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GREENHOUSE GAS TRADING PROGRAM

HEARING

BEFORE THE

COMMITTEE ON ENERGY AND NATURAL RESOURCES UNITED STATES SENATE

ONE HUNDRED ELEVENTH CONGRESS

FIRST SESSION

TO

EXPLORE POTENTIAL COSTS AND PRICE VOLATILITY IN THE ENERGY SECTOR AS A RESULT OF A GREENHOUSE GAS TRADING PROGRAM AND WAYS TO REDUCE OR CONTAIN THOSE COSTS

SEPTEMBER 15, 2009

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GREENHOUSE GAS TRADING PROGRAM

TUESDAY, SEPTEMBER 15, 2009

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

The committee met, pursuant to notice, at 2:35 p.m. in room SD–366, Dirksen Senate Office Building, Hon. Senator Jeff Bingaman, chairman, presiding.

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

The CHAIRMAN. Ok, why don't we get started? Let me just advise members. We have, in addition to the hearing that we've got our witnesses for today, we have three pending nominations that we hope to deal with in a business meeting.

My hope is if we get 12 members here at some point during our hearing we would interrupt the hearing long enough to go ahead and deal with those nominations in a business meeting. Until that happens why don't we go right ahead with the hearing.

Global climate change is one of the most consequential and difficult problems that we face in this Congress. It's a problem of vast scale that obviously requires a solution of vast scale. More precisely it requires that we find a way to reinvent our energy infrastructure.

Many members are currently absorbed by the health care debate, but it is important to continue to make progress on this issue as well. This week in our Energy Committee we will have two hearings on the issue of energy and climate change legislation.

Today we will receive testimony on the topic of containing costs in a greenhouse gas emissions market. Thursday we'll learn about economic analyses and what models could tell us about the expected impacts of energy and climate legislation.

Many members of the committee have expressed an interest in climate legislation and its impacts on the energy sector. So I believe it's important that the committee do its part to help the full Senate understand this connection, and having available the most current and credible information on key issues in the energy climate connection is a constructive step that this committee can take in moving forward on the issue.

The discussion this week will revolve around the implementation of a cap and trade program for greenhouse gases. The primary goal of any such program must be to achieve our environmental objectives with the least possible disruption to our economy. As we contemplate cap and trade, we need to ensure that the costs of carbon

permits do not become either excessively high or excessively volatile.

At today's hearing we will receive testimony on policy options to avoid these types of unexpected and potentially dangerous costs. I'm very pleased with the bipartisan approach we've been able to take in the committee in putting the energy legislation together that we reported several months ago. We reported a bill that contained important incentives and programs for clean and efficient energy. I very much hope we can see those provisions enacted into law.

At the same time I'm dedicated to doing what I can to enact effective greenhouse gas legislation. I have worked, as have several members of this committee, to help craft legislation in previous Congresses that would help us to achieve this result. Senator Murkowski co-sponsored a bill that Senator Specter and I introduced in the last Congress.

I thought that was a contribution to the discussion. Failure to act on the issue does carry real costs both for the global environment and for the economy. The search for effective legislative proposals to avoid climate change involves avoiding the costs of global warming without imposing other unintended costs that would have few benefits and could even have negative impacts on our society. So we need to provide assurances that the costs of a cap and trade system will not go out of control either because of excessive prices or because of excessive volatility.

Today's hearing is to explore some of the mechanisms that can be used to address these concerns. Let me defer to Senator Murkowski. Then I'll introduce the various witnesses, and we'll hear from the panel.

Go right ahead.

[The prepared statement of Senator Bunning follows:]

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

Thank you Mr. Chairman. I look forward to the hearing today to discuss some of the financial issues involved through enacting a cap and trade program.

I think it is made clear in the testimony today that we need to be careful of moving too quickly in addressing climate change.

I have long said that I do not support imposing mandatory caps on emissions. I believe in providing incentives for new technology, moving to lower emission technologies and improving energy efficiency.

These immediate-impact policies accomplish the goals of a cap and trade program with less complication and potential opportunity for market manipulation.

Under a cap and trade program the federal government would be forced to oversee yet another area of financial transactions through the trading of carbon credits. This is at a time when we are struggling to maintain an effective banking system.

Supporters of cap and trade argue that they can impose cost containment mechanisms—such as offiets or price collars—to lower the financial risks and costs of implementing such a program. These proposals, however, are unworkable and unrealistic.

Instead of focusing on ways to mitigate the negative costs of imposing a cap and trade system, Congress should instead focus on policies that provide incentives for businesses so they can create jobs and grow.

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.

At a time when our country is struggling to come out of our longest and deepest economic downturn since the Great Depression, enacting a regressive energy tax is reckless and irresponsible.

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.

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

Senator MURKOWSKI. Thank you, Mr. Chairman. I appreciate your scheduling this hearing. I hope this will be the first of many constructive discussions on the issue of climate change here in the committee.

Effectively dealing with the issues that we're here to discuss, cost containment and price volatility in a cap and trade market, is clearly essential to any legislation that has a chance of passing. Chairman Bingaman, you have mentioned the importance of many of these factors last year. They played a significant role in the legislation that you mentioned that I had agreed to co-sponsor.

But as we saw in the floor debate that followed it became clear that perhaps not everyone agreed with us. Provisions to contain costs and volatility were largely absent from the measure that was brought up, the Boxer/Lieberman/Warner bill. In my opinion, by failing to address those concerns the failure of that bill was all but guaranteed.

Today it's become even more important to control the cost of climate legislation. We've got millions of Americans that are struggling to find work, to pay mortgages and getting through a rough economy. We must make sure that climate policies do not add to their burdens.

I think it's disappointing, at least with the legislation that we saw coming out of the House of Representatives, that some in Congress have failed to learn this lesson from this summer. That's really about the only explanation that I have with the bill that passed the House, by seven votes on the 26th of June. Instead of lightening the load for Americans it asks Americans to shoulder more, oblivious to how difficult life may be for so many families.

Let me list just a few of the impacts of the House bill, which are projected by the Energy Information Administration. This is again, on the House bill.

By 2030, the House bill could cost as much as $1,870 per household.

Raise diesel prices by 44 percent.

Raise electricity prices by 77 percent.

May reduce domestic employment by up to 2.3 million people.

I appreciate that there are other numbers from other entities that put the impact at different levels. But I also understand why so many folks have written and called to express their opposition to the House bill. I think they have every reason to be nervous about the impact it may have to them and to their families.

It would take money that many Americans don't have.

Impose prices that many can't afford.

Destroy the jobs that our country so desperately needs.

In my opinion, the principle reason why estimates of the House bill's price tag are so high is that the sponsors did little to limit the costs and reduce market volatility. They relied, I think to an irresponsible degree, on international offsets that would give the

appearance of cost containment. They utilized a strategic reserve concept that is flawed.

The House bill strategic reserve provision allows for the introduction of additional allowances into the market if prices spike to 60 percent above the 3-year rolling average. While this may be marginally useful for blunting massive short term run ups in allowance prices. It doesn't do anything to contain sustained high prices. Furthermore the protections that kick in over a 3-year period will be of little use if allowance prices bring our economy to its knees in the first or second year of the program.

Now these are specific issues, problems, contained within a very large, a massive bill, a 1,400 page bill. There are many other issues that must be addressed and debated. I'm happy that we'll be able to do so in an objective way here in this committee.

We need to recognize that steps to contain costs and limit volatility will not be enough to fix the House bill. Those concerns are just the tip of the iceberg. There's far more and far larger problems that lurk beneath the surface.

We must resolve these issues in a fair, transparent, and effective manner. For now they simply make clear that we have got a great deal of work ahead. A great amount of work needs to be done before climate legislation has a chance of passage in the Senate.

As the climate debate continues I would encourage my colleagues to keep a couple things in mind.

First, climate change is certainly an important issue and one that must be addressed. The people of our country and certainly in my State of Alaska, are feeling the impacts. I believe that those impacts will only worsen in the years ahead.

Second, I think we need to avoid what has happened in the House. The Senate debate should be about more than who will receive free allowances or bonus allowances or exemptions. We need to consider all of our options in an even handed and thoughtful way. Our goal should be good policy, not politics.

For now looking at ways to reduce the costs and price volatility that may result from climate change legislation is a good starting point. It's very clear that a policy as comprehensive as cap and trade could impose a tremendous burden on families, consumers and businesses, especially if it's not designed properly. So I view this hearing, Mr. Chairman, and those we have scheduled to be an essential part of the sound process that can result in sound policy decisions.

I look forward to the testimony from the witnesses and the questions that we'll be able to ask.

The CHAIRMAN. Thank you very much. Let me introduce the witnesses.

First, Mr. Brent Yacobucci, who is a specialist in energy and environment policy with the Congressional Research Service. Mr. Yacobucci is going to make a short presentation about some of the different mechanisms that have been put forward or suggested as ways to deal with this problem; sort of give us a little short tutorial.

Second will be Eileen Claussen, who is President of the Pew Center on Global Climate Change and has spent a lot of time on this issue.

Dr. Michael Wara, who is a professor of law at Stanford Law School. Thank you for being here.

Dr. Joseph Mason, who is a professor at Louisiana State University in Baton Rouge.

Mr. Jason Grumet, who is a familiar witness to us here and was very helpful to us in our deliberations on this issue here for the last several Congresses.

So Mr. Yacobucci, why don't you go ahead? If each of you could take about 6 minutes and give us a summary of the main points you think we need to understand. Then we will have questions.

STATEMENT OF BRENT YACOBUCCI, SPECIALIST IN ENERGY AND ENVIRONMENTAL POLICY, CONGRESSIONAL RESEARCH SERVICE

Mr. YACOBUCCI. Good afternoon. My name is Brent Yacobucci. On behalf of the Congressional Research Service, I would like to thank the chair and ranking member for the invitation to testify here today.

I've been asked by the committee to help frame the subject of the hearing first by describing some of the concepts that will be discussed. Second by relating those to H.R. 2454, the American Clean Energy and Security Act of 2009 as passed by the House of Representatives. I should note that CRS takes no position on legislation. In the interest of time I will forgo a discussion of the basic fundamentals of the cap and trade system.

Under cap and trade the term cost containment has two components.

First, mechanisms designed to limit or contain the overall cost of the program to a socially acceptable level.

Second, mechanisms designed to limit short term volatility in the allowance market created by the system.

While the two components are complementary, policies to achieve them may differ and may even conflict. A critical policy decision is whether the maintenance of the program's overall cap is paramount or whether there are conditions under which policy concerns may require a relaxation of the cap. Shifting allowances across time is a key technique to limit short term volatility while maintaining the cap.

Mechanisms to achieve this time shifting include banking, borrowing, multiyear compliance periods and a strategic allowance reserve auction. H.R. 2454 includes all four to some degree. Banking of allowances is unlimited while the bill allows entities with free allocations to borrow allowances from the coming year. However the bill places a substantial rate of borrowing beyond that first year.

H.R. 2454 also contains a strategic allowance reserve. Under this mechanism a portion of emissions allowances from each year is placed in a reserve. These allowances are then available to covered entities at a minimum reserve price. A price set considerably higher than the average allowance price.

With a strategic reserve firms have the option of tapping into an emergency supply of allowances. However this supply is limited as the reserve is created by shifting emissions allowances from later

years. The effect on volatility would depend on the size of the reserve, demand for the allowances and the trigger price.

It should be noted that there is uncertainty on how effectively time shifting will work. Many studies suggest that it should have some mitigating effect. But data from existing programs have not fully validated the effectiveness of the primary mechanism, banking.

On the other side of the coin attempting to prevent volatility at the lower limit of allowance prices have generally involved setting a reserve price for any allowance auctions. The bill's quarterly allowance auctions contain such a reserve price. So far the techniques I've discussed are aimed at limiting volatility, not long run costs of the program.

A key technique for limiting the overall cost to the program is to effectively expand the supply of allowances through the use of offsets. H.R. 2454 allows a generous offset supply, up to one billion tons each, of domestic and international offsets every year. Further expanding the offset supply would likely lower long term costs.

According to the Congressional Budget Office doubling the supply of international offsets allowed under the bill lowers allowance prices by 30 percent or more. Conversely most studies of H.R. 2454 find that eliminating international offsets raises the price of allowances by more than half. H.R. 2454's offset supply is fixed.

Another alternative would be to establish a flexible offset supply like that established by the regional greenhouse gas initiative. Under this mechanism the availability of offsets expands as the allowance price increases effectively increasing allowance supply. Whether this approach would work under H.R. 2454 is unclear as its offset limits are already quite generous and indeed some analyses of the bill suggest that the limits may never be met.

If one decides that there are conditions where the reduction requirement should be modified possible mechanisms generally include an alternative means of compliance or a suspension of the cap under certain conditions. The former, commonly called a safety valve, essentially allows covered entities to make a cash payment in lieu of submitting allowances. If the allowance price is above the safety valve price entities would find it cost effective to make the alternative payment rather than by allowances on the market, thus a ceiling is placed on allowance prices.

While H.R. 2454's cap and trade program does not contain such a safety valve, its renewable electricity standard does. In lieu of meeting the RES requirement retail electricity suppliers may submit a payment to their State which the State then uses to encourage renewable energy development. Such an approach could be used for the cap and trade program as well where any safety valve payments could be used to purchase additional offsets or to do develop new, low carbon energy technology.

Arguably the most comprehensive cost containment scheme would be a price collar that combined a reserve price auction to help establish a price floor with a safety valve to set a price ceiling. Such a price collar might operate to cutoff the peaks and valleys of the allowance price curve. Developing a cost containment scheme to address overall costs and short term allowance price volatility will require consensus on acceptable costs, acceptable volatility and

acceptable environmental protection. A key policy decision is whether the cap must be maintained at all times or if policies may allow emissions to exceed the cap under certain conditions.

Thank you for inviting me to appear. I will be pleased to address any questions you may have.

[The prepared statement of Mr. Yacobucci follows:]

PREPARED STATEMENT OF BRENT YACOBUCCI, SPECIALIST IN ENERGY AND ENVIRONMENTAL POLICY, CONGRESSIONAL RESEARCH SERVICE

Good afternoon Chairman, Ranking Member, and Members of the Committee. My name is Brent Yacobucci. On behalf of the Congressional Research Service (CRS), I would like to thank the Committee for its invitation to testify here today. I have been asked by the Committee to help frame the subject of the hearing, first by providing an explanation for some of the terms and concepts that will be discussed, and second by relating those to H.R. 2454, the American Clean Energy and Security Act of 2009, as passed by the House of Representatives on June 26, 2009. I should note that CRS takes no position on this or any other legislation. In the interest of time I will forego a discussion of the basic fundamentals of a cap-and-trade system to limit emissions.

In a cap-and-trade system, the term "cost containment" has two components (as suggested by the title of the hearing). The first involves mechanisms designed to limit or contain the potential cost of the program to a socially acceptable level. The second involves mechanisms designed to prevent or dampen potential short-term volatility in the allowance market created by the system. While the two components of cost containment are complimentary, the mechanisms involved in achieving them may differ and even conflict.

A critical policy decision that one is faced with in determining any appropriate cost containment mechanism is whether maintenance of the program's overall cap is paramount, or whether there are conditions under which economic or energy policy concerns may mandate a change in the reduction system (at least temporarily). One may decide the cap must be maintained at any economic cost for a variety of reasons, including the need to send a consistent signal to the allowance market, a consistent signal to innovators of new technology, and to achieve the tonnage mandated. Likewise, a variety of economic and energy policy reasons can be posited for allowing those concerns to trump the cap in specific situations, including economic disruption, timetable to deploy emerging technology, and unforeseen international events.

LIMITING UPWARD PRICE VOLATILITY—TIME SHIFTING

Shifting allowances across time is a key technique for maintaining the cap within any cost containment mechanism designed to prevent or dampen short-term volatility in the allowance market. Mechanisms to achieve this time-shifting include banking, borrowing, multi-year compliance periods, and a strategic allowance reserve auction (effectively a form of emergency borrowing). H.R. 2454 includes all four to some degree. Banking of allowances under H.R. 2454 is unlimited. Borrowing from future allocations of allowances under H.R. 2454 is free for the first year (effectively creating a two-year compliance period for those entities receiving allowance allocations), but places a substantial rate on borrowing beyond that first year.

H.R. 2454 also contains a strategic allowance reserve. Under this mechanism, a portion of emissions allowances from each year is placed in a reserve. These allowances are then available to covered entities at a minimum reserve price—a price set considerably higher than the average allowance price projected under H.R. 2454. With a strategic reserve, firms have the option of tapping into an emergency supply of allowances. However, this supply is limited, as the reserve was created by shifting emission allowances from later years. The effect on mitigating price volatility would depend on the size of the reserve, demand for the allowances, and the trigger price.

It should be noted that there is uncertainty on how effectively these mechanisms will work. Many studies have been conducted on them (particularly on banking) suggesting that they should have some mitigating effect. However, data from existing programs have not fully validated the effectiveness of the primary mechanism-banking.

LIMITING DOWNWARD VOLATILITY—RESERVE PRICES

On the other side of the coin, attempting to prevent volatility at the lower limit of allowance prices while maintaining the cap has generally involved setting a reserve price for any allowance auctions. H.R. 2454's quarterly allowance auctions contain such a reserve price: $10 in 2012 (2009$), rising at 5% (in real terms) annually thereafter.

LONG-RUN COST CONTROL UNDER THE CAP—EXPANDED OFFSET SUPPLY

So far, the techniques I have discussed are aimed at limiting volatility, not long-run costs of the program. A key technique for limiting the overall cost of the program is to effectively expand the supply of allowances through the use of offsets—reductions made by entities not covered by the cap. H.R. 2454 allows a very generous offset supply, up to 1 billion tons of domestic and one billion tons of international offsets each year. Further expanding offset supply would likely lower long-term costs. According to the Congressional Budget Office, doubling the supply of international offsets allowed under the bill lowers allowance prices by 30% or more. Conversely, most studies of H.R. 2454 find that eliminating international offsets raises the price of allowances by more than half.

H.R. 2454's offset supply is fixed. Another alternative would be to establish a flexible offset supply like that established by the Regional Greenhouse Gas Initiative. Under this mechanism the availability of offsets expands as the allowance price increases, effectively increasing allowance supply. Whether this approach would work under H.R. 2454 is unclear as its offset limits are already quite generous, and indeed, some analyses of H.R. 2454 suggest that the limits may never be met.

ALTERNATIVE COMPLIANCE OUTSIDE OF THE CAP—SAFETY VALVES AND PRICE COLLARS

If one decides that there are conditions where the reduction requirement should be modified, the mechanisms involved generally incorporate an alternative means of compliance, or suspension of the reduction requirement at a specific trigger price. The former, commonly called a safety valve, essentially allows covered entities to make a cash payment in lieu of submitting allowances. If the allowance price is above the safety valve price, entities would find it cost-effective to make the alternative payment rather than buy allowances on the market. Thus, a ceiling is placed on allowance costs.

While H.R. 2454's cap-and-trade program does not contain such a safety valve, its renewable electricity standard does. In lieu of meeting the RES requirement, retail electricity suppliers may submit a payment to their state, which the state then uses to encourage renewable energy development. Such an approach could be used for the cap-and-trade program where any safety valve payments could be used to purchase offsets or to develop new low-carbon energy technologies.

As suggested earlier, combinations of these mechanisms are possible. Outside of a carbon tax (which would be the ultimate form of cost containment) arguably the most comprehensive cost containment scheme would be a price collar that combined a reserve price auction to help establish a price floor, with a safety valve to set a price ceiling. The attached figure* shows how such a price collar might operate to cut off the peaks and valleys of the allowance price curve. However, developing a cost-containment scheme to address overall costs and short-term allowance price volatility will require consensus on acceptable costs, acceptable volatility, and acceptable environmental protection.

CONCLUSION

To conclude, cost containment in a cap-and-trade system generally implies one of two things, either limiting volatility in allowance markets, or limiting the overall cost of the program over its life. Different policy tools may be needed to address these two objectives. Further, cost control options can either maintain overall emissions at or below the cap or limit costs by allowing emissions to rise above the level of the cap.

Thank you for inviting me to appear. I will be pleased to address any questions you may have.

The CHAIRMAN. Thank you very much.

Ms. Claussen, please go right ahead.

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*Graphic has been retained in committee files.

STATEMENT OF EILEEN CLAUSSEN, PRESIDENT, PEW CENTER ON GLOBAL CLIMATE CHANGE, ARLINGTON, VA

Ms. CLAUSSEN. Mr. Chairman, Senator Murkowski, members of the committee, thank you for the opportunity to testify here today. My name is Eileen Claussen. I'm the President of the Pew Center on Global Climate Change. We are founding members of the U.S. Climate Action Partnership, a coalition of 25 leading businesses and five environmental organizations that have come together to call on the Federal Government to quickly enact strong national legislation to require significant reductions of greenhouse gas emissions.

Let me start by thanking you, Mr. Chairman, not only for holding this hearing, but for your years of leadership on the climate issue and in particular on the issue of cost containment. I hope that you will see in the work of the Pew Center and USCAP, an effort to build on your leadership in a positive way. The Pew Center has long supported enactment of an economy wide, greenhouse gas cap and trade bill as a primary measure for reducing U.S. greenhouse gas emissions.

A cap and trade program provides an excellent division of responsibilities. Government establishes the public policy objective to reduce emissions by a certain amount in a given year. Businesses decide how to meet the objective as cost effectively as possible.

The Pew Center believes, as does USCAP that the most powerful way to contain costs is a robust cap and trade program. Cap and trade minimizes cost because it provides industry the flexibility to reduce emissions at the lowest possible cost. It also provides a powerful incentive for industry to invent and commercialize the innovative clean energy technologies that will help us to achieve our climate protection goals.

That said. There are legitimate concerns that greenhouse gas allowance prices may either get too low or too high or be excessively volatile. Let me talk in particular about the second and third concerns.

We know from a wide range of economic analyses that two factors are critical to avoid excessively high prices, the availability of offsets and the availability of low carbon technologies including carbon capture and storage and nuclear power. Recent economic modeling by the EIA suggests that barring the use of international offsets in a cap and trade program would increase allowance prices by 65 percent. We would recommend being restrictive on the quality of offsets while being liberal on quantity.

We want to make sure that offsets meet or exceed standards for what qualifies while at the same time ensuring that there are adequate quantities available to support lower allowance prices. The potential for cost reductions is especially large from international offsets where there are huge opportunities for achieving low cost emission reductions while assisting poor countries to develop in more sustainable ways. We would recommend that agencies start now even in advance of legislation to lay the ground work for an effective offset program.

Economic modeling studies show that the availability of key technologies such as CCS and nuclear power also play an important role in reducing the costs of climate protection. For example, EIA's

modeling projects that when critical technology is not available, compliance costs could be 10 percent higher. We recommend combining a cap and trade program with increased funding and incentives for technology research development and deployment since the price signal for a cap and trade program alone may not be adequate to drive the low carbon innovation that we need.

To avoid excessive allowance price volatility we recommend that Congress provide as much "when" flexibility as possible in the cap and trade program. The legislation should allow banking of offsets and allowances, along with a multiyear compliance period and multiyear allocations. It is clear from past cap and trade programs that banking and multiyear compliance periods are extremely effective tools for smoothing out price fluctuations.

However we must also understand that some price fluctuations are inevitable and under some circumstances even desirable. For example, one particular advantage of a cap and trade over a tax is that if the overall economy turns down so will allowance prices. Reducing the economic costs of compliance under a tax regime further government intervention would be required to make similar adjustments.

If allowance prices spike to a high level and stay there one obvious response would be simply to make additional allowances available thus bringing down the price. The fundamental issue is how to do this without breaking the cap on greenhouse gas emissions and therefore undermining the environmental integrity of the program. USCAP recommends an approach that meets both of these objectives.

It makes additional allowances available to drive down excessive prices but does so by creating a pool of allowances that does not break the long term cap. This would be done by creating a strategic reserve pool that would be filled with a combination of offsets and allowances borrowed from future years. Both of which would ensure that the integrity of the cap is maintained over time.

I want to stress that the strategic reserve would perform much the same function as a price cap, but without undermining the environmental integrity of the program. It would provide additional supply into the market to reduce allowance prices, increase certainty about market price, function automatically by means of regularly scheduled auctions and be adjusted to accommodate economic conditions. Neither a price cap nor a strategic reserve would provide perfect cost certainty. But with the strategic reserve the environmental outcome would be much more assured.

Climate legislation is critical to both our future economic prosperity and our environmental well being. I am convinced that if we draw from experience to enact measures that reward innovation and limit costs, we will provide once again, that no challenge is beyond our reach. Thank you very much.

[The prepared statement of Ms. Claussen follows:]

PREPARED STATEMENT OF EILEEN CLAUSSEN, PRESIDENT, PEW CENTER ON GLOBAL CLIMATE CHANGE, ARLINGTON, VA

Mr. Chairman, Sen. Murkowski, Members of the Committee, thank you for the opportunity to testify on how we can best design climate legislation to contain costs and minimize greenhouse gas allowance price volatility. My name is Eileen Claussen, and I am the President of the Pew Center on Global Climate Change.

