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CLIMATE CHANGE LEGISLATION

HEARING

BEFORE THE

COMMITTEE ON ENERGY AND NATURAL RESOURCES UNITED STATES SENATE

ONE HUNDRED ELEVENTH CONGRESS

FIRST SESSION

TO

RECEIVE TESTIMONY ON ENERGY AND RELATED ECONOMIC EFFECTS OF GLOBAL CLIMATE CHANGE LEGISLATION

OCTOBER 14, 2009

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CLIMATE CHANGE LEGISLATION

WEDNESDAY, OCTOBER 14, 2009

U.S. SENATE,
COMMITTEE ON ENERGY AND NATURAL RESOURCES,
Washington, DC.

The committee met, pursuant to notice, at 10:03 a.m. in room SD–366, Dirksen Senate Office Building, Hon. Jeff Bingaman, chairman, presiding.

OPENING STATEMENT OF HON. JEFF BINGAMAN, U.S. SENATOR FROM NEW MEXICO

The CHAIRMAN. Why don't we go ahead. I'm informed that Senator Murkowski is on her way and will be here shortly, but we should proceed.

As the Senate continues to consider ways to deal with the global environmental problem of climate change, much of the discussion centers around overall costs and benefits of such a program; how the costs and benefits will be distributed throughout our economy. Addressing the issue of climate change will require major transformation of our energy sectors. So, this committee will continue to take a interest in the topic in the months ahead.

Our last hearing on climate change examined different policy options to contain both the long-term costs and the short-term price volatility of an economywide program to reduce greenhouse gas emissions. As a follow-on to that discussion, in today's hearing we will receive testimony on the various economic models and analyses of the American Clean Energy Security Act, or ACES, which was passed by the House of Representatives this June.

While no one can say for certain what the future holds, scientific and economic models can be used as tools to approximate reality and to help us understand how the environment or the economy may react to policies that we adopt. Models can be very useful tools for estimating what a particular program may cost, showing how particular goals may be best achieved and revealing where the economy may be most sensitive to the choices that we make. We understand they are imperfect tools, however, and models have often been used or manipulated to make a predetermined point or to show favorable or unfavorable results for any given policy.

Over the course of our discussions on climate change legislations, this has been particularly true. Interest groups and stakeholders have circled Capitol Hill with various analyses, some showing that cap-and-trade legislation will wreck the economy and provide nothing but costs, others showing only the benefits of job creation and new industry.

In the case of cap-and-trade programs and climate legislation, we can use real-world experiences alongside model analyses to keep us grounded in reality. For example, the cap-and-trade system for sulfur dioxide that was put in place by the 1990 Clean Air Act amendments was an unprecedented environmental success in combating acid rain and turned out to cost only about a quarter of the price that economic models at the time were projecting.

My impression is that the greenhouse gas emissions trading program in Europe has shown that emissions trading can be successful at reducing emissions without having a disastrous effect on the economy. While it's true that the European emissions trading program experienced significant volatility in its initial experimental phase, they have learned from their trial period, and they've made important improvements to that system. We need to learn from the experience that they've had.

Today, the witnesses will explain the strengths and weaknesses of the different models that have been used to analyze the House-passed legislation and what they, collectively, may tell us about the proper design of climate legislation.

Let me call on Senator Murkowski for any opening statements she'd like to make.

[The prepared statement of Senator Bunning follows:]

PREPARED STATEMENT OF OF HON. JIM BUNNING, U.S. SENATOR FROM KENTUCKY

Thank you Mr. Chairman. I look forward to the hearing today to discuss the economic effects of enacting a cap and trade program.

Efforts to reduce carbon emissions through the imposition of strict federal mandates as outlined in a cap and trade system are nothing more than a national energy tax.

It will bankrupt our industries, cost Americans jobs and cause energy prices to skyrocket. It is wrong for Kentucky and wrong for America.

Estimates show that if enacted a cap and trade system will only reduce global greenhouse gas emissions by four percent, while imposing one of largest tax increases in American history.

In these tough economic times it is irresponsible and reckless to enact legislation that would have such a small effect on global warming while imposing substantial costs on all American households.

It will affect the prices we pay to fill up our gas tanks, heat and cool our homes and use electricity as well as the costs of practically all goods and services.

And the costs will be disproportionally shouldered by the states that have more carbon based resources than other states.

In my home state of Kentucky over 95% of electricity is generated by coal. Estimates show that if passed Kentucky will be one of the highest impacted states by cap and trade legislation.

Make no mistake. Cap and trade is an anti-growth proposal that will hurt American industries and American families more than it will help them.

I thank the witnesses for appearing before the committee today and appreciate their comments. I look forward to continuing the conversation on this issue and discussing the entire scope of the cost of enacting climate change legislation.

Thank you Mr. Chairman.

STATEMENT OF HON. LISA MURKOWSKI, U.S. SENATOR FROM ALASKA

Senator MURKOWSKI. Thank you, Mr. Chairman.

Welcome, to those of you who have joined us this morning.

The cost estimates that we are here to discuss are clearly very important, and will significantly impact the Senate's ability to pass climate legislation.

Last May, at about the same point in the climate debate, we learned that every major analysis of cap-and-trade projected higher energy prices and lower economic growth. These costs were exceeded by one factor, and that factor was uncertainty. When it became clear that we could expect minimal environmental benefit unless other nations made similar cuts, the outcome of the eventual floor debate was predictable.

For the bills introduced this year, the story hasn't been much different. Each analysis projects significant costs and, among assessments, there's great uncertainty.

The EPA analysis of the House bill includes 7 different scenarios. EIA's contain a total of 11. Yet, neither accounts for the cumulative impact of every provision. Limitations and caveats and constraints are routinely noted.

I don't mean to criticize these reports instead, the underlying legislation. The House bill's cap-and-trade provisions draw most of the attention, but in reality take up only about 200 of its 1400 pages. The rest creates an unprecedented web of command-and-control regulations that would be layered on top of cap-and-trade, each other, as well as existing law, which makes estimating costs difficult, to say the least.

With the Senate now headed down the same road, many of the same difficulties will be encountered when the bill from Senators Kerry and Boxer is complete enough to be analyzed. That measure is already 821 pages, and counting, even though many blanks remain and the work of 5 other committees has not yet been added.

I appreciate the work the agencies and understand the need for sensitive analysis, but I also recognize that these are sweeping proposals that will affect every facet of our economy for decades to come. It is incredibly difficult, but incredibly important to know how they might work and what they may cost.

We all know we're in the midst of a recession that is costing us millions of jobs, trillions of dollars. Even as it begins to ease, we continue to face high unemployment and massive Federal deficits. We must ensure that climate legislation does not endanger our recovery. We must seek to reduce energy prices, not drive them up. Americans are hoping that when the economy turns around, it will stay strong. They're hoping, in the meantime, at a minimum, that Congress won't make life any harder than it already is.

I do believe that climate change must be addressed, but only after considering all of our options. Before we ask our constituents to do more, we need to make absolutely sure that we can't ask less, perhaps much less, and still achieve the same results.

Estimates of the House bill's price tag are high and varied, as were the estimates for last year's bills. When Alaskans ask me how much cap-and-trade legislation is going to cost them and my best answer still is, "A lot, I think," that tells me that we're not yet on the right track.

I suspect that I'm not alone in this thinking. Just this past weekend, Senator Kerry and Senator Graham joined together and they laid out a framework for climate policy that would mark a significant departure from where we are today. Now, to be sure, they wrote a column; they didn't write a bill. Their outline could be improved, and there's no guarantee legislation along those lines

would pass the Senate, but, in my opinion, the framework that they laid out in 1,000 words is already better than the policies it took the House 1,400 pages to impose.

I'm hopeful that their column will mark a shift in the climate debate. Instead of cutting emissions at any cost, we should be working on a policy that incorporates the best ideas of both parties, a policy that accounts for our near-term energy needs, limits costs, and is flexible enough to work under different economic circumstances.

With that, Mr. Chairman, I thank you for the time this morning, and I look forward to the comments from the witnesses, and good discussion on this very important topic.

The CHAIRMAN. Thank you very much.

Before I introduce the witnesses, let me just advise all Senators we're—there's a cloture vote, I'm told, at 11:15. Our hope was that members would go and vote, once that vote is called, and then return here, and we—if we get—can get 12 members, about 11:30, when we return, we would then vote out a couple nominations at that point, and then proceed with additional questions. I'm sure we won't be through with our questions by then. But, that's the hope, if we can pursue it.

Let me introduce our witnesses today. We have a very distinguished group of witnesses. Dr. Doug Elmendorf, who's the director of the Congressional Budget Office. Thank you very much, for being here. He'll begin with an overview of the economic impacts of different climate policy choices made in the House-passed legislation. Dr. Richard Newell, from the Energy Information Agency. Mr. Reid Harvey, from the Environmental Protection Agency. They will discuss the results of their analyses. Mr. Harvey is accompanied by Dr. Allen Fawcett, and we appreciate him being here, as well. Then, Dr. Larry Parker, from the Congressional Research Service, will conclude with a description of their new report that provides a comparison—a fairly exhaustive comparison of seven different analyses of the House-passed bill, from a wide range of groups.

So, Dr. Elmendorf, we promise not to keep you here as long as the Finance Committee kept you yesterday. So, we're glad to have you here.

STATEMENT OF DOUGLAS W. ELMENDORF, DIRECTOR, CONGRESSIONAL BUDGET OFFICE

Mr. ELMENDORF. Thank you, Mr. Chairman. You have my eternal gratitude for that.

Thanks, to you and Senator Murkowski and the other members of the committee, for inviting us to be here today. I appreciate the invitation to testify on the economic effects of legislation to reduce greenhouse gas emissions.

As you know, global climate change poses one of the Nation's most significant long-term policy challenges. Human activities are producing increasingly large quantities of greenhouse gases, especially carbon dioxide. A strong consensus has developed in the expert community that, if allowed to continue unabated, the accumulation of greenhouse gases in the atmosphere will have extensive, highly uncertain, but potentially serious and costly impacts on re-

gional climates throughout the world. Moreover, the risk of abrupt and even catastrophic changes in climate cannot be ruled out.

Those expected and possible harms may motivate policy actions to reduce the extent of climate change. However, the cost of doing so could be significant, because it would entail substantial reductions in U.S. emissions and to the emissions from other countries over the coming decade.

Achieving such reductions in this country would probably involve some combination of three broad changes: transforming the U.S. economy from one that runs on carbon-dioxide-emitting fossil fuels to one that increasingly relies on nuclear and renewable energy; accomplishing substantial improvements in energy efficiency; and implementing a large-scale capture and storage of carbon dioxide emissions.

As you consider policies to reduce the dangers of climate change, my testimony makes five points regarding the economic implications of the policies you choose:

First, the economic impact would depend, importantly, on the design of the policy. Decisions about whether to reduce greenhouse gases, primarily through market-based systems, such as taxes or a cap-and-trade system, or primarily through traditional regulatory approaches that specify performance and technology standards, would influence the total costs of reducing emissions and the distribution of those costs. The costs would also depend, of course, on the stringency of the policy, whether other countries impose similar policies, the amount of flexibility about when, where, and how emissions will be reduced, and the allocation of allowances if a cap-and-trade system was used.

My second point is that reducing the risk of climate change would come at some cost to the economy. A cap-and-trade system, for example, would lead to higher prices for energy from fossil fuels and for energy-intensive goods, which would, in turn, provide incentives for households and businesses to develop energy sources that emit smaller amounts of carbon dioxide.

Changes in the relative prices for energy and energy-intensive goods would also shift income among households at different points in the income distribution and across industries and regions of the country.

Policymakers could counteract some of those income losses and shifts by having the government sell emission allowances and use the proceeds to compensate certain households or businesses, or by having the government give allowances away to certain households and businesses. But, even so, some income losses—and certainly shifts—would occur. For example, CBO concludes that the cap-and-trade provisions of H.R. 2454—the American Clean Energy and Security Act of 2009—would reduce GDP below what it would otherwise have been by roughly one-quarter to three-quarter percent in 2020 and by between 1 and 3 and a half percent in 2050. By way of comparison, CBO projects that real—that is, inflation-adjusted—GDP will be roughly two and a half times as large in 2050 as it is today. So, these changes would be comparatively modest.

In the models that CBO has reviewed, the long-run cost to households would be somewhat smaller than the changes in GDP because consumption falls by less than GDP and because households

benefit from more time spent in nonmarket activities. Moreover, these measures of potential costs do not include any benefits from averting climate change.

A third point is that climate legislation would cause permanent shifts in production and employment away from industries that produce carbon-based energy and energ-intensive goods and services and toward industries that produce alternative energy sources and less energy-intensive goods and services. While those shifts were occurring, total employment would probably be reduced a little, compared with what it would have been without such a policy, because labor markets would most likely not adjust as quickly as would the composition of demand for final outputs.

Fourth, CBO has estimated the loss in purchasing power that would result from the primary cap-and-trade program in H.R. 2454. CBO's measure reflects the higher prices that the households would face and the compensation they would receive primarily through the allocation of allowances or the proceeds from their sale. However, our measure omits some channels of influence on households' well-being that cannot be readily quantified. It appears that CBO's measure probably understates the true burden, to a small degree. As estimated, the loss in purchasing power would be modest and would rise over time as the cap became more stringent, accounting for two-tenths of a percent of after-tax income in 2020 and 1.2 percent in 2050.

Fifth, the distribution of the loss in purchasing power across households depends, importantly, on policymakers' decisions about how to allocate the allowances. According to CBO's calculations, households in the lowest fifth of households, when arrayed by income, would see gains in purchasing power, in both 2020 and 2050, because the compensation they would receive would exceed the costs they would bear. However, households in the middle fifth would see net losses in purchasing power amounting to six-tenths of a percent of after-tax income in 2020 and 1.1 percent in 2050.

Thank you. That concludes my prepared remarks.

[The prepared statement of Mr. Elmendorf follows:]

PREPARED STATEMENT OF DOUGLAS W. ELMENDORF, DIRECTOR, CONGRESSIONAL BUDGET OFFICE

Chairman Bingaman, Senator Murkowski, and Members of the Committee, thank you for the invitation to testify on the economic effects of legislation to reduce emissions of carbon dioxide (CO_2) and other greenhouse gases.

Global climate change poses one of the nation's most significant long-term policy challenges. Human activities are producing increasingly large quantities of greenhouse gases, especially CO_2. A strong consensus has developed in the expert community that, if allowed to continue unabated, the accumulation of greenhouse gases in the atmosphere will have extensive, highly uncertain, but potentially serious and costly impacts on regional climates throughout the world. Those impacts are expected to include widespread changes in the physical environment, changes in biological systems (including agriculture), and changes in the viability of some economic sectors. Moreover, the risk of abrupt and even catastrophic changes in climate cannot be ruled out.[1]

Those expected and possible harms may motivate policy actions to reduce the extent of climate change. However, the cost of doing so may be significant because it would entail substantial reductions in global emissions over the coming decades. U.S. emissions currently account for roughly 20 percent of global emissions. As a

[1] For additional information, see Congressional Budget Office, Uncertainty in Analyzing Climate Change: Policy Implications (January 2005).

result, substantially reducing global emissions would probably entail large reductions in U.S. emissions as well as emissions in other countries. Achieving such reductions would probably involve transforming the U.S. economy from one that runs on CO_2-emitting fossil fuels to one that increasingly relies on nuclear and renewable fuels, accomplishing substantial improvements in energy efficiency, or implementing the large-scale capture and storage of CO_2 emissions.

One option for reducing emissions in a cost-effective manner is to establish a carefully designed cap-and-trade program. Under such a program, the government would set gradually tightening limits on emissions, issue rights (or allowances) consistent with those limits, and then let firms trade the allowances among themselves. Such a capand-trade program would lead to higher prices for energy from fossil fuels and for energy-intensive goods, which would in turn provide incentives for households and businesses to use less carbon-based energy and to develop energy sources that emit smaller amounts of CO_2.

Changes in the relative prices for energy and energy-intensive goods would also shift income among households at different points in the income distribution and across industries and regions of the country. Policymakers could counteract some but not all of those income shifts by authorizing the government to sell CO_2 emission allowances and using the revenues to compensate certain households or businesses, or to give allowances away to some households or businesses.

My testimony makes the following key points:

- Climate change is an international problem. The economic impacts of climate change are extremely uncertain and will vary globally. Impacts in the United States over the next 100 years are most likely to be modestly negative in the absence of policies to reduce greenhouse gases, but there is a risk that they could be severe. Impacts are almost certain to be serious in at least some parts of the world.
- The economic impact of a policy to ameliorate that risk would depend importantly on the design of the policy. Decisions about whether to reduce greenhouse gases primarily through market-based systems (such as taxes or a cap-and-trade program) or primarily through traditional regulatory approaches that specify performance or technology standards would influence the total cost of reducing those emissions and the distribution of those costs in the economy. The cost of a policy to reduce greenhouse gases would also depend on the stringency of the policy; whether other countries also imposed similar policies; the amount of flexibility about when, where, and how emissions would be reduced; and the allocation of allowances if a cap-and-trade system was used.
- Reducing the risk of climate change would come at some cost to the economy. For example, the Congressional Budget Office (CBO) concludes that the capandtrade provisions of H.R. 2454, the American Clean Energy and Security Act of 2009 (ACESA), if implemented, would reduce gross domestic product (GDP) below what it would otherwise have been—by roughly ¼ percent to ¾ percent in 2020 and by between 1 percent and 3 ½ percent in 2050. By way of comparison, CBO projects that real (inflation-adjusted) GDP will be roughly two and a half times as large in 2050 as it is today, so those changes would be comparatively modest. In the models that CBO reviewed, the long-run cost to households would be smaller than the changes in GDP. Projected GDP impacts include declines in investment, which only gradually translate into reduced household consumption. Also, the effect on households' well-being of the reduction in output as measured by GDP (which reflects the market value of goods and services) would be offset in part by the effect of more time spent in nonmarket activities, such as childrearing, caring for the home, and leisure. Moreover, these measures of potential costs imposed by the policy do not include any benefits of averting climate change.
- Climate legislation would cause permanent shifts in production and employment away from industries focused on the production of carbon-based energy and energy-intensive goods and services and toward the production of alternative energy sources and less-energy-intensive goods and services. While those shifts were occurring, total employment would probably be reduced a little compared with what it would have been without a comparably stringent policy to reduce carbon emissions because labor markets would most likely not adjust as quickly as would the composition of demand for different outputs.
- CBO has estimated the loss in purchasing power that would result from the primary cap-and-trade program that would be established by the ACESA. CBO's measure reflects the higher prices that households would face as a result of the policy and the compensation that households would receive, primarily through the allocation of allowances or the proceeds from their sale. The loss in pur-

chasing power would be modest and would rise over time as the cap became more stringent and larger amounts of resources were dedicated to cutting emissions, accounting for 0.2 percent of after-tax income in 2020 and 1.2 percent in 2050.

- The expected distribution of the loss in purchasing power across households depends importantly on policymakers' decisions about how to allocate the allowances. The allocation of allowances specified in H.R. 2454 would impose the largest loss in purchasing power on households near the middle of the income distribution. Which categories of households would ultimately benefit from the allocation of allowances is more uncertain in 2020 than in 2050. A large fraction of the allowances in 2020 would be distributed to households via private entities, and the distribution of the allowance value would depend on whether those entities passed the value on to customers, workers, or shareholders. In contrast, most of the value of allowances in 2050 would flow to households directly.

AGGREGATE ECONOMIC IMPACTS OF CLIMATE CHANGE

Many of the natural changes that are likely to result from climate change (such as more frequent storms, hurricanes, and floods) will affect agriculture, forestry, and fishing; the demand for energy; and the nation's infrastructure. Despite the wide variety of projected impacts of climate change over the course of the 21st century, published estimates of the economic costs of direct impacts in the United States tend to be small.[2] Most of the economy involves activities that are not likely to be directly affected by changes in climate. Moreover, researchers generally expect the growth in the U.S. economy over the coming century to be concentrated in sectors—such as information technology and medical care—that are relatively insulated from climate effects. Damages are therefore likely to be a smaller share of the future economy than they would be if they occurred today.

As a consequence, a relatively pessimistic estimate for the loss in projected real gross domestic product is about 3 percent for warming of about 7° Fahrenheit (F) by 2100.[3] However, even for the levels of warming that have been examined, most of the estimates cover only a portion of the potential costs. Other costs in the United States could come from nonmarket impacts (which are not measured in GDP) and from the potential for abrupt changes:

- Nonmarket impacts.—Some types of impacts are very difficult to evaluate in monetary terms because they do not directly involve products that are traded in markets. Although such difficulties apply to effects on human health and quality of life, they are particularly significant for biological impacts, such as loss of species' habitat, biodiversity, and the various resources and processes that are supplied by natural ecosystems. Experts in such issues generally believe that those nonmarket impacts are much more likely to be negative than positive and could be large.
- The potential for abrupt changes.—Experts believe that there is a small possibility that even relatively modest warming could trigger abrupt and unforeseen effects during the 21st century that could result in large economic costs in the United States. Two examples of such possible effects are shifts in ocean currents that could change weather patterns and affect agriculture over large areas, and rapid disintegration of ice sheets, which could dramatically raise sea levels around the world. The sources and nature of such abrupt changes, their likelihood, and their potential impacts remain very poorly understood.

The most comprehensive published study includes estimates of nonmarket damages as well as costs arising from the risk of catastrophic outcomes associated with about 11°F of warming by 2100.[4] That study projects a loss equivalent to about 5 percent of U.S. output and, because of substantially larger losses in a number of other countries, a loss of about 10 percent of global output.

THE EFFECTS OF POLICY DESIGN CHOICES

The economic impact of any policy to reduce greenhouse-gas emissions would depend on a variety of policy and program design decisions that would be made by the Congress or the regulatory agencies that implemented such a policy. Most im-

[2] For additional information, see Congressional Budget Office, Potential Impacts of Climate Change in the United States (May 2009).

[3] See Dale W. Jorgenson and others, U.S. Market Consequences of Global Climate Change (Arlington, Va.: Pew Center on Global Climate Change, 2004), p. 36.

[4] William D. Nordhaus and Joseph Boyer, Warming the World: Economic Models of Global Warming (Cambridge, Mass.: MIT Press, 2000), pp. 95–96.

portantly, the economic impact would depend on whether the policy worked primarily through taxes on emissions, a cap-and-trade program for emissions, regulatory standards to reduce emissions, or a combination of those approaches. The economic impact would also depend on the stringency of the cap, whether other countries also adopted programs to reduce emissions, and other factors that would be specific to the approach chosen.

Approaches to Reducing Emissions

The most fundamental choice facing policymakers is whether to adopt conventional regulatory approaches, such as standards for energy-using machinery and equipment, or to employ market-based approaches, such as taxes on emissions or cap-and-trade programs. Market-based approaches, most experts conclude, would generally limit emissions at a lower cost than command-and-control regulations would. Whereas conventional regulatory approaches would impose specific requirements that might not be the least costly means of reducing emissions, market-based approaches would provide more latitude for firms and households to determine the most cost-effective means of accomplishing that goal.

A tax per unit of emissions would effectively fix the incremental cost of reducing emissions in any given period. Proposals for such taxes would generally specify rates that gradually increased year by year, with the aim of making activities that produced emissions increasingly expensive. A cap-and-trade system, by contrast, would explicitly restrict the annual quantity of emissions. Under such programs, allowances would be allocated or sold, and the trading of allowances would permit emissions reductions to be achieved in the lowest-cost manner. If caps increased in stringency over time, then the incremental costs of reducing emissions would rise as well.

If policymakers had full and accurate information about the cost of reducing emissions, taxes and caps could be equivalent: Policymakers could set a cap, and they would know what allowance price it would yield, or they could set a tax at that same allowance price and achieve the same reduction in emissions as under the cap. However, because policymakers face uncertainty, there is a crucial difference between the two approaches: A tax would leave the resulting amount of emissions uncertain, whereas a fixed cap would leave the resulting allowance price uncertain.

Most economists conclude that in the face of uncertainty about the cost of reducing emissions, a policy that set a year-by-year price path for greenhouse-gas emissions (such as a gradually increasing tax) would probably cost less overall than a policy that specified year-by-year emissions targets.[5] That conclusion is based on three observations:

- Climate change results from the accumulation of greenhouse gases in the atmosphere over many decades and centuries. As a result, reducing the potential risk of climate change would entail reducing cumulative emissions of greenhouse gases over multiple decades, but year-to-year fluctuations in emissions have little effect on the climate. By contrast, the economic cost of reducing emissions can vary a lot from year to year—depending on the weather, economic activity, and the prices of fossil fuels. A tax would motivate firms to cut their emissions more when the cost of doing so was relatively low and allow them to emit more when the cost of cutting emissions was high. A cap-and-trade program would offer firms less flexibility (although such a program could incorporate features, such as banking and borrowing of allowances, that would allow a degree of flexibility, as described below).
- There is such great uncertainty about how a given quantity of emissions would ultimately affect global temperatures that there is very little additional certainty to be gained from choosing a fixed emissions goal (even one that is set over multiple decades) rather than a price path that is expected to achieve the same emissions goal—but that may exceed or may fall short of it depending on actual cost conditions. In essence, the additional certainty that a cap-and-trade program could provide about the amount of cumulative emissions would be bought at a relatively high cost without yielding corresponding certainty about the amount of climate change that would occur.
- The greater certainty about the price of emissions in the future that a tax would offer would provide affected firms and households with greater certainty about the conditions they would face in adjusting to restrictions than a cap would provide. That greater certainty would ease planning for capital investments and could lower the risk associated with developing new technologies.

[5] For additional information on the difference between taxes and cap-and-trade programs, see Congressional Budget Office, Policy Options for Reducing CO_2 Emissions (February 2008).

Many proposals would augment basic cap-and-trade or tax provisions with subsidies for activities that reduced emissions or with regulations (such as standards for energyusing machinery and equipment). Some such approaches—subsidies for basic energy research, for example—would probably be useful and effective supplements to market-based approaches. Standards might also be the most effective regulatory approach in cases where market forces are unable to convey appropriate incentives, such as when a tax on energy would not provide an incentive for building owners to make efficiency improvements when renters are responsible for their electricity bills. Moreover, subsidies could help protect certain people or industries from the adverse economic effects of reducing emissions. However, to the extent that such additional elements supplanted the effective reliance on market forces to determine the lowestcost means of reducing emissions, they might increase the overall economic costs of the program even though they might result in a lower allowance price in a cap-andtrade program.[6]

Government policy beyond research and standards directly tied to climate change would also indirectly affect the cost of restricting emissions. The tax treatment of investment could influence the cost and availability of particular technologies. Many experts believe that nuclear power could easily displace a significant amount of fossil fuel use, but only if the regulatory framework was adjusted to allow it. Similarly, existing land-use regulations and highway building might limit efforts to increase urban density and to foster the development of public transportation networks.

Cap-and-Trade Design Features

Many proposals for reducing emissions would include cap-and-trade systems to limit emissions of carbon dioxide and other greenhouse gases. Such systems raise numerous design issues. Four issues are especially important in considering the economic effects of a cap-and-trade system: the coverage and stringency of the cap, the degree of international coordination, flexibility in the timing of emissions reductions, and the allocation of emission allowances.

Coverage and Stringency.—Under a cap-and-trade system, policymakers would face decisions about which emissions to control and when and how much to reduce them. Coverage could sharply affect costs: A given quantity of reductions in greenhouse-gas emissions could be achieved at a lower cost if the cap covered more types of gases and more sources of emissions. For example, although carbon dioxide emissions account for roughly 80 percent of greenhouse-gas emissions, some cuts in emissions of other greenhouse gases, such as methane or nitrous oxide, could be achieved at a relatively low cost. Likewise, even though research suggests that the bulk of reductions in CO_2 emissions would probably come from the electricity-generating sector, cost-effective reductions could also be found in other sectors, such as the transportation and residential sectors. Thus, a cap-and-trade program that covered as many types of greenhouse gases and sources of emissions as possible would be most likely to yield the most cost-effective reductions.

Most recent policy proposals would control nearly all CO_2 emissions from the burning of fossil fuels and would cover at least some emissions of non-CO_2 gases. In recognition of the difficulties in monitoring and measuring emissions, no proposal would include all types of emissions from all sources. Nevertheless, many proposals would provide incentives for sources of emissions that are not covered under the program to voluntarily participate. For example, landowners could earn credits by planting trees that absorb CO_2 from the atmosphere—credits that might then be sold to covered entities who would submit them in lieu of emission allowances. Some proposals would limit the use of such "offsets" to a fixed annual amount or a fixed fraction of total emissions. Greater latitude for such activities by uncovered sources could help moderate the costs of achieving a given emissions target because cheap reductions by uncovered sources could substitute for expensive reductions by covered ones. However, difficulties in ensuring the credibility and permanence of offsets could at least partially undermine their effectiveness in reducing overall costs.[7]

Cumulative U.S. greenhouse-gas emissions through 2050 are projected to total more than 300 billion metric tons of CO_2 equivalent (CO_2e). Recent legislative proposals vary in the magnitude of the reduction in cumulative emissions that they would require. Because requiring larger cuts in emissions would typically require deploying increasingly costly technologies, doubling the magnitude of the cuts required would be expected to more than double the cost of achieving them.

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[6] Congressional Budget Office, How Regulatory Standards Can Affect a Cap-and-Trade Program for Greenhouse Gases, Issue Brief (September 16, 2009).

[7] For additional information, see Congressional Budget Office, The Use of Offsets to Reduce Greenhouse Gases, Issue Brief (August 3, 2009).

International Coordination.—Climate change is an international problem that cannot be resolved without significant international cooperation and coordination. Emissions from anywhere in the world contribute to the global change in climate, so reducing emissions in any single country—even the United States—will do relatively little to avert climate change. Moreover, the stringency of foreign efforts to reduce emissions could strongly influence the cost of limiting them domestically. As long as a significant fraction of the world did not adopt similar policies, some of the reductions in the United States would probably be offset by increases in emissions elsewhere. For example, foreign consumption of oil would rise as declining domestic consumption pushed down international oil prices, and energy-intensive production overseas (and exports of such products to the United States) would most likely grow as domestic manufacturing costs rose relative to foreign costs. Such emissions "leakage" would lead countries that were controlling emissions to incur greater costs while achieving smaller reductions in global emissions.

Leakage could be avoided if most or all countries restricted emissions at the same time. Moreover, if a domestic cap-and-trade system was linked to similar systems in other countries, the United States might benefit from being able to buy low-cost foreign allowances—or it could find that prices for domestic allowances were driven up by foreign demand.

Flexibility in the Timing of Emissions Reductions.—Offering firms subject to the cap flexibility as to when they made cuts in greenhouse gases—by including provisions that would require them to meet the annual caps only on average—could result in substantial cost savings while producing the same effect on the climate.[8] The ability to shift efforts to cut emissions over time could lower costs while achieving an equivalent reduction in warming because of the long-run nature of climate change.

Options for granting flexibility in the timing of emissions reductions fall into two categories. The first category would permit firms to transfer allowances across time. One important such provision would allow regulated entities to "bank" allowances in any given year for use many years after they were initially allocated. If, for example, reducing emissions this year proved less costly than expected, a firm might choose to do so and save some allowances for use in future years. A similar "borrowing" provision would allow firms to use allowances from future years (to be repaid with interest) during earlier periods when particularly high demand led to spikes in the cost of reducing emissions. A variant would create a "reserve pool" of allowances from future years that could be used in earlier years only under certain circumstances, such as when allowance prices rose above a threshold.

The second category of provisions would allow regulators to manage the price or quantity of allowances in a manner that induced a cost-effective time pattern of emissions reductions by specifying a path for allowance prices over time. For example, one such provision would allow annual caps to be exceeded if the market price for allowances rose above some specified value (referred to as a "safety valve"). That value—typically specified to rise over time—would determine the maximum incremental cost in any given period. An alternative provision would set a ceiling and a floor—sometimes called a "price collar"—for the price of allowances.[9]

Allocation of Allowances.—A key decision is how to distribute the value of the allowances. One option would be to have the government capture the value of the allowances by selling them, as it does with licenses to use the electromagnetic spectrum. Another possibility would be to give the allowances to energy producers, some energy users, or other entities at no charge. The European Union has used that approach in its cap-and-trade program for CO_2 emissions, and nearly all of the allowances issued under the 14-year-old U.S. cap-and-trade program for sulfur dioxide emissions are distributed in that way. Giving the allowances away to specific entities is equivalent to selling the allowances and giving the entities cash because those allowances could be sold in a liquid secondary market and thus could be easily converted into cash.

