective job on your individual portfolio, but also understanding it is part of a national strategy as we deal with the energy issues.

I thank you for that commitment to get the job done, going well beyond what is your immediate responsibility.

I want to just underscore two points that were made. Secretary Chu, your point about conservation in our energy policy, critically important; and Secretary LaHood, about investment and how we make our investments. Let me start first by saying, I agree completely on the comments about passenger rail, but I take that a lot further. I want to talk about transportation for a moment. Transportation represents 30 percent of our greenhouse gas emissions and 60 or 70 percent of our oil use. So it is a huge issue. And we could do a lot better.

I want to get to public transportation, going well beyond just passenger rail. I first start off by saying, this legislation makes a huge investment in this area. Thank you, Madam Chair. Thank you for what you have done for public transportation in this, in your mark. It will make a huge difference on the infrastructure we need to conserve energy, as well as to have a more efficient way to have transportation needs met.

But I want to get to the second point, which is how you use your existing authorities. I would underscore the point that Senator Whitehouse made about Administrator Jackson. You have put the Environment back into the Protection Agency. We thank you for that. You have used the tools you have. You have tools today that you can use, and you are using those tools.

And Secretary LaHood, I know you have a huge budget. Not big enough, you would like to have more, we would all like you to have more, we would like you to have more predictable funding. But we do subsidize the passenger car more than we do public transportation in this country. And we need to change that. It is not going to be easy.

But we need to look at how we use the existing resources we have at our disposal. So I guess my point is, we need to get this bill done. This bill provides opportunities for us to make the type of investments in transportation that will make our country more secure, much more competitive and certainly friendlier toward the environment.

And by the way, for those who live in the Washington area, maybe I could have gotten here in time if we had a better transportation system in place for commuting. It affects all of our lives. It is the second worst congested area in the country, next to New York. We could double the number of people using public transit here. We just don't have the capacity, and it is old, and it needs investments.

So it is a matter of investment. This bill will make a difference. But I just urge you all, in each one of your areas, be aggressive with the tools that are currently available. This bill is meant to supplement, not to be the sole effort we have in the type of commitments we make to an energy policy in this country.

That is my message. Let's figure out a way we can get this budget more focused on what we need to do as we work to give you the additional tools that are necessary. Thank you for your commitment. I have a lot of confidence that what you are doing is going to make a huge difference. We need to work together to get the job done.

Thank you, Madam Chair.

Senator BOXER. Thank you very much.

Let me just thank everybody. I am very proud to say that President Obama today, in a speech, noted the markup in this Environment and Public Works Committee today. He said he believes that a comprehensive piece of legislation is what needs to happen. I am paraphrasing here. He said that is finally going to make clean energy the profitable kind of energy in America. Legislation that will make the best use of resources we have in abundance through clean coal technology, safe nuclear power, sustainably grown biofuels and energy we harness from the wind, waves and the Sun.

So he noted then that we are having these hearings.

I just want to say to all of you, thank you so much, not only for your eloquence today, but just for working with us these many, many, many weeks and months to get to this stage. And there are always naysayers when you are about to embark on change. But positive change only comes with courage. And all of you have shown that courage here today.

Thank you very much. We stand adjourned until 9:30 tomorrow.

[Whereupon, at 1 p.m., the committee was adjourned, to reconvene at 9:30 a.m. the following day.]

[An additional statement submitted for the record follows:]

STATEMENT OF HON. KIRSTEN GILLIBRAND,
U.S. SENATOR FROM THE STATE OF NEW YORK

Thank you, Chairman Boxer, for your leadership and hard work on this very critical legislation.

I'd like to recognize my Chairman from the Senate Foreign Relations Committee, Senator Kerry, who has joined us today, for his dedication to these issues.

I'd also like to thank our witnesses for taking the time to be here today to provide their perspective and expert analysis of this legislation.

S. 1733, the Clean Energy Jobs and American Power Act, is the platform to move America forward on a path to achieve energy independence, revitalize our economy by creating green jobs here at home, and protect our environment from the threats of global climate change.

I have heard from thousands upon thousands of New Yorkers of all age groups, from Brookhaven to Brooklyn, to Buffalo, who have called, written, visited my offices, and attended events to push for strong legislation that will transition our Nation to a clean energy economy.

I am confident that the Clean Energy Jobs and American Power Act is the framework that will do just that.

The passion and advocacy of my constituents have been invaluable leading up to these important hearings, and I thank them for their continued support to see strong climate change legislation across the finish line.

Over the course of these hearings I look forward to receiving testimony from witnesses representing business interests and local governments from around the country, describing how this legislation will lead to American prosperity and a demonstration of the kind of innovation and ingenuity that our country is built on.

In particular, I am interested in exploring a number of aspects of this legislation that are critical to my constituents in the State of New York.

First, the Clean Energy Jobs and American Power Act includes a framework for significant investments in carbon reducing transportation planning.

The development and expansion of mass transit systems are critical to New Yorkers who take one-third of the Nation's mass transit rides and are vital to mitigating America's greenhouse emissions, 30 percent of which comes from the transportation sector.

I'm also interested in the many ways that this legislation prioritizes and incentivizes energy efficiency, which as we all know is one of the most reliable and cost effective ways to reduce energy bills for consumers and cut harmful emissions.

S. 1733 includes a provision I authored, entitled the Green Taxis Act. This legislation will allow municipalities to set standards for emissions and fuel economy for taxicabs using Federal minimums and predicated on the commercial availability of vehicle technologies.

These provisions will be beneficial to many cities across the United States.

Replacing the current fleet of taxicabs on New York City streets with fuel efficient vehicles would reduce greenhouse gas emissions by more than 296,000 tons, or the equivalent of taking 35,000 cars off the road.

In addition, switching to fuel efficient vehicles would save each driver an average of $4,500 annually in gas costs and reduce the upward pressure on passenger fares.

As I have stated in previous hearings, one area that is of vital concern to me is providing effective oversight for the carbon market created by this legislation.

Ensuring that we have an active carbon market that allows for the type of customization that end users need in order to finance a new clean power facility, large scale solar or wind project, or international reforestation project is central to this legislation's success.

I look forward to working with my colleagues, Senators Baucus and Klobuchar and Chairman Lincoln in the Agriculture Committee, as we engage in comprehensive market reform that will set a framework for how carbon markets are regulated to protect consumers from market manipulation while facilitating investment in emissions reductions.

I am particularly interested in the provisions in this legislation that will allow our farms and forests to engage in activities that have real, measurable benefits in emission reductions.

Ensuring that New York's dairy farms and private forest lands can participate in activities that help us reach our climate goals is important to me.

Just as important as what is in this legislation, is what is not.

S. 1733 does not include provisions that were part of the House passed version that I believe are detrimental to reaching the goals of comprehensive climate change legislation.

The Clean Energy Jobs and American Power Act preserves Clean Air Act authority to regulate the Nation's oldest and dirtiest coal plants.

These protections are critical to New Yorkers, as we are on the receiving end of air pollution from many of these plants—contributing to acid rain, harming natural resources such as the Adirondacks, increasing contamination in our waterways, limiting the number of fish we can eat, and increasingly growing asthma rates that raise our health care costs.

The Clean Energy Jobs and American Power Act will lead to long-term economic prosperity, energy security, and the protection of our environment for future generations.

Chairman Boxer, I want to thank you, my colleagues on the committee, and the staff for all of their hard work on this legislation.

[Additional material submitted for the record follows:]

Statement For the Record

Secretary Shaun Donovan

Secretary of Housing and Urban Development

Before The

Committee on Environment and Public Works

United States Senate

October 30, 2009

Chairwoman Boxer, Ranking Member Inhofe, and members of the Committee, I appreciate this opportunity to submit a statement for the record on the critical role of and potential impact of climate change on our cities, metropolitan areas and rural communities. I would like to commend you, Senator Kerry and your colleagues for the important work that you have undertaken with S. 1733, the Clean Energy Jobs and American Power Act, to improve our nation's competitiveness in the world, reduce our impact on climate change, and ensure America's prosperity in the 21st century. This bill represents an important first step toward passage of comprehensive energy and climate legislation in the Senate.

The Department of Housing and Urban Development has a strong interest in the outcome of this important legislation. The built environment is now universally recognized as a significant source of greenhouse gas emissions, and an important part of the solution to solving the critical environmental and economic challenge of our time: global warming.

In recent years, we have made great progress in our understanding of the sources behind carbon emissions. As the American people are well aware, transportation accounts for 28 percent of all greenhouse gas emissions according to EPA's inventory of green house gas emissions. But most people would be surprised to learn that commercial and residential buildings account for almost 40 percent of total emissions.[1] Housing is a significant source, accounting for more than

[1] U.S. Department of Energy, *2008 Buildings Energy Data Book*, Table 1.4.1, Carbon Emissions for U.S Buildings by Year (39% of total), Table 2.4.1, Carbon Dioxide Emissions for Residential Buildings (21% of total), Table 3.4.1,

one half of emissions associated with buildings, in part because of large transmission losses in the residential sector.

And it's not just emissions from buildings, but also the location of the buildings themselves that contribute to greenhouse gas emissions. Driven in part by the advent of the automobile, as well as the availability of low-cost fuel, we have seen an explosion of dispersed development in our metropolitan areas, with increasing numbers of families moving further out from our urban centers in search of affordable housing. In many cases the result has been dramatic increases in vehicle miles traveled, and significant increases in carbon emissions. So it is now clear that the built environment – how and where we build - will be a key element in any effort to address carbon emissions and climate change.

But this is not just an environmental issue: it is also about the health and economic vitality of our nation's cities, counties and rural communities. While suburban and exurban growth have provided opportunities for millions of Americans, and in many cases has served them well, we also see families struggling with long commutes to work, increasing dependence on the car for most of their travel, and a growing share of their household budgets devoted to transportation expenditures – in many instances, significantly reducing the housing affordability gains.

For all our housing challenges today, we now see that that the goal of a "decent home for every American" can therefore only be achieved in the broader context of the dynamic changes that have been taking place in cities, suburbs and metropolitan regions. The average American household now spends 34 percent of their annual budget on housing and 18 percent on transportation. More than half of their budgets are wrapped up in these two expenses alone.

For low-income working families, the impact is particularly serious – with transportation representing almost a third of their costs. The extremes can be eye-opening – the average Houston-area household spends over $11,000 per year on transportation. For these families, the expense of transportation poses a particular burden. And in many metropolitan areas, working families are spending more on transportation than on housing.

Carbon Emissions for Commercial Buildings (18% of total). Total excludes emissions from industrial buildings. Note that EPA's 2009 Inventory of Greenhouse Gas Emissions - Fast Facts shows a somewhat lower share for buildings (34.7%).

This mismatch between good housing choices and good transportation choices is particularly acute in metropolitan regions – which have increasingly become the engines of America's growth. These metropolitan regions look very different from those that existed in the mid-1960's, when HUD was created and much of our transportation system was being built. The populations of these areas and employment opportunities available in them are now widely dispersed, with only 22 percent of the jobs in the top metropolitan areas located within 3 miles of the central business district.

Fortunately, the two criteria for successful and sustainable urban and metropolitan growth are now well-known: *location efficiency* and *energy efficiency*, and there are several important elements of the bill that address these goals. Communities across the country are adopting these elements as central components of alternative housing, land use and transportation plans - with promising and encouraging results.

In order to lower carbon emissions in the transportation sector, a "four legged stool" will be needed: one leg related to vehicle fuel efficiency; another to the carbon content of the fuel itself, one for vehicle and system operations, inclusive of traveler information and intelligent highway systems; and a fourth for the amount of driving or vehicle miles traveled (VMTs). It is this last leg, which has generally received less attention, where location efficiency can play a significant role. We cannot afford to see projected fuel economy gains erased by continued growth (at current rates) of VMTs, which according to the Energy Information Administration's 2007 Annual Energy Outlook is projected to grow by 59 percent by 2030, compared to only 23 percent population growth, and a 12 percent gain in fuel economy over the same period.[2]

Preliminary models for California's compliance with A.B. 32 greenhouse gas reduction goals, show that there are huge carbon reduction gains to be made by encouraging more compact, location efficient building, with good access to public transportation, preferably in existing communities. Alternative growth scenarios for the Salt Lake City region through the *Envision Utah* plan show similar reductions. Local plans, such as Chicago's Climate Action Plan, and New York's PlanNYC 2030 show that carbon emissions can be reduced by adopting location- and energy- efficient building practices and policies. In Atlanta, performance data for Atlantic

[2] Energy Information Administration, Annual Energy Outlook, 2007

Station, a mixed-use transit-oriented redevelopment of an abandoned steel mill site, show that residents drive an average of 9 miles per day, in stark contrast to a regional average of more than 30 miles per day - exceeding initial projections of a 36 percent reduction in vehicle miles traveled and emissions compared to conventional development.[3]

These local projects point to the need to coordinate federal action across agencies to ensure that location and energy efficiency are embedded in federal programs and policies as well. I have joined with my counterparts at the Department of Energy, the Department of Transportation, and the Environmental Protection Agency, as well as other agencies, to ensure that, going forward, this approach is followed.

In the building sector, we have made a strong commitment to energy efficient green building in spending our Recovery Act dollars. Some $4 billion in Capital Fund dollars are going to public housing authorities for energy efficiency and other upgrades, including $600 million specifically targeted to high performing and energy efficient carbon reduction projects. Another $250 million is being provided for green energy retrofits in multifamily housing, and additional funds are being spent on energy efficiency through our Native American programs, as well as through the Neighborhood Stabilization Program ("NSP2"), both of which have strong incentives for energy efficiency and green building. Looking ahead, our FY 2010 budget proposal includes a $100 million Energy Innovation Fund that will help catalyze a home energy retrofit market through innovative public and private sector financing, and through re-engineering FHA energy efficient mortgages.

We have also formed a new Partnership for Sustainable Communities with DOT and EPA that will, for the first time, ensure that housing and transportation planning and resources are coordinated to support more compact, mixed use development, in proximity to a broad range of transportation choices that will yield reductions in carbon emissions. Our agencies have adopted a set of shared sustainability principles, that I believe represent an important new playbook for federal investments and policies that impact land use, transportation, housing and the environment in our cities, suburbs, counties and rural communities.

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[3] Reid Ewing et al, *Growing Cooler, the Evidence of Urban Development and Climate Change.*

We are moving to implement these principles through our Fiscal Year 2010 budget request, which includes several proposals that support our vision of sustainable growth, including funding to support a new generation of integrated land use, transportation and environmental planning at the metropolitan and regional level, as well as in rural communities.

Building on these partnerships and these coordinated strategies, we believe climate change solutions can be achieved through smarter place-based development. HUD in partnership with EPA, DOT and DOE is poised to assist states and municipalities to help develop and review carbon reduction plans. This is consistent with, and will build on, the strong partnership that we have already established with these agencies through our Partnership for Sustainable Communities.

Thank you for your attention and we look forward to providing the Committee with additional information or input as you move ahead in your deliberations.

STATEMENT FOR THE RECORD OF

GARY F. LOCKE
SECRETARY OF COMMERCE

BEFORE THE

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS
UNITED STATES SENATE

OCTOBER 27, 2009

Chairwoman Boxer, Ranking Member Inhofe, and members of the Committee, I appreciate this opportunity to submit a statement for the record on S. 1733, the Clean Energy Jobs and American Power Act, and the Department of Commerce's role in fostering America's transition to a new clean energy economy. I am pleased that the Senate is moving forward in its consideration of this important bill, and want to thank Senator Kerry and Chairwoman Boxer for their leadership and hard work on this legislation.

Home to world-class climate scientists, economic development experts, and trade and investment specialists, the Department of Commerce is uniquely situated to help unleash the economic opportunity presented by America's transition to cleaner sources of energy. For the past one-hundred years, American businesses have experienced unprecedented growth. Throughout that period, fossil fuels were available at low costs, and the greenhouse gas externalities associated with using fossil fuels were not addressed. Unequivocally, that business environment has shifted. The methods by which we produce and consume energy are environmentally unsustainable and pose a risk to our nation's security and stability. The transition to a clean energy economy should help to mitigate many of the consequences of climate change, and would also be an engine of job creation and economic growth for decades to come.

Let's be clear. American businesses are stepping up to the challenges posed by climate change – developing innovative solutions to reduce greenhouse gas emissions, utilize energy more efficiently, and adapt to some of the climate changes already occurring. For example, in 2007,

not one U.S. company was listed in the top ten global solar companies. Today, First Solar, based in Tempe, AZ, is the largest solar company in the world.

But businesses are not investing in clean energy for only altruistic reasons. They know international competition for the clean energy market – and the good jobs it can provide – is fierce. I am not able to be with you in person because I am co-chairing the 20th session of the U.S.-China Joint Commission on Commerce and Trade (JCCT) in Hangzhou, China. China is currently the second largest energy consumer behind the United States, and China's demand for energy continues to increase exponentially. As such, the Chinese market presents tremendous opportunity for U.S. clean energy businesses. To capitalize on this opportunity, just this week, the Department of Commerce facilitated a Memorandum of Understanding (MOU) between the U.S. Trade and Development Agency and China's Ministry of Commerce to support the U.S.-China Energy Cooperation Program (ECP), an innovative new public-private partnership that will deploy the expertise of U.S. companies to help develop clean energy solutions in China.

But, we cannot ignore the race to lead in this competitive market. China is investing more than $12 million an hour in clean energy and efficiency. These investments are not just to meet its own domestic energy needs and climate challenges, they are designed to turn China into the global destination for clean energy innovation. The Chinese government is supporting the development of clean energy and energy efficiency industries to meet the demands of the world. The United States must step up if we do not want to witness the capital, the businesses and the good-paying jobs associated with the clean energy economy ending up overseas rather than in communities across America.

As Secretary of Commerce, I speak daily with business leaders, innovators and entrepreneurs eager to capitalize on the opportunities presented by clean energy but stymied by the uncertainties in the marketplace. Too many companies and entrepreneurs and investors are sitting on the sidelines because of the lack of certainty in U.S. policy. The Congress needs to pass energy and climate change legislation as soon as possible to provide that certainty. The longer the United States waits, the bigger the headstart other countries will have in establishing dominant clean energy and energy efficiency industries to serve the world.

Just last week, I hosted approximately 100 clean energy business leaders at the White House for a discussion on American competitiveness in the clean energy economy. We heard from a Michigan company that partners with the Department of Commerce's Sustainable Manufacturing Initiative to help manufacturers become more energy efficient and reduce their power costs. And, we heard from the CEO of Easy Energy based in Welcome, Minnesota, how a modular ethanol production system could translate renewable energy into economic opportunity for rural communities. The conversation that ensued was lively but the message was clear: American business needs proper market incentives that encourage long-term investment in clean energy.

We need comprehensive energy legislation to send a signal to private capital that it is safe to invest for the long-term in clean energy technologies and compete with the rest of the world in this area. To support the creation of good, well-paying jobs in this new economy, we also need to start training our workers now. Finally, we need comprehensive energy legislation to begin to address the potential for environmental damage that will severely and negatively impact the business environment if left unchecked.

To be successful in this endeavor, we need not only to give businesses the certainty of a coherent national framework, we must be sure this framework is built on the underpinnings of sound climate science. We must also deliver timely and reliable climate information to aid public and private sector decision-makers in making sound economic and social choices. That is where the Department's National Oceanic and Atmospheric Administration (NOAA) is indispensable.

NOAA is one of the world's leaders in providing the scientific understanding of climate change and its impacts. NOAA's broad climate mandate was established in 1978, and its capabilities span operational climate observing networks, global greenhouse gas monitoring, climate predictions and projections, climate research and climate data stewardship. With these capabilities, and in partnership with other Federal agencies, NOAA continues to provide successful leadership and support to domestic and global scientific assessments of climate change science and impacts, including the recent U.S. Climate Impacts report and those of the U.S. Global Change Research Program and the Intergovernmental Panel on Climate Change.

NOAA is responsible for monitoring and predicting global and national climate conditions. NOAA's climate data provide information about changes and variations in climate dating back

many decades to hundreds of thousands of years. These data are critical to predicting and projecting future climate using some of the world's best climate models.

NOAA also monitors the carbon cycle in the atmosphere and oceans, and has been doing so for 40 years, taking observations on the ground, under the sea, and in space. NOAA's measurements and modeling of carbon dioxide and other greenhouse gas concentrations in the atmosphere are among the most comprehensive in the world – and are widely considered among the best available modeling of carbon sources and sinks. These measurements are also fundamental to understanding and monitoring ocean acidification.

This information is not merely of academic interest. These measurements will play an important role in verifying the effectiveness of our domestic and international policies through independent verification of bottom-up emissions – from both domestic and international sources – and allow us to understand whether emissions reductions are having their intended effects on our climate.

In addition, the Department's National Institute of Standards and Technology (NIST) supports climate research and monitoring systems by providing the traceable measurements necessary to ensure accuracy and comparability. NIST also has programs aimed at improving industrial processes to reduce carbon at the source. For example, NIST focuses on documentary standards, test beds for developing new and existing technology, and testing and verification programs.

More and more, decision-makers from the private and public sectors are demanding improved information to understand the changing climate, impacts to the economy and the environment, and emerging opportunities. For example, until now, the Nation's systems and infrastructure for water, energy, transportation, agriculture, and other sectors have been designed and built based on knowledge about local conditions and our understanding of the past. As climate changes, much of this infrastructure will become obsolete unless it is reconfigured in light of new patterns of wind, water, temperature and other factors.

To bridge climate science and these needs of decision makers now and in the future, NOAA, through partnerships and user engagement, is continuing to lead the way by providing an evolving suite of climate information and services to other federal agencies, state and local governments, and the private sector as they make decisions about adjusting to climate change.

For example, the climate data from NOAA's air freezing index program provides information to allow building foundations to be more economically constructed, reducing the materials costs of the U.S. construction industry by approximately $300 million per year. (*Economic Value for the Nation*, U. S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Service, September 2001.)

To respond to these demands for climate information, our national climate policy should include the establishment of a National Climate Service. A national climate service should provide credible and authoritative climate information and services across sectors and geographic regions to assist the Nation in making informed decisions related to climate change mitigation and adaptation.

Chairwoman Boxer, Ranking Member Inhofe, and members of the Committee, thank you for your attention and the Department of Commerce looks forward to providing the Committee with additional information or input as you move ahead in your deliberations.