The Pew Center on Global Climate Change is an independent non-profit, non-partisan organization dedicated to advancing practical and effective solutions and policies to address global climate change. Our work is informed by our Business Environmental Leadership Council (BELC), a group of 44 major companies, most in the Fortune 500, that work with the Center to educate opinion leaders on climate change risks, challenges, and solutions. The Pew Center is also a founding member of the U. S. Climate Action Partnership (USCAP), a coalition of 25 leading businesses and five environmental organizations that have come together to call on the federal government to quickly enact strong national legislation to require significant reductions of greenhouse gas (GHG) emissions.

The Pew Center has long supported enactment of an economy-wide GHG cap-and-trade bill as a primary measure for reducing U.S. GHG emissions. A cap-and-trade program provides an excellent division of responsibilities: Government establishes the public policy objective—to reduce emissions by a certain amount in a given year—and businesses decide how to meet that objective as cost effectively as possible. The Pew Center believes, as does USCAP, that the most powerful way to contain costs is a robust cap-and-trade program. It is clear from economic theory, from our experience with the U.S. acid rain program, and from a vast body of economic modeling analysis, that cap-and-trade will dramatically reduce the costs of reducing GHG emissions compared to traditional command-and-control regulatory approaches. Cap-and-trade minimizes cost because it provides industry the flexibility to reduce emissions at the lowest possible cost. It also provides a powerful incentive for industry to invent and commercialize the innovative clean energy technologies that will help us to achieve our climate protection goals.

That said, there are legitimate concerns that GHG allowance prices may get either too low or too high, or be excessively volatile. Too low a price could undermine long-term investments critical to moving to clean energy economy. Too high a price could cause economic harm. Too volatile a price could create risk and uncertainty for businesses.

Let us talk about each of these problems in turn.

AVOIDING EXCESSIVELY LOW PRICES

While we would all like to keep the costs of reducing GHG emissions low, allowance prices that fall too low would discourage long-term capital investments in critical new clean energy technologies. In order to keep prices from going too low, we believe Congress should establish a minimum reserve price for the auction of allowances. We believe the reserve price that could accomplish this policy objective is approximately $10 per ton at the outset of the program. This price should escalate over time at a rate greater than inflation and then flatten out, for example, by 2025. The reserve price should be reviewed over time to determine whether it should be adjusted, stay the same, or be phased out by the program's administrator.

AVOIDING EXCESSIVELY HIGH PRICES

We know from a wide range of economic analyses that two factors are critical to avoid excessively high prices—the availability of significant quantities of domestic and international offsets and the availability of clean technologies, including carbon capture and storage (CCS) and nuclear power.

1. The Critical Role of Offsets

Recent economic modeling by the Energy Information Administration (EIA) suggests that barring the use of international offsets in a cap-and-trade program would increase allowance prices by 65 percent. (Modeling by the Environmental Protection Agency (EPA) similarly projects a price increase of 89 percent without international offsets.) These results are fully consistent with modeling being done by other organizations. Restricting offsets would lead to higher allowance prices and larger impacts on the overall economy.

We would recommend being restrictive on the quality of offsets, while being liberal on quantity. We want to make sure that offsets meet or exceed standards for what qualifies, while at the same time ensuring that there are adequate quantities available to support lower allowance prices. The potential for cost reductions is especially large from international offsets, where there are huge opportunities for achieving low-cost emission reductions while assisting poor countries to develop in more sustainable ways.

To be an effective cost containment measure and an effective environmental policy tool, however, safeguards must be in place to ensure that all such reductions are environmentally additional, verifiable, permanent, measurable, and enforceable. We recommend the following:

- The offset program administrator (which could be, for example, the EPA, the U.S. Department of Agriculture (USDA), or a joint effort of the two agencies) should be directed to establish an offset program using a standards-based approach within 18 months of enactment. Under a standards-based approach, rules should identify specific categories of offsets that are eligible to qualify, along with clear procedures to achieve certification, and clear guidance to offset providers about how they can meet the standards. The eligible categories of offsets should be added to or modified over time based on experience, and standards should be periodically updated to ensure environmental integrity.
- The program administrator(s) should be directed to establish a transparent process for evaluating and approving high-quality international offsets. These offsets would be approved during the early years of the program, with a schedule to assure that over time developing countries are encouraged to move as rapidly as possible to curb their emissions through national or sector emission reduction commitments, while ensuring that the overall quantities of offsets and international allowances are adequate for cost containment.

We recommend the following approach for managing the amount of offsets used:

- Set an overall upper level limit on the use of offsets for compliance in any year of 1.5 billion metric tons domestic and 1.5 billion metric tons international offsets and specifying that initially 2 billion metric tons of offsets in total would be allowed.
- Allow the program administer (e.g., EPA, USDA or a Carbon Market Board) to increase the upper limit of offsets to 3 billion metric tons per year, should additional cost containment be needed. In making this adjustment to the annual offset limit, the program administrator should take into account the number of banked offsets in the private sector, the degree to which the criteria for offset quality described above have been effectively implemented, the potential supply of offsets in the market and the size of the "strategic reserve pool" described later in this testimony.

While there is an inherent tension between striving to ensure adequate offset availability and offset quality, we believe it is in the best interest of all parties to ensure that a balance is reached. This balance will be easier to achieve if agencies start now—even in advance of legislation—to begin laying the groundwork for a GHG offset program. Early efforts of agency personnel could include assessing existing protocols and existing offset programs, starting work on new protocols, and identifying experts for advisory roles. With respect to international offsets, our international agencies could begin to work with developing countries to improve their emission inventories, develop forestry plans and generally engage in reforms currently being discussed within the existing international offset mechanisms (i.e., the Kyoto Protocol's Clean Development Mechanism (CDM) and Joint Implementation (JI) programs).

Some have criticized these existing international offset mechanisms, especially CDM, and without a doubt, there has been and is room for improvement. Work is now underway to fix many of the problems that have been identified, including streamlining the very bureaucratic (and, some would argue, overly rigorous) process. We believe, for example, that movement by the CDM's Executive Board toward more standardized protocols and a more efficient project review process are good steps forward. U.S. engagement could only make this tool better and more efficient.

2. Accelerating Technology Development

Economic modeling studies also show that the timely availability and reasonable costs of key technologies, such as CCS and nuclear power, play an important role in determining the costs of climate protection. For example, EIA's modeling projects that when critical technology is not available, compliance costs could be 10 percent higher. EPA's modeling shows that when the use of nuclear power is constrained, compliance costs increase by 15 percent. Both demonstrate the need to accelerate technological innovation. We recommend doing this by combining a cap-and-trade program with increased funding and incentives for research, development and deployment (RD&D), since the price signal from a cap-and-trade program alone may not be adequate to drive the low-carbon innovation that we need. Numerous studies indicate that a combination of "market push" (such as RD&D) and "market pull" (such as capand-trade) are much more cost-effective in tandem than they are by themselves. For example, a Pew Center study written by Dr. Lawrence H. Goulder of Stanford University finds that it can be up to 10 times cheaper to push and pull technology in tandem than relying on either push or pull by itself. We strongly recommend measures to support development and deployment of CCS technology and

clean vehicle technologies, to facilitate expansion of nuclear power and renewable technologies, and to create a new energy technology deployment administration.

AVOIDING PRICE VOLATILITY

To avoid excessive allowance price volatility, we recommend that Congress provide as much "when" flexibility as possible in the cap-and-trade program. The legislation should allow banking of offsets and allowances, along with a multi-year compliance period and multi-year allocations. It is clear from past cap-and-trade programs that banking and multi-year compliance periods are extremely effective tools for smoothing out price fluctuations. Banking allows firms the ability to save their offsets and allowances for future use. It also promotes near-term reductions as firms seek to do more so they can save their allowances for a day when prices might be higher. The absence of banking between the initial "learning phase" of the EU's Emissions Trading Program (2005—2007) and the current five year phase was one of the main reasons the EU allowance prices crashed as the learning period came to a close at the end of 2007. While this limit on banking between the two periods was intended to keep problems from the learning phase from spilling over into the current phase, it also clearly illustrated how not having banking can impact the price of allowances. Notably, today, the EU program does allow banking between the current phase and the next.

The EU also has effective multi-year compliance, as does the Regional Greenhouse Gas Initiative (RGGI) trading program that has been established by ten northeastern U.S. states. Giving firms a compliance obligation that covers more than one year at a time means that firms do not have to turn in their allowances and offsets yearly. The EU essentially has a two year compliance window, while RGGI has a three year window. Multi-year compliance adds "when" flexibility, which in-turn can help control price volatility.

With regard to multi-year allocation, EPA in the Acid Rain Program allocated 30 years worth of allowances at the beginning of the program. I do not believe that we need to allocate allowances that far into the future at the beginning of a climate program, but we certainly need to allocate enough (maybe 5 or 10 years worth) to provide sufficient market liquidity. Markets just getting started tend to have a more price volatility, in part because people are uncertain about whether there is going to be adequate liquidity (supply and demand) in the market. Having more allowances in circulation, even if they cannot be used for compliance before their vintage year, will help provide market liquidity, increase certainty and dampen price volatility.

We must, however, also understand that some price fluctuations are inevitable and, under some circumstances, even desirable. Changes in allowance prices would result from changes in supply and demand for allowances, which in turn could be affected by how fast or slow the economy grows, by shifts in the relative prices of fuels, and even by short-term fluctuations in the weather. One particular advantage of a cap-and-trade over a tax is that if the overall economy turns down, so will allowance prices, reducing the economic costs of compliance. Under a tax regime, further government intervention would be required to make similar adjustments.

INSURANCE AGAINST HIGHER PRICES

The smart design of a domestic cap-and-trade regime, including the mechanisms described above (offsets, banking, multi-year compliance and multi-year allocation), along with proper incentives to spur technological change, should go a long way to minimizing the economic costs of climate protection. Nonetheless, given the uncertainties that remain (rate and costs of new technologies, availability of offsets, the extent that increased energy efficiency can be mobilized), and especially given the large role energy plays in our economy, it is also critical to include additional safeguards to insure that GHG allowance prices will not be excessively high.

If allowance prices spike to a high level and stay there, one obvious response would be simply to make additional allowances available, thus bringing down the price. The fundamental issue is how to do this without breaking the cap on GHG emissions and therefore undermining the environmental integrity of the program. USCAP recommends an approach that meets both of these objectives—it makes additional allowances available to drive down excessive prices, but does so by creating a pool of allowances that does not break the long-term cap. This would be done by creating a "strategic reserve pool" that would be filled with a combination of offsets and allowances borrowed from future years, both of which would insure that the integrity of the cap is maintained over time.

The offsets in the pool would include both domestic and international offsets that meet high quality standards and would be certified by the U.S. government. We

would envision that the pool would also include "forest carbon tons," offsets generated from avoided tropical deforestation. The allowances in the pool would be borrowed by the program administrator from future compliance periods. If the borrowed allowances were not used, the emissions cap over time would stay fixed; if they were used, future emission reduction targets would be made more stringent.

To serve as an insurance mechanism against sustained high prices, offsets and allowances in the strategic reserve pool would be released into the market when allowance prices exceed a specific threshold price. This threshold price should be set at a level that is low enough to prevent undue economic harm from excessively high allowance prices but that is high enough to encourage technology transformation, including the deployment of CCS and nuclear power. Figure 1* illustrates how the strategic reserve would essentially bend the emissions cap over time, even while it maintains the program's environmental objectives.

The USCAP Blueprint recommends that a Carbon Market Board decide the threshold price, but USCAP is currently discussing the possibility of recommending a specified threshold price in the legislation, instead. The Blueprint also contains details on how the offsets and allowances would be brought into the strategic reserve, how the strategic reserve would be replenished, what rules would be established for auctioning off strategic reserve allowances, and what role a program administrator, like the Carbon Market Board, could play. Business as Usual Emissions The green line indicates the emissions goals of the program. The orange line shows how borrowing allowances from future years to fill the strategic reserve—if needed to dampen high allowance prices—bends the emissions trajectory but does not change the cumulative amount of emissions allowed under the cap.

I want to stress that the strategic reserve would perform much the same function as a price cap (also sometimes called a "safety valve"), but without undermining the environmental integrity of the program. It would provide additional supply into the market to reduce allowance prices; increase certainty about market price; function automatically by means of regularly scheduled auctions; and be adjusted to accommodate economic conditions. Neither a price cap nor a strategic reserve would provide perfect cost certainty, but with the strategic reserve the environmental outcome would be assured.

CONCLUSION

Climate legislation is critical to both our future economic prosperity and our environmental well-being. I am convinced that if we draw from experience to enact measures that reward innovation and limit costs, we will prove once again that no challenge is beyond our reach.

Thank you. I look forward to your questions.

The CHAIRMAN. Thank you very much.

Dr. Wara, go right ahead.

STATEMENT OF MICHAEL WARA, ASSISTANT PROFESSOR, STANFORD LAW SCHOOL, FACULTY FELLOW, PROGRAM ON ENERGY AND SUSTAINABLE DEVELOPMENT, CENTER FELLOW, WOODS INSTITUTE FOR THE ENVIRONMENT, PALO ALTO, CA

Mr. WARA. Thank you very much, Senator Bingaman and Senator Murkowski and other members of the committee for inviting me to testify today. My name is Michael Wara. I'm an Assistant Professor at Stanford Law School. My research focuses on existing emissions trading markets, especially the largest offset market in existence today, the Clean Development Mechanism.

In my written testimony today I hope to drive home two key conclusions.

Offsets have not and most likely cannot provide both effective cost control and environmental integrity.

Second, a price collar can provide superior cost control that is both effective, transparent and importantly, easily administrable

* Graph has been retained in committee files.

while at the same time essentially providing many of the benefits to uncapped sectors that offsets provide.

I think a key concern when contemplating climate legislation, especially legislation that conceives a time table out to 2050, is ensuring that we enact a durable program. My belief is that a safety valve or price collar can provide a much more durable program than offsets. Experience with the largest existing carbon offset program in the world, the Clean Development Mechanism, or CDM, suggests that environmental integrity while possible in theory is very difficult to achieve in practice, even with the best intentioned and well resourced regulators.

The key problem at the heart of all offset programs, including the CDM and a future offset program under the American Clean Energy and Security Act is operationalizing the determination of what's called in offset jargon, the emissions baseline. Essentially what would have happened in the absence of the incentive created by a carbon offset market. In practice the CDM has been unable to accomplish this objective in a cost effective way or at in large enough quantity to produce a reliable supply of offsets.

This is especially true. This problem is especially difficult to resolve in heavily regulated sectors of the economy such as the energy sector in China, a place where my research is focused or within the United States potentially in the forestry sector, a portion of the economy that is heavily regulated by other environmental laws. In addition the CDM has illustrated despite good intentions and a focus on environmental integrity it's very difficult to produce a large supply of credits. Large enough in this case to supply effective cost control for governments that are seeking to comply the Kyoto Protocol and perhaps more relevantly, for the EU emissions trading scheme which is a large, not economy wide, but covers a substantial fraction of the European Union's economy especially the electricity sector and heavy industry.

This is important as we think about an ACES or ACES like bill because the offset markets contemplated by that bill would have to be 20 to 50 times larger than the Clean Development Mechanism while at the same time requiring greater environmental integrity. To the credit of the House, there are significant important provisions in the bill that would strengthen the environmental integrity of the offset program created under ACES relative to the CDM. ACES is extraordinarily dependent on offsets. It's more or less four times as many offsets are allowed under ACES as are allowed under the EU emissions trading currently.

That translates into according to EPA modeling, that more than half of the reductions prior to 2030 derived from a system come from offsets rather than from emissions reductions by what are called covered entities or sectors covered by the cap. As has been mentioned earlier prices increase in the allowance market nearly two fold. If has occurred under the CDM offset supply is limited.

More importantly real offsets, offsets that are actually an offset system that's actually implemented in the real world places in significant doubt the promised theoretical benefit of an offset system. That is to have your cake and eat it too. Have cost control on the impact to the U.S. economy and also certainty as to the quantity. Because we don't know, because we don't have in practice a very

difficult time even with the best intentions and with the best resources in determining what would or would not have happened anyway under an offset system quantity certainty is placed in significant doubt.

A price collar or symmetric safety valve sets, as has been described, a firm price, both a minimum and a maximum price for allowances. It provides superior cost certainty on both the high end for firm space and compliance and importantly the low end for firms that seek to innovate and supply new technologies to the market. Funds raised from a safety valve could be used to accomplish many of the environmental benefits of an offset system.

That is they could be used to fund reductions in uncapped sectors. That might actually create substantial benefits for uncapped sectors in that a fund approach to those emissions reductions would create greater flexibility in terms of how emissions reductions are created and accomplished domestically for Ag and forestry. Also internationally allow that fund to access key strategies such as energy efficiency in buildings, appliances and heavy industry that are difficult to monetize by a carbon offset market.

So in conclusion, I would urge the committee to consider a price collar alongside or instead of offsets as a cost containment strategy in implementing an effective and cost and durable U.S. climate policy. Thank you.

[The prepared statement of Mr. Wara follows:]

PREPARED STATEMENT OF MICHAEL WARA, ASSISTANT PROFESSOR, STANFORD LAW SCHOOL, FACULTY FELLOW, PROGRAM ON ENERGY AND SUSTAINABLE DEVELOPMENT, CENTER FELLOW, WOODS INSTITUTE FOR THE ENVIRONMENT, PALO ALTO, CA

1. INTRODUCTION AND SUMMARY

Mr. Chairman and members of the committee, I am honored to appear before you to testify on the potential role of carbon offsets as a cost containment mechanism for a US greenhouse gas emissions trading market. Overall, I believe that offsets hold limited promise, both as a cost control mechanism and as a method for reducing emissions beyond the sectors covered by a cap-and-trade scheme. Alternative cost-containment measures, such as a symmetric safety valve with revenues dedicated to a climate trust fund, are more likely to supply many of the hoped for benefits of with fewer of the risks associated with their use. This is especially likely to be the case for the cap and trade system proposed in Title III of the American Clean Energy and Security Act of 2009 (ACES)[1]. The ACES's cap and trade system depends very heavily on the provision of unprecedented numbers of offsets from both domestic and international programs for cost containment ,while at the same time requiring that these systems meet exacting environmental standards. My research focuses on the implementation and function of the only existing compliance grade carbon offset market, the Kyoto Protocol's Clean Development Mechanism (CDM). Detailed analysis of this large and growing carbon offset market suggests that these twin objectives for an ACES offset market, of copious offset supply and high environmental integrity, are likely to be fundamentally incompatible.

In this testimony, I will address several key lessons learned from the international experience with carbon offsets under the Kyoto Protocol so far. I will then describe the relevance of these lessons to the offsets program contemplated by ACES. Finally, I will describe an alternative cost-containment mechanism, a symmetric safety valve or price collar, combined with a climate trust fund. Based on experience with carbon offsets so far, a price-collar is likely to provide far more reliable cost-containment than carbon offsets. I conclude the following:

(1) There has been and will continue to be substantial crediting of businessasusual behavior within the CDM. This is particularly true for sectors

[1] The American Clean Energy and Security Act, H.R. 2454, 111th Cong. (2009).

such as electricity generation that are highly regulated by developing country governments. This crediting of counterfeit emissions reductions is likely to be a hallmark of any real offset program. The crux of the problem is the inability in practice to tell which of the many applicants for carbon offsets are telling a genuine story regarding emissions reductions and which would have installed cleaner technology even in the absence of the carbon market.

(2) The CDM has yet to perform as a reliable costcontainment strategy. Actual issuance of offsets has been far lower than predicted because of concerns about environmental integrity. These concerns have led of necessity to an elaborate and time consuming regulatory process. The impact of this failure to produce offsets has been largely hidden by the reduction in demand for permits due to the global recession.

(3) Realworld implementation of an offset market of the scale contemplated by ACES could not avoid the CDM's pitfalls. ACES as passed requires an offset market and regulatory structure of between 10 and 50 times the size of the current CDM. While there are process efficiencies that a US system could realize, the potential for crediting business-as-usual behavior, for uncertain offset supply, or both, is substantial. In practice as opposed to theory, both effective cost control and certainty as to emissions levels are impossible to achieve under such a system.

(4) A symmetric safety valve or price collar that includes both a price floor and a price ceiling for emissions allowances is preferable to offsets as a costcontrol option. A price collar would be simple to administer, would not require an elaborate regulatory system to administer, and would produce certainty ex-post as to the actual level of emissions under the cap. Offsets will deliver none of these. A price-collar would keep costs within the ACES emissions trading market commensurate with expectations. By doing so it would help to ensure the ongoing support of constituencies essential for an enduring and stable climate policy. Finally and most importantly, a price collar would provide a guaranteed minimum return for clean-tech innovators seeking to displace older fossil generation. This guaranteed return ould increase the provision of new and innovative technologies to the US economy. By doing so, it would also increase the number of green jobs created by a US climate program, and help to position the US as a leader in the global energy revolution.

(5) A price collar would produce substantial revenues via the sale of extra permits. These funds could be used to produce many of the environmental benefits promised by offsets. While use of the safety valve would increase the level of emissions under the cap, the revenue could be directed into a Climate Trust Fund. This fund could accomplish many of the emission reduction objectives of an offset program and do so more costeffectively. By allowing for increased flexibility and by reducing the rents captured by offset producers a Climate Trust Fund would quite possibly produce greater reductions from uncapped sources than would be possible under a carbon offset system.

2. CREDITING OF BUSINESS-AS-USUAL ACTIVITIES IN THE CLEAN DEVELOPMENT MECHANISM

The environmental integrity and costeffectiveness of a carbon offset system depend on the ability to rapidly, reliably, and cheaply determine how entities seeking carbon offsets would have behaved in the absence of the financial incentives created by emissions trading. The "business-as-usual" or baseline scenario can then be compared to what actually happens. Any reduction in emissions from the baseline to reality can then be credited with offsets. Offsets must, if they are to be effective, result in changed behavior. If not, then the result is that emissions do not fall either under the cap (where the offset is used as an alternative compliance tool) or outside the cap (where emissions remain unchanged relative to the baseline scenario). If an offset system performs perfectly, total uncapped and capped emissions remain unchanged. For every ton reduced outside the cap, one ton is emitted by a covered entity inside the cap. Of course, no offsets market is likely to work perfectly; in practice, a balance must be struck between the over-crediting of business-as-usual behavior and the under-crediting of real reductions. But even evaluating this type-1 versus type-2 error requires some ability to objectively determine the counterfactual baseline scenario. In too many contexts, this has proven impossible to do in real offset systems.

The Clean Development Mechanism of the Kyoto Protocol (CDM) is the largest carbon offset market in the world, both in terms of volume of credits and value transacted. The CDM is also the world's first compliance grade carbon offset market. Firms covered by cap-and-trade regimes, most notably the European Union's Emis-

sions Trading Scheme (EU ETS), can use CDM offsets in lieu of allowances for compliance. The CDM was conceived with the twin goals of lowering compliance costs for parties to the Kyoto Protocol and assisting in the financing of sustainable development. The performance of the CDM holds important lessons for an analogous compliance grade carbon offset system proposed for the US.

The CDM has evolved through time as it has both grown in size, from just a few emission reduction projects to more than four thousand, and in complexity, from just a few project types to over one hundred. During this growth process, the regulators of the CDM have learned by doing and have improved practices. These improvements have been made mainly with the intention of insuring greater environmental integrity. Both anecdotal and systematic evidence suggests that substantial crediting of businessasusual projects continues to occur. The root cause of the problem appears to be an inability to reliably determine the baseline scenario for a particular project or class of projects.

The problems in the CDM have been greatest in sectors and countries where government regulation plays an important role in economic activity. In China where more than half of all CDM credits originate, this is most evident in the energy sector. The Chinese energy sector, because of its strategic importance, remains largely state controlled and in many cases, state owned. The basic problem for the CDM is that state mandates and subsidy programs, along with a complicated and nontransparent interaction between state owned banks, state owned utilities, and financial and energy regulators, already strongly favor the construction of renewable and natural-gas fired energy production. Some small fraction of the new capacity added is no doubt caused by the additional finance provided by CDM. However, in practice, almost all new plants in the wind, hydro, and natural gas sectors apply for and receive credit under the CDM for emissions reductions (see Figure 1*)[2] [3]

The problem for the CDM has been that in practice, there is no straightforward way to determine whose behavior has been altered because of offsets and therefore who should receive them. CDM regulators have been forced to add layers of bureaucracy in an ultimately futile effort to determine which of the many applicants are telling a genuine story regarding emissions reductions and which would have installed cleaner technology even in the absence of the carbon market. As a result, there are lingering uncertainties as to the quality of credits that have been and are being issued by the CDM.