How policymakers decided to use the value of the allowances would affect the overall cost of a policy. For instance, the government could use the revenues from auctioning allowances to reduce existing taxes that tend to dampen economic activity. Some of the effects of a CO_2 cap would be similar to those of raising such taxes: The higher prices caused by the cap would reduce real wages and real returns on

[8] For additional information, see the statement of Douglas W. Elmendorf, Director, Congressional Budget Office, before the House Committee on Ways and Means, *Flexibility in the Timing of Emission Reductions Under a Cap-and-Trade Program* (March 26, 2009).

[9] Ibid.; also see the statement of Douglas W. Elmendorf, Director, Congressional Budget Office, before the Senate Committee on Finance, *The Distribution of Revenues from a Cap-and-Trade Program for CO_2* Emissions (May 7, 2009).

capital, which would be like raising marginal tax rates on those sources of income. Using the value of the allowances to reduce taxes could help mitigate the overall economic impact of a cap. Alternatively, policymakers could increase the cost of meeting the desired cap on emissions if they gave the allowances away in a manner that undermined the market incentives that the cap-and-trade program was intended to provide. For example, if electricity generators were given allowances on the basis of the amount of electricity that they produced with no further restrictions, they would be less likely to pass on the cost of meeting the cap to their customers in the form of higher prices. As a result, their customers would lack an incentive to find cost-effective ways to reduce their use of electricity. Moreover, as discussed below, decisions about how to allocate the allowances would have significant implications for the distribution of gains and losses among U.S. households.

THE AMERICAN CLEAN ENERGY AND SECURITY ACT OF 2009

H.R. 2454, the American Clean Energy and Security Act of 2009, as passed by the House of Representatives on June 26, 2009, would create two cap-and-trade programs for greenhouse-gas emissions—one applying to CO_2 and most other greenhouse gases, and a much smaller one for hydrofluorocarbons—and make a number of other significant changes in climate and energy policy. The cap-and-trade program would restrict greenhouse-gas emissions from covered entities to 17 percent below 2005 levels by 2020 and 83 percent below 2005 levels by 2050.

In the main cap-and-trade program, covered entities would be phased into the program between 2012 and 2016. When the phase-in was complete, the cap would apply to entities that account for roughly 85 percent of total U.S. greenhouse-gas emissions. H.R. 2454 would not restrict the types of entities or individuals that could purchase, hold, exchange, or retire emission allowances in the main cap-and-trade program. An unlimited number of allowances could be banked for future use or sale, and a limited number of allowances could be borrowed from future allocations. A portion of each entity's compliance obligation could be met by purchasing offset credits from either domestic or international providers; in the aggregate, entities could use offset credits in lieu of reducing up to 2 billion tons of greenhouse-gas emissions annually, or more than half the emissions reductions projected around the middle of the policy period (roughly in 2030).

CBO estimates that the price of the allowances under H.R. 2454 would be $15 in 2012, the initial year that the cap took effect, and would rise at an annual real rate of 5.6 percent over the course of the policy, reaching $23 in 2020 and $118 by 2050 (all in 2007 dollars).[10] As a result of the price on emissions, the prices of goods and services throughout the economy would increase in rough proportion to the emissions associated with their production and consumption. At the same time, the allowances would become a source of income for the government or others. The government could capture the value of the allowances by selling them, or it could allow others to capture the value by giving them the allowances for free.

Key design features of H.R. 2454's cap-and-trade policy that influenced CBO's price estimate included:

- Coverage and stringency.—CBO found that allowing firms to comply by purchasing offset credits (from both domestic and international providers) would reduce the allowance price by 70 percent.
- Timing flexibility.—If covered entities were required to use all of their allowances in the designated year, then the price of the allowances would rise at a rate that was dictated by the speed at which the cap became more stringent. Banking helps to smooth out the price path—and compliance costs—over time. In CBO's projections, firms would bank allowances in the early years of the program, when the cap was relatively lenient, leading them to make more emissions reductions than necessary under the cap and pushing up the price of allowances. The accumulated supply of banked allowances would enable firms to meet their requirements under the cap in succeeding periods, helping to moderate allowance prices in later years. Firms would continue to bank allowances up to the point at which the rate of increase in the price of allowances was 5.6 percent, CBO's projection of the rate of return that they would make on alternative investments.

[10] For additional information, see Congressional Budget Office, cost estimate for H.R. 2454, the American Clean Energy and Security Act of 2009, as ordered reported by the House Committee on Energy and Commerce on May 21, 2009 (June 5, 2009). The costs in that estimate refer to federal budgetary costs and not the effects on the U.S. economy described in this testimony. The cost estimate reports allowance prices in nominal dollars. CBO estimates that the price of allowances in nominal dollars will rise from $16 in 2012 to $26 in 2019.

- Allocation.—In general, the allocation of allowances in a cap-and-trade program would not affect the allowance price. An exception to that conclusion would occur if the allowances were allocated in a manner that would tend to undo the higher prices for energy-intensive goods and services that would result from the cap-andtrade program. CBO estimated that the allowance allocation in H.R. 2454 would have a small effect on the allowance price.
- Standards and subsidies.—In general, the imposition of some regulatory standards and the provision of subsidies to develop new technologies would reduce the price of allowances to the extent that those standards or subsidies would change the source of emissions reductions from those that would have occurred with just the cap-and-trade program alone to others that would be motivated by the standard or subsidy. CBO estimated that the standards and subsidies in H.R. 2454 (including those for energy efficiency and for electricity generation that would capture and store CO_2) would lower the allowance price by roughly 10 percent. Most of that reduction would stem from the subsidy for carbon capture and storage. (However, reductions in allowance prices stemming from standards and subsidies could lead to higher, not lower, economywide costs because—to the extent that they generated changes in emissions patterns different from those that would arise from the cap-and-trade program alone—those reductions would not all be made in the most cost-effective manner.)

ECONOMYWIDE EFFECTS OF THE CAP-AND-TRADE PROVISIONS OF THE ACESA

By gradually increasing the prices of fossil fuels and other goods and services associated with greenhouse-gas emissions, climate legislation—including the cap-and-trade provisions of H.R. 2454—would tend to reduce long-run risks from climate change. Such legislation would also reduce economic activity through a number of different channels, although the total effect would be modest compared with expected future growth in the economy. The key channels are:

- Shift production, investment, and employment away from industries involved in the production of carbon-based energy and energy-intensive goods and services and toward industries involved in the development and production of alternative energy sources and non-energy-intensive goods and services;
- Reduce the productivity of existing capital and labor, which are currently geared to relatively inexpensive energy;
- Reduce domestic households' income, thus tending to reduce domestic saving;
- Discourage investment by increasing the costs of producing capital goods, which is a relatively energy-intensive process;
- Reduce net inflows of capital from abroad (because lower productivity and higher production costs for capital goods in the United States would make it more attractive for investors to invest in other countries);
- Reduce the total supply of labor by raising the prices of consumer goods and thus reducing workers' real wages; and
- Interact with the distortions of economic behavior imposed by the existing tax system.

Taken together, those changes would affect the levels and composition of gross domestic product and employment and would thus influence households' economic well-being.

Effects of Emissions Restrictions on Gross Domestic Product

Researchers often report the likely effect of climate policies on the economy in terms of their projected impact on GDP. On the basis of a review of estimates by other analysts, CBO concluded that climate legislation that would significantly reduce greenhouse-gas emissions in the United States would probably reduce GDP by a modest amount compared with what it would be without the legislation. The studies reviewed by CBO yielded a wide range of estimates of losses in GDP from climate policies, but all of them concluded that, all else being equal, higher prices for emission allowances would impose greater losses in GDP. On the basis of those studies, CBO concluded that GDP losses over the entire period of the policy were likely to fall in the range of 0.01 percent to 0.03 percent per dollar of allowance price.[11] CBO then estimated losses in GDP by combining its own estimates for the

[11] In a 2003 review of studies of the potential impacts of the Kyoto Protocol, CBO concluded that GDP would be reduced by 0.018 percent to 0.028 percent per dollar of allowance price (measured in 2007 dollars) for each metric ton of CO_2 equivalent, depending on how the policy was implemented. See Mark Lasky, *The Economic Costs of Reducing Emissions of Greenhouse Gases: A Survey of Economic Models*, CBO Technical Paper 2003-3 (May 2003). A more recent

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prices of allowances under H.R. 2454 with the range of predicted GDP losses per dollar of allowance price.

Using that approach, CBO concluded that the cap-and-trade provisions of H.R. 2454 would reduce the projected average annual rate of growth of GDP between 2010 and 2050 by 0.03 to 0.09 percentage points, resulting in progressively larger reductions in the level of GDP over time relative to what would otherwise occur (see Table 1).* To place the size of those changes into perspective, CBO projects that real GDP in the United States will grow at an average annual rate of about 2.4 percent between now and 2050 and will be roughly two and a half times as large in 2050 as it is today.

The uncertainty about the effects of H.R. 2454 on GDP is probably even greater than is expressed by that projected range of effects, even though the studies reflect a wide range of assumptions about possible future technological developments that might decrease the cost of reducing emissions, and about the degree to which people would adjust their decisions about working, saving, and investing in response to the legislation. All of the analyses that CBO reviewed characterize the economy in a very similar manner; none of them accounts for all of the possible economic effects of the legislation; and none explicitly addresses the uncertainty of its point estimates.

Unchecked increases in greenhouse-gas emissions would also probably reduce output over time, especially later in this century. Those climate-change-induced reductions in output would be moderated if actions that the United States took to reduce emissions were accompanied by similar efforts by other major emitting countries. Nonetheless, CBO concludes that the net effects on GDP of restricting emissions in the United States—combining the effects of diverting resources to reduce emissions and moderating losses in GDP by averting warming—are likely to be negative over the next few decades because most of the benefits from averting warming are expected to accrue in the second half of the 21st century and beyond.

Effects of Emissions Restrictions on Employment

By raising the prices of goods and services in proportion to the covered greenhousegas emissions associated with their production and consumption, climate legislation would affect the total level of employment as well as the distribution of employment among industries. Although supply-and-demand responses in many markets would influence the magnitude of industry-specific and total employment effects, a key consideration is how quickly and extensively labor markets would respond to sustained increases in energy prices. If businesses and workers treated each successive increase in energy prices as a surprise, then adjustment would be slow, and the policy would lead to slightly higher unemployment for some time. If, conversely, businesses and workers exercised foresight and acted in their self-interest, adjustment would occur more quickly, and the policy would have little effect on overall unemployment. In either case, a cap-and-trade program would have adverse effects on workers in specific industries and geographic areas; some provisions of H.R. 2454 are intended to ameliorate those effects.

Economywide Employment.—The cap-and-trade program established by H.R. 2454 would probably have only a small effect on total employment in the long run, but changes induced by the program would still have costs for workers. The increases in the price of energy caused by the program would reduce workers' real wages. Total employment would be lower in the long run to the extent that some workers chose to work fewer hours or not at all—but for nearly all workers, the choice in the long run would probably be to remain in the workforce and accept the prevailing

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review of estimates of the economic effects of H.R. 2454 and similar policies found that the predictions differ considerably for the short and medium term, mainly because the studies incorporate different assessments about the rates at which important markets can be expected to adjust in response to the new policies, but the long-term predictions agree much more closely. After 2030, point estimates of the percentage losses in GDP per dollar of allowance price yield average values similar to the range implied by the 2003 CBO analysis but suggest a wider range. (The high end of that range comes from a model that assumes that the supply of labor responds very sharply to changes in wages.) The studies that CBO reviewed include Environmental Protection Agency, Office of Atmospheric Programs, "EPA Analysis of the American Clean Energy and Security Act of 2009 H.R. 2454 in the 111th Congress" (June 23, 2009); Energy Information Administration, *Energy Market and Economic Impacts of S. 2191, the Lieberman-Warner Climate Security Act of 2007*, Report No. SR-OIAF/2008-1 (April 2008); Sergey Paltsev and others, *The Cost of Climate Policy in the United States* (Cambridge, Mass: MIT Joint Program on the Science and Policy of Global Change, April 2009); Warwick McKibbin and others, "Consequences of Cap and Trade" (fact sheet, Brookings Institution, 2009); and David Montgomery and others, *Impact on the Economy of the American Clean Energy and Security Act of 2009, H.R. 2454* (Washington, D.C.: CRA International, May 2009).

* All tables and figures have been retained in committee files.

wage. Moreover, experience shows that, apart from recessionary periods, the dynamic U.S. economy provides jobs for most people who want to work.

Employment in Different Industries.—The small effect on overall employment would mask a significant shift in the composition of employment over time. A cap-and-trade program for carbon dioxide emissions would reduce the number of jobs in industries that produce carbon-based energy, use energy intensively in their production processes, or produce products whose use involves energy consumption, because those industries would experience the greatest increases in costs and declines in sales. The industries that produce carbon-based energy—coal mining, oil and gas extraction, and petroleum refining—would probably suffer significant employment losses over time. Reductions also would be likely to occur in industries that use those forms of energy intensively or purchase emissions-intensive inputs to their production process from other industries, including chemicals, primary metals, minerals mining, nonmetallic mineral products, transportation, and construction. Among those industries, employment losses in chemicals and transportation services could be relatively large.

The shifts in demand caused by the policy would also create new employment opportunities in some industries. Businesses that produce the machinery necessary to generate energy without CO_2 emissions and that produce that energy—for example, electricity generated by the wind or the sun—would hire more workers. Employment would also probably increase in industry sectors that supply goods and services that use less energy in their production or that require consumers to purchase less energy when using the industry's product. In the automobile industry, for instance, employment would shift from producing vehicles that rely solely on internal-combustion engines fueled by gasoline to producing vehicles with hybrid or electric engines. The largest gains in employment would probably be in service industries.

The shift in employment between sectors of the economy would occur over a long period, as the cap on emissions became progressively more stringent and the allowance price (and, therefore, the price of emissions) became progressively higher. The experience of the U.S. economy over the last half-century in adjusting to a sustained decline in manufacturing employment provides evidence that the economy can absorb such long-term changes and maintain high levels of overall employment. From a peak of almost 20 million jobs in 1979, manufacturing employment fell to about 14 million jobs in 2007. Although manufacturing employment rose and fell with the business cycle over the period, the larger story is one of offsetting job creation and shifts of workers to other sectors of the economy. For example, from 2000 through 2007, employment in manufacturing fell by 3.5 million jobs, while nonmanufacturing private employment increased by 8.2 million jobs.[12]

Job turnover is always large in U.S. labor markets. In 2008, for example, employers reported that they hired about 56 million workers and that about 59 million workers left their jobs.[13] In reviewing several studies that addressed the aggregate employment effects of climate legislation, CBO found a wide range of implied estimates of annual workforce turnover—gross jobs created and gross jobs lost—and concluded that the annual churning in the workforce might range from hundreds of thousands of jobs to several million jobs depending on the year.[14] Even at the high end of that range, the churning of jobs that would be spurred by climate legislation would be small compared with what normally occurs.

The process of shifting employment can have substantial costs for the workers, families, and communities involved. For example, one-quarter of the workers who were displaced from their jobs in 2003—that is, workers who were permanently separated from their jobs because their employers closed or moved, there was insufficient work for them to do, or their positions were abolished—and who were subse-

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[12] For an analysis of the economy's adjustment to a declining demand for U.S. manufacturing, see Congressional Budget Office, *Factors Underlying the Decline in Manufacturing Employment Since 2000*, Issue Brief (December 2008).

[13] See Department of Labor, Bureau of Labor Statistics, *Job Openings and Labor Turnover: January 2009*, USDL 09-0245 (March 10, 2009), Tables 11 to 14.

[14] CBO reviewed a number of studies that addressed the effects of policies like those that H.R. 2454 would put in place, including David Kreutzer and others, *The Economic Consequences of Waxman-Markey: An Analysis of the American Clean Energy and Security Act of 2009*, CDA09-04 (Washington, D.C.: The Heritage Foundation, August 5, 2009); McKibbin and others, "Consequences of Cap and Trade"; Environmental Protection Agency, Office of Atmospheric Programs, "EPA Analysis of the American Clean Energy and Security Act of 2009 H.R. 2454 in the 111th Congress"; Montgomery and others, *Impact on the Economy of the American Clean Energy and Security Act of 2009 (H.R. 2454)*; Energy Information Administration, *Energy Market and Economic Impacts of S. 2191, the Lieberman-Warner Climate Security Act of 2007*; Paltsev and others, *The Cost of Climate Policy in the United States*; and Mun S. Ho, Richard Morgenstern, and Jhih-Shyang Shih, *Impact of Carbon Price Policies on U.S. Industry*, Discussion Paper 08-37 (Washington, D.C.: Resources for the Future, November 2008).

quently reemployed were jobless for 27 weeks or more.[15] Finding a new job might require substantial worker flexibility. Some workers would need to migrate to new geographic areas. An earlier study indicated that in states whose industries were hit by significant adverse shocks between 1950 and 1990, the rate of unemployment generally decreased only when workers moved to different states, a process that often took more than five years to unfold.[16] And some workers might need to acquire new skills more suited to the employment opportunities available to them.

Moreover, some workers would never find the new employment they were seeking. Some might end up working fewer hours than they might prefer. And some might leave the labor force entirely. Almost half of the unemployment spells completed in 2003 ended with the individuals leaving the labor force rather than becoming employed.[17] Women, less-educated workers, and older workers who lose their jobs appear to be more likely to leave the labor force than men, more-educated workers, and younger workers who lose their jobs.[18] Some workers leaving the labor force, especially older or less-educated workers, might opt to seek disability payments that they would not have claimed otherwise.

Even workers who find new jobs might suffer permanent adverse effects. For example, reductions in employment that occur rapidly in particular geographic areas or industries could lead to significant reductions in the lifetime earnings of some affected workers. Even 15 to 20 years later, men who separated from their stable jobs in a mass layoff during the 1982 recession had annual earnings that were 20 percent lower than similar workers who did not experience such a job loss.[19]

Provisions of H.R. 2454 Intended to Ameliorate Those Employment Effects.—Some provisions of the bill—those that would subsidize the development and deployment of technologies that reduced emissions or that would subsidize production by specific industries and firms—would dampen the effects of the policy on employment in industries and areas where they are expected to be most severe.

- Selected provisions of the bill would subsidize petroleum refiners through 2026 and trade-exposed, energy-intensive industries—those in which domestic firms compete with foreign firms that do not bear the cost of complying with comparable policies to control emissions—through 2035. Those subsidies would be linked to output, causing the firms receiving them to produce more than they otherwise would under the cap-and-trade system and in doing so employ more people (although that process also dampens the reallocation of output and employment to industries that produce fewer carbon emissions).
- The bill also includes measures that would decrease the negative effects of the capand-trade system on output and employment in the coal mining and processing industries. Those provisions would establish and provide funding for the Carbon Storage Research Corporation. That entity would, in the 15 years after enactment of the bill, support the development of technologies to capture and store carbon, potentially enabling coal-fired plants to generate electricity without releasing greenhouse gases into the atmosphere. Through 2050, utilities or merchant generators that invested in and operated plants that used those technologies to generate electricity would be paid subsidies to offset the higher costs of that technology. Those subsidies would increase demand for coal and boost output and employment in the coal industry relative to what would occur under the emissions restrictions in the legislation but without those subsidies.
- The bill also would establish the Climate Change Worker Adjustment Assistance program and provide funding of $4.1 billion through 2019 for that program. That program would aim to cushion the effects of the emissions-control policies on workers who lost their job as a consequence of the policy. It also would seek to complement the flexibility evident in U.S. labor markets by providing job training and assisting workers searching for employment.

The Overall Burden on Households

Households' well-being depends on the amount and composition of goods and services they consume as well as how much time they have for nonmarket household

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[15] Data for people who lost jobs in 2003 are from Congressional Budget Office, *Long-Term Unemployment* (October 2007), p. 11.

[16] Oliver Jean Blanchard and Lawrence F. Katz, "Regional Evolutions," *Brookings Papers on Economic Activity*, no. 1 (1992).

[17] See Randy Ilg, "Analyzing CPS Data Using Gross Flows," *Monthly Labor Review* (September 2005), pp. 10–18.

[18] Henry Farber, "What Do We Know About Job Loss in the United States? Evidence from the Displaced Workers Survey, 1984-2004," *Economic Perspectives* (2005), pp. 13-28.

[19] Till von Wachter, Jae Song, and Joyce Manchester, *Long-Term Earnings Losses Due to Mass Layoffs During the 1982 Recession: An Analysis Using U.S. Administrative Data from 1974 to 2004* (April 2009), www.columbia.edu/~vw2112/papers/mass__layoffs__1982.pdf.

activities including leisure. Policies to restrict emissions could affect all elements of households' well-being, and the legislation's overall burden would be determined by the value that people place on those various elements. For example, if people found products and activities that were not greenhouse-gas-intensive to be good substitutes for ones that were, they would be more willing to switch between them. As a result, they would find rising prices for greenhouse-gas-intensive products and activities less burdensome than if there were no good substitutes for them.

Some of those components of well-being—mainly the consumption of marketed goods and services—are included in GDP, but other components are not. Conversely, some components of GDP, such as exports and investment, do not directly affect households' well-being in the same way that consumption does, although they support jobs and provide for the future. A substantial proportion of projected GDP impacts are due to declines in investment, mainly from the increased costs of producing energy-intensive capital goods. Declines in investment translate only gradually into reduced household consumption. As another example, if the policies caused output and real wages to fall, the burden of lower consumption might be partly offset if people also chose to supply less labor and instead devoted more time to valuable nonpaid activities not included in GDP, such as childrearing, production within the home, and leisure activities.

Measuring the overall burden of policies like those embodied in H.R. 2454 requires estimates not only of supply and demand responses in many markets but also of households' valuation of activities that take place outside markets. Such estimates are difficult to obtain and very uncertain. Only two of the analyses of H.R. 2454 reviewed by CBO provide estimates of the overall burden, and the results differ considerably, reflecting differences in assumptions about households' behavior.[20] On the basis of those estimates and of estimates of the burden of other types of policies such as tax shifts and trade liberalization, CBO concludes that the overall burden of H.R. 2454 is likely to be smaller than the projected loss in GDP.

CBO developed an estimate of households' loss in purchasing power as a rough indication of the direct effect that the cap-and-trade program established in H.R. 2454 would have on households. That loss in purchasing power equals the costs of complying with the policy minus the compensation that would be received as a result of the policy.[21] Compliance costs include the cost of purchasing allowances and offsets, and of reducing emissions—costs that businesses would generally pass along to households in the form of higher prices. Compensation includes the free allocation of allowances, receipt of proceeds from the sale of allowances, and profits earned from producing offsets; much of that compensation would be passed to households from businesses and governments.

Although CBO's measure of the loss in purchasing power provides an estimate of the direct effect of the cap-and-trade program on households, it ignores some channels of influence on economic activity and households' well-being that cannot be readily quantified. Some of the omitted channels lead CBO's measure to overstate households' true burden, and some lead CBO's measure to understate the burden. The latest research in this area does not reach a clear conclusion about the relative magnitude of those channels, but it appears that CBO's measure of the loss in purchasing power probably understates to a small degree the true burden of the cap-and-trade program.

On the one hand, in keeping with the standard procedures followed by CBO, the Office of Management and Budget, and the Congressional Budget Committees in identifying federal budgetary costs, CBO estimated the price path for allowances

[20] Some models—including one that provides an estimate of the burden—assume that households are very willing to work less and to shift their consumption away from goods and services that become relatively more expensive. Such models conclude that cap-and-trade policies to reduce carbon dioxide emissions would have a larger effect on GDP (because households would provide less labor to produce goods and services and would save less as well) but would impose only a small overall burden (because households could easily substitute relatively cheaper goods and services for more expensive ones and substitute household production or leisure for work). Much empirical work suggests that the supply of labor is significantly less flexible than those models assume, and CBO's own models and analyses in other areas generally assume less flexibility. By contrast, models that assume that households are relatively inflexible about shifting their consumption of goods, services, and leisure generally (including the other model in CBO's review that provides an estimate of the burden) conclude that policies would have smaller effects on GDP but larger effects on the overall burden (although still somewhat smaller than the GDP effects). Those estimates of the burden do not include any value people place on averting climate change by reducing emissions.

[21] Once the compensation received by U.S. households is deducted from the compliance costs, the remaining loss in purchasing power stems from the cost of reducing emissions and producing domestic offsets, expenditures on international offsets, and the value of allowances that would be directed overseas.

that would reduce emissions to the levels defined by the annual caps without accounting for the effect that the policy might have on GDP. Because the program would reduce GDP (and thus lessen the overall demand for energy), the allowance price required to meet the cap would be slightly lower than CBO's estimate. A lower allowance price, in turn, would lead to a smaller loss in purchasing power. CBO's estimate of the loss in purchasing power, therefore, is slightly larger than would be the case if the agency had accounted for the potential decline in GDP when it estimated the price of allowances. In addition, CBO's measure ignores ways in which the program might interact with distortions of economic behavior (and, thus, costs ultimately imposed on households) generated by the existing tax system. Some of those interactions would tend to reduce overall economic costs. For example, the existing incentive for overconsumption of housing from the mortgage interest deduction might be countered to some extent by higher energy prices, as housing is energy intensive.

On the other hand, CBO's estimate of the loss of purchasing power does not capture all of the ways in which the cap-and-trade program could impose costs on households. There would be transition costs of lost earnings by workers who would become temporarily unemployed or underemployed during the adjustment to higher prices for energy from fossil fuels. There would also be indirect effects on household consumption relative to what would happen in the absence of the cap-and-trade program. The premature obsolescence of existing long-lived capital, such as coal-fired power plants that would no longer generate as much electricity, would reduce household wealth a little (through shareholders' losses) and in turn reduce consumption. Both lower household wealth and higher costs of producing energy-intensive capital goods would reduce domestic saving and investment, leading to slightly lower economic growth and household consumption. Finally, some interactions of the cap-and-trade program with existing taxes could tend to add to economic costs. For example, the increase in prices for fossil fuel energy and energy-intensive goods and services would tend to aggravate distortions in the labor market caused by existing taxes on earnings.

The loss in purchasing power would rise over time as the cap became more stringent and larger amounts of resources were dedicated to cutting emissions—for example, by generating electricity from natural gas rather than coal or by improving energy efficiency. As a share of GDP, the aggregate loss of purchasing power would be 0.1 percent in 2012 and 0.8 percent in 2050, CBO estimates, and would average 0.4 percent over the entire 2012–2050 period. Measured at the projected 2010 level of income, the average per-household loss in purchasing power would be $90 in 2012 and $925 in 2050 and would average about $455 per U.S. household per year over the 2012–2050 period.

EFFECTS ON HOUSEHOLDS IN DIFFERENT INCOME GROUPS

Estimates of the average loss in purchasing power per household do not reveal the range of effects that the program would have on households in different circumstances, including their income level, sectors of the economy in which they work, and regions of the country in which they live. CBO does not have the capability to estimate effects by region or by sector of employment, but the agency does estimate effects on households of different income levels.

Specifically, CBO estimated the effects of the cap-and-trade program established by H.R. 2454 on households in each fifth of the population arrayed by income (and adjusted for household size) on the basis of the provisions of the program as defined for both 2020 and 2050. The loss in purchasing power that would be faced by households at each point in the income distribution would depend on the amount of compliance costs they would bear minus the amount of offsetting real income they would receive as a result of the policy. To show the burden of the loss in purchasing power that households would experience, CBO presents those losses as shares of after-tax income.

Avenues by Which Households Would Incur Costs and Receive Compensation

Estimating the effects of the cap-and-trade program on households in different income brackets entails accounting for the various means by which households would bear compliance costs and receive compensation in their various roles as consumers, workers, shareholders, taxpayers, and recipients of government services.

Compliance Costs.—CBO assumed that businesses would pass the costs of acquiring emissions allowances, purchasing domestic and international offset credits, and reducing emissions on to their customers through higher prices for goods and services. (That assumption, which is standard in distributional analyses, stems from the fact that the price of an item in the long run generally reflects the incremental cost of producing that item.) CBO estimated price increases for categories of goods and

services using a model of the U.S. economy that relates final prices of goods to the costs of production inputs. Households and governments would bear those costs through their consumption of goods and services. Households account for the bulk of total spending, and they would bear an estimated 87 percent of the compliance costs. Those costs were allocated among households on the basis of their consumption of those goods and services as reported in the Consumer Expenditure Survey from the Bureau of Labor Statistics.[22]

The federal government and state and local governments would bear the remainder of compliance costs (an estimated 13 percent) through their spending on goods and services. CBO did not distribute governmental costs across households because their incidence was unclear. If governments chose to increase taxes across the board, the cost would fall on households in proportion to their share of federal, state, and local taxes. In contrast, if governments chose to cover the additional expenses by cutting back on the services they provide, the cost would fall on households that no longer received those services.

Emissions Allowances.—

Under H.R. 2454, the distribution of allowances would change between 2020 and 2050, which would alter the distribution of the loss in purchasing power across households.

In 2020, the government would issue most of the allowances at no cost to private entities, state governments, or the federal government. More specifically:

- 15 percent of the value of the allowances would be set aside for an energy rebate program for households whose gross income does not exceed 150 percent of the federal poverty level or that are receiving benefits through the Supplemental Nutrition Assistance Program, the Medicare Part D low-income subsidy, the Supplemental Security Income program, or other low-income assistance, and for an expansion in the earned income tax credit payable to individuals without qualifying children;
- 16 percent of the value of the allowances would be given to companies that distribute electricity and natural gas, with instructions to pass those benefits on to their residential customers;
- 29 percent of the value of the allowances would be given to those same distributors of electricity and natural gas, with instructions to pass the value on to their commercial and industrial customers;
- 15 percent of the value of the allowances would be given to what are termed trade-exposed, energy-intensive industries—which would be less able to pass their compliance costs on to their customers than would other industries facing less international competition—and oil refiners;
- 18 percent of the value of the allowances would be directed to the federal government and to state governments to spend within the United States (not including the amount used to fund the energy rebate and tax credit). For example, the bill would direct a portion of the value to be spent encouraging the development of particular technologies (such as electricity generation that includes the capture and storage of carbon dioxide) and improvements in energy efficiency; and
- 7 percent of the allowance value would be spent overseas, to fund efforts to prevent deforestation in developing countries, encourage the adoption of more efficient technologies, and assist those countries in adapting to climate change.

The allocation of allowances under the 2050 provisions of the ACESA is quite different from that in 2020, with a much larger fraction of the allowance value flowing directly to households:

- 15 percent of the value of the allowances would continue to be used to fund the energy rebate program and the expansion in the earned income tax credit;
- 54 percent of the allowance value would be used to fund a Climate Change Consumer Refund Account and would be paid on a per capita basis;

[22] The database for the analysis was constructed by statistically matching income information from the Statistics of Income data (from the Internal Revenue Service), households' characteristics from the Current Population Survey (reported by the Census Bureau), and data on households' expenditures from the Consumer Expenditure Survey (from the Bureau of Labor Statistics). The data are from 2006, the latest year for which information from all three sources was available, and thus reflect the patterns of income and consumption in that year. The data were extrapolated to 2010 levels using the estimated overall growth in population and income. For the purposes of this analysis, CBO allocated the cost of reducing all of the gases covered in the cap-and-trade program among households and governments on the basis of their contributions to emissions of carbon dioxide, which constitute more than 85 percent of greenhouse gases.

- 21 percent of the value would be directed to federal and state governments (not counting the shares allocated for household rebates, tax credits, and refunds) to be spent on various objectives, including encouraging investments in clean energy technology, increasing energy efficiency, facilitating adaptation, and protecting wildlife; and
- 10 percent of the value would be spent overseas to fund efforts to prevent deforestation in developing countries, encourage the adoption of more efficient technologies, and assist those countries in adapting to climate change.