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Testimony Submitted for the
Full U.S. Senate Environment and Public Works (EPW) Committee hearing entitled,
"Legislative Hearing on S. 1733, Clean Energy Jobs and American Power Act"

Tuesday, October 27, 2009

My name is Grover G. Norquist, and I am the founder and President of Americans for Tax Reform. ATR was founded in 1985 at the request of President Ronald Reagan and serves as a non-partisan organization that opposes any and all tax increases.

I would like to thank Senator David Vitter (R-LA) and his office for introducing my testimony in the Congressional record for this hearing. The Cap and Trade legislation this Committee is considering is being sold as an attempt to control the climate; however there is no conclusive proof that it will have any effect. Rather there is considerable evidence that this legislation will have a disastrous economic effect on the country. This proposal, S. 1733, the "Clean Energy Jobs and American Power Act," will negatively impact the economy, hurt families, and kill jobs. It will also make the United States less competitive in the global marketplace while allowing other countries take the lead with an unrestrained economy.

A recent Freedom of Information Act (FOIA) request, issued by the Competitive Enterprise Institute (CEI), to the U.S. Treasury Department reviled the government's internal reports estimate a cap and trade program will cost between $100 to $200 billion dollars in new taxes per year. This is the equivalent of a hike in personal income taxes by about 15% and the average American household would pay an additional $1,761 a year.[1] Another study by The Institute for Energy Research (IER) found that Waxman-Markey will increase taxes on electricity from coal and natural gas-fired power plants by $1 billion.[2]

Americans will also feel increased pain at the pump as a result of this legislation. A study by Senators Kay Bailey Hutchinson (R-TX) and Kit Bond (R-MO) found that the Waxman-Markey bill will result in a $3.6 trillion gas tax. That breaks down to an additional $2.0 trillion tax on gasoline, a $1.3 trillion tax on diesel fuel, and a $330 billion tax on jet fuel.[3]

These massive new taxes on energy producers and every American family will be far more destructive to those in the lower and middle class. On September 12, 2008, then candidate-Obama said, "I can make a firm pledge. Under my plan, no family making less than $250,000 a year will see any form of tax increase. Not your income tax, not your payroll tax, not your capital gains taxes, not any of your taxes." However, later, President Obama said, "Under my plan of a cap-and-trade system, electricity rates would necessarily skyrocket."[4] The President's own Treasury Department noted that the increase in rates would be the equivalent of a 15% personal income tax increase by raising an estimated $100 to $200 billion per year.

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[1] McCullagh, Declan, "Obama Admin: Can and Trade Could Cost Families $1,761 A Year." *CBS News*. September 15, 2009. http://www.cbsnews.com/blogs/2009/09/15/taking_liberties/entry5314040.shtml.
[2] "The Other Half of Waxman-Markey: An Examination of the Non-cap-and-trade provisions." The Institute for Energy Research. October 12, 2009. http://www.instituteforenergyresearch.org/2009/10/12/the-other-half-of-waxman-markey-an-examination-of-the-non-cap-and-trade-provisions/.
[3] Hutchinson, Kay Bailey and Bond, Kit, "Climate Change Legislation: A $3.6 Trillion Gas Tax." 2009 http://hutchison.senate.gov/resources/HutchisonBondGasTaxReport.pdf.
[4] Borelli, Deneen, "Rising energy costs triggered by cap-and-trade will harm low-income workers in inner cities." *The Baltimore Sun*. October 22, 2009. http://www.baltimoresun.com/health/sns-200910220803mctnewsservbc-capandtrade-minoriti,0,7394488.story.

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President Obama, not candidate Obama was right. Prices will skyrocket, and it will be those that make less than the $250,000 he promised that will be harmed the most.

As the Hutchinson-Bond report explained, the average household spends five percent of its annual budget on fuel costs. For most lower and middle class working families, gasoline is necessary to get to work and make a living. These families also tend to have longer commutes than the rich and will be hit harder by increased fuel costs.[5]

The Institute for Energy Research has found that the Waxman-Markey bill will result in a $14 billion redistribution of resources from the poor to the rich. This is primarily because shareholders and those involved in trading allowances will be in a position to make money, while those with lower incomes will be paying for the increased taxes and costs.[6]

Increased burdens on lower class families will also come in the form of new regulations on home sales. The Waxman-Markey bill contains 397 new regulations, one of which requires almost all homes to undergo environmental inspections prior to sale. These inspections will increase home prices, as additional inspections and repairs increase base prices. This cost increase is passed on to the buyers making home ownership more difficult. This will also eliminate the "fixer-upper" type homes upon which many low income buyers depend. Many low income families buy less-than-perfect homes because they are cheaper and they can perform needed repairs and improvements themselves. If the home has to pass an inspection prior to sale, the seller will have to make all of the necessary improvements before selling the home. The cap and trade proposal considered today will make home ownership nearly impossible for millions of Americans.[7]

Beyond the direct economic impact of this energy tax, it will also dramatically change the American way of life. Increased travel and commuting costs coupled with an increase in cost to heat and cool homes and keep the lights on means many families will have to make a major shift in priorities. They will also have limited discretionary income for consumer purchases. Families will be forced to live in smaller houses and drive smaller cars. Communities will be constricted because of increased commuting costs, and people will have fewer employment opportunities.[8]

Increased energy costs and regulatory burdens are going to destroy jobs in America, sending them overseas to countries like China and India. The Black Chamber of Commerce estimated cap and trade would kill over 2.7 million jobs every year through 2030. The Heritage Foundation estimated 1.1 million jobs lost from 2012- 2030 and 2.5 million each year after that. Even the liberal Brookings Institution estimated 1.7 million jobs would be lost per year.[9]

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[5] Hutchinson, Kay Bailey and Bond, Kit, "Democrats' hidden gas tax: Extra $1 per gallon at the pump will mean all pain, no gain." *The Washington Times*. October 21, 2009. http://www.washingtontimes.com/news/2009/oct/21/democrats-hidden-gas-tax/?feat=home_commentary

[6] "Blockbuster Study: Working-Class Bears Burden of Cap-and-Trade." The Institute for Energy Research. September 29, 2009. http://www.instituteforenergyresearch.org/2009/09/29/blockbuster-study-working-class-bears-burden-of-cap-and-trade/.

[7] Young, Ryan, "Cap-and-Trade Will Depress Home Prices." Competitive Enterprise Institute. September 23, 2009. http://cei.org/articles/2009/09/23/cap-and-trade-will-depress-home-prices.

[8] Franc, Michael, "Cap and Trade vs. the American Dream: The House's bill is an economic disaster that keeps getting worse." The Heritage Foundation. May 22, 2009. http://www.heritage.org/Press/Commentary/ed052209b.cfm.

[9] Borelli, Deneen, "Rising energy costs triggered by cap-and-trade will harm low-income workers in inner cities." *The Baltimore Sun*. October 22, 2009. http://www.baltimoresun.com/health/sns-200910220803mctnewsservbc-capandtrade-minoriti,0,7394488.story.

AMERICANS for TAX REFORM

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We are told that these job loses will be offset with new "Green Jobs." The Institute for Energy Research has released a study about the "Green Jobs" program in Germany, and found that not only are these jobs costly, they are also unsustainable. Government subsidies for the solar industry have had a net cost from 2000-2010 of $73 billion (US$) and wind subsidies have cost $28 billion (US$). When compared to the US economy, which is five times the size of Germany's, we can see that it would cost us approximately half a trillion dollars. The entire wind and solar industry is dependent on government handouts including the "Green Jobs" we are told are created from this scheme. The government must pay an estimated $240,000 (US$) for every solar employee. As soon as the government handouts go away for these jobs, so do the jobs. Not only do these new jobs create a new class of people dependent on government welfare, they also kill productive jobs.[10] A Heritage Foundation study has estimated that net job losses, jobs that will be destroyed even if we take the government-dependent "Green Jobs" into consideration, will be 1.145 million.[11]

With a void in U.S. based jobs, and the global economy continuing their demand, these manufacturing jobs will go to countries such as China who not putting economic-shackles disguised as climate change legislation on their economies. While the U.S. is imposing higher taxes and energy costs on its citizens and businesses, China is increasing its production and carbon emissions. The result will be the US committing economic suicide while having no proven effect on the climate.

As the United States considers economic destruction and China continues to prosper, what will we gain for all of our sacrifice – increased job loss, higher energy costs and an increased burden on already strained American families? Climatologists estimate that the cap and trade energy tax this Committee will soon consider will at best lower the world-wide temperature by hundredths of a degree by 2050 and no more than two-tenths of a degree by the end of the century.[12]

On top of not reducing the temperature, it also won't reduce our usage or dependency on fossil fuels. In 2015, the US is expected to consume 127 billion gallons of gasoline. As a result of cap and trade, by 2050 we would consume 100 billion gallons of gasoline. In 2015, however, we will use 78 billion gallons of diesel fuel and 31 billion gallons of jet fuel. In 2050, we will use 118 billion gallons of diesel and 48 billion gallons of jet fuel. While gasoline consumption is expected to slightly decrease, diesel consumption will increase by 30 billion gallons, and jet fuel consumption would increase by 17 billion gallons.[13] A recent Environmental Protection Agency (EPA) analysis of the Senate Kerry-Boxer draft concluded that "average household consumption [of energy] would be reduced by less that 1% in all years."[14]

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[10] "Strike Three: First Spain, Then Denmark, and Now Germany…" Institute for Energy Research. October 19, 2009. http://www.instituteforenergyresearch.org/germany/Germany_Study_-_Fact_Sheet_(Final_Version).pdf.

[11] Lieberman, Ben. "Green Job Subsidies Will Destroy Far More Jobs Than They Create." The Heritage Foundation. October 2, 2009. http://www.heritage.org/press/commentary/ed100209c.cfm.

[12] Franc, Michael, "Cap and Trade vs. the American Dream: The House's bill is an economic disaster that keeps getting worse." The Heritage Foundation. May 22, 2009. http://www.heritage.org/Press/Commentary/ed052209b.cfm.

[13] Hutchinson, Kay Bailey and Bond, Kit, "Democrats' hidden gas tax: Extra $1 per gallon at the pump will mean all pain, no gain." *The Washington Times*. October 21, 2009. http://www.washingtontimes.com/news/2009/oct/21/democrats-hidden-gas-tax/?feat=home_commentary

[14] "Boxer Releases Chairman's Mark of Clean Energy Jobs and American Power Act." U.S. Senate Committee on Environment and Public Works. October 23, 2009. http://epw.senate.gov/public/index.cfm?FuseAction=Majority.PressReleases&ContentRecord_id=84691b8e-802a-23ad-4728-e60de8d50fea.

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I agree with the *New York Times* reporter John M. Broder who wrote, "Cap and trade… is almost perfectly designed for the buying and selling of political support through the granting of valuable emissions permits to favor specific industries and even specific Congressional districts."[15]

In conclusion, what is the real purpose of this legislation? It will not create jobs; in fact it will destroy jobs and cripple the economy. It will also not help the environment or reduce our dependency on foreign oil. It will raise taxes and energy costs on every American family and force more jobs to our economic competitors. We believe in an "all of the above" energy approach that incorporates a diverse blend of energy sources without raising taxes and/or increasing the regulatory burden on businesses and without growing the size and scope of the federal government. Thank you.

[15] Broder, John M. "From a Theory to a Consensus on Emissions." *The New York Times*. May 16, 2009. http://www.nytimes.com/2009/05/17/us/politics/17cap.html.

Testimony in Support of Renewable Bio-gas Market Development to Reduce Greenhouse Gas Emissions and Create New Green Jobs

To the Senate Environment and Public Works Committee

Submitted by Gas Technology Institute

10/27/09

GTI would like to thank the Chairman, ranking member and the Committee for this opportunity to provide scientific and other information regarding the benefits of renewable bio-gas. GTI is a non-profit research and development (R&D) organization focused on increasing energy supply, enhancing the reliability and safety of energy delivery; and ensuring energy is used in the most efficient and environmentally responsible manner.

We have been developing energy-related technologies for over 60 years. Some notable GTI innovations you may be familiar with are the phosphoric acid fuel cell and the high efficiency natural gas furnace. GTI is also a leader in the development of unconventional natural gas resources, including shale, tight sands, and coal bed methane, which now account for over 40 percent of all domestic natural gas supply.

In addition to research related to natural gas, one third of the organization's R&D portfolio is focused on renewable energy, in technologies such as biomass gasification and pyrolysis for liquid fuels production; anaerobic digestion for biogas and renewable power; and hybrid solar thermal/natural gas equipment for residential and commercial markets. GTI is active in the development and deployment of technologies suitable for the production and clean-up of renewable bio-gas.

Currently, elected officials, business representatives, energy and environmental groups and many others are discussing options to reduce greenhouse gas emissions (GHG's). It is seen by many as the primary means to address climate change, which as an international issue has produced a variety of approaches and many different international, national, regional and local designs to reduce GHG's.

In the US, one primary approach has been the development of a renewable liquid transportation fuels and renewable electricity market. Incentivizing these renewable markets, especially in the case of liquid transportation fuels, has also been a means to increased national energy security.

One new emerging conversation is how do we bring renewables into the 23% of our nation's energy use which is represented by natural gas? The nation has invested hundreds of billions of dollars to deploy our pipeline transportation system which is extremely efficient at delivering

natural gas from the "wellhead to the burner tip". Approximately, 91% of the primary energy is delivered to the end-user. From "source to site", there is no other fuel that is delivered with anything close to that type of efficiency as a fungible, useable energy product.

Renewable bio-gas(produced from renewable bio-mass, livestock manure and landfill gas) can be upgraded to be interchangeable with natural gas and purchased like other natural gas resources for energy consumption by consumers that can be used in transportation, industry or in homes and businesses. Because both the production and delivery of renewable bio-gas are very efficient, when compared to renewable liquid bio-fuels and electricity made from renewable bio-mass; **renewable bio-gas is an excellent choice to incentivize**. This production and delivery efficiency means less of the original renewable feedstock will be needed to provide an equal amount of useable energy to a consumer, when compared to other renewable options.

Growth in the production and use of renewable bio-gas can impact almost all end-use sectors and provide a fuel that can reduce GHG emissions in transportation, industry, residential and commercial applications as well as electricity production. Renewable bio-gas can also easily be stored underground, like natural gas for future use, which makes it different then almost every other renewable energy option.

CLIMATE CHANGE LEGISLATIVE LANGUAGE

The Climate change legislation that has passed the US House of Representatives, however, compels a Natural Gas local distribution company (LDC), which is regulated under the bill, to hold allowances for any gaseous fuel within in its delivery system co-mingled with natural gas; **even if produced from renewable resources.** If this specific language becomes law, it will diminish market pull for the renewable bio-gas product and creates a disincentive for natural gas LDC's to accept the fuel into their systems. This in turn will dramatically reduce the opportunity for most consumer sectors to use the fuel because only projects where bio-gas production and it use are co-located will be viable under climate change legislation. This is not as large an opportunity to reduce GHG emissions compared to every natural gas meter to becoming a "renewable bio-gas spigot" for a variety of consumers that rely on natural gas.

On top of the following page are the suggested language changes that will help recognize the GHG reduction value of renewable bio-gas. The suggested changes are in red bold.

Changes to ACES 2009 to Exclude Renewable Bio-gas

The legislative language should be changed in two instances so that the emissions resulting from the combustion of renewable bio-gas by the customers of natural gas local distribution utilities do not require an emissions allowance:

ACES §311 (Enrolled House Bill page 738)

§722(b)(8) NATURAL GAS LOCAL DISTRIBUTION COMPANIES.—For a covered entity described in section 700(13)(J), 1 emission allowance for each ton of carbon dioxide equivalent of greenhouse gas that would be emitted from the combustion of the natural gas, and any other gas meeting the specifications for commingling with natural gas for purposes of delivery (**with the exception of gas derived from renewable biomass, landfills, or wastewater treatment sludge**), that such entity delivered during the previous calendar year to customers that are not covered entities, assuming no capture and sequestration of that greenhouse gas.

ACES §312 (Enrolled House Bill page 851)

Clean Air Act §700(6)(c) For a natural gas local distribution company described in paragraph (13)(J), greenhouse gases that would be emitted from the combustion of the natural gas, and any other gas meeting the specifications for commingling with natural gas for purposes of delivery (**with the exception of gas derived from renewable biomass, landfills, or wastewater treatment sludge**), that such entity delivered during the previous calendar year to customers that are not covered entities, assuming no capture and sequestration of that greenhouse gas.

With the changes above, the opportunity for a robust renewable bio-gas market to develop will be greatly increased and all consumers of natural gas can look forward to the potential of a renewable option being available in the near future.

RENEWABLE BIO-GAS TAX INCENTIVES

United States policy to incentivize the production and use of renewable liquid transportation fuels and renewable electricity is well documented throughout both State and Federal law. Currently, however, no incentive exists for the production of renewable bio-gas which can reach a large base of consumers as discussed earlier and can provide dramatic GHG emission reductions.

The 3 exhibits that follow provide information regarding current opportunities that exist in the Congress to incentivize the production of renewable bio-gas, the potential for GHG emission reductions and benefits to the US economy and the environment. Also provided is a letter outlining the support of almost 80 companies for the passage of renewable bio-gas production incentives.

Thank you for this opportunity to provide testimony to the Committee.

EXHIBIT 1

Renewable Bio-gas PTC – Talking Points

The Renewable Biogas PTC proposed by Senator Nelson (S-306) and Congressman Higgins (HR 1158) addresses environmental issues, national energy security and the economy by creating jobs and providing new income streams for livestock producers, food processors, bio-gas project developers, and agri-businesses. This tax credit seeks to provide the necessary incentives to turn wastes into energy: from livestock manure, and cellulosic feed-stocks to landfill and sewage wastes.

- The job creation potential of renewable bio-gas gas projects is significant. It has been estimated[1] [2] that 550-860 jobs per billion cubic feet (Bcf) of useful renewable bio-gas can be created.
- Given a market potential of 1 quadrillion Btu's, or about 1,000 Bcf, the near term job creation potential would be in the range of 550,000-860,000 new jobs. Longer term an additional 1 quadrillion Btu's could be produced adding an additional 550,000 to 860,000 jobs to the economy.
- This PTC can lead to 47.9 million metric tons (MMTs) annually of CO2 reductions from animal waste, 57.5 MMTs annually from cellulosic materials and 21.5 MMTs annually from landfills. This total of 127 MMT's annually is the equivalent of taking 25.4 million cars off the road.
- The California Air Resources Board (CARB), in a 2009 report, has determined that bio-methane is the lowest carbon transportation fuel available today.
- Every state in the Union has the resources to participate in the production of renewable gas with the potential to create new green jobs in every state.
- Bio-gas from renewable sources including animal manure, forest residues and agricultural wastes can be produced at efficiencies ranging from 60–70%[3], thus using our renewable resources in a very responsible and efficient manner.
- All of the technology components to produce renewable bio-gas from this variety of sources exist today.
- Renewable bio-gas production in digesters provides the agricultural sector additional environmental benefits by improving waste management and nutrient control and dramatically reducing carbon emissions through the control of methane by placing manure in enclosed vessels instead of open lagoons.
- Another benefit of generating renewable bio-gas is that it can be upgraded and delivered to customers via an existing U.S. pipeline infrastructure providing a renewable option to 25% of our energy market which has few renewable options today.
- Renewable bio-gas upgraded and delivered through the pipeline system can provide a renewable option for heating homes and businesses throughout the country and for many heavy industries in urban areas as well as in transportation and for electricity production

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[1] Socioeconomic Drivers in Implementing Bio-Energy Projects, Domas et al, Science Direct,28 (2005) 97-106

[2] http://peakenergy.blogspot.com/2008/03/banana-methane-powered-cars-pig-poo.html

[3] http://www.sgc.se/Rapporter/resources/seminar_screen.pdf, p. 305.

thus reducing carbon emissions - while creating new rural green jobs to produce renewable bio-gas.

While wind, solar, biomass and geothermal remain absolutely vital, we are missing a substantial opportunity to turn wastes and waste problems into energy and energy solutions that help the environment and the economy. **Through the production of renewable bio-gas, and upgrading to pipeline quality, we can provide a renewable option for natural gas, which represents 25% of our U.S. energy use.**

EXHIBIT 2

Renewable Bio-gas Carbon Emissions Reductions Benefits

There are several broad categories of renewable gas including: (1) biomass derived; (2) landfill gas; and (3) animal (livestock) waste derived. Each of these renewable gases can provide for substantial reduction in carbon emissions. However a new federal production tax credit (PTC) for renewable gas is needed to make many such projects economically viable particularly during this time of low energy prices for competing fossil fuels like natural gas.

Estimated CO_2 reduction benefits achievable, based on proposed bio-gas PTCs in the Nelson and Higgins' bills are conservatively 127 million metric tons annually. This is the equivalent of taking 25.4 million cars off the road.

Below is an analysis of the levels of CO_2 reductions for the production and use of each type of renewable derived bio-gas described above, followed by a synopsis of the potential total national CO_2 reduction benefits.

Animal Waste

Animal waste includes the liquid and solid excretions of virtually any type of livestock, and can also include sludge from water treatment facilities. The decomposition of these wastes produces methane and other gases. By gathering these wastes and accelerating their decomposition in anaerobic digesters, the gases can be contained, and further processed into high-methane-content gas. This gas can then be used to supplant other fuels for combustion for heat or electricity generation. The productive use of these wastes is a force multiplier in reducing GHG emissions. While the product gas does offset the use of natural gas in the 1:1 ratio described below for landfill gas and biomass gas, the elimination of the methane emissions is even more compelling. One ton of methane (CH_4) is considered to have the radiative forcing effect of 23 tons of CO_2. One MMBtu of methane weighs 42.2 pounds. Multiplying this by 23 gives a CO_2 equivalent (not released) of 970 lbs of CO_2 released for each MMBtu of methane emitted to the atmosphere. To this must be added the 117 pounds per MMBtu of CO_2 produced when natural gas is combusted.

Biomass Derived Gas

Renewable gas can be produced from a variety of biomass sources, including woody biomass (i.e., trees and forestry waste) and crop processing waste (e.g., corn husks/cobs). These input materials are all carbon-based, and through the normal cycle of death and decomposition, or destruction through combustion, the carbon is ultimately released into the atmosphere,

uncontrolled and in gaseous form. By capturing and converting these wastes to high quality gas, the carbon normally released by decomposition or open burning is eliminated. The result is that instead of emitting CO_2 from the non-productive decomposition of the biomass, gasification is done in a controlled and contained fashion. The useful gas produced then offsets natural gas on a 1:1 ratio. Thus for every MMBtu of biomass gas produced, one MMBtu of natural gas is not combusted.