CDM offsets are ultimately bought for use as alternative compliance in a capandtrade system. The impact of their uncertainty quality creates uncertainty as to the quantity of emission reductions produced by the overall program of cap, trade, and offset. In the EU ETS, this uncertainty has turned out to be less than anticipated because of the global recession causing a fall in demand for electric power and hence for allowances and offsets. The fall in demand, combined with free allocation of allowances to emitters has resulted in relatively little use of offsets.[4] Even so, approximately one third of the reduction between the cap in 2007 and the cap in 2008 was covered by CDM offsets. To the extent that these offsets are of doubtful quality, we will never know whether a third of the reductions within covered sectors for the first year of the Kyoto Protocol were real or mere paper reductions. Unless ACES can somehow resolve the lingering uncertainty and criticism that has surrounded determination of baselines and consequent emissions reductions in offset programs, it will suffer the same fate. And ACES if enacted, would rely on offsets to a far greater extent than does the current EU ETS.

3. THE CLEAN DEVELOPMENT MECHANISM STRUGGLES TO PRODUCE A LARGE OFFSET SUPPLY

Another surprise of the first 5 years of CDM operation has been the difficulty the system has had in producing large numbers of issued credits. Reliable supply of large volumes of offsets is a necessity for a cost-containment mechanism. The prob-

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* Figures have been retained in committee files.

[2] See, Michael Wara and David Victor, A Realistic Policy on International Carbon Offsets, Stanford Program on Energy and Sustainable Development Working Paper #74 (2008), at http://pesd.stanford.edu/people/michaelwara

[3] Hydro and wind CDM applications exceed new capacity additions in part because some plants applying for credit in 2007 were built earlier and in part because some plants that applying for credit experienced construction delays. Data Sources: National Development and Reform Council; International Gas Union; International Energy Agency; Jorgen Fenhann, UNEP-Riso Centre, CDM-JI Pipeline Database.

[4] 4 In 2008, the first year during which covered entities could use CDM offsets as alternative compliance in the EU ETS, just 82 million offsets were surrendered, compared to a maximum allowed usage of 8% of the cap or approximately 150 million offsets. Data obtained from the European Commission Community Independent Transaction Log.

lem for CDM offsets has been that in order to maintain environmental integrity, a relatively complex regulatory system has been required. The CDM system works by first requiring that a project apply for registration, after which it operates, producing emission reductions. Reductions claimed by a project are then audited by an accredited third-party verifier. Only after this verification can an offset project owner apply for issuance of credits that can be used for compliance purposes. The ACES offset program is designed to operate in a similar fashion.[5]

In practice in the CDM, this process has proven fraught with delay such that the number of issued credits is far lower than had been expected or has been promised in offset project application documents. Estimates vary depending on methodologies used to assess project and country risk, but expected deliveries of CDM credits were on the order of billions of tons. To the end of date, in 5 years, the program has produced just over 300 million offsets (See Figure 2)[6]. Further, the rate of issuance, which increased through the early phases of the program, has recently stabilized at about 12 million offsets per month (See Figure 3). At this rate, the CDM will issue just 800 million tons of offsets by the end of the Kyoto Protocol compliance period in 2012. This slow rate of issuance has been caused largely by the need to carefully check issuance requests prior to issuance because of concerns about environmental integrity. Because each request and audit trail must be checked individually before approval, this is not an area where significant economies of scale have been found. Instead, issuance has emerged as perhaps the most significant bottleneck in the CDM process.

Furthermore, the composition of the projects generating credits is strongly biased towards those that generate large numbers of credits. This reduces the number of requests for issuance that must be reviewed by the CDM. Thus the current rate of issuance is probably unrealistically fast relative to the entire universe of offset projects. Shown in red in Figure 2 are the industrial gas capture projects, which have generated more than 70% of the issued credits to date. These offset projects capture high global warming potential gases at industrial facilities. Because each ton of high GWP gas is worth between 310 and 11,700 times a ton of carbon dioxide, these projects generate enormous volumes of credits. Industrial gas projects greatly simplify the workload for the CDM, since a few large issuances from these projects make up most of the issuance request throughput. Unfortunately, these are unlikely to be representative of either the future of the CDM or of any other large offset system. Because these projects are highly profitable, there is essentially complete global participation on the part of the eligible industries.[7] The remainder of projects in the CDM portfolio or in any other potential offset portfolio will be significantly smaller in scale and so require proportionately more work on the part of regulators to process.[8]

Whatever the ultimate issuance rate achieved by the CDM, one thing the system has made clear is that actually producing compliance grade offsets is a complex and time consuming regulatory undertaking. Building the regulatory apparatus for the CDM has proven quite challenging, especially as concerns about quality have caused greater scrutiny to be applied to each project registration and request for issuance. This scrutiny takes time and leads to delays and hence a slower than anticipated production rate of offsets. Luckily for those nations and firms otherwise dependent on the CDM for cost containment of their Kyoto Protocol compliance obligation, the global recession, by reducing economic activity, substantially lowered emissions.[9] This in turn has greatly reduced the need for

4. IMPLICATIONS OF THE CDM EXAMPLE FOR ACES

The CDM is the carbon offset system about which we know the most. But how relevant is experience gained under the Kyoto Protocol to the ACES offset program? I believe that the lessons presented above, of difficulty telling good from bad credits,

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[5] ACES supra note 1, §§ 735, 736.

[6] Data compiled by the author from the CDM issuance database, at http://cdm.unfccc.int/issuance/index.html.

[7] Indeed, these projects are so profitable that the carbon offsets produced by them are worth substantially more than the underlying products—most notably refrigerant gases for mobile air conditioners—being produced by the polluting industries. See, Michael Wara, The Performance and Potential of the Clean Development Mechanism, 55 UCLA Law Review 1759 (2008), available at http://pesd.stanford.edu/people/michaelwara.

[8] Ibid.

[9] The United States is a useful point of reference in this regard since it did not ratify the Kyoto Protocol and so is not trying to reduce emissions in order to comply. During 2008 and 2009, the EIA estimates that offsets and the costs of not having them, averting what could have been a compliance crisis.

and of the challenges of producing adequate supplies of credits, are likely to be highly relevant to an offset program of the scale contemplated by ACES.

No offsets system, including the CDM or ACES, can avoid the problem of establishing emissions baselines against which actual emissions are judged. The CDM has illustrated the difficulty of this task. By 2020, the ACES offset program would likely be approximately 20 times the size of the current CDM, if measured in terms of issuance rate (See figure 3).[10] Extrapolating from the relatively small size of the CDM to the much larger ACES program is necessarily uncertain. This is especially the case because ACES contains provisions for both a large international forestry offsets program[11] as well as a large domestic agricultural and forestry offsets program.[12] Also, ACES incorporates numerous provisions aimed at improving the quality of its offsets program compared to the CDM.[13] Nevertheless, the fundamental conceptual and administrative challenges that have confronted the CDM are unlikely to be absent from an ACES or ACES-like offset program. Such a program will struggle to create offsets of undisputed high quality because of difficult baseline determination problems, both in domestic agricultural and forestry settings and in the international regime. Finally, it will have to confront the reality that its rulemakings are potentially subject to challenge in court. The CDM Executive Board faces no such scrutiny of its decisions, or potential source of delay, in its implementation.

In addition, the ACES capandtrade program is, far more than the EU ETS, dependent on offsets both for costcontrol and for environmental effectiveness. Most analyses of the bill indicate that allowance prices will approximately double in the absence of a ready supply of offsets.[14] In its analyses of the bill, EPA estimates that less than 50% of emission reductions that occur due to its enactment will be in capped sectors prior to 2030 (See Figure 4). That is, the majority of the bill's environmental impact hinges on the offsets program having superb environmental quality. If not, then emissions will occur under the cap and be covered by offset credits that due not represent real world reductions. In order to accomplish this objective, the ACES offset program, both international and domestic, will have to accomplish a far higher level of environmental oversight than has proven possible, even with the best intentions, within the CDM.

In order to avoid chronic shortages of credits, and consequently very high allowance prices for covered entities, USDA and EPA will have to accomplish more stringent environmental review of offsets at a much faster rate than the CDM—at least 20 times the speed of the current CDM. All economic analyses of the bill suggest that its' costs will nearly double if offset supply is significantly constrained or delayed.[15] Failure to accomplish this issuance rate might both cause undue harm to the US economy and undermine long-term support for the ACES program. In the event that offset supply proves lower than expected under ACES, the EPA and USDA will come under tremendous pressure to lower standards in order to increase the rate of supply of new offsets into the US emissions trading market. The dependence of ACES on offsets thus exposes it to significant risks. Either that insufficient offset supply will drive a reduction in standards or, if the regulator is unwilling to increase supply in this way (or cannot on the timescale the health of the US economy demands) the undermining of political support for continued implementation.

THE ADVANTAGES OF A PRICE COLLAR OVER OFFSETS FOR COST-CONTROL

A price collar or symmetric safety valve sets a reliable and simple upper and lower bound on allowance prices in a cap and trade system. A price collar places a hard and certain limit beyond which US permit prices would not fluctuate. These trigger points would increase each year at a predetermined rate in excess of inflation over the life of the program. Operating such a system would be relatively straightforward compared to the complexity of a high quality offsets system. If allowance prices exceeded the price ceiling, the government would sell allowances into the market until the price fell below the ceiling. All allowance auctions would be held with a reserve price such that no allowances would enter the market at a price

[10] See, Environmental Protection Agency, EPA Analysis of the American Clean Energy and Security Act of 2009: HR 2454 in the 111th Congress (Jun 23, 2009);

[11] ACES supra note 1, §§751–756.

[12] ACES supra note 1, §§501–511.

[13] ACES supra note 1, §§731, 739, 509, 531.

[14] EPA supra note 9; Congressional Budget Office, Economic and Budget Issue Brief: The Use of Offsets to Reduce Greenhouse Gases (August 3, 2009); Energy Information Administration, Energy Market and Economic Impacts of H.R. 2454, the American Clean Energy and Security Act of 2009 (Aug. 4, 2009).

[15] Ibid.

below the floor. If an exogenous shock caused prices in the secondary market for allowances to fall below the floor, the government could respond by reducing the number of allowances released for auction at regularly scheduled intervals until the price stabilized at the desired level.

The history of emissions trading schemes indicates that ex ante predictions of permit prices are generally inaccurate and biased toward overestimation of cost. Experience with cap-and-trade programs to date indicates that a lower bound on prices is as important as an upper bound. The US Acid Rain Trading Program (ARTP), the Regional Clean Air Incentives Market (RECLAIM), and the EU ETS have, more often than not, exhibited prices far below marginal abatement costs predicted prior to their enactment. In the ARTP case, this was because abatement costs were in fact far lower than predicted. For RECLAIM, the problem was early overallocation of allowances. In the EU ETS case, this was because of over-allocation in the first phase of trading (2005-2007) and due to recession in the second (2008-present). All three emissions trading markets have also experienced relatively brief periods of very high prices. The truth is that because we don't know with much certainty what marginal abatement costs will be under cap and trade, what fuel prices will be, and the future trajectory of GDP, it is impossible to predict with any accuracy or precision what allowance prices will be. Pretending otherwise is a misuse of the models used to estimate differences between policy outcomes.[16]

A symmetric safety valve provides reliable costcontainment for covered entities planning for compliance with a capandtrade system. In theory, offsets provide a solution for firms worried about the costs of compliance with cap-andtrade. In practice as described above, the biggest carbon offset market has been unable to provide either cost-containment or the environmental integrity required to ensure quantity certainty. Further, there is little reason to believe that the causes of this failure can be avoided under ACES. In contrast, a safety valve, because it responds directly to the price of allowances, provides far greater certainty that costs will not exceed a particular level during any given compliance period. Especially under a program like ACES that provides emissions targets until the mid-twentyfirst century, such cost certainty allows for sound long-term investment planning on the part of vertically integrated utilities and merchant generators. In Europe under the EU ETS, it has proven very difficult for utilities to plan for new generation when there is tremendous uncertainty as to the carbon price. Such planning certainty is an important policy objective of any US climate program and a key prerequisite to charting a secure, clean, and low-carbon US energy future.

A symmetric safety valve will also provide a reliable minimum price for allowances that will enable firms to confidently make investments in new pollution reduction technologies. The history of cap-and-trade programs is as much a story of prices that fell below expectation as above. This result has led the clean-tech start-ups that create and venture capital firms that fund new energy technologies to ignore carbon prices when planning and investing. A price collar that provides long-term certainty as to the minimum price of allowances in a US cap-and-trade would allow the innovative firms to count on a certain level of advantage relative to traditional fossil generation technologies. Providing this minimum certainty would allow startups to more fully capitalize on the societal benefits that their new low-carbon technologies will provide. As a consequence, a price floor would increase the provision of these technologies to the US economy, increase the number of green jobs created by a US climate program, and help to position the US as a leader in the global energy revolution.

While a price collar does not provide absolute certainty of emissions limits, neither would a realworld carbon offset system. It's important to emphasize what is not given up in the choice of cost-containment strategy. The main criticism of symmetric safety-valve proposals is that they do not provide quantity certainty for climate policy.[17] That is, they do not pretend to provide certainty as to the level of pollution that will be allowed in any given year. As has been shown above, offset systems promise to provide this certainty, but in practice fail to do so. Thus the choice between quantity certainty under a cap, trade, and offset system like ACES and quantity uncertainty under cap-and-trade with a price collar is in reality, a false choice—neither approach can provide both cost containment and certainty as to the maximum pollution level. In fact, given the low allowance price history of emissions trading programs, it is at least likely that a price collar would provide

[16] The computed general equilibrium and energy system models used to estimate future allowance price and program costs are likely far more reliable at estimating differences between policies than absolute costs. For example, estimates of the difference between a case with offsets and without offsets is likely more informative than an estimate of the absolute cost of either.

[17] A lack of quantity certainty is also the major criticism of carbon taxes.

superior environmental results due to its ability to reduce the supply of allowances when prices fall too far.

6. REVENUES FROM A PRICE COLLAR COULD FUND ADDITIONAL COST-EFFECTIVE REDUCTIONS

In the event that prices within a US capandtrade program exceed expectations and so trigger the safety valve, revenues raised from the auction of extra allowances could be used to accomplish many of the benefits promised by offsets. One of the key benefits of offsets is that they extend incentives to reduce emissions beyond the scope of sectors covered by the cap. Offsets create a potential financial benefit for reductions in uncapped sectors, such as agriculture, or uncapped jurisdictions, such as Brazil, to reduce GHG pollution even though they are not required to do so. This benefit need not be sacrificed just because offsets are not relied upon for cost-containment. The simple solution is to dedicate revenues raised by the price collar to reductions outside of the cap.

Any revenues generated by a safety valve should be deposited into a Climate Trust Fund (CTF) dedicated to reducing emissions outside of the cap. Such a trust fund could be utilized as a source of funding to assist the agricultural and forestry sectors in reducing their emissions or to assist developing countries in doing the same. These goals might be accomplished via payment for the cost of particular activities that are known to result in lowered emissions or via open requests for proposal for emission reduction activities.

Administration of an agricultural and forestry emissions reduction program by a CTF would be far simpler than via offsets. The two great challenges of administering an agricultural offset program are measurement and permanence. A CTF administered system, because it is not linked to an emissions trading market greatly simplifies both. Measurement of carbon emissions of similar accuracy and precision to covered sources is difficult and costly to accomplish on farms and in forests. At the same time, permanence looms large for sequestration based offsets because reversals threaten the integrity of the cap. In contrast, a CTF could handle both issues more flexibly and could more realistically shape an emissions reduction program to fit the needs and capabilities of both US farms and forests. A CTF would enable society to capture greater benefits from the contributions that farms and forests have to make towards reducing emissions while also simplifying the process of farmers and foresters gaining credit for their actions.

Administration of a CTF would allow for far greater costeffectiveness in an international emissions reduction program. One of the major criticisms leveled at the CDM has been that most of the reductions in GHG emissions it has produced could have been had at far lower prices.[18] Careful study of the emission reduction opportunities available at lowest cost in developing countries shows that these are accessible via good regulatory design and effective implementation in areas like building standards, industrial efficiency, and appliance energy efficiency.[19] These are areas that are typically inaccessible to carbon offsets because regulations are part of the emissions baseline, because results are nearly impossible to quantify with sufficient certainty for offset creation, and because there is unclear title to the emissions reductions. A CTF could more easily realize these key emission reduction strategies, available at a cost far below the likely price of emissions in the US capand-trade market, without concern for what was or was not a part of the regulatory baseline. Indeed, the goal of a CTF would be to shape this baseline in ways that drive large-scale change. Further, a CTF, because not tied to an emissions trading market, would be free to grasp such low-cost solutions without the need for strict quantification and clarity of ownership. In sum, a CTF, freed from the strictures of an offset market, could produce greater reductions at lower cost.

7. CONCLUSIONS

A price collar will provide superior cost-containment for a US cap-and-trade system compared to offsets along a wide variety of dimensions.

Experience with the CDM has shown that large compliance grade offset markets fail to provide either adequate environmental integrity or a sufficient supply of offsets. The former results in substantial doubt as to the reality of reductions promised by the cap on emissions; the latter in significant cost uncertainty for the program.

A symmetric safety valve, by creating certainty as to the range of possible allowance prices allows firms to plan for a worst case compliance situation while allowing new technologies to fully capitalize on a minimum guaranteed return from the car-

[18] See, Michael Wara, Is the Global Carbon Market Working?, 445 Nature 559 (Feb. 8, 2007).
[19] See, McKinsey & Company, Pathways to a Low Carbon Economy (Jan. 2009).

bon market. It also insures that if estimates of program costs turn out to be lower than expected, extra emissions reductions can be wrung from the capped sectors. This insures that the political calculus of costs and benefits central to the enactment of the program is in fact realized in practice.

Revenues raised from the safety valve, assuming that it is employed, invested via a Climate Trust Fund, could be used to create a domestic agricultural and forest GHG pollution reduction program that better matches the needs and capabilities of these sectors. These funds could also be used to access the very low-cost emission reduction opportunities available from energy efficiency of buildings, appliances, and industry in the developing world.

The CHAIRMAN. Thank you very much.

Dr. Mason, go right ahead.

STATEMENT OF JOSEPH R. MASON, PH.D., PROFESSOR, LOUISIANA STATE UNIVERSITY, BATON ROUGE, LA

Mr. MASON. Thank you, Chairman Bingaman, Senator Murkowski and members of the committee for inviting me to testify today.

The two major schools of thought among academics studying how to limit climate change are delineated primarily by whether policymakers should control either the quantity of carbon emissions via cap and trade policies or the price of carbon emissions via taxes. Theoretical economic models have been developed to support cap and trade. But those models of cap and trade dominate taxation only when optimal banking and borrowing are assumed to occur.

The problem is that the economists advocating such banking and borrowing strategies are public choice economists, not monetary or financial economists. In practice banking and borrowing is implemented even at a relatively well understood realm of monetary policy is rarely optimal. Monetary policy uses tools like discount window borrowing, reserve requirements and quantity constraints to manipulate the supply of contraction order to affect economic growth.

Analogous policy tools are proposed for carbon permits. But contemporary carbon market proposals rarely acknowledge the limits of those policy tools which are described in more detail in my longer written testimony which I'd like to ask to be included in the record. For the moment let's clarify. Borrowing doesn't work for monetary policy. So why should it be expected to work for carbon contracts.

The clearest advice that's ever been given for managing discount window borrowing in the banking sector is Bagehot's Rule which suggests that liquidity crises should be addressed by "lending freely at a penalty rate." Of course operationalizing Bagehot's Rule in monetary policy has been tricky. What constitutes a crisis? What constitutes lending freely? What's a penalty rate?

Environmental authors therefore routinely make it seem like they can freely adopt a readymade policy that has in fact not yet been invented for hundreds of years. Reserve requirements help stabilize banks, but are not used to actively manipulate monetary policy. The problem is that reserve requirement manipulations require every bank, irrespective of its resources, to expand or more importantly contract reserves by a fixed amount to meet policy goals.

Seeing reserve policy is too blunt the Federal Reserve moved away from actively using reserve requirements for policy purposes

in the 1950s. Reserve requirements are not considered a realistic central bank policy tool. Are probably too heavy handed for environmental policy as well.

Open market operations are the current vanguard of monetary policy. But the effects and limits of open market operations are still largely unknown. Modern central banks influence markets primarily by purchasing and selling key market instrument, thereby affecting the supply of money and secondarily the price that is interest rates.

The supply of money related to consumption demand is the most important for driving economic growth, the ultimate target variable of monetary policy. If money that is injected through open market operations however is merely absorbed by investment or speculative demand it doesn't drive growth as directly as does consumption. When the money is merely held in excess reserves equivalent to stuffing money in the mattress the link between open market operations and economic growth breaks down completely which can create a liquidity trap.

Academic proposal for carbon market designs have acknowledged difficulties dealing with these competing demands even if they haven't yet formally adopted the vocabulary of monetary economics. For instance the ability to bank carbon permits may create a political problem akin to "undo wealth accumulation" or "hoarding" when some firms have a large residual supply of permits on hold.

The second, some say greater problem, is that firms with large banked permit resources could corner markets and drive up prices.

The risk lies in the way that some authors think of rectifying the problems. The simplest proposals call for an expiration date on the permits much like how Zimbabwe and other dysfunctional developing countries impose expiration dates on their currencies. Others suggest imposing more stringent project requirements on firms with greater wealth in terms of these banked permits.

Even environmental authors like Murray Newell and Pizer admit that permit demand function is largely unknown. "There's little evidence concerning how large of an allowance banked firms might accumulate. It could in fact be much larger than 1 year's worth of allowances. How fast they might spend it down and in turn how much this might affect any future tightening of a cap." Those are crucial unknowns for a system that will be so inextricably tied to U.S. economic growth.

At the end of the day the situation is even more simple. Manipulating carbon permit supply via something that has at times been called a carbon market efficiency board that is charged with restraining emissions without unduly harming economic growth necessarily decreases the benefit certainty that is the hallmark of cap and trade. Without that benefit certainty the convoluted carbon permit market design and risk of market collapse is both theoretically and practically unnecessary because at the extreme if the carbon market efficiency board works. They peg the price of carbon while allowing benefits to fluctuate you get exactly the same result that you'd get from a carbon tax.

So there's no need to develop this plethora of complex institutions to get the same result. In fact, worse yet, history is rife with examples that suggest borrowing economic institutions from one

setting for use in another and rarely works. So I expect similar outcomes for central bank features applied to nascent carbon markets, especially when a tax can achieve the same goal of price certainty. Thank you.

[The prepared statement of Mr. Mason follows:]

PREPARED STATEMENT OF JOSEPH R. MASON, PH.D., PROFESSOR, LOUISIANA STATE UNIVERSITY, BATON ROUGE, LA

THE ECONOMIC POLICY RISKS OF CAP AND TRADE MARKETS FOR CARBON EMISSIONS: A MONETARY ECONOMIST'S VIEW OF CAP AND TRADE MARKET AND CARBON MARKET EFFICIENCY BOARD DESIGNS

ABSTRACT

The two major schools of thought among academics studying how to limit climate change are delineated primarily by whether policymakers should control (1) the quantity of emissions via cap and trade policies or (2) the price of carbon emissions via direct taxation. The lack of theoretical "fit" between carbon pollutants and cap and trade, however, has given rise to notions of a management board design that can manipulate the carbon market to achieve the economic ideal. The idea is that something like a central bank, most recently referred to as a "Carbon Market Efficiency Board," in the U.S., can manipulate contract supply, smoothing price volatility and dynamically adjusting carbon permit supply to policy goals. But manipulating carbon permit supply via a Carbon Market Efficiency Board that is charged with restraining emissions without unduly harming economic growth necessarily decreases the benefit certainty that is the hallmark of cap and trade. Without that benefit certainty, the convoluted carbon permit market design and risk of market collapse is both theoretically and practically unnecessary. At the extreme, the Carbon Market Efficiency Board pegs the price of carbon while allowing benefits to fluctuate, which is exactly the result of a carbon tax.

Recent scholarship on climate change begins with the assumption that some adjustment mechanism is needed to limit carbon emissions.[1] There are two major schools of thought among academics studying how to limit climate change.[2] They are delineated primarily by whether policy-makers should control (1) the quantity or (2) the price of carbon emissions. The first school is commonly associated with command-and-control "cap and trade" policies, whereas the second school is usually associated with incentive-based carbon taxes.[3]

Cap and trade, as its name suggests, focuses on achieving an absolute cap on carbon emissions using special tradable carbon emissions permits. Policymakers control the total number of permits, so that total emissions can be set by fiat. Many policymakers and environmental theorists believe that cap and trade provides "benefit certainty" because it achieves a hard cap on carbon emissions.[4]

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[1] Related research has also been conducted to examine the political development of environmental regulation, the interaction between state and federal pollution control policies, and avenues of future positive research. See, e.g., Robert W. Hahn, Sheila M. Olmstead, & Robert N. Stavins, Environmental Regulation During the 1990s: A Retrospective Analysis, 27 Harvard Environmental L. Rev. 377 (2003) (discussing the political and economic development of thought on environmental policies during the 1990s); Meghan McGuinness & A. Denny Ellerman, "The Effects of Interactions between Federal and State Climate Policies," Center for Energy and Environmental Policy Research Working Paper, May 2008 (exploring the interplay between state and federal policymaking); Robert W. Hahn & Robert N. Stavins, Economic Incentives for Environmental Protection: Integrating Theory and Practice, 82 AEA Papers and Proceedings 464 (1992) (exploring avenues of research).