For the allowances given to local distributors of electricity or national gas with instructions to pass the benefits on to their residential customers, CBO assumed that the value of those allowances would be received by those households. For the allowances given to those local distributors with instructions to pass the benefits on to their commercial and industrial customers, CBO assumed that the value of those allowances would be received by shareholders, because that allocation of allowances would not generally reduce the cost of producing an incremental unit of output and thus would not generally be passed through to households in the form of lower prices.[23] For the allowances given to trade-exposed industries and oil refiners, CBO assumed that the value would be passed through in the form of lower prices for customers.[24] With the exception of the allowances used to fund household rebates, refunds, or tax credits, CBO lacked sufficient information to distribute the value of allowances that were given to federal or state governments to spend within the United States. CBO also did not distribute among U.S. households the value of allowances that would be spent overseas.

Domestic Offset Credits.—Covered entities would purchase domestic offset credits to comply with the cap under both the 2020 and 2050 provisions of ACESA. Spending on domestic offsets would rise over time because the increase in the price of allowances would make it cost-effective for firms to comply by purchasing increasingly costly offsets. Suppliers of domestic offset credits would experience increases in net income—the gross income received from selling the offsets minus the costs incurred to generate them.[25]

Additional Financial Transfers and Costs That Would Affect Households.—The cap-and-trade program under H.R. 2454 would result in some additional transfers of income—and additional costs—that are not reflected in the gross compliance costs, the disposition of the allowance value, or the net income from domestic offset production. Households would receive additional income in three ways:

- The value of the rebates and tax credits for low-income households in excess of the 15 percent of the allowance value that the bill would set aside to pay for them[26].—That amount would add to the sums received by households but would also increase the cost to the government.
- Increases in government benefit payments that are pegged to the consumer price index, such as Social Security benefits.—Under the assumption that the costs of compliance would be passed through to consumers in the form of higher prices and that the Federal Reserve would not act to offset those price increases, the rise in the consumer price index would trigger increased cost-of-living adjustments in benefits from certain government programs. The increase in those transfer payments would help offset the higher expenditures for the households that received them but would also impose a cost on the federal government.
- Reduced federal income taxes.—Because the federal income tax system is largely indexed to the consumer price index, an increase in consumer prices with no increase in nominal income would reduce households' federal income tax pay-

[23] All increased profits, net of taxes, were allocated to households according to their holdings of equities, which were estimated from the Federal Reserve's Survey of Consumer Finances for 2004. Those holdings include equity held through mutual funds and private pension accounts.

[24] That approach was used to account for CBO's inability to distribute the initial cost of the cap among such firms. The cost of the emissions cap would tend to fall on workers and shareholders in those industries; correspondingly, the relief aimed at those industries (which would be linked to their level of production) would tend to offset costs that workers and shareholders in those industries would otherwise incur. Because of data limitations, CBO assumed for this analysis that the cost of complying with the cap would lead to price increases for those industries. Correspondingly, CBO reflected the value of allowances allocated to those industries as offsetting price decreases.

[25] Like other profits, increased after-tax net income by providers of domestic offsets was allocated to households according to their holdings of equities, which were estimated from the Federal Reserve's Survey of Consumer Finances for 2004. Those holdings include equity held through mutual funds and private pension accounts.

[26] Estimates of the low-income rebates and tax credits were made by CBO and the staff of the Joint Committee on Taxation, respectively.

ments. That effect would increase households' after-tax income but would also add to the federal deficit. Because each of those transfers of income would have equal and offsetting costs (increased Social Security benefits would ultimately need to be paid for by higher taxes or reductions in other government spending, for example), they would neither add to nor reduce the loss in purchasing power associated with the policy. However, because CBO was able to distribute the benefits associated with the transfers but lacked sufficient information to distribute the costs, the transfers do affect the estimated distribution of the loss in purchasing power described below.

Effects of the Policy's Provisions in 2020

CBO estimates that households in the lowest income quintile in 2020 would see an average gain in purchasing power of 0.7 percent of after-tax income, or about $125 measured at 2010 income levels. Households in the highest income quintile would see a loss in purchasing power of 0.1 percent of after-tax income, or about $165 at 2010 income levels (see Figure 1 and Table 2), and households in the middle quintile would experience a loss in purchasing power equivalent to 0.6 percent of after-tax income, or about $310 at 2010 income levels.

Although households in the lowest income quintile would experience a net gain in purchasing power in 2020 under the provisions of H.R. 2454, they would experience the largest financial burden prior to compensation. The price increases triggered by the compliance costs would cause a loss in purchasing power of 2.5 percent of aftertax income for households in the lowest quintile, compared with 0.7 percent of aftertax income for households in the highest quintile. Although the dollar increase in outof-pocket expenditures stemming from the compliance costs would be substantially larger for high-income households ($1,400) than for low-income households ($430), it would impose a larger proportional burden on low-income households because those households consume a larger fraction of their income and because energyintensive goods and services make up a larger share of expenditures by low-income households.

In estimating households' loss of purchasing power, CBO lacked sufficient information to allocate across households in different income brackets the benefits of some proposed government spending programs. In addition, the agency was not able to allocate across households the 13 percent of compliance costs that would be borne by the government as well as other expenditures that the federal government would face as a result of the policy and that would not be funded by revenue from the allowances. The government could finance those expenditures in various ways, including increasing taxes or reducing other spending, which could have very different effects on households at different points in the income spectrum. In 2020, the aggregate amounts of benefits and costs that CBO was not able to allocate across households roughly canceled each other out. As a result, the loss in purchasing power that CBO allocated across households in different income brackets was nearly the same as the average loss in purchasing power experienced by all households in aggregate (0.2 percent of after-tax income, or $160 per household when measured at 2010 income levels).[27]

Effects of the Policy's Provisions in 2050

The cap-and-trade program in H.R. 2454 would have different impacts across households in 2050 than in 2020. CBO estimates that households in the lowest income quintile in 2050 would see an average increase in purchasing power equal to 2.1 percent of their after-tax income, or $355 measured at 2010 income levels (see Table 3 and Figure 2). Households in the highest income quintile would see a loss in purchasing power of 0.7 percent of after-tax income, or about $1,360 measured at 2010 income levels, and households in the middle quintile would have a loss in purchasing power of 1.1 percent of after-tax income, or about $590 at 2010 levels.

In 2050, the aggregate amount of costs that CBO was unable to allocate across households would exceed the aggregate amount of unallocated benefits. In particular, the magnitude of the rebates and tax credits for low-income households in 2050 would be significantly larger than the 15 percent of the allowance value set aside to pay for them. In addition, more revenue would be required to fund the in-

[27] That average loss in purchasing power in 2020 is slightly lower than the $175 reported in CBO's June 2009 analysis (and which CBO referred to as "net economywide cost") because of refinements in CBO's methodology and subsequent changes in legislative provisions. In addition, the allocation of the loss in purchasing power across households is different than in the June 19th analysis because the final version of the bill targeted more relief at households in the lowest income quintile. For more information, see Congressional Budget Office, "The Estimated Costs to Households from the Cap-and-Trade Provisions of H.R. 2454," letter to the Honorable Dave Camp (June 19, 2009).

creases in indexed benefits (such as Social Security income) that would be triggered by higher prices. As a result, the loss in purchasing power allocated across households in different income brackets is only about 60 percent of the estimated aggregate loss in purchasing power (1.2 percent of after-tax income, or $925 per household when measured against 2010 income levels).

Comparison of the Effects of the 2020 and 2050 Policy Provisions

The 2020 and 2050 policy provisions and the losses in purchasing power associated with them have some similarities and some differences.

First, the loss in purchasing power stemming from both the 2020 and 2050 policy provisions would impose the largest burden (measured as a fraction of after-tax income) on households in the middle and next-to-highest income quintiles (see Figures 1 and 2).

Second, the amount of compensation received by households in the lowest income quintile would be substantially higher in 2050 than in 2020. Households in the bottom quintile would receive greater relief in 2050 because they would continue to receive protection in their loss of purchasing power through the low-income rebate and tax credit provisions and would also receive refunds through the Climate Change Consumer Refund Account. If the low-income rebates and tax credits that households received were reduced to account for the Climate Change Refunds that they would also receive, the net gain by the average household in the lowest quintile would be about $135.

Third, the ultimate beneficiaries of the value of the allowances would be more certain in 2050 than in 2020 because most of the allowances in 2020 would be distributed to households via private entities or government programs designed to promote new technologies or energy efficiency. As a result, CBO had to make assumptions as to how the allowances given to private entities would ultimately accrue to households. In contrast, most of the allowance value in 2050 would flow to households directly via rebates from the federal government.

The CHAIRMAN. Thank you very much.

Why don't we go ahead with the other witnesses before we ask questions.

Mr. Newell, I understand this is your first hearing before our committee in your new position as administrator at Energy Information Administration. We welcome you and wish you well in that job.

Mr. NEWELL. Thank you very much.

It is, and I appreciate the opportunity.

STATEMENT OF RICHARD NEWELL, ADMINISTRATOR, ENERGY INFORMATION ADMINISTRATION, DEPARTMENT OF ENERGY

Mr. NEWELL. Mr. Chairman and members of the committee, I appreciate the opportunity to appear before you today. The Energy Information Administration is the statistical and analytical agency within the U.S. Department of Energy. By law, our data, analyses, and forecasts are independent of approval by any other officer or employee of the U.S. Government. Therefore, our views should not be construed as representing those of the Department of Energy or the administration.

The cap-and-trade program that is the centerpiece of H.R. 2454, the American Clean Energy and Security Act, establishes caps on covered greenhouse gas emissions through 2050. EIA's analysis focuses on the 2012 to 2030 period, during which the cumulative cap on covered emissions represents a 21-percent reduction requirement from the 113 billion metric tons of covered emissions in EIA's baseline projection. The actual reduction in covered emissions over the 2012 to 2030 period could be larger if covered entities decide to build a significant bank of allowances by 2030, or smaller if they decide to purchase less expensive offsets as a substitute for reductions in covered emissions.

I'll focus now on certain key findings and insights from the analysis.

First, I should say that, while I believe it is critical to undertake analyses of the type discussed here today, one must be humble and cautious when making projections decades into the future. There are a number of important but uncertain assumptions that must be made and that are critical to understanding the ultimate results of analysis.

All analyses of this type must establish a baseline projection against which the effects of a policy scenario are measured. These baseline assumptions are one of the most important determinants of the estimated impacts of any change in policy relative to that baseline. EIA's baseline uses the April 2009 revision of the Annual Energy Outlook Reference Case, which takes into account impacts of the recent economic slowdown, as well as the American Recovery and Reinvestment Act.

EIA's analysis shows that the estimated impacts of H.R. 2454 on energy prices, energy use, and the economy are highly sensitive to assumptions about the availability and cost of both international offsets as well as no- and low-carbon technologies for power generation. The six main analysis cases considered in EIA's report reflect a range of different assumptions about these factors. The scenarios help inform decisions about policy design and provide insight into how policies might perform under alternative conditions.

As shown in figure 1 of my written testimony, allowance prices through 2030 are more than four times larger, using the least favorable assumptions, than using the most favorable ones. EIA's other cases, which we believe to be more likely, lie within this range. Future energy prices are additional factors in future allowance-price uncertainty.

Another important factor is policy design, including provisions for allowance trading, banking, and borrowing, which can increase the opportunities for cost-effective reductions. Provisions for allowance price ceilings and floors can also reduce price uncertainty.

Regarding consumer energy prices, as shown in figure 2 of my testimony, EIA's result suggests that the free allocation of allowances to electricity and natural gas distributors significantly lowers direct impacts on consumer electricity and natural gas bills prior to 2025.

EIA also modeled the combined efficiency and renewable electricity standard included in H.R. 2454. We found it does not play a significant role in driving the generation mix because its requirements appear likely to be met as a result of existing State-level mandates, Federal incentives for renewable energy, and the carbon price itself.

Turning to energy system impacts, as shown in figure 4 of my testimony, electricity-related reductions account for 80 to 88 percent of overall reductions in energy-related CO_2 emissions in 2030, even though electricity comprises 41 percent of such emissions. Among other things, this result occurs because over 90 percent of coal is used in the electricity sector, yet, there are several alternative no-and low-emission electricity generation technologies already demonstrated, and others are being developed.

In contrast, the transportation sector is 95 percent dependent on petroleum, with comparatively few low-and no-greenhouse gas alternatives that work readily within the current system. Therefore, while transport comprises 34 percent of U.S. energy-related CO_2 emissions in 2030, a relatively smaller 5 to 8 percent of reductions come out of the transportation sector in EIA's analysis.

Turning to the aggregate economic impacts, the left-hand panels of figure 6 in my written testimony compare the cumulative reductions in gross domestic product, or GDP, and consumption across different analysis cases. All impacts are measured relative to the Reference Case. The total discounted GDP change over the 2012-to-2030 period is -0.3 percent in the Basic Case, with a range from -0.2 percent to -0.9 percent across the main cases that we analyzed.

The change in personal consumption is somewhat lower than this and other measures of economic impact, such as consumption per household and impacts on household energy bills, are also developed and discussed in the detailed report.

Mr. Chairman, members of the committee, this concludes my testimony, and I'd be happy to answer any questions.

Thank you.

[The prepared statement of Mr. Newell follows:]

PREPARED STATEMENT OF RICHARD NEWELL, ADMINISTRATOR, ENERGY INFORMATION ADMINISTRATION, DEPARTMENT OF ENERGY

Mr. Chairman, and members of the Committee, I appreciate the opportunity to appear before you today to discuss the recent U.S. Energy Information Administration (EIA) analysis of the energy and economic impacts of H.R. 2454, the American Clean Energy and Security Act of 2009 (ACESA).

EIA is the statistical and analytical agency within the U.S. Department of Energy. EIA collects, analyzes, and disseminates independent and impartial energy information to promote sound policymaking, efficient markets, and public understanding regarding energy and its interaction with the economy and the environment. EIA is the Nation's premier source of energy information and, by law, its data, analyses, and forecasts are independent of approval by any other officer or employee of the United States Government. The views herein therefore should not be construed as representing those of the Department or the Administration.

EIA's analysis of ACESA focuses on those provisions that can be readily analyzed using our National Energy Modeling System (NEMS). Key provisions of ACESA that are represented include:

- the cap-and-trade program for greenhouse gases (GHGs) other than hydrofluorocarbons, including provisions for the allocation of allowances to electricity and natural gas distribution utilities, low-income consumers, State efficiency programs, rebate programs, energy-intensive industries, and other specified purposes;
- the combined renewable electricity and efficiency standard for electricity sellers;
- the carbon capture and storage (CCS) demonstration and early deployment program;
- Federal building code updates for both residential and commercial buildings; and
- Federal efficiency standards for lighting and other appliances.

Provisions that are not represented in EIA's analysis include the Clean Energy Deployment Administration, the strategic allowance reserve, the separate cap-and-trade program for hydrofluorocarbon emissions, the GHG performance standards for activities not subject to the cap-and-trade program (e.g., methane emissions from coal mines and landfills), the distribution of allowances to coal merchant plants, new efficiency standards for transportation equipment, and the effects of increased investment in energy research and development.

The choice of a baseline is one of the most influential assumptions for any analysis of climate and energy legislation. The starting point for EIA's analysis is an updated version of the *Annual Energy Outlook 2009 (AEO2009)* Reference Case issued in April 2009 that reflects the projected impacts of the American Recovery

and Reinvestment Act, which was enacted in February 2009. The *AEO2009* also reflects other significant energy laws, including the Energy Improvement and Extension Act of 2008, the Energy Independence and Security Act of 2007, and the Energy Policy Act of 2005 (the latter two laws, following their enactment, were reflected in AEOs prior to the 2009 edition).[1] This baseline projection through 2030 is not meant to be an exact prediction of the future but rather represents a plausible energy future given technological and demographic trends, current laws and regulations, and consumer behavior as derived from available data. EIA recognizes that projections of energy markets extending more than 20 years into the future are highly uncertain and subject to many events that cannot be foreseen, such as energy supply disruptions, policy changes, and technological breakthroughs. In addition to these phenomena, long-term trends in technology development, demographics, economic growth, and energy resources may evolve along a different path than expected in the projections. Generally, differences between cases, which are the focus of the report, are likely to be more robust than the specific projections for any one case.

Relative to their emissions in 2005, sources covered by the ACESA cap-and-trade program must reduce their emissions 3 percent by 2012, 17 percent by 2020, 58 percent by 2030, and 83 percent by 2050. Over the 2012 to 2030 period covered by EIA's analysis, the cumulative cap on covered emissions totals 89 billion metric tons (BMT) of carbon dioxide-equivalent (CO_2e), representing a 21-percent or 24.6-BMT reduction requirement from the 113 BMT of covered emissions in EIA's baseline over the same period. The actual reduction in covered emissions over the 2012 to 2030 period could be either larger or smaller than this requirement. Actual reductions could be larger during this period because covered entities may have an incentive to hold a significant bank of allowances in 2030 to help them meet increasingly stringent caps that apply between 2030 and 2050. Actual reductions in covered emissions could be smaller than required to the extent offsets are used as a substitute.

This testimony briefly summarizes projected impacts on energy prices, energy use, and economic activity as well as several key findings and additional insights drawn from EIA's analysis. The complete analysis report, which includes a description of the bill, EIA's modeling approach and results, as well as a discussion of uncertainties, caveats, and additional analysis cases, has been provided to the Committee and is available on EIA's web site (www.eia.doe.gov).

Starting with key findings and insights, EIA's analysis shows that the estimated impacts of the ACESA on energy prices, energy use, and the economy are highly sensitive to assumptions about the availability and cost of international offsets as well as no- and low-carbon technologies for power generation. The six main analysis cases considered in EIA's report reflect a variety of different assumptions regarding these factors, with the Zero Bank and High Offsets cases representing the most favorable situations for ease of compliance with the ACESA cap-and-trade program and the No International/Limited Case representing the least favorable situation. As discussed below, GHG allowance prices and economic impacts through 2030 are more than 4 times larger using the least favorable assumptions than using the most favorable ones. EIA's other cases, which we believe to be more likely, lie in between these alternative cases.

It is well-known that some key technologies for reducing emissions face a variety of technical challenges (e.g., CCS) and, in some cases, additional questions regarding public acceptance of their widespread deployment arising from concerns unrelated to global climate change (e.g., nuclear power). As noted in EIA's previous analyses, barriers to potentially cost-effective low-and no-emissions technologies can be directly influenced by policy choices, including regulatory planning and siting decisions, incentives for early technology deployment, as well as the design of a cost-containment mechanism.

EIA's results also suggest that the free allocation of allowances to electricity and natural gas distributors significantly lowers direct impacts on consumer electricity and natural gas prices prior to 2025, when it starts to be phased out. While this result may serve goals related to regional and overall fairness of the program, the overall efficiency of the cap-and-trade program is reduced to the extent that the price signal that would encourage cost-effective changes by consumers in their use of electricity and natural gas is delayed.

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[1] The development of the updated Reference Case is described in a recent EIA report, *An Updated Annual Energy Outlook 2009 Reference Case Reflecting Provisions of the American Recovery and Reinvestment Act and Recent Changes in the Economic Outlook*, SR/OIAF/2009-03 (Washington, DC, April 2009), web site http://www.eia.doe.gov/oiaf/servicerpt/stimulus/index.html.

In previous hearings, EIA has been asked about the main factors contributing to allowance price uncertainty under a cap-and-trade program. In addition to uncertainty regarding the cost and availability of international offsets and key no-and low-carbon technologies, future energy prices also play an important role in determining the cost and energy price impacts of meeting a fixed emissions target. Policy design is another important factor in allowance price behavior, including the design of provisions for allowance trading, banking, and borrowing, additional cost-containment mechanisms, and market oversight. The strategic allowance reserve in ACESA, which is not addressed in EIA's analysis, focuses on the important issue of short-term volatility in allowance prices but does not appear to address longer-term cost containment. Specifically, following a startup period, the strategic allowance reserve in ACESA relies on a "trigger price" for auctions that is set in relation to recent allowance prices, which does not appear to preclude a scenario in which allowance prices evolve along a relatively high trajectory given underlying conditions that would support such an outcome, such as those examined in the No International and No International/Limited cases.

Let me now turn briefly to the specific results of EIA's analysis.

ALLOWANCE AND ENERGY PRICE IMPACTS

Figure 1* shows that, under ACESA, allowance prices—the key driver of energy price impacts—vary widely depending on assumptions regarding the availability and cost of international offsets and key no-and low-carbon electricity technologies such as nuclear and coal with CCS.

ACESA increases delivered energy prices, but effects on electricity and natural gas bills of consumers are substantially lessened through 2025 by the allocation of free allowances to regulated electricity and natural gas distribution companies. For example, Figure 2 shows that electricity prices in five of the six main ACESA cases range from 9.5 to 9.6 cents per kilowatthour in 2020, lower than recent prices and only 3 to 4 percent above the Reference Case level.[2] Average impacts on electricity prices in 2030 are projected to be substantially greater, reflecting both higher allowance prices and the phase-out of the free allocation of allowances to distributors between 2025 and 2030. By 2030, electricity prices in the ACESA Basic Case are 19 percent above the Reference Case level, with a wider band across all six main policy cases. As shown in Figure 3, electricity price impacts in 2030 vary significantly by region—in general, larger price impacts occur in those regions that are most reliant on coal and have competitive wholesale power markets.

Almost all of the increase in household energy costs prior to 2025 arises from the increases in the delivered price of motor fuels, stemming from the requirement that fuel producers or importers hold enough emissions allowances to cover the emissions that result when their product is used by consumers. Even so, the gasoline price changes anticipated to result from ACESA are much smaller than the changes experienced over the past several years.

ENERGY SYSTEM IMPACTS

As shown in Figure 4, the vast majority of reductions in energy-related emissions are expected to occur in the electric power sector. Across the ACESA main cases, the electricity sector accounts for between 80 percent and 88 percent of the total reduction in energy-related carbon dioxide (CO_2) emissions relative to the Reference Case in 2030, even though electricity comprises only 41 percent of such emissions. Emission reductions in the electricity sector come primarily from reducing conventional coal-fired generation, which in 2007 provided 50 percent of total U.S. generation. A portion of the electricity-related CO_2 emissions reductions results from reduced electricity demand stimulated both by consumer responses to higher electricity prices and incentives in ACESA to stimulate greater energy efficiency.

There are several reasons for the concentration of emissions reductions in the electric power sector. First, over 90 percent of coal, the fuel with the highest carbon content, is used in the electricity sector. Second, while coal-fired generation is a major source of current and projected Reference Case emissions, there are several alternative generation sources already demonstrated (e.g., natural gas, renewables, and nuclear) and others are being developed (e.g., fossil with CCS). Third, changes in electricity generation fuels do not require fundamental changes in distribution infrastructure or electricity-using equipment.

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* All figures have been retained in committee files.

[2] The average electricity price in the No International/Limited case in 2020 is 10.7 cents per kilowatthour. The recent 12-month rolling average electricity price through the end of May 2009 was 10.06 cents per kilowatthour.

In contrast, the transportation sector is 95 percent dependent on petroleum for fuel, with its own dedicated distribution network and associated vehicle technologies, and comparatively few low-or no-GHG alternatives that work readily within this system. Recent U.S. experience and relatively high fuel prices over an extended period in Europe and other world regions illustrate that major shifts in transportation energy use are not likely to be induced by the impact of the ACESA cap-and-trade program on the price of motor fuels. Therefore, while transport comprises 34 percent of U.S. CO_2 emissions in 2030, a relatively smaller 5 to 8 percent of reductions come out of the transportation sector in EIA's analysis.

In addition to changing the projected mix of electricity generation sources, as shown in Figure 5, ACESA is likely to increase the total amount of new electric capacity that must be added between now and 2030 in most of our analysis cases. The requirement for capacity additions beyond the Reference Case, which poses siting challenges for both generation and transmission facilities, reflects the retirement of many existing coal-fired power plants that would be expected to continue operating beyond 2030 absent the limitations on GHG emissions required under ACESA.

GDP AND HOUSEHOLD CONSUMPTION IMPACTS

In the process of reducing GHG emissions, ACESA increases the cost of producing energy, which reduces real economic output, reduces purchasing power, and lowers aggregate demand for goods and services. While a broad economic assessment of ACESA would also take into account the benefits of GHG reductions—through lower climate change impacts—this is beyond the scope of EIA's modeling capacity. EIA's analysis therefore focuses on the cost side of this balance, while the benefits can be inferred from the magnitude of resulting emission reductions.

The result is that projected real gross domestic product (GDP) is generally lower relative to the Reference Case, as are emissions. Note, however, that even including the highest cost scenario analyzed by EIA, the economy is still projected to continue to grow at a rate of 2.5 percent or more on average from 2012 to 2030. The left-hand panels of Figure 6 compare the cumulative reductions in GDP and consumption over the 2009-through-2030 period across cases. All impacts are relative to the Reference Case. The total discounted GDP change over the 2012-to-2030 time period is -0.3 percent in the ACESA Basic Case, with a range from -0.2 percent to -0.9 percent across the main ACESA cases. Similarly, the cumulative discounted change in personal consumption is -0.2 percent in the ACESA Basic Case and ranges from -0.1 percent to -0.7 percent across the main cases.

Consumption and energy bill impacts can also be expressed on a per household basis in particular years. In 2020, the reduction in consumption is $134 per household (2007 dollars) in the ACESA Basic Case, with a range of $30 to $362 across all main ACESA cases. In 2030, household consumption is reduced by $339 in the ACESA Basic Case, with a range of $157 to $850 per household across all main ACESA cases. By 2030, the estimated reductions in household consumption in the ACESA No International/Limited Case, at the top of these ranges, are approximately double the impacts in the ACESA High Cost Case, which has the next highest level of impacts.

While addressing GHG emissions is a challenge of unprecedented scale in terms of its implications for our energy system, the scale of the economy itself is also huge. Therefore, the same estimated economic impacts from any given analysis can be expressed in ways that may appear either large or small. Figure 6, which in its right hand panels presents the same results discussed above but in terms of the absolute levels of GDP and consumption in 2020 and 2030, shows how this framing matters. EIA strives, however, to present our results as neutrally as possible.

Mr. Chairman and members of the Committee, this concludes my testimony. I would be happy to answer any questions you may have.

The CHAIRMAN. Thank you very much.

Mr. Harvey, why don't you go right ahead and give us the EPA's perspective.

STATEMENT OF REID P. HARVEY, CHIEF, CLIMATE ECONOMICS BRANCH, OFFICE OF AIR AND RADIATION, ENVIRONMENTAL PROTECTION AGENCY, ACCOMPANIED BY ALLEN FAWCETT

Mr. HARVEY. Thank you, Mr. Chairman and Ranking Member Murkowski, members of the committee. Thank you for the opportunity to testify about EPA's analysis of H.R. 2454.

EPA's overall cost estimates of the bill are similar to those of CBO's and EIA's; and so, in view of that, I'll focus on several policy implications of our analyses that may be useful to you in the Senate as you continue your deliberations. The details of our analyses are available on EPA's Web site.

It is important to note at the outset that EPA's analysis did not assess the costs if we don't act to reduce greenhouse gases, to weigh the cost of action against the cost of inaction, or to compare the costs of H.R. 2454 with other policy approaches to reduce greenhouse gas emissions.

The U.S. Global Change Research Program, in its June 2009 report, described the impacts that we're already seeing and that are likely to dramatically increase, this century, if we allow global warming to continue unchecked. In the report, it documents how communities throughout America would experience increased costs, including for more sustained droughts, increased heat stress on livestock, more frequent and intense spring floods, and more frequent and intense forest wildfires.

Over the last several years, EPA's analyses of cap-and-trade approaches in climate change legislation have shed light on three key factors that are important to the cost of a cap-and-trade program: one, the coverage and cumulative reductions of the cap; two, the type and availability of offsets; three, the penetration of new technologies and existing technologies. I'll describe each of these in turn.

First, our analysis of H.R. 2454 and related Senate bills tells us that what affects overall costs are the cumulative emissions reductions that the bills would achieve over decades, rather than the cap level that they set for any particular year. Because H.R. 2454, like several recent Senate bills, allows emissions allowances to be banked over time, its 2050 cap drives overall behavior and encourages banking in the early years of the cap-and-trade program. In other words, just changing the 2020 cap alone does not have a significant effect on total costs if all else stays the same. Costs will be lower the sooner that we start acting, but a national commitment to meeting these long-run emissions targets is key.

Second, allowing capped sources to meet some of their obligation through offsets lowers costs significantly. Our analysis of offsets was aided by our experience managing and analyzing emissions trading programs and voluntary programs, such as our methane programs. We found, through several scenario analyses, that delaying or limiting the ability to use low-cost international or domestic offsets to meet compliance obligations increased costs substantially, compared to the core case with full availability of offsets. For example, if no international offsets were allowed, allowance prices would be 89 percent higher than the core case.

Moreover, we found that the number of international offsets purchased is sensitive to other policy provisions in the bill. For example, we conducted sensitivities with respect to the energy efficiency provisions of H.R. 2454 that we modeled for the core case. Without the energy efficiency provisions, we found that the allowance price increased by about 2 percent. But, the number of international offsets purchased under that scenario rose by 11 percent, to compensate.

So, it's important to note that the cost and availability of international offsets will be influenced by factors beyond U.S. policy choices, including the efforts of other nations to mitigate their emissions, and that there will always be some uncertainty about the future cost and availability of offsets.

Third, penetration of low- or no-carbon technologies, such as renewable technologies, nuclear power, and carbon capture and storage, increases substantially by 2050 under H.R. 2454 and similar Senate bills in the 110th Congress that we analyzed. For H.R. 2454, we estimated that these technologies would grow as a share of primary energy by 18 percent to 2020, to 26 percent by 2030, and to 38 percent by 2050, compared to a steady share of 14 percent in the business-as-usual case. So, these results demonstrate the key importance of placing a price on carbon emissions to incentivize the deployment of low- or no-carbon technologies.

However, there's much uncertainty about the rate at which various technologies will penetrate. For example, the availability of nuclear power has a significant impact on our results. We used estimates of the costs of nuclear power from EIA, and we constrained the growth of nuclear power generation, using the same assumptions as those used by the U.S. Climate Change Science Program, which assumes that nuclear generation could increase by 150 percent by 2050.

We also conducted sensitivity analyses, holding nuclear power to reference levels. We found that if the additional nuclear capacity were not available, allowance prices would increase by 15 percent. We also saw, in the short term, that H.R. 2454 would reduce overall electricity demand.

Furthermore, financial incentives, such as bonus allowances for early deployment of carbon capture and sequestration, were found to increase deployment of cleaner technology in the near term.

Overall, our analysis of H.R. 2454 highlights some of the factors that will affect the costs of meeting particular emissions targets that are inherently uncertain, such as the availability of offsets or the potential for technological advances. How these underlying uncertainties translate into uncertainty about the cost of a cap-and-trade program depends on the kinds of cost-containment provisions that are incorporated in the program.

In conclusion, these three factors and their effects on costs are among the most important to consider in crafting climate change legislation. Our work, along with those of the other agencies represented on this panel, hopefully will provide some guidance on the likely outcomes of different policy choices.

Thank you, again, for this opportunity to discuss EPA's analyses, and I look forward to any questions you may have.

[The prepared statement of Mr. Harvey follows:]

PREPARED STATEMENT OF REID P. HARVEY, CHIEF, CLIMATE ECONOMICS BRANCH, OFFICE OF AIR AND RADIATION, ENVIRONMENTAL PROTECTION AGENCY

Mr. Chairman, Ranking Member Murkowski, and Members of the Committee, thank you for the opportunity to testify today about EPA's analysis of H.R. 2454, the American Clean Energy and Security Act.

EPA's overall cost estimates of the bill are similar in many respects to those of the Congressional Budget Office (CBO) and the Energy Information Administration (EIA). In view of those similarities, I will focus on several policy implications of our analyses that may be useful as the Senate continues its deliberations. The details of our analyses, along with the underlying data and spreadsheets, are available on EPA's website (www.epa.gov/climatechange/economics/economicanalyses.html).

It is important to note at the outset that EPA's analysis did not attempt to assess the costs if we don't act to reduce greenhouse gases; to weigh the costs of action against the costs of inaction; or to compare the costs of H.R. 2454 with other policy approaches to address GHG emissions. The U.S. Global Change Research Program (in its June 2009 report, "Global Climate Change Impacts in the United States") described the impacts that we are already seeing and that are likely to dramatically increase this century if we allow global warming to continue unchecked. In the report, it documents how communities throughout America would experience increased costs, including from more sustained droughts, increased heat stress on livestock, more frequent and intense spring floods, and more frequent and intense forest wildfires.