Landfill Gas

Landfills of significant size are required by New Source Performance Standards (NSPS) to install well fields to collect gases from decomposition; typically methane, CO_2, and other minor constituents. This use supplants the natural gas that would otherwise be used. As an example, for each MMBTU of methane that is flared, 117 pounds of CO_2 are emitted. At the same time for each MMBTU of natural gas combusted by a consumer, a similar 117 lbs of CO_2 emitted. By cleaning up the landfill gas and using it to supplant natural gas, the 117 lbs of CO_2 that was emitting twice, is now only emitted once.

Benefits of Renewable Gas

The U.S. EPA estimates that biogas levels of 96 billion cubic feet (Bcf) are technically feasible using anaerobic digestion at 7,000 of our nation's dairy and swine farms. (There are over 65,000 dairy farms and another 65,000 pig and hog farms in the U.S.) With a PTC in place, all of these 7,000 farms, over time, can be converted to renewable gas production economically. Using a global warming potential for methane of 23 times CO_2, this equates to 42.6 million metric tons of CO_2 reductions per year. Additionally, another 96 Bcf of methane can be displaced with combustion of renewable natural gas in place of natural gas for another 5.3 million metric tons per year for ***a total of 47.9 million metric tons annually of CO_2 reductions.*** Additionally, because the EPA analysis doesn't account for a tax credit or the prospect of connecting smaller farms with a pipeline gathering system, we believe conservatively a tax credit could create thousands of more farms becoming economically and technically feasible to produce renewable gas leading to the potential for a doubling of aforementioned CO_2 reductions.

Thermochemical gasification, in addition to the anaerobic digestion just discussed, opens up the resource base to include cellulosic materials like forest wastes, woody bio-mass and crop residues. The U.S. Energy Information Administration (EIA) in their Renewable Portfolio Standard (RPS) analysis estimates that 2.2 quads of renewable gas could be produced from biomass-related RPS facilities (not including the above anaerobic digestion). If we assume a 50% penetration for biogas to renewable natural gas through the PTC, or about 1.1 quads per

year of renewable methane produced and combusted, then ***another 57.5 million metric tons per year of CO_2 can be avoided.***

How many bio-mass gasification plants are required? If there are 137 2,000-ton-per-day facilities, that will produce 1.1 quads of renewable gas per year. Additionally these gasification facilities, due to the need for separation and capture of CO_2 to produce renewable gas, will be carbon sequestration ready; so that in the future CO_2 can be placed in a pipeline and sent to a sequestration site or used to support other CO_2 mitigation options like algae production.

There are about 3,000 landfills in the U.S and very few of these produce high BTU renewable biogas because of the high costs of doing so. The EPA's Landfill Methane Outreach Program (LMOP) estimates that 520 of these have the potential to produce biogas. The PTC will enable these to be developed to produce renewable gas. The potential for these facilities is 1.08 Bcf/day, or 390 Bcf of renewable gas per year. ***This produces CO_2 savings of 21.5 million metric tons per year from LFG sites.***

Thus, a PTC can create a total CO_2 savings of 127 million metric tons per year.

HYPERLINK "http://www.epa.gov/agstar/pdf/biogas%20recovery%20systems_screenres.pdf"
http://www.epa.gov/agstar/pdf/biogas%20recovery%20systems_screenres.pdf
HYPERLINK "http://www.epa.gov/lmop/res/calc.htm" http://www.epa.gov/lmop/res/calc.htm

EXHIBIT 3

Renewable Bio-gas Production Tax Incentive Support Letter

October 6, 2009

The Honorable Max Baucus
Chairman
Finance Committee
U.S. Senate
Washington, DC 20510

The Honorable Charles E. Grassley
Ranking Member
Finance Committee
U.S. Senate
Washington, DC 20510

The Honorable Charles B. Rangel
Chairman
Ways and Means Committee
U.S. House of Representatives
Washington, DC 20515

The Honorable Dave Camp
Ranking Member
Ways and Means Committee
U.S. House of Representatives
Washington, DC 20515

The following companies and organizations recommend that Congress develop and pass legislation providing a $4.27 per MMBTU tax credit for the production of renewable gas. The Biogas Production Incentive Act introduced by Representative Higgins in the previous Congress (D-NY), with original co-sponsors Rahm Emanuel (D-IL) and Devin Nunes (R-CA) would have established such a credit. Representative Higgins has re-introduced his legislation this session along with Senator Nelson (D-NE). We believe this tax incentive would lead to new green jobs and rural economic development.

The U.S. Congress has wisely supported the expanded use of domestic renewable resources through a variety of tax incentives and other programs. Up to this point, Congress has focused primarily on measures that support the production of renewable liquid transportation fuels or electricity. In the U.S., however, natural gas represents 27 percent of the energy consumed.

Natural gas is the fuel of choice to provide residential and commercial heat for space and hot water in most applications and is used to produce steam in a variety of commercial and industrial applications. Natural gas is also the fuel that provides the energy to manufacture many industrial products including aluminum, steel, glass, chemicals, fertilizer, and ethanol. Compressed natural gas can also provide the fuel for light, medium and heavy-duty vehicles.

Incentivizing the production of renewable gas (RG) from sources that include animal manure, landfills, renewable biomass and agricultural wastes will support expanding the role of renewables into this existing energy sector, where little opportunity exists today. It will also create another business investment prospect for renewable project developers and the potential to expand rural economies

while supporting existing industrial jobs and dramatically reducing carbon emissions.

Please consider the following:

- RG is a versatile form of bio-energy. It can be used directly at the site of production, or placed in the pipeline to support a variety of residential, commercial, industrial or transportation applications.
- RG produced from renewable sources including animal manure, landfills, renewable biomass and agricultural wastes can be produced at *high* efficiencies ranging from 60–70 percent. Additionally, all of the technology components to produce renewable gas from this variety of sources exist today.
- RG can be delivered to customers via the existing U.S. pipeline infrastructure.
- RG can provide a renewable option for many heavy industries, which could save existing industrial jobs in a carbon constrained economy - while creating new rural green jobs to produce RG.
- RG production in digesters provides the agricultural sector additional environmental benefits by improving waste management and nutrient control.

The following companies and organizations urge your support of a $4.27 per MMBTU tax credit for the production of renewable gas. We believe this is a fiscally responsible proposal that will spur new gas production, create green jobs, expand the rural economy, increase energy independence and reduce greenhouse gas emissions.

If you have questions regarding this request or would like further information please contact Lloyd Ritter at (202) 215-5512 or lritter@greencapitol.net.

Thank you.

Companies and organizations in support are listed below.

As of 10/06/2009

AGL Resources
Atlanta, GA

American Biogas Company
Madisonville, KY

American Gas Association
Washington, DC

American Iron and Steel Institute
Washington, DC

Cayuga Renewable Energy LLC
Union Springs, NY

Central Hudson Enterprises Corporation
Poughkeepsie, NY

Chattanooga Gas Company
Chattanooga, TN

Consolidated Edison Company of New York, Inc.
New York, NY

American Public Gas Association
Washington, DC

Andigen, LLC
Logan, UT

ASERTTI
Washington, DC

Atlanta Gas Light
Atlanta, GA

Atmos Energy
Dallas, TX

Beacon Generating
McLean, VA

BioEnergy Solutions
Bakersfield, CA

Bison Renewable Energy
Sioux Falls, SD

Business Council for Sustainable Energy
Washington, DC

Cayuga Marketing LLC
Union Springs, NY

Florida City Gas
Rockledge, FL

Gas Technology Institute
Des Plaines, IL

Genex Farm Systems
Melrose, MN

GHD, Inc.
Chilton, WI

Green Capital
Sioux Falls, SD

Harvest Power, Inc.
Waltham, MA

Intermountain Gas Company
Boise, ID

Linde, Inc.
Murray Hill, NJ

Liquid Environmental Solutions Corporation
San Diego, CA

Mack Trucks, Inc.
Allentown, PA

Montauk Energy Capital
Pittsburgh, PA

National Fuel Gas Distribution Corporation
Williamsville, NY

National Grid
Waltham, MA

Council of Northeast Dairy Farmer Cooperatives
Alexandria, VA

Cygnus Energy
Skaneateles, NY

Dairy Business Association
Oneida, WI

DTE Energy
Detroit, MI

Elizabethtown Gas Company
Berkeley Heights, NJ

Elkton Gas Company
Elkton, MD

Energy Systems Group
Newburgh, IN

Environmental Intelligence, Inc.
St. Paul, MN

Environmental Power Corporation
Tarrytown, NY

Exelon Corporation
Washington, DC

Republic Services, Inc.
Phoenix, AZ

River Birch Inc.
New Orleans, LA

Sanimax
DeForest, WI

Schmack BioEnergy
Cleveland, OH

SEMPRA Energy
San Diego, CA

Sequent Energy Management
Houston, TX

Southwaste Services, Inc.
Houston, TX

Spruce Haven Farm and Research Center
Union Springs, NY

StormFisher BioGas
Hartford, CT

Sustainable Conservation
San Francisco, CA

TECO-Peoples Gas
Tampa, FL

Terracastus Technologies
New York, NY

Think-21
New York, NY

National Milk Producers Federation
Arlington, VA

New Jersey Resources
Wall, NJ

NGV America
Washington, DC

NWNatural
Portland, OR

Organix, Inc.
Walla Walla, WA

Palmer Capital
Cohasset, MA

PG&E Corporation
San Francisco, CA

Phase 3 Renewables
Cincinnati, OH

RealEnergy, LLC
Yountville, CA

Recycled Energy Development
Westmont, IL

United Liquid Waste Recycling, Inc.
Clyman, WI

Universal Entech, LLC
Phoenix, AZ

Virginia Natural Gas
Norfolk, VA

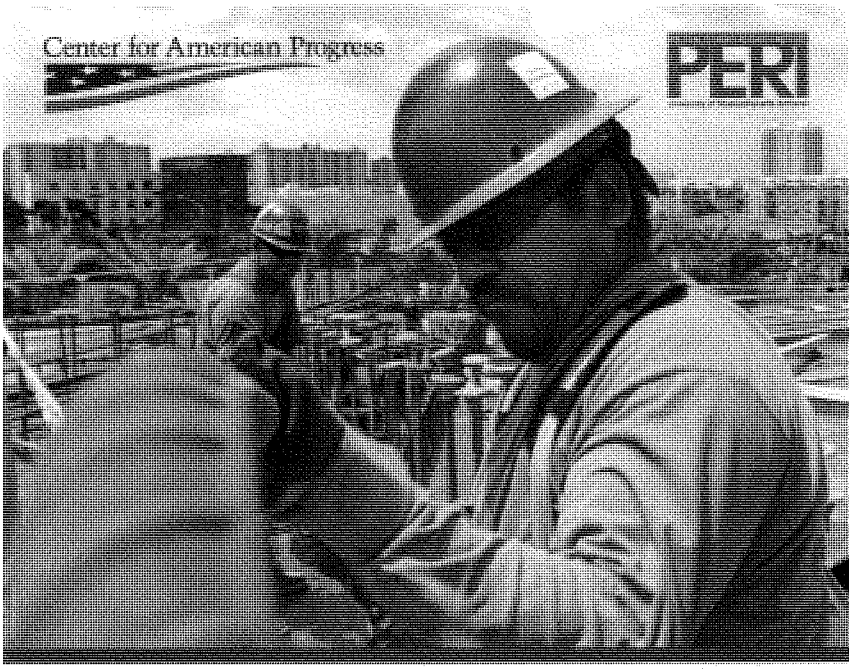
Volvo Group North America
Washington, DC

Waste Energy Solutions, LLC
Pittsburgh, PA

Waste Management
Houston, TX

Western United Dairymen
Modesto, CA

Ze-gen
Boston, MA



The Economic Benefits of Investing in Clean Energy

How the economic stimulus program and new legislation can boost U.S. economic growth and employment

Robert Pollin, James Heintz, and Heidi Garrett-Peltier June 2009
Department of Economics and Political Economy Research Institute (PERI)
University of Massachusetts, Amherst

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Introduction and summary

The United States in the 21st century faces an enormous challenge—successfully managing the transformation from a predominantly carbon-intensive economy to becoming a predominantly clean energy-based economy. The reality of global climate change due to rising carbon emissions makes it imperative that the U.S. economy dramatically cut its consumption of traditional fossil fuels, the primary source of carbon dioxide (CO_2) delivered into our atmosphere by human activity. Rising levels of CO_2 in the atmosphere is in turn the primary cause of global warming.

This economic transformation will engage a huge range of people and activities. But there are only three interrelated objectives that will define the entire enterprise:

- Dramatically increasing energy efficiency.
- Dramatically lowering the cost of supplying energy from such renewable sources of energy as solar, wind and biomass.
- Mandating limits and then establishing a price on pollution from the burning of oil, coal, and natural gas.

It is crucial for economic policymakers and the American people to nnderstand the likely effects of these three overarching objectives as much as possible. Specifically, we need to gauge our success in curbing CO_2 emissions alongside the broader effects on the U.S. economy, particularly on employment opportunities, economic growth and people's incomes.

This paper examines these broader economic considerations—jobs, incomes, and economic growth—through the lens of two government initiatives this year by the Obama administration and Congress. The first is the set of clean-energy provisions incorporated within the American Recovery and Reinvestment Act, initiated by the Obama administration and passed into law by Congress in February. The second is the proposed American Clean Energy and Security Act, co-sponsored by Rep. Henry Waxman (D-CA) and Rep. Edward Markey (D-MA), which is now before Congress.

Our analysis in this paper shows that these two measures operating together can generate roughly $150 billion per year in new clean-energy investments in the United States over the next decade. This estimated $150 billion in new spending annually includes government funding but is notably dominated by private-sector investments. We estimate this

sustained expansion in clean-energy investments triggered by the economic stimulus program and the forthcoming American Clean Energy and Security Act can generate a net increase of about 1.7 million jobs. This expansion in job opportunities can continue as long as the economy maintains a commitment to clean-energy investments in the $150 billion per year range. If clean-energy investments expand still faster, overall job creation will increase correspondingly.

These job gains would be enough—on their own—to reduce the unemployment rate in today's economy by about one full percentage point, to 8.4 percent from current 9.4-percent levels—even after taking into full account the inevitable job losses in conventional fossil fuel sectors of the U.S. economy as they contract. Our detailed analysis, based on robust economic-modeling methodologies that are explained in detail in the paper and in Appendix 1, beginning on page 48, calculates that roughly 2.5 million new jobs will be created overall by spending $150 billion on clean-energy investments, while close to 800,000 jobs would be lost if conventional fossil fuel spending were to decline by an equivalent amount. It is not likely that all $150 billion in new clean-energy investment spending would come at the expense of reductions in the fossil fuel industry. However, we present this scenario to establish a high-end estimate for reductions in conventional fossil fuel spending, and the net gains in employment that will still result through spending $150 billion per year on clean-energy investments. In appendix 2, we also present these figures on net job creation broken down on a state-by-state basis for all 50 states and the District of Columbia.

The stimulus program enacted in February to help the economy recover from a deep recession already in its 18th month includes a range of measures to begin building a clean-energy economy. These measures include:

- $24.4 billion in federal government spending to promote energy efficiency.
- $23 billion for transportation investments.
- $25.3 billion for renewable energy.

Some of this funding will be in 2010, but a significant amount will also spark new economic activity between 2011 and 2014.

Congress still must pass the American Clean Energy and Security Act, or ACESA, and the president must still sign it. But the legislation contains three broad categories of initiatives that are unlikely to change in substance:

- Regulations aimed at promoting clean energy.
- A mandated cap on carbon emissions that will be phased in through 2050.
- Measures designed to assist businesses, communities and individuals successfully manage the transition to a clean-energy economy.

The general thrust of this forthcoming legislation and the clean-energy provisions within the economic stimulus program is to promote energy efficiency and renewable energy. Yet as an economic stimulus program, ARRA operates through direct government spending and financial incentives to promote private investments in clean energy. In contrast, ACESA will boost clean-energy investments mostly by private businesses, investors and households through new regulations that encourage the clean and efficient use of energy and discourage the use of high-carbon fuels. Many of the regulatory initiatives proposed within the ACESA are not fully fleshed out within the legislation itself. As such, it is more difficult to estimate their effects on overall clean-energy investments than is true with the spending initiatives advanced by the ARRA.

In the following pages, this paper first examines the basic clean-energy features of the economic stimulus program and the proposed ACESA. Specifically, we will detail the distinct features of both measures and the ways in which they would operate in concert to encourage investments in clean energy and energy efficiency as well as discourage spending on conventional high-carbon fuels.

We will then explain how ARRA and ACESA operating in tandem would create new employment opportunities across the United States by spurring $150 billion a year over the next decade in new clean-energy investments. Understanding how we calculated these investment levels over 10 years requires an understanding of the different economic models available to analysts and why we chose a simple but reliable method for estimating employment effects based on data generated by the U.S. Commerce Department's industrial census. We explain the reasons for our analytical decisions on pages 15–20, beginning with how we estimated the effects on jobs of shifting spending in the U.S. economy away from high-carbon fuels and toward clean-energy investments. We will show why our simple approach offers a robust framework for understanding how a shift in spending from conventional fossil fuels to clean energy generates a net expansion of employment that will be sustained as long as the U.S. economy maintains its commitment to clean-energy investments.

We then present our detailed employment estimates. Our key finding is that clean-energy investments generate roughly three times more jobs than an equivalent amount of money spent on carbon-based fuels. We consider some of the implications of this result, including how a large-scale shift from conventional fossil fuels to clean-energy investments—on the order of $150 billion a year—would affect conditions in the U.S. labor market.

Our paper then turns to the various economic models used to estimate the impact of a carbon cap on the long-run growth trajectory of the U.S. economy. Our key finding: All of the models, without exception, forecast that a carbon cap, such as that proposed in ACESA, would have, at worst, a minimally negative impact on the U.S. economy's long-term growth path. Moreover, these models generate this basic finding without considering some of the major ways in which clean-energy policies can stimulate economic growth.

These include the expansion of employment opportunities itself, a reduction in the trade deficit, promoting technological improvements and thus falling prices in renewable energy sources, and reducing the negative impacts on economic activity of greenhouse gas emissions and unmitigated global warming.

To be sure, any economic modeling effort that estimates changes in employment growth, economic growth, and income growth will result in forecasts that are problematic by nature. We make this clear in our paper wherever we rely on our own economic models and those employed by others. But we also take pains to examine the relative strengths and weaknesses of all the modeling approaches—including our own. This enables us to cross check our own conclusions with those of other researchers to reach the most reliable possible understanding of the overall impact of advancing a clean-energy agenda within the U.S. economy.

Understanding the economic stimulus program and new clean-energy legislation

The clean-energy components of the American Recovery and Reinvestment Act programs and the entire American Clean Energy and Security Act now before Congress are designed to transition our economy from its reliance on high-carbon fuels to one operating more efficiently on clean energy. Understanding the specific features of ARRA and ACESA and how they will work in combination allows us to estimate the level of public- and private-sector investments in clean energy. As we will demonstrate, the two programs together could create $150 billion a year in new investment and 1.7 million net new jobs a year—that is, 1.7 million more jobs each year than would be the case without a $150 billion shift in spending from conventional fossil fuels to clean energy investments.

The economic stimulus program

There are three separate ways to break down the various spending categories on clean energy within the $787 billion economic stimulus program that kicked in after the passage of ARRA in February this year. The first is according to the specific categories of environmental spending. The second is the financial mechanism for allocating the federal funds. And the third is the amount of additional spending by state and local governments and private businesses that are likely to result through the incentives offered under ARRA (see Table 1). It is crucial to keep these distinctions clear, especially when we later consider the impact of ARRA in conjunction with the types of measures proposed in the ACESA.

Categories of environmental spending

As Table 1 shows, total federal environmental spending in ARRA amounts to about $100 billion, divided into nine categories: renewable energy, energy efficiency, transportation, the electrical grid, nuclear decontamination, carbon capture-and-storage technologies for fossil fuels, basic science, along with general categories "other" and "government administration." The four largest areas of federal spending are renewable energy, energy efficiency, transportation, and the electrical grid, accounting for about $86 billion of the $100 billion total.

TABLE 1
Environmental spending through the ARRA

Billions of dollars

Type of funding	Direct public spending	Grants	Tax incentives	Loan guarantees	Bonds	Total
Federal spending						
Renewable energy	$2.5	$2.3	$16.0	$4.0	$0.6	$25.3
Energy efficiency	7.2	14.4	2.0	0	0.8	24.4
Transportation	0.6	20.1	2.1	0	0.3	23.0
Grid	6.6	4.4	0	2.0	0	13.0
Nuclear decontamination	6.0	0	0	0	0	6.0
Fossil		3.4	0	0	0	3.4
Science	1.6	0	0	0	0	1.6
Other	2.3	0.7	0	0	0	3.0
Government admin	0.75		0	0	0	0.8
Total	$27.6	$45.3	$20.0	$6.0	$1.7	$100.5
State/local government and private investment						
State/local government and private spending induced by federal funds: *as proportion of federal funds*	0	Ranges by program between 0–3 times federal spending	Up to 2.3 times federal spending	Up to 10 times federal spending	Up to 3 times federal spending	--
State/local government and private spending induced by federal funds: *as dollar amounts*	0	$68 estimated *(= 1.5 times federal spending average)*	Up to $46	Up to $60	Up to $5.1	Up to $179.1
Total, all sources	**$27.6 billion**	**Up to $113.3**	**Up to $66**	**Up to $66**	**Up to $6.8**	**Up to $280.0**

Source: ARRA; grants.gov; irs.gov; www.stateecovery.org; www.dot.gov/recovery; edocket.access.gpo.gov; epa.gov; www.recovery.gov; cbo.gov; dsireusa.org.
Note: Totals may not add up due to rounding.

Financial mechanisms for allocating federal funds

There are five separate categories: direct public spending, grants, tax incentives, loan guarantees, and bonds. Direct public spending programs by the federal government—at $27.6 billion—represents only about one-fourth of the total $100 billion in federal spending. With the remaining $73 billion in federal spending that will be allocated through grants, tax incentives, loan guarantees and bonds, the federal ARRA funds are used as incentives to induce still higher levels of environmental investment spending both by state and local governments and even more so by private investors.

Additional spending by state and local governments and private business

How much additional clean-energy investments will the $73 billion in incentives for state and local governments and especially private businesses end up encouraging? Estimating this amount of additional spending beyond the $73 billion in incentives is difficult,

because of the very nature of incentives. The federal government obviously does not have the power to force anyone to accept the incentives they are offering; nevertheless, it is essential to establish at least some broad parameters as to how extensive the non-federal environmental spending induced by ARRA is likely to be.