[2] Weitzman's seminal work was among the first to examine the dichotomy between price-based and quantity-based pollution regulations. See Martin L. Weitzman, Prices vs. Quantities, 41 Rev. Econ. Studies 477 (1974).

[3] A discussion of both the cap and trade and tax approaches to pollution abatement is available in William J. Baumol & Wallace E. Oates, The Theory of Environmental Policy (Cambridge University Press, 2d ed. 1988).

[4] See Reuven S. Avi-Yonah & David M. Uhlmann, Combating Global Climate Change: Why a Carbon Tax Is a Better Response to Global Warming Than Cap and Trade, 28 Stanford Environmental L. J. 3, 8 (2009), and Robert N. Stavins, Addressing Climate Change with a Comprehensive U.S. Cap and Trade System, 24 Oxford Rev. Econ. Policy 2 (2008). For related work, see Nicholas Brozovic, Prices vs. Quantities Reconsidered, University of California Working Paper, Sept. 12, 2002; James K. Boyce & Matthew Riddle, Cap and Dividend: How to Curb Global Warming while Protecting the Incomes of American Families, Political Economy Research Institute Working Paper, Nov. 2007; Sergey Paltsev, John M. Reilly, Henry D. Jacoby, Angelo C.

Continued

The primary alternative to the cap and trade scheme is the flat "carbon tax" proposal, which sets a stable positive price for carbon emissions. Proponents believe that this price based mechanism provides greater policymaking flexibility.[5] The "price certainty" arising from a carbon tax would allow businesses to plan efficiently, because an increase in the tax rate beyond any foreseen adjustment would require a vote in Congress that would adjust only slowly, better smoothing business investment plans, employment, and economic growth.[6]

The economic debate has led researchers to theoretically describe conditions under which a cap and trade approach is more efficient than a carbon tax.[7] Section I describes the economic foundations of cap and trade. While cap and trade can work for some pollutants, applications to carbon are less than ideal.

Section II goes on to introduce the experience with cap and trade using carbon contracts to date. Even though active markets for such contracts have begun to trade in Europe, the contract mechanisms and price dynamics do not fit any traditional financial economic contract design. Uncertainty about the nature of the contracts has therefore led to tremendous price volatility on European markets that threatens the viability of that system.

Environmental researchers and public policy economists have more recently argued that the lack of theoretical "fit" between carbon pollutants and cap and trade and the problems with European carbon price volatility can be overcome by implementing a management board design. The idea is that something like a central bank, most recently referred to as a "Carbon Market Efficiency Board," in the U.S., can manipulate contract supply, smoothing price volatility and dynamically adjusting carbon permit supply to policy goals. Section III, therefore, frankly discusses problems of managing central bank policy that are still unresolved after hundreds of years of monetary economics research and policy application. Hence, manipulating carbon permits' supply to restrain emissions without harming economic growth necessarily undermines the benefit certainty that is the hallmark of cap and trade policy, decreasing cap and trade efficiencies to levels no better than—and perhaps worse than—a simple carbon tax. Section IV provides a summary and a policy recommendation of a carbon tax as the most effective and efficient approach to pollution abatement.

I. CAP AND TRADE POLICY VASTLY OVERSIMPLIFIES A TREMENDOUSLY COMPLEX MARKET-BASED ECONOMIC THEORY

Economists first suggested cap and trade as an alternative to levying usage taxes to curb privately beneficial but socially undesirable action. In economic terms, the goal of both measures is to curb a recognized and measurable externality.[8]

Public finance, and more specifically the sub-discipline of environmental economics, defines the theoretical optimality of the choice between cap and trade and abatement taxes. The optimal level of emissions is found in Figure 1* at the intersection of the marginal costs with the marginal benefits of pollution abatement. Figure 1 graphically depicts the intersection of these two curves and the resulting socially optimal equilibrium in the market.

In Figure 1, the horizontal axis indicates the amount by which emissions are reduced relative to their unregulated level, while the vertical axis represents the value society derives from reduced emissions measured in dollars. The curve labeled MB represents that marginal benefit to society of pollution abatement—that is, the additional value to society derived from an incremental increase in pollution abatement above and beyond the pollution that has already been eliminated up to that point.

Gurgel, Gilbert E. Metcalf, Andrei P. Sokolov, & Jennifer F. Holak, Assessment of U.S. Cap and Trade Proposals, MIT Global Science Policy Change Report No. 146, Apr. 2007; Richard G. Newell, Adam B. Jaffe, & Robert N. Stavins, The Effects of Economic and Policy Incentives on Carbon Mitigation Technologies, 28 Energy Econ. 563 (2006).

[5] William D. Nordhaus, A Question of Balance: Economic Modeling of Global Warming 202 (2008). Karen Palmer, Dallas Burtraw, & Danny Kahn, Simple Rules for Targeting CO_2 Allowance Allocations to Compensate Firms, Resources for the Future Discussion Paper 06-27, June 2006, at 8 ("This part argues that both a carbon tax and a cap and trade system incorporate the necessary carbon price signal, with a tax offering 'price certainty' and cap and trade offering "benefit certainty," but asserts that a carbon tax would be simpler to implement, more transparent, and less vulnerable to abuse.").

[6] See Avi-Yonah & Uhlmann, supra at 42.

[7] Roberton C. Williams III, Prices vs. Quantities vs. Tradable Quantities, NBER Working Paper 9283, Oct. 2002.

[8] Harvey S. Rosen, Public Finance 56 (McGraw-Hill Irwin 7th ed, 2005). See also Paul A. Samuelson, The Pure Theory of Public Expenditure, 36 Rev. Econ. Stat. 387-89 (1954), and Baumol & Oates, Environmental Policy, supra at 14-20.

* Figures 1–4 have been retained in committee files.

The curve has a downward slope because "the greater the degree of purity of air or water that has already been achieved, the less the marginal benefit of a further 'unit' of purification."[9] The curve labeled MAC represents the scarce resources society must expend to precipitate an incremental increase in pollution abatement above and beyond the pollution that has already been eliminated up to that point. The curve has an upward slope "because of the rising cost of further abatement as the zero emissions point is approached."[10] The optimal level of pollution abatement is represented graphically at the point where the MAC curve and the MB curve intersect. Conceptually, this point is optimal because at this level of pollution abatement, represented by Q*, society has maximized the value of abatement relative to the cost of using society's scarce resources to further cleanse the environment, represented by P*.

An important point to note about the result presented in Figure 1 is that the optimal outcome can be achieved either through cap and trade or through a pollution charge. Specifically, capping the amount of emissions that can be produced at Q* results in the equality of marginal abatement costs and the marginal benefits of abatement. On the other hand, by creating a charge of P* for every unit of carbon that is emitted, producers have incentive to reduce emissions by Q* units of carbon. Specifically, because P* lies above the cost of reducing emissions for all points to the left of Q*, it is less costly to simply reduce pollutants by Q* than to pay the tax. Therefore, an emissions charge of P* has the same effect on the market as an emissions cap that results in emissions abatement of Q*.

In reality, once P or Q is set as a policy variable, MAC and MB can fluctuate, similar to supply and demand curves. Hence, when setting P, Q may fluctuate due to market and other economic forces. Similarly, setting Q will result in P fluctuating due to similar influences. Setting either costs (P) or benefits (Q) with certainty is key to the environmental debate around carbon policy.

It is not clear, from a purely theoretical basis, whether cost certainty or benefit certainty is more important in the carbon abatement debate. Some scholars have argued that a focus on benefit certainty is superior because it puts the emphasis on the environment rather than on the economics.[11] But it could also be argued that the benefits of any policy to reduce greenhouse gas emissions are worldwide, while the cost of any policy adopted by the United States will be confined to the United States.[12] Moreover, small taxes can have disproportionately large effects on economic behavior. As a result, a cap and trade system may, with perfect hindsight, be overkill, were a moderate tax on emissions found to achieve substantial effect.[13]

The negative consequences of environmental advocates capturing cap and trade programs are likely to be exacerbated by Wall Street investment firms. A recent article in Environment: Yale Magazine quotes Peter Fusaro, an energy consultant,

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[9] Baumol & Oates, Environmental Policy, supra at 59.

[10] Id.

[11] Baumol & Oates, Environmental Policy, supra at 74.

[12] Avi-Yonah & Uhlmann, supra at 36.

[13] The Federal Reserve's policy toward daylight overdrafts provides an example of how a small change in policy can have a dramatic effect on economic activity. A daylight overdraft occurs when a bank transfers funds that exceed its reserve balance at a Federal Reserve Bank early in the day and then eliminates the overdraft before the end of the banking day. In this manner, daylight overdrafts serve as intraday credit for banks. To curb daylight overdrafts, the Fed imposed a small fee on this activity in 1994. Originally, the Fed planned to double this fee in 1995 and increase it again in 1996. However, the Fed ultimately decided to increase the fee by 50 percent in 1995 and then monitor activity for two years before taking further action. (Heidi Willmann Richards, Daylight Overdraft Fees and the Federal Reserve's Payment System Risk Policy, Federal Reserve Bulletin (Dec. 1995)). No additional increases were made, as the small fee sufficiently reduced overdrafts to manageable levels.

Another example of the implementation of a small cost by policymakers resulting in a dramatic shift in economic behavior exists within the design of spectrum auctions in the United States. In early auctions, the Federal Communications Commission did not apply a fee to bid withdrawals that occurred during the auction. As a result, withdrawals were frequent, as bidders used them to signal one another in an effort to divide up the market at low prices. To curb this activity, the FCC imposed a relatively small fee on withdrawals. The result was a dramatic decline in the number of withdrawals in spectrum auctions. (For example, there were more than 780 withdrawals during the FCC DEF block auction in 1996. By contrast, there were only 16 withdrawals during the AWS-1 auction in 2006, which occurred years after the FCC imposed only a small fee on withdrawals. Data on prior FCC auctions is downloadable from the FCC's website at http://wireless.fcc.gov/auctions/default.htm?job=auctions_home.) The experience in FCC auctions again shows that the imposition of only small costs on an activity that is deemed undesirable can have large effects on the market. Such examples suggest that imposing a usage tax on carbon emissions rather than cap and trade may have immediate and profound effects on emissions while helping policymakers better understand the effect of environmental policy on economic behavior.

who notes the climate change finance sector includes 90 hedge funds and 80 private equity funds, in addition to a large number of venture capitalists. Fusaro maintains, "It's the most complex financial market ever created." Fusaro counts 38 distinct markets in the United States dealing in everything from acid rain emissions permits to California's mobile emissions reductions credits—that is, credits for reducing tailpipe exhaust. Mutual funds and ETFs (exchange-traded funds) specializing in climate change issues have sprung up in Europe and the United States. Nonetheless, in 2007, $64 billion in assets was traded on the global carbon market, and in 2008 that number was projected to exceed $100 billion.[14]

Of course, there is nothing wrong with financial firms profiting from making markets for stocks, bonds, and other valuable commodities. However, when a market is created and operated according to government fiat, it is all but certain that vested interests, financial firms that operate and make markets in this case, will lobby for socially inefficient provisions that increase their profits to the detriment of society as a whole. This phenomenon, where well-coordinated interest groups manipulate government programs meant to provide for the common good, is known as public choice theory.[15]

As far as cap and trade proposals are concerned, both Wall Street investment firms and environmentalists have similar goals—to restrict the number of carbon permits such that marginal cost to society of pollution abatement exceeds its social benefit. Environmentalists' motivations are obvious. What is less apparent in the emotion of the environmental debate is the fact that financial firms that make markets for tradable pollution permits will be able to make higher commissions the scarcer the permits are. An alliance between environmentalists and Wall Street presents a particularly intractable problem as far as public choice theory is concerned.

The empirical evidence indicates that these public choice concerns are well-founded. Indeed, two companies infamously associated with corporate malfeasance and financial manipulation, Enron and AIG, both lobbied for cap and trade programs so that they could reap profits by making markets for the permits.[16] In 2007, Martin Sullivan, CEO of AIG at the time, explained that the firm would seek to "help shape a broad-based cap and trade legislative proposal, bringing to this critical endeavor a unique business perspective on the business opportunities and risks that climate change poses for our industry."[17] Although systematic academic analysis of nascent cap and trade programs is only beginning, the initial results suggest that special interests have succeeded in "capturing" the European program. Looking at the greenhouse gas (GHG) market, a recent article in the journal Energy Policy concluded "Here, we find that the dominant interest groups indeed influenced the final design of an EU GHG market."[18]

II. CAP AND TRADE CONTRACTS ARE SUSCEPTIBLE TO NUMEROUS PRICING ANOMALIES THAT REMAIN TO BE UNDERSTOOD

A significant problem with cap and trade that has become apparent in recent years is that carbon prices under cap and trade systems have been far more volatile than originally envisioned. Part of the problem is related to carbon permit demand that fluctuates with weather conditions that are highly correlated with electric power generation. Furthermore, although monetizing and trading in various assets and commodities often helps to improve economic efficiency, financial market applications created additional volatility in carbon permits.

The underlying problem is that ill-understood pricing anomalies in the price of carbon credits have undermined the ability of the market to properly internalize both short-and long-term price dynamics. As a result, a firm's incentives to invest significantly in newer, cleaner technologies for the long-term are undermined when prices of emissions credits are extremely volatile and therefore cloud longterm price signals in the short-term.

This section summarizes the European experience with cap and trade and reviews the complexity of emissions credit valuation and resulting pricing anomalies. As a

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[14] See Richard Conniff, Wall Street's Carbon Conversion, Environment: Yale Magazine 7 (2008).

[15] See, e.g., generally Mancur Olson, The Logic of Collective Action (Harvard University Press Revised ed. 1971); James M. Buchanan & Gordon Tullock, The Calculus of Consent: Logical Foundations of Constitutional Democracy (University of Michigan Press 1962).

[16] See Phil Kerpen, Cap and Trade for AIG?, Washington Times, Mar. 25, 2009, available at http://washingtontimes.com/news/2009/mar/25/cap-and-trade-for-aig.

[17] Id.

[18] See Peter Markussen & Gert Tinggaard Svedsen, Industry Lobbying and the Political Economy of GHG Trade in the European Union, 33 Energy Policy 245 (2005).

whole, exhibited anomalies are the result of both weather and political uncertainties as well as idiosyncrasies in the carbon permit contract.

The European Union provides a wealth of information and data on markets that have developed from cap and trade programs. In the European Union's Emissions Trading Scheme ("EU ETS"), both cash and futures contracts are traded in a variety of markets. While trade with EU Allowances (EUAs) began in 2003, the official EU ETS began in 2005. Prices before 2005 are therefore forward prices on a not-yet-traded underlying asset. In the "pre-2005" period, the traded volume was quite low, at some days even zero as the highest bidder price was smaller than the lowest seller price. Daily EUA prices between August 27, 2003, and December 29, 2004, before agreement on EU-ETS, were generally stable. The price during this entire period was stable during any small time window, and fluctuated between 7 and 13 Euros over the entire 18-month period, with bid-ask spreads were quite large, often exceeding 4 Euros. By contrast, prices between early 2005 and December 29, 2006, fluctuated greatly. Prices spiked at nearly 30 Euros in July 2005 and again in April 2006, and fell to lows of about 6 Euros by December 2006.[19]

A review of daily EUA prices shows that prices were increasingly volatile after 2004. Figure 2 displays daily price and traded volume of futures contracts for December 2009 settlements between February 2006 and December 2008. The data in Figure 2 first confirms that the price of carbon futures fell significantly during 2006. The price then rose through 2007 and the first half of 2008, but plummeted after July 2008.

Important drivers of the market seem to be a combination of short-run weather and political policy announcements rather than any long-term economic fundamentals. Before the EU Parliament agreed on the introduction of the EU ETS in July 2003 and before the first suggestions for National Allocation Plans (NAPs) were published at the end of 2003, prices were stable. Both announcements led to an increase in prices. Because of the initially generous allocation of allowances to the countries, prices calmed down again between February and March 2004. Reviewing and accepting the NAPs in the second half of the year, prices increased to about 9 Euros. As the main framework of the trading scheme became defined, the price determinants became more fundamental after January 2005.[20]

Chief among those fundamentals, however, is the weather. For example, prices fell due to mild weather and high supply of wind energy from Scandinavia and North Germany. At the end of January 2005, cold weather and high gas and oil prices in the United Kingdom coupled with low coal prices resulted in a strong price increase of EUAs.[21] This effect was magnified by a dry summer in July 2005 in Southwestern Europe. Low rainfall depleted reserves and prevented full utilization of hydroelectric plants. The lack of cooling water for nuclear power plants resulted in greater utilization of high-emission-producing assets, which therefore increased the demand for carbon permits. By July 2005, prices peaked at 29.15 Euros. During the last four months of 2005, prices fell to 22 Euros. By March 2006, however, prices again increased to approximately 27 Euros, due to a long and cold winter between 2005 and 2006.[22]

May 2006 marked completion of the first full cycle of the EU ETS. By April 2006, however, it was apparent that a surplus of allowances of approximately 10 percent existed. As a consequence, EUA prices fell by 60 percent within one week, amid fears that emissions prices would drop to zero. The EUA market recovered during the summer of 2006 as the industrial sector began selling EUAs to utilities investors as a dry, hot European summer increased the demand for high-emissions assets.[23]

The European experience outlined above is important because the primary purpose of a cap and trade-based carbon market is to provide long-term incentives for firms to invest in clean-air technologies. Such technologies—nuclear assets or clean-air coal assets, for example—are extremely costly to build, and they are large base-load units that are technologically intensive. Private investment in these types of assets only makes sense if the long-term benefits of the investment are clear. With carbon permit prices fluctuating wildly, long-term signals regarding the carbon-reducing benefits of investment in clean-air technology are clouded at best and non-existent at worst. Therefore, it is not apparent that a cap and trade system resulting in a market for carbon permits is helpful in aligning private interests with pol-

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[19] Eva Benz & Stefan Trück, Modeling the Price Dynamics of CO_2 Emission Allowances, 31 Energy Economics 11 (2009).

[20] Id. at 11-12.

[21] PointCarbon, Carbon Market Monitor 2005 Review, Jan. 2006, available at: http://www.pointcarbon.com/research/carbonmarketresearch/monitor/.

[22] Benz & Truck, supra at 12.

[23] Id. at 12-13.

icymakers' long-term goals: the dissemination of technologies that will reduce carbon emissions.

In fact, numerous asset pricing anomalies can be expected to continue to frustrate long-term pricing signals in a market for carbon emissions, in addition to the volatility arising from weather and politics.

A. While Carbon Permits Are Usually Thought of as a Commodity Contract Because the Deliverable Is a Factor of Production, Price Dynamics of the Contracts Are Not Those Expected for Commodities

In many ways, cap and trade emissions contracts are commodity contracts. A commodity contract is a contract to deliver a raw product or primary input such as food, metal, or energy. In the case of cap and trade contracts, the deliverable is carbon emissions, which is a primary input for production. Emission allowances are classified as "normal" factors of production. Since the allowances are used for production, they are removed from the market as they are consumed. Therefore, the right to emit carbon can be compared with other commodities that are traditionally used as factor inputs in production, and standard commodity pricing models can be applied to the carbon emissions market.[24]

Commodity markets work on a spot and a futures basis. The spot market is the market for immediate delivery of the commodity. The futures market is the market for delivering the commodity at some point in the future. The futures market is a derivatives market, meaning that its value is derived from the current spot market for the underlying asset. The spot and futures market for the EU's current cap and trade contracts exists on a number of different commodity exchanges.[25] Empirical data from these exchanges can show whether the real-world pricing of cap and trade contracts conforms to price behavior of other commodities possessing similar characteristics.

> The expected future value of a commodity is equal to the current spot price plus carrying costs. This can be stated as
>
> [1] $F_t = Se^{(r-\delta)(T-t)}$
>
> where F is the future price, S is the current spot price, r is the risk-free rate, δ is the carrying cost, t is today, and T is the maturity of the contract.

The conditions just described are the result of what are commonly referred to as arbitrage conditions. If, for instance, the futures price was above the spot price plus storage, arbitrageurs could sell futures and buy on the spot market, storing the commodity for future delivery at a risk-less profit. The opposite also generally holds true.

But in the case of carbon emissions, the optimal level of emissions is stochastic, so that a firm's demand for emissions allowance contracts is also stochastic.[26] Because of these uncertainties and costs, a firm benefits from holding an inventory of the commodity to hedge against any unexpected higher prices. Therefore, allowances for different vintages will have different spot prices at a given point in time.

> The benefit that accrues from holding the underlying commodity rather than the contract for the future is known as the *convenience yield.* The convenience yield keeps spot prices higher relative to futures prices — a pricing structure known as *backwardation.* Backwardation can be expressed in [1] as a condition in which δ represents a positive convenience yield.

In other words, the convenience yield is sufficiently large such that the future price is less than the spot price. In addition, the future price decreases as time to maturity increases.[27]

The opposite of a backwardation structure is contango—spot prices are less than futures prices. Empirical evidence from the EU carbon market shows that the carbon futures market illustrates characteristics not of backwardation, but of contango,

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[24] Id. at 4-15.

[25] Marc S. Paolella & Luca Taschini, An Econometric Analysis of Emission Trading Allowances, Swiss Finance Institute Research Paper Series (2006) at 5-6.

[26] Id. at 13-14.

[27] Id. at 14-15.

where spot prices are less than futures prices.[28] But the financial economics literature suggests that commodities with contango structures usually have readily available inventories that are easily accessed and stored and stable supply and demand functions. Those conditions contradict the performance of carbon markets to date. Even if cap and trade contracts have no cost of storage and are easily accessed, levels of supply and demand for carbon emissions are not easily predicted. In addition, the level of inventories for cap and trade contracts is dependent on current emission levels, which are stochastic and unpredictable.

Because the empirically observed convenience yield for cap and trade contracts does not conform to standard finance theory for commodities, a price analysis based on a historically consistent theory of future-spot parity is probably not very useful.[29]

B. While Carbon Permits Can Be Considered an Option Contract Because the Producer Can Choose Whether to Use the Allowances in Any Given Settlement Period, Price Dynamics of the Contracts Are Not Those Expected for Typical Options

A futures contract only allows for delivery at a specific date in the future. A carbon contract can be used for production at any time until expiration. A carbon cap and trade contract may therefore be more like an option than a future.[30] An option is a contract between a buyer and a seller that gives the buyer the right, but not the obligation, to buy or sell an asset at a specified price on or before a specified date. The option to buy an asset is known as a call option, and the right to sell an asset is known as a put option. In the context of a carbon market, an emissions contract would be similar to a put option, because it allows the contract holder to exercise a right to emit carbon during a specific time period.

A multi-period cap and trade contract can be characterized as a sequence of European put options (options that can be exercised at a specific expiration date in the future) that come into effect sequentially through the life of a contract. The decision of when to exercise each put option is characterized as a real option, optimal-stopping-time problem, similar to the problem of early exercise on an American option. Consistent with common intuition, early exercise is optimal only when the holder's demand for emissions increases.

One of the most common models to price options is the Black-Scholes model. According to the Black-Scholes valuation model, the value p of a European put on a non-dividend-paying asset is estimated by:

[2] $$p = Xe^{-r_f T}\Phi(-d_2) - S\Phi(-d_1)\text{, where}$$

$$d_1 = \frac{\ln(S/X) + r_f T}{\sigma\sqrt{T}} + \frac{1}{2}\sigma\sqrt{T}$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

Φ = the standard normal cumulative distribution function;
X = strike price;
S = price of the underlying asset;
T = time to maturity;
r_f = discount rate; and
σ = volatility of the underlying asset value.

The Black-Scholes model is commonly applied to stock options. Since contracts give holders a put option to produce emissions until a given maturity date, the Black-Scholes model could similarly be applied to a cap and trade contract. This option can be traded, just as a stock can, and a market participant could value the put option using the Black-Scholes model. However, the Black-Scholes model has numerous shortcuts and anomalies that limit its use in valuing even common stock options.

Characteristics of the carbon market will most likely reveal further complications to the usefulness of the BlackScholes model. The Black-Scholes model for valuing options already contains many important limitations. First, the model is only used to value an option if it will be exercised at expiration (European options). Therefore, it cannot value American options, which can be exercised at any point in time before expiration. Second, the model also assumes that the return on the underlying asset

[28] Id. at 15.