Over the last several years, EPA's analyses of cap-and-trade approaches in climate change legislation have shed light on three key factors that are important to the costs of a cap-and-trade program:

1. the coverage and cumulative reductions of the cap;
2. the type and availability of offsets; and
3. the penetration of new and existing technologies.

I'll describe the implications of each of these factors in turn.

First, our analysis of H.R. 2454 and related Senate bills tells us that what affects overall costs are the cumulative emissions reductions the bills would achieve over decades, rather than the cap level they set for any particular year. Because H.R. 2454 (like several recent Senate bills) allows emission allowances to be banked over time, its 2050 cap (an 83% reduction from 2005 levels by 2050) drives overall behavior and encourages banking in the early years of the cap-and-trade program. In other words, just changing the 2020 cap alone does not have a significant effect on total costs if all else stays the same. Costs will be lower the sooner we start acting but a national commitment to meeting these long-run emission reduction targets is key.

Second, allowing capped sources to meet some of their obligation through offsets—emission reductions achieved by non-capped sources—lowers costs significantly. Our analysis of offsets was aided by EPA's experience managing and analyzing emissions trading and voluntary programs, such as our methane programs. We found through several scenario analyses that delaying or eliminating the ability to use low-cost international or domestic offsets to meet compliance obligations increased costs substantially compared to the core case with full availability of offsets. For example, if no international offsets were allowed, allowance prices would be 89 percent higher than the core case. Moreover, we found that the number of international offsets purchased is sensitive to other policy provisions in the bill. For example, we conducted sensitivities with respect to the energy efficiency provisions of H.R. 2454 that we modeled for the core case. Without the energy efficiency provisions, we found that the allowance price increased by about two percent, but the number of international offsets purchased under that scenario rose by 11 percent to compensate. It is important to note that the cost and availability of international offsets will be influenced by factors beyond U.S. policy choices, including the efforts of other nations to mitigate emissions, and that there will always be some uncertainty about the future cost and availability of offsets.

Third, penetration of low or no-carbon technologies, such as renewable technologies, nuclear power, and carbon capture and storage (CCS), increases substantially by 2050 under H.R. 2454 and similar Senate bills in the 110th Congress that we have analyzed. For H.R. 2454, we estimated that these technologies would grow, as a share of primary energy, to 18 percent by 2020, to 26 percent by 2030, and to 38 percent by 2050, compared to a steady share of 14 percent in the business-as-usual case. These results demonstrate the key importance of placing a price on carbon emissions to incentivize the deployment of low and no-carbon technologies. However, there is much uncertainty about the rate at which various technologies

will penetrate. For example, the availability of nuclear power has a significant impact on our results. We used estimates of the cost of nuclear power from EIA, and constrained the growth of nuclear power generation using the same assumptions as used by the U.S. Climate Change Science Program in developing their *Scenarios of Greenhouse Gas Emissions and Atmospheric Concentrations* report, which assumes that nuclear generation could increase by 150 percent by 2050. We also conducted sensitivity analyses holding nuclear power growth to reference levels and found that, if the additional nuclear capacity were not available, allowance prices would increase by 15 percent. We also saw in the short-term that H.R. 2454 would reduce overall electricity demand. Furthermore, financial incentives, such as bonus allowances for early deployment of carbon capture and sequestration were found to increase deployment of cleaner technology in the near term. Overall, our analysis of H.R. 2454 highlights some of the factors that will affect the costs of meeting particular emission targets that are inherently uncertain, such as the availability of offsets or the potential for technological advances. How these underlying uncertainties translate into uncertainty about the cost of a cap-and-trade program depends on the kinds of cost-containment provisions that are incorporated in the program.

In conclusion, these three factors and their effects on costs are among the most important to consider when crafting climate change legislation. Our work, along with those of the other agencies represented on this panel, hopefully will provide some guidance on likely outcomes of different policy choices. Thank you again for this opportunity to discuss EPA's analyses and I look forward to any questions you may have.

The CHAIRMAN. Thank you very much.

Mr. Fawcett, you're available to answer questions, is that right?—but didn't plan to testify?

Mr. FAWCETT. Correct.

The CHAIRMAN. All right.

Dr. Parker, why don't you go right ahead, with your testimony.

STATEMENT OF LARRY PARKER, SPECIALIST IN ENERGY AND ENVIRONMENTAL POLICY, CONGRESSIONAL RESEARCH SERVICE

Mr. PARKER. Thank you, sir. My name is Larry Parker. On behalf of the Congressional Research Service, Brent Yacobucci and I would like to thank the committee for its invitation to testify here today about cost projections of H.R. 2454.

CRS has completed a review and synthesis of seven studies that attempt to project the cost of the bill's cap-and-trade program. Before I summarize these analyses, I must state a caveat. It is difficult, and some would consider it unwise, to project costs out to the year 2030, much less beyond. The already tenuous assumption that current regulatory standards will remain constant becomes more unrealistic and other unforeseen events loom as critical issues that cannot be modeled. Hence, long-term projections are, at best, speculative and should be viewed with attentive skepticism. The finer and more detailed the estimate presented, the greater the skepticism should be.

But, if models cannot accurately predict the future, they can indicate the sensitivity of a program's provisions to various economic, technological, and behavioral assumptions that may assist policymakers in designing a greenhouse gas reduction strategy.

The various cases presented here do provide some important insights in the costs and benefits of H.R. 2454 and its many provisions. We have summarized these into six points:

No. 1, if enacted, the ultimate cost of H.R. 2454 would be determined by the response of the economy to the technological challenges presented by the bill. The potential for new technology to re-

duce the cost of H.R. 2454 is not fully analyzed by any of the cases, nor can it be. The process of technology development and dissemination is not sufficiently understood at the current time for models to replicate with any long-term confidence. In the same vein, it is difficult to determine whether or not the various incentives provided by the bill are directed in an optimum manner. In many cases, the bill focuses on specific technologies and not on broader research and development strategies.

No. 2, the distribution of allowance value under 2454 will determine who bears much of the program's cost. The allowances created by H.R. 2454 are essentially licenses to emit greenhouse gases, and therefore, will have market value based on supply and demand. Total allowance value could approach or exceed $100 billion annually. The bill transfers that value to a wide range of covered and noncovered entities. Those entities receiving that value will bear less of the program's cost, compared to those who do not. The major impact of H.R. 2454's allowance allocation scheme is not in changing the cost required to comply with the program's requirement, instead it is to change who bears those costs.

No. 3, the cases studied generally indicate that the availability of offsets, particularly international offsets, is a major factor in determining the cost of H.R. 2454. Sensitivity analysis found that eliminating international offsets would raise allowance prices by 60 percent or more. In general, those studies that assumed a restrictive supply of offsets projected higher allowance prices than cases that ramped up the availability of offsets.

No. 4, the interplay among the various cases between nuclear power, renewables, natural gas, and coal-fired capacity with carbon capture and storage emphasizes the need for a low-carbon source of electric generating capacity in the mid- to long-term. The cases presented here do not agree on the amount of new generating capacity necessary under the bill, or the mix of fuels and technologies that would be employed. The estimated amount of capacity constructed depends on the case's assumption about the need for new capacity and the replacement or retirement of existing capacity, along with consumer-demand response to the rising prices and incentives contained in the bill.

No. 5, attempts to estimate household effects or conduct other fine-grained analysis are fraught with numerous difficulties. Estimates generated reflect more on the philosophies and assumptions of the cases reviewed than on any credible future effect. Decisions about appropriate welfare measure, household size, and discounting, and, indeed, the value of government services in general, dwarf any insight that can be gained from these estimates. For example, estimates of household effects in the studies reviewed vary by an order of magnitude even when normalized by household size and accounting method.

No. 6, H.R. 2454's climate-related environmental benefit is best considered in a global context and the desire to engage the developing world in the reduction effort. When the United States and other developed countries ratify the 1992 United Nations Framework Convention on Climate Change, they agreed both to reduce their own emissions to help stabilize greenhouse gas emissions, but to take the lead in reducing those gases.

This global scope raises two issues for H.R. 2454; first, whether the bill's greenhouse gas reduction program and other provisions would be considered sufficiently credible by developing countries so that schemes for including them in future international agreements becomes more likely; and second, whether the bill's reductions meet U.S. commitments to stabilization under the international treaty and would occur in a timely manner.

Thank you. I will be happy to answer any questions you may have.

[The prepared statement of Mr. Parker follows:]

PREPARED STATEMENT OF LARRY PARKER AND BRENT YACOBUCCI, SPECIALISTS IN ENERGY AND ENVIRONMENTAL POLICY, CONGRESSIONAL RESEARCH SERVICE

My name is Larry Parker. On behalf of the Congressional Research Service, Brent Yacobucci and I would like to thank the Committee for its invitation to testify here today about cost projections of H.R. 2454, which would establish a cap-and-trade program to reduce U.S. greenhouse gas emissions through the year 2050. CRS has just completed a review and synthesis of seven studies that attempt to project the costs of H.R. 2454 to the year 2030 or 2050.

Before I summarize the analyses, I must state a caveat: It is difficult (and some would consider it unwise) to project costs out to the year 2030, much less beyond. The already tenuous assumption that current regulatory standards will remain constant becomes more unrealistic, and other unforeseen events (such as technological breakthroughs) loom as critical issues which cannot be modeled. Hence, long-term cost projections are at best speculative, and should be viewed with attentive skepticism. The finer and more detailed the estimate presented, the greater the skepticism should be. In the words of the late Dr. Lincoln Moses, the first Administrator of the Energy Information Administration: "There are no facts about the future."

But if models cannot accurately predict the future, they can indicate the sensitivity of a program's provisions to varying economic, technological, and behavioral assumptions that may assist policymakers in designing a greenhouse gas reduction strategy. The various cases examined here do provide some important insights on the costs and benefits of H.R. 2454 and its many provisions. We have summarized these insights into six points.

First, if enacted, the ultimate cost of H.R. 2454 would be determined by the response of the economy to the technological challenges presented by the bill. The bill provides numerous price, research and development, deployment, and regulatory incentives for technology innovation. The potential for new technology to reduce the costs of H.R. 2454 is not fully analyzed by any of the cases examined, nor can it be. The process of technology development and dissemination is not sufficiently understood at the current time for models to replicate with any long-term confidence. In the same vein, it is difficult to determine whether the various incentives provided by the bill are directed in an optimal manner. In many cases the bill focuses on specific technologies and not on broader research and development strategies.

Second, the distribution of allowance value (either through free allocations or auction revenue) under H.R. 2454 will determine who bears much of the program's cost. The allowances created by H.R. 2454 are essentially licenses to emit a metric ton of carbon dioxide equivalent, and, therefore, will have market value based on supply and demand. Total allowance value could approach or exceed $100 billion (2005$) annually—-significantly more than the projected resource costs to comply with the bill's emissions reduction requirement. H.R. 2454 transfers that value to a wide range of covered and non-covered entities. Those entities receiving that value will bear less of the program's costs compared with those who do not. The major impact of H.R. 2454's allowance allocation scheme is not in changing the resource costs required to comply with the program's requirement; instead, it is in changing who bears those costs.

Third, the cases studied generally indicate that the availability of offsets (particularly international offsets) is a major factor in determining the cost of H.R. 2454. Sensitivity analyses generally found that eliminating international offsets would raise allowance prices by 60% or more. In general, those studies that assumed restrictive (and in some cases, declining) offset supply projected higher allowance prices. Cases that ramped up availability of offsets generally projected lower allowance prices. No case assumed that the full amount of offsets permitted under H.R. 2454 would be available or used immediately in 2012.

Fourth, the interplay between nuclear power, renewables, natural gas, and coal-fired capacity with carbon capture and storage (CCS) among the cases emphasizes the need for a low-carbon source of electric generating capacity in the mid-to long-term. A considerable amount of low-carbon generation will have to be built under H.R. 2454 in order to meet the reduction requirement. The cases presented here do not agree on the amount of new generating capacity necessary under the bill, or the mix of fuels and technologies that would be employed. The estimated amount of capacity constructed depends on the cases' assumptions about the need for new capacity and replacement/retirement of existing capacity under H.R. 2454, along with consumer demand response to the rising prices and incentives contained in the bill. Here again, technological development will be critical.

Fifth, attempts to estimate household effects (or conduct other fine-grained analyses) are fraught with numerous difficulties; estimates generated reflect more on the philosophies and assumptions of the cases reviewed than on any credible future effect. Decisions about appropriate welfare measure, household size, and discounting, and, indeed, the value of government services in general, dwarf any insight that could be gained from such estimates. For example, estimates of household effects in the studies reviewed vary by an order of magnitude, even when normalized by household size and accounting method. Likewise, fine-grained analysis of effects on specific states and/or economic sectors are similarly suspect.

Sixth, H.R. 2454's climate-related environmental benefit is best considered in a global context and the desire to engage the developing world in the reduction effort. When the United States and other developed countries ratified the 1992 United Nations Framework Convention on Climate Change (UNFCCC), they agreed both to reduce their own emissions to help stabilize atmospheric concentrations of greenhouse gases and to take the lead in reducing greenhouse gases. This global scope raises two issues for H.R. 2454: (1) whether the bill's greenhouse gas reduction program and other provisions would be considered sufficiently credible by developing countries so that schemes for including them in future international agreements become more likely, and (2) whether the bill's reductions meet U.S. commitments to stabilization under the UNFCCC and occur in a timely fashion so that global stabilization of atmospheric greenhouse gas concentrations may occur at an acceptable level.

Thank you, We will be glad to answer any questions you may have.

The CHAIRMAN. Thank all of you for your excellent testimony.

Let me start with 5 minutes of questions, and then we'll just take turns and get through as many questions as we can.

One issue—and maybe, Dr. Elmendorf, you could comment on this first—this whole issue of the baseline that we're talking about here is one that I think is particularly troublesome—the baseline projection of economic growth going forward and also of emissions, particularly in light of the recession that we find ourselves in. My understanding is, there's been about an 8-percent reduction in emissions from 2007 levels that we're experiencing this year. What is CBO's view of what the appropriate projection ought to be—or baseline projection—if we're talking about a 20-percent cut in emissions—or maybe 17 percent is what the House bill calls for—17 percent from 2005 levels by 2020. Where does that 17 percent start getting counted from?

Mr. ELMENDORF. So, Mr. Chairman, as several witnesses have emphasized, the baseline plays a crucial role in the estimates. We and, I think, many of the modelers use the baseline emissions projections of the Energy Information Administration. Maybe Richard could speak to the logic that underlies that baseline. But, that's what we and others tend to follow. You're right, that is one of the many sources of uncertainty and sensitivity in our analysis.

The CHAIRMAN. Dr. Newell, did you have any thoughts about the appropriate baseline?

I guess one question that has to be answered in order to develop one of these models is, Are we expecting to get back to the 2007 level of GDP, here, in the near future, and then build off of that?

Or, is this a new level we're starting at here? How do you answer those issues, Dr. Newell.

Mr. NEWELL. As I mentioned in my testimony, the baseline that EIA has used was an update of the Annual Energy Outlook 2009 forecast. Every year, EIA puts out a forecast of energy supply, demand, and CO_2 emissions through 2030. This year we'll actually do it through 2035.

In April, due to the significant changes in the near-term outlook, particularly due to the economic downturn, and then, in response, the Recovery and Reinvestment Act, EIA actually did an unusual thing and updated its forecast.

In the near-term, that forecast was lower than it was before, primarily due to the economic downturn. As you pointed out, our estimate for this year is that emissions are likely to be 5.9 percent lower than they were last year, primarily, again, due to the economic downturn.

In terms of what that's going to look like, moving forward, a lot of that, over the next several years, depends on the rate of economic recovery, which, as we know, has a significant degree of uncertainty associated with it. But, over the longer term, we expect that, in the absence of additional policies of the type that we're discussing around here today, emission growth would return roughly to what it was before the economic downturn.

The CHAIRMAN. Let me ask about this offset issue, here. EPA's analysis of the House-passed legislation has shown that having no offsets at all in the first 10 years of the program results in a very small increase in the overall price of carbon allowances. I gather you do that by assuming that the offsets that will be acquired in those early years of the program will not be used for compliance obligations; instead, they will be used for banking. They will be banked for future years. Am I understanding your analysis correctly? Is this assumption you're making, that all of these allowances are going to be banked, is this the same assumption that others are making, as well? Or are you sort of an outlier on that issue?

Mr. HARVEY. That's correct. Our analysis showed that if you delay the international offsets' availability by about 10 years—so, instead of being available in 2012, they were available in 2022—the effect on the overall allowance prices would be about 3 percent. We're using a model that has foresight out to 2050, and so, people are looking at the availability of the international allowances occurring after 2022, and their behavior reflects that long-term approach. So, it's an outcome of our model and of other models that would reflect banking.

The CHAIRMAN. My impression is that this is very different from the assumptions built into some of the other analyses that have been made. Let me ask Dr. Parker if that's accurate.

Mr. PARKER. Of course, a couple of the other analyses, in fact, restrict the use of offsets altogether. For example, the one by the Heritage Foundation does not allow any banking whatsoever and also has a declining availability of offsets over time. Likewise, the study done for the National Association of Manufacturers has a very high effective discount rate of 10 percent on future investments. Therefore, you would not tend to bank very much there, because you're thinking very short-term. So, most of the studies, I

would say, follow the line that EPA is, that if these allowances are—if these offsets are available at less than the current allowance price, that people will buy them, bank them in anticipation of higher allowance prices down the road.

So, I would say most of the studies follow the logic of EPA. But, there are these couple of other studies which use higher effective discount rates, and therefore, people are thinking much shorter-term. They do not bank.

Mr. ELMENDORF. Mr. Chairman, could I just add, for——

The CHAIRMAN. Sure.

Mr. ELMENDORF. [continuing]. On behalf of CBO, that because of—we do expect there will be banking of offsets and allowances in the early years that would be—then be used later, when the caps become more stringent.

Because of the possibility of banking, what matters for the price of allowances in the near term is the entire expected path of demand for allowances and the supply of allowances and the supply of offsets. So, the total amount of offsets available over the entire next 40 years plays a very important role in the price of allowances that we estimate. But, taking allowances away for just a few years doesn't matter very much, because that's only a small share of all the allowances that will be available over the entire period, and it doesn't matter as much when they're available because of this possibility of banking. So, the total supply of offsets is critically important in the estimates, as several of us have discussed, but we expect that the supply would increase a good deal over time as more international agreements were negotiated so that there—we don't think there's as much offset supply in the first few years. That's part of why that amount itself is not as important for the allowance price as the total amount of offsets.

The CHAIRMAN. Thank you very much.

Senator MURKOWSKI. Thank you, Mr. Chairman.

Mr. Elmendorf, let's start with you. In the CBO analysis, you have identified a cost figure of about $175 a year, and that's been kind of catchy, because it is "a postage stamp a day" has been cited. In that analysis, you're looking at the year 2020. By 2020 it's probably fair to say that the most severe and the most drastic of the greenhouse gas limits haven't gone into effect, so the costs—we would expect them to be somewhat lower.

Dr. Parker has suggested that it is "skeptical". When looking beyond 2020, the crystal ball gets a little more difficult to read. Why did you choose 2020 as the—year to set this analysis? Can CBO produce an analysis, or estimates, for the years 2030, 2050, with any degree of reliability, when we know this is when we anticipate these more drastic cuts?

Mr. ELMENDORF. So Senator, our initial analysis was about 2020. We chose that as a year at which the provisions of the House bill—this is what we were referring to at the time—would have been, essentially, phased in. Everything would be up and running. But yet, it was not so far off as to seem so completely hypothetical. I mean, it is certainly true, that the uncertainties are very large, even for 2020. They get larger over time. So, we thought it had a concreteness—more tangibility to it, in a way that would be useful for people. But, we understand that's only one snapshot, in a sense,

of the effects of the legislation. In the report we released a few weeks ago in preparation for this hearing, we, in fact, have redone the distributional analysis for 2050, as well as for 2020. 2020 numbers are slightly different, because the final version of the House bill that we've now used was different than the version that we used at the time.

So, our estimate that the net loss in purchasing power in 2020 would be $160 per household, but in 2050 would be $925 per household. Those are both expressed, I should say, in comparable years. The actual nominal amounts would be much greater. So, just as you suspect, and as others suspect, the cost in 2050 is many times the cost in 2020—it's from $160 to $925.

Senator MURKOWSKI. I have got some questions. I think we could spend all morning here, with you but I would like to follow up, in the next round, about the whole aspect of discounting and appreciating how that factors in.

Mr. Harvey, I wanted to ask you a question, because you had suggested in your comments this morning that the impacts of climate change on the globe, whether it's drought, whether it's intense spring flooding, fires—the impact is real. But, in looking at the costs that we're talking about, with the various analyses that are out there, none of them really tell us whether or not the bill will achieve the stated objective of mitigating global climate change. When you were analyzing the House bill, did you take into consideration the impact of projected greenhouse gas levels, or did you look at whether or not temperatures are increasing, whether sea levels will increase?

Mr. HARVEY. No, Senator, we did not do that analysis for the House bill. We did something similar for that in the Senate several years ago, but not for the House bill.

Senator MURKOWSKI. Why didn't you do it in the House one, then?

Mr. HARVEY. We weren't asked to.

Senator MURKOWSKI. OK.

This will need to be a quick question for whoever wants to answer. When discussing the importance of climate change, one of the underlying reasons that we should move forward is from a national security perspective, because it will allow us to reduce the amount of oil that we have to import. Can any of you speak to the extent to which the House bill is projected to reduce our reliance on foreign imports of oil?

Mr. Elmendorf, you're saying, "No."

Mr. Newell.

Mr. NEWELL. Yes, as part of our analysis, we did look at that issue, and we find that oil imports decline by 8 to 24 percent, or 1 to 2 million barrels per day. That's by 2030, under a range of scenarios. So, yes, it does lead to a reduction in petroleum consumption and most of that reduction in petroleum consumption actually comes out of imports, in our projections.

Senator MURKOWSKI. Dr. Harvey, you looked at the same?

Mr. HARVEY. We did not look at the import question, no.

Senator MURKOWSKI. Dr. Parker.

Mr. PARKER. Basically, three of the models gave us enough information to talk about the general use of oil—not necessarily im-

ports, but oil itself. The EIA did it. MIT did it. They showed a somewhat larger reduction in oil supply. By 2030, they said the amount of oil would go down by almost 20 percent. So, if that 20 percent of total oil usage came out of imports, that's obviously a much higher percentage of oil that would be—oil imports that would be reduced. If you assume it's about half or three-quarters imports, that would all come out of that sector. So, that analysis was done for them.

Also, one of the EPA models, the ADAGE model provided, also, its reductions in oil usage, and that number is roughly the same as EIA's number.

Senator MURKOWSKI. Thank you, Mr. Chairman.

Mr. FAWCETT. Explicitly, the ADAGE model shows, in 2030, 700,000 barrels-per-day savings in oil primary energy use.

The CHAIRMAN. Senator Shaheen.

Senator SHAHEEN. Thank you, Mr. Chairman.

Mr. Elmendorf, you testified that your analysis looked at the costs of the House bill, but not any potential gains from the changes that are being talked about. Why is that?

Mr. ELMENDORF. We were able to quantify the direct costs for households, meaning both the gross costs of complying with legislation and the return of money to them through the allowance value, and so on. Assessing the economic impacts of climate change in that quantitative way is very, very difficult. The uncertainty that we've all talked about looms very large there.

We have written about the effects of climate change drawing on other people's research, in terms of both the climate and the economy. We talk about some of those in my written remarks.

One estimate that we draw on, what seems to us to be perhaps the most comprehensive estimate now, is that by 2100—in other words, the end of this century—there could be a loss equivalent to about 5 percent of U.S. output. That's not just in measured GDP, it also incorporates nonmarket damages and costs associated with the risk of a catastrophic outcome; puts that cost—that loss as equivalent to about 5 percent of U.S. output.

Most of that loss would be later in the century, as we understand—everybody understands; it's the cumulative amount of greenhouse gases that lead to these climate changes. So, those costs tend to be backloaded over the coming century. So, our view is that, over the next few decades, the economic losses from policies to avert climate change would exceed the economic gains, in terms of climate change. At some point over the longer term, those lines may cross as the expected risk and the—the expected costs and the risk of climate change rise. But, we just aren't able to quantify those, and the crystal ball really does just get too hazy for us to want to be attaching exact dollar values to that. It's just a limitation, I think, of the science.

Senator SHAHEEN. So, let me run this question to other people on the panel.

Has anybody looked at the potential gains to the economy from transition to new energy technologies and energy efficiency, in terms of job created, manufacturing output increases or reductions, anything like that?

Mr. Harvey.

Mr. HARVEY. I was going to say that we have not assessed the benefits of the legislation. But, in our analysis of our vehicle rule recently, we showed that the benefits of that to address—to reduce greenhouse gas emissions from vehicles would be about $250 billion over the lifetime of the vehicles that were sold from 2012 to 2016. Those benefits really greatly exceed the costs, which are less than $60 billion. That's not just the greenhouse gas benefits of the vehicle rule, but it's also fuel savings, particulate-matter benefits, and energy security.

We haven't analyzed the job question in our model, because it's a full-employment model.

Senator SHAHEEN. Has anybody else?

Dr. Newell, have you looked at potential gains as the result of some of these policy changes, as well as costs?

Mr. NEWELL. No. EIA's modeling capacity is limited to focusing on the energy sector and the CO_2 emissions associated with that.

Senator SHAHEEN. Dr. Parker.

Mr. PARKER. The only ones who claim to have done work on the green jobs issue was CRA International. But, they found in their study that the green job benefit was completely overcome by the losses in the more traditional manufacturing sector. So, it was a net deficit.

Mr. ELMENDORF. Senator, could I just add that in our——

Senator SHAHEEN. Yes.

Mr. ELMENDORF. I was speaking before to our analysis of the effects climate change itself.

Senator SHAHEEN. Right.

Mr. ELMENDORF. In terms of the employment, we do talk about, and have drawn on some outside research on, trying to quantify that. As I said, there's certainly a decline in employment in fossil-fuel-intensive parts of the economy. There is an increase in employment in nonfossil-fuel-intensive parts of the economy. The net effect of that, we think, would likely be some decline in employment during that transition, because labor markets do not move that fluidly. Workers live in certain places, with particular skills, and they can't, immediately turn out living in some other place, with a different set of skills.

But, there's no doubt that the—there's a—very significant shifts from some places to other places in the economy, and the GDP effects that we draw on from other people's estimates in our own work, are meant to incorporate both sides of that, both the losses in some areas and the gains in others.

Senator SHAHEEN. Thank you.

My State of New Hampshire is part of the Regional Greenhouse Gas Initiative that is already involved in a program to address carbon reductions among our utilities. One of the things that modeling for RGGI has shown is that investing in energy efficiency has considerable benefits: to cut energy consumption and to reduce demand for emission allowances in the underlying costs of electricity.

Have any of these models looked at the potential benefits for energy efficiency and what that would mean if there were an emphasis on energy efficiency as part of a policy change to address climate change?

Mr. Harvey.

Mr. HARVEY. Sure. Yes. We have looked at some of the energy efficiency provisions that were in the House bill, and we see improvements in energy efficiency that are driven by two factors. The first is energy efficiency results in the modest increases in energy prices that result from the cap. So, there's increased investment in more energy efficient technologies, and that leads to reduced energy demand. Then, second, we modeled some of the specific provisions of the bill which contained—for example, combined efficiency renewable electricity standard, building codes, and allowance allocations to States and to gas utilities, in support of energy efficiency. What we found in some of the areas where we took out the energy efficiency provisions to try to isolate their effect, and, without those provisions, that we found that the price changes result in the reduction of electricity demand of about almost 7 percent by 2030. When we modeled the energy efficiency provisions, they found that they reduced demand by about 5 percent. So, they definitely have an effect.

Senator SHAHEEN. Did anybody else do anything that you think is significant in this area?

Dr. Newell.

Mr. NEWELL. Yes. The Energy Information Administration, in our analysis, also incorporated most of the provisions related to energy efficiency that were in the H.R. 2454, and they do provide a cost-effective means of reducing greenhouse gas emissions, along with the other supply side alternatives.

Senator SHAHEEN. Thank you.

Mr. ELMENDORF. Senator, I could just add quickly, if I might, that our estimate of allowance prices is built off estimates from the literature about how responsive the economy will be over time to changes in prices. That incorporates, implicitly, some assumption about the development of new technologies.

We looked explicitly at the renewable electricity standard in the House bill, but our view is similar to those of others, that it was not likely to be a binding standard; that, in fact, that amount of renewable electricity would be created anyway under the other incentives in the bill.

Beyond that, there are other standards and subsidies in the House bill that we think would lead to some additional energy efficiency improvements, and that would hold down our estimate of the allowance price by a little bit.

Senator SHAHEEN. Thank you.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you.

Before we go on to more questions, we did notify folks we were going to try to report two nominations today.

[Recess.]

The CHAIRMAN. Senator Corker, you're next.

Senator CORKER. Thank you, Mr. Chairman.

Thank all of you for your testimony. It's much appreciated.

To Dr. Elmendorf and Newell, since the point of cap-and-trade is to reduce carbon emission by increasing the price of carbon, therefore reducing consumption—I mean, I think that's the point of all of this—isn't it counterproductive to give away free allowances to the utility sector, in that what you're doing is causing that pricing

mechanism that is there to reduce consumption not to be, if you will, "learned," if you will, by the consumers? Doesn't that also cause the cost of the program to be even greater, because that moves it over to other sectors?

If both of you could respond to that, I'd appreciate it.

Mr. ELMENDORF. So, Senator, it would be counterproductive to give away allowances in a way that reduced the price of electricity—of using an extra kilowatt-hour of electricity. Because, you're right that the purpose—the way in which the cap-and-trade system encourages development of alternative energy sources and encourages efficiency is to raise the price of electricity. So, if one counteracts that price signal, then one's diminished that channel of influence. But if, on the other hand, one can give allowances to a utility and say, "We'll give them back to the customers, not on a reduction in the price per kilowatt-hour, but just give back a flat amount per customer," for example—if you do it that way, then that doesn't change my incentive to turn up the air-conditioning, because I would still pay the same incremental cost of having a cooler house. So, it depends, critically, on not just who they're given to, but what the restrictions are on how that money can be used in affecting the price to the ultimate users.

Senator CORKER. Dr. Newell, agree? Disagree?

Mr. NEWELL. I would roughly agree.

The issue of the allowance allocation, be it to electrical utilities or to others, depends on how that is then used. If it's used to keep prices lower than they otherwise would be, due to increased cost of carbon emissions—which is purpose of the policy, then you would be eliminating an incentive for a cost-effective emission reductions through conservation or energy efficiency.

Senator CORKER. Since we're on the subject right now, I'll skip down to another question, that—wouldn't we be better off just selling or auctioning all of the allowances and reducing—either giving a dividend back to taxpayers or reducing some other cost, instead of creating the sort of Rube Goldberg mechanism that this bill envisions?

Mr. ELMENDORF. So, Senator, you know, the CBO does not make policy recommendations. I think that——

Senator CORKER. From the standpoint of having——

Mr. ELMENDORF [continuing]. The differences——

Senator CORKER [continuing]. The proper result.

Mr. ELMENDORF [continuing]. In how the—as long as one doesn't distort the price signal to—for greater energy efficiency and for substituting other forms of fuel, then how one gives away those allowances—the value of the allowances—whether by giving the allowance away or by selling them and giving the money away, is basically a distributional question. It's who bears the burden. That is incredibly important, perhaps, in the design of the policy, but not something about which economists have a particular comparative advantage in judging. But, it is very important, as you said, if you want the maximum efficiency in reducing carbon emissions, to not give the allowances away in a fashion that reduces the price signal.

Senator CORKER. My fear is, it's going to be very difficult to give them out to the utilities and that not be the case.

Mr. ELMENDORF. It's a challenge in policy design. Yes, Senator.

Senator CORKER. So, one would have to say, if someone were looking at the flaws in how this might work, that would be an area one might examine.

Mr. ELMENDORF. I would say it's an area that one needs to construct very carefully to preserve that price signal. Yes, sir.

Senator CORKER. So, to you Dr. Newell, I noticed, in your testimony, you talked a lot about many of the uncertainties that exist. Wouldn't we be just a whole lot better off to alleviate the uncertainties, especially as it relates to offsets and those kinds of things, by just utilizing a carbon tax and lowering another tax so that there's no net gain, if you will, by government consumption of taxes?