We therefore present in Table 1 some rough estimates of how much additional funding by state and local governments and the private sector is likely to occur because of the $73 billion in federal incentives. Our estimates vary due to the nature of the different incentives. Among the federal grants on offer, for example, are those that require no matching funds from state or local governments or private businesses, such as "transit capital improvements" and the "state energy program." And then there are those federal grants that do require matching investments, such as "concentrating solar power" and "transportation electrification." We assume an average level of matching funds at about 1.5 times the level of federal funds allocated for these grants, since this is a midpoint figure for the range of matching fund requirements in the various grant programs.

With the tax incentives, loan guarantees, and bond financing programs, the upward range by which federal funds may be matched by state and local government or private investments is more consistently specified within the ARRA legislation. Based on this information, we estimate that non-federal spending will range between 2.3 times federal spending for the various tax incentive measures to 10 times federal spending for the loan guarantees and bond financings to help finance investments in renewable energy and smart grid transmission systems. We explain in detail on page 49 of Appendix 1 how we derive these upper end estimates for non-federal spending induced by the ARRA.

Overall, as Table 1 shows, we estimate that the various grants, loan guarantees, tax incentives and bond financings could spur up to about $180 billion in total spending in addition to the $100 billion in federal spending in clean energy through the economic stimulus program. Yet the total level of investments could fall below that $280 billion if the private sector does not respond with sufficient enthusiasm to the incentive programs provided by ARRA. This could happen depending on the implementation of other clean-energy regulations and incentives.

This is the crucial point of convergence of the clean-energy incentives advanced through the economic stimulus program and the set of regulations and incentives currently included in the American Clean Energy and Security Act before Congress. This combination of incentives will create the overall investment environment for clean energy in the U.S. economy. But before we detail how this convergence will affect overall investment flows from state and local governments and the private sector over the next decade, we first must consider the rate at which clean-energy spending through the ARRA is likely to be distributed throughout the economy.

Rate of spending on economic stimulus programs

About 90 percent of the overall spending under the $787 billion American Recovery and Reinvestment Act is designed to occur between 2009 and 2014.[1] But ARRA's clean-energy components are largely designed to encourage private-sector participation, which means the rate of spending on clean energy will stretch out over a longer period of time. This is the case for several interrelated reasons. It takes longer for a private investor to decide to pursue an investment opportunity because of federal government incentives than for the federal government to undertake on its own a direct federal spending project. It then takes time to obtain financing for such projects and organize the various contracting and subcontracting parties involved in the project. Then and only then can the spending begin on a private sector clean-energy project operating with federal subsidies.

The Congressional Budget Office recognized these factors in a recent analysis. CBO developed an eight-year time frame for the nearly full disbursement of ARRA-related investment funds on renewable energy and energy efficiency—managed by the Department of Energy—with the bulk of spending on these projects occurring between 2010 and 2014. Table 2 shows the rate at which the CBO is assuming these ARRA funds will be spent.

The CBO assumes that 35 percent of total funding will be spent as of 2011, 90 percent by 2014, and 96 percent by 2015. We therefore assume that the rate of spending for the other clean-energy investment components of ARRA will proceed at roughly the same rate as these renewable-energy and energy-efficiency projects within the Department of Energy budget. We can conclude that all of the clean-energy components of the economic stimulus program will operate on a large scale for about five years, from 2010 to 2014.[3]

TABLE 2
Congressional Budget Office estimated rate of ARRA spending on renewable energy and energy efficiency

Year of ARRA spending	Percentage of total direct federal spending in given year	Cumulative percentage of direct federal spending as of given year
2009	2.6%	2.6%
2010	12.2%	14.8% (2009–10 spending)
2011	19.9%	34.7% (2009–11 spending)
2012	22.1%	56.8% (2009–12 spending)
2013	17.6%	74.4% (2009–13 spending)
2014	15.1%	90.0% (2009–14 spending)
2015	6.2%	95.7% (2009–15 spending)
2016	1.6%	97.3% (2009–16 spending)

Source: Congressional Budget Office, "Estimated Cost of the American Recovery and Reinvestment Act of 2009," Estimated Cost for the Conference Agreement of H.R. 1, available at "http://www.cbo.gov/ftpdocs/99xx/doc9989/hr1conference.pdf.

If we then also assume that nearly $280 billion in total is spent by the public and private sectors over this five-year period, this would amount to an average level of clean-energy investments tied to ARRA of about $56 billion per year over five years. Nevertheless, the rate at which the federal money tied to incentive-based programs within the ARRA—the grants, loan guarantees, tax incentives and bond programs—are actually spent will depend on the broader set of regulations and incentives operating within the economy. As such, the policies proposed through the ACESA will play a central role in strengthening the clean-energy incentives introduced through the ARRA.

The American Clean Energy and Security Act of 2009

The current draft of ACESA sets out a variety of standards, regulations, and restrictions governing energy efficiency and carbon emissions. As of June 18, 2009 the bill was still under debate in Congress and will undergo further revisions before it reaches the president for his probable signature. But the basic framework and parameters of the measure will likely remain as presented in the draft legislation as it currently stands.

ACESA is primarily a piece of regulatory legislation, not a spending bill. Upon implementation, the law will influence the allocation of private resources and the direction of technological change, and thereby alter the ways in which energy is produced and consumed. This will happen most directly through the introduction of a carbon cap-and-trade program that will put a price on carbon emissions for the first time and then allow companies to trade carbon-emission credits among themselves as the cap on emissions rises.

This differs significantly from the clean-energy investment components of the economic stimulus program that, as we have seen, are direct spending measures or subsidies to promote private investment in these areas. Yet the underlying aim of the ACESA is also to encourage new investments in clean-energy activities and correspondingly discourage reliance on high-carbon fuels. Specifically, the new carbon cap-and-trade program will explicitly limit conventional fossil fuel production and consumption and encourage investors to meet market demaud for energy by providing consumers with clean-energy alternatives.

ACESA boasts one section that deals directly with reducing carbon emissions through a cap-and-trade program. Other aspects of the bill would: increase energy efficiency; diversify sources of energy through the development of clean-energy alternatives; reduce dependency on imported high-carbon fuels; and modernize the energy transmission and distribntion system through the adoption of "smart grid" technologies. Together, ACESA would promote clean-energy and energy efficiency; reduce our reliance on high-carbon fuels, and support companies, individuals and communities through the transition to a clean-energy economy.

Besides the cap-and-trade program, ACESA includes regulations governing a new national standard for electricity generation through renewable energy sources and a set of broad guidelines by which new standards and regulations would be determined through future legislative and regulatory initiatives. These major additional provisions in ACESA include:

- **A carbon capture-and-storage program.** The bill calls for a study to assess the barriers to the broad deployment of carbon capture-and-storage technologies alongside funds for pilot demonstration projects through a new Carbon Storage Research Corporation.

- **A low-carbon fuel standard.** The bill would establish a low-carbon fuel standard within three years after the bill is passed, but does not contain the details of such a standard in the actual legislation.

- **New energy-efficient building standards.** The bill would implement new standards based on the International Energy Conservation Code for commercial buildings and the American Society of Heating, Refrigeration, and Air Conditioning Engineers standards for residential buildings, with the two standards based on "each model code or standard released after the date of enactment of the Act."[3] The bill also requires the federal government to provide financial support for commercial and residential retrofits in order to achieve compliance with the standards.

- **New fuel-efficiency standards for motor vehicles.** The bill authorizes the president to set these new standards based on what is achievable by the automobile industry but designed to achieve emissions reductions at the same level as California law AB1493. The California regulations aim to reduce greenhouse gas emissions from new vehicles by 23 percent by 2012 and by 30 percent as of 2016.

- **New industrial energy-efficiency standards.** The bill would require the development of energy-efficiency standards for factories and other types of industrial plants, with the task of doing so assigned to the Secretary of Energy.

Because these additional provisions of ACESA do not include specific regulations, it is not possible to consider categorically what their impact is likely to be on employment or economic growth. But it is possible to calculate broadly how these new regulatory measures would operate along with the two measures in ACESA—the renewable electricity standard and the carbon cap-and-trade program—where detailed regulatory standards are presented. We therefore consider those two detailed regulatory programs within the ACESA.

Renewable energy electricity standard

ACESA proposes that six percent of all electricity generation supplied by retail electricity providers in the United States must come from renewable energy sources by 2012, rising to 15 percent by 2020. These renewable-energy sources include wind, solar, geothermal, biomass, municipal waste, and hydropower. The draft legislation includes a provision allowing utility companies that surpass the standard to trade their credits to other companies. Consequently, not all retail electricity companies will necessarily need to meet the standard themselves, though on average the standard would hold for all retailers.

To analyze the implications of this standard, we draw on the most recent energy forecasts in the *Annual Energy Outlook 2009*, published by the Department of Energy's Energy Information Administration. We specifically base our analysis of the forthcoming renewable energy electricity standards on the Energy Information Administration's so-called "reference case." This reference case takes into account existing policies to estimate the impact of this standard on the economy, but it does not consider how possible new policies or other future developments—such as new technological advances—could influence the ways a renewable energy standard would impact the economy's overall performance.

Based on this reference case from the EIA, the United States already meets the six percent renewable standard set for 2012. Moreover, based on the reference-case forecasts in the 2009 *Annual Energy Outlook*, the new regulations would not be difficult for retail energy suppliers to reach until around 2018, when the standard would rise to 14 percent.

But how much additional investment in renewable electricity generation would be needed to meet the 15 percent standard by 2020? The EIA estimates that our nation's overall available electricity supply would total 4,618 kilowatt hours by 2020. If 15 percent of this came from renewable sources, annual renewable electricity generation would total about 690 kwhs.

We estimate that total installed renewable-energy electricity generation capacity would have to increase by about 53 gigawatts from its current level to generate 690 kilowatts of electricity from renewable sources by 2020. The dollar value of this investment would total approximately $148 billion. If we spread out this level of investment over the next decade, it would amount to approximately $15 billion in investment each year (see Appendix 1 on page 48 for the detailed analysis).

The 15-percent renewable electricity mandate is not the only provision in ACESA that will encourage investments in the production of renewable energy-based electricity. Other provisions in ACESA—such as the cap-and-trade program—would also create incentives for the more rapid shift towards renewable energy. In this broader context, it is conceivable that the U.S. economy could exceed the 15 percent target by 2020, provided other complementary policies operate effectively in support of that goal.

To calculate the level of investment needed to reach a 20 percent renewable electricity standard by 2020, we draw again from the EIA database. We calculate that it would require an additional 104 gigawatts in total additional capacity to reach the 20 percent renewable standard, which would entail about $290 billion overall in new renewable-energy investments. Spread out over a decade, this level of renewable energy investment would be about $30 billion per year.

Carbon cap-and-trade system

ACESA contains a specific schedule for reducing greenhouse gas emissions through 2050 via a carbon cap-and-trade system. That proposed schedule is as follows:

- 2012: Three percent below 2005 emissions levels, which is 12 percent above 1990 emissions levels.
- 2020: Twenty percent below 2005, which is seven percent below 1990 emissions levels.
- 2030: Forty-two percent below 2005 (33 percent below 1990 levels).
- 2050: Eighty-three percent below 2005 (80 percent below 1990 levels).

Under this schedule—or any schedule ultimately endorsed by Congress and signed by the president—new costs would be imposed on businesses for emitting carbon into the atmosphere while businesses that use clean energy, or improve their efficiency, could see savings in their energy bills. Businesses will pass along a significant share of these costs and savings to consumers. The net result would be to discourage both businesses and consumers from consuming energy from carbon-emitting sources; and to correspondingly promote both energy efficiency and reliance on clean energy sources.

In this way, a carbon cap-and-trade system would operate in concert with the full range of incentives included in the economic stimulus programs and ACESA to shift overall energy production and consumption toward efficiency and renewable sources and away from high-carbon fuels. How much a carbon cap would reduce conventional fossil fuel consumption and encourage clean-energy sources and efficiency would depend on how large are the additional costs imposed by any such measure. It would also depend on how affordable are the clean-energy alternatives to conventional fossil fuel consumption.

We can illustrate this point with a simple example. According to the Environmental Protection Agency's most recent model of the ACESA draft, the carbon-cap component of the proposal would produce an increase in gasoline prices of about 10 percent relative to the reference case as of 2030; the reference case price is approximately $4.15 per gallon, while under cap-and-trade, EPA forecasts the price at about $4.50 per gallon. How much is a 10-percent increase in gasoline prices likely to affect economic activity more broadly?

According to many standard references in economic studies, what economists term the "price elasticity of demand" for gasoline is in the range of -0.3.[4] This price elasticity estimate refers to how much demand for gasoline would fall when the price of gasoline rises. The estimate of a -0.3 elasticity means that if the price of gasoline rises by 10 percent then demand would fall by three percent. Using the EPA model, gasoline prices will rise by 10 percent relative to the reference case—from about $4.15 to $4.50 per gallon—due to the carbon cap, which in turn will mean gasoline consumption would fall by 3 percent relative to the reference case.

Deriving this result is completely dependent on working with the price elasticity figure of -0.3. But the price elasticity could also be raised substantially if, for example, there were affordable and readily accessible options for raising efficiency and purchasing renewable energy sources. If accessibility to public transportation improved substantially and if biomass fuels became widely available and price competitive—two outcomes that are likely to happen because of economic stimulus programs within ARRA and the full range of incentives included in the ACESA—then we can imagine that the price elasticity for gasoline could increase from -0.3 to -0.6. This would mean that a 10-percent price increase in gasoline would reduce gasoline consumption by six percent rather than three percent. At the same time, consumers need not see their costs for transportation rise, since clean-energy investments are aimed precisely at encouraging energy-efficient vehicles, improving the quality of public transit offerings, and driving down the cost of renewable energy sources for automobile fuel.

Overall, we can see once again that the full effects of the cap-and-trade system interacting with other clean-energy incentives in the economy under ARRA and other elements of the ACESA will encourage businesses, households, state and local governments to embrace the clean-energy investment agenda, including the opportunities for their investments to be subsidized by federal government programs. We will now examine how this full range of incentives could generate in the range of $150 billion per year in new clean-energy investments throughout the U.S. economy.

Creating $150 billion a year in clean-energy investments

Our analysis of how the ARRA stimulus measure and ACESA will work together as complementary initiatives allows us to estimate an overall level of new clean-energy investments in the United States in the range of $150 billion per year over roughly the next decade. In addition to our assessment of the various incentives and subsidies provided by the ARRA, this calculation is based on our analysis of the potential size of the overall market for clean-energy investments in the United States, including unsubsidized investments by businesses as well as investments receiving some form of government subsidy.

A total level of clean-energy investment spending in this range would represent about eight percent of total annual private investment in the U.S. economy as of 2007 and about 1.1 percent of 2007 U.S. gross domestic product. By "investments" we refer to spending that either improves energy efficiency or contributes toward the expansion of renewable energy supplies. Retrofitting buildings, for example, is an energy-efficiency investment, while research on improving the cost competitiveness of biomass fuels and building wind farms are forms of renewable-energy investments.

A crucial feature of our approach is that we include in our $150 billion estimate only investments that have the potential to significantly expand employment opportunities in the U.S. economy. There are major areas of energy-efficiency investments that will not generate a large net expansion of employment, including building energy-efficient automobiles and appliances as well as construction of new buildings that operate at higher efficiency levels than the existing building stock. In these cases, the employment requirements are not likely to be larger than those for inefficient cars, appliances and buildings, though the gains in efficiency will make important contributions to reducing greenhouse gas emissions.

We can consider the overall level of clean-energy investments according to two criteria:

- Investments that are either completely funded by the federal government or are government-subsidized private investments.
- Unsubsidized private investments that result from the overall expansion of markets, new technologies and related opportunities in the clean-energy sector.

We first consider the scope of the subsidized market then address more broadly the overall market, including both the subsidized and unsubsidized segments.

Subsidized public- and private-sector investments

Establishing an estimate for government funded and subsidized investments requires us to work from two concrete reference points. The first is the spending levels that are likely to result through ARRA. In a previous section of the paper we estimated this high-end level at $56 billion per year between 2010 and 2014, including federal spending as well as state and local government spending and private investments that could be induced by the federal programs. This level of investment is predicated on private investors taking full advantage of the range of clean-energy investment initiatives being offered through the ARRA alongside the range of regulations and incentives included in ACESA.

The second reference point is our estimate that the total level of new investments in renewable energy electricity generating capacity would need to be around $15 billion per year over 10 years to meet the 2020 standard now included in ACESA. It is likely that a significant share of this new renewable energy investment capacity would be subsidized through ARRA-based incentive programs. As such, we would be double-counting to assume that all $15 billion per year in renewable energy electrical generating capacity would be an increment of investment spending in addition to the $56 billion year in clean-energy investments included in the ARRA. It is more reasonable to assume that some of the new renewable electricity capacity will be financed out of the $56 billion in ARRA spending, while a significant share will be come from unsubsidized private investors.

Expanding unsubsidized private-sector, clean-energy investments

Moving beyond the specific case of the renewable electricity standard detailed on pages 11–12, we can, more generally, expect that the opportunities generated by the combination of ARRA and ACESA will lead to an expansion of the new investment opportunities connected to clean energy, a corresponding rise in business opportunities, and a related increase in productive efficiencies as these investment projects take root across the country. That is, the *unsubsidized* market for clean-energy investments will expand as an outgrowth of the subsidized market as businesses create and profit from these new opportunities and as technologies improve. That in turn means the cost of producing clean energy or increasing efficiency will fall as linkages strengthen among companies operating in new clean-energy sectors and as financial institutions supply more funds to support these investments.[5]

Market potential for job-creating clean-energy investments

How large is the potential market for energy efficiency and renewable energy investments that will also generate job creation in the United States, including both the subsidized and unsubsidized segments of the market? We can obtain a sense of this by considering some of

the possibilities in distinct parts of the overall market. As we will demonstrate, the potential market for energy efficiency investments that also are new sources of job creation is around $110 billion per year.[6] A rough approximation, which assumes an average investment in retrofits of around $4,000 per unit, implies an overall potential market of $400 billion.

Energy efficiency

Improving energy efficiency through building retrofits, public transportation, freight rail, and smart-grid electrical transmission systems involves technologies that are already known. The returns on investment are also fairly certain and rapid. Once a growing market infrastructure is established to support these investment activities, the private opportunities will become increasingly clear to a widening range of investors operating without government subsidies. Let's consider each of these investment categories in turn.

Building retrofits

An average-sized single-family home in the United States would require an investment of as little as $2,500 in energy-efficiency retrofits to produce a cost savings in the range of 30 percent per year.[7] This would involve caulking to plug air leaks in the house and adding insulation to attics and basement ceilings. For an additional $2,500, further energy savings are available through replacing windows with air leaks and installing energy efficient appliances.

Despite these potential savings, most homeowners have not retrofitted their homes because they are unaware of the costs savings available to them or they cannot afford the upfront expenses and time commitment involved. But these barriers to retrofit investments will come down through the specific government spending programs that finance retrofits, the building codes that establish higher efficiency standards in buildings, and the more general regulatory environment that raises the costs of burning conventional fossil fuels. As the market becomes more extensive and efficient, this will further encourage new investment in retrofits. In particular, banks, utility companies and various types of nonprofit groups will increasingly organize themselves to supply the upfront financing for these projects. In addition, construction crews will begin to organize their services to take advantage of the expanding opportunities.

The potential market for building retrofits is huge. There are roughly 110 million occupied housing units in the United States, including 80 million single-family detached homes, as well as smaller numbers of attached units, apartments, and trailers. As a rough approximation, assuming an average investment in retrofits would be around $4,000 per unit, implies an overall potential market of $400 billion. We would then add the corresponding market for non-residential structures. The U.S. Green Building Council surveyed the existing stock of these structures in 2008, including all educational buildings, hospitals, retail outlets, and office buildings of various sorts. They estimated the costs of retrofitting all of these buildings at $358 billion.[8]

In short, the potential market for building retrofits alone in the United States is in the range of $800 billion. If all of these structures were retrofitted over the course of a decade, then it would provide a high-end level of this type of energy efficiency investment at $80 billion per year.

Smart grid

A recent study by Mark Chupka, Robert Earle, Peter Fox-Penner, and Ryan Hledik[9] provides a basis for roughly estimating the potential market for smart grid investments over the next decade. They project future investment in electrical distribution and transmission infrastructure will need to be $44 billion per year to meet the growing demand for electricity over the 20-year period between 2010 and 2030. Their estimate includes all types of investment in electrical transmission equipment, including conventional and smart-grid distribution and transmission systems. They do not specify what they consider as a likely breakdown between conventional and smart-grid systems within this overall investment agenda.

One consideration here is that the use of electricity generation from renewable sources often entails accessing energy from more remote locations where wind, sun, or tidal waves can be relatively intense. Making increased use of these new electrical generating sources will correspondingly increase demand for investment in transmission lines. Operating electricity generating systems through renewable energy sources will also entail an improved capacity for transmission systems to deal with the intermittent flow of energy coming from wind and solar sources. This is a key feature of smart grid systems. We would argue that it is reasonable to assume that roughly half—for instance, about $20 billion of the overall $44 billion in annual investments—will represent energy efficiency improvements and investments needed to support the growth of renewable energy generation.

Public transportation

Funds for public transportation will come entirely from the public sector, but some of these funds will come from state and local governments to match levels of support provided by the federal government. The ARRA allocates $23 billion for all transportation investments. This includes highways and other road projects in addition to public transportation, but does not specify the breakdown in spending levels between these two broad areas.

Given the environmental benefits of public transportation and the country's needs for improved services, it is reasonable to assume that roughly half of these funds are devoted to public transportation. If we also allow that state and local governments match this level of funding on a one-for-one basis, then overall public investment funding would total about $25 billion.[10] Spread out on an annual basis, this would mean $5 billion per year over the full span of the economic stimulus program. We also anticipate this level of funding for public transportation will extend beyond the life of ARRA itself as one feature of a broader clean-energy investment push in the United States. This would mean, in total, $5 billion in investment over the full 10-year period being considered.

Cogeneration

Energy cogeneration systems utilize the heat generated by industrial processes to generate electricity on-site. These systems therefore offer a significant means for utilizing available energy sources at higher levels of efficiency. These investments will thus be encouraged—along with other energy efficiency investments—through regulations that set a cap on carbon emissions and subsequent increases in conventional fossil fuel prices. The Energy Information Administration projects that investment in on-site cogeneration is expected to grow by about 40 percent between 2007 and 2030.[11] It is reasonable to expect that this will roughly entail an additional $5 billion in investment each year.