[29] Id.; S. Trück, S. Borak, W. Hardle, & R. Weron, Convenience Yields for CO_2 Emission Allowance Future Contracts, School of Economics and Finance, Queensland University of Technology, Brisbane, Australia (2006).

[30] For a primer on financial options, see John Hull, Options, Futures, and Other Derivatives 6 (Prentice Hall, 6th ed. 2006).

is normally distributed, which may not be the case for carbon emissions, and has certainly not been the case for stocks. (Historically, stock market returns have been skewed or leptokurtic—exhibiting more returns in the "tails" of the distribution than would be found in a normal distribution.)[31] Third, the model assumes a constant discount rate, even though the discount rate could change over the life of the contract. Fourth, the model assumes a constant volatility of the underlying asset, which market experience has already shown to vary substantially over time.

The empirical literature testing the accuracy of the BlackScholes model is enormous. Although most studies confirm that market prices generally are close to the estimates resulting from Black-Scholes, several anomalies have been found. For example, because of the model's assumption of normally distributed returns when returns are in fact skewed or leptokurtic, Black-Scholes generally undervalues deep in-the-money call options (or out-of-the-money put options) and overvalues deep out-of-the money call options.[32] Figure 3 illustrates the difference between the normal distribution assumed by the Black-Scholes model and a skewed leptokurtic distribution that is commonly observed in stock returns.

As Figure 3 shows, "distribution B"—that is, the skewed distribution with thick tails—is asymmetric, which leads to deviations from outcomes common to the normal distribution. For example, if both tails in the distribution of asset returns are thinner than a normal distribution, then the Black-Scholes model overprices out-of-the-money and in-the-money calls and puts. If the left tail is fatter, and the right tail is thinner, then the Black-Scholes model overprices out-of-the-money calls and in-the-money puts, and it underprices out-of-the-money puts and in-the-money calls. If the left tail is thinner, and the right tail is fatter, then the Black-Scholes model overprices out-of-the-money puts and in-the-money calls, and it underprices in-themoney puts and out-of-the-money calls. If both tails are fatter, then the Black-Scholes model underprices out-ofthe-money and in-the-money calls and puts.

Several alternatives to the Black-Scholes model exist, but they each have their own problems. For example, Geske's compound option model treats the equity in a firm as a call option on the value of the firm, making the option an option on an option. A second alternative model is the displaced diffusion model, which values an option based on the volatility of the percentage of risky assets held by the firm. A third alternative, the constant elasticity of variance model, assumes that volatility of a firm's value is a function of its fixed costs, and the volatility of firm value increases when stock prices drop. Each of these three alternative models, however, overprices out-of-the-money calls and in-themoney puts, and underprices out-of-the-money puts and in-the-money calls.

Other alternatives include the pure jump model, which assumes stock prices do not change continuously but jump randomly, and the jump diffusion model, which puts jumps together with geometric Brownian motion (also called a "random walk"). However, the pure jump model overprices out-of-themoney puts and in-the-money calls, and underprices in-themoney puts and out-of-the-money calls. The jump diffusion model underprices out-of-the-money and in-the-money calls and puts.

In addition to the established anomalies of Black-Scholes and other models in pricing stock options, the market for carbon emissions has its own anomalies that complicate the valuation of cap and trade contracts as options. As discussed above, cap and trade contracts leave holders with the risk of having too few abatement options at the end of the commitment term when they may need those options. On the other hand, a firm that holds more permits than it expects to need may still hold onto the surplus because those permits have some option value, given that purchasing options in the future may be costly. Illiquidity arises endogenously from the fact that firms cannot emit without having permits and thus fear that they may face a market squeeze at the end of the year. The combination of the general anomalies of commodities, and options valuation models with the anomalies in the carbon emissions market have the capacity to seriously complicate the valuation analysis of a cap and trade market.

C. Exhibited Characteristics of Carbon Permit Prices Confirm That They Are Tremendously Complex Financial Contracts So That Financial Economics Is Unlikely to Find the True Value of "Cap and Trade" Permits

Emission allowance prices have exhibited periods of high volatility, arising in part due to the correlation between CO_2 emissions and external events such as seasonal

[31] See, e.g., B. Mandelbrot, The Variation of Certain Speculative Prices, 36 Journal of Business 394-419 (1963); E. F. Fama, The Behavior of Stock Market Prices, 38 Journal of Business 34-105 (1965); P. Theodossiou, Financial Data and the Skewed Generalized T Distribution, 44 Management Science 1650-1661 (1998).

[32] M. Rubinstein, Implied Binomial Trees, 49 Journal of Finance 771-818 (1994).

changes and environmental disasters. Those external factors increase the difficulty of modeling emission allowance values, making it difficult for market participants to plan ahead for their future carbon emissions.

Figure 4 shows the daily allowance spot prices for sulfur dioxide (SO_2) from 1999 through May 2006. These allowances are traded on the over-the-counter market as well as through the Chicago Climate Exchange.[33] Producers of SO_2 emissions have been granted allowance permits through the United States Acid Rain Program since 1995.[34] The spot price for SO_2, at least from June 2003 until November 2005, could be consistent with a stochastic mean-reverting process with a constant positive drift, as desired by the stated cap and trade policy. The enormous price drop after November 2005, however, indicates that an assumption that the SO_2 cap and trade market was working correctly and that the policy was responsible for the gradual upward trend in price movement would most likely have been very wrong.[35]

Studies of the European markets for CO_2 allowances have also shown the difficulty in using cap and trade for risk-management purposes. In a paper discussing an optimal design for emission allowance derivatives, two financial economists from Universität Karlsruhe note that political and regulatory uncertainties, weather, and fuel prices were the most important and most volatile factors affecting allowance prices, according to surveyed market participants.[36] Weather changes (such as temperature, rainfall, and wind speed), fuel prices, and economic growth all affect CO_2 production levels. Unexpected events, such as power plant breakdowns or environmental disasters that shock the supply and demand balance for CO_2, and changes in fuel spreads shock the demand and supply side of CO_2 allowances and consequently market prices.[37]

For example, energy consumption (and hence CO_2 emissions) increases with cold weather. Non-CO_2 power generation is affected by rainfall and wind speed. In addition, the relative costs of coal, oil, and natural gas affect the decision to move forward with CO_2 abatement projects, and fuel switching costs can be high. These sources of price uncertainty have a short-or medium-term impact on liquidity, which in turn affects the volatility of emission allowance prices.[38] In addition, the prohibition on banking emission allowances between distinct phases of the EU ETS significantly affects futures pricing in that market.[39]

As a result of the complex fundamental dynamics, forecasting models based on fundamentals and future-spot parity of CO_2 yield implausible results due to market complexity and to the particular behavior of the allowances, such as inconsistent behavior of CO_2 allowance convenience yield.[40] Other studies have also shown that CO_2 emission allowance prices are nonstationary and exhibit abrupt discontinuous shifts, short periods of high volatility, with heavy tails in the distribution.[41] One study analyzing the dynamic behavior of CO_2 emission allowance spot prices for the European emissions market demonstrates that a steep price increase will occur when the end of the trading period is approaching, in contrast to a smooth approach to spot prices demonstrated in typical commodity markets.[42]

The institutional and financial characteristics described above make the choice of a proper statistical model crucial (albeit perhaps impossible) for purposes of risk management and carbon permit securities valuation. Given the interrelationship of carbon prices with both fundamental and policy variables, emission allowance prices and returns will exhibit different periods of behavior that include price spikes, volatility spikes, and heteroskedastic returns. The "jumpiness" of price series neces-

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[33] Marc S. Paolella & Luca Taschini, An Econometric Analysis of Emission Trading Allowances, Swiss Finance Institute Research Paper Series (2006), at 5.

[34] Id. at 2.

[35] Id. at 7-8.

[36] Marliese Uhrig-Homburg & Michael Wagner, Success Chances and Optimal Design of Derivatives on CO_2 Emission Certificates (2006), at 23.

[37] Eva Benz & Stefan Trück, Modeling the Price Dynamics of CO_2 Emission Allowances, 31 Energy Econ. 4, 6 (January 2009).

[38] Id.

[39] George Daskalakisa, Dimitris Psychoyiosb, & Raphael N. Markellosa, Modeling CO_2 emission allowance prices and derivatives: Evidence from the European trading scheme, J. Banking Fin. (forthcoming 2009).

[40] Marc S. Paolella & Luca Taschini, An Econometric Analysis of Emission Trading Allowances, Swiss Finance Institute Research Paper Series N°06—26, 2006.

[41] George Daskalakisa, Dimitris Psychoyiosb, & Raphael N. Markellosa, Modeling CO_2 emission allowance prices and derivatives: Evidence from the European trading scheme, J. Banking Fin. (forthcoming 2009).

[42] Jan Seifert, Marliese Uhrig-Homburg, & Michael Wagner, Dynamic behavior of CO_2 Spot Prices, 56 J. Envtl Econ. & Mgmt. 180 (2008).

sitates using not only traditional time series models, but jump and jump-diffusion models to analyze the statistical properties of the series.[43]

The dynamics discussed above are not limited to the EU. In addition to the EU cap and trade emission allowances, which are government-issued offsets that are limited in supply, other "low cost" emission credits that will assist the countries that are signatories to the Kyoto protocol in meeting their emission reduction targets include Certified Emission Reductions (CERs) and Emission Reduction Units (ERUs). CERs are created from projects in developing countries such as Brazil, Mexico, China, and India that reduce greenhouse gas, whereas ERUs are allowances that have been allocated to mainly Eastern European countries that have already met their emission reduction targets. CERs and ERUs are both fully fungible with the EU emission allowances and can therefore be banked and traded within the EU ETS. According to an early 2006 report, some project developers had already sold forward their CERs for delivery in 2006 and 2007, while others were banking their CERs until the price became more favorable.[44]

An important lesson from the EU's experience with CERs and ERUs is the arbitrage opportunities that have arisen due to the significant price difference between EU allowances and CERs. Funds and other entities finance energy projects that result in CERs. Then, those entities aggregate the CERs that are produced and create pools of carbon credits that are diversified across projects and countries.[45] These arbitrage opportunities mitigate both credit and country risk, but further complicate efforts to price emission allowance contracts alone.

Given the number of pricing anomalies that exist in financial markets, and the fact that carbon permits would share properties, at least in part, with many financial assets whose prices exhibit similar—but not identical—anomalies, valuations driven by financial markets are unlikely to uncover the true price of carbon permits in the multiple sources of statistical noise in market prices. Should a market for carbon permits in the United States emerge, one can be sure that investors will use the most innovative—and therefore untested—valuation techniques available to value and to trade what would be, arguably, one of the most important contracts in the economy and the environment. Although uncertainty may surround the value of such contracts ex ante, one can be sure that market participants will soon discover weaknesses in either the contract terms or the market structure and will seek to exploit any arbitrage opportunities that present themselves. Consequently, the nascent market will have to be monitored closely and carefully regulated. Market regulation itself, however, is far from efficient and fraught with difficulties.

III. MANAGING THE SUPPLY OF CARBON PERMITS IS LIKE CENTRAL BANKING, AND CENTRAL BANK POLICY HAS NOT BEEN WORKING WELL LATELY

Theoretical mathematical and economic models have been designed to show that a cap and trade program with sufficient banking and borrowing can, in principle, deliver a better outcome than taxing emissions. This conclusion has been recognized to some degree in papers that extended the prior work on optimal carbon permit banking and borrowing. More recently, public policy work for Resources for the Future by Richard Newell et al. (2005) showed how inter-temporal banking and borrowing would allow firms to smooth abatement costs across time, offsetting the traditional disadvantage of cap and trade relative to taxes.[46]

The results of Newell et al. (2005) in particular, however, rely crucially on several mechanisms borrowed directly from central bank policy. Using those features, Newell et al. (2005) claim to have written a theoretical economic model that, for the first time, suggested cap and trade (with appropriate dynamic modifications adopted from central bank theory) can achieve greater economic efficiency than tax-based approaches.[47]

As a result, most recent carbon market development proposals now routinely borrow institutional features from central bank design and organization that are thought to be able to effectively regulate and constrain carbon markets to achieve

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[43] Eva Benz & Stefan Trück, Modeling the Price Dynamics of CO_2 Emission Allowances, 31 Energy Econ. 4, 14 (January 2009).

[44] Ronald S. Borod & Madeleine Tan, Carbon: Is It Just Hot or Is It a New Asset Class?, 9 INTL. Securitization & Fin. Rep. 11 (February 15, 2006).

[45] Id.

[46] Richard Newell, William Pizer, & Jiangfeng Zhang, Managing Permit Markets to Stabilize Prices, 31 Environ. & Resource Econ. 133-57 (2005).

[47] Id. at 149 ("We demonstrate that permit systems incorporating banking, borrowing, and adjustments to the quantity of outstanding permits can replicate price-based regulation. The methods do not require any monetary transfers between the government and the regulated firms, thereby avoiding a politically unattractive aspect of price-based policies.").

environmentalists' objectives. It is those institutional features, working optimally according to assumptions embedded in the economic models, which generate the models' efficiency gains over straight carbon taxes. The problem is that—as demonstrated in markets today—central bank policy rarely achieves those ideal efficiencies because central banking is far more complicated than it looks. In fact, given the theoretical and practical difficulties of central bank policy and application, Newell et al. (2005), style carbon market manipulation is more likely to undermine the benefit certainty that is the hallmark of cap and trade policy, decreasing cap and trade efficiencies to levels no better than—and perhaps worse than (depending on political volatility)—a simple carbon tax.

Like carbon contracts, money is a necessary input to production, and can be used to store value for the future and as a source of income. The fundamental source of value for both carbon contracts and money lies in the necessity of their use as a production input by government fiat. Hence, it makes sense to think of carbon permit supply management in the same light as managing a fiat money supply.

The section below shows that monetary theory—the branch of economics that concerns itself with attempting to achieve the simultaneous objectives of maintaining a valuable fiat currency without stifling economic growth, typically through central bank operations—separates three sources of demand for money: consuming, investing and speculating. Those demands are analogous to the uses of carbon permits as inputs to production, savings for future production, and options on expanding production in the future.

Those three demands create great complexity in monetary system design. Traditionally, three common ways of addressing the different needs are through discount window operations, reserve requirements, and manipulating the supply of fiat contracts. Contemporary carbon market proposals also include such features, but rarely acknowledge the limits to economists' knowledge with regard to best practices and effectiveness.

Last, therefore, I discuss the central bank's role in monetary policy, actively monitoring hitherto unknown dimensions of the economy in attempts to smooth economic growth by manipulating the money supply to stabilize the relative value of the fiat contract against the production, investment, and speculative demands for the contract. While it is one thing for a central bank to try to operate such a system with a relatively-well-established instrument called money, whose supply can be both expanded and contracted over time, it is quite unreasonable to expect to efficiently manage innovative financially engineered markets of financial instruments with a long-term objective of decreasing supply and maintain reasonable economic efficiency in the short-term without substantial and sometimes repeated economic disruption.

The section stresses throughout how little is really known by economists about monetary theory and central banking, even after hundreds of years of academic research and policy application. Indeed, the current credit crisis is a manifestation of those limits to knowledge. Hence, the section proposes that applying the principles and practices of monetary economics to a new fiat instrument with unknown properties can have crucially important unintended consequences. While it may make sense to experiment with carbon market design in a relatively constrained application in order to learn how to harness that market, reducing carbon emissions can best be attained in the short-term through taxes rather than cap and trade policies.

A. Productive Use, Investment Use, and Speculative Use of Contracts Will Compete for Limited Supply of Contracts

Money is thought of as having three distinct uses whose relative importance varies over time: consumption use, investment use, and speculative use. First, and most straightforward, money is used to buy things, that is, for consumption. A carbon contract can only buy one thing, carbon emissions, but the analogy is still apt.

The second use of money is to store consumption potential over time and, more powerfully, until a time when that potential may be greater than today. Such activity is commonly called investment, and carbon permit holders can invest similarly when schemes involve banking provisions. Sometimes economies suffer from too much investment, that is, too little consumption. Some monies, typically in developing countries, may therefore have expiration dates to get consumers to use them more quickly. Usually, however, trade (legitimate or illegitimate) in different financial contracts can smooth individual inter-temporal consumption preferences despite such restrictions.

Investment differs from speculation in that investment targets some goal of future consumption. Speculation, in contrast, merely attempts to realize the maximum value of exchange either inter-temporally or across contracts of different types. If contracts are either mispriced or expected to be of far greater value in different

times or places, speculators may demand some fraction of the contracts to take advantage of those relationships. Speculators have no use of the contracts for their own purposes, but may rent them from others to take advantage of speculative opportunities, creating leverage. While such activity is harder to observe with money (since money is fungible), it may be easier to identify among carbon permit holders with no emissions needs.

That fungibility is an advantage to fiat money over carbon permits. The "hard" carbon permit value makes the contract more vulnerable to demand shocks than the "soft" fiat money contract—just as money backed by gold was more difficult to defend than fiat currency. This is an important point, because what is envisioned as a tightly controlled supply of carbon permits will not just be used for consumption (producing carbon this period) but also for investment (producing carbon next period) and speculation (betting on the price of carbon).

Academic proposals for carbon market designs have acknowledged difficulties dealing with competing demands, even if they have not yet formally adopted the vocabulary of monetary economics. For instance, the ability to bank carbon permits may create a political problem akin to "undue wealth accumulation" or "hoarding" when some firms have a large residual supply of permits on hold. The second, some say greater, problem is that firms with large banked permit resources could corner markets and drive up prices. The risk lies in the way some authors think of rectifying the problems. The most simple proposals call for an expiration date on the permits, much like Zimbabwe (annual inflation last year of roughly 10,000 percent), and other dysfunctional developing countries impose expiration dates on their currency. Others suggest imposing more stringent project requirements on firms with greater "wealth" in terms of banked permits. Nevertheless, authors admit that the permit demand function is largely unknown, noting "...there is little evidence concerning how large of an allowance bank firms might accumulate (it could, in fact, be much larger than one year's worth of allowances), how fast they might spend it down, and in turn how much this might affect any future tightening of the cap."[48]

B. Typical Ways of Managing the Competing Demands for Money Are Not at All Straightforward in Practice

Typical proposals maintain that uncertainties about the permit demand function can be addressed through a central bank "discount window" equivalent, imposing a "reserve requirement" on permit holders, or regularly intervening in permit markets to dynamically manipulate permit supplies in a manner similar to open-market operations. While such features appear attractive at face value, closer inspection quickly reveals the well-known—within the field of monetary economics—problems associated with using these tools to manipulate the money supply and how much more complex and potentially intractable the problems would be if implemented with carbon permits.

1. Discount windows do not work for the money supply, so why should they be expected to work for carbon contracts?

Accepted approaches to carbon permit supply management have evolved to allow some form of borrowing if permit costs are unexpectedly high or supply is otherwise unavailable. Notwithstanding the fact that such policies are generally frowned upon by staunch environmentalists who want emissions limits treated as rigid constraints, the question becomes when to intervene and how many permits to offer. Those are precisely the questions that have confounded monetary theory for hundreds of years.

The clearest advice that has been given for managing such discount window applications is Bagehot's rule, which suggests that liquidity crises should be addressed by "lending freely at a penalty rate." The idea is that financial market crises are accompanied by liquidity difficulties arising when investors cannot sort out weak firms from strong ones. Firms that are otherwise sound but lack temporary liquidity can, therefore, be helped through discount window lending by a monetary authority that has inside information about firm conditions. The carbon permit problem would be similar, if firms did not hold enough reserve permits to meet production requirements, say, in a cold winter. Hence, the policy approach is argued to be similar, as well.

Of course, operationalizing Bagehot's rule in central banking has been tricky. What constitutes a crisis? What constitutes lending "freely"? What is a penalty rate? Environmental authors are feeling their way around such policy problems, effectively reinventing the wheel. Some suggest allowing the regulator to "...react to spe-

[48] See Brian C. Murray, Richard G. Newell & William A. Pizer, Balancing Cost and Emissions Certainty, Resources for the Future Discussion Paper (2008) at 10.

cific high-permit-price circumstances by making special allocations." Far from applying the penalty rate, however, such authors suggest the regulator "...give away some volume of additional permits, thereby lowering permit prices," which is like a central bank dropping interest rates to zero. Of course, it would be desirable to only facilitate a temporary increase in permits (similar to facilitating only a temporary increase in the money supply to avoid inflation), leading some to suggest the permits be loaned instead of sold.[49] All the approaches will be applied in a highly politicized environment, detracting—perhaps substantially—from economic efficiency.

Moreover, the environmental debate ignores the fact that the importance of central bank discount window policy has waned considerably over recent decades. While discount window lending can help smooth typical small fluctuations in currency demand, discount window lending is not an advantageous way to address crises where solvency difficulties are often paramount, since more credit does not help firms become less insolvent. Similarly, additional subsidized permits will only help insolvent environmentally value-destroying firms hold on a little longer at the margin and will destabilize the carbon regulatory authority. Hence, after hundreds of years of experimentation, the discount window lies largely unused for significant policy purposes. The carbon market equivalent similarly holds little promise.

2. Reserve requirements help stabilize banks but are not used to actively manipulate monetary policy

Environmentalists have also come to advocate central bank reserve requirements as not only a means of smoothing permit demand, but also manipulating permit supply. As with other central bank applications, the principle is deceptively simple. Firms that use carbon permits to some substantial degree are required to hold a quantity of unused permits to accommodate normal production demand, perhaps based on a certain percentage of the allocation or based on a certain percentage of last year's emissions. "These reserves would be roughly analogous to the reserve requirement that the Federal Reserve places on banks, whereby they are required to always hold and not loan out certain percentage of deposits. As with the Fed's reserve requirement, firms not meeting the permit reserve requirement could be allowed to borrow from the regulatory authority in order to meet it."[50]

Again, problems arise when environmentalists read too much into central bank policy, unaware of the pitfalls that such policy options have demonstrated over the history of practical application. Some environmentalists suggest the reserves give "...the regulator an additional policy lever to stabilize permit prices by influencing the effective amount of permits in circulation, in the same manner that the Fed can adjust reserve requirements to influence the interest rate. Raising the reserve requirement, for example, would lower the effective amount of permits available in the market, thereby raising the permit price. Lowering the reserve requirement would have the opposite effect. The regulator could take this action any time it saw prices deviating from the target."[51]

Central bankers long ago, however, accepted that reserve requirements were too heavy-handed to be used as a policy tool. In the monetary world, reserve requirement manipulations required every bank, irrespective of its resources, to expand or—more importantly—contract reserves by a fixed amount to meet policy goals. Such broad policy is obviously detrimental to institutions with even idiosyncratically temporarily low reserves, penalizing such banks for what may be advantageous use of capital. Hence, the Federal Reserve moved away from actively using reserve requirements for policy purposes in the 1950s. While undergraduate textbooks still correctly teach that central banks still have the authority to change reserve requirements, reserve requirements are not considered a realistic central bank policy tool and are probably too heavy-handed for environmental policy, as well.

3. Open market operations are the current vanguard of monetary policy, but the effects and limits of open market operations are still largely unknown

Modern central banks influence markets primarily by purchasing and selling key market instruments, thereby affecting the supply of money and, secondarily, the price (interest rates). While overall supply is affected by open market operations, however, the supply of money related to consumption demand is most important for driving economic growth, the ultimate target variable of monetary policy. If money that is injected through open market operations is merely absorbed by investment or speculative demand, it is transformed back into securities and therefore does not drive growth as directly as does consumption. When the money injected is merely

[49] Newell, Pizer, & Zhang, supra at 148.
[50] Id. at 147.
[51] Id.

held in excess reserves (equivalent to "stuffing money in the mattress"), the link between open market operations and economic growth breaks down completely. To the extent such preference shifts are understood in monetary economics, the field refers to the conditions as a breakdown in the credit channel of monetary policy transmission, which can create a liquidity trap.[52]

A similar phenomenon can be imagined for carbon open market operations, where productive, investment, and speculative demand are more closely tied to the target variable of economic growth. If productive users do not receive permits sold through open market operations—whether because productive users do not desire such permits or because speculators desire those permits more highly than productive users (who value the permits at the marginal cost of fuel substitution or production cutbacks)—the link between carbon permits and production will be broken.

Breaking a carbon market "liquidity trap" may involve increasing the supply of carbon permits dramatically. When the Federal Reserve embarks upon such action, it runs the risk of inflation. When the carbon market regulator embarks upon such action, it runs the risk of obviating the long-term carbon emissions restrictions it seeks to impose. Both invoke vast unknowns in the economics of engineering and manipulating markets for public benefit. Both are potentially damaging and even reckless, both economically and politically.

4. Regulatory credibility and optimal policy consistency are not easily obtained

Since the early days of Kydland and Prescott (1977) and many authors who followed, the risks that central banks assume in generating policy credibility, consistency, and openness have become well-known.[53] With central banks, such considerations arise out of investor concern for inflation and economic growth. With carbon markets, similar considerations can be expected to arise with respect to long-term carbon emissions goals and economic growth.