Mr. NEWELL. There are a number of different design options within either a cap-and-trade system or a carbon tax to address issues of what the price of carbon would be.

In fact, when you start getting into the specific designs, the distinctions between them become grayer. Within a cap-and-trade system, you can incorporate price ceilings, price floors, which——

Senator CORKER. Which is like putting in place a tax, right? If you have a price ceiling and a price floor, it's a backhanded way of just having a tax, isn't it?

Mr. NEWELL. A cap-and-trade system, at a fundamental level, is a policy that allocates emission allowances. So, there are distinctions, as opposed to being written into the tax code. The other distinction is that, in terms of an energy tax, a cap-and-trade system is on emissions, as opposed to energy, per se. So——

Senator CORKER. It just seems that it would be a far more transparent way of dealing with this issue. You know, we're creating this policy, or at least this bill contemplates creating a policy, that has a lot of human giving away of free allowances, all kinds of things that distort the market, and it just seems that if, truly, the goal was to lower the amount of carbon, there would be a proposal just to tax it and to lower some other tax and be done with it. It seems to me that the Treasury Secretary, or somebody, could raise or lower that over time, to try to hit 2020 targets and we'd be done with this, instead of this mechanism where, in essence, we're—sort of have a command-and-control situation through central government. It just seems like if you're going to get from A to B, a better way to get from A to B.

But, I realize my time is up. Mr. Chairman, thank you for the 1-minute-and-45-seconds indulgence.

The CHAIRMAN. Not a problem.

Senator LANDRIEU.

Senator LANDRIEU. Thank you.

Let me follow up on those questions, because I think they're very important, about market volatility. In the current economic climate, this is a major issue that many are concerned about.

As you all know, oil closed at 71.77 a barrel just on Friday. But, analysis that I've looked at shows that there's a two-thirds probability that oil will be as high as $99 or as low as $43. You all are all familiar with the ups and downs of this market. So, my question is, Does the House bill help us to reduce volatility in this price, or will it contribute to the volatility of this price? Have you all analyzed that? If so, if you'd comment.

Mr. ELMENDORF. So, Senator, we have not analyzed the effects of this proposal on the volatility of oil prices. I think the issue of volatility in the price of allowances, and the way that would pass through to the prices that households and businesses faced, is a very real one. That's one of the reasons that a lot of analysts would favor a carbon tax over a cap-and-trade system, as Senator Corker was suggesting. In fact, a number of features of the cap-and-trade system, though, as it is written into the House legislation, are designed to reduce the volatility of allowance prices to——

Senator LANDRIEU. By setting the ceiling and the floor.

Mr. ELMENDORF [continuing]. To move that system in the direction of a carbon tax, in terms of trying to maintain a steadier price on carbon emissions.

Senator LANDRIEU. Because I would argue that one of our goals should be—I mean, not just cleaning the environment, but stabilizing these prices in a way that allow industries to make smart decisions. Part of problem with our current system, but also part of the problem with the House approach, is that it's not really doing anything to reduce the volatility. I think that's a big problem. At least, it is from the State that I represent, that can't seem to get a handle on where prices are going, so they don't know whether to invest money, whether to rent the rigs. We've got low rig counts while we have a lot more oil and gas out there, and a lot more opportunities to produce.

So, I'm glad that you mentioned that, and I'm glad that Senator Corker raised it, because I think it's a real challenge, as we move forward.

Let me move on, though, to another aspect that I'm concerned about. Senator Murkowski questioned you about the reduction of crude oil, based on your analysis. You said that crude oil will be reduced by 20 percent, or something. I'm not sure which one of you. Analysis that I've been reading, while they recognize that crude oil might be reduced, but refined petroleum products, they're claiming, will be increased because of the loss of manufacturing and refinery capacity, or the results or consequences on the refining industry.

Could you, No. 1, clarify if it is actually true, and why? Is it a volume reduction, or is it a percentage of reduction which is—I think it's a significant difference of crude—and then, how it affects refined products—did you all do any analysis on that?

Mr. NEWELL. The numbers that I had given earlier, which were a }to-24-percent reduction in petroleum-based liquid fuels, would include both crude oil and refined products—that would be the reduction in 2030. In terms of the breakdown between crude and refined products, I don't have that with me right now. But, I'd be happy to get that to you.

Senator LANDRIEU. But, focused on imports, we understand that we will be—if we stay on the same path as the House bill, the impact to the domestic refining industry will be contracted so that we will not be refining our own product, we'll be refining our products offshore and importing them. Is that what your analysis shows? Or should we look again?

Mr. NEWELL. Again, I don't have the specific numbers in front of me on the implications for domestic petroleum versus imported petroleum products.

[The information follows:]

Petroleum import disposition: What is the breakdown of the projected impact of H.R. 2454 on imports of refined products, versus the impact on crude oil imports?

Net petroleum imports are projected to decline from 12.1 million barrels per day in 2007 to 8.3 million barrels per day in 2030 in the *AEO2009* reference case. In 2007, crude oil imports accounted for 83 percent of all petroleum imported. Beyond 2007, EIA projects that the crude oil share of total petroleum imports will rise slightly due to an overall decrease in petroleum consumption, caused first by higher prices and then by the recession. However, by 2030, EIA projects the crude oil share of imports will return to about 83 percent. In the main cases of EIA's analysis of H.R. 2454, net petroleum imports are projected to decline to between 7.6 and 6.3 million barrels per day in 2030. Crude oil isprojected to continue to account for the vast majority—between 84 and 87 percent—of petroleum imported into the United States.

While we are confident that crude oil will continue to represent the predominant share of net petroleum imports, EIA recognizes that the share of net imports of refined products in total net petroleum imports can be sensitive to the future implementation of H.R. 2454. For example, regulations to be developed under proposed section 787 of the Clean Air Act (CAA) in H.R. 2454 to allocate among refiners the allowances provided to the refinery sector by proposed CAA section 782, will play a significant role in determining the net impact of H.R. 2454 on the cost of energy used at domestic refineries. Changes in domestic refiners' cost of energy used onsite relative to that borne by their foreign competitors will also depend to a significant extent on the details of emissions reduction programs that affect foreign refiners. Lacking clear guidance in the language of H.R. 2454 or the details of emissions reduction efforts in other countries, these issues were not examined in our analysis. Beyond changes in relative energy cost, other factors that will continue to affect trade flows in refined products are differences in regional production and consumption slates, and the competitiveness of individual refinery configurations, which depend on price differentials across different grades of crude oil and different product types.

Senator LANDRIEU. If you all would look at that—because it's very important—because another focus that I'm going to have is not just cleaner environment, but more economic security and national security. Having to import more refined products is not moving us in the right direction.

I know I have only 8 seconds, so I'm going to ask my question and then ask you to submit it in writing.

Have you all analyzed the approach, maybe using cap-and-trade for the utility sector, but using a different approach for the transportation energy sector? You know, sort of looking at the sectors differently. The utility electric sector using one approach and maybe getting to our goals through the transportation sector a different way?

I know that's not what the bill contemplates in the House, but just any broad analysis, real quickly?

Mr. ELMENDORF. So, we have not, I think, looked at that question, specifically. I think the general point to remember is that the broader the coverage of sources of carbon dioxide emissions, and the more they're included in the bill, and the more flexibility that households and businesses have in choosing where and when and how to reduce carbon emissions, the lower will be the overall cost of a given amount of emissions reductions. The more that you and your colleagues specify particular sources of emissions reductions, the less you are allowing the market forces to determine what is the most cost-effective way of reducing those emissions.

Senator LANDRIEU. Thank you.

The CHAIRMAN. Senator Barrasso.

Senator BARRASSO. Thank you very much, Mr. Chairman.

Thank you all for being here today.

Mr. Elmendorf, if I could, in your testimony you said "If this bill passes, I think, that it would come at a cost to the economy, that there would be permanent job shifts, and that, while those shifts were occurring, total unemployment would be reduced so that unemployment would essentially go up; for families, there would be a loss in purchasing power, and that that loss of purchasing power could get worse as the caps become more stringent."

You talked about certain industries that produced carbon-based energy—coal-mining, very important in Wyoming; oil and gas extraction; petroleum refining—that they would probably suffer significant employment losses over time.

Where are those jobs going to go? Is that impact going to be significant in—more significant in some States rather than others?

Mr. ELMENDORF. So, you summarized the raw conclusions just the way we wrote them, Senator. The shifts will be significant. As we said, there will be reductions in employment in industries that produce fossil fuels, that use fossil fuels intensively, or that make products whose use by households involves a lot of fossil fuel use. Instead, jobs will emerge in industries that develop nonfossil fuel energy or use less energy.

We talk, in the written testimony, about the experience of the United States with the transition from manufacturing employment over the last several decades, significant decline in manufacturing employment. Nonetheless, apart from this, obviously, very deep recession we're in now, total employment has grown rather rapidly.

But, very clearly we say in the testimony—and I want to leave no misunderstanding—that that aggregate performance—the fact that jobs turn up somewhere else for some people—does not mean that there aren't substantial costs borne by people, communities, firms in affected industries in affected areas. I mean, we saw that in manufacturing and we would see that in response to the sort of changes this legislation would produce.

Senator BARRASSO. I appreciate your candor in that. Thank you very much. Because I'm looking at this from—in terms of alternative energy sources, and I'm wondering, Will those sources be available in the next 10 years to, one, replace the jobs and, two, replace the carbon-based energy that—in terms of the capacity of that energy for fueling the country?

Mr. ELMENDORF. So, and as a number of us has discussed, one of the great uncertainties about the costs of reducing carbon emissions is how readily the economy can move toward an economy which uses different sorts of energy. There are some very serious technological challenges; also, of course, in the country, tremendous technological abilities. Guessing the rate at which that sort of evolution can occur is—and I use the word "guess" deliberately—is difficult for those of us in the projection business. We do say, in the testimony, that we think the effect on overall unemployment would be small. But, again, there are in particular areas, in particular industries, there will be significant effects.

Senator BARRASSO. Thank you.

Dr. Newell, you talked about a reduction in CO_2 and coming from the electricity sector—in terms of the modeling in the Waxman-Markey bill—I think you said this is going to decrease the amount

of coal consumed, and decrease the amount of natural gas consumed, and increase the amount of renewable energy consumed. Is that your assessment? Is that correct?

Mr. NEWELL. On coal, that is correct. On renewables, that is correct. It would increase our natural gas use, but it depends on the circumstances of the policy and the time at which you're talking.

Senator BARRASSO. OK. Now, in terms of the nuclear energy, how many new nuclear power plants are we going to need to build to achieve the range that are consistent with your studies?

Mr. NEWELL. It depends on which scenario. We looked at a range of different scenarios, as I just described earlier. In our Basic Case, my recollection is that it's 96 gigawatts of new nuclear power by 2030. Under other assumptions, we looked at a range of assumptions, due to the degree of uncertainty.

Senator BARRASSO. For folks listening, about how many new nuclear power plants are you talking about to do that? How many plants are going to need to be constructed to give you that number of gigawatts?

Mr. NEWELL. I don't have that number right in front of me, in terms of the number of plants.

[The information follows:]

What does your analysis of H.R. 2454 project in terms of new nuclear plants by 2030 that would be needed in order to meet the emission reductions called for in the bill?

In our analysis, the role played by new nuclear power generation varied with assumptions about the cost of availability of international offsets and low/no-carbon-emitting electricity generating technologies. In our Basic Case, 96 gigawatts of new nuclear capacity was added, or roughly 74 plants if each is assumed to be 1.3 gigawatts in capacity. (The actual number of plants would depend on plant capacity, which could range from well under 1 gigawatt up to 1.5 gigawatts per plant, based on planned configurations.) This level of additions roughly equals the amount of new U.S. nuclear capacity that was added between 1970 and 1990. However, across the main alternative cases in our analysis, the amount of new nuclear capacity added varied from 11 gigawatts to 135 gigawatts, or roughly 8 to 104 plants if each is assumed to be 1.3 gigawatts in capacity.

Senator BARRASSO. Do you know how many were built in the last 20 years in the United States?

Mr. NEWELL. That number, though 96 gigawatts, is roughly consistent with the rate of increase in nuclear power over the 1970 to 1990 period.

Senator BARRASSO. OK. Secretary Chu recently announced an ambitious timetable for deployment of a carbon-capture technology—also to Dr. Newell—said the U.S. could have 10 to 12 commercial demonstration projects operational in the next 7 years. Does your modeling assume similar success with deployment of carbon-capture technology?

Mr. NEWELL. I would have to go back and check our projections, as opposed to what you laid out regarding the Secretary. But we do have significant penetration of coal with carbon-capture and storage in our projections under the Markey-Waxman bill.

[The information follows:]

In our analysis, the role played by new coal plants with CCS varied with assumptions about the cost and availability of international offsets and low/no carbon-emitting electricity generating technologies. In our Basic Case, 5 gigawatts of new CCS capacity was added through 2017. Across the main alternative cases in our analysis, the amount of new CCS capacity added through 2017 varied from 2 gigawatts to 6 gigawatts. Assuming that the early plants would be fairly small—200–400

megawatts or less—the level of additions we show is in line with the statement by Secretary Chu.

Senator BARRASSO. Thank you.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you.

Senator Cantwell.

Senator CANTWELL. Thank you, Mr. Chairman.

I would like to submit, for the record, a study that is called "Unlocking the Green Economy: How Carbon Pricing Can Open the Floodgates of Private Investment in Clean Energy."*

To say that there aren't reports out there that show that there is a linkage between the stability that can come from more price predictability is, I think, missing at least one report, and I'm sure there are others.

I'd like to go back to Senator Corker's question.

Mr. Elmendorf, good to see you.

Mr. ELMENDORF. Good to see you again, Senator.

Senator CANTWELL. Out of the frying pan, into the fire. Although, I actually think that CBO's determining outcome is probably easier on climate than it is on healthcare. Would you agree?

Mr. ELMENDORF. Every day, Senator, I am overwhelmed by the uncertainties in all of the things we're trying to do.

Senator CANTWELL. OK.

One certainty you seem to have on the CBO estimates on the House bill as it related to giving emission allowances to local electricity companies—and I just want to emphasize, because I think Senator Corker brought up an important point, and that is, in your analysis, that the—40 percent of the allowances would end up in the pockets of the residential consumers, but more than 60 percent would go to the utilities. Your analysis is that they would not pass those savings on to the consumer; the utilities would keep is a profits, rather than pass on to the consumers.

Mr. ELMENDORF. Assessing the effects of giving allowances to utilities is—or a local distribution companies—is difficult. One of the things that we say in this testimony today is that it's easier to assess the distributional consequences of the legislation in 2050 because the allowances are auctioned and the revenues collected and distributed by the government, rather than having so many allowances given away in particular categories. I think that's related to Senator Corker's concern about the transparency, or lack thereof, in what's going on.

So, we have made assumptions about the ways in which the utilities and the local distribution companies would behave. As you said, we think the money directed to residential customers would, in fact, be passed through to households. The ones dedicated to commercial and industrial customers, we think would end up in profits.

Senator CANTWELL. So, basically, skip the middleman. If you want more predictability about getting the money into the hands of consumers, skip the middleman and give it directly to them.

Mr. ELMENDORF. Certainly increases the predictability. Yes, Senator.

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*The study has been retained in committee files.

Senator CANTWELL. Thank you.

On EPA, on this question—well, you know what? I'm going to come back to this because the allowances—I'll let you think about the 1.4 trillion we're going to give to foreign governments, as far as allowances—I don't even think there is enough. I think that's more than seven times our current total emissions. That's what the House bill would do, in giving money away to allowance—I don't even know if you could accomplish that.

But, anyway, back to this question my colleagues were talking about—several of my colleagues—the predictability that comes, or, I should say, when predictability exists in the market—and this is for Mr. Harvey or Mr. Newell—that it allows investment to occur. So, it's not putting a specific price at any moment, but the certainty and the predictability then leads to the investment. So, could either Mr. Newell or Mr. Harvey talk about that, particularly as it relates that dynamic, having a consistent price signal, giving innovators the signal to make investments, particularly in the area of nuclear power.

Mr. NEWELL. There are a number of different factors that govern the degree of technological investment or innovation in any particular area. One of them is certainly the expected allowance price under a cap-and-trade system. Providing more certainty about that price, or putting within a range, I think would increase the predictability for investors and would encourage that kind of innovation.

Senator CANTWELL. Back to Senator Landrieu's—we don't have that right now. The fluctuation she's talking about is not going to generate that, correct? It's not going to generate the certainty in the market to get the investment.

Mr. NEWELL. EIA did not specifically analyze the uncertainty, in short periods of time, of the Waxman-Markey bill. The provision in the Waxman-Markey bill, though, for the strategic reserve has a strategic reserve price which has a 36-month rolling average, plus 60 percent. So, in terms of providing a stable ceiling on prices, it doesn't do that over any extended period.

Senator CANTWELL. Mr. Harvey.

I'm not talking about so much—I'm talking about the fact that our current state of affairs, for the next 30 years, is likely to be a roller coaster on price.

Mr. HARVEY. Sure. As I mentioned earlier, you know, we're using a long-term model over 2050, so we're not capturing the shorter-term market fluctuations.

I think, in the design of the program, our experience with the acid rain programs, with the NO_X-trading program, with RGGI, with the EU system, has shown that they've been able to weather, you know, ups and downs in the overall energy markets. So, I think we do have some experience, at least since the 1990s, of running the acid rain program, seeing that that's been able to be addressed.

There are features in the House bill, such as the banking provisions, that also address the concerns about volatility, as well as borrowing, which is not a feature that we currently have in the acid rain program.

So, I would also mention the strategic reserve allowance, which is sort of a price-ceiling feature, as well.

So, all of those are design mechanisms that you may want to consider.

Senator CANTWELL. Thank you.

Thank you, Mr. Chairman. My time's up.

The CHAIRMAN. Senator Bunning.

Senator BUNNING. Thank you, Mr. Chairman.

Dr. Newell, good to see you, again. Thank you, for being here.

In your cost analysis of the House-passed bill of cap-and-trade, you relied very heavily on the assumption that nuclear power would provide a large amount of low carbon emission power. I've always said that's absolutely needed if we're going to get from here to where we want to get to.

Given that we have not licensed any nuclear reactors in over 30 years, do you believe that we will have any new nuclear online by 2012?

Mr. NEWELL. The different scenarios that we looked at, due to the degree of uncertainty, as you pointed out, in matters such as the deployment of new nuclear power had a range of increase in nuclear power from 11 to 135 gigawatts, across different cases.

Senator BUNNING. But, would you please answer my question?

Mr. NEWELL. In terms of what's likely to happen between now and 2012?

Senator BUNNING. 2012.

Mr. NEWELL. No, nothing new by 2012.

Senator BUNNING. Nothing new. Thank you. That's what I thought.

Dr. Parker, under the cap-and-trade system do you believe that the technology needed to further develop advanced coal technologies and coal with carbon-capture and storage can remain a cost-competitive option for utilities to invest in?

Mr. PARKER. The analysis that we—oh, I'm sorry.

Senator BUNNING. Thank you.

Mr. PARKER. Yes. Sorry.

The analysis that we looked at were considerably less enthusiastic about carbon-capture and storage than they were last year, when these analyses were done, on the Lieberman-Warner bill. The most optimistic analysis was that conducted by EIA in their basic case. Other analyses assumed anywhere between no carbon-capture and storage being available through the year 2030, to very minimum amounts through the year 2030.

This is due both to the fact that estimates of the cost of CCS has gone up over the last year and, second, the price of its primary competitor, which is natural gas. The assumptions of availability have gotten more optimistic over the last year.

These 2 things have combined to have a less hopeful outlook for CCS than if you had asked me that question last year.

Senator BUNNING. Thank you.

Being from Kentucky, since we produce 95 percent of all of our electric power from coal-based or coal-fired generation, you can imagine the cost-shifting that will be required in the next 20 years, to 2030, and the job loss that will occur not only in Wyoming, but Kentucky and anybody that produces electricity from coal-fired generation.

Mr. Elmendorf, it's great to see you again—since I spent 5 hours with you yesterday, it's great to see you again today. In you testimony, you described the rise of an annual real rate of 5.6 percent over the course of a cap-and-trade system. As a result, the price of goods and services throughout the economy will increase in proportion to the emissions associated with their production and consumption. What is the proportion of increase, and why did the CBO not score these specific costs to consumers?

Mr. ELMENDORF. So, let me—I think, a couple of questions in that, Senator.

The 5.6 percent is our assumption about the rate of return that businesses will earn, on average over that whole period, on investments of all sorts. We assume that their decisions about whether to sell a carbon emission allowance today, or to bank it, will be a decision that they will use the same rate of return in that calculation that they think they can earn on other investments. But, that's——

Senator BUNNING. You haven't anticipated that they would get a higher return by banking them now and using—10 years down the road—that they wouldn't be worth more, 10 years down the road than——

Mr. PARKER. Oh, no. So, we think they will bank them now.

Senator BUNNING. Oh. OK.

Mr. PARKER. We think they will bank them to the point at which through the banking, they will bank them to the point at which the price will rise at this 5.6 percent. Because if they expected the price to rise faster, that would be a good investment; they would bank even more, and that additional banking would then serve to bring down the—push up the price today and bring down the price in later years. So, it is the banking that enables that to happen. The effect of that is that our allowance price, as we project it, rises by 5.6 percent a year over that period. But, it's the banking that makes that happen.

In our assessment of the consequences of the legislation for households, we definitely take account of the way in which the higher prices for fossil fuels would percolate through all the connections in the economy. We use input-output tables to do this, into the prices of the goods and services that households consume, and that is what underlies our estimate of the effect on households in 2020 and in 2050, and the later numbers are a larger cost, because the prices are higher.

Senator BUNNING. OK. Thank you.

My time is expired.

The CHAIRMAN. Senator Sessions.

Senator SESSIONS. Thank you, all of you. I appreciate your statements of humility and recognize—that you recognize this—your inability to predict the future and economic factors and technological advancements.

But, I think we are participating in something in which our conceit is such that we think we can manage the climate. We think we can manage a huge portion of the most dynamic economy the world has ever known. I'm wary of it. Just let me tell you. My experience says that when we get into this, things don't end up very well. They end up less efficient than if we could figure out a more

free-market way to handle it. As I want to say sometimes, "Oh, what a tangled web we create when we first begin to regulate." So, I just would say to you, that's a fundamental concern about it.

Has anybody calculated the number of regulators that are going to be necessary for this? Recognizing, of course, this is wealth extracted from the economy and placed into an area of the economy that produces no clean energy, have any of you all calculated that from—I see, "no," Dr. Newell——

Mr. ELMENDORF. So, Senator, I'm told that we did incorporate, in our cost estimate for the House-passed legislation, an estimate of the cost of administering the program, as part of the discretionary costs that we think would——

Senator SESSIONS. For example, did——

Mr. ELMENDORF [continuing]. Be required by the bill, but I don't have the——

Senator SESSIONS [continuing]. Did you include things—I'd like to have those numbers, if you would submit them.

Do you include things like FBI agents and investigators to do fraud? EPA got a 3-percent increase in their budget this year. You should be happy, Mr. Harvey. But, that may just be the beginning.

Mr. ELMENDORF. So, we'll submit that for the record to you, Senator. I don't know, offhand. We're pretty careful about the——

Senator SESSIONS. One more——

Mr. ELMENDORF [continuing]. Effect——

Senator SESSIONS [continuing]. Thing you should calculate. You should calculate what every regulated business in America will have to add to their payroll, because the CEO, I assume, Mr. Harvey, will certify how many CO_2 molecules are emitted, how much ton of carbon is emitted, and he's got to hire somebody that he trusts to do that, and that person won't be producing clean energy; that person will just be counting and certifying. So, we trade a large amount—so, I just would say to us—insofar as we're humanly possible, I think our focus should be to move our wealth to areas that create clean energy, and not regulators.

Mr. ELMENDORF. So, Senator, I could say briefly, our cost estimate includes, as they generally do, an assessment of the intergovernmental and private-sector impacts of the legislation. This is from the Unfunded Mandates Reform Act that Congress passed more than a decade ago. So, we talk at some length about the imposition of the mandates. We note here that we don't have information to quantify the costs of all of them.

Senator SESSIONS. So, you haven't quantified the billions that would be expended which could be utilized to build a nuclear power plant, for example, that would actually do something worthwhile.

Mr. ELMENDORF. Sir, there are some costs that we do quantify here, but there are others that we do not.

Senator SESSIONS. Now, am I correct, does anybody dispute the testimony we've had, that the net of this would be some at least diminishment of employment?

[No response.]

Senator SESSIONS. All right. So, I think it's fair to say that it is not a good argument to contend that a cap-and-trade program will increase employment. In fact, a study in Spain showed a rather significant reduction.

Also, it can reduce employment in areas like steel manufacturing, the chemical industry, which is already being savaged in America because of energy prices. They find lower places around the world. Fertilizer manufacturing will always be damaged by higher energy costs.

Isn't it a fact—I guess, Mr. Elmendorf, that I'll ask you—that an international offset transfers wealth and jobs overseas?

Mr. ELMENDORF. So, Senator, I think an international offset is like other sorts of imports. When we import a regular good or a service from overseas, we do pay for it, but we do that, in general, because we think it is less expensive to obtain from overseas than to grow that or make that, or whatever, ourselves.

Senator SESSIONS. But, if you tax—an American corporation that makes steel, in effect, to purchase an offset abroad that makes their competitor more efficient economically, that can cost jobs in our manufacturing, can it not? Are you scoring that in this?

Mr. ELMENDORF. So, that is part of our analysis, yes. I mean, I think, again, we import something if we think it's cheaper. In this case, it is cheaper to achieve that given amount of carbon emissions——

Senator SESSIONS. I understand.

Mr. ELMENDORF [continuing]. Reduction.

Senator SESSIONS. You're saying it's cheaper to buy the——

Senator SESSIONS [continuing]. Offset. Indeed, the numbers I think you've said is that, if we didn't have international offsets, the offsets would increase by 96 percent. But, if you do have international offsets, you're taking American wealth and transferring it to help make our competitors more efficient.

Mr. ELMENDORF. So, and the effects of that transfer are included in our estimates of the—and the modelers on whom we draw—estimates of the effect on American GDP and American employment and on American households.

Senator SESSIONS. Thank you, Mr. Chairman. There are a lot of things I'm convinced that we can do to be cleaner, improve national security, and make this a more prosperous country. We've just got to be very careful.

The CHAIRMAN. Senator Brownback.

Senator BROWNBACK. Thank you, Mr. Chairman.

I want to thank the panel. It's been very informative.

You all are putting forward a lot of speculative information. I think, Dr. Parker, I appreciate your statements the most, about the speculative nature of what we're speculating on here. I appreciate that, because I certainly am a skeptic on this and the ability for us to be able to manage and micromanage the impacts of this.

I want to give you, though, some real-world data that's near-term. Always, around here, it seems like the further out you project it, the less credible it probably is.

I just had a Kansas City, Kansas Board of Public Utilities in my office this morning. They are saying, under H.R. 2454, their costs to their customers will go up in 2012 by 25—in the first year of this—by 25 percent, their utility rates, in Kansas City, Kansas. That's a near-term—and they're saying that's a pretty cheap price of an allowance for coal. They're pretty heavy coal use, they also have some wind energy.

I also have in numbers, from Kansas City Power and Light area, a broader region. They're saying their utility rates will go up 33 to 44 percent under the scenario that's being put forward on the trading. That's on the lower-to midrange of allocation.

Then, McPherson, Kansas—they're in the middle of the State, smaller community—they're projecting, just for their community, a $5 million cost to comply, and then they've got a oil refinery that's there that they project's going to go out of business because they won't be able to compete as an oil refinery.

I just want to give you some real-world numbers for this speculative bill that we're putting forward, and its real-world impact on people, which is a big reason why I'm such a skeptic on going this route, because, while we're projecting these things, people are having to deal with their basic lives on it, and this is going to be very expensive.

Mr. Elmendorf, I gather, from your scenario and what you're saying, that manufacturing will be further pressured to leave the United States under this bill. Manufacturing that involves any sort of energy use, from what I gather from page 12 of your testimony. Would that be correct?

Mr. ELMENDORF. So, I think there are some aspects of manufacturing that would do well, others that would not do well. Again, I think the main distinction to draw is between those parts of the economy, manufacturing or other areas, that are energy—fossil-fuel energy-intensive, and those that aren't. So, certainly the energy-intensive aspects of manufacturing would be particularly hard hit. We list some of those industries here.

Senator BROWNBACK. OK. It looks like, to us, in our State, that we're going to hit pretty hard with this, being a fairly high-energy-using State—agriculture is an industry that uses a lot of energy—that you're likely to drive a fair amount of that overseas to places with lower energy costs?

Mr. ELMENDORF. It depends on what other countries did. If other countries didn't act, then more would be driven overseas, that's right.

I mean, one thing just to note, Senator—you mentioned agriculture is obviously a very important part of the economy in Kansas—that is one of the sectors of our economy that are at some risk of—from climate change. The uncertainties——

Senator BROWNBACK. We're very——

Mr. ELMENDORF [continuing]. Around the——

Senator BROWNBACK [continuing]. Familiar with that.

Mr. ELMENDORF [continuing]. The damage of climate change are also great, and many analysts believe that in the—and CBO has written about this—these uncertainties at great length. Many economists believe that the right response to that kind of uncertainty is to take out some insurance, if you will, against some of the worst outcomes.That's what motivates some of the——

Senator BROWNBACK. If I could, because I'm going to lose my time, here—if I could, on that, that's why we believe that investment in innovation, rather than taxes and regulation, is the way to go to address it, that you should go on a—just a different model of this, and one that I don't think involves near the speculation, nor the market manipulation, of what this panel is talking about.

You're talking about a massive market manipulation, here, on a grand scale that has significant impacts, it looks like to me, particularly on the Midwest and the South in this country, for as far as what you're going to do of moving of cost, and the likelihood for us to lose a lot of jobs, a lot of businesses. It looks like oil refinery processing, you're probably going to drive all overseas. We've got several oil refineries in our State. So, I say, yes, address it, but do it through investment and innovation, not this sort of huge taxing and regulatory scheme.

Appreciate it, Mr. Chairman.

Mr. ELMENDORF. So, I'll just be clear. So, obviously, I'm not advocating for this bill, and I'm not trying to fight against this bill. I'm just trying to explain what people talk about in its workings.

You talk about innovation, and I think many people who support putting a price on carbon emissions through a cap-and-trade system, or through a tax, do so because they believe that that sort of price signal is a very effective way of spurring innovation and reaching the end that you have in mind.

But, of course, there are other ways that one might——

Senator BROWNBACK. Such as us investing, us doing research and—supportive of that—us subsidizing methane-production electricity from landfills or from large livestock operations—all those things would be a way of investing, rather than putting a big tax on my customers of utilities in Kansas City, Kansas.

The CHAIRMAN. Senator McCain.

Senator MCCAIN. Thank you, Mr. Chairman.

I thank the witnesses.

Mr. Harvey, EPA's estimate includes a significant increase in the deployment of nuclear power by 2050, and I hope that's the case. Are there regulatory changes in the Waxman-Markey bill that bring you this conclusion?

Mr. HARVEY. I'm not aware of regulatory changes to nuclear power in the Waxman-Markey bill, Senator.

Senator MCCAIN. Wouldn't you then assume that, given the state of nuclear power in the United States, that, unless there are significant changes, that we're basically looking at a stagnant industry, particularly in light of the fact that we're going to close the facility that was intended to store spent nuclear fuel?

Mr. HARVEY. I think the biggest driver for us is the carbon price, Senator, that's driving the penetration of new nuclear power.

Senator MCCAIN. Again—and we continue this discussion endlessly, unfortunately—if you don't have recycle, if you don't have a place to store, you don't have sufficient loan guarantees, you don't have sufficient regulatory expedition of the licensing process, you're not going to—you're going to repeat what's been happening for the last 20 years. So, in all due respect, it's a bit presumptuous of you to take into your calculations a significant increase in nuclear power when there's nothing in the landscape that would indicate that that's the case, and nothing in this legislation. I'll be glad to be corrected in that assumption, if you have that for me.