Renewable energy

Investments in renewable energy—wind, solar, biomass, geothermal, and hydroelectric power—will aim at advancing technologies to the point where they are fully cost-competitive with conventional fossil fuels, and to integrate these cost-competitive technologies into the U.S. economy's ongoing operations. This will also proceed across the range of markets in which renewable energy sources are viable, including on- and off-grid electricity generation, non-electricity forms of energy generation, and alternative fuels.

On-grid renewable energy

As we have discussed, it would require about $15 billion a year in renewable energy investments in order to reach the 15 percent renewable electricity standard by 2020 as stipulated in the current draft of ACESA. The renewable electricity standard would apply to electricity retailers who supply energy to residential, commercial, and industrial customers through the national distribution system—that is, "the grid."

But if the investments in renewable electricity were to grow more rapidly as technologies improve, then renewable energy sources could supply as much as 20 percent of total electricity as of 2020 to the electricity grid. To achieve this level of renewable electricity supply by 2020, it would entail new investments of about $30 billion per year over the next decade.

Off-grid renewable electricity

It is reasonable to anticipate a comparable growth in renewable energy investments for end-users of electrical power. This includes businesses and households who generate electricity off the grid for their own use from solar, wind, geothermal, and biomass sources. The EIA, for example, projects that end-use generation of electricity from renewable sources will grow at an annual rate of 6.5 percent from 2007 to 2030. This level of off-grid power generation using renewable energy would involve approximately $56 billion in investment over approximately 20 years, or about $3 billion a year.[12] This figure does not include any effects on investment levels from climate change legislation. The rate of investment would therefore likely increase further as a result of the range of incentives and regulations established by the ACESA.

Nonelectric renewable energy

Electricity represents only one form of renewable energy that final users can generate themselves. There are other forms of decentralized renewable energy production such as geothermal pumps, solar hot water systems and even wood-burning stoves, in which individual households and businesses alike could invest. If we assume that the investment in these non-electrical forms of energy production is roughly equivalent to investment in renewable electricity generation by end-users—as calculated by the EIA—then investment by final users would total about $3 billion per year.

Alternative fuels for motor vehicles

Biofuels from non-food sources—for example, cellulosic biofuels—that can be used for motor vehicle transportation represent another area of growing clean-energy investment. By 2020, the market for ethanol from a variety of sources is expected to be about 20 billion gallons per year.[13] To produce one-third of this quantity of ethanol from cellulosic sources by 2020, additional investment of about $50 billion would be needed over 10 years, or about $5 billion per year.[14]

Clean-energy investments can total $150 billion a year

We calculate that overall clean-energy investments in the United States that also promote job creation could reach $150 billion per year (see Table 3). This estimate is based, first, on implementation of public policies included in the economic stimulus program and

TABLE 3
Breakdown of $150 billion in potential annual U.S. clean-energy investment

Includes only clean-energy investment areas that expand job opportunities

Clean-energy investment area	Potential annual investment level
Energy efficiency	
Building retrofits	$80 billion
Smart grid	$20 billion
Public transportation	$5 billion
Cogeneration	$5 billion
Renewable energy	
On grid renewable electricity	$30 billion
Off grid renewable electricity	$3 billion
Off grid renewable—nonelectrical	$3 billion
Alternative motor fuels	$5 billion
Total	**$151 billion**

Source: See discussion in text.

ACESA, including as much as $56 billion per year in direct public spending and subsidies for private investors over the life of ARRA, which will encourage state and local government clean-energy programs and private-sector investments. We also allow for the strong possibility that accelerated private investment rates could occur as technologies advance and market structures develop, producing a cumulative, self-reinforcing process of innovation and market expansion. This self-reinforcing process would proceed primarily without relying on government subsidies. At the same time, achieving this kind of self-reinforcing investment momentum in clean energy is precisely the aim of the combined incentives advanced through ARRA and ACESA. It is through taking account of these various factors that we conclude that the overall level of clean-energy investments that will boost employment growth in the United States can be in the range of $150 billion annually.

Methodologies for estimating employment and GDP growth

The consequences of public policies on U.S. economic growth and employment growth necessarily happen over time. That's why we cannot know with certainty what the effects of policy will be. That's also why we rely on economic models and various forecasting techniques to generate estimates of what future outcomes are likely to be.

But there is a wide range of approaches to generating such estimates. Before proceeding with our discussions as to how policies within ARRA and ACESA are likely to affect future employment and gross domestic income growth, it is important to consider these methodological points in some detail.

First, we have developed an approach to estimating the employment effects of clean-energy investments that is, in our view, generally reliable. Our approach is reliable because it operates on the basis of very few assumptions and is firmly grounded in the detailed realities of the contemporary U.S. economy. Specifically, it is based on observing the current detailed industrial survey data of U.S. business activity.

From these survey figures, as organized by the U.S. Department of Commerce into its input-output model, we undertake a very simple set of exercises. We consider in today's economy how employment levels would change when we shift the proportions of overall spending on energy from high-carbon sources to clean-energy and energy efficiency.

In contrast with our approach, models that attempt to estimate the effects of environmental policies such as a carbon cap on GDP growth over the next 20-40 years rely on a much larger number of assumptions about the economy's future growth path. These forecasting models are thus highly sensitive to the assumptions on which the models are based.

We will demonstrate that these models are generally unreliable in predicting future GDP growth even in the short term—much less over two to four decades. At the same time, these more complex forecasting models do offer useful perspectives on how one should think about the effects of a given policy, such as a carbon cap, on GDP growth. We will detail below why we consider our model to be the best way to calculate the employment effects of shifting energy spending from high-carbon fuels to clean-energy investments, why we think the long-term GDP forecasting models are highly fragile and unreliable, but also why these models nevertheless offer perspectives that are broadly useful in assessing the effects of a carbon cap on GDP.

Our approach to estimating employment growth

Our employment estimates are figures generated directly from data from the Commerce Department's surveys of businesses within the United States, and organized systematically within their input-output model. Within the given structure of the current U.S. economy, these figures provide the most accurate evidence available as to what happens within private and public enterprises when they produce the economies' goods and services. The data help us and others know how many workers were hired to produce a given set of products or services, and what kinds of materials were purchased in the process. Our methodology is to work within this detailed survey evidence and data set and to pose simple questions.

Here's one example of how our methodology works (for a complete analysis, see Appendix 1 on page 48). If we spend an additional $1 million on building retrofits, how will businesses utilize that money to actually complete the retrofit project? How much of the $1 million will they spend on hiring workers, and how much will they spend on non-labor inputs, including materials, energy costs, and renting office space? And when businesses spend on non-labor inputs, what are the employment effects through giving orders to suppliers, such as lumber and glass producers or trucking companies?

We also ask the same questions within the oil industry. To produce $1 million worth of petroleum that can be sold to consumers at gas stations as a refined product, how many workers will need to be employed, and how much money will need to be spent on non-labor inputs? Through this approach, we have been able to make observations as to the potential job effects of alternative energy investment and spending strategies at a level of detail that is not available through any alternative approach.

Estimating employment gains and losses within the input-output model is possible because we are comparing the impact of total spending within clean-energy sectors and conventional fossil fuel sectors. In particular, we do not distinguish between investment and spending in creating new productive capacity as opposed to all other forms of spending within each sector. But there is an important distinction here to note with respect to the type of spending that will be predominant within clean-energy industries versus conventional fossil fuel industries. In the case of clean energy, virtually all the new spending will be devoted to investments to either promote energy efficiency or to expand renewable energy generating capacity. This is precisely because the existing level of productive capacity in energy efficiency and renewable energy remains tiny relative to the long-term needs.

In contrast, conventional fossil fuel industries spend on extracting, refining, transporting, and delivering retail supplies within an already mature and vast productive infrastructure. New investments to expand the fossil fuel productive infrastructure will therefore account for a much smaller proportion of total spending within the sector than will be the case with clean energy. To be sure, exploring for new sources of oil and gas frequently entail enormous amounts of up front investments—this is less the case with coal, where the location of huge

deposits of existing reserves are well known. Once companies are ready to extract new fossil fuel supplies, high levels of up-front investments will again be required. Overall though, these activities will operate within a fossil fuel energy infrastructure that is already highly developed, so that the ability to deliver these newly developed energy supply sources to market can proceed without requiring large-scale new investments.

There are certainly weaknesses with our use of the input-output model. The most important are that it is a static model, a linear model, and a model that does not take into account structural changes in the economy. But these flaws in our approach need to be considered in the context of alternative approaches that operate with even more serious deficiencies. So let's first consider these points about the static model, the linear model and structural change.

Static model

We make estimates as though everything is happening at one fixed point in time. A more realistic picture of the economy would of course have to recognize that the effects of public- and private-sector spending will take place in sequences over time, and that these timing effects are important. Adding a time dimension would make the model "dynamic," in the technical jargon.

The problem here is how to incorporate a time dimension in an effective way. In principle, a dynamic model does offer a more complete picture than a static model as to how the economy operates overtime. But dynamic forecasting models are generally unreliable in their forecasts, as we detail below. We therefore think it is preferable to work within a simpler framework, and draw out assessments within this simple framework of how transitions affect the results eventually.

Linear model

Our model also assumes that a given amount of spending will have a proportionate effect on employment no matter how much the level of spending changes, either up or down. For example, the impact of spending $1 billion on an energy efficiency project will be exactly 1,000 times greater than spending only $1 million on the exact same project.

The most significant consequence here is that we take no account of potential supply constraints in moving from a $1 million project to a $1 billion project. Under some circumstances, this could be a serious deficiency in the model. But under current conditions in the U.S. economy—with widespread slack in the midst of a severe recession, unemployment and with private-sector lending and investment almost flat—we are on safe grounds with our assumption that supply constraints will not exert a major influence on how the

spending on green recovery effects the economy. Supply constraints could create problems for our estimation methods if the U.S. economy begins to approach full employment. But the economy has not approached full employment since the late 1990s, and then only briefly. We will certainly have time to make appropriate adjustments in our model if and when the economy again begins moving toward full employment.

Another dimension of our assumption of linearity is that it assumes that prices remain fixed, regardless of changes in demand. Our model, for example, does not take account of the effects of prices of solar panels when demand for these panels falls due to the recession. Again, a more fully specified model would take account of such factors—that is, if the recession leads to reduced demand for solar panels then prices of the panels will fall, all else being equal. This means that for a given level of spending more panels will be purchased at lower prices per panel. The upshot for employment estimates is that a given level of spending on panels will likely mean that more jobs will get created to build, deliver, and install the panels. But here again, the forecasting record of more fully specified models that do attempt to incorporate such price effects is not encouraging.

Structural change

Our employment estimates are derived from the most recent 2007 input-output model of the U.S. economy, and reflect the industrial structure of the economy as of the most recent industrial surveys. But it is certainly the case that the U.S. industrial structure will be evolving over time. This issue would seem especially relevant in considering employment conditions within the clean-energy economy, since our economy will certainly undergo significant structural changes as technologies develop. How does this reality of structural change affect the reliability of our employment forecasts?

In fact, the use of workers in clean energy industries and services will not change at an equivalently rapid pace over time even though clean energy technologies will be advancing substantially. Consider this example: A high proportion of energy-efficiency investments—such as for building retrofits, public transportation, and smart grid electrical transmission systems—will heavily rely on the construction industry. Detailed aspects of the work involved in retrofitting a home, for example, will change as retrofitting methods develop. But the overall level of demand for workers to conduct retrofits—whatever are the detailed features of such projects—is likely to remain fairly stable.

A similar situation is likely to hold with the production of renewable energy, regardless of whether the solar panels, wind turbines, or biomass fuel refining plants are more or less efficient because of technologies that convert their raw materials into useful energy. That is, the need to employ workers to manufacture, transport, and install these newly developed renewable energy products is likely to remain fairly stable as a proportion of overall activity in the industry.

Overall, then, we are confident that our input-output framework provides the basis for as accurate a set of job estimates as can be obtained through the existing available models and modeling techniques.

Forecasting models for GDP growth

Models that forecast long-term GDP growth face much more difficult challenges than our simple framework for estimating employment effects from a shift from high-carbon fuels to clean energy investments within the existing economic structure. This is because the long-term forecasting models not only aim to describe the economy as it functions at present but attempt to predict how its operations will evolve into the future. This becomes difficult, as basic features of the economy's future growth path are simply unknowable at the time the forecasts are produced.

There is little dispute abuut the dismal record of economic forecasting models in estimating the economy's growth path even over the short term. In this regard, it is useful to recall two highly relevant and interrelated cases in point. Few, if any, economic forecasting models predicted that by June 2008 crude oil would be selling at $140 a barrel—including forecasts generated less than one year before crude hit that record mark.[15] Once the price of crude oil did rise to $140 a barrel, few forecasters then predicted that the price would collapse to $35 a barrel only six months later.

More generally, almost no economic forecasts predicted that the U.S. economy would enter into a recession of historic severity in December 2007. This includes even the forecasts that were published after the recession had already begun.[16]

One faces still greater difficulties in attempting to provide accurate forecasts over a long time period—such as 20 to 40 years—of the effects on economic growth of a carbon cap, such as that proposed in ACESA. This is because the impact of any carbon cap-and-trade initiative will depend, first of all, on the overall policy agenda focused on counteracting global climate change. The economic stimulus program, for example, includes about $100 billion in federal funds to advance energy efficiency and the commercialization of renewable sources of energy, and another $180 billion of incentives for state and local governments and private businesses to invest in clean-energy projects.

Policy measures on this large a scale will certainly accelerate energy efficiency measures and lower renewable energy prices such that they become increasingly competitive with high-carbon energy sources. But we cannot know in advance the pace of this process. We cannot know how long such supportive measures for energy efficiency and renewable energy will be forthcoming from government policy.

These considerations will be decisive in determining the impact of a carbon cap, and related measures, on economic growth.[17] In short, we cannot assume that models that attempt to assess the impact of a cap-and-trade policy on U.S. gross domestic product in 2030 or 2050 are reliable in terms of their GDP forecasts. This is certainly true when judged relative to our simple input-output framework for estimating the employment effects of shifting investment priorities from conventional fossil fuels to clean energy within a given economic structure. Our input-output framework enables us to observe in detail how any such shifts in investment priorities—even within a given overall economy and at a given level of GDP, without making any assumptions at all about the pace of GDP growth—can themselves produce significant changes in employment opportunities.

At the same time, these other forecasting exercises can still offer useful frameworks and perspectives for our efforts at assessing how a cap-and-trade policy or related policy interventions would impact economic growth. In the discussion beginning on page 40, we therefore consider the effects of a cap-and-trade program on GDP growth that draws on a range of existing forecasting exercises focused on this question.

Job creation through clean-energy investments

Spending money in any area of the U.S. economy will create jobs since people are needed to produce any good or service that the economy supplies. This is true regardless of whether the spending is done by private businesses, households, or a government entity. But spending directed toward a clean-energy investment program will have a much larger positive impact on jobs than spending in other areas, including the oil industry even when taking into account all phases of oil production, refining, transportation, and marketing.

Spending on clean energy will create a higher net source of job creation in the United States relative to spending the same amount of money on high-carbon fuels because of the three sources of job creation associated with any expansion of spending—direct, indirect, and induced effects. These three effects in, say, investments in home retrofitting and building wind turbines can be described in this way:

- **Direct effects.** The jobs created by retrofitting homes to make them more energy efficient, or building wind turbines.
- **Indirect effects.** The jobs associated with industries that supply intermediate goods for the building retrofits or wind turbines, such as lumber, steel, and transportation.
- **Induced effects.** The expansion of employment that results when people who are paid in the construction or steel industries spend the money they have earned from producing these immediate and intermediate goods for clean energy industries on other products in the economy.

Now let's consider how these various sources of job creation operate with respect to investments in both the clean-energy and conventional fossil fuels.

Direct and indirect job creation

Our analysis here begins with the U.S. industrial surveys and input-output tables we used for our models to generate results on direct and indirect job creation.[18] Table 4 shows the extent of direct and indirect job creation generated by $1 million in expenditures on producing alternative energy sources.[19] We present the total job creation figures as absolute

TABLE 4
Employment impacts of alternative energy sources
Job creation per $1 million in output

Energy source	Direct job creation per $1 million in output (# of jobs)	Indirect job creation per $1 million in output (# of jobs)	Direct and indirect job creation per $1 million in output (# of jobs)	Direct and indirect job creation relative to oil (% difference)
Fossil fuels				
Oil and natural gas	0.8	2.9	3.7	--
Coal	1.9	3.0	4.9	+32.4%
Energy efficiency				
Building retrofits	7.0	4.9	11.9	+221.6%
Mass transit/freight rail (90% MT, 10% FR)	11.0	4.9	15.9	+329.7%
Smart grid	4.3	4.6	8.9	+140.5%
Renewables				
Wind	4.6	4.9	9.5	+156.8%
Solar	5.4	4.4	9.8	+164.9%
Biomass	7.4	5.0	12.4	+235.1%

numbers of jobs as well as in relative terms, as a percentage of job growth relative to that generated by spending $1 million on oil and natural gas.

As the table shows, spending $1 million on energy efficiency and renewable energy produces a much larger expansion of employment than spending the same amount on fossil fuels or nuclear energy. Among fossil fuels, job creation in coal is about 32 percent greater than that for oil and natural gas.

The employment creation for energy efficiency—retrofitting and mass transit—is 2.5 times to four times larger than that for oil and natural gas. With renewable energy, the job creation ranges between 2.5 times to three times more than that for oil and gas.

Induced job creation

It is more difficult to estimate the size of the induced employment effects—or what is commonly termed the "consumption multiplier" within standard macroeconomic models—than to estimate direct and indirect effects. There are still aspects of the induced effects we can estimate with a high degree of confidence.

In particular, we have a good sense of what is termed the "consumption function," or what percentage of the additional money people receive from being newly employed will be spent. But it is more difficult to project accurately what the overall employment effects will always be of that extra spending.

First, the magnitude of the induced effect will depend on existing conditions in the economy. If unemployment is high, then this will mean that there are a large number of people able and willing to take jobs if new job opportunities open up. But if unemployment is low, then there will be less room for employment to expand—even if newly employed people have more money to spend.

Similarly, if there is slack in the economy's physical resources, then the capacity to expand employment will be greater—and the induced effects larger. If the economy is operating at a high level of activity, there is not likely to be a large employment gain beyond what resulted from the initial direct and indirect effects.

Given the rapid deterioration of economic conditions over the past 18 months—including rapidly rising rates of unemployment—the U.S. economy is not likely to bump up against this kind of capacity constraint in the near future. Thus we would expect the induced effects to be significant in the current climate. More generally, the U.S. economy has not come close to approximating a full employment economy since the late 1990s, and even then, the tight labor market conditions were sustained only briefly, until the dot.com stock market bubble burst. Consequently, it is unlikely that the induced effects of a direct and indirect employment expansion will be diminished by excessively tight labor markets in the future.

We have developed a formal model to estimate the broad magnitude of the induced emplnyment effects more systematically. We present our procedure's details in Appendix I on page 48. The basic approach is straightforward: We begin by estimating how much of the additional employment income earned as a result of the increased investments is spent

TABLE 5

Total employment creation through alternative energy sources

Direct, indirect, and induced effects for $1 million in spending (induced jobs = 0.4(direct + indirect jobs))

Energy source	Total job creation	Total job creation relative to oil
Fossil fuels		
Oil and natural gas	5.2	---
Coal	6.9	+32.7%
Energy efficiency		
Building retrofits	16.7	+221.2%
Mass transit/freight rail (90% MT, 10% FR)	22.3	+328.8%
Smart grid	12.5	+140.4%
Renewables		
Wind	13.3	+155.8%
Solar	13.7	+163.5 %
Biomass	17.4	+234.6%

on household consumption. Using our basic input-output model, we estimate the number of jobs that this additional consumption spending would generate, assuming that there is ample excess capacity in the economy due to the prevailing high levels of unemployment.

Working with this model, we find that the level of induced job creation is about 40 percent of the level of direct plus indirect job creation. For this study, we therefore proceed under the assumption that induced jobs will expand overall job creation by 40 percent beyond what occurs through the direct plus indirect effects. We present figures for total job creation for all investment areas in Table 5. We can now see the total level of job creation through spending $1 million in each energy area. The range is between 5.2 jobs in the oil industry to 22.3 jobs in mass transit.

Overall job growth—clean-energy investments vs. conventional fossil fuels

We combine and summarize these results on overall job creation in Figure 1. This figure shows the total number of jobs—direct, indirect, and induced—that we estimate would be created from spending $1 million in a combination of six clean energy investment areas—three energy efficiency investment areas (building retrofits, public transportation and freight rail, and smart grid electrical transmission systems) and three renewable energy areas (solar power, wind power, and biomass fuels).[20]

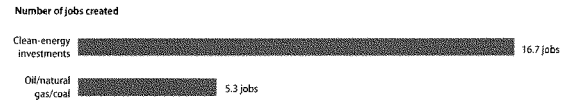
This combination of clean-energy investments will generate about 16.7 jobs per $1 million in spending. As Figure 1 also shows, $1 million in spending within the fossil fuel industry, divided according to the actual proportions of spending in these sectors as of 2007 will generate 5.3 jobs in total.

Spending a given amount of money on a clean-energy investment agenda generates approximately 3.2 times the number of jobs within the United States as does spending the same amount of money within the fossil fuel sectors.

FIGURE 1

Job creation through $1 million in spending

Green investments vs. fossil fuels



Source: Input-Output tables of U.S. Commerce Department.

Note: Employment estimates include direct, indirect, and induced jobs. Details of calculations presented in appendix.

Sources of greater job expansion through clean-energy investments

Why does a combination of clean-energy investments create in excess of three times more jobs per a given amount of spending than the fossil fuel industry? Three factors are at work:

- **Relative labor intensity.** Relative to spending within the fossil fuel industries, the clean-energy program—including the direct spending on specific projects plus the indirect spending of purchasing supplies—utilizes far more of its overall investment budget on hiring people, and relatively less on acquiring machines, supplies, land (either on- or offshore) and energy itself.

- **Domestic content.** The clean-energy investment program—again, considering direct plus indirect spending—relies much more on economic activities taking place within the United States—such as retrofitting homes or upgrading the electrical grid system in communities throughout the country—and less on imports than spending within conventional fossil fuel sectors. We consider this issue in more detail below.