The main problem with central banks is that credibility, consistency, and openness are only measurable against long-term economic growth, which may take several years to evolve from any given policy shift. With applications to carbon markets, credibility must be maintained with respect to not only long-term economic growth but also long-long-term carbon emissions reduction targets, which may take decades to measure.

The issue of credibility is central to academic discussions of whether central banks should set policy on the basis of rules or subjective judgment. Rules are attractive because investors can transparently weigh whether the central bank intends to meet their long-run policy goals by observing whether the central bank is following the rule to which it has committed.[54] The rule therefore helps investors filter through the noise of short-term economic fluctuations to determine policymakers' credibility.

Rules, however, do not fit every situation. Hence, central banks prefer to have discretion over how to address idiosyncratic issues affecting short-term economic growth. Discretion can also be used, however, to eviscerate policy goals. Hence, rules are stronger than discretion in establishing central bank credibility. Once credibility is established, however, mature central banks can usually be trusted to undertake some level of more discretionary and effective short-term policymaking.

Of course, setting rules precisely in the context of specific policy questions can be difficult. Monetary theorists have struggled with growth rules, inflation rules, and other monetary policy target rules. The well-published Taylor Rule is one example of an outside metric that is used to judge deviation from steady-state policy in a discretionary central bank.

What rules would an environmental regulator set? The simplest relates to the benefit certainty that is thought to be the hallmark of cap and trade: reduce carbon emissions over time. In the short-term, however, holding tightly to such a rule may impose substantial costs on economic growth. Furthermore, according to the now-famous Lucas critique, once traders figure out rules, they act accordingly. As with developing country central banks, the regulator may therefore be attacked by speculators buying contracts in hopes of driving prices up. As long as regulators hold

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[52] See, for instance, Ben S. Bernanke, Nonmonetary Effects of the Financial Crisis in the Propagation of the Great Depression, 73 Am. Econ. Rev. 257-76 (1983).

[53] Finn E. Kydland & Edward C. Prescott, Rules Rather Than Discretion: The Inconsistency of Optimal Plans, 85 J. of Pol. Econ. 473-91 (1977).

[54] Id. Rules are credible precisely because they impose discipline in the face of economic upheavals. Inflexible rules regarding gold parity of the dollar and other worldwide currencies certainly helped cause the Great Depression. While inflation—dropping the rule—helped spur recovery in every country, each inflated with the objective of reestablishing pre-Depression gold parity sometime in the future. It was not until 1973 that countries moved to fiat currencies (not based on gold), and recent crises in Latin America and Asia remind us that economists' understanding of the relationship between rules and credibility is still in formative stages.

tightly to their rules, speculators gain. Hence, while the regulator seeks to establish credibility, the speculator seeks to push prices to levels that break the regulators' resource constraints. Such was the case in the Asian and Latin American crises of the 1990s and George Soros' speculation against the British Pound in 1992.

Once the regulator deviates from its rule, it must once again establish credibility. After the crises of the 1990s, more countries adopted other sorts of currency pegs and floating pegs to allow rule-based policy with greater degrees of discretion to guard against speculative incursions. Some countries maintained their rules-based policies and defended them through capital controls, prohibiting exchange between foreign and domestic currency in times of necessity. Overall, however, the problem of establishing central bank credibility has not yet been solved in monetary economics, and policy-makers seeking to apply central bank paradigms to carbon markets should expect similar difficulties.

Once credibility is established, central banks are still not free to do as they wish. Policy inconsistency has been shown by many authors to be as disruptive as any financial crisis. The regulator cannot set a discretionary paradigm or an operating target and then change it without expecting economic disruption as businesses and investors try to understand the new "rules of the game." In fact, modern central bank policy has changed significantly across recent decades, and those changes have sometimes caused tremendous disruptions. Central banks have struggled over appropriate operating target variables for some time now, and ongoing financial innovation perpetuates the struggle.

Policy inconsistency was related to the 1970s stagflationary episode. In the 1970s, the Federal Reserve implemented monetary policy by targeting the federal funds rate. Interest rates rose dramatically, however, during the 1970s. The Federal Reserve responded to interest rate increases by increasing the money supply, which led to historically high levels of inflation (e.g., over 10 percent in the summer of 1979). With rapidly rising inflation, Paul Volcker (chairman of the Federal Reserve Board at the time) felt that interest rate targets were not doing an appropriate job in constraining the demand for money (and the inflationary side of the economy). Thus, on October 6, 1979, the Federal Reserve chose to completely refocus its monetary policy, moving away from interest rate targets toward targeting the money supply itself, and in particular bank reserves—so-called non-borrowed reserves, which are the difference between total reserves and reserves borrowed through the discount window.

Growth in the money supply, however, did not turn out to be any easier to control. For example, the Federal Reserve missed its M1 growth rate targets in each of the first three years in which reserve targeting was used. Further, in contrast to expectations, volatility in the money supply growth rate grew as well. In October 1982, the Federal Reserve abandoned its policy of targeting non-borrowed reserves for a policy of targeting borrowed reserves (those reserves banks borrow from the Fed's discount window).

The borrowed reserve targeting system lasted from October 1982 until 1993, when the Federal Reserve announced that it would no longer target bank reserves and money supply growth at all. At this time, the Federal Reserve announced that it would again use interest rates—the federal funds rate—as the main target variable to guide monetary policy (initially setting the target rate at a constant 3 percent). Under the current regime, and contrary to previous tradition such as in the 1970s, the Federal Reserve now announces whether the federal funds rate target has been increased, decreased, or left unchanged after every FOMC meeting—previously, the federal funds rate change had been kept secret.

Some signs of policy inconsistency have already shown up in European carbon markets. The trading period break between 2007 and 2008, institutionalized in first-generation carbon contracts, prohibited continuous spot trading between the two trading periods. The result has been two separate markets over time, and the potential EU ETS transition into a third trading period would create further disruption. According to European writers, the break has made "...planning or risk management a lot more difficult for companies active in the EU ETS. Policy makers should thus think about a smoother transition into a potential third trading period. "[55]

In summary, therefore, central bank operating paradigms are not as simple as they seem. The Federal Reserve retains one of the most impressive staffs of economists worldwide not because the governors are fans of economic research, but because that research is necessary to guide monetary policy on a path through great unknowns. That is also why the governance structure of the Federal Reserve is con-

[55] See Marliese Uhrig-Homburg & Michael Wagner, Futures Price Dynamics of CO_2 Emission Certificates.

structed to provide consistent policy across long periods of time, so that knowledge and experience can potentially be buffered from political demands across time.

C. A Carbon Market Efficiency Board modeled on central bank operations will operate with all the above constraints plus additional uncertainties and political interference

Policies to date have suggested that the supply of carbon permits be constrained to meet environmental goals. Problems arise, however, when considering that—as with monetary policy—the price of those contracts will be left to vary widely in response to market conditions. Indeed, analysis in the previous sections showed that we have already seen incredible price volatility in European markets, obviating efforts to push carbon prices to levels that will stimulate green investment.

A further advantage of money market manipulation over carbon market manipulation is that there is no intended fixed constraint on money supply or consumption that can be used to influence economic growth. In fact, the U.S. is unique among countries worldwide in that roughly two-thirds of the money supply is estimated to be held outside the country. Hence, there is no worry about running into a hard constraint on the amount of money necessary to facilitate consumption while accommodating investment and speculative demands. Whereas central bankers are allowed to raise the money supply above a prespecified ceiling, the stated ideal is for carbon permit supply to remain constrained, which—adding complexity—will be decreased over time.

More importantly, even central banks have learned over time that they can target either the price of money (interest rates) or the quantity of money, but not both. If the money supply is the target, variable interest rates must be allowed to fluctuate. By contrast, if an interest rate (such as the fed funds rate) is the target, then the money supply must be allowed to fluctuate relatively freely.

In summary, carbon permit supply will need to be dynamically controlled to adjust for numerous unobservable influences, just like the money supply. If investment or speculative demand rises, there will be fewer permits available for production. If, on the other hand, investment or speculative demand falls, carbon overproduction may result. Hence, managing a carbon permit market will be far more complex than managing the money supply, which—indeed—is already tremendously complex, leading to cyclical booms and busts that remain the focus of an entire body of economic research.

Managing a carbon permit market will therefore rely even more crucially on economists who can staff a Carbon Market Efficiency Board with the courage to stanch booms and the talent to mitigate busts, much as the Federal Reserve is expected to accomplish today. According to environmental researchers, all policy proposals "...run into a barrier of establishing some type of management board to manage the reserve allocations and otherwise administer the program."[56] It is that board that is crucially responsible for the dynamic optimality of the implemented cap and trade solution over a carbon tax alternative.

Like a central bank, the important issues would be the precise governing mandate for such a board, the tools available to it, and the degree to which it operated subject to legislated rules versus having complete discretion. Even the Federal Reserve faces multiple conflicting goals, including seeking "to promote effectively the goals of maximum employment, stable prices, and moderate long-term interest rates." In steady-state economic growth, those goals all work in tandem. But in economic booms and busts, the goals may conflict with one another. For instance, the only way to bring high inflation down is to restrain economic growth, resulting in higher unemployment. In such a situation, "those responsible for monetary policy face a dilemma and must decide whether to focus on defusing price pressures or on cushioning the loss of employment and output."[57]

A Carbon Market Efficiency Board is expected to face similar conflicts, at once protecting the environment and containing costs to firms of doing so. The board will therefore have to not only maintain, but define, an appropriate balance of "contract demand" and "contract supply," which will take considerable time and resources in an environment of great political and economic demands. Even the Federal Reserve was politically captured during its first 40 years of existence to serve the Treasury by keeping interest rates low, ultimately being released from such duty only in the Treasury-Federal Reserve Accord of 1951.

But what of the Carbon Market Efficiency Board's mandate to restrict carbon emissions and contain costs to preserve economic growth? Balancing both long-run

[56] See Murray, Newell, & Pizer, supra at 21.

[57] See Purposes and Functions of the Federal Reserve, available at http://federalreserve.gov/pf/pdf/pf__complete.pdf, at 15.

costs and long-run growth makes the Federal Reserve's job look simple, in comparison. When both emissions and economic growth targets are long-term, the management of the two takes on an air of supposition beyond even that managed by central banks. Operationalizing the Carbon Market Efficiency Board's mandate will require settling on a measure of emissions among the vast number of possibilities, as well as settling on a measure of costs. Like a central bank, unable to directly measure either, the board will have to choose target variables it thinks are related—to one extent or another—to the ultimate policy variable and manage to those targets while trying to make sense of the targets' relationship to the ultimate policy measure.

None of this is new: central banks still struggle with a proper definition of economic growth, since classic measures like GDP, for instance, exclude services and other key segments of productive activity. Central banks also struggle with the definition of inflation, relying on CPI and PPI measures that—classically now that we have experienced another asset bubble—exclude financial market prices and housing prices. With greater integration of financial markets and commercial banks, central banks are not even sure anymore what money is. Indeed, those uncertainties are why economies still experience financial crises, recessions, and depressions. With theoretical economic certainty, there would be no credit crisis, nor 10,000 percent annual inflation in Zimbabwe, nor any of the booms and crashes that inexorably repeat themselves through history.

Instead of certainty, modern economies rely on central bank representatives who are thought to be wizened individuals with industry knowledge and economic backgrounds that can help them make creative and meaningful policy even where economic theory falls short. Members of the Federal Reserve Board of Governors are chosen in a manner that attempts to balance conflicting interests, coming from diverse backgrounds such as banking, monetary economics, and law, with practitioners and academics represented in the mix. Furthermore, the governors can rely upon a staff of some of the best economists in the world to undertake market and economic studies that help create strong central banking principles that serve as guideposts to our ever-evolving understanding of central banking and its relationships with markets and the economy. The diverse board composition and economic might are crucial to a well functioning central bank because, even after hundreds of years, central banking is still more art than science. We would expect no less in the present (infant) application of a Carbon Market Efficiency Board.

In summary, in adopting a cap and trade system we are hinging economic growth on a complex contract and a convoluted market design, both of which have yet to be tested in the real world. In theory, therefore, cap and trade systems predicated upon a market stabilized by a Carbon Market Efficiency Board may be able to generate efficiency levels greater than a flat tax. In practice, however, cap and trade plans that rely crucially upon idealized applications of central bank operations with an unlimited supply of benevolent governors and a full and complete understanding of market characteristics and functions are rare, at best. Practical difficulties, therefore, will detract significantly from the theoretically ideal benefit certainty thought to be conferred under a cap and trade system for the foreseeable future. With such policy uncertainty, it is hard to imagine a Carbon Market Efficiency Board will be more efficient than a carbon tax, which is—in effect—the ultimate policy rule.

IV. POLICY RECOMMENDATIONS AND CONCLUSIONS

The crux of current greenhouse gas emissions policy debates is whether to implement a cap and trade system or a carbon tax. Economically, the question comes down to which program provides the most effective means of catalyzing pollution abatement while limiting economic distortions.

Based on economic research and the available empirical evidence, the most efficient policy approach would be to impose a carbon tax on all coal, natural gas, and oil produced domestically or imported into the United States. While both a carbon tax and a cap and trade system achieve the same goals in theory, a carbon tax would be simpler to implement, more transparent, and less vulnerable to manipulation or malfeasance.[58]

The present paper shows myriad benefits associated with implementing a carbon tax over a cap and trade program. In terms of simplicity of administration, carbon taxes are both easier to enforce and can more readily be adjusted if the policy is too weak or too aggressive. A carbon tax also reduces the time lag between the promulgation of a pollution target and its achievement, as a tax can be administered

[58] Avi-Yonah & Uhlmann at 4-6.

immediately. A cap and trade system, in contrast, requires extensive administrative and market infrastructure that will take decades to develop.

Additionally, a carbon tax would result in an immediate revenue inflow, as it would rely on the existing federal tax structure for collection. This revenue could then be used to promote further environmental protection in the form of research grants for the development of alternative energy sources, which are not forthcoming from carbon permit market revenues. Carbon tax revenues could also be used to offset any regressive effects of the carbon tax, especially where small businesses will be adversely affected by additional production costs in a positive-carbon price world.[59]

The most important drawback of cap and trade programs is that they do not work in practice. The tradable permits program initiated by the European Union has been subject to administrative folly and disappointing results. On the other hand, carbon taxes have been successfully introduced in a growing number of countries, including Canada, Denmark, Finland, Italy, and the Netherlands.[60] The simplicity and efficiency of carbon taxes render their use less ripe for regulatory capture than a cap and trade program.

Nevertheless, if policymakers decide to ignore the clear benefits of a carbon tax and opt to implement a cap and trade program instead, the most direct route to preventing speculative abuse and protecting economic growth is to guard the market through attentive monitoring and regulation. The carbon market regulator—referred to in U.S. proposals as the Carbon Market Efficiency Board—must have the power to stanch speculative abuses and attempts to corner the market, whether by domestic or foreign traders, by requiring market participants to be registered with the board and giving the board adequate powers to rescind registration in cases of domestic or international abuse.

The board also must have macro-prudential authority to play a substantial role in decisions about how to value and report carbon contract holdings for accounting purposes in order to ensure sufficient transparency in financial statements of businesses that use the contracts for production, investment, and speculation. The board must have the power to provide an adequate stock of carbon contracts to "lean against the wind" of global warming while ensuring economic growth and employment.

Last, the board must have the power to change the terms of the carbon contracts if the original design proves flawed or ineffective. Alternative contract designs, such as a carbon fee or tax structure, may yet prove superior, and transition may be necessary if the present "cap and trade" carbon contract proves crucially flawed. Just like the Federal Reserve can choose its monetary policy tools and targets, limiting the Carbon Market Efficiency Board to one tool or target may ultimately prevent it from accomplishing the task for which it is established: cutting carbon emissions and helping the environment.

Proposed U.S. cap and trade policies are attempting to implement something far different from the original cap and trade theory using complex financial contracts and convoluted market designs to mitigate price uncertainty at the cost of the benefit certainty that is the hallmark of cap and trade. But such mechanisms and designs will not only substantially reduce the policy's impact on the environment; they may also pose significant risks to U.S. economic growth and competitiveness. In a world where economic outcomes are couched in uncertainty and the optimal level of pollution abatement cannot be established with precision, a carbon tax provides the flexibility policymakers need to grapple with the problems presented by climate change.

In summary, manipulating carbon permit supply via a Carbon Market Efficiency Board that is charged with restraining emissions without unduly harming economic growth necessarily decreases the benefit certainty that is the hallmark of cap and trade. Without that benefit certainty, the convoluted carbon permit market design and risk of market collapse is both theoretically and practically unnecessary. A carbon tax confers far greater economic efficiency than an ill-defined, unstable, and environmentalist—and Wall Street—driven cap and trade market design.

The CHAIRMAN. Thank you very much.

Jason, you're the cleanup batter here. Go right ahead.

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[59] Id at 4-5.

[60] Id at 33.

STATEMENT OF JASON GRUMET, PRESIDENT, BIPARTISAN POLICY CENTER

Mr. GRUMET. I'll do my best, Senator.

Chairman Bingaman, Senator Murkowski and the rest of the committee, it is really a pleasure to be here on behalf of the Bipartisan Policy Center. The BPC was formed a few years ago by former Senate Majority Leaders Daschle, Dole, Baker and Mitchell with the goal of providing both the motivation and the infrastructure to encourage some meaningful bipartisan engagement. Our interest is not the esoteric desire that you all play nice together, but rather the view that truly durable change is going to require a different kind of collective engagement that involves all members of this Congress.

I will admit that some have fairly noted recently that our efforts to change the debate have been subtle at best. But we do believe that we are going to have a more collective and collaborative mood here. I really think that there's no better place to start than with this committee.

As you point out, Mr. Chairman, not only did you mark up bipartisan legislation this year. But in 2005 and 2007 this committee brought forward bipartisan legislation that passed with 74 and 86 votes respectively. So it my great hope that this committee will take an even more active role in the weeks ahead. I'm going to focus principally on costs and then say a few words on offsets.

On costs our flagship project, the National Commission on Energy Policy has long held that providing predictable and transparent cost containment is one of the absolute keys to moving climate legislation through the Congress. In 2004 we offered recommendations that provided a simple safety valve. Again, you know, not an abstract idea. But like Congress, many members of our group have dramatically different views on the expected and predicted costs of a climate program.

Senator Murkowski, you point out that very modest differences of views about offset availability or natural gas prices or the speed and the price of new technologies lead even our national governmental institutions to reach broadly different conclusions on the costs of the same program. So the benefit of a cost cap is that it essentially allows people to agree to disagree. If the prices are low as many would hope then the presence of a cost cap is of no accord.

If prices in fact are much higher than people predicted well then, you want a cost cap because you don't want to have the potential damage to the economy. In broad strokes I think the combination of a cap and a price cap or collar really provides the best elements of both the tax proposal and a cap and trade program. That's why we think it really is the obvious way forward.

Now while this issue remains controversial. I think there is clearly a different mood in the Senate about a price cap then there has been before. I think that's very encouraging.

I also want to note though that our positions have evolved over the last few years. We now support and believe in the value of having a price floor as well as a price ceiling, having that collar. We have also generally comfortable with the numbers for that collar, if it was a true collar in the House bill. The idea of a $10 floor and

a $28 ceiling for reasons I'm happy to elaborate on seem, you know, within the realm of good reason.

Also we are now supportive of a well designed, strategic reserve. As Ms. Claussen pointed out, that has much of the benefits of a true cost cap. At the same time does provide over the course of the 50 year program an expectation of having the complete emission reductions realized.

I should say that with regard to a strategic reserve we think it has to be simple, straight forward and easily understandable. Have published a paper where we make some recommendations as to how we think you can in fact, improve upon the House legislation in that regard. Because we think it does, because of the 3-year running average, really have a fluctuating price that doesn't provide the predictability that we think is important both to the Congress and to the market.

A final thought on cost containment. We share the very broad desire that there be aggressive oversight of this market. Understand that this real anxiety many of you must have at this moment in our Nation's history of creating a new market that may have, you know, one to $2 billion of value.

An important benefit of a price collar is that combined with the reforms that are generally being proposed by the Administration for all commodities you can dramatically reduce the price volatility. In doing so, dramatically reduce the potential for market manipulation and the potential for undue profits. Recognize that there are some who are calling essentially for cap without trade and others who are arguing for a very prescriptive controls on who can participate in the marketplace and what instruments are allowed.

We would urge great caution in going down those paths. They are truly a return toward a command to control regulatory style that I think we have learned over years is not the most cost effective way to move forward. Hope that having a true price collar we can in fact allow the market to work, but bounded by those publicly intended floor and ceiling price.

Finally on offsets, I can be very brief because I'm very much in accord with on our paper that we released today is very much in accord with what Professor Wara suggested. Though, I think our Energy Commission is more optimistic than Dr. Wara about the long term opportunities for emissions offsets to play a meaningful role under a truly global regime. We strongly share the view that there is just tremendous uncertainty in how this market will mature.

I think of emission offsets like I think of any of the kind of breakthrough technologies, advanced nuclear, carbon capture and sequestration and dramatic increases of renewables. Many of these are going to work profoundly well. But it's going to take some time. It's very hard to predict.

I think it's much more likely that in the early years we will see about 100 million tons of international offsets, much more like anything we'll see that number than the 1 billion to 1 ½ billion that's contemplated in the ACES bill. You know, the European Union collectively right now after 6 years has about a 300 million ton program going forward. I think that's probably the high water mark for what we could imagine.

So in closing I guess, Chairman Bingaman, Senator Murkowski, I just want to acknowledge on behalf of this entire committee that you have worked together. You have held workshops and numerous hearings that really try to understand and address the key obstacles and concerns that have served as barriers to moving legislation through the Congress. As I reflect on the broad political dynamic right now I would assume I want to close by saying we need you and are very hopeful that we'll have opportunities to work with this committee going forward. Thank you.

[The prepared statement of Mr. Grumet follows:]

PREPARED STATEMENT OF JASON GRUMET, PRESIDENT, BIPARTISAN POLICY CENTER,

Chairman Bingaman, Ranking Member Murkowski and members of the Committee, thank you for the opportunity to testify today.

I am pleased to be here on behalf of the Bipartisan Policy Center (BPC), which was founded by four former majority leaders, Senators Tom Daschle, Bob Dole, Howard Baker and George Mitchell. BPC was created to help provide the motivation and infrastructure to forge the bipartisan consensus we believe is necessary for durable change. The model of principled, bipartisan compromise we pioneered with the National Commission on Energy Policy (NCEP) later came to serve as the founding idea for the Bipartisan Policy Center. Launched in 2007, the BPC has projects underway that address a broad suite of issues, including energy, national security, health care, transportation, financial services and science. The BPC's mission is to develop and promote solutions that can attract the public support and political momentum to achieve real progress.

Bipartisan policy is of course very familiar to this Committee. You have historically worked in a truly bipartisan way to pass legislation, including the 2005 and 2007 energy bills that combine enhanced energy security with meaningful greenhouse gas emissions reductions.

BPC's flagship project, the National Commission on Energy Policy, was formed in 2001 to bring together a diverse group of 20 nationally recognized energy experts to address critical energy policy issues.

In 2004 and 2007, the Commission released reports proposing detailed bipartisan strategies to meet our nation's energy challenges. Since then the Commission has undertaken a wide array of projects and analyses to inform the national energy and climate change debates. Recent reports seek to address the legitimate concerns of rate payers, business, organized labor, agriculture and energy intensive industries.

The major remaining recommendation from our 2004 and 2007 reports that Congress has not yet enacted is an economy-wide cap and trade program that, in combination with other complementary measures and commensurate international action, will help prevent the most damaging potential consequences of global climate change.

In furtherance of our efforts to educate the public on critical design elements of such a program, the Commission has recently released two papers pertinent to this hearing: "Managing Economic Risk" and "Domestic and International Offsets." These papers accompany my testimony and I ask that they be accepted as part of the record.*

The Commission's principles for an effective economy-wide cap and trade program are clear: under a well-designed climate bill, emission limits would initially be modest and ramp up in a gradual and predictable way over multiple years, with effective mechanisms in place from the outset to (a) guard against high or excessively volatile allowance prices and (b) protect low-income households and trade-sensitive/energy-intensive businesses. This approach will provide time and a favorable investment environment for robust low-carbon technology alternatives to become available, thereby reducing climate-related costs to the economy. It will also help ensure that the transition to a low-carbon economy provides a steady impetus for the creation of durable new industries and employment opportunities with minimal regional economic dislocation.

We believe that Congress must act to address climate change as soon as possible-urgency must take precedence over competing views of perfection. In our mind, there is no question that, left unchecked, climate change will compound environ-

* Documents have been retained in committee files.

mental and economic as well as national security risks to the United States and its citizens.