Mr. HARVEY. We did sensitivities on that. We did a case where we held nuclear power to reference levels, with some slight growth, and we found that allowance prices were about 15 percent higher. That was the major analysis we did.

You know, driving our analysis was input assumptions that we brought in from EIA on the cost of nuclear power. You know, we also are aware that there are about 20 projects currently in the licensing process. So, you know, perhaps, you know, Dr. Newell could speak more to EIA's projections about nuclear power. But, I think, you know, we didn't assume it; it came in because of the carbon prices, which are a significant incentive.

Senator MCCAIN. Do you want to comment, Dr. Newell.

Mr. NEWELL. In our reference case scenario—which would be in the absence of this particular climate bill—there's an assumption of 11 gigawatts of new nuclear power by 2030. This is primarily induced by previous legislation—loan guarantees and tax incentives and so on. But, due to the significant degree of uncertainty about other conditions that would affect the potential for nuclear power, such as long-term storage, regulatory processes, public acceptance, we looked at a range of different scenarios, holding that 11 gigawatts at its base level and going up to as high as 135 gigawatts. But, as you point out, there's a significant degree of uncertainty.

Senator MCCAIN. Mr. Harvey, have you seen any estimates that, without nuclear power, we could reach a goal of significant renewable fuels by the year 2050 that would have a significant impact on that, on our renewable energy requirements?

Mr. HARVEY. Again, I would sort of go back to the scenario that we did, where we held nuclear power constant. We did reach the goal, but carbon prices were higher. Alan, would you add anything to that?

Mr. FAWCETT. Yes. Holding nuclear power constant, essentially, you know, there are other technologies that we see coming in if the nuclear power isn't available. On higher allowance prices, we see more carbon capture and sequestration, more renewable power coming in, and greater use of offsets to be able to still meet the targets.

Senator MCCAIN. Boy, I'd love to see that, because the previous estimates of the Department of Energy is that wind, tide, solar, and all the others would reach about 20 to 25 percent, maximum, of our renewable requirements. So, I'd be really interested in seeing your analysis.

Mr. Elmendorf, thank you for your great work. As I mentioned to you before, your reward will be in heaven, not here on Earth. Have you had a chance to look at the European cap-and-trade system?

Mr. ELMENDORF. We have looked at the European cap-and-trade system, yes, Senator.

Senator MCCAIN. It's been fits and starts, right?

Mr. ELMENDORF. That's right. I'm not personally an expert, but I have some colleagues, here, who may be able to help me if you want to dig into that issue.

Senator MCCAIN. The reason why I think it's important is because the Europeans have been in the cap-and-trade business for some years. So, it seems to me patently obvious that we should look at what they've done, or haven't done, since they have been involved in the experiment for, what, 10, 15 years?

Mr. ELMENDORF. Yes, Senator. So, one thing I do know is—about that example—is that some of the volatility that they've seen stems from hindering flexibility in the timing of achieving emissions reductions, so that the provisions that are now discussed in—as part of cap-and-trade legislation in this country, involving the banking of allowances, ability to borrow allowances, reserve pools, and so on, are designed to try to at least dampen some of that volatility, which, in my understanding, has arisen in some of these cases in Europe from hitting ends of periods in which there was no ability to shift behavior into the next year. This flexibility in timing that's now being contemplated for U.S. bills is designed to ameliorate some of that. But, it is a risk.

Senator MCCAIN. Let me strongly suggest, to all the witnesses, that we look carefully at the European experiment. It has not lived up to the expectations that were advertised at the time that it was implemented. It was practically nirvana. So, let's look carefully at the European experiment; let's also look at our acid rain experiment, which succeeded; and find out, at least, if you could submit to this committee, the lessons learned from both of those cases, if we are going to seriously—we certainly don't want to repeat the mistakes that others have already made.

My time is expired. I thank you, Mr. Chairman.

I thank the witnesses.

Mr. ELMENDORF. Mr. Chairman, I actually have an answer to Senator Sessions' question from earlier. It is, in fact, in our cost estimate for the House bill, but I had forgotten. We say, "CBO estimates that fully funding Federal agencies' administrative costs would require gross appropriations totaling $8.2 over the 2010–2019 period. This estimate is based on historical information on how large regulatory programs have been implemented and on information provided by EPA, FERC, and other agencies with significant administrative responsibilities under the bill."

Senator SESSIONS. Do you have actual employee numbers for that?

Mr. ELMENDORF. But, I don't think we have employee numbers. But we have——

Senator SESSIONS. How can you calculate if you don't have the employee numbers?

Mr. ELMENDORF. There are different ways of coming at the question.

Senator SESSIONS. I'd like to see what you've got. I know time is short. Thank you for sharing that.

The CHAIRMAN. Let me just advise members, we've started a vote. We can recess and come back and ask additional questions if members want to do that, or we can go ahead and proceed for another 6 or 8 minutes.

Yes, Senator McCain, did you have an opinion on what we ought to do?

Senator MCCAIN. I just had one additional question for the——

The CHAIRMAN. OK.

Senator MCCAIN. [continuing]. Panel if——

The CHAIRMAN. Let me see if Senator Cantwell had any additional question, first, and then we'll go back over to this side and take any additional question.

Did you have another question, or did you want——

Senator CANTWELL. Thank you, Mr. Chairman. Now? You're saying——

The CHAIRMAN. Yes, I'd like to see if we could finish up before we——

Senator CANTWELL. Thank you.

The CHAIRMAN [continuing]. Go vote, if we could.

Senator CANTWELL. Yes. I would like to go back to Mr. Harvey on this allowance question, because obviously EPA's analysis of the House bill has a reliance on international offsets that would result in 1.4 trillion in payments to foreign governments and companies to purchase the offsets. I just have serious concerns about why we would spend so much money overseas making that kind of investment when we really need to be making the investment here in the United States.

So, I know we had some experts, Mr. Chairman, here last—or 2 weeks ago—who didn't even believe in the analysis of the original numbers.

So, maybe you could help us with that. What would happen if the projects were not available?

Mr. HARVEY. Thank you, Senator.

As I mentioned in my testimony, we ran a scenario where we omitted the use of international offsets altogether, and the costs would be 90 percent higher. The——

Senator CANTWELL. How much? How much?

Mr. HARVEY. Ninety percent—89 percent higher—if you just had domestic offsets and the other technologies domestically. So, there's support for international offsets, obviously from people who are concerned about reducing the cost of meeting these targets by the U.S. alone. So, allowing international offsets does involve those transfers you talked about, but it also reduces the cost to U.S. firms.

Senator CANTWELL. But, we should spend $1.4 trillion investing in——

Mr. HARVEY. It's the general argument that—we were talking a little bit about this, about international trade savings, as well.

Senator CANTWELL. I'd rather see $1.4 trillion invested in U.S.——

Mr. HARVEY. That's a policy choice for Congress.

Senator CANTWELL. Yes. Thank you.

Thank you, Mr. Chairman.

The CHAIRMAN. Senator McCain, did you have a question?

Senator McCain: Just one.

The CHAIRMAN. Then, Senator Corker——

Senator MCCAIN. Mr. Harvey, have you looked at the acid rain experiment?

Mr. HARVEY. Yes, I was actually an employee of the Clean Air Markets division, before I worked on this, so I'm——

Senator MCCAIN. How do you account for its success?

Mr. HARVEY. It set clear, long-term goals. It reduced acid rain emissions by about 50 percent. It got EPA out of the business of telling companies how to make the reductions. They went out, and they were innovative, and they found ways to meet their goals at

their least cost. So, it's been a great success, both environmentally and from an economic point of view.

Senator MCCAIN. But, it was simple.

Mr. HARVEY. It was very simple. The rules were clear. Congress defined the allocations. We had very few lawsuits challenging the implementing rules. It's been quite a success for us. We've been able to do it with a very small number of employees.

The CHAIRMAN. Senator Corker.

Senator MCCAIN. I thank you, Mr. Chairman.

Senator CORKER. I want to thank all of you, for your testimony.

Dr. Parker, I didn't ask any questions today, but I continue to be appreciative of the great work you all do at CRS, and all of you for your testimony today.

Going to Senator McCain's comment about the European system—and certainly my comments are anecdotal, only from personal experience. Senator Bingaman and I spend a good deal of time meeting. Every policy person would come up to us after the meetings that we had, and they would say, "Whatever you do, do not give away free allowances." That is the reason we had so many problems with our European system, is giving away free allowances. Obviously, that's what we do in this Rube Goldberg system that's been put in place by the House. Would you all mind commenting on the issue of how free allowances, in essence, distort and make less simple a system like we're talking about?

Mr. ELMENDORF. So, again, Senator, I can't make a policy recommendation. Many analysts do favor simpler approaches, and they favor the simple approach in this context of auctioning allowances and then having Congress decide what to do with those proceeds in a more transparent fashion. I think, from a substantive point of view, the crucial effects of the—giving away the allowances depend, first of all, on whether they change the prices, distort the price signals that the system is trying to create. As I've suggested, there are ways from them not to do that, but it is complicated. Second, there are very important distributional consequences. That's a policy choice, again, that you get to make. But, I agree that those choices are more obscured by giving them away in this complicated fashion.

Senator CORKER. These free allowances are equal to marketable securities. I mean, when you're giving away an allowance, it's like giving away a share of IBM stock. You can sell it immediately. So, we speak as if "free" means at "no money," but the fact is, it's huge transference of wealth that does, in fact, make a system like this far less simple. Is that correct?

Mr. ELMENDORF. For just that logic, Senator, CBO includes both the costs of giving that allowance away at market value and we impute the revenue to the government budget that could have been earned from selling that allowance.

Senator CORKER. Thank you.

The CHAIRMAN. Senator Murkowski.

Senator MURKOWSKI. Very quickly, Mr. Chairman.

I just want to note that Senator McCain brings up the issue of acid rain and you know how did that worked. We need to appreciate it was limited to what was happening here in this country. It was a domestic issue, it didn't require technological break-

throughs. We haven't had much discussion today regarding what we will be putting in place through climate change policy not only depends on innovative technologies, but it also depends on the cooperation from other countries over which we have very limited, if any, control at all.

There has been great testimony this afternoon. I really appreciate it, Mr. Chairman. However, I am reminded that so much of what we're talking about is theoretical. In the cost-containment hearing we had a couple of weeks ago, we kept talking about the theoretical offsets. Now we're talking about the technologies that will be needed. Nuclear technology isn't new, but when we talk about our ability to get up and running what we actually need—again, it goes back to the level of skepticism that is out there.

We talk about Carbon Capture & Storage and where we're going to be when our reality is that we're still trying to figure out how we commercialize it. You know, we can't be implementing policies that are "a wish and a prayer" policy. We've got to know that this is tangible. We've got to push it, absolutely. But, we talk at great lengths about the theoretical aspects of it.

Mr. Chairman, I know we've got to go, and I appreciate your indulgence. Thank you.

The CHAIRMAN. Thank you all. This is very useful testimony. We appreciate your giving us the time and the effort.

That ends our hearing.

[Whereupon, at 11:59 a.m., the hearing was adjourned.]

APPENDIX

RESPONSES TO ADDITIONAL QUESTIONS

RESPONSE OF DOUGLAS W. ELMENDORF TO QUESTION FROM SENATOR BINGAMAN

Question 1. A key uncertainty is how the models handle the recession and recovery. Do the models assume that growth and emissions will return to trend (i.e., that there will be a period of higher than normal growth after the recession ends as unused capacity is put into service) or that there has been a step-change in GDP and after the recession, growth rate will return to normal but that the US economy will set out from a low base. This question is fundamentally important because US emissions will have fallen by more than 8% from 2007 levels by the end of this year. This is the initial condition from which the models are being initiated. How they handle it is critical to projecting 2020 and 2030 costs.

Answer. Most groups in the United States that model the effects of climate policies, CBO included, rely on the Energy Information Administration (EIA) for a projection of baseline emissions. That projection is driven in part by EIA's expectations about future GDP growth, which are similar to CBO's. Both CBO and EIA take into account the substantial decline in GDP as a result of the recession and a significant bounceback from it. However, for reasons largely unrelated to GDP growth, EIA is projecting lower emissions through 2030 than it projected a few years ago.

RESPONSES OF DOUGLAS W. ELMENDORF TO QUESTIONS FROM SENATOR MURKOWSKI

TREATMENT OF ALLOWANCE ALLOCATION COSTS

Question 1. The creation of carbon allowances creates value, and therefore wealth that can be distributed by the government. When allowances are auctioned, it is my understanding that CBO assumes a 25% reduction in net revenues because the purchase of allowances would be tax deductible. Similarly, allowances given away for free are treated as expenditures just as if they were cash payments. However, CBO asserted in a letter earlier this year that.

"Depending on who would receive the allowances and what they would be used for, the reduction in taxable income . . . could be accompanied by a matching increase in taxable income elsewhere in the economy. If so, the added tax revenues would offset the initial loss . . . In such cases, the issuance of the allowances would be budget neutral-that is, it would have no net effect on the budget deficit. In other circumstances, however, that would not be the result".

What are those other circumstances, and why would CBO tend to view them differently than a situation in which allowances are given away for free?

Answer. For the purposes of calculating the net impact on the federal budget of distributing allowances, CBO makes no distinction between allowances that are auctioned and those that are distributed for free. Whether an allowance is auctioned or given away, CBO applies a 25 percent revenue offset to the proceeds or to the allowance value to account for the loss of income and payroll tax revenues that would result because the acquisition and use of allowances would create an additional business expense for companies that would have to comply with the cap. Even if companies received the allowances for free, using the allowances, rather than selling them, would result in forgone income to those companies. Businesses might pass that cost on to their customers, but it is a cost that would be borne and reduce tax collections at some point in the economy.

Similarly, whether the federal government spends auction proceeds or gives allowances away for free, there could be a matching increase in income and payroll tax revenues, depending on who would receive the money or the allowances and what

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[1] See Congressional Budget Office, letter to Honorable Henry A. Waxman, *The Budgetary Treatment of Emission Allowances Under Cap-and-Trade Policies* (May 15, 2009), p.5.

they would be used for. In some cases (whether using auction proceeds or issuing allowances for free), the process of issuing and distributing allowances would be budget neutral—that is, the initial loss of income and payroll tax revenues (estimated at 25 percent of the allowance value) could be offset by other increases in income and payroll taxes. That outcome would depend on how the allowances or auction proceeds were used, not on whether the "value" is distributed through an auction or is freely allocated.

For example, under H.R. 2454, providing allowances free of charge (as passed by the House) to businesses (such as merchant coal generators, generators with long-term power purchase agreements, and petroleum refiners) would fit into the category of transactions that would be budget neutral because they would generate taxable income; under the legislation, those entities could sell or use the allowances and consequently increase their taxable incomes. Distributing auction proceeds to businesses with no strings attached as to how that money should be used would similarly be budget neutral.

In contrast, providing allowances to non-business entities-such as states to support specific activities, or to other countries to support efforts to reduce greenhouse gases-would not be budget neutral because it would not generate taxable income. Spending by those entities would simply substitute for spending elsewhere in the economy, generating no additional taxable income. In the same way, use of auction proceeds by the federal government for activities like research and development or for distribution to low-income households who do not pay taxes would not be budget neutral.

ANTICIPATED MARKET VOLATILITY

Question 2. There is a great deal of variation among the cost estimates that have been produced for the Waxman-Markey bill. While that is generally a cause for concern, perhaps it gives a reliable idea of the market volatility we can expect for carbon allowance prices over the next four decades.

Assuming this is the case, can you provide us with an anecdotal assessment of these potential fluctuations in allowance prices and how they compare to volatility we have seen in the oil and gas markets recently?

Answer. The variation in cost estimates for the Waxman-Markey bill reflects different analysts' assumptions about a wide variety of factors, including: the development of new technologies that regulated entities might use to reduce their emissions; the availability of domestic and international offset credits; trade-offs that regulated entities would make between current and future costs, which would govern their decisions about banking allowances for future use; and the effect of subsidies and mandates that H.R. 2454 would provide for energy efficiency, research and development, and specific technologies. For example:

- Studies that assumed that carbon capture and sequestration or nuclear generation would be more readily available options for lowering emissions tended to project lower compliance costs than those that assumed more restricted availability;
- Studies that assumed that domestic and international offsets would not be readily available due to problems in meeting the criteria established in the legislation or subsequent regulations projected relatively high compliance costs;
- Studies that assumed that firms would engage in relatively more banking of allowances tended to predict higher costs in the near term and lower costs in the future; and
- Studies that assumed that subsidies for energy efficiency or new technologies would have relatively large effects tend to find lower compliance costs.

For a discussion of some of those factors see:

- The Use of Offsets to Reduce Greenhouse Gases (CBO Economic and Budget Issue Brief, August 3, 2009) which is available at www.cbo.gov/ftpdocs/104xx/doc10497/08-03-Offsets.pdf
- How Regulatory Standards Can Affect a Cap-and-Trade Program for Greenhouse Gases (CBO Economic and Budget Issue Brief, September 16, 2009) which is available at www.cbo.gov/ftpdocs/105xx/doc10562/09-16-CapandStandards.pdf
- CBO's cost estimate for H.R. 2454, the American Clean Energy and Security Act of 2009, as ordered reported by the House Committee on Energy and Commerce on May 21, 2009 which is available at www.cbo.gov/ftpdocs/102xx/doc10262/hr2454.pdf

The prices for emission allowances that underlie various cost estimates represent potential opening bids during a hypothetical auction on the first day of trading in the carbon market. As regulated entities, investors, entrepreneurs, and others who have information about the cost of reducing emissions submit their bids, that market would open with a single price that represents everyone's initial knowledge and expectations about current and future demand for allowances relative to their supply. The volatility that would occur once that market was in operation would reflect changing market conditions. For example, an announcement that the EPA is on the verge of approving a large number of offset allowances could result in a decrease in the allowance price because market participants would expect the demand for allowances to fall because of the compliance obligation that would be met by this new supply of offsets. Similarly, allowance prices would rise if heat waves boosted consumer demand for electricity to operate air conditioning units. Market participants would foresee the need to hold additional allowances to cover the increase in emissions resulting from meeting that increased demand for electricity.

The price of allowances would generally be expected to rise over time, but could vary widely from day-to-day or year-to-year depending on the design of the market, economic growth, and other factors that affect the use of fossil fuels. The price in the market for sulfur dioxide (SO_2), which causes acid rain, in the United States and the price of carbon allowances in the European Union's Emission Trading Scheme have both shown wide fluctuations over time, but the design of those markets is different than the market that would be established by H.R. 2454, which passed the House of Representatives, and the prominent proposals that are under consideration in the Senate. CBO is currently examining how financial instruments (such as futures contracts) and regulatory instruments (such as price collars) might affect volatility. However, that work is not yet complete.

DISCOUNT RATES

Question 3. The difficulty of looking decades into the future at the impact of a climate policy is compounded by how much the value of a dollar changes over time.

If we were to go back to 1969, and wanted to explain the value of a $23,000, 2009 model-year car, there are a few ways we could attempt to do so. We might adjust the 2009 price tag for inflation and say "it will cost the equivalent of $3,960 in today's dollars". Or we could say, "put $562 in the bank, and at a 5% interest rate you will have enough to buy the car in 2009". This latter explanation would rely upon a 'net present value inflation adjusted' calculation, which is what most of these reports use.

But it should be apparent that this is a very bad indication of what something will actually cost in 40 years. Climate bills do not require Americans to put away money now to cover costs later; they simply impose those costs at some future date.

So I have to ask if there is something I am missing here. I understand that discounting is a standard practice in the computer models used by the agencies, but it seems like these models and the numbers they generate are better for comparing two pieces of legislation than providing a real idea of what costs we can expect.

Are there better ways to explain the costs of these bills, or at least ways that would make more sense to my constituents?

What would the use of actual dollar amounts, simply adjusted for inflation without discounting, do to the cost estimates produced for these climate bills?

Answer. CBO reports the effect of legislation on the federal budget in nominal terms; that is, there is no discounting or adjustment for expected inflation. Correspondingly, CBO uses nominal estimates of allowance prices for its estimate of the costs that H.R. 2454 would impose on the federal budget.

CBO estimates the loss in purchasing power that households might experience in future years as a result of the cap-and-trade program defined in H.R. 2454. Those costs would be incurred in future years when income levels are expected to be higher than they are currently. In order to provide a current context for the magnitude of those future costs, CBO reports the costs in the context of 2010 income levels. For example, CBO estimates that the average per household loss in purchasing power in 2020 would be 0.2 percent of after-tax income in that year. Measured at 2010 income levels, 0.2 percent of after-tax income would be $165. CBO's estimates of the loss in purchasing power do not involve any discounting.

RESPONSES OF DOUGLAS W. ELMENDORF TO QUESTIONS FROM SENATOR BARRASSO

Question 1. Based on your analysis, would imposing a cap and trade program like the one in Waxman-Markey cause job losses in the fossil fuel sector similar to the massive job losses experienced by the manufacturing industry since the 1970s? Which specific States will be most impacted?

Answer. In 1979 about 19 million people were employed in the U.S. manufacturing sector. By end of 2008 that number had decreased by almost a third, a loss of over 6 million jobs. By comparison, in 2007 about 800,000 people in the United States were employed in the industries that extract and process oil, natural gas, and coal, according to the Bureau of the Census.

CBO reviewed several studies of the likely impact of climate policy on employment. Those studies identified the fossil-fuel cluster of industries as one in which employment would decline if a cap-and-trade program like that provided for by H.R. 2454 were put in place. The absolute number of jobs lost in those industries would be much lower than the number of jobs lost in the manufacturing sector since 1979 simply because those industries are much smaller than the manufacturing sector. However, some of the studies that CBO reviewed projected percentage job losses, in coal mining, for example, comparable to those experienced in the manufacturing sector over the past thirty years.

CBO has not analyzed the effects of H.R. 2454 on employment at the state level.

Question 2. If Waxman-Markey passed, you stated in your testimony that there would be "significant shifts" from emissions-intense sectors such as oil and refining firms to low-carbon businesses such as wind and solar power.

You also stated "We want to leave no misunderstanding that aggregate performance, the fact that jobs turn up somewhere else for some people does not mean that there are not substantial costs borne by people, communities, firms in affected industries and affected areas. You saw that in manufacturing, and we would see that in response to changes that this legislation would produce."

You further stated that "The net effect of that we think would likely be some decline in employment during the transition because labor markets don't move that fluidly."

Would states in the West, such as Wyoming, which are heavily dependent on coal, oil, and natural gas production and use, suffer significant job losses in these sectors as a result of Waxman-Markey passing? In the initial years, would the people in those sectors displaced by the passage of the bill have the "skill sets" to transfer into jobs in low carbon sectors of the economy? Would a likely outcome include moving to other regions of the country to get jobs in low carbon sectors of the economy?

Answer. A cap-and-trade program for greenhouse gases would cause employment shifts in the economy. Such a program would decrease employment in the production of carbon-intensive fuels, such as coal, and in other industries that rely on such fuels. It would also create employment opportunities in the production of less carbon-intensive forms of energy and other goods and services that depend less on carbon-intensive fuels.

If a cap-and-trade program like that provided for by H.R. 2454 were put into place, employment would probably decline in industries such as those that extract and process oil, natural gas and coal. Although CBO has not done a state-by-state analysis of employment, the decline in employment in those industries would translate into job losses in the states in which those industries are concentrated. Some people who would lose their jobs would find themselves lacking the skills to move easily from one industry to the other. In addition, it is not clear that new jobs would arise in the same areas of the country in which the old jobs were lost, causing some people seeking new employment to move to a new area that they believed to have better job prospects.

Question 3. Would states in the South, some of which are dependent on off-shore oil exploration, oil refining, and coal production, and states in the Midwest, which rely on coal production and use, suffer similar losses? Would the impact in the initial years be the same in these regions as in Western states?

Answer. As noted above, some of the industries that are at the greatest risk of declining employment are those that produce carbon-intensive fuels such as coal, oil, and natural gas. Although CBO has not done a state-by-state or regional analysis of employment, declines in employment in such industries would translate into job losses in the states in which those industries are concentrated. The shift in the economy to less reliance on carbon-intensive fuels, goods, and services would also create employment opportunities elsewhere in the economy, but those opportunities could be in other areas of the country.

RESPONSES OF DOUGLAS W. ELMENDORF TO QUESTIONS FROM SENATOR CANTWELL

Question 1. CBO's analysis of the House passed climate bill found that the middle income quintiles bear most of financial burden under H.R. 2454. While the lowest income households are kept whole through government refunds of auction revenues, the system is strongly regressive for the middle income households,

- Could you provide a more detailed explanation of anticipated distribution of costs under H.R. 2454?

Answer. CBO anticipates that businesses would largely pass the cost of complying with a cap-and-trade program-the cost of purchasing allowances, purchasing domestic and international offset credits, and reducing emissions-on to their customers through higher prices for goods and services. Higher income households would incur a larger portion of that cost because they consume more than lower income households. However, those compliance costs would impose a larger financial burden measured as a share of income on lower income households because those households tend to consume more of their total income, and because energy-intensive goods and services generally make up a larger fraction of their total consumption.

Although compliance costs would generally be distributed among households based on their purchases of goods and services, policymakers could substantially offset those costs for some households through the allocation of allowances (or the revenue raised by selling allowances). CBO developed an estimate of households' loss in purchasing power as a rough indication of the direct effect that the cap-and-trade program established in H.R. 2454 would have on households. That loss in purchasing power equals the costs of complying with the policy minus the compensation that would be received as a result of the policy.[2] The combination of compliance costs and the allocation of allowances specified in H.R. 2454 would impose the largest loss in purchasing power on households near the middle of the income distribution.

- CBO's analysis shows that the richest 20% of Americans pay less than the middle brackets, why is that the case?

Answer. CBO estimates that in 2020, compliance costs for the 20 percent of the population with the highest income would be about twice that for households in the middle income group ($1,400 vs. $685, measured at 2010 income levels).

That difference would be more than offset, however, by the impact of the allowance allocations. In 2020, CBO estimates that roughly 35 percent of the allowances would be allocated in a manner that benefited shareholders, who are more likely to be members of higher income households. As a result, the loss in purchasing power-that is, the compliance cost minus the compensation received as a result of the policy-experienced by the average household in the top one fifth of all households arrayed by income, $165 (measured at 2010 income levels), would be less than the loss in purchasing power experienced by households in the middle and fourth income quintiles-$310 and $375 (at 2010 income levels), respectively. The disparity in the loss in purchasing power in 2020 would be larger when measured in relative terms; that loss would be about 0.1 percent of after-tax income for the average household in the top income quintile and 0.6 percent and 0.5 percent for the average household in the middle and fourth income quintiles, respectively.

The results would be different in 2050, because a smaller fraction of the allowance value would benefit higher income households, by CBO's estimate. In that year, the dollar loss in purchasing power (measured at 2010 income levels) would be largest for the average household in the highest income quintile. Measured relative to after-tax income, however, the loss in purchasing power would still be greatest for households in the middle quintile (1.1 percent for that group vs. 0.7 percent for the highest income quintile).

- Could the income distributional disparity be alleviated if more—or all—allowances were auctioned, generating revenues that could be distributed more equally and directly to American families to offset energy cost increases?

Answer. Instructing the government to sell the allowances and use the revenue to provide rebates to households would be a more direct method of distributing the allowance value than giving the allowances to private entities and instructing them in how to use the value of the allowances to benefit customers. For example, it is unclear exactly how the allowances given to local distributors of electricity under H.R. 2454 would ultimately accrue to households. CBO estimated that roughly one-third of that value would be received by households in the form of rebates while the other two-thirds would benefit commercial and industrial businesses that are served by those distributors.

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[2] Once the compensation received by U.S. households is deducted from the compliance costs, the remaining loss in purchasing power stems from the cost of reducing emissions and producing domestic offsets, expenditures on international offsets, and the value of allowances that would be directed overseas.

If the Congress wanted to ensure that each household received an equal (uniform) amount of the allowance value, measured in dollars, it could do so by requiring the sale of all of the allowances and using the revenue to provide rebates to U.S. households. For households with relatively low consumption levels, that rebate could more than offset the higher costs that they would incur (by paying higher prices for the goods and services that they consume) as a result of the policy. Measured as a share of income, such a policy would impose a larger burden (taking into account both compliance costs and the distribution of allowance value) on higher income households than on lower income households. Additional information about the distributional effects of such a strategy is discussed in The Distribution of Revenues from a Cap-and-Trade Program for CO_2 Emissions (Statement of Douglas W. Elmendorf, Director, CBO, before the Committee on Finance, United States Senate, May 7, 2009) which is available at: http://www.cbo.gov/ftpdocs/101xx/doc10115/05-07-Cap__and__Trade__Testimony.pdf.

- Has CBO done any analysis on how different climate policies differentially impact consumers in various regions of the country?

Answer. CBO has not done such analysis itself. However, the agency recently reviewed two studies that examined how the costs of complying with a cap-and-trade program might vary across the country. Like CBO's national level analysis, those studies-one produced by a team of experts affiliated with the National Bureau of Economic Research (NBER) and one by researchers at Resources for the Future (RFF)-assumed that businesses would pass the cost of complying with the cap-and-trade program on to their customers in the form of higher prices. The two studies suggest that regional differences in the burden that those higher prices would impose on households would be relatively small. In particular, the NBER study suggests that the increase in households' spending (resulting from the higher prices) would range from 1.9 percent of annual income in what it defines as the East South Central region to 1.5 percent in the West North Central region.

The RFF study also finds only small regional differences, although the differences are somewhat larger for low-income households. Specifically, the increase in households' spending would range from 1.6 percent of annual income in the Ohio Valley to 1.3 percent in California, New York, and the Northwest. Effects on households in the bottom deciles of the income distribution would range from 5.5 percent in the Ohio Valley to 4.0 percent in California. For more information see: http://www.cbo.gov/ftpdocs/104xx/doc10432/07-09-RegionalEffects__Cap-Trade.pdf.

- Would an upstream point of regulation at the point of fossil fuel production, in other words at the beginning of the value chain, minimize regional disparities since the actual amount of carbon consumed per capita is quite similar across the country?

Answer. The decision about where to place the cap would probably not substantially affect the distribution of the compliance costs among regions. As described above, most analysts anticipate that the bulk of the compliance costs would be ultimately be borne by consumers in the form of higher prices for the goods and services that they buy. Thus, regional differences in the incidence of the compliance costs would stem from differences in consumption patterns among regions, but would be largely unrelated to the point of regulation.

- Would an equal, per capita distribution of some portion of revenues raised in an auction for emission allowances help reduce regional disparities?

As indicated above, two studies that CBO reviewed found little difference in the burden (measured as a share of income) that the cost of complying with a cap-and-trade program would have on households in different regions. An equal per capita rebate would provide greater benefits to lower income households (as a share of income) and thus would tend to benefit lower income regions of the country. Other alternatives, such as giving revenues from the sale of allowances (or the allowances themselves) to affected industries, could also change the distribution of the net costs. That strategy would likely benefit shareholders, who are typically from higher income households, and thus would tend to benefit higher income regions of the country.

Question 2. I understand that the CBO's cost estimate for the House climate bill was a net gain in federal revenues of $24 billion between 2010 and 2019, but I am wondering about the longer-term cost implications of the bill and understand that CBO scores things a little differently in the Senate, namely by adopting a longer timeframe when assessing policy impacts.

- Assuming for now that the Senate bill will be a companion to the House bill and will have the same provisions, can you give us your impression of what the CBO score on the House bill is likely to be in the Senate?

Answer. By law, CBO is required to prepare a cost estimate for each bill reported by any committee of the House of Representatives or the Senate. Generally, those estimates provide CBO's assessment of effects on spending subject to appropriation action (known as discretionary spending), effects on direct spending (also sometimes referred to as mandatory spending), and effects on revenues (incorporating estimates by the Joint Committee on Taxation[JCT]). The Congressional Budget Act requires that such estimates cover all the costs that would be incurred in each of the five fiscal years beginning with the year that the proposed legislation would become effective.

However, to assist both the House and Senate in carrying out the annual budget resolution, CBO and JCT routinely provide estimates for direct spending and revenue provisions for a period of 10 years. Such 10-year estimates are necessary for the Budget Committees' determination of whether legislation complies with the pay-as-you-go rules in each House.