- **Pay levels.** Clean-energy investments produce far more jobs at all pay levels—higher as well as lower-paying jobs—than the fossil fuel industry. Clean-energy investments also produce more jobs for a given dollar of expenditure due to the larger number of entry-level jobs relative to the fossil fuel industry. Workers thus benefit through the expansion of job opportunities at all levels within the U.S. labor market. We also return to this issue below.

TABLE 6
Green investments and jobs

Major areas for green investment agenda	Representative jobs
Building retrofitting	Electricians, heating/air conditioning installers, carpenters, construction equipment operators, roofers, insulation workers, carpenter helpers, industrial truck drivers, construction managers, building inspectors.
Mass transit/freight rail	Civil engineers, rail track layers, electricians, welders, metal fabricators, engine assemblers, bus drivers, dispatchers, locomotive engineers, railroad conductors.
Smart grid	Computer software engineers, electrical engineers, electrical equipment assemblers, electrical equipment technicians, machinists, team assemblers, construction laborers, operating engineers, electrical power line installers and repairers.
Wind power	Environmental engineers, iron and steel workers, millwrights, sheet metal workers, machinists, electrical equipment assemblers, construction equipment operators, industrial truck drivers, industrial production managers, first-line production supervisors.
Solar power	Electrical engineers, electricians, industrial machinery mechanics, welders, metal fabricators, electrical equipment assemblers, construction equipment operators, installation helpers, laborers, construction managers.
Cellulosic biofuels	Chemical engineers, chemists, chemical equipment operators, chemical technicians, mixing and blending machine operators, agricultural workers, industrial truck drivers, farm product purchasers, agricultural and forestry supervisors, agricultural inspectors.

Source: See appendix.

Range of jobs generated by clean-energy investments

As Table 6 shows, building a clean-energy economy would create new job activities. Some of these jobs will be in specialized areas such as installing solar panels and researching new building material technologies. But the vast majority of jobs are in the same areas of employment that people already work in today—in every region and state of the country.

Constructing wind farms, for example, creates jobs for sheet metal workers, machinists and truck drivers, among others. Increasing the energy efficiency of buildings through retrofitting requires roofers, insulators and building inspectors, and expanding mass transit systems employs civil engineers, electricians, and dispatchers. More generally, this overall clean-energy investment program will provide a major boost to the construction and manufacturing sectors throughout the United States.

In addition, all of these clean-energy investment strategies engage a normal range of service and support activities—including accountants, lawyers, office clerks, human resource managers, cashiers, and retail sales people. We have not listed these and other related occupations in Table 6 because these jobs are not linked in any particular way to our six clean-energy investment strategies. But new employment opportunities will certainly also open up in these areas as a result of the clean-energy investment program, through all of the same direct, indirect, and induced job creation channels that are also generating the jobs we have listed in Table 6.

Then there's the range of jobs by occupational groupings created through clean-energy investments. In Table 7 we present data on the distribution of job types that are created

TABLE 7
Economic activity by energy-related sector

Figures are percentages of total jobs for each sector

Energy source	Extraction	Agriculture	Manufacturing	Construction	Utilities	Trade	Transport	Independent admin/ professional
Fossil fuels								
Oil and natural gas	14.6	0.4	13.9	2.4	11.3	6.6	13.1	37.5
Coal	41.6	0.3	13.1	0.9	7.8	5.9	6.8	23.6
Energy efficiency								
Building retrofits	0.5	1.4	13.6	61.5	0.1	7.9	2.5	12.4
Mass transit/freight rail	0.3	0.6	7.8	21.7	0.1	4.4	54.4	10.7
Smart grid	0.4	0.6	38.1	15.7	0.2	6.3	2.8	35.9
Renewables								
Wind	0.6	0.9	47.4	20.3	0.2	7.1	3.7	19.8
Solar	0.5	0.9	37.4	23.7	0.2	6.9	3.2	27.4
Biomass	1.3	50.4	20.6	0.4	0.2	3.8	2.8	10.5

Source: See appendix.

through alternative-energy spending programs. As the table shows, employment is spread fairly evenly in the oil industry across a range of sectors, including extraction, manufacturing, utilities, transport, and administrative and professional occupations, such as lawyers, accountants, and technical/scientific personnel. Coal, by contrast, is much more heavily concentrated in extraction, with nearly 42 percent of total value coming from extraction.

Of course, different parts of the clean-energy economy also generate different combinations of job creation. Building retrofitting is dominated by the construction industry, with some economic activity in manufacturing and professional services. In wind and solar power generation, the largest proportion of new jobs created will be in manufacturing, with construction second. Wind and solar also draw heavily on independent professionals, including research and development personnel.

The overall point is that for a clean-energy investment program to provide a range of new employment opportunities comparable to what is made available through the oil industry, it will be necessary to promote the full array of clean-energy initiatives. The range of job opportunities available within the oil industry cannot be duplicated by any single clean-energy activity alone.

Employment effects of $150 billion a year clean-energy investments

To consider how a clean-energy program can create major economy-wide impacts, we have to consider the issue within the context of the $150 billion in new clean-energy investments that we have discussed above. As we have seen above, this level of clean-energy investments can be achieved through the combination of spending programs, subsidies, and regulations included in the ARRA and ACESA, along with continued advances in clean-energy technologies and a corresponding expansion of private markets and business investment opportunities.

As we see in Table 8, an annual $150 billion clean-energy investment level would generate a total of about 2.5 million jobs. By contrast, spending the same $150 billion within the fossil-fuel industry would produce about 800,000 jobs. This is a difference of roughly 1.7 million jobs. In Appendix 2, we break out these economy-wide estimates for net employment expansion through clean-energy investments on a state-by-state basis.

It is not likely that the funds to finance $150 billion in clean-energy investments would all come out of equivalent spending reductions on fossil fuels. Nevertheless, we emphasize a crucial point by comparing the expansion in employment through $150 billion in clean-energy investment spending relative to an equivalent decline in fossil fuel spending—clean-energy investments will generate a large *net expansion* in employment even after allowing for a maximum transfer of funds out of fossil fuel spending.

TABLE 8
Impact of $150 billion in clean-energy investments on U.S. labor market

A) Overall employment expansion through $150 billion shift from fossil fuels to clean energy	
1) Job creation through $150 billion spending on clean energy.	2.5 million jobs
2) Job creation through $150 billion spending on fossil fuels.	795,000 jobs
3) Net job creation through shift to clean energy (row 1–2).	1.7 million jobs
B) Impact of clean energy job expansion on 2008 U.S. labor market	
1) Overall labor force.	154.3 million
2) Total employed before clean-energy investments.	145.4 million
3) Total unemployed before clean-energy investments.	8.9 million
4) Unemployment rate before clean-energy investments (= rows 3/1).	5.8% (=8.9 million/154.3 million)
5) Impact on total employment of shift from fossil fuels to clean energy.	Employment rises by 1.7 million jobs: 1.2% increase to 147.1million
6) Impact on unemployment rate of shift from fossil fuels to clean energy (= rows (3–5)/1)).	Unemployment falls from 5.8% to 4.7% (=7.2 million/154.3 million)

Source: U.S. Bureau of Labor Statistics and IMPLAN.

In the lower panel of Table 8, we then consider what the impact would have been on the 2008 U.S. labor market if there had been a net increase in employment of 1.7 million jobs. We know that, in reality, conditions in the labor market do not remain static, and that we are not describing what is actually likely to happen when we consider an immediate employment expansion. We present these data simply to provide a broad reference for gauging the impact of a net clean-energy investment transition—including reductions in fossil fuel spending—at the rate of about $150 billion per year.

Over the full year of 2008, there were 145.4 million people employed and 8.9 million unemployed, producing an unemployment rate for the year of 5.8 percent. A net increase of 1.7 million new jobs would therefore lower the unemployment rate to 4.7 percent.

This greater than one percentage-point reduction in the country's unemployment rate would generate a rise in wages across the board—particularly for low-income workers. According to the body of research surveyed by Timothy Bartik of the W.E. Upjohn Institute, a one percentage-point fall in the unemployment rate will in turn lead to a rise in average earnings of about two percent.[21] Bartik notes that this positive wage effect is likely to be somewhat stronger at the lower end of the labor market. This is probably because, other than the falling unemployment rate itself, those at the low end of the labor market are not likely to have other tools to help them raise their bargaining power.[22]

More jobs through low productivity, protectionism, and bad pay?

Some critics of our previous work comparing job growth in clean-energy industries and fossil fuel industries acknowledge—at least implicitly—that the clean-energy investments can be a positive source of job creation.[23] But they claim that the job expansion comes at a stiff price since it occurs through promoting low productivity, protectionism, and low wages. But, as we discuss below, these claims are wrong.

Low productivity is not the result of clean-energy investments

Let's begin with the critics' own framework for thinking about labor productivity, which is total output per worker. From this perspective, the matter is easy to settle, virtually as a matter of definition. By definition, if we increase labor intensity through clean-energy investments—if we generate about 17 jobs per $1 million through clean-energy investments versus about five jobs through fossil fuel spending—then we reduce labor productivity in the energy sector through shifting spending toward clean energy.

Yet this perspective ignores two crucial and widely understood considerations. First, by raising overall employment, clean-energy investments provide new opportunities to previously unemployed workers. This raises the productivity level of millions of workers from zero to a positive number. Any economy-wide measure of labor productivity has to take account of this effect. Similarly, clean-energy investments create new opportunities for underemployed workers—thereby raising their productivity from a lower to a higher level.

Second, given the global climate crisis, we need to begin incorporating environmental effects into the measurement of output and productivity. That is, spending on high-carbon fuels creates the output "good" of electrical power. But it also creates the output "bad" of pollution and greenhouse gas emissions. This point has long been recognized in discussions of the environmental costs of economic growth, and is included in virtually every introductory economics textbook. Thus, with every unit of energy generated by clean-energy investments as opposed to conventional fossil fuels, the net increase in output is greater to the extent that we are not producing the "bad" of pollution and greenhouse gas emissions.

This is why clean-energy investments will raise economy-wide labor productivity substantially through two channels:

- By expanding total employment per dollar of expenditure in the economy, it provides millions of people with new opportunities to become productive workers.
- By generating energy from clean sources, it increases the level of "goods" we produce and correspondingly reduces our production of "bads."

The critics' contention that clean-energy investments result in low productivity growth ignores this crucial set of considerations.

Clean-energy investments are not protectionist

The relatively high level of domestic content in clean-energy products and services is—along with relatively high labor intensity—a major factor generating the higher level of job creation relative to fossil fuels for a given level of spending. Yet it is crucial to recognize that the high domestic content for clean-energy products and services occurs

TABLE 9
Domestic content for alternative energy sources and energy-efficiency investments

Energy source	Domestic content as share of total industry output (in percentages)	Domestic content relative to oil (percentage-point difference)
Fossil fuels		
Oil and natural gas	82.9	
Coal	93.5	+10.6
Conservation		
Building retrofitting	97.3	+14.4
Mass transit/rail	96.7	+13.8
Smart grid	84.1	+1.2
Renewables		
Wind	87.8	+4.9
Solar	84.7	+1.8
Biomass	93.8	+10.9

Source: See appendix.

through the specific characteristics of the alternative investment activities spurred by clean-energy investments and will occur independent of any formal legal mandates regarding domestic content.

This becomes clear by considering the relative extent of economic activity provided by domestic sources for each of our specific energy sources. As Table 9 shows, there are major differences by energy sector in terms of their degree of domestic content. Oil and gas have the lowest relative domestic content, at around 83 percent of total value generated in producing this energy type. The domestic content of crude oil production, at about 50 percent of total crude oil sold in the United States, is much lower than for all other subsectors within the oil industry.[24] These other subsectors include the full range of administration, transportation, and marketing of crude and refined oil as well as natural gas—all activities that would be readily transferrable into a growing clean-energy sector.

The domestic content of coal production, at 94 percent, is significantly higher than the overall level for the oil industry. The three renewable energy sources operate with levels of domestic content roughly in line with the oil and coal sectors, with solar at 85 percent, wind at 88 percent, and biomass at 94 percent.[25] The smart grid is also in the same range, at around 84 percent. These are all areas where innovation in manufacturing clean-energy products and services will be central to raising domestic content.

The significant difference in domestic content occurs with retrofits, mass transit, and freight rail. In these cases, the level of domestic content is around 97 percent. For the most part this result is because these energy-efficiency investments are bound to specific loca-

tions. That is, retrofitting a home in Philadelphia can only be done in Philadelphia, and upgrading the Los Angeles electrical grid system will entail large-scale construction activity in Los Angeles. This is true even though some of the supplies for both the Philadelphia and Los Angeles projects could be imported. The point is that most of the spending on both projects will be on the local construction work itself, not the purchase of supplies.

By contrast, the more an energy sector is linked to manufacturing and extractive activity, the more it naturally becomes exposed to import competition. The United States is certainly capable of expanding its manufacturing capacity in areas such as wind turbines and solar panels. But unlike the retrofit case, where the bulk of the work is construction and that construction work must be performed on-site, there is no reason why a wind turbine needs to be manufactured within the United States.

Bad jobs are not the result of clean-energy investments

The single most important point to stress in evaluating the employment effects of clean-energy versus fossil fuel investments is that clean-energy spending creates far more jobs across all categories than spending on fossil fuels. We can see this clearly by considering the profile of jobs created according to the range of credential levels in clean-energy jobs versus those in the fossil fuel sectors. This discussion is based on a companion study we have conducted under commission with the Natural Resources Defense Council and Green For All, "Green Prosperity: How Clean-Energy Policies Can Fight Poverty and Raise Living Standards in the United States."[28] A fuller treatment on this and related questions is presented in this NRDC/Green For All study on page 12.

Working from that study, we provide evidence on this type of job breakdown in Table 10, where we sort the total number of jobs generated by $1 million in spending according to three job credential categories:

- High-credentialed jobs requiring at least a bachelor's degree and paying on average $24.50 an hour.
- Mid-credentialed jobs requiring some college but not a B.A. and paying on average $14.60 per hour.
- Low-credentialed jobs requiring a high school degree or less and paying on average $12.00 per hour.

We show these breakdowns both for clean-energy investments and fossil fuel investments and show the difference between the two based on all three of these categories. We also include as our final category the low-credentialed jobs that offer decent opportunities for advancement and higher wages over time. These are jobs in construction, manufacturing, and transportation.

TABLE 10
Breakdown of job creation through green investments versus fossil fuels by formal credential levels
Based on $1 million of spending

	1) Green investments	2) Fossil fuels	3) Difference in job creation (= column 1–2)
Total job creation	16.7	5.3	11.4
High-credentialed jobs • B.A. or above • $24.50 average wage	3.9 (23.3% of green investment jobs)	1.5 (28.3% of fossil fuel jobs)	2.4
Mid-credentialed jobs • Some college but not B.A. • $14.60 average wage	4.8 (28.7% of green investment jobs)	1.6 (30.2% of fossil fuel jobs)	3.2
Low-credentialed jobs • High school degree or less • $12.00 average wage	8.0 (47.9% of green investment jobs	2.2 (41.5% of fossil fuel jobs)	5.8
Note: Low-credentialed jobs with decent earnings potential • $15.00 average wage	4.8 (28.7% of green investment jobs)	0.7 (13.2% of fossil fuel jobs)	4.1

Note: Average wage is the median wage for all workers across all industries within each of the credential categories listed above.
Source: 2008 Current Population Survey, IMPLAN.

To begin with, we can see in Table 10 that the net job creation is substantially higher with clean-energy investments than conventional fossil fuels across all three credential categories. This is true even while the proportions of jobs created in the different categories differ. As a case in point, about 23 percent of the total clean-energy jobs created by investments in this sector are high credentialed compared to 28 percent in fossil fuel sectors, but clean-energy investments create 2.5 times more high-credentialed jobs.

Clean-energy investments also create three times more mid-credentialed jobs, but again the proportion of mid-credentialed jobs for fossil fuel spending, at 30.2 percent, is higher than with clean-energy investments. The most substantial difference is with low-credentialed jobs. Clean-energy investments create 7.7 jobs per $1 million in spending versus only 2.2 jobs per $1 million with fossil fuels. This is a difference of 5.5 jobs for low-credentialed workers.

What's more, these more numerous low-credentialed jobs resulting from clean-energy investments by and large lead to greater possibilities for advancement. In particular, industries in which low-income workers are better able to achieve decent earnings growth include construction first of all, but also durable goods manufacturing, employment services (temporary employment agencies), health services, public administration, social services, transportation and utilities, and wholesale trade. Workers employed in industries such as apparel and textile manufacturing, hotels, personal services (dry cleaning service), and restaurants and bars have far less opportunity to improve their earnings over time.[27]

What about job advancement opportunities in fossil fuel industries? In the final row of Table 10 we provide data comparing the clean-energy and fossil fuel investments in terms of the numbers of low-credentialed jobs they create with decent longer-term employment opportunities. The difference is particularly sharp. Clean-energy investments create 4.8 jobs per $1 million in spending while fossil fuel investments produce only 0.7 jobs. This is in the job category that is likely to be most crucial for generating decent new employment opportunities for low-income people through clean-energy investments under the economic stimulus program and American Clean Energy and Security Act now before Congress.

The overall message is that clean-energy investments offer a more favorable result for working people in the United States according to any criteria. There are more jobs created across the board—twice as many high-paying jobs and nearly four times more low-credentialed and low-paying jobs.

Forecasting the impact of a carbon cap on economic growth

The impact of the environmental regulations in ACESA, in particular the new cap-and-trade system, will produce higher prices over time for anyone using oil, coal, and natural gas. How much higher and how fast these prices will rise is uncertain.

Nor can we know in advance how much any increases in fossil fuel prices will affect the economy's overall performance over time. Offsetting savings from lower-cost, clean-energy and efficiency measures will, at worst, take much of the sting out of the price increases and at best reduce overall costs. Furthermore, increased U.S. competitiveness in growing clean-energy industries as conventional fossil fuels become less important will also improve U.S. economic conditions.

Taking all of these and related considerations into account, it is crucial to try to reach an overall assessment as to how the rise in fossil fuel prices will affect the economy's growth trajectory. This is true even though—as discussed above—the standard long-term growth forecasting models are fraught with serious pitfalls. It is nevertheless important to try to extract as much useful information as possible from these models.

The basic question that these models attempt to answer is: how much would a given energy price increase affect GDP growth? All the forecasts agree that this first depends on how large the price increases will be. It then also depends on the "elasticities"—how much the demand for a given source of energy would fall as the price of that energy source rises. For example, how much purchasing gasoline at the pump would fall when the price of gasoline rises.

The forecasting models that are calibrated to the Department of Energy's most recent (2009) *Annual Energy Outlook* predict that price increases that would be associated with a carbon cap such as that proposed within the ACESA will range from roughly 10 percent for gasoline to 20 percent for electricity and 29 percent for natural gas.

The Department of Energy model, however, also allows for increases in energy efficiency as well as rising consumption of clean-energy sources in response to the rise of fossil fuel prices. So even if gasoline prices are assumed to rise by 10 percent in a forecasting model, the amount of money people will spend on gasoline will not also rise by 10 percent but by something less. This is partly because people will respond to the 10-percent price increase by conserving on energy or shifting to clean-energy sources, where prices will tend to be falling due to technological advances. With all this in mind, let's examine several different forecasts.

Long-run GDP growth forecasts

The general approach with these exercises is to generate two long-term growth projections. The first is a baseline case in which the economy is operating without a carbon cap over the time period in question. The second is a projection in which a carbon cap-and-trade system has been in operation during the relevant time period.

Most of these forecasts are responding to the carbon cap proposal debated last year in Congress, which was the so-called Lieberman-Warner bill, named after its co-sponsors Sens. Joseph Lieberman (I-CT) and (the now retired) John Warner (R-VA). Because the cap-and-trade component of ACESA is similar to that of Lieberman-Warner, these previous forecasting exercises remain useful in assessing the effects of this more recent cap-and-trade proposal.

In addition, the Environmental Protection Agency recently produced two long-term forecasts of the effects on economic growth of the ACESA carbon cap proposal. We compare these most recent forecasts with those generated in response to Lieberman-Warner in Table 11.[28]

In considering first the forecasts of Lieberman-Warner in the upper panel of Table 11, one central finding stands out above all: According to *all* the forecasts—including the worst-case scenario developed by the most pessimistic forecasters, the American Council

TABLE 11

Comparison of alternative U.S. GDP growth forecasts under baseline scenario and with cap and trade

Figures are average annual growth rate forecasts for specified time periods

	1) Baseline GDP forecast	2) GDP forecast under Lieberman-Warner cap and trade	3) Difference between baseline and cap-and-trade growth forecasts (columns 1-2)
A) Forecasts based on Lieberman-Warner cap and trade			
MIT (2005 to 2050)	2.94%	2.93%	0.01%
Energy Information Administration (2005 to 2030)	2.47%	2.45%	0.02%
Clean Air Task Force (2005 to 2030)	2.89%	2.86%	0.03%
Environmental Protection Agency (2005 to 2050)	2.78%	2.72%	0.06%
ACCF/NAM—"High Cost Case" (2007 to 2030)	2.56%	2.45%	0.11%
B) Forecasts based on ACESA cap-and-trade			
EPA-1 (ADAGE model—2015–50)	2.41%	2.36%	0.05%
EPA-2 (IGEM model—2015–50)	2.35%	2.30%	0.05%

Source: References for models are all at Pew Center on Global Climate Change, "Insights from Modeling Analyses of the Lieberman-Warner Climate Security Act (S. 2191)," (May 2008) available at http://www.pewclimate.org/docUploads/L-W-Modeling.pdf; Environmental Protection Agency, *EPA Preliminary Analysis of the Waxman-Markey Discussion Draft* (April 20, 2009) available at www.epa.gov/climatechange/economics/pdfs/WM-Analysis.pdf.

on Capital Formation/National Association of Manufacturers—the impact of a cap-and-trade system on U.S. GDP growth will be negligible. According to most forecasts, it will be almost indiscernible.

The differences in the forecasts of long-term average annual GDP growth range between 0.01 percent using the model developed by the Massachusetts Institute of Technology and 0.11 percent using the ACCF/NAM model. Even with the most pessimistic ACCF/NAM model, the impact of the carbon cap on economic growth amounts to a difference in average growth of between 2.6 percent per year when no carbon cap is in place versus 2.5 percent with a carbon cap in operation. Even assuming this most severe negative effect of a carbon cap on economic growth, it would still only require, over the course of 23 years, an additional 14 months for the U.S. economy to reach the same level of GDP under a carbon cap as against the baseline scenario.