Many will argue that with a struggling economy this is exactly the wrong time to tackle climate change. Last year some argued against acting on the basis of $4 gasoline prices. Once an economic recovery takes hold, arguments will again center on China, India, and other developing nations or the lack of perfected clean energy technologies. There will always be an excuse to avoid confronting the single biggest environmental challenge of our generation, but the longer we delay acting the more costly the eventual solution.

If anything, our current predicament—a recession caused in part by rising energy prices and a nascent recovery threatened by the next increase in energy prices—illustrates the danger of drifting along with the status quo. In the long run, the policies we need to address global warming are also the policies we need to regain control of our energy destiny. And with appropriate cost containment mechanisms and allocation designs we can be confident that the energy security and economic impacts of any climate policy we adopt now are manageable in the near term and positively beneficial in the medium and long-term.

CONTROLLING COSTS IN A CAP AND TRADE PROGRAM

Since the cap-and-trade debate began, the ability to form a meaningful consensus has been hampered by disagreements over the projected costs of compliance. Taken together, even moderately different views on the cost of new technologies, the speed at which they will deploy, the availability of offset credits, and the macro-economic response to a price on greenhouse gas emissions can lead to dramatically different estimates. Such disparities point to the inherent difficulty of making predictions about the future, particularly when it involves complex social, economic, and technological factors. As a result, the debate over compliance costs remains a formidable barrier to forging a legislative consensus.

For several years, we have advocated for a price ceiling that would set a maximum cap on the price of allowances. The initial price for this cap should be set in statute and increase by 5% annually above inflation. We reached this agreement to address the fact that members of our Commission, like Members of Congress, have substantially different expectations about the costs of compliance. The inclusion of a price ceiling enables people to essentially "agree to disagree" while collectively moving forward in support of a cap-and-trade program. If compliance costs are low, as many advocates believe, then the presence of a price ceiling is of no accord. Conversely, if prices are substantially higher than forecasted, the price cap limits costs while new technologies are developed that are capable of achieving lower-cost reductions.

Recently, the Commission also embraced the adoption of a price floor. Just as some are concerned about potential high costs, others fear that allowance prices could dip so low that the program will fail to provide a meaningful incentive for technology advancement and innovation. They argue that low natural gas prices, significant volumes of cheap offsets, or slower-than-expected economic growth could lead to extremely low allowance prices. Setting a price floor provides more consistent financial incentives for sustained investment in low-carbon technologies that can reduce compliance costs in the long run. Rather than being subject to boom-bust cycles when allowance prices fall, new low-carbon technologies would be assured a certain level of market stability. Together, a price ceiling and floor-or "price collar".substantially reduces the uncertainty about the costs of a climate program.

There are two basic approaches to determining where to set the initial floor and ceiling prices. One approach is to examine economic modeling of the projected price of a reduction target and set the collar levels at a certain percentage above and below these projections. The other approach is to examine the impact of different price levels on key factors like electricity prices, gasoline prices, coal production and set the ceiling at a level that prevents costs from reaching unacceptable levels. NCEP believes that the $10 floor and $28 ceiling set in the Waxman Markey bill for year one are in line with both of the above approaches. EPA's projected 2015 cost for the Waxman-Markey bill is $13-$15 per ton. The proposed $28 ceiling is therefore double the midpoint in EPA's projection.

As an alternative approach, a price floor could be coupled with a "strategic allowance reserve" that would, in effect, create a price ceiling by making additional allowances available through an auction that begins at a specified price. The allowance reserve would be similar to a price ceiling, except that instead of providing a potentially unlimited number of allowances at the predetermined price, the reserve would contain a limited number of allowances borrowed from the future that would eventually be paid back. If allowances in the reserve were used, they could be replaced

either by using the proceeds from the reserve auction to purchase offset credits or by tightening emission targets in later years. While the Commission continues to believe that a simple price ceiling coupled with a minimum price floor is the most straightforward approach to managing economic risks in a cap-and-trade program, a well-designed strategic allowance reserve and price floor offer many of the same benefits and may better ensure that all of the contemplated emission reductions are achieved over the life of the program.

To be effective as a mechanism for managing economic risk, however, the allowance reserve must be structured to reduce uncertainty, not add to it. In our paper, we suggest several modifications to the reserve provision in the Waxman-Markey bill that would make this cost containment mechanism more predictable and effective. For example, we recommend changing the mechanism by which the strategic reserve auction price is set so that the price would rise over time in a transparent, pre-determined fashion (just as we have recommended for a simple price ceiling). We also suggest a larger strategic reserve and that the government be directed to use reserve auction revenues to pay back allowances borrowed from future years.

With respect to the price floor there has been less debate. Most who face potential burdens under the program would accept a $10 allowance price and technology advocates seem comfortable that this price would provide sufficient incentives for long term technology development.

Overall, a price floor coupled with a price cap, or a robust, well-designed reserve auction mechanism could be extremely useful for increasing public confidence in a new greenhouse gas allowance market. These mechanisms will limit volatility, making prices more predictable and transparent. While the presence of a price collar could change the market dynamics, we view these changes as improving both the functioning and public support for the program.

Finally, to the extent that the Committee is concerned about the potential for emission credit traders to reap substantial profits at an undesirable cost to the average consumer, reducing volatility substantially reduces the ability of market participants to reap unreasonable profits from this new market. While NCEP shares concerns stated by many on this Committee that there must be aggressive market oversight, we believe that the adoption of a price collar would substantially reduce the need for adopting specific restrictions on market participants and trading instruments beyond the requirements the Administration is proposing for all commodities. The presence of a price collar ensures that there will be a functioning trading market to achieve compliance at lower costs.

In short, we believe that a climate bill must have price certainty. It is our view that simplifying and strengthening the cost containment provisions in the House legislation with the modest and important revisions I mentioned is critical to building a bipartisan consensus for meaningful action this year.

OFFSETS

I would also like to briefly discuss the role of offsets in managing the program costs. EPA's analysis of Waxman-Markey assumes the immediate availability of substantial international offset credits (up to 1.5 billion tons). While the inclusion of offsets as an alternative compliance option gives emissions sources greater flexibility and can reduce short-and long-term costs, it also introduces an additional source of uncertainty since numerous difficult-to-predict administrative and environmental factors will affect the supply of offset credits and ultimately allowance prices. We are fully supportive of a robust offset market and hope that they are abundant, inexpensive, and represent real, verifiable emission reductions. However, we should not rely on them as our primary cost-containment mechanism. There is too much uncertainty about the quantity and quality of international offsets to feel confident about their adequacy in managing economic risk in the critical early years of a cap-and-trade program. The price collar mitigates uncertainty about the availability of offsets (just like it does with uncertainty around technology deployment). To the extent that offsets are plentiful, costs will stay below the cap. Conversely, in the event that sufficient offsets do not materialize quickly enough, the price cap (or robust strategic reserve auction) will be the tool that controls cost. In short, offsets are a complementary cost control measure, not a substitute for effective cost control.

It is simply impossible to predict with accuracy how many offsets will be available in the early years of a U.S. cap-and-trade program. This is particularly true for international offsets. The number of these offsets used for compliance will depend on a variety of factors, including rules for "additionality," administrative procedures for reviewing projects, policies in host countries, and the ability to negotiate agreements for broader, sectoral offsets. Based on past experience with offset programs, however, we would expect the international offset market to ramp up slowly com-

pared to some of the more optimistic estimates associated with recent House-passed climate legislation. For example, consider the Clean Development Mechanism (CDM) set up under the Kyoto Protocol to promote greenhouse gas abatement activities in developing countries. From its inception in 2004 through May 2009, the CDM has registered projects that now yield a total of roughly 300 million metric tons of carbon dioxide-equivalent offset credits annually. We therefore believe it is unlikely that U.S. purchases of international offsets would exceed 300 million tons of carbon dioxide-equivalent credit per year during the first several years of the program, and while this estimate may be conservative over the long term, the five-fold increase (1.5 billion ton limit) contemplated by the Waxman-Markey bill seems unrealistic. The inclusion of a price ceiling or a robust allowance auction reserve in the early years of a cap-and-trade program for greenhouse gas emissions would ease the pressure for short-term reliance on international offsets as the primary mechanism for managing program-related economic risks. This, in turn, should make it less likely that there will be design and implementation decisions that prioritize quick approval of large quantities of offset credits over the objectives of maintaining environmental integrity and promoting the strategic engagement of developing countries.

Regarding domestic offsets, we believe there should be a "set-aside" program that dedicates a percentage of allowances-say 2 percent to 5 percent-to reward eligible agricultural sequestration practices. Using emission permits to, in essence, "insure" new and innovative sequestration activities will make it possible to create a more streamlined approach than under a traditional offset regime. This can be used to reward early action and promote experimentation while avoiding burdensome administration and accounting rules and reducing uncertainty as new measurement and verification protocols are being developed.

By reducing the pressure to process huge numbers of offsets in the early years of a cap and trade program, the cost containment mechanisms and soil carbon set-aside will help preserve the integrity, and ultimately the viability of international and domestic offset provisions. Past offset programs have shown that even a small number of imperfectly documented offset credits can significantly undermine confidence in the emerging offset market. There is every reason to expect continued controversy, critical media attention, and a high degree of scrutiny by NGO's and oversight bodies. This dynamic has the potential to stifle innovation and slow the learning that is needed to realize the full potential of domestic and international offsets.

In addition to reducing costs, an international offsets program should engage developing countries in ways that induce more significant commitments on greenhouse gas emissions. The Commission believes that the development of sectoral offset programs and "offset aggregator" institutions are potentially important innovations and should be explored as part of a U.S. climate program. At the same time, these approaches raise a number of questions and may take time to develop. Thus, we do not support an approach that would rely solely on these types of mechanisms at the beginning of the program and believe that a robust project-based offset program should go forward while sectoral or aggregated offset options are being developed.

Finally, the Commission recommends that Congress establish guidelines for an international offsets program and authorize the appropriate federal agencies to periodically review and, if necessary, modify the details of program design and implementation to be responsive to evolving economic, policy, and diplomatic developments.

While we can all agree that U.S. action alone cannot solve a global problem, it is equally true that we have no hope of securing effective and equitable global action absent U.S. leadership. The key is to design a program that protects our economy, strengthens our security and encourages innovation in both the production of low carbon energy and sequestration of carbon emissions domestically and abroad.

Thank you for this opportunity to testify.

The CHAIRMAN. Thank you very much. Thank you all for your excellent testimony. I'll start with 5 minutes of questions and then Senator Murkowski and other members I'm sure will have questions as well.

Let me ask about this issue of international forestry projects. That's one issue that was given a lot of attention in the House passed bill. I guess I'd be interested in anyone's view as to whether or not this is an opportunity for very major numbers of offsets in the future.

Large quantities of offsets can be obtained from this source? What are the challenges that we face if we rely upon that? I'm just not clear. Dr. Wara, did you have a thought about that?

Mr. WARA. Yes. I think I see forestry offsets, international forestry offsets as being a potential long term source. But there are really two significant obstacles to that coming to pass.

The first is developing some mutually agreed upon, relatively objective framework for determining deforestation baselines. That remains a challenge. Without that we won't know really, how to quantify the offsets.

The second perhaps more fundamental and more long term challenge is solidifying property rights regimes in the key developing countries that would sell us these forestry offsets. In many of those countries currently the environmental laws are not enforced, especially with respect to the illegal logging. There's an inability to exclude many parties from land that is in theory owned by a particular land owner.

All of that uncertainty with respect to both property ownership and use creates a tremendous uncertainty as to permanence and also as to quite frankly, who owns the offset to be sold. Resolving those issues is complicated and is delicate, political process in any country. I think it will take time for the major developing countries, especially Brazil and Indonesia to get to the point where their land title regime is mature enough to allow for large scale forestry offsets.

The CHAIRMAN. Jason, did you have a comment on this?

Mr. GRUMET. Just briefly. I very much agree that it is extremely challenging. I do think that this is the most hopeful area for significant international offsets.

I think the ability in a government to government fashion to have a big package that looks at tens of thousands, hundreds of thousands of acres as opposed to having U.S. corporations entering into private agreements with other individuals and assuming that those will all somehow become aggregated. I think it's relatively much more promising approach. I agree that it's not going to be available in the next, you know, 12 to 36 months.

The CHAIRMAN. Ok. Eileen, did you have a comment on that?

Ms. CLAUSSEN. Yes. I mean, I think I agree in principle that there are real challenges here. That these will most likely be of greatest value in the not immediate future.

But I do think they are a real possibility for the future. I think they can play an important role. One of the things that strikes me in, for example, Dr. Wara's comments on the CDM which I think are actually really useful to contemplate is that we, the United States, who are usually the most analytical in these international fora in trying to put real numbers and real analysis on the table have not really been involved.

I think that if we were involved, the United States, a lot of the things that have been done quite as well as we might have expected would actually have been dealt with. I really do believe that if we engage in a constructive way on the international forestry thing as part of a regime we can have an enormous influence on making sure that the offsets that are there are real, verifiable and something that we can count on.

The CHAIRMAN. Let me ask. You referred to the problem of establishing a deforestation baseline. I believe that was the phrase that you used, Dr. Wara.

My impression is that in Europe they have not, as far as their offset policy there, they have not been willing to recognize agricultural offsets to some extent the same kind of concerns about the difficulty of establishing a baseline. The difficulty of getting agreement on how you quantify the value of the so-called offset or the changed telling practices or whatever it is that's being done in the agricultural sector. I don't hear much discussion of that?

I didn't hear much discussion of that in the House when they were passing their bill. I think there's a lot of expectation in this country that a substantial amount of our domestic offsets are going to be from agricultural sources. Is this a real problem? Are the Europeans seeing ghosts here or are we too Pollyannaish about our ability to do this?

Mr. WARA. I think that agricultural offsets will be challenging to do well. Some of the toughest problems have to do with quantification. A field is not a smokestack and emissions trading works best when you have a smokestack that you can put a continuous emissions monitoring device on and monitor the flow of gas.

Fields just are not amenable to that treatment. So and are sensitive to things like the history of land use, climate practice, or I'm sorry, the history of the weather on the site, soil type, lots of variables that are tough to monitor and practice and quantify. So there's a quantification issue.

But there's also the fact that we have a currently existing subsidy program within the U.S. that funds conservation tillage. In fact the numbers that I have heard are that 52 percent of agricultural land in the U.S. is currently under conservation tillage. So deciding what the appropriate conservation tillage baseline and level of crediting should be under an offset program that's conservative and concerned with additionality will be challenging.

The CHAIRMAN. Senator Murkowski.

Senator MURKOWSKI. Thank you, Mr. Chairman. Listening to this conversation about offsets it just strikes me. No wonder the people I talk to back home are just scratching their head saying, so tell me what is it that is contained in this House bill and how it works? Recognizing that at least with the House measure so much of their cost containment revolves around this issue of offsets.

We sit here talking about what is a real offset and what is a theoretical offset or something that may materialize in the future and recognizing that we acknowledge there is a finite amount of offsets and how this all plays in. Again, you can talk to people and they can understand it if it's real. But if it's something that we're hoping is going to materialize.

This is the basis for our policy. When it comes to the issue of cost containment, which I think we all agree is something that we must be focused on. This is a big issue.

I wanted to ask and it may be nothing more than has been provided. Jason, you mentioned it and Dr. Mason, you certainly alluded to it in your testimony.

The issue of manipulation, Robert Shapiro said as a former Under Secretary in the Clinton administration. Many others have suggested that we're on the verge of creating a new trillion dollar market and financial assets that will be securitized, derivitized and speculated by Wall Street like the mortgage back securities market and the concern regarding structure in such a way that we don't see market manipulation that many are concerned about. You suggested, Dr. Mason, in your opinion the best way to avoid it was just a straight up tax. Was I correct in hearing that?

Mr. MASON. Yes, I suggested that if we really go all the way toward stabilizing prices we've effectively already adopted a tax and avoided this problem of market manipulation and deeper crite financial market or carbon market crises that may pose a problem for economic development. Just even that something as simple on the subject of offsets we're today seeing a crisis and a verification structure for offset markets. That's already occurring, if you think of that as something like the problems that we solve with rating agencies leading up to the financial crisis.

So knowing what we know today to go further into that market without assurances and institutional preconditions that can provide better verification would be, in my opinion, reckless. But worse yet I think that Dr. Wara also mentioned property rights are crucial to these markets. If an individual in a country doesn't truly have the property rights or stable property rights that allow them to sell a meaningful offset, again you run into a similar problem.

Last, the types of countries that we're talking about are developing countries that often have political instability. While we like to think that people have the best intentions and we certainly do in this room. We cannot assume that worldwide and all regimes and all states of the world.

I can think of, right now, just as happens with typical sovereign risk, where a country will seize oil fields or other industrial capacity of a country's ability to effective seize their offsets, create a scenic crisis on the order of what we saw say with AIG with credit default swaps where the cost of removing these offsets suddenly from the system will be prohibitive and will command a bailout from the U.S. Government. It's not unthinkable. In fact we should think through some of these incentives, these ways to gain the system now so that we don't have our backs against the wall of these ways to gain the system of like unexpectedly later on.

Senator MURKOWSKI. Are we thinking it through, Mr. Grumet? Would you like to respond? I was just given an article here. The headline of an article I have is "Carbon Trading Market Hit as U.N. Suspends Clean Energy Auditor," which is certainly in line with what we're discussing.

Mr. GRUMET. So, I'll try to give you a brief response to what is admittedly a very complicated topic.

First of all there's no question that a tax would be much easier to implement and reduce the potential—well there will be some tax evasion. But reduce the potential for market manipulation. I think a number of folks on this committee have voiced a lot of support for a tax.

What has yet to happen is building any kind of real political coalition around that idea. I think if there was a strong, meaningful,

bipartisan, political coalition advancing a serious tax proposal it would garner a lot of steam. But there's a lot of people who don't think that's likely to happen.

In the absence of that the price collar is actually a pretty elegant solution. It provides, you know, a tax provides a point estimate and a collar provides a bit of a band. But as Senator Cantwell is—and very much appreciate your legislative efforts and others have pointed out. If you reduce the volume of that volatility, you reduce the potential for the malfeasance. So I think it is a significant, but not complete solution.

Senator MURKOWSKI. Thank you, Mr. Chairman.

The CHAIRMAN. Senator Cantwell.

Senator CANTWELL. Thank you, Mr. Chairman. Dr. Mason, your comments are almost music to my ears. Because I think this committee has had many, many hearings about manipulation of energy markets and to have someone who can actually provide research about the activities of what's going on in the European trading I think is the specificity we need.

I think with Enron it took somebody really getting a tape that said, you know, let's get Grandma Milly. Then everybody really realized that there was manipulation of energy markets. I think your specificity gives us some understanding that these markets really are very vulnerable.

In fact I guess I was going to start with Mr. Grumet and others to talk about the price collar. But I did want to ask you because obviously, I mean, we are seeing a system that is just inherent with special interests when you have the trading that's been involved in Europe. Your point is it's, you know, if you're going to get to the point of removing those, and I don't know if you think where Europe is going today whether they're talking about doing that is the right direction. But then you get to the point of providing predictability a different way.

So I guess I'm asking if there's any way to avoid those special interests if you have a trading system?

Mr. MASON. I don't think there's any way to avoid the special interests. We all know how political systems work. Of course, they do their best to make themselves heard.

In my mind the best you can do is insulate both political processes and market processes from those with overt interests and buffer those as good as you can. In that respect when I hear talk about collars and bands around prices my mind, as a financial economist, goes to the stories of countries attempting to convert their currencies into the Euro, of which Britain was one. As Britain attempted to decrease the volatility of the pound relative to the Euro into a tight band, the speculator intervened and pushed them off of that band.

So when you try to hold to tight bands in fact you incentivize speculators to put your back to the wall to see how much money you're going to put up to stay in that band and try to break a country's reserves and their pledge of maintaining that rule. That's the problem with any rule. We've seen that time and time again.

But one more point I'd like to make just on the subject of a tax is I think one of the main obstacles——

Senator CANTWELL. Just price certainty, price predictability. There's lots of ways to get a price predictability, but——

Mr. MASON. Yes, I'm going to call it a tax now just for colloquial reasons. But a set price so to speak is that many have thought that that set price has to fully internalize the costs of the externality. What a lot of research in taxation has been showing is it's sometimes just a nominal user fee can get you 80 percent of the way there without trying to fully price the externality and getting into this tax stickiness problem that Eileen brought up where you'd have to reduce the tax to accommodate economic difficulties and so on and so forth.

So I'd like to just say I think a system could be a lot simpler and get a lot of the effect today.

Senator CANTWELL. I couldn't agree more.

Mr. GRUMET. Just a quick point to your original question.

Senator CANTWELL. Can I throw out too, for you and Dr. Wara? Could you talk about the floor? You were talking about a price collar and the benefit of that.

But can you talk about the benefit of a floor for emerging technologies because to me that it what, I mean, this is what we should be doing. I mean we're not going to get the investment. We can't subsidize our way to this transition. So having a floor is critical to helping us get all the type of investment that we want to see in various technologies.

Mr. GRUMET. So my initial thought just on this question of special interests is that my hunch is there are a number of special interests that those of you around the table don't really want to reward. Right? It's the Wall Street folks who have arbitrage credits and you know, Wall Street, not Main Street.

But the market actually provides incentives for a lot of other special interests like technology innovators. People who think because there's a market out there they can invent a new product and achieve reductions more cheaply and garner credits. So there is a larger frame of the market which in the acid rain program and other places we've seen be very effective. So my only suggestion is to try very hard to find that balance where we kind of clamp down on what we want to avoid without stifling and going right back to a command and control program.

On the point of the floor just like there is uncertainty about the upward price there is tremendous uncertainty about the low price. You know, there are those who say that because we are going to have a painful and ongoing recession which will limit economic activity. There was a report today that emissions have gone down more in the last year than in any year before. Of course, not for the reasons any of you desire.

But if you combine that with very significant low cost natural gas and the possibility of significant influx of offsets. So if you put those three ideas together you could have, you know, permit prices in the $2 or $3 range. So as you point out you don't want to guess wrong low just like you don't want to guess wrong high.

The $10 number, to my knowledge, has not, it's been a little more art than science. It is a number that most people believe will in fact motivate technology. A number that's low enough that just

about everybody would in the kind of emitting community would be thrilled if it stopped there.

There may be more math behind it. But it seems to be a number that people have kind of rallied around. You know, we're quite comfortable with it.

Senator CANTWELL. Dr. Wara.

Mr. WARA. The key issue as I see it. The reason to have a price floor is to provide a number that innovative firms can take to the bank or in the case of the firms that I work most closely with to the venture fund. Right now when clean tech firms, even firms that plan significant operations in Europe.

So firms that operate in an environment where there is a carbon price. When they try to raise funding rounds the experienced and most knowledgeable venture funds force them to justify their business case with a carbon price of zero. That is because the venture funds do not believe there's any predictability to the carbon price. They recognize that actually the real world experience of cap and trade markets has been that the downside price risk is greater than the upside price risk.

In practice many emission trading markets have produced lower prices than predicted ex ante. Firms that are planning investments in technologies that are innovative and disruptive are thinking about that risk when they make their decisions.

Senator CANTWELL. Thank you, Mr. Chairman.

The CHAIRMAN. Thank you.

Senator Corker.

Senator CORKER. Mr. Chairman, thank you. I'll tell you what. This has been an outstanding hearing.

I thank you for having these great panelists. I wish every American could have listened to the 30 minutes of testimony each of you gave. I think it points to, especially in this time of tremendous distrust of Washington, that we've earned fairly, this whole Rube Goldberg notion of creating this vehicle to basically not be straight with the American people is interesting to hear.

I thank all of you for your testimony. I think every one of you are being 100 percent honest. I think all of you basically talked about price volatility other than CRS giving us definitions.

I do wonder and I guess I'll start with Eileen, who's been certainly a leader in this cause. Why is it you think that climate change activists don't have the courage just to be straight with the American people? Say this is about raising the price of carbon and setting a carbon price and everybody understanding that?

I mean wouldn't that build good will among the American people to at least be honest? Wouldn't it do away with the issue of the green technology piece where in essence we have ethanol folks in here talking about they can't compete because the price of oil has dropped. The whole issue of having a floor on the price of carbon certainly would cause those technology folks, the special interest that you like to reward, not the special interest that have come up here and sat at the table and calls the Waxman-Markey bill to be highly beneficial to their bottom line that maybe are not innovators.

But I just would ask the question. Why don't—is this just sort of a romance and they want a date with the idea? They don't really want to marry the issue? What is the answer to that?

Ms. CLAUSSEN. I'm sorry. I'm not sure I can answer your question. I'm in favor of telling the truth and being straight with the American people and with Members of Congress on what we're actually doing here and why we are doing it.

Senator CORKER. But you—but it is to raise the price—raising the price of carbon——

Ms. CLAUSSEN. You don't get the technology that you need to solve the problem.