Further, the Senate has an additional rule that pertains to longer-term effects on federal deficits, covering a total period of 50 years. As a result, CBO is required, pursuant to section 311(b) of the fiscal year 2009 budget resolution (S. Con. Res. 70), to provide an estimate of whether enactment of a bill would cause a net increase in deficits in excess of $5 billion in any of the four 10-year periods following the 10-year budget window covered by the pay-as-you-go rule.

In June 2009, CBO estimated that H.R. 2454, as passed by the House of Representatives, would yield a reduction in deficits of about $9 billion between 2010 and 2019 (the 10-year period currently covered by the pay-as-you-go rule). At that time, CBO did not provide any estimate of the long-term budget effects of H.R. 2454. For potential Senate consideration of H.R. 2454, consistent with section 311(b) of S. Con. Res. 70, CBO estimates that enactment of the legislation would increase budget deficits by significantly more than $5 billion in each of the three 10-year periods following 2019. Finally, CBO estimates that enacting the House bill would generate a reduction in deficits for the 10-year period beginning in 2050.

To understand the net budget impact of H.R. 2454, as passed by the House, it is important to understand the budgetary treatment of emission allowances. The cost of purchasing allowances, whether from the government or from other entities that might receive allowances, would become an additional business expense for companies. Such costs would result in a decrease in taxable income in the economy and would result in a loss of government revenue from income and payroll taxes. Those losses would offset an estimated 25 percent of the revenues the federal government would receive from auctioning allowances.

Depending on who would receive the allowances and what they would be used for, the reduction in taxable income could be accompanied by a matching increase in taxable income elsewhere in the economy. In those cases, the added revenues from income and payroll taxes would offset the initial loss of tax revenues from the sale of the allowances and the whole transaction would be budget neutral-that is, it would have no net effect on the budget deficit. In other circumstances, there would be no offset to the initial tax loss so there would be a net loss of revenues and hence an increase in the budget deficit.

By CBO's estimate, H.R. 2454, as passed by the House, would reduce budget deficits by about $9 billion over the 2010-2019 period. That budgetary gain would occur because spending of some of the proceeds from the auction of allowances (about $25 billion over the 2010-1029 period) would be subject to subsequent Congressional action (and thus would not add to the deficit unless provided for in future appropriation bills). Those allowances that would be distributed during that period would be allocated to entities in a way that would be budget neutral. In the subsequent three decades (2020-2049), the bill would add large amounts to budget deficits. Two major factors underlie this shift from a net budgetary gain to net increases in deficits over time:

- First, most of the allowance allocations that would be budget neutral (that is, allocations that would not generate the net 25 percent revenue reduction) would be phased out in the mid-2020s. The allowance allocations that would be budget neutral are primarily those that would be given to businesses either directly, such as the allowances that would be given to trade-exposed energy-intensive businesses, or indirectly, such as those given to commercial or industrial consumers of electricity via their local distribution companies. When businesses receive allowance value-and are not instructed how to use that value-it generally increases their taxable income. In those cases, the added tax revenue would off-

set the initial loss in tax revenue from the cost of using allowances. By 2025, most of the allowances given to businesses would be phased out. Instead the revenue from auctioning allowances would be used to fund payments for low-income households (see below) and the Climate Change Consumer Rebate, a nontaxable rebate to all households; the use of allowances in that way would not be budget neutral because those payments would not be taxable income to households and would not yield additional tax revenue to offset the revenue losses (the 25 percent revenue reduction) that would result from sale of the allowances.

- Second, the payments for low-income programs created by the bill would become much more expensive after 2020 relative to the amounts set aside by the bill to fund them. Those household payments would be an entitlement: low-income households would receive payments equal to their "loss in purchasing power" as determined by the Energy Information Administration. The size of those payments would increase as the caps on emissions became tighter over time.[3] H.R. 2454 would set aside 15 percent of the allowance value to fund the payments to low-income households. However, those funds would not be sufficient to fund the payments in the latter years of the program because the value of the allowances would not grow proportionately with the loss in purchasing power that households would experience.

CBO estimates a large surplus in the 2050-2059 period because a large amount of the revenue collected during this period from the sale of allowances would not be allocated or spent (that is, they would be deposited in the Treasury). Those unallocated revenues would be counted toward deficit reduction.

- I also noticed that CBO found that the unfunded mandates that the House bill would impose on industry and state and federal government exceeds the threshold established by the Unfunded Mandates Reform Act. Were these mandates reflected in any way in the CBO's estimate of the House bill's cost?

Answer. CBO determined that H.R. 2454, as passed by the House, would impose both intergovernmental and private-sector mandates as defined in the Unfunded Mandates Reform Act (UMRA). We estimated that the aggregate costs of those mandates would well exceed the annual thresholds established in UMRA ($69 million for intergovernmental mandates and $139 million for mandates on the private sector in 2009, adjusted annually for inflation). CBO could not estimate the cost of some of the mandates in the bill because we lacked adequate information about the scope of future regulations.

The mandates CBO identified include: requirements that utilities, manufacturers, and other entities reduce greenhouse gas emissions through cap-and-trade programs and performance standards; requirements that public and private entities provide information on greenhouse gases to a federal registry; a requirement that public and private utilities pay an annual assessment following a referendum by the affected utilities; limitations on certain commodity transactions; restrictions on the production and importation of hydrofluorocarbons; new efficiency standards and required capabilities for lighting and appliances; new standards for the manufacture of vehicles capable of using alternative fuels such as ethanol, methanol, and biodiesel, and for new heavy-duty vehicles and engines; and several preemptions of state and local authority.

Some of the costs of complying with the mandates imposed by the bill (for example, the expenditures covered facilities would have to make to acquire allowances) are included in the cost estimate's tables showing the budgetary impacts of H.R. 2454. That is because the revenues we estimate would be collected by the federal government are mandate costs to the entities that would have to pay those amounts. Other compliance costs (for example, the cost of purchasing offset credits, the costs of directly reducing emissions, and the costs or preparing reports) are not included in those budgetary tables because they would not directly affect the federal budget. All of the mandates and their impacts on state, local, and private entities, however, are discussed at length in the section entitled "Intergovernmental and Private-Sector Impact" on pages 35-40 of CBO's cost estimate for H.R. 2454, as ordered reported by the House Committee on Energy and Commerce on May 21, 2009, which is available at www.cbo.gov/ftpdocs/102xx/doc10262/hr2454.pdf.

- Did CBO's score of H.R.2454 assume the cost of a larger federal bureaucracy? If yes, what were those costs and what assumptions were they based on?

[3] The bill introduced in the Senate would do away with this entitlement and specify that only 15 percent of allowance value will be used to fund low-income programs.

Answer. Several federal agencies, including the Environmental Protection Agency (EPA), the Federal Regulatory Energy Regulatory Commission (FERC), the Department of State, the Department of Energy, and others would be responsible for administering programs under H.R. 2454. In total, CBO estimates that fully funding federal agencies' administrative costs required to implement the provisions of H.R. 2454 would require gross appropriations totaling $540 million in 2010 and $8.2 billion over the 2010-2019 period. A significant portion of the estimated costs would be incurred by EPA to administer the proposed greenhouse gas cap-and-trade program, including a roughly five percent increase in personnel each year. Such personnel would be responsible for developing regulations, preparing rulemakings, assessments, and studies, distributing proceeds generated from the auctions, and other activities related to the cap-and-trade program. Other agencies would be responsible for supporting the proposed energy-efficiency and renewable electricity standard, providing rebates to low-income individuals and undertaking a variety of rulemakings and studies related to the new programs authorized under the bill; consequently, those agencies would incur costs for additional personnel, contractors, and information technology. The estimates of cost are primarily based on input from EPA and other federal agencies and on historical information on how large regulatory programs have been implemented.

FERC, which has the authority to offset 100 percent of its administrative costs through fees on regulated entities, would levy additional fees sufficient to offset any increased administrative costs incurred under H.R. 2454. Based on information from FERC, CBO estimates that increased user fees to the agency would offset roughly $40 million of annual estimated costs under H.R. 2454. Consistent with current budgetary treatment, such fees would be recorded as offsetting collections, thus reducing the net appropriations that would be necessary to implement the legislation to roughly $7.8 billion over the next 10 years. CBO estimates that net outlays resulting from that amount of funding would total $390 million in 2010 and $7.5 billion over the 2010-2019 period. Those costs are not counted for pay-as-you-go purposes because they would be subject to future appropriation action.

Question 3. Assuming the United States adopts cap-and-trade legislation such as those currently under consideration in Congress, are there any alternative cost containment options if verifiable international offsets are not available in sufficient quantity?

Answer. Cap-and-trade programs could include a variety of design features that would help contain compliance costs. Those options include:

- Allowing firms to transfer allowance requirements across time-by defining compliance periods over multiple years, and by allowing firms to "bank" allowances to use in a future year or to "borrow" allowances from a future year for use in an earlier year,
- Allowing firms to purchase "offset credits" that are generated by entities that reduce emissions that would not otherwise be subject to the cap in approved ways,
- Allowing firms to purchase an additional supply of allowances at or above a stated price. One variant of this approach is to create a "reserve pool". another variant is to establish a "price ceiling." Under the reserve pool approach, the government would sell a limited number of allowances in "reserve auction" at or above a minimum reserve auction price. Allowances sold in the reserve auction would be taken from allocations in future years. Under the price ceiling approach, the government would sell an unlimited number of supplemental allowances (that is, in addition to the allowances initially created under the legislation) at a pre-specified "safety valve" price.

H.R. 2454 and S. 1733 would utilize several of those cost containment mechanisms. Both bills would allow firms to bank unlimited numbers of allowances, to undertake limited borrowing of future allowances, to comply over multiple years, and to purchase offset credits as a way of containing the cost of meeting the cap.

CBO finds that allowing firms to comply by submitting offset credits would significantly lower firms' compliance costs under this legislation. For example, CBO estimates that the use of offset credits would reduce the allowance price for H.R. 2454 by roughly 70 percent. Further, CBO estimates that international offsets play a more significant role in holding down costs than do domestic offsets: firms are not projected to use the maximum number of domestic offset credits allowed under H.R. 2454 (one billion) until 2042, while firms are projected to reach the one billion limit on the use of international offsets more than a decade earlier. (Firms would be able to use additional international offsets to make up for the lack of availability of domestic offsets in the intervening years). Thus, if international offset credits were not

as readily available as CBO projects, compliance costs would be higher than CBO estimates.

Both H.R. 2454 and S. 1733 would establish a reserve pool to help contain costs if costs were higher than anticipated. That reserve would be initially stocked with a limited number of allowances withheld from annual allocations at the onset of the program and could be refilled by government purchases of international offsets. Specifically, the bills would instruct the Administrator of the Environmental Protection Agency to use the revenue obtained by selling allowances from the reserve pool to purchase domestic and international offset credits. The Administrator would be instructed to retire those credits and create a number of allowances equal to the number of international offset credits retired. Those allowances would be used to restock the reserve pool. If international offset credits were not readily available, restocking the reserve pool would be difficult.

Because a scarce supply of international offsets could both increase the likelihood that firms would wish to purchase allowances from the reserve pool and would limit the Administrator's ability to restock that pool, the reserve pool would probably not hold down costs in that situation. Legislation could seek to address this situation by authorizing the Administrator to find other ways to restock the reserve pool, for example, by using domestic offset credits, should they happen to be more readily available than international offset credits.

Establishing a price ceiling, which would result in an increase in the number of available allowances, could avoid the potential problem of running out of additional allowances (that is, depleting the reserve pool). Unlike what would occur in the case of the reserve pool, the government would maintain the price ceiling by supplementing the total number of allowances over the course of the policy. For example, under the provisions of H.R. 2454, the government might agree to sell firms as many allowances as they might wish to purchase at a price of $28 in the initial year of the policy. That price ceiling could rise over time. Although such an approach would avoid potential difficulties with restocking the reserve pool, it would also create more uncertainty about the quantity of emissions over the course of the policy.

Numerous variations of reserve pools and price collars could be considered, with different implications for policy outcomes. CBO is performing additional analysis on this topic.

For further information, see:

- Flexibility in the Timing of Emission Reductions Under a Cap-and-Trade Program (Statement of Douglas W. Elmendorf, Director, CBO, before the Committee on Ways and Means, United States House of Representatives, March 26, 2009) which is available at: www.cbo.gov/ftpdocs/100xx/doc10020/03-26-Cap-Trade_Testimony.pdf
- Congressional Budget Office, Policy Options for Reducing CO_2 Emissions (February 2008), which is available at: www.cbo.gov/ftpdocs/89xx/doc8934/02-12-Carbon.pdf

Question 4. Do you believe consumers need to feel a price signal in order to undertake energy efficiency investments and make the behavioral changes necessary to reduce national fossil fuel use? Do measures meant to reduce the burden of higher electricity prices, such as the significant share of emissions allowances allocated to local electricity distribution companies (LDCs) under H.R. 2454, effectively dampen the carbon price signal and thus consumers' incentives to make choices and behavioral changes that will be needed to decarbonize the economy?

Answer. Price signals are an effective and efficient way to encourage consumers (and businesses) to reduce energy consumption and increase investment in energy efficiency. Although other regulatory approaches can achieve the same goals, under most circumstances, those alternative approaches are a more expensive means to achieving the same goal.

The cap-and-trade program for greenhouse gases (GHGs) that would be created by H.R. 2454 would provide incentives for emissions reduction in two ways. First, it would motivate generators that are covered by the cap to reduce the amounts of GHGs that they emit directly in the production of electricity. Second, it would result in higher prices for goods and services whose production or consumption leads to relatively large quantities of GHG emissions. Those higher prices would encourage consumers to purchase fewer of those products.

H.R. 2454 would also provide rebates to electricity consumers through local distribution companies (LDCs). Those rebates would be provided as reductions to the fixed portion of electric bills rather than as reductions to the rate charged for electricity. To the extent that consumers view such rebates as unrelated to the price of electricity, the rebates would not affect the incentive to reduce consumption. Con-

versely, if consumers view the rebates as offsetting the price increase, the rebates would eliminate the added incentive to reduce their consumption of electricity.

CBO concluded that the share of emissions allowances allocated to local electricity distribution companies (LDCs) in the manner described in H.R. 2454 would dampen, but not eliminate, the carbon price signal to residential electricity consumers. Although the fixed rebates that LDCs would provide to customers would not, in theory, reduce incentives to conserve energy, CBO concluded that not all residential consumers would distinguish changes in the fixed portion of their bill from changes in the what they pay based on their use of electricity. Therefore, CBO estimated that rebates to residential consumers would cut the price signal in half, but not completely eliminate it. That dampening of the price signal for residential customers would cause the overall price on emissions to rise slightly to generate additional reductions in usage in other sectors of the economy.

RESPONSE OF LARRY PARKER TO QUESTION FROM SENATOR BINGAMAN

Question 1. A key uncertainty is how the models handle the recession and recovery. Do the models assume that growth and emissions will return to trend (ie that there will be a period of higher than normal growth after the recession ends as unused capacity is put into service) or that there has been a step-change in GDP and after the recession, growth rate will return to normal but that the US economy will set out from a low base. This question is fundamentally important because US emissions will have fallen by more than 8% from 2007 levels by the end of this year. This is the initial condition from which the models are being initiated. How they handle it is critical to projecting 2020 and 2030 costs.

Answer. In general, the models do assume that smooth, steady economic growth will return after the recession ends, but from a lower starting point. In addition to the lower starting point, the reference case scenario developed by the Energy Information Administration for its Annual Energy Outlook has become increasingly pessimistic about future U.S. economic growth. This is illustrated in our report, CRS Report 40809, by Figure 3 on page 16.

RESPONSES OF LARRY PARKER TO QUESTIONS FROM SENATOR MURKOWSKI

ANTICIPATED MARKET VOLATILITY

Question 1. There is a great deal of variation among the cost estimates that have been produced for the Waxman-Markey bill. While that is generally a cause for concern, perhaps it gives a reliable idea of the market volatility we can expect for carbon allowance prices over the next four decades.

Assuming this is the case, can you provide us with an anecdotal assessment of these potential fluctuations in allowance prices and how they compare to volatility we have seen in the oil and gas markets recently?

Answer. Attached to this memorandum is a CRS powerpoint presentation that discusses allowance volatility within existing cap-and-trade programs.* As noted, volatility in allowance markets can be caused by a variety of allowance supply, demand and market design dynamics. In some cases (such as the European Union's Emissions Trading Scheme (ETS)), the volatility can be substantial. Perhaps more importantly with respect to allowance prices and energy market volatility, analysis of ETS allowance prices during Phase 1 suggests the most important variables in determining allowance price changes in the European program were oil and natural gas price changes. See: Maria Mansanet-Bataller, Angel Pardo, and Enric Valor, "CO_2 Prices, Energy and Weather," 28 The Energy Journal 3 (2007), pp. 73-92.

DISCOUNT RATES

Question 2. The difficulty of looking decades into the future at the impact of a climate policy is compounded by how much the value of a dollar changes over time.

If we were to go back to 1969, and wanted to explain the value of a $23,000 2009 model-year car, there are a few ways we could attempt to do so. We might adjust the 2009 price tag for inflation and say "it will cost the equivalent of $3,960 in today's dollars". Or we could say, "put $562 in the bank, and at a 5% interest rate you will have enough to buy the car in 2009". This latter explanation would rely upon a 'net present value inflation adjusted' calculation, which is what most of these reports use.

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*Attachment has been retained in committee files.

But it should be apparent that this is a very bad indication of what something will actually cost in 40 years. Climate bills do not require Americans to put away money now to cover costs later; they simply impose those costs at some future date.

So I have to ask if there is something I am missing here. I understand that discounting is a standard practice in the computer models used by the agencies, but it seems like these models and the numbers they generate are better for comparing two pieces of legislation than providing a real idea of what costs we can expect.

Are there better ways to explain the costs of these bills, or at least ways that would make more sense to my constituents?

What would the use of actual dollar amounts, simply adjusted for inflation without discounting, do to the cost estimates produced for these climate bills?

Answer. The general purpose of a discount rate is to convert future revenues and costs into their value today so that they can be compared to each other in a meaningful fashion. As noted in your example, businesses use discount rates to account for the "time value" of money in making investments (see discussion of discount rates in CRS Report 40809, page 40). Since a first-order effect of climate change legislation is the cost businesses incur in complying with the reduction requirements, use of discount rates by the models reflects standard business practice.

With respect to attempting to estimate impacts on consumers, model results are problematic and should be viewed with the utmost skepticism (CRS Report 40809, pages 76-82). The "time" issue here is not related to making long-term investment decisions (as your example illustrates correctly), but putting any costs in the context of the economy in which they would occur at the time they would occur. Talking about a cost to be incurred in 2020 in terms of today is mixing a 2020 cost estimate with a 2009 economy (currently in recession) and 2009 wages. If, as suggested by your question, one only adjusts for inflation, one is assuming the U.S. economy and wages in real terms will not increase for the next 10, 20, 30, or even 40 years (depending on the cost estimate being used). All models project future real economy growth (beyond inflation), and therefore, the economy of the future is assumed to be larger than it currently is. Individuals in 2020, 2030, or 2050 are projected to have higher real income (beyond inflation) than they have today. Thus, simply adjusting future costs to inflation may be inadequate, unless one believes that the U.S. economy and people's wages will remain stagnant and not increase in real terms for the next decade or more.

The analyses by CBO and CRA International referenced in CRS Report 40809 recognize this problem by estimating their projected 2020 costs in terms of a 2010 economy (i.e., the estimated impact in 2020 has been scaled to represent an equivalent impact in terms of the size of the 2010 economy). Based on CBO's projections of GDP growth, population growth, and inflation, CRS estimated the imputed real discount rate of CBO's scaling methodology at 2% annually in real terms. By using this discount rate, the impact of a 2020 costs can be converted into an impact reflective of today's economy. This allows one to compare a cost and an economy in the same time period (2010).

CRS Report 40809 presents household effect estimates for 2020 in both undiscounted (Figure 17) and the CRS calculated discounted (Figure 18) forms. As stated in the Report on page 80:

> The data for household effects in the various cases are presented in either discounted or undiscounted form. As noted earlier, discounting is a way in which economics expresses time, and is a standard convention when examining a stream of economic data across time. With respect to household effects, discounting costs accounts for the fact that program costs will occur in the future when incomes are expected to be higher. For the purposes of this section, CRS has generally presented data in undiscounted form, partly because the discount rates of the studies vary substantially.
>
> A second accounting issue is the context in which the household effects estimates are presented. Most of the cases here present their household effects estimates in the economic context of the year in which they would occur; i.e., effects in 2020 are presented in terms of its impact on a 2020 economy. Two cases, CBO and NBCC/CRA scaled their estimates in the context of the 2010 economy. In its discussion of results below, CRS attempts to normalize the various cases' household effects estimates in the context a 2010 economy.
>
> Because household estimates are problematic for reasons suggested above, CRS focuses on those effects estimated for the year 2020. Any estimate beyond that point, or any cumulative estimate to 2030 or beyond, should be viewed with the utmost skepticism.

RESPONSES OF LARRY PARKER TO QUESTIONS FROM SENATOR CANTWELL

Question 1. Assuming the United States adopts cap-and-trade legislation such as those currently under consideration in Congress, are there any alternative cost containment options if verifiable international offsets are not available in sufficient quantity?

Answer. As noted in CRS Report 40809, all the analyses examined agreed that international offsets were a critical cost containment mechanism under H.R. 2454 (pages 46-47). The CRS has two other reports that discuss a range of cost containment options that designers of a cap-and-trade program could use instead of international offsets. These reports are: (1) CRS Report RL33799, Climate Change: Design Approaches for a Greenhouse Gas Reduction Program by Larry Parker, and (2) CRS Report R40242, Carbon Tax and Greenhouse Gas Control: Options and Considerations for Congress by Jonathan Ramseur and Larry Parker. As discussed in CRS Report RL33799, there are three primary foci to containing costs under a cap-and-trade program.

- The tonnage requirement, and options include making the cap more flexible (e.g., using emission rates rather than tonnage caps based on historic emissions, expanding availability of domestic offsets, imposing a carbon tax).
- The timetable for compliance and options for delaying compliance under certain conditions (e.g., triggering reduction "circuit-breakers" under specific economic or technology development conditions).
- The techniques and options covered entities are permitted to use in coming into compliance (e.g., banking, borrowing, auctioning of permits, safety valve).

Question 2. Do you believe consumers need to feel a price signal in order to undertake energy efficiency investments and make the behavioral changes necessary to reduce national fossil fuel use? Do measures meant to reduce the burden of higher electricity prices, such as the significant share of emissions allowances allocated to local electricity distribution companies (LDCs) under H.R. 2454, effectively dampen the carbon price signal and thus consumers' incentives to make choices and behavioral changes that will be needed to decarbonizes the economy?

Answer. All of the models examined by CRS assume some price-induced demand response by consumers to higher prices (see CRS Report 40809, pages 64-76). With respect to the potential dampening effect of a rebate via the LDC, we state on pages 67-68:

> The manner in which allowances are allocated does not reduce the program's compliance cost,it only changes who bears the cost.[1] As stated by W. David Montgomery of CRA International during congressional testimony:
>
> The allocation of allowances cannot eliminate the cost of a cap and trade program; it can only change who bears the cost. Free allocations can remove some or all of the cost of obtaining allowances that grant permission to emit up to the stated caps; but no matter how allowances are distributed, none of the cost of the actions that must be undertaken to bring emissions down to satisfy the caps can be removed. At best, that distribution can eliminate the cost of purchasing allowances from the government. Nothing can eliminate the cost of reducing emissions from their projected business-as-usual level to the capped level, though there are many ways of hiding or shifting that cost around.[2]
>
> Indeed, free allocation of allowances can increase the cost of the program if it dilutes the price signal, resulting in less economically efficient compliance schemes. As EPA stated in its analysis of H.R. 2454:
>
> Returning the allowance value to consumers of electricity via local distribution companies in a non-lump sum fashion prevents electricity prices from rising but make the cap-and-trade more costly overall. This form of redistribution makes the cap-and-trade more costly since greater emission reductions have to be achieved by other sectors of the economy. Resulting

[1] There is research to suggest that using allowance value to reduce other distorting taxes (e.g., income and payroll taxes), can produce a more efficient tax system, and therefore reduce the overall cost to the economy from the cap-and-trade program. However, H.R. 2454 does not use allowance value to reform the tax system.

[2] W. David Montgomery, Prepared Testimony. Hearing on Allowance Allocation Policies in Climate Legislation. House. Committee on Energy and Commerce, Subcommittee on Energy and Environment, (June 9, 2009), p. 1.

changes in prices of other energy-intensive goods also influence the overall distributional impacts of the policy.[3]

In the case of H.R. 2454, this diluting effect does not seem to dominate the cost analysis. For example, in analyzing the May discussion draft that preceded the introduction of H.R. 2454, EPA assumed that the cap-and-trade program would allocate its allowances entirely by auction-the most economically efficient means of distributing allowances. In its June analysis of H.R. 2454 as reported by House Energy and Commerce Committee, EPA included scenarios that incorporated the free allocation provisions of the bill in a manner that reduced electricity price increases to consumers and which increased electricity demand and associated emissions. However, in comparing the overall impact of the two versions, the projected allowance prices were less in the reported version than the discussion draft-a result driven primarily by the reported version's less stringent 2020 emissions cap and its provisions permitting expanded use of international offsets.[4] This suggests that, in the case of H.R. 2454, there may be design parameters, particularly the assumed availability of international offsets, that could substantially outweigh whatever economic inefficiencies are introduced by its free allocation scheme.

In the case of H.R. 2454, there are three factors that affect the efficiency of its allocation system. First, as indicated earlier, H.R. 2454 uses a mixture of free allocation schemes and auctions to distribute allowances. Over time, the distribution becomes increasingly based on auctions with per-capita rebates to consumers. Thus, the allocation system becomes increasingly efficient economically over time with over 65% of allowances auctioned by 2030. Second, there is a significant amount of free allowances allocated for other purposes (state energy efficiency programs, international activities, etc.,) that would have little or no effect on the price signal. Third, the bill contains language that attempts to prevent electricity and natural gas LDCs from using the free allowances provided them to reward increased use of energy. Alternatives include focusing on the fixed component of energy bills and use of allowance value to fund energy efficiency activities (mandated for one-third of natural gas LDCs' allocation).

Of the analyses examined here, the EPA cases assume that the allowances allocated to electricity LDCs do dilute the price signal, resulting in the need for increased emission reductions. However, the scenario most focused on by EPA (scenario 2) incorporates some of the efficiency provisions of H.R. 2454 that counteract this effect. The CRA International analysis assumes that LDCs do distribute the allowances in the manner mandated by the bill, preventing a dilution of the price signal. Disagreeing with EPA's interpretation, CRA International states: "The specific provisions on the use of the allowances do not allow the use of the allowances for rebates based 'solely on the quantity of electricity delivered to such ratepayer.' [footnote to H.R. 2454 omitted] Since the rebate is not to be based on electricity use it should not distort the incentive for consumers to conserve electricity."[5] For EIA, electricity allowances allocated freely to load serving entities are reflected as a reduction in "effective" electricity rates to consumers.[6] When asked by CRS about how its study distributed allowance value, the Heritage Foundation rejected the entire notion a priori that allowance value could be used to reduce energy prices. Instead, the Heritage Foundation models the macro-economic and pricing effects of H.R. 2454 as if all the allowances are auctioned, treating the allowance value created by H.R. 2454

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[3] U.S. Environmental Protection Agency, *EPA Analysis of the American Clean Energy and Security Act of 2009: H.R. 2454 in the 111th Congress* (June 23, 2009), p. 49.

[4] The Heritage Foundation found that the less efficient allocation of the reported version of H.R. 2454 overweighed the reduction in the 2020 reduction requirements from the discussion draft. However, the Heritage Foundation did not alter its somewhat restrictive assumptions about the availability of offsets in recalculating H.R. 2454 costs. See The Heritage Foundation, *Son of Waxman-Markey: More Politics Makes for a More Costly Bill*, (May 18, 2009).

[5] CRA International, *Impact on the Economy of the American Clean Energy and Security Act of 2009 (H.R. 2454)* (May 2009) p. 53.

[6] EIA models the natural gas LDC allowance allocation similarly, except for the ⅓ that is designated for energy efficiency. EIA models this provision by using ⅓ of the value of allowances for programs that accelerate penetration of more efficient technologies and therefore lower gas demand.

as government revenue (similar to a tax) regardless of whether they are formally auctioned or not.[7]

RESPONSE OF RICHARD NEWELL TO QUESTION FROM SENATOR BINGAMAN

Question 1. A key uncertainty is how the models handle the recession and recovery. Do the models assume that growth and emissions will return to trend (i.e., that there will be a period of higher than normal growth after the recession ends as unused capacity is put into service) or that there has been a step-change in GDP and after the recession, growth rate will return to normal but that the US economy will set out from a low base. This question is fundamentally important because US emissions will have fallen by more than 8% from 2007 levels by the end of this year. This is the initial condition from which the models are being initiated. How they handle it is critical to projecting 2020 and 2030 costs.

Answer. EIA's analysis of H.R. 2454 was prepared before the full depth of the recessionas apparent. However, the analysis did incorporate a fall in U.S. economic output and energy-related carbon dioxide (CO_2) emissions in 2008 and 2009. In the Updated Annual Energy Outlook 2009 Reference Case (April 2009), U.S. energy-related CO_2 emissions do grow as the recession ends, but they do not reach the 2005 level until the year 2024.

RESPONSES OF RICHARD NEWELL TO QUESTIONS FROM SENATOR MURKOWSKI

ANTICIPATED MARKET VOLATILITY

Question 1. There is a great deal of variation among the cost estimates that have been produced for the Waxman-Markey bill. While that is generally a cause for concern, perhaps it gives a reliable idea of the market volatility we can expect for carbon allowance prices over the next four decades.

Assuming this is the case, can you provide us with an anecdotal assessment of these potential fluctuations in allowance prices and how they compare to volatility we have seen in the oil and gas markets recently?

Answer. While EIA has not examined each of the published analyses of H.R. 2454 in detail, we believe that the key drivers in the wide range of cost estimates are assumptions about the longer-term cost and availability of offsets and zero-and low-emitting electricity generating technologies such as nuclear and fossil with carbon capture and storage. As a result, we do not believe that the variation in allowance cost estimates in these studies is a good measure of the potential short-term volatility in allowance prices. Any short-term price volatility would be more likely to be due to variation in energy prices, weather, short-term energy supply and demand shocks, or other factors. These short term changes are not typically assessed in existing studies.

DISCOUNT RATES

Question 2. The difficulty of looking decades into the future at the impact of a climate policy is compounded by how much the value of a dollar changes over time.

If we were to go back to 1969, and wanted to explain the value of a $23,000, 2009 model-year car, there are a few ways we could attempt to do so. We might adjust the 2009 price tag for inflation and say "it will cost the equivalent of $3,960 in today's dollars." Or we could say, "put $562 in the bank, and at a 5% interest rate you will have enough to buy the car in 2009." This latter explanation would rely upon a 'net present value inflation adjusted' calculation, which is what most of these reports use.

But it should be apparent that this is a very bad indication of what something will actually cost in 40 years. Climate bills do not require Americans to put away money now to cover costs later; they simply impose those costs at some future date.

So I have to ask if there is something I am missing here. I understand that discounting is a standard practice in the computer models used by the agencies, but it seems like these models and the numbers they generate are better for comparing two pieces of legislation than providing a real idea of what costs we can expect.

Are there better ways to explain the costs of these bills, or at least ways that would make more sense to my constituents?

What would the use of actual dollar amounts, simply adjusted for inflation without discounting, do to the cost estimates produced for these climate bills?

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[7] The Heritage Center for Data Analysis, *The Economic Consequences of Waxman-Markey: An Analysis of the American Clean Energy and Security Act of 2009* (August 5, 2009) p. 16.

Answer. EIA recognizes that there are multiple ways to express the costs of complying with H.R. 2454 and, as a result, in our study we provided costs during each year separately, as well as both discounted and undiscounted cumulative costs. The undiscounted cumulative costs are always higher; however, when one wants to compare alternative policies and scenarios that have different time paths of costs and benefits, discounting is necessary to put them on a comparable basis. Discounting is the widely-accepted economic method for aggregating impacts that occur at different points in time.