The lower panel of Table 11 shows two separate forecasts from EPA based on ACESA specifically. The main difference between these forecasts and those for Lieberman-Warner is the general shifting downward of growth projections. Thus in the top panel of the table, the EPA's own forecasts with reference to the Lieberman-Warner proposal had ranged between 2.78 percent average annual growth under their baseline case versus 2.72 percent under a carbon cap—a difference of only 0.06 percent in average annual growth.

EPA's two forecasts both estimate a significant drop in the baseline growth rate, with the two forecasts at 2.35 percent and 2.41 percent. But these two forecasts also show a slightly smaller impact of the carbon cap itself relative to the baseline, with the growth decline due to the carbon cap now forecasted at 0.05 percent relative to the baseline.

Overall, then, these most recent EPA forecasts of the ACESA's impact on economic growth affirm the earlier conclusions of the forecasts derived from Lieberman-Warner—that a carbon cap will have no significant effect on the U.S. economy's long-term growth trajectory. These forecasts may all be wrong, but it is still notable that this is the overarching conclusion that emerges from these modeling exercises, without exception.

This basic finding is even more notable given that these models all leave out significant considerations that would tend to encourage the long-term growth rate to rise. These basic considerations include:

- The positive effects of higher employment.
- The benefits of a higher level of domestic content and thus a reduced trade deficit.
- The possibilities for major technological breakthroughs.
- The economic benefits of reducing greenhouse gas emissions.

Let's consider in turn each of these possible beneficial results that could derive from a $150 billion annual clean-energy investment program.

Benefits of higher employment

The forecasting models we are considering here—like many macroeconomic models developed over the past 20 years—assume that the economy is always operating at full employment.[39] These models do allow for people to make choices between working and leisure activities, but all within the framework of a full-employment economy.

This means that if people are out of work, it is because they have voluntarily chosen leisure over having a job. Thus, by assumption within these models, no benefits can result from an expansion of employment opportunities—no matter what is the source of this employment expansion. This is because, according to these models, everyone who wants to be employed is in fact always employed.

In contrast, we have shown that clean-energy investments will generate an expansion of job opportunities through direct plus indirect employment-creation channels. Because we do not assume that the economy operates at full employment, this expansion of job opportunities through the clean-energy investment agenda will produce a net increase of employment throughout the economy. More people will have jobs as well as additional money to spend.

When these newly employed workers increase their level of spending, this in turn creates more jobs through the induced-employment effect. The consequent fall in the unemployment rate should, in turn, encourage rising wages throughout the economy, which should expand overall market demand in the economy still further. Through this combination of channels that lead to lower unemployment, clean-energy investments will be supportive of a higher overall rate of economic growth.

Clean-energy investments and the trade deficit

The persistent gap between the total amount of imports we purchase and the exports we sell abroad now amounts to roughly 6 percent of U.S. GDP. This trade deficit is being financed by foreigners piling up their holdings of dollar assets. This in turn has become a major factor contributing to the instability of U.S. and global financial markets.

Clean-energy investments will almost certainly advance in conjunction with a decline in fossil fuel consumption, which in turn will lead to a reduction in the huge levels of spending the United States now devotes to oil imports. As of 2007, the last year before the onset of the financial crisis and recession, oil imports amounted to about $300 billioo per year, or roughly half of total U.S. spending on fossil fuels. This level of spending on oil imports also accounted for 36 percent of the total U.S. trade deficit of $819 billion as of 2007. Overall, then, the net effects of clean-energy investments on the U.S. balance of trade will certainly be favorable. How soon, and to what degree, these positive effects on the U.S.

trade balance will emerge will depend on how quickly clean-energy elements of the economic stimulus package and the entirety of ACESA encourage clean-energy development and displace high-carbon fuels as an energy source.

Reducing the U.S. trade deficit through cutting oil imports means, by definition, a higher proportion of spending by U.S. households, businesses, and governments will happen within the domestic U.S. economy. This promotes faster U.S. GDP growth. Moreover, reducing the trade deficit will, in turn, contribute toward a more stable value of the dollar in international currency markets, and thereby facilitate the management of U.S. monetary policy. This should also contribute toward a faster rate of U.S. GDP growth. To achieve these benefits of a smaller trade deficit, moreover, will not require that the deficit be closed entirely and right away. The fact that the deficit is diminishing steadily over time will itself generate incremental benefits to the U.S. ecooomy.

Furthermore, the introduction of ever-increasing quantities of clean energy and energy efficiency helps lower costs and decrease price volatility in the economy overall by diversifying the U.S. energy mix and reducing our susceptibility to volatile price fluctuations for primary fossil fuel commodities.

Incorporating the effects of technological change

EPA and related models build in assumptions as to how technological changes will affect energy prices over time. It is impossible to know how quickly the prices of, say, cellulosic biomass, wind, and solar energy will decline with time as technologies advance. But if the United States continues to increase its commitment to advancing these technologies through measures contained in ARRA and ACESA, then the opportunities will increase and renewable energy prices could fall faster than these models are forecasting.

Once government policies help create a supportive environment for introducing and commercializing new renewable energy technologies, this should accelerate the investment market for these clean sources of energy. An expanding market also then will raise the likelihood for larger jumps in technological change beyond the incremental pace of improvement built into standard long-term GDP forecasting models.

The potential for underestimating the effects of technological change is increased further because these models assume that households and businesses operate with full knowledge of how the economy will operate over time; the models assume "perfect foresight" on the part of households and businesses. Indeed, the models assume not only that we can accurately know the trajectory of technological change in the energy industry but also how households and businesses will react to these changes.

These models therefore leave aside by assumption the real pnssibility that energy technologies will improve quickly and produce a stronger positive expansion in employment than households or businesses operating in the models with "perfect foresight" could have anticipated.

Overall, then, we again see how changes in the policy environment as well as a rising level of public commitment to building a clean-energy economy can themselves generate positive pressures for an accelerated rate of technological improvements. These improvements, in turn, could contribute to a faster rate of GDP growth than the forecasting models are anticipating. The pace at which businesses and households invest in these efficiencies will depend on the success of ARRA and ACESA.

Benefits of lower carbon emissions

The main purpose of the forecasting models we have discussed above is to estimate the future costs of a carbon cap. But these models do not attempt to estimate any potential economic benefits accruing from the carbon cap or related policy interventions. In fact, it is difficult to quantify the economic benefits of insuring against climate change, even while we know that such benefits are potentially enormous.

Most climate scientists hold that global warming is contributing throughout the world to extreme weather patterns, a rising sea level, and significant shifts in many ecosystems. These patterns will intensify as long as we fail to limit carbon emissions.

Disruptions of normal economic activities will increase correspondingly. Economic welfare will decline as a result. This is certainly true in terms of an increase in environmental "bads," many of which—such as a rising sea level and destroying natural habitats for species—are not captured through traditional GDP statistics. But some of these negative effects are incorporated in GDP. One case in point is that costs of hurricane damages are included as part of GDP. Also included in GDP will be the costs that are already emerging (and will worsen over time) of managing water systems in arid Western states as droughts become more frequent and severe.[30]

Of course, the most important consideration here is to recognize the overall welfare costs, and especially the real dangers of an irreversible environmental crisis that could result throngh allowing carbon emissions to continue unchecked. These considerations transcend the issue of whether such costs and risks are captured within our conventional GDP statistics.

Still, considering models that attempt only to forecast future GDP, leaving broader welfare considerations outside the model, the benefits of controlling carbon emissions will be measureable and significant. Neglecting all such benefits means that future GDP forecasts—the baseline forecasts as well as those that allow for a carbon cap mandate—are likely to be understated.

Conclusion

The United States needs to promote an aggressive policy agenda now to defeat global warming. This fact is now widely if not universally recognized. The overarching challenge before us is therefore to determine a policy path that is effective in building a clean-energy economy as rapidly as possible and in promoting widespread employment opportunities and broadly shared well-being. The current severe recession has only intensified the need to pursue such a unified program that can both promote job creation and build a clean-energy economy.

The recently enacted American Recovery and Reinvestment Act and the proposed American Clean Energy and Security Act that Congress is now considering are both federal policy initiatives aimed at creating a clean-energy foundation for the U.S. economy. The two measures are distinct. The ARRA is a $787 billion spending program designed to counteract the recession, which includes clean-energy components as one tool among several others to stimulate job creation and economic growth. These components include both direct federal spending provisions as well as subsidies for private investors.

In contrast, ACESA will operate primarily by establishing regulations and incentives for private businesses to encourage energy efficiency and investments in renewable energy, and correspondingly discourage continued reliance on high-carbon energy sources. Among its main provisions are a carbon cap-and-trade program that would be phased in through 2050, and a renewable energy electricity standard that would be phased in through 2020.

The specific features of ARRA and ACESA complement each other. In this paper we have demonstrated how the two measures work in combination to advance clean-energy investments and the transition to a clean-energy economy. Specifically, we examined the effect these two measures are likely to have on job creation and economic growth. We conclude that these two measures operating effectively as a complementary set of policy initiatives, in conjunction with related initiatives both at the state and local government level and especially by private investors, could produce over the next decade about $150 billion a year in clean-energy investments that also expand job opportunities. The net expansion in employment through this combination of initiatives could be about 1.7 million jobs.

This $150 billion a year includes public spending and private investments. Within the private sector, it would include projects that are both supported by government subsidies

of some sort as well as unsubsidized investments. We anticipate that the largest share of an overall $150 billion annual spending level would be unsubsidized private investments that are nevertheless encouraged by the expansion of markets and opportunities encouraged by ARRA and ACESA.

Our central finding on employment growth is that a combination of clean-energy investments—including building retrofits, public transportation, and constructing a smart grid, as well as promoting renewable energy sources such as wind, solar, and biomass power—will generate roughly three times more jobs than an equivalent amount of money spent on conventional fossil fuels. So if the United States proceeds with combined public- and private-sector investments in clean energy amounting to $150 billion a year, this would generate about 2.5 million jobs. In contrast, spending the same $150 billion within the fossil fuel sector generates about 800,000 jobs. Therefore, the net impact—jobs gained through expanding clean-energy investments by $150 billion minus jobs lost through reducing spending on fossil fuels by the same amount—would be a net gain of 1.7 million new jobs within the U.S. economy.

This expansion of job opportunities would occur strictly as a result of the shift in spending of a given $150 billion in favor of clean energy and away from fossil fuels. It will not be necessary for U.S. GDP to grow more quickly in order for these positive job effects to emerge through a clean-energy investment agenda.

Our overall conclusions are therefore that the clean-energy components of ARRA and ACESA will have significant economic benefits aside from the contributions they will make to reducing carbon emissions and combating global warming. The most important and most clearly established economic benefit is that clean-energy investments will be a substantial source of new employment opportunities throughout the United States.

Forecasting the impact of these measures on long-run economic growth is fraught with difficulties. But it is still useful to highlight the fact that all the models that attempt such forecasts find that any possible negative impacts of a carbon cap on economic growth will be minimal. It is also important to recognize that these models reach this common conclusion even though they do not take account of several channels through which the project of building a clean-energy economy will promote a wide range of new job opportunities and the broader expansion of well-being in the United States.

Appendix 1: Technical methods

Environmental investment in the ARRA

Estimating the overall level of environmental spending

The American Recovery and Reinvestment Act of 2009 contains funding for a number of environmental programs through various departments and agencies within the federal government. Estimates of clean-energy spending in the ARRA vary widely—depending on whether only funding through the Department of Energy is considered or whether a broader approach is taken. We have pursued the latter.

Our estimate of approximately $100 billion in environmental spending is derived by identifying and summing all of the programs in the ARRA which fall under the DOE, as well as any program in other departments and agencies (such as the Department of Transportation, the Environmental Protection Agency, the Department of Housing, the Treasury Department, etc.) that contains funding for energy efficiency, renewable energy, public transit, high-speed rail, and environmental management. Specifically, in addition to the DOE programs, our $100 billion estimate of environmental investments contains the following programs:

Government:	Building retrofits and efficient fleet procurement
Outdoors:	Conservation, national parks, environmental clean-up and wildfire management
Military:	Defense energy conservation projects
Veterans:	Energy efficiency in buildings
Transportation:	Amtrak, high-speed rail, and public transit improvements
Housing:	Energy efficiency on Indian lands, and energy efficiency and renewable energy for low-income housing
Tax provisions:	All tax incentives related to energy efficiency and renewable energy

Financial mechanisms for allocating federal funds

The roughly $100 billion of environment investments identified above are allocated according to various financial mechanisms. These include direct spending by the federal government (for efficient fleet procurement, for example), as well as grants, loan guarantees, bonds,

and tax incentives. Each of these mechanisms, in turn, targets certain populations (local governments, private investors) and will induce additional spending by those populations.

In order to obtain a rough estimate of the level of funds likely to be spent by these entities in addition to the federal funds, we first identified the funding mechanism within the text of the ARRA. We then used a variety of websites (see below) to ascertain whether there were matching requirements or estimates of leveraged funds through the ARRA programs. For example, residential renewable energy property is eligible for a 30 percent tax credit. Thus for the total cost of the project, the federal government will pay 30 percent and the private investor will pay 70 percent, or 2.33 times the value of the federal funds. Therefore this credit, which amounts to $268 million of federal funding, will raise an additional $625 million in private funding for a total of $893 million economy-wide.

In order to ascertain the types of programs and the level of matching required, we consulted documents provided to us by the Department of Energy as well as the following sites:

www.grants.gov
www.dsireusa.org
www.staterecovery.org
www.treasury.gov/recovery
www.irs.gov
www.fms.treas.gov
www.dot.gov/recovery
Edocket.access.gpo.gov
www.epa.gov
www.fra.dot.gov
www.recovery.gov
www.cbo.gov
www.ustreas.gov/recovery

Assessment of new investment in electricity generation capacity to meet the revised 15-percent renewable energy standard in the ACESA

We base our analysis on two recent publications from the Energy Information Administration (U.S. Department of Energy): *Annual Energy Outlook 2009 (AEO 2009) and Assumptions to the Annual Energy Outlook 2009*. At the time of this writing, the ACESA would require that 15 percent of electricity generation would come from renewable sources by 2020. We use the projections of future electricity generation contained in AEO 2009, based on the Department of Energy's National Energy Modeling System, or NEMS, as the basis for our estimates of the dollar value of investments needed to comply with these standards.

According to the AEO 2009, electricity generation will total 4,618 billion kilowatt hours, or kwhs in 2020. If electricity generation from renewable sources were to meet the ACESA standard in 2020, 692 kwhs would have to come from renewable sources. We need to convert this amount of electricity generation into a measurement of capacity needed. Based on the estimates in AEO 2009, we estimate that on average across renewable sources of electricity, 0.2 gigawatts in capacity (net summer capacity) is associated with every 1 billion kwhs in generation. We use this ratio to calculate the shortfall in renewable capacity. Using this

assumption, about 153.8 gigawatts in renewable capacity would be needed to generate 692 kwhs of electricity. According to AEO 2009, in 2007 renewable generation capacity was 100.8 gigawatts. Therefore, we would need an additional 53 gigawatts in renewable capacity to meet the 15-percent standard by 2020.

The publication *Assumptions to the Annual Energy Outlook 2009* provides estimates of the overnight capital cost of different sources of electricity generation. Using the actual composition of renewable energy from various sources contained in the AEO 2009, we calculate that a weighted average of the cost of capital would be $2,750 in 2007 dollars per kilowatt of capacity. For the purposes of our estimations we round this up to $2,800 per kilowatt of capacity. This means that the total additional investment needed to reach the 15-percent standard would be about $148 billion by 2020.

If the U.S. economy were able to achieve a goal of 20 percent renewable electricity by 2020, we estimate that the total capacity needed at that time would be 205 gigawatts—or an increase of 104.2 gigawatts over the 2007 level. This would require about $292 billion in investment.

Employment estimates

Employment multipliers

Data and methodology The employment estimates in this report are derived from an input-output model. The input-output model allows us to observe relationships between different industries in the production of goods and services. We can also observe relationships between consumers of goods and services, including households and governments, and the various producing industries. For our purposes specifically, the input-output modeling approach enables us to estimate the effects on employment resulting from an increase in final demand for the products of a given industry. For example, we can estimate the number of jobs directly created in the construction industry for each $1 million of spending on construction. We can also estimate the jobs that are indirectly created in other industries through the $1 million in spending on construction—industries such as lumber and hardware. Overall, the input-output model allows us to estimate the economy-wide employment results from a given level of spending.

For this report, we used the IMPLAN 2.0 software and IMPLAN 2007 data set constructed by the Minnesota IMPLAN Group, Inc. This data provides 440-industry level detail and is based on the Bureau of Economic Analysis input-output tables.

Using IMPLAN to estimate direct and indirect effects in energy industries

To perform the kind of employment analysis featured in this report we needed to match the various energy spending categories with the industrial categories in the IMPLAN data set in order to calculate employment multipliers. IMPLAN's data is based on the Bureau of

Economic Analysis input-output tables. The BEA, in turn, organizes industries according to the North American Industrial Classification System, or NAICS. This system unfortunately does not identify energy industries as such. While certain industries such as oil and gas extraction or coal mining are identified in the tables, others such as wind and solar are not. Furthermore, the oil and gas industry does not consist solely of extraction but also of research, manufacturing, and distribution. Therefore for both identified and unidentified energy industries we must make certain assumptions in using the input-output tables to study output and employment.

For each energy strategy, we identified the industries most relevant to the strategy and assigned weights for the share of that industry within the energy strategy. These weights were chosen based on various industry journals and energy reports, as well as our best judgment when information was unavailable. So, for example, we defined the coal industry as 44 percent coal extraction, 8 percent support activities for coal mining, and 48 percent coal products manufacturing. In this way we were able to use weighted averages of the figures in the output and employment tables to generate estimates of output and employment in the coal industry, given a certain level of demand for that industry's product. In order to ensure that our employment estimates for each energy strategy were not driven primarily by the weights we assigned, we ran the model with various alternative weighting schemes and found that the results were in fact quite robust and varied only slightly even when weights changed quite drastically. The final weights that we selected for each energy strategy are listed at the end of this section.

In order to be able to compare employment estimates between various energy strategies, we needed a common metric to use as a basis for comparison. We chose to compare job estimates in relation to a given amount of spending rather than a given amount of energy production. So for instance we compare the employment estimates in solar energy versus coal by showing how the same level of spending in each category results in a certain number of jobs. The alternative, which is to show how many jobs are supported by a given level of energy production, would produce inflated estimates in industries with high energy costs. If we had used a given level of BTUs as the basis for comparison, then the number of jobs needed to produce a given level of BTUs in solar would be very high compared to the number of jobs needed to produce that level of energy production through coal. This would have simply been due to the fact that the cost per BTU for solar power is still much higher than the cost per BTU of coal. Therefore we chose to compare the number of jobs created by a given level of spending, which is not sensitive to the current prices of these various energy sources and technologies.

Energy industries—sectors and weights

Biomass

25 percent	grain farming
25 percent	logging
25 percent	other new construction
12.5 percent	refining
12.5 percent	scientific R&D

Building weatherization

50 percent	nonresidential repair construction
50 percent	residential repair construction

Coal

44 percent	coal mining
08 percent	support activities for coal mining
48 percent	coal product manufacturing

Oil and gas

23 percent	oil and gas extraction
07 percent	drilling oil and gas wells
04 percent	support activities for oil and gas extraction
10 percent	natural gas distribution
45 percent	petroleum refineries
08 percent	petroleum product manufacturing
03 percent	pipeline transport

Smart grid

25 percent	construction
25 percent	machinery
25 percent	electronic equipment
12.5 percent	electrical power goods
12.5 percent	storage batteries

Solar

30 percent	construction
17.5 percent	hardware manufacturing
17.5 percent	electrical equipment
17.5 percent	electronic components
17.5 percent	scientific and technical services

Transit and rail

45 percent	other construction
10 percent	rail transportation
45 percent	ground passenger transportation

Wind

26 percent	construction
12 percent	plastic products
12 percent	fabricated metal
37 percent	machinery
03 percent	mechanical power transmission equipment
03 percent	electronic components
07 percent	scientific and technical services

"Green program"

40 percent	building weatherization
20 percent	transit and rail
10 percent	smart grid
10 percent	wind
10 percent	solar
10 percent	biomass

Induced effects

Induced effects refer to the additional employment, output, and value added that is produced when the additional employment income generated by an initial demand stimulus—as captured by the direct and indirect effects—is spent. The magnitude of the induced effects depends on how the additional employment income translates into household expenditures and the size of the multiplier effects associated with the increase in household spending.

Induced effects are often estimated by endogenizing the household sector in the input-output model. The assumption is that increases in employee compensation (or value added) finance greater household spending, as reflected in the vector of household consumption

in overall final demand. The endogenous household model often yields very large induced effects, in part because the propensity to consume out of employee compensation (or value added) implicit in the endogenous household input-output model is large.

Instead of relying on the consumption function that is implicit in the input-output accounts, we estimate the relationship between real gross employee compensation and real personal consumption expenditures econometrically using a dynamic empirical model. This gives us a more accurate sense of how household consumption responds to changes in employee compensation. We then integrate this estimated relationship into our basic input-output model to calculate induced effects.

The first step of the process is to estimate the relationship between personal consumption expenditures and employee compensation. To do this, we begin with the following dynamic empirical model:

$$C_t = \alpha + \beta_1 C_{t-1} + \beta_2 C_{t-2} + \beta_3 C_{t-3} + \gamma E_t + \mu_t$$

In the above equation, C_t represents real personal consumption expenditures in time period "t," E_t represents real employee compensation, and μ_t is a stochastic error term. We are interested in how changes in employee compensation affect changes in personal consumption expenditures. Therefore, we estimate the model in first differences. First differencing also insures that the variables are stationary (based on augmented Dickey-Fuller unit root tests). The GDP-deflator for personal consumption expenditures is used to transform nominal values into real variables. The time series is quarterly, and extends from 1950 to 2007. All data comes from the Bureau of Economic Analysis, U.S. Department of Commerce.

The estimated model is (rounding off the coefficients):

$$\underset{}{C_t} = \underset{(3.2)}{7.83} + \underset{(1.7)}{0.10}\, C_{t-1} + \underset{(3.5)}{0.20}\, C_{t-2} + \underset{(3.6)}{0.21}\, C_{t-3} + \underset{(5.9)}{0.30}\, E_t$$

T-values are reported in parentheses. From this model, we can calculate the impact of a change in employee compensation on personal consumption expenditures, taking into account the dynamic feedback effects captured by the lag endogenous variables:

$$\frac{\gamma}{1-(\beta_1 + \beta_2 + \beta_3)} = \frac{0.2952}{1-0.5186} = 0.6132$$

This implies that a $1 million increase in gross employee compensation will be associated with a $613,200 increase in household consumption.

Next, we need to estimate the feedback effects—that is, the impact of the increase in household consumption on employee compensation. Additional household consumption expenditures will increase the vector of final demand in the input-output model and, through direct and indirect employment effects, raise employee compensation.

Using our input-out model and restricting the estimates to direct and indirect effects only, we find that a $1 increase in household final demand is associated with an increase in employee compensation of $0.416.[21]

We can now estimate the number of jobs that would be created for each additional $1 million in employee compensation generated by the direct and indirect effects of any particular final demand stimulus. First, we calculate the total impact on household consumption of a $1 increase in employee compensation. This would be given by the following expression:

$$\text{Total impact on HH consumption} = x + x^2y + x^3y^2 + x^4y^3 + \ldots\ldots$$

In which 'x' is the estimated propensity to consume out of additional employee compensation (0.6132 according to our estimates described above) and "y" is the additional employee compensation generated by a $1 increase in final household demand (0.416 from the basic input-output model). We can factor out a single "x," giving us:

$$\text{Total impact on HH consumption} = x\{1 + xy + (xy)^2 + (xy)^3 + \ldots\ldots\}$$

The expression in the brackets is an infinite series. Since $xy<1$, we know that the series converges to:

$$\text{Total impact on HH consumption} = x/(1-xy).$$

Using our estimates, the total impact on household consumption expenditures of a $1 increase in employee compensation is +$0.8232.

Finally, we use these estimates to calculate a general induced employment multiplier. From the basic input-output model, we estimate that a $1 million change in final household consumption would create 10.6 additional jobs. However, we are interested in the number of jobs that would be generated by an additional $1 million in employee compensation. We know that $1 in employee compensation will generate $0.8232 in induced household consumption. Therefore, $1 million in additional employee compensation generates $823,200 in new household expenditures and approximately 8.7 additional jobs (10.6 * 0.8232)—when all dynamic multiplier effects are taken into account.

We can apply this general analysis of induced effects to any specific stimulus. All we need to know is the direct and indirect effects of the stimulus in terms of employee compensation. For each $1 million in additional employee compensation generated, we know that 8.7 additional jobs would be generated through induced effects. For example, an additional $10 million spent on building weatherization generates $5.42 million in additional employee compensation through the direct and indirect effects. These direct and indirect effects would generate about 127 new jobs. These numbers come directly from the

basic input-output model. The induced job creation—taking into account all multiplier effects—would amount to approximately 47 additional jobs (5.42*8.7) for a total employment impact of 174 jobs.

Characteristics of jobs generated by clean-energy investments and fossil fuel investments

In this report we are concerned not only with the overall level of job creation, but also with the types of occupations and the credentials needed by workers in these occupations. Our basic strategy for identifying the types of jobs that would be added to the economy due to an investment in the clean-energy or fossil fuel sectors (as defined above) involves two steps. The first step is to calculate each industry's share of total employment created through either an investment in clean energy or fossil fuels. We calculated the percentage of new employment generated in each of the 440 sectors in our input-output model. These industry shares take into account the direct, indirect, and induced effects as discussed above. The second step is to combine this information on the industry composition of new employment created by investing in each energy sector—clean energy or fossil fuels—with data on workers currently employed in the industries. We use the characteristics of these workers to determine the types of occupations (and the credential requirements of these occupations) that will add jobs with an investment in each energy sector. Our data on current workers comes from the 2008 Current Population Survey, or CPS, maintained by the Bureau of Labor Statistics.

Specifically, we used the industry shares to weight the worker data in the CPS so that the industry composition of the workers in the CPS sample matches the industry composition of the new jobs that will be added by investing in the energy sector we are analyzing. We do this by using the industry shares to adjust the CPS-provided sampling weights. The CPS-provided sampling weights weight the survey sample so that it is nationally representative. We use the industry shares to adjust these sampling weights so that the sample of workers in the CPS is representative of the industrial mix of jobs that IMPLAN estimates will be produced by new investments in clean energy or fossil fuels.

In order to create the weights we first aggregated the 440 industry shares to the three-digit level NAICS industries (for a total of 69 industries). This allowed us to merge the industry share data to the CPS worker data using the most detailed industry variable provided in the CPS. So, for example, at the 440 sector level there are seven construction sectors while at the three-digit NAICS level there is one construction industry

We adjust the CPS-provided sampling weights by multiplying each individual worker's sampling weight with the following:

$$S \times \frac{\text{IMPLAN's estimate of the share of new jobs in worker's industry I}}{\Sigma \text{ (CPS sampling weights of all workers in industry I)}}$$

where S is a scalar equal to the number of jobs produced overall by the particular level and type of investment being considered, and I represents a particular industrial sector.

We use these adjusted sampling weights to estimate the proportion of workers in each energy sector that has 1) a high school degree and no college experience; 2) some college but no bachelor's degree; and 3) a bachelor's degree or more. We then assume that the same proportion of jobs in each energy sector requires each level of education credentials. These figures are presented in the main text in Table 10.

Appendix 2: The employment impact of clean-energy investments across individual states

We report here a state-by-state breakdown of the overall employment expansion that would result through shifting $150 billion in overall spending out of the fossil fuel industry and into clean-energy investments. Before reporting the figures themselves, we begin by discussing the approach we have taken for allocating both the expansion in clean-energy investments in each state and the corresponding decline in fossil fuel spending. Our estimates of the net employment effects of the transition to a clean-energy economy are based on the amounts by which clean-energy investments increase and fossil fuel spending decreases in each state. The employment figures we report in the second part of this appendix are the result of both of those calculations.

As described in the main text, we have derived the $150 billion level of economy-wide clean-energy investment spending based on two criteria: 1) our assessment of the combined impact on the U.S. economy of the American Recovery and Reinvestment Act and the set of incentives and regulations included in the American Clean Energy and Security Act, now being debated in Congress; and 2) developments that are likely to occur in the private clean-energy investment market, driven primarily by advances in clean-energy technologies and the maturation of the institutions and linkages serving this market. Of course, these two broad sets of factors—the impact of government policies and advances in technologies and market practices—are also closely interrelated.

To proceed with a state-by-state breakdown of this $150 billion in total clean-energy investment spending throughout the U.S. economy, we first need to establish criteria for estimating how the funds are likely to be distributed. And based on the worst-case scenario assumption that we describe in the main text (page 33) that the total $150 billion in clean-energy investments will be matched dollar-for-dollar by declines in fossil fuel spending, we also need to establish criteria for distributing the decline in fossil fuel spending across the states that will total to $150 billion. In fact, we conclude that the same approach is appropriate for both distributing the gains in clean-energy investments and declines in fossil fuel spending. That is, as we explain in detail, we generate both the clean-energy investment increases and the fossil fuel spending declines as equally weighted averages of the level of GDP and the level of population in each state.

Clean-energy investment increases

One way to allocate the flow of clean-energy investment funds would be to make a determination as to which states have advantages in various investment areas, such as solar or wind power, urban density for mass transit investments, or agriculture to produce targeted advances in next-generation biofuels. But whatever funding assumptions we would establish from these criteria would inevitably be highly sensitive to our assumptions. That is, we do not have an empirically rigorous way to balance the importance of these geographic or climatic advantages for any given state or region relative to the economic resources available in other regions.

With this in mind, we considered two approaches to assigning investment levels for each state based on two easily observable and measurable traits for each state: state gross domestic product and population levels.

Distributing the total $150 billion in clean-energy investments on the basis of each state's share of total GDP means assigning proportions of spending based on existing patterns of financial investments and levels of development. This provides an accurate measure of how clean-energy investments would flow if they followed current levels of economic development across the states. Distributing the funds based on each state's population assumes a more egalitarian approach, with each person in the country effectively receiving an equal dollar claim on the overall pool of investment funds. We then try to balance these two considerations, recognizing that building retrofits, for example, will in part follow a pattern based on population density, but that new capital investment will also naturally flow toward areas of pre-existing capital investment in industry, infrastructure, and building stock.

In our view, both a GDP-share and a population-based allocation of funds represent reasonable criteria for estimating what state-level clean-energy investments should be. This is because, regardless of a state's topography or climate, major opportunities for clean-energy investments exist now and will grow with time. Accordingly, our approach is to calculate what the allocation of new investment funds would be under both the GDP- and population-based approaches, and use the midpoint of these two calculations as our figure for each state's allocation of the total $150 billion in new clean-energy investments.

Fossil fuel spending declines

Similar issues arise in deciding an approach for estimating the distribution of declines in fossil fuel spending across the states. One approach would be to distribute the cuts in proportion to the existing levels of fossil fuel spending in each state. According to this standard, oil-producing states such as Texas, Louisiana, and Oklahoma and coal-producing regions such as the Appalachian region and Montana would experience larger overall spending reductions than other states in which the fossil fuel industry plays a less significant role.

Under this scenario, the costs of the transition from a fossil fuel to a clean-energy based economy would therefore fall disproportionately on states that have large-scale fossil fuel industries. But if we used this criterion for allocating the distribution of fossil fuel spending declines, we would be contradicting a principle incorporated into the draft language of the ACESA, which is to compensate people and communities tied to the fossil fuel industry as one feature of the transition to a clean-energy economy.

Thus, to remain consistent with the policy approach incorporated into the ACESA, we follow the same principle which we used for allocating the spending increases in each state. That is, in our approach, the declines in fossil fuel spending in each state are distributed across states as an equally weighted average of each state's population and GDP. How could this weighting scheme be made compatible with the fact that states do have very different levels of fossil fuel expenditures? Following the principle of equitable impacts across all regions, the simplest way is to assume that states with larger-than-average fossil fuel industries will also be given disproportionate levels of compensation through the ACESA compensation programs. Related to this, we would also assume that states with relatively large fossil fuel industries will also receive a disproportionate level of government support for investments in clean energy, in particular clean-energy projects that are necessarily tied to specific locations, such as building retrofits, public transportation, and smart grid.

State-by-state employment changes through shift to clean-energy investments

The table below reports the net effects of the shift in employment from fossil fuels to clean-energy investments on employment by state, according to the approach described above. We also place these net employment effects into the broader context of the state's employment conditions as of 2008. That is, we show what the actual level of unemployment was in each state over 2008, and how much that unemployment rate would have declined had each state been affected by the $150-billion shift in spending from fossil fuels to clean-energy investments. As we see, for all states, there would be a net reduction in unemployment in the range of 0.8 - 1.7 percentage points.

State-by-state net job effects of $150 billion clean-energy investment program

	Net change in employment from $150-billion shift from fossil fuels to clean-energy investments	Actual unemployment rate in state for 2008	Unemployment rate in 2008 with $150-billion shift from fossil fuels to clean-energy investments
Alabama	+ 29,173 jobs	5.0%	3.7%
Alaska	+ 3,730	6.7%	5.6%
Arizona	+ 29,548	5.5%	4.6%
Arkansas	+ 17,732	5.1%	3.8%
California	+ 174,927	7.2%	6.3%
Colorado	+ 28,149	4.9%	3.9%
Connecticut	+ 16,741	5.7%	4.8%
Delaware	+ 5,726	4.8%	3.5%
DC	+ 5,514	7.0%	5.3%
Florida	+ 94,725	6.2%	5.2%
Georgia	+ 58,816	6.2%	5.0%
Hawaii	+ 7,146	3.9%	2.9%
Idaho	+ 8,504	4.9%	3.7%
Illinois	+ 69,624	6.5%	5.4%
Indiana	+ 38,013	5.9%	4.7%
Iowa	+ 18,290	4.1%	3.0%
Kansas	+ 17,070	4.4%	3.2%
Kentucky	+ 25,705	6.4%	5.2%
Louisiana	+ 29,095	4.6%	3.2%
Maine	+ 9,957	5.4%	4.0%
Maryland	+ 26,605	4.4%	3.5%
Massachusetts	+ 38,410	5.3%	4.1%
Michigan	+ 53,816	8.4%	7.3%
Minnesota	+ 30,263	5.4%	4.4%
Mississippi	+ 19,007	6.9%	5.4%
Missouri	+ 35,989	6.1%	4.9%
Montana	+ 6,303	4.5%	3.2%
Nebraska	+ 11,059	3.3%	2.2%
Nevada	+ 10,553	6.7%	5.9%
New Hampshire	+ 7,686	3.8%	2.8%
New Jersey	+ 47,519	5.5%	4.4%
New Mexico	+ 11,443	4.2%	3.0%
New York	+ 109,441	5.4%	4.3%
North Carolina	+ 51,210	6.3%	5.2%
North Dakota	+ 4,257	3.2%	2.0%
Ohio	+ 67,356	6.5%	5.4%
Oklahoma	+ 27,684	3.8%	2.2%
Oregon	+ 20,931	6.4%	5.3%
Pennsylvania	+ 71,667	5.4%	4.3%
Rhode Island	+ 4,540	7.8%	7.0%
South Carolina	+ 24,757	6.9%	5.8%
South Dakota	+ 5,272	3.0%	1.9%
Tennessee	+ 39,128	6.4%	5.1%
Texas	+ 152,760	4.9%	3.6%
Utah	+ 16,149	3.4%	2.3%
Vermont	+ 4,270	4.8%	3.6%
Virginia	+ 44,668	4.0%	2.9%
Washington	+ 33,505	5.3%	4.4%
West Virginia	+ 10,334	4.3%	3.0%
Wisconsin	+ 35,238	4.7%	3.6%
Wyoming	+ 3,522	3.1%	1.9%

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Endnotes

1 Congressional Budget Office, "Estimated Cost for the Conference Agreement of H.R. 1," available at "http://www.cbo.gov/ftpdocs/99xx/doc9989/hr1conference.pdf

2 At the same time, the CBO is projecting a relatively slow pace for the disbursement of these funds given that the bulk of overall ARRA spending will be completed by 2011. If anything, we might anticipate that larger proportions of the total green investment allocations will be distributed more quickly than projected by the CBO.

3 *American Clean Energy and Security Act of 2009*, Title II, Sec. 304 (Draft: March 31, 2009)., p. 158.

4 These references include Dahl and Sterner (1991), Espey (1996 and 1998), and Puller and Greening (1999).

5 We are referring here to a process of endogenous growth fueled by technical innovation and adaptation that, in turn, will have been induced by government incentives such as those advanced in the ARRA and ACESA. In various forms the analyses of such a growth process has been at the heart of research in economics over the past two decades on the interaction of technical innovation, the diffusion of such new technologies, the expansion of markets that results through diffusion, and the impacts of these cumulative processes on economic growth. For excellent surveys of the extensive literature on what are termed "endogenous growth" theory and "induced innovation" see Aghion and Howett (1997) and Ruttan (2001)

6 In a careful study that attempts to estimate the overall size of the energy efficiency market in the United States, Ehrhardt-Martinez and Laitner (2008) estimate the level of investment, as of 2004, to be $300 billion per year. They also estimate that the level of investment could potentially rise to $700 billion per year "in an environment of accelerated market transformation," (p. vii). The reason their estimate of the potential market for efficiency investments is so much larger than ours—ours being in the range of $110 billion as opposed to their $700 billion figure—is that they are including in their accounting all energy-efficiency investments, including ones that will not have any appreciable impact on employment creation. That is, their figure includes all investments in energy-efficient appliances and transportation vehicles. It also includes all new building projects that incorporate energy-efficient features, such as efficient windows, roofing, and insulation. When we exclude these categories of energy-efficient investments from their calculations, their total figures for current market size and potential future size in the remaining categories—i.e. building retrofits, public transportation, smart grid, energy recycling, and freight rail—are similar to our $110 billion figure for potential market size over the next decade.

7 See Pollin, Garrett-Peltier, Heintz, and Scharber (2008) and Pollin, Wicks-Lim, Garrett-Peltier (2009) for discussions on this.

8 This figure is derived in an unpublished memorandum circulated by the Green Building Council in April 2008.

9 Mark W. Chupka and others, "Transforming America's Power Industry: The Investment Challenge 2010-2030," Research report prepared for the Edison Foundation (2008). We use an estimate of $298 billion in transmission investment and $582 billion in distribution investment (based on the selected methods of estimating investment needs reported in the study). The total investment of $880 billion, spread over 20 years, amounts to $44 a year.

10 See Pollin, Wicks-Lim, and Garrett-Peltier (2009) for an extensive discussion on public transportation needs and benefits for low-income communities in particular from new investments in this area.

11 Table A6, pp. 121-23, *Annual Energy Outlook 2009*. In 2007, industrial generation capacity from combined heat and power systems was 25.4 gigawatts—this is projected to grow to 45.7 gigawatts by 2030.

12 Approximately 20 gigawatts in capacity would need to be installed by end-users over this period, based on projections from the *Annual Energy Outlook 2009*. Using a cost of capital of $2,800 per kilowatt (based on a weighted average of the cost of capital used by the Energy Information Administration) yields an estimate of $56 billion.

13 The Annual Energy Outlook 2009 projects that ethanol consumed as E85 and in motor gasoline would total 1.66 quadrillion btus by 2020. Ethanol contains about 80,000 btus per gallon. Using this conversion factor, the estimated ethanol market for motor vehicle use would be 20 billion gallons.

14 Energy Information Administration, "Annual Energy Outlook 2007" (February 2007). See "Biofuels in the transportation sector," available at www.eia.doe.gov/oiaf/analysispaper/biomass.html. This report contains a recent estimate of the capital cost required for a cellulosic ethanol plant with a capacity of 50 million gallons a year, which is $375 million. Current cellulosic ethanol production in the United States is very limited. If one-third of the 20 billion gallons of ethanol were to be generated from cellulosic production, it would involve increasing capacity by about 6.7 billion gallons, requiring total investment of about $50 billion at current capital costs. These costs will be reduced with technological progress and would potential lead to more widespread adoption of cellulosic ethanol production.

15 Three prominent forecasts published in 2007 of where crude oil prices would be in 2008 include JP Morgan in August 2007, estimating $59.75 a barrel; Goldman Sachs in September 2007, estimating $85 a barrel; and the U.S. Energy Information Agency, also in September 2007, estimating $71.17 a barrel. Crude oil prices in the U.S. market are reported at: http://tonto.eia.doe.gov/dnav/pet/hist/wtotworldw.htm

16 This general problem of making accurate economic forecasts was captured well by former Federal Reserve Chair Alan Greenspan's unintentionally amusing observation made at the 1999 annual meeting of the International Monetary Fund and World Bank that "The fact that our econometric models at the Fed, the best in the world, have been wrong for fourteen straight quarters does not mean they will not be right in the fifteenth quarter" (Martin Mayer 2001, *The Fed*, p. 180).

17 It is through consideration of such factors that we have established a $150 billion annual level of investment on clean energy as a level that is desirable as well as realistic within our existing economy, but not something that will emerge inevitably due to any single policy measure.

18 We present a detailed discussion of our methodology in the appendix.

19 This $1 million increase in expenditures is "final demand" expenditures within the input-output model.

20 The allocation of total investment funds that we are working with is 40 percent retrofits; 20 percent mass transit/freight rail; and 10 percent each for smart grid, wind power, solar power, and biomass fuels. Adjusting the budgetary allocations would affect the job tntal estimates, but not by a dramatic extent. These proportions are closely aligned with the green investment spending priorities of the government ARRA program. Appendix 1how we derived the overall job figures based on this proportioning of overall clean-energy investments.

21 A range of estimates exist on the impact of unemployment on earnings. For example, Bartik's 2001 survey of five studies (Bartik 1991, 1994, 2000; Blank and Card 1993; Card 1995) provides a range of a 1.5- to 3.5-percent increase in average real earnings when the unemployment rate falls by 1 percent. Additionally, Bartik's 2001 study estimates that the average household experiences a 1.9-percent increase in real earnings when the unemployment rate falls by 1 percent. Finally, Hines, Hoynes, and Krueger (2001) estimate that the average family earnings increases by 1.3 percent for a 1-percent fall in the unemployment rate. A simple average of the seven estimates produced by these various studies suggests that the impact of a 1-percent decline in the unemployment rate produces approximately a 2-percent rise in earnings.

22 If an employment expansion leads to a disproportionate rise in the labor force participation rate, the subsequent disproportionate rise in the labor supply is likely to counteract positive bargaining effect for low-income workers. The key factor is that however much the labor force participation rate rises, the unemployment rate must still fall by one percentage point in order for workers to see wage increases resulting through this channel.

23 See Pollin (2009) for references.

24 We provide a detailed breakdown of the subsectors within the oil industry and all other energy sectors in Appendix 1.

25 These figures are for the synthetic wind, solar, and biomass industries that we have created from the input-output tables. The actual level of current domestic content may be somewhat different than this estimate. We will obtain a better sense of this once we are able to incorporate figures from our ongoing survey of the renewable energy/energy efficiency sectors.

26 See Pollin, Wicks-Lim, and Garrett-Peltier (2009).

27 Their findings are also consistent with the research of Cancian and Meyer (2000) who found that when women initially work in clerical, cleaning, professional, production, or manufacturing occupations after leaving welfare their wages rise faster over time compared to retail sales, food services, or private housekeeping.

28 The main difference between the two measures is over offsets, which are the investments in emissions reductions that fossil fuel industry firms can make outside of the regulations stipulated in the carbon cap law. For example, carbon-generating firms could receive offset credits against their emission limits by investments in tree planting or in clean-energy projects in other countries. The ACESA effectively corrects a conceptual flaw with the Lieberman-Warner approach to offsets. Many offsets are long-run investments whose effects would last years. Under Lieberman-Warner, such long-run investments could become invalid after the initial investment occurs, as the total number of allowances drops. The ACESA sets the initial level of allowable offsets at around the same level as Lieberman-Warner. However, if the regulated entities invest in approved offsets, those investments would remain valid (in terms of counting toward emissions allowances) even as the number of allowances drops. New offsets may be precluded, but existing investments in offsets would not be invalidated.

29 So-called "market clearing" macroeconomic models are described in most contemporary intermediate textbooks. Perhaps the most systematic textbook presentation of this approach is Barro (2008).

30 These and related issues are analyzed carefully in Ackerman and Stanton (2008).

31 We use the IMPLAN calibrated model and restrict our focus to households with annual incomes between $10,000 and $100,000, under the assumption that the vast majority of the jobs created would affect households with incomes in this range.

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