RESPONSES OF RICHARD NEWELL TO QUESTIONS FROM SENATOR CANTWELL

Question 1. Both the EPA and EIA analyses have addressed the question of costs associated with various pieces of climate change legislation, most recently H.R. 2454. Has either of these agencies, or any other government agency, ever analyzed the potential economic costs of business-as-usual, assuming that climate impacts projected by the Intergovernmental Panel on Climate Change and the U.S. Climate Change Science Program come to pass in the upcoming decades? How do the economic costs of inaction compare with those of policy action on climate change?

Answer. EIA has not performed such an analysis, and would defer to EPA as to whether or not that agency has. A recent interagency effort has focused on measures of the "social cost of carbon.".

Question 2. According to the EIA, in January of 2008, crude oil cost $87 per barrel, in July itost $128 a barrel, and in December it cost $37 a barrel, for an annual average cost of $94/barrel.

- Does ETA's or EPA's modeling of H.R. 2454 give us any indication of the extent to which seasonal energy price volatility might result from a capand-trade policy?
- Could a well-designed price collar mitigate this volatility?

Answer. EIA's analysis of H.R. 2454 assumes that allowance prices will rise smoothly athe rate of return that investors would require. It does not specifically address the volatility in prices that might occur in the actual market. In principle, theanking provisions of the legislation would tend to dampen any volatility because, if the allowance price were to fall below a long-term expected value, allowances would be banked for future use. In addition, a well-designed price collar could likely dampen the volatility in prices that might otherwise occur, depending on the price ceiling, the price floor, and the amount of allowances available to support the price collar.

Question 3. To what extent does the length and complexity of H.R. 2454 increase the uncertainties and the sensitivities in the modeling results?

Answer. While a shorter, less complex bill would likely be easier to model, the keyompliance uncertainties would remain. These uncertainties center on assumptions about the cost and availability of offsets and zero- and low-emitting electricity generating technologies such as nuclear and fossil with carbon capture and storage (CCS). Until there is some significant market experience with offsets and several new nuclear plants and fossil plants with CCS are built, it will be difficult to reduce these uncertainties.

Question 4. To what extent does [sic] H.R. 2454's cost containment measures, such as itseavy reliance on offsets to meet emission reduction targets, increase the uncertainties and the sensitivities in the modeling results?

Answer. EIA found that the use of offsets, particularly international offsets, was a keyompliance option under H.R. 2454. In fact, in our Basic Case, offsets account for nearly 60 percent of the compliance through 2030. This led us to prepare several sensitivity cases with alternative offset assumptions. Until there is some significant market experience with offsets, it will be difficult to reduce these uncertainties.

Question 5. To what extent does the development of a carbon market in H.R. 2454, which will likely cause price changes independent of supply and demand fundamentals, increase the uncertainties and the sensitivities in the modeling results?

Answer. EIA's analysis of H.R. 2454 assumes that allowance prices will rise smoothly athe rate of return that investors would require. It does not specifically address the volatility in prices that might occur in the actual market. In practice, there could be periods when prices vary significantly and careful market monitoring would also be required. Nonetheless, the use of a cap-and-trade system as the centerpiece of H.R. 2454 would tend to lessen the sensitivity of the bill's cost to various key factors. This is due to the flexibility of cap-and-trade, which allows substitute compliance options to provide cost-effective reductions when other options turn out to be limited or of relatively high cost.

Question 6. Both the EIA and EPA analyses of the House bill show significant expansion of nuclear power as the constraints on fossil carbon get tighter in future decades. Could you talk about the expansion of nuclear power and assumptions that facilitate it in your models?

- Is price the principal driver of nuclear power in the models, or doovernment subsidies play a role in the industry's expansion?
- What role do you believe a clear and consistent carbon price signal play [sic] in the future development of nuclear power? How would you rate the impact of a carbon price signal on future nuclear energy development relative to expansion of existing industry subsidies and removal of other institutional barriers?
- How could we manage volatility in the carbon market to ensure a consistent price signal for energy technology innovators and investors?

Answer. Although the existing tax credits do play a role in spurring the construction of amall number of new nuclear plants, the emission allowance price is the primary factor that makes new nuclear power generation attractive in EIA's analysis of H.R. 2454. Because zero-emissions technologies such as nuclear and renewable power are more readily available for electricity generation than for other energy applications, there would be a substantial incentive to move toward emissions-free sources of electricity as part of cost-effective plans to meet a cap on covered emissions that requires an 83 percent reduction in emissions by 2050.

Because new nuclear plants and other low-emitting electricity generating technologies are very long-lived assets, uncertainty about future costs, including allowance costs, is a key concern when evaluating a potential investment. A policy instrument, such as an allowance price collar, could contain this cost uncertainty and improve the viability of such investments.

Nonetheless, substantial uncertainty about the future would'still remain, which is why EIA's analysis contains several alternative cases, including sensitivity cases around nuclear power. The ACESA Basic Case represents an environment where key low-emissions technologies, including nuclear, fossil with CCS, and various renewables, are developed and deployed on a large scale in a timeframe consistent with the emissions reduction requirements of ACESA and without encountering any major obstacles.

The ACESA High Cost Case is similar to the ACESA Basic Case except that the costs of nuclear, fossil with CCS, and biomass generating technologies are assumed to be 50 percent higher. There is great uncertainty about the costs of these technologies, as well as the feasibility of introducing them rapidly on a large scale. Cost estimates for these technologies rose rapidly from 2000 through 2008 and have only recently begun to moderate. The actual costs of these technologies will not become clearer until a number of full-scale projects are constructed and brought on line.

The ACESA Limited Alternatives Case represents an environment where the deployment of key technologies, including nuclear, fossil with CCS, and biomass, is limited to their Reference Case levels through 2030. There is great uncertainty about how fast these technologies, the industries that support them, and the regulatory infrastructure that license/permit them might be able to grow and, for fossil with CCS, when the technology will be fully commercialized.

Question 7. Any climate policy enacted into law today is unlikely to start until at least 2012,but how much uncertainty is there regarding the projected emissions in 2012? Does this uncertainty suggest that Congress might want to defer to the executive branch and give it the authority to set the base year emissions target in 2011 so that more reliable estimates closer to the implementation date can be used?

Answer. The cost of complying with H.R. 2454 is driven by the cumulative emissions reductions required over the entire period covered by the legislation. As a result, shifting the initial baseline year of the bill would not have a large impact if all the targets in later years remained unchanged. If, however, the targets for all years were shifted with the baseline year, there could be a larger impact.

Question 8. The Natural Resources Defense Council (NRDC) recently did their own analysis of the House-passed bill and predicted that enhanced oil recovery from captured CO_2 would increase domestic oil production by 1.3 million barrels per day in 2020 and 2.6 million barrels per day by 2050.

- How does NRDC's analysis compare to ETA's projections of domestic oil production?
- What does ETA's analysis tell us about petroleum use under the House-passed bill and what does this imply about our foreign oil dependence?

Answer. There are several important differences between the NRDC and EIA analyses. First, the NRDC's analysis assigned all of the production arising from the use of CO_2-enhanced oil recovery (EOR) technology to the passage of the legislation,

whereas EIA's *Annual Energy Outlook 2009 (AE02009)* Reference Case (April), already projects 1.45 million barrels per day of domestic crude oil production (20 percent of the total) from CO_2-EOR in 2030 (the limit of our modeling horizon)—with a portion of that CO_2 supply being provided by carbon capture at industrial facilities.

Second, in EIA's analysis the amount that oil producers using CO_2-EOR would be able to collect from emitters for taking captured CO_2 under either a carbon capandtrade scheme or tax is limited by the cost of alternative CO_2 sequestration options available to emitters, such as storage in deep saline aquifers and unminable coal seams. NRDC's analysis apparently allows oil producers to collect a larger fee for taking and using CO_2, despite the availability of lower-cost options for emitters seeking to sequester their captured CO_2.

Third, the NRDC projections of CO_2-EOR production include both the onshore lower-48 and the offshore Louisiana regions. The EIA excludes the offshore Louisiana region because of the considerable cost of constructing offshore CO_2 pipelines and building new offshore platforms to accommodate CO_2—EOR facilities. EIA and NRDC also use different methodologies for assessing the increment to the technically recoverable resource (TRR) base that would arise from implementation of the CO_2—EOR technology.

EIA's analysis of ACESA showed an incremental CO_2—EOR production of approximately 200,000 barrels per day above the *AE02009* Reference Case across the cases that EIA analyzed. With regard to domestic crude oil production, EIA projects that, under the *AE02009* Reference Case, CO_2—EOR will provide 20 percent of domestic crude oil production by 2030 and that the technology for the CO_2—EOR capture at industrial facilities will be developed and deployed without climate change legislation under projected crude oil prices.

Projected U.S. petroleum use in 2030 is 20.9 million barrels per day (bpd) in the *AE02009* Reference Case, and ranges from 19.3 million bpd to 20.1 million bpd across the main policy cases in EIA's analysis of ACESA. Across the policy cases, more optimistic assumptions regarding the cost and availability of offsets and low- and no-carbon electric generation technologies tend to result in lower allowance prices and higher levels of projected oil consumption. The share of net crude and product imports in projected 2030 petroleum consumption is 40 percent in the Reference Case, and ranges from 34 to 38 percent across the ACESA policy cases.

Question 9. I understand EIA recently started incorporating the impact financial marketrading might be having on energy market prices. Are there lessons from that effort that could be applied to better predicting future prices under H.R. 2454? What impact do you think a new multi-trillion carbon trading market might have on cash and future carbon prices?

Answer. In September 2009, EIA launched the Energy and Financial Markets Initiative toupplement EIA's data collection and analysis of oil and natural gas fundamentals. Key actions under this Initiative are: (1) collection of critical information on factors affecting energy prices, (2) analysis through in-depth studies of energy market behavior, (3) outreach to solicit feedback from a broad range of experts on the interrelationship of energy and financial markets, and (4) coordination with other Federal agencies engaged in energy market information collection and analysis. Together, these actions should help us better understand what drives short-term energy prices.

The fundamental supply and demand characteristics of a greenhouse gas (GHG) allowances market are likely to be significantly different from oil markets. Oil supply and oil demand are not very responsive to prices in the short-run. New sources of supply have a long time horizon, and transportation sector demand, a key part of the oil market, does not have ready alternatives to petroleum and cannot replace its stock of vehicles quickly. This means that there can be a wide range of prices that are roughly consistent with a physical balancing of supply and demand. Because of this, other factors, such as hedging, investment, and speculative activities in futures and options, also affect prices.

In contrast, the demand for GHG allowances should be relatively more responsive to price changes because there are a number of different options to substitute formitting GHGs, i.e, various low-carbon energy sources as well as offsets. On the allowance supply side, the government actually controls the supply of allowances, so it can make the supply of allowances as flexible or inflexible as it desires. Given the supply and demand characteristics of a GHG market, policy can be designed to reduce the possibility of price volatility due to financial market behavior. Cost containment mechanisms can adjust the supply of allowances, limits can be placed on how far prices can move, and offset provisions can be designed to expand abatement opportunities and thus allowance supply.

Question 10. What assumptions does EIA make in its analysis of H.R. 2454 on the timing, scale, and cost of carbon capture and storage deployments? Do these assumptions rely on any particular legislative proposals in the bill or do they reflect the current state of technology?

Answer. The role of coal plants with carbon capture and storage (CCS) equipment varies in our analysis. There is significant uncertainty about when this technology will be commercially available and what the new plants will cost. As a result, several cases with alternative assumptions about the technologies' cost and availability were prepared. In our Basic Case, 5 gigawatts of new CCS capacity is added through 2017. The cumulative additions through 2030 in our main cases vary from 2 gigawatts when it is assumed the technology will not be broadly available through 2030, to 69 gigawatts when it is assumed that new additions will begin in 2016 and be widely available thereafter with overnight construction costs (i.e., with no interest costs incurred) starting just over $3,500 per kilowatt. The key drivers for the additions are the emissions allowance price and the special bonus allowances for new plants with CCS.

Question 11. If the U.S. does not enact any limits on greenhouse gases, does EIA still project fossil fuel prices rising in the future? What percentage increase is predicted for coal, oil, and natural gas for the years 2015, 2020, 2025, and 2030? What level of volatility does EIA project in fossil fuel prices over the next 20 years, and how does that compare to the volatility we have experienced over the last decade?

Answer. The table below shows the natural gas, coal and oil prices in 2007 dollars in our updated 2009 Reference Case. As shown, prices are expected to rise over time, though they do initially fall from the high levels they reached in 2008. EIA's long-term projections only provide average annual prices, so they do not address the market volatility that will likely occur.

	2007	2015	2020	2025	2030
Natural Gas (dollars per Mcf)	6.39	5.60	6.79	6.82	8.01
Coal (dollars per million Btu)	1.86	1.98	2.02	2.05	2.09
Oil (dollars per barrel)	72.33	98.88	116.79	122.63	130.92

Question 12. Assuming the United States adopts cap-and-trade legislation such as those currently under consideration in Congress, are there any alternative cost containment options if verifiable international offsets are not available in sufficient quantity?

Answer. EIA found that the use of offsets, particularly international offsets, was a key compliance option under H.R. 2454. In fact, in our Basic Case, offsets account for nearly 60 percent of the compliance through 2030. This led us to prepare several sensitivity cases with alternative offset assumptions. When it was assumed that international offsets were not available, the allowance price in 2030 was 64 percent above the Basic Case level. Besides offsets, other potential cost control mechanisms include banking and borrowing (often referred to as temporal flexibility), an explicit safety valve or price ceiling that sets a maximum allowance price, or a price collar that includes both a floor and ceiling price for allowances.

Question 13. Do you believe consumers need to feel a price signal in order to undertake energy efficiency investments and make the behavioral changes necessary to reduce national fossil fuel use? Do measures meant to reduce the burden of higher electricity prices, such as the significant share of emissions allowances allocated to local electricity distribution companies (LDCs) under H.R. 2454, effectively dampen the carbon price signal and thus consumers' incentives to make choices and behavioral changes that will be needed to decarbonize the economy?

Answer. A price signal for consumers would provide them an incentive to increase their investments in energy efficiency. Absent such a price signal, it would be more difficult to induce such investments. The free allocation of allowances to LDCs could lower the incentive of consumers to invest in efficiency if LDCs are not very careful in how they pass on the allowance value to their consumers. If the LDCs adjust their monthly bills to reflect the value of the freely allocated allowances, many consumers, reacting to the final bills they receive, may not even realize that energy prices have actually risen. If, on the other hand, LDCs send adjustment checks separately from their energy bills, or make adjustments infrequently (e.g., annually), consumers will see the higher monthly prices and that will give them more of an incentive to invest in energy efficiency.

RESPONSE OF REID P. HARVEY TO QUESTION FROM SENATOR BINGAMAN

Question 1. A key uncertainty is how the models handle the recession and recovery. Do the models assume that growth and emissions will return to trend (ie that there will be a period of higher than normal growth after the recession ends as unused capacity is put into service) or that there has been a step-change in GDP and after the recession, growth rate will return to normal but that the US economy will set out from a low base. This question is fundamentally important because US emissions will have fallen by more than 8% from 2007 levels by the end of this year. This is the initial condition from which the models are being initiated. How they handle it is critical to projecting 2020 and 2030 costs.

Answer. EPA's models are calibrated to EIA's 2009 Annual Energy Outlook (March release for ADAGE and IGEM, April release for IPM). The AEO 2009 forecast projects that GDP growth in the years 2011–2013 is approximately one percentage point higher than the average over the entire forecast.

RESPONSES OF REID P. HARVEY TO QUESTIONS FROM SENATOR MURKOWSKI

ANTICIPATED MARKET VOLATILITY

Question 1a. There is a great deal of variation among the cost estimates that have been produced for the Waxman-Markey bill. While that is generally a cause for concern, perhaps it gives a reliable idea of the market volatility we can expect for carbon allowance prices over the next four decades.

Answer. The models that have been used to analyze the Waxman-Markey bill do not represent price volatility. The variation in cost estimates reflects uncertainty about the realized cost of the bill.

Question 1b. Assuming this is the case, can you provide us with an anecdotal assessment of these potential fluctuations in allowance prices and how they compare to volatility we have seen in the oil and gas markets recently?

Answer. EPA acknowledges that any market for carbon will have some degree of volatility, although all recent legislative proposals include mechanisms to reduce volatility. However, EPA models are not suited to assess likely short-term market volatility and are instead designed to assess the economic impacts of the policy over a longer time horizon. Based on past experience with existing cap-and-trade markets in the U.S., EPA has assessed the prices for SO_2 allowances for the Acid Rain Program from August 1994 to December 2003, to capture a time period of market behavior in the absence of major regulatory adjustments. The findings suggest that the volatility of SO_2 allowance prices during this period were very comparable to the volatility of other energy related prices, if not generally lower, for the time period considered.

DISCOUNT RATES

Question 2a. The difficulty of looking decades into the future at the impact of a climate policy is compounded by how much the value of a dollar changes over time.

If we were to go back to 1969, and wanted to explain the value of a $23,000 2009 model-year car, there are a few ways we could attempt to do so. We might adjust the 2009 price tag for inflation and say "it will cost the equivalent of $3,960 in today's dollars". Or we could say, "put $562 in the bank, and at a 5% interest rate you will have enough to buy the car in 2009". This latter explanation would rely upon a 'net present value inflation adjusted' calculation, which is what most of these reports use.

But it should be apparent that this is a very bad indication of what something will actually cost in 40 years. Climate bills do not require Americans to put away money now to cover costs later; they simply impose those costs at some future date.

So I have to ask if there is something I am missing here. I understand that discounting is a standard practice in the computer models used by the agencies, but it seems like these models and the numbers they generate are better for comparing two pieces of legislation than providing a real idea of what costs we can expect.

Answer. 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 today of this loss 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.

Question 2b. Are there better ways to explain the costs of these bills, or at least ways that would make more sense to my constituents?

Answer. There are many different ways to present the cost of these bills. Examples of cost metrics included in EPA's analysis of H.R. 2454 include (all values are from ADAGE scenario 2 in 2030 unless otherwise noted):

- Allowance price: $27/t$CO_2$e
- Average annual net present value cost per household (2005 $): -$111
- Change in average household energy expenditures (%): 2%
- Change in GDP (billion 2005 $): -$83
- Change in GDP (%): -0.37%

Question 2c. What would the use of actual dollar amounts, simply adjusted for inflation without discounting, do to the cost estimates produced for these climate bills?

Answer. On a per household basis, the undiscounted cost of H.R. 2454 is estimated to be $0.23 to $0.29 per day in 2020, $0.76 to $1.00 per day in 2030, and $2.50-$3.52 per day in 2050 in the core scenario of EPA's analysis. All of these costs are presented in real 2005 dollars.

RESPONSES OF REID P. HARVEY TO QUESTIONS FROM SENATOR CANTWELL

Question 1. Both the EPA and EIA analyses have addressed the question of costs associated with various pieces of climate change legislation, most recently H.R. 2454. Has either of these agencies, or any other government agency, ever analyzed the potential economic costs of business-as-usual, assuming that climate impacts projected by the Intergovernmental Panel on Climate Change and the U.S. Climate Change Science Program come to pass in the upcoming decades? How do the economic costs of inaction compare with those of policy action on climate change?

Answer. EPA has not analyzed the total economic costs (damages) associated with no action on climate change, nor are we aware of any other government agency's work on this topic. For marginal (small) changes in greenhouse gases, the benefits of action (the avoided damages) have been estimated by EPA[1], NHTSA[2], and DOE[3] and more recently using newly developed interim values[4] for the damages associated with avoided damages. However, these values are more appropriately applied to regulatory changes, rather than climate legislation, because they were developed for marginal changes in emissions, rather than the comparatively large changes resulting from current climate proposals under review. To examine the avoided economic costs from legislation, a different approach would be required and to date EPA has not analyzed this. The June report from the U.S. Global Change Research Program[5] did, however, examine impacts on the United States from lower versus higher greenhouse gas emission scenarios. This report examined all regions and all sectors (e.g., agriculture, human health, etc.) but did not attempt to estimate total costs.

Question 2. According to the EIA, in January of 2008, crude oil cost $87 per barrel, in July it cost $128 a barrel, and in December it cost $37 a barrel, for an annual average cost of $94/barrel.

- Does EIA's or EPA's modeling of H.R. 2454 give us any indication of the extent to which seasonal energy price volatility might result from a cap-and-trade policy?

Answer. The models used for EPA and EIA's analyses of H.R. 2454 are not designed to capture price volatility or seasonal energy price fluctuations.

- Could a well-designed price collar mitigate this volatility?

Answer. A well-designed price collar could mitigate potential price volatility. Banking and borrowing provisions also help address price volatility.

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[1] U.S. Environmental Protection Agency. "Regulating Greenhouse Gas Emissions Under the Clean Air Act: Advance Notice of Proposed Rulemaking-Technical Support Document on Benefits of Reducing GHG Emissions" (2008) and "Proposed Rulemaking To Establish Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards" (2009)

[2] U.S. National Highway Transportation and Safety Administration. "Average Fuel Economy Standards: Passenger Cars and Light Trucks Model Year 2011: Final Rule" (2009) and "Proposed Rulemaking To Establish Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards" (2009)

[3] U.S. Department of Energy, "Energy Conservation Program for Commercial and Industrial Equipment: Packaged Terminal Air Conditioner and Packaged Terminal Heat Pump Energy Conservation Standards: Final Rule" (2008)

[4] For example, see Federal Register 40 CFR Parts 86 and 600, September 28, 2009 "Proposed Rulemaking To Establish Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards; Proposed Rule".

[5] U.S. Global Change Research Program, "Global Climate Change Impacts in the United States" (2009).

Question 3. To what extent does the length and complexity of H.R. 2454 increase the uncertainties and the sensitivities in the modeling results?

Answer. EPA's analysis did not attempt to model all of the provisions contained in H.R. 2454. Instead, the analysis focused on the cap-and-trade provisions in Title III, the competitiveness provisions in Title IV, and a few of the energy efficiency provisions in Titles I & II. To the extent that the non-modeled provisions would impact the cost of the bill, this increases the uncertainties in the modeling results.

Question 4. To what extent does H.R. 2454's cost containment measures, such as its heavy reliance on offsets to meet emission reduction targets, increase the uncertainties and the sensitivities in the modeling results?

Answer. As stated in EPA's October 23, 2009 analysis of S. 1733, "the cost and availability of offsets, particularly international offsets, is one of the greatest uncertainties in forecasting the cost of climate legislation. . .All analyses that have looked at the issue have shown that the availability of offsets is one of the most important factors influencing allowance prices." To address this issue, EPA has in the past conducted a number of sensitivity analyses on offset use.

Question 5. To what extent does the development of a carbon market in H.R. 2454, which will likely cause price changes independent of supply and demand fundamentals, increase the uncertainties and the sensitivities in the modeling results?

Answer. EPA's analysis did not attempt to model price volatility. The economic models used by EPA estimate equilibrium conditions. Specifically, they assume rational behavior and full information.

Question 6. Both the EIA and EPA analyses of the House bill show significant expansion of nuclear power as the constraints on fossil carbon get tighter in future decades. Could you talk about the expansion of nuclear power and assumptions that facilitate it in your models?

- Is price the principal driver of nuclear power in the models, or do government subsidies play a role in the industry's expansion?

Answer. EPA's reference case projection of nuclear energy in the ADAGE model is simply calibrated to the DOE's forecast in the March release of the AEO 2009. The AEO forecast projects nuclear power to grow 12% from 2010 levels to 907 billion kWh of nuclear generation in 2030. This reference case projection reflects existing industry subsidies and existing institutional barriers. We have not modeled the impact of changing existing nuclear subsidies.

In the policy case, price is the principal driver of nuclear power in EPA's models; however assumed limits are placed on the growth of nuclear power. EPA's analysis of H.R. 2454 projects a 150-percent increase in nuclear generating capacity by 2050, in response to the carbon price generated by 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 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 (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 hoped or expected, irrespective of the economic incentives created by the policy under analysis.

- What role do you believe a clear and consistent carbon price signal play in the future development of nuclear power? How would you rate the impact of a carbon price signal on future nuclear energy development relative to expansion of existing industry subsidies and removal of other institutional barriers?

Answer. See above answer.

- How could we manage volatility in the carbon market to ensure a consistent price signal for in energy technology innovators and investors?

Answer. There is a large body of literature on how best to control volatility through market design. This literature is too vast to be completely covered here. But it highlights several measures that are widely recognized as important to ensuring the clarity and consistency of market signals, some of which are included in HR 2454:

- Allowing a large number of buyers and sellers of allowances
- Allowing banking and borrowing of allowances
- Other cost containment mechanisms (e.g. strategic reserve; price collar) Providing a floor for allowances prices through an auction "reserve price"

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Question 7. EPA's analysis of H.R. 2454 suggests that the House-passed bills unlimited allowance banking provisions and heavy reliance on domestic and international offsets result in just a 20 percent reduction in actual gross CO_2 equivalent emissions (i.e. the actual amount of greenhouse gas emitted into the atmosphere for a given year referenced to global warming potential) in 2050 from 2005 levels.

- Is this an accurate interpretation of EPA's analysis, and if so would you agree that a 20% reduction in gross greenhouse gas emissions means that H.R. 2454 fundamentally does not decarbonize our economy? What alternative climate policies might accelerate decarbonization of the economy?

Answer. The claim that H.R. 2454 results in, "just a 20 percent reduction in actual gross CO_2 equivalent emissions . . . in 2050 from 2005 levels," is not an accurate interpretation of EPA's analysis. Depending on which emissions abatement sources you include, there are different ways of calculating emissions reductions in 2050 relative to 2005 (2005 GHG Emissions = 7,109 $MtCO_2e$). The following calculations are from in EPA's H.R. 2454 analysis, ADAGE scenario 2.

- Total U.S. GHG emissions in 2050, accounting for all sources of reductions (e.g. including domestic covered and non-covered GHG abatement, the HFC cap, international and domestic offsets, forest set-asides, and discounted international offsets) would be 2,468 $MtCO_2e$, 65.3% below 2005 levels.
- Total U.S. GHG emissions in 2050, accounting for all sources of reductions except forest set-asides and discounted international offsets would be 2,797 $MtCO_2e$, 60.6% below 2005 levels.
- Total U.S. GHG emissions in 2050 accounting for all domestic abatement (e.g. including domestic covered and non-covered GHG abatement, the HFC cap, and domestic offsets, but excluding all international abatement attributed to the bill) would be 4,018 $MtCO_2e$, 43.5% below 2005 levels.

- Total U.S. GHG emissions in 2050 accounting for all domestic emissions abatement (e.g. including domestic covered and non-covered GHG abatement, and the HFC cap, but excluding all domestic sinks related offsets and all international abatement attributed to the bill) would be 4,617 $MtCO_2e$, 35.0% below 2005 levels. This is the number that would be consistent with the U.S. GHG inventory calculation.
- Total U.S. GHG emissions in 2050 accounting for only domestic covered emissions abatement (e.g. including domestic covered, but excluding non-covered GHG abatement, the HFC cap, all domestic sinks related offsets and all international abatement attributed to the bill) would be 5,351 $MtCO_2e$, 24.7% below 2005 levels.

EPA's analysis of H.R. 2454 shows that the bill would transform the structure of energy production and consumption, moving the 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. Increased energy efficiency and reduced demand for energy resulting from the policy mean that energy consumption levels that would be reached in 2015 without the policy are not reached until 2040 with the policy. The share of low-or zero-carbon primary energy (including nuclear, renewables, and CCS) would rise substantially under the policy to 18% of primary energy by 2020, 26% by 2030, and to 38% by 2050, whereas without the policy the share would remain steady at 14%. Increased energy efficiency and reduced energy demand would simultaneously reduce primary energy needs by 7% in 2020, 10% in 2030, and 12% in 2050. Petroleum primary energy use declines by 0.4 million barrels per day in 2020, 0.7 million barrels per day in 2030, and 1.6 million barrels per day in 2050.

- How long, on average, do these models assume that businesses are saving allowances in order to accumulate 20 billion allowances by 2030 and how much otherwise productive capital do you estimate that might tie up?

Answer. In EPA's H.R. 2454 analysis, the bank of allowances is built up over the period between 2012 and 2029, and then drawn down to zero between 2030 and 2050. In the IGEM model, the size of the bank in 2030 is 20 $GtCO_2e$ with a total value of $524 billion. In ADAGE, the size of the bank in 2030 is 14 $GtCO_2e$, with a total value of $373 billion.

Because of the option to bank allowances, the rate of return for holding allowances is expected to equalize with the rate of return from other available investments. If instead the allowance price were rising faster than the interest rate, firms would have an incentive to increase abatement in order to hold onto their allowances, which would be earning a return better than the market interest rate. This would have the effect of increasing allowance prices in the present, and decreasing allowance prices in the future. Conversely, if the allowance price were rising slower than the interest rate, firms would have an incentive to draw down their bank of allowances, and use the money that would have been spent on abatement for alternative investments that earn the market rate of return. This behavior would decrease prices in the present and increase prices in the future. Because of these arbitrage opportunities, the allowance price is expected to rise at the interest rate. Allowing banking increases the flexibility in respect to when emissions abatement takes place, which reduces price volatility and decreases the overall cost of the program.

Question 8. EPA's analysis of H.R. 2454 shows that there is no reduction in U.S. petroleum consumption through 2040. Is this assessment accurate? If so, how can this projection be reconciled with the fact that the policy's goal is to reduce overall greenhouse gas emissions from energy use?

Answer. In scenario 2 of EPA's analysis of H.R. 2454, the ADAGE model showed that relative to the reference scenario, petroleum use would fall by 0.4 million barrels per day in 2020, 0.7 million barrels per day in 2030, and 1.0 million barrels per day in 2040. This projection is consistent with the policies goal to reduce greenhouse gas emissions. The cap-and-trade system is designed to achieve greenhouse gas abatement where it is most cost-effective, instead of mandating specific reductions from greenhouse gas emissions from petroleum use and other specific sources.

Question 9. Under EPA's analysis of H.R. 2454, what is the total volume, in gigatons, of international offsets purchased between 2012 and 2050? What is the total monetary value of these international offsets?

Answer. In scenario 2 of EPA's analysis of H.R. 2454, the IGEM model showed that cumulative international offset purchases (before applying the 5 to 4 turn-in-ratio) from 2012 through 2050 are equal to approximately 51 gigatons. The total

value of these international offsets over the entire 2012 through 2050 time period is $1.3 trillion (2005 dollars).

Question 10. Under EPA's analysis of H.R. 2454, what is the total volume, in gigatons, of domestic offsets purchased between 2012 and 2050? What is the total monetary value of these domestic offsets?

Answer. In scenario 2 of EPA's analysis of H.R. 2454, the IGEM model showed that cumulative domestic offset purchases from 2012 through 2050 are equal to approximately 12 gigatons. The total value of these international offsets over the entire 2012 through 2050 time period is $0.5 trillion (2005 dollars).

Question 11. Assuming the United States adopts cap-and-trade legislation such as those currently under consideration in Congress, are there any alternative cost containment options if verifiable international offsets are not available in sufficient quantity?

Answer. Various legislation and conceptual papers have proposed different means of containing costs within the context of a cap-and-trade scheme. A July 2008 RFF working paper provides a good introduction to a number of alternatives:

> Tatsutani, Marika and William Pizer (2008). "Managing Costs in a U.S. Greenhouse Gas Trading Program." Discussion Paper, Resources for the Future, July 2008.

Question 12. Do you believe consumers need to feel a price signal in order to undertake energy efficiency investments and make the behavioral changes necessary to reduce national fossil fuel use? Do measures meant to reduce the burden of higher electricity prices, such as the significant share of emissions allowances allocated to local electricity distribution companies (LDCs) under H.R. 2454, effectively dampen the carbon price signal and thus consumers' incentives to make choices and behavioral changes that will be needed to decarbonizes the economy?

Answer. A carbon price signal will lead to increased investment in energy efficiency by consumers as well as behavioral changes (e.g., adjusting the thermostat setting at home) that together will reduce national energy demand. The degree to which the price signal is dampened by allowance allocations to electric LDCs depends upon how that value is used. If used exclusively to reduce fixed charges (not tied to the level of energy consumption) to consumers then the dampening effect should be minimal. If used exclusively to reduce charges based upon the level of energy consumption (e.g., to reduce costs per KWh of electricity demand) then it would have a dampening effect on energy efficiency investments and behavioral changes that would otherwise tend to reduce energy demand.

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