Senator CORKER. Would a carbon tax instead of all these folks sitting around the table and some people making money off of it, if they have good lobbyists and some people not, if they don't. Would that not be a better approach for those who are climate change activists?

Ms. CLAUSSEN. I mean I happen to think that there's difficulty with the tax because I don't know exactly where to set the level of the tax. I myself would prefer that the market set the level which you would get under a cap and trade program. So I mean if you designed a good enough tax at a high enough level to get the result. I would probably end up by saying let's pass it.

But I would rather the market set the price rather than——

Senator CORKER. But this is——

Ms. CLAUSSEN. Those in Washington set the price.

Senator CORKER. What's been discussed in the House is not a market. I mean, my gosh, anytime you have offsets, Dr. Wara mentioned that 50 percent of the reductions through 2030 are with offsets. That's not a market. That's like an Alice in Wonderland, make believe kind of thing.

Ms. CLAUSSEN. I guess I'm not, as you know, not negative on offsets. There are—I mean what is an offset? It's really an unregulated sector.

So if you decide that you're going to regulate the large emitters there are lots of smaller emitters who I think should be part of this as well. One way to bring them in rather than with command and control regulation which actually is a little bit in the Waxman-Markey bill. I mean there are standards there for smaller sources is to actually allow them to be offsets.

So if for example you have a small methane source which you can verify, which could be real. I don't actually have a problem with using that because it would reduce emissions of greenhouse gases.

Senator CORKER. Dr. Wara, how many of the offsets you're predicting 50 percent through 2030. I mean how much will those be international and how much of those will be domestic?

Ms. CLAUSSEN. I mean the international——

Senator CORKER. Dr. Wara. I've only got a minute left.

Ms. CLAUSSEN. Thank you.

Senator CORKER. Thank you for your mostly honesty.

[Laughter.]

Mr. WARA. It's important to emphasize that that's EPA's prediction. That's not my prediction.

Senator CORKER. Do you know how much of those will be international?

Mr. WARA. The vast majority are international.

Senator CORKER. So I'd just like to point out to the committee what that means in code. Is thanks to CRS giving us these great definitions, is that we are transferring wealth out of this country to other countries around the world. An absolute transference of wealth from our companies, from our constituents, from our citizens, to people around the world at a high level to create some Rube Goldberg mechanism to really get around the fact that we're really trying to raise carbon prices.

Instead of being honest with the American people where those revenues would actually stay in the country and actually could be used, I understand under certain schemes, just dollar for dollar to reduce another tax which it's amazing the President of France is actually advocating that. You have to give him credit for his directness and honesty. But we're not doing that.

So I know my time is up. I hope we'll have the opportunity to pursue this further. But the whole issue of looking at safety valves and collars is in essence a way of creating a carbon tax. But you still have all these mechanisms where special interests are winning and our citizens are losing.

So thank you, Mr. Chairman for an outstanding hearing. I hope many more.

The CHAIRMAN. Senator Shaheen.

Senator SHAHEEN. Thank you, Mr. Chairman. I guess I would—I'm not sure that I would agree with Senator Corker that I wish the American public had been able to hear all of your testimony this afternoon. I think they would have gotten a little concerned about what's being proposed because I think as Senator Murkowski said that what we're talking about is a very complicated system. That's part of the challenge with trying to do this is that it is complicated and so it's hard to understand.

But I would like to follow up on the previous questioning about how we set prices. I mean I appreciate and I think I share the point that part of setting up a cap and trade system is to try and establish a market. That the market is best able to set prices on carbon and on emissions.

But how do we design this so that this price cap doesn't interfere with market dynamics? I don't know. Mr. Grumet?

Mr. GRUMET. I would start by saying that the interference of the price collar is salutary. In other words what we want to interfere with is difficult volatility that allows, you know, the market traders to reap significant profits that don't result in technology increases. We want to avoid the volatility that makes it harder for investors and large companies to plan forwards. I mean I think that this is an intervention. But it's just the kind of intervention we want, you know.

The second part of your question I think implicitly is that well how much, you know, where should you set the price?

Senator SHAHEEN. Right.

Mr. GRUMET. There's kind of two ways you could think about it. You can think about it from an emissions or a cost standpoint.

You know, from an emissions standpoint the modeling that EPA did of the Waxman-Markey bill albeit I think under many circumstances somewhat optimistic suggests that a range of program prices from $13 to $15. So the midpoint, 14, double it for 28. So many would argue that you want to set the price ceiling at you know, two times the anticipated price of the program which I think is the reasonable way to go.

The other way is to think from a cost standpoint. Look at if permit prices were at $20, if they were at $30, if they were at $40, where do you start to experience costs that you don't want to see in this country and pass onto your consumers? You know, we've done some analysis that is also a little technical.

I wouldn't want to share it with the American public. But be happy to share it with you. That looks at what the costs would be on gasoline and electricity rates and other things at different prices. Our sense is that, you know, somewhere in the $25 to, you know, $30 range the prices are sustainable. You don't start to see the really egregious impacts that I think you would all be reluctant to embrace.

So for those two reasons maybe they were brilliant. Maybe they were lucky. But $28 a ton seems pretty reasonable.

Senator SHAHEEN. Ms. Claussen, did you want to add to that?

Ms. CLAUSSEN. Yes, I'd like to answer it in a slightly different way because one of the reasons I don't like the safety valve or the upper limit. I mean I do support the lower limit. I mean for all the reasons about technology innovation is the same reason why I don't like the tax.

If you have a hard cap and it's too low you lose the climate protection that you're after. If you have a hard cap and it's too high you end up with economic impacts that you don't like. So it's a guessing game for the Congress to figure out what the right level is.

I mean that's one reason we like the strategic reserve better. Because you don't end up in that kind of a situation.

Mr. GRUMET. Can I just add to that. I'm more comfortable with the reserve too. I think you can apply those numbers to either. It's just a question of whether you want to pay back the future or deal with the present.

Senator SHAHEEN. So as we're talking about setting a floor then as Senator Cantwell talked about. Where do we set the floor so that we incentivize new technologies? How do we make that determination?

I mean I've had, we've had groups suggests that what is in the House bill is not a high enough floor to incentivize new technology. So again, how do we come up with that number?

Mr. GRUMET. I think there's some art and some science. If you talk to a number of technology investors I think they'll say something that a number of people have mentioned which is just the clarity that there is going to be a carbon price. It's going to be increasing each and every year which is something that we hadn't talked about. But I think most of us who support either a floor or a ceiling believe that there should be a ratchet at about 5 percent a year above inflation.

So the simple knowledge that there is a price on carbon, that the full faith and credit of the United States is behind it and then it's going to be going up for the foreseeable future is probably as important as the precise number. But again, you know, having spoken to a number of technology investors, they've told us that a $10 floor that accelerates by 5 percent over inflation a year would be very meaningful. I mean they'd like a $20 floor, a $30 floor even more. But that $10 would be helpful.

Senator SHAHEEN. Isn't this though pretty critical because if we don't—if the number isn't high enough at the start don't we then lose the potential for the market to encourage those new, very new technologies that we're trying to develop? So how much time have we got to experiment with this?

Mr. GRUMET. All I'll say is this. I think that the relative comparison is to the current price floor which is Europe. So, you know, we've always felt that urgency is more important at this moment than perfection.

So whether it's 8 or 15, I think that may ultimately just be a political decision. We would support just about whatever you come up with.

Senator SHAHEEN. Ok. Yes.

Mr. Mason.

Mr. MASON. I'd just like to build upon a point. I think you're right to ask how much time do we have to consider this when the price is zero now. While we may risk getting the floor too low by moving with something like a simple call it a floor, a tax, we could raise that later on. But the time that we're dithering is time that could be spent building familiarity with the data and understanding the system better to build even a better system.

My objection to cap and trade, and it's been touched upon in various elements of the discussion here. So I'd like to bring that out. I think and feel free to correct me if I'm wrong. I think I'm the only economist on the panel.

Cap and trade was designed to work with a well identified externality problem. So if we have something in this room on this floor and we can decide we want one ton of that thing on this floor and we can measure that. We can set one ton as the cap and we can let the market price that.

Part of the problem with carbon is we don't know what that amount is. So right from the get go we're violating some of the key economic assumptions behind the original theory that gave birth to cap and trade. Once we then start talking about well, we don't like this price or that price, then we're getting further away from the theory of cap and trade.

While Ms. Claussen does bring up, cap and trade is the perfect way to control that one ton of the externality right on this floor here that's easily identifiable. It is indeed, theoretically the perfect way. I think that we're letting the perfect be the enemy of the good right here and that we could move forward very quickly with a simple capital charge that would get us off square one. Get us gathering data on the dynamics of the market so that maybe later on if the market was amenable we could get to that perfect.

But right now with no data and no movement I find it very difficult to jump right to that end point.

Senator SHAHEEN. Thank you. I know I've gone over my time. Thank you, Mr. Chairman.

The CHAIRMAN. Thank you very much.

Senator Stabenow.

Senator STABENOW. Thank you very much, Mr. Chairman, on this really excellent panel and all of the work that you and our Ranking Member have been doing on this issue. Welcome to each of you, a lot of important information, a lot of questions that I have.

First I do want to indicate and actually put into the record, Mr. Chairman, a letter I just received from the Secretary of the Department of Agriculture. Just indicating that they're—based on a letter I had sent with a number of colleagues about the involvement of the USDA in this process and what they were doing to develop their technical capabilities. They recently developed a climate change program office and their office of chief economists.

Have indicated in the letter they're preparing to conduct a rigorous technical and science based process to develop guidelines for quantifying greenhouse gas benefits of agricultural and forestry practices. I think that one of the things that the panelists talked about was getting ahead of the curve by preparing and planning to be ready and so I really commend the Secretary for moving forward aggressively on that process.

I think that one of the things that a panelist talked about was getting ahead of the curve by preparing and planning to be ready and so I really commend the Secretary for moving forward aggressively on that process. When we talk about this issue and I agree with many of the comments concerning a price collar. It makes sense to me that we need both a floor so there can be confidence investing in new technology which is absolutely critical. That we need to know that there is a floor for a number of reasons in tackling what is a global crisis and also a ceiling so that we have that framework.

I guess from my perspective it makes sense also to have offsets. That I don't see those as mutually exclusive and would like comments related to that. Because both of those I think make sense to me.

Dr. Wara, in your—I think you've often time been viewed as a critic of offsets. But when I've looked at your writings actually you talk about smart design choices which is exactly what I think we are trying to do and what the efforts in the House bill have been to deal with the deforestation guidelines and so on that you've talked about. You try to address that. We need to make sure that's done right, that these are quality offsets.

But that it's important to do that. I think it's important to note that if we were to look at completely eliminating the offsets of a cap and trade program which some would say that incorporating them have environmental uncertainties. But also not incorporating any offsets has environmental uncertainties with it as well.

It would seem to me that completely eliminating the use of offsets in favor of only a price collar would simply introduce another set of uncertainties. I would point to the CBO analysis of the House bill that found that with offsets that the House bill, the allowance price of $40 a ton by 2030, approximately 1.8 billion tons

in emission reductions would be achieved with offset projects. But without the offsets in the House bill the price would be $138 billion a ton. Yet we would have lost the 1.8 billion in reductions.

So I would like some comments about molding those two together. I understand and I share with my friend from Tennessee on the initial look at offsets, particularly international offsets. What that seems to be the reality is that this is a global crisis and a ton of carbon is a ton of carbon. That we benefit by the entire world.

In fact I want as someone coming from a manufacturing State to make sure other countries are holding up their fair share so we're not losing jobs to them. So I think and we have to look at this as a global challenge for us. Offsets are really, in my judgment, a bridge to get to new technologies. They don't take the place of new technology and what needs to happen. But it helps us and our industries be able to get there.

But I wonder if anyone might comment about offsets and the price collar and how they might fit together in a credible way.

Mr. Wara.

Mr. WARA. I think it's certainly possible to imagine a system design that involves both a price collar and offsets and would have one important advantage over an offsets only system. That is that in the current experience with offsets is that multiple constituencies favor low quality issuance. Those are both at the buyer—oh, I'm sorry the seller, the creator of the offset because they want to make more money. Which is completely rational and understandable.

But also the buyer that is the regulated entities recognize that the greater supply of offsets, the lower their allowance price will be. So they also come to the table. Put pressure on the regulators to use their discretion which is substantial in the creation of offset methodologies to favor the creation of emission reduction credits rather than a more conservative approach that comes down on the areas where there is uncertainty and favor of environmental integrity instead of issuance.

But so you could certainly imagine the political economy of that regulatory process being improved by a price collar. So that actually a domestic Ag and forestry offsets program I think would be strengthened by a price collar. It would provide greater incentives to the regulators to focus on quality and make sure that farmers and foresters were fully compensated for the emissions reductions they create, but not overcompensated which everyone I think, thinks is fair.

Without the worry that those decisions would create another problem, a spike in allowance prices that would potentially call the durability of the program into question.

Mr. GRUMET. If I could just add a thought. We believe that they're absolutely complementary. In fact you have to have both.

The kind of precise concern we have is the idea of using offsets principally as a cost containment mechanism. We have two concerns.

One, that it either won't work, that you won't get enough offsets in early enough to in fact provide the cost reductions that you hoped. I think a lot of people agree there's just a lot of uncertainty

about how many will come, how fast. The alternative which is something I think Dr. Wara was alluding to is that the tremendous pressure to bring offsets in will in fact force us or somehow convince us to bring in lower quality offsets.

That we will start an offset program relying on it too heavily too soon and they'll be some things that investigative reporters point out just don't add up. Will actually undermine the mechanism before it has a chance to start. So I think it's a key issue just of using them for the right reason. We argue that if you have a cost collar then you should have unlimited offsets because we think then the system could function. It's in the absence of a cost collar that we think the pressures create a real potential for undermining the integrity.

I won't continue but to say that we should talk about domestic offsets at some point because I think we've all spoken about international offsets. I think you've done a tremendous amount of work on the domestic issue. I think they're very different issues.

Senator STABENOW. Thank you, Mr. Chairman. I realize I've gone over.

The CHAIRMAN. Thank you.

Senator Barrasso.

Senator BARRASSO. Thank you very much, Mr. Chairman. Dr. Mason, if I could. I'm very concerned that any, any tax and cap scheme is simply going to benefit the same Wall Street elite who got us into this financial mess that we find ourself in today.

We don't have a bill yet on the Senate side. Yet we're already debating the ways to mitigate the price volatility that any cap and trade bill is going to cause. So whether we're talking about a safety valve or price collar as others have talked about, in reality the only people who are going to understand this whole new system are going to be the elite on Wall Street.

I see you're smiling and nodding your head in agreement. I am concerned that a cap in tax is going to be a recipe for green collar crime, for greed and for abuse. I know Senator Murkowski just referenced an article that appeared in the Sunday Times in the UK. The article is entitled, "Carbon Trading Market hit as U.N. suspends Clean Energy Auditor."

The article goes on to state, the legitimacy of the hundred billion dollar carbon trading market has been called into question after the world's largest auditor of clean energy projects was suspended by United Nations inspectors.

The article goes on to say, SGS UK has its accreditation suspended last week after it was unable to prove its staff had properly vetted projects that were approved for the carbon trading scheme or even that they were qualified to do so.

The article goes on to say, SGS, the second such company to be suspended. Norway's DNV was penalized last November for similar infractions.

Dr. Wara, how are we not creating just another Enron type situation by creating such a carbon market in the Waxman-Markey bill or other cap and trade bills that may come to us in the Senate?

Mr. WARA. I actually think the SGS suspension was a tremendous positive step on the part of the CDM executive board. That's because the auditors to date have been operating in an environ-

ment of relative impunity for their actions. Auditors, just like everyone else, respond to incentives. Part of the job of any offset regulator will be to create the right set of incentives for auditors.

I think the CDM executive board took an important step when they suspended SGS. Was there behavior adequate? Absolutely not. It points to—I mean there's been systematic study of auditor behavior that suggests that it's inadequate under the CDM.

But I think everyone who looks at the issue closely realizes that the solution is real penalties and real costs imposed on auditors for bad behavior. That hasn't been the case to date. It's starting to be the case. So that should actually help.

Senator BARRASSO. Then Dr. Mason, would you like to comment on that as well?

Mr. MASON. This pattern of inappropriate auditor behavior is all too familiar from the financial crisis. It is something that is a possibility we could properly incentivize in a grander system that's described over 1,400 pages which to me undoubtedly leaves room for some holes for other incentive conflicts as well. I think you're right, those 1,400 pages will be scrutinized with the most effort by those with a financial incentive to do so.

Those holes will be found. Those holes are the principle risk that I see in jumping with both feet into a cap and trade system today as our primary means of helping the environment. I think at the end of the day we're at risk of getting too little effect for the environment and placing too much risk on the U.S. economy.

Senator BARRASSO. Then that brings up the article that appeared in Climate Wire on September 9. The article was entitled, "Lobbying: Chicago Climate Exchange Seeks DC Muscle on Climate Bill." In this article it talks about the thousands of dollars the Chicago Climate Exchange paid to hire advocates who come from "influential positions within Congress and the executive branch."

I think Dr. Wara was quoted as saying that the Chicago Climate Exchange was "concerned that rules for trading flourish and that the Exchange wanted to ensure that regulation of commodities isn't so strict." Did I quote you correctly there? I guess the question is why do we want lax rules for carbon commodity trading?

Mr. WARA. To be honest I haven't seen the article. I do recall speaking with the reporter. But my sense and her concern was, you know, why would CCX be hiring lobbyists at this point?

My thought on the issue was twofold.

One, that they might be seeking to ensure that their offset methodologies are granted early action credit under a program, a U.S. program.

Also that CCX is owned, at least I believe wholly by the European Climate Exchange. Is that correct?

Senator BARRASSO. I would encourage you to take a look at this article if you're Michael Wara, Law Professor at Stanford University. You're quoted as saying, "They are concerned that rules for trading flourish. They want to ensure that regulation of commodities isn't so strict."

So I would——

Mr. WARA. Isn't stricter than other commodities I think is the concern. The concern is that for instance, limitations would be placed upon who can participate in the market for emissions allow-

ances or offsets. That, for instance the Wall Street firms that we have spoken a lot about today would be forbidden from participating.

In practice and for example the acid rain trading program, investment banks have played an important role by being essentially suppliers of credit. People who can afford to pulled allowances for the day. When prices go up they sell them. They make a profit.

But they also are essentially an important source of stability in the market. That's, I think, that's what I was referring to.

Senator BARRASSO. Thank you, Mr. Chairman.

The CHAIRMAN. Senator Dorgan.

Senator DORGAN. Thank you very much. Although I was not here for the testimony, I've had a chance to look at the submissions. I thank the panel for being here.

This is a very complicated and difficult issue. I guess I've said publicly that I have problems with the trade side of cap and "trade." Representatives from the Energy Information Administration sat at the table you are sitting at in a previous hearing. We spent $110 million funding this administration, that is staffed with about 400 people.

We wanted to know from them how it was that the price of oil went from $40 a barrel to $147 a barrel on day trading. We asked them what was the cause of the price increase? The representatives from the Energy Information Administration sat there and didn't have the foggiest idea. They didn't have any idea what was the cause for the rise in oil prices.

It was speculation in the market that caused the sharp rise in the price of oil. It's rather berserk in the sense that it had no relationship to supply and demand, it just went off the charts. It's interesting the discussion today about a price collar.

I mean, I understand why you would never want to have a carbon trading market without a price collar. The discussion of a price collar itself demonstrates that the lack of confidence in a market for carbon. Otherwise there wouldn't be talk about a price collar.

It seems to me that a price collar undermines the notion of having the market make the decision. I'm not someone who supports having the market make that decision because I think we should not be heading in the direction of creating a trillion dollar carbon securities market. The difference, Dr. Mason, in what you described as the product here, a ton of CO_2, the difference between a carbon market and most markets is there will be a diminishing product year by year.

So you create a product that diminishes and a very large securities market on which carbon is traded. There could be a point in the future where we make a decision that our energy prices on Thursday shall be developed by some investment banks and traders on Wednesday. So the price that we're going to pay the next day is consigned to the rolling seas of a carbon securities market in cap and trade. So I guess count me as—well, you know how to count me after what I've just said.

Let me ask you a question, Dr. Mason. I read the piece that you wrote expressing great skepticism about the trade piece of cap and trade. What is your sense of the size of the carbon market and the

potential volatility of this market? I know that you've responded to others as well, but would you give me some more information?

Mr. MASON. I think that the size estimates of a trillion are far south of the real size of the market. I think there's far more to be gained in this market than one trillion. As far as the volatility, I find it hard to see a market without market volatility.

The discipline that we desire to arise from having a market price arises from the volatility in that price. I think we should admit that if we don't like price volatility than we don't like the market solution here because you can't have both. You can't have a market without market volatility.

It's kind of like the approach that we've taken to the financial crisis where we like the upside volatility. But we don't like the downside volatility. So we let traders take away the profits and then we bail everybody out when the prices go through the floor.

Here we're talking about kind of the opposite because it's carbon. We let traders take the profit from the low price, but we insulate them from somehow defined undue high prices. Make artificial restrictions that we will prevent Wall Street firms from transacting in these securities so as to staunch investment or undue trading. I have a home office you can use if we can call that a non Wall Street firm. I'll profit from this.

I can set up a company and call it an energy company. Check off the right code on my tax form and I can trade. Is that the key to arbitrage in this market? This is what I find troubling.

There's money to be had. There's numerous ways to arbitrage it.

Senator DORGAN. Is there any doubt in your mind—and again I apologize for not asking the others their questions because you've raised a lot of questions. Is there doubt in your mind that, in a relatively short time, we'll have derivatives, synthetic derivatives, swaps, everything that comes with a carbon market and all of the carnival attractions and dramatic amount of risk that we've seen developed in other markets in the last decade or so?

Mr. MASON. We have them. We have securitization of carbon credits in Europe already. Markets are everywhere working and efficient and creating new innovative products.

My only problem is hanging a substantial amount of U.S. economic growth on those new innovative products.

Senator DORGAN. Senator Corker asked the question—I don't know whether he would actually support this issue, but he asked the question about a carbon tax. Let me ask the question a different way, calling it a carbon fee.

Would a carbon fee be a much more direct way of addressing the issue rather than creating the intricate devices that are described in the Waxman-Markey bill?

Mr. GRUMET. I think Senator if you could convince everyone else to also call it a carbon fee, it would be. I think the concern that our group reached was just a concern that has been very difficult over the last several years, certainly since the BTU tax experience to generate enthusiasm there. There's a practicality here.

I think you do have to, you know, obviously ask from the first instance is this a problem that you really believe has urgency behind it? If there was the opportunity to quickly move a significant tax proposal I think you would see dramatic support. If you believe

pragmatically that's not the case, then the question really is and you pointed out, do you want to go with the market based approach or a more command and control approach?

You know, the argument is, despite all the concerns visceral that we've shared about the market, the government has got to fix that. Right? I mean you all have to do that not just for carbon. There's going to be legislation that I hope moves quickly that will dramatically place new constraints on commodities across the board.

Senator DORGAN. I read the papers every day. It's a pretty pathetic record of the government fixing the markets or even addressing it. I live with the hope that you just described, but that's a triumph of hope over experience regrettably.

Mr. GRUMET. I think that may be fair. But I guess the question is if you believe this is a critical problem, do you want to accept the higher costs of a command and control approach which, you know, from an environmental standpoint it would justify or do you want to grapple with the very real challenges of a market.

Senator DORGAN. Right.

Mr. GRUMET. The idea of a collar is just that you put training wheels on it while you figure it out.

Senator DORGAN. No that's not the case. The idea of a price collar is to actually constrain the market in a way we don't typically do.

Mr. GRUMET. It's to try to balance the desire for the benefits of the market without tolerating very real concerns you point out.

Senator DORGAN. I'm not advocating having a price collar or not having a price collar. I approach this issue saying that I don't support the "trade" side of cap and trade. I just said to the Chairman that I hope at some point we might have a hearing that evaluates what the range of alternatives are for capping carbon. There are more than you've mentioned.

You mentioned a carbon fee or carbon tax. You mentioned command and control and cap and trade. But there are other options as well. We sort of moved right into this rut of one option. We're going down this direction and all we can really talk about is cap and trade. I think there's more to talk about frankly.

The CHAIRMAN. Senator Bennett.

Senator BENNETT. Thank you very much, Mr. Chairman. I apologize to the panel that I was called out. I've been very interested in what you have to say. Most of the ground has been covered by the questions you've already been asked.

So let me just re-emphasize a conclusion that I believe Dr. Mason is in the piece that came from you. Is this your piece? The highlight, you say on page 20, "In adopting a cap and trade system we are hinging economic growth on a complex contract and a convoluted market design both of which have yet to be tested in the real world."

That's a pretty scary statement. I happen to believe it's true. So let me ask this question that I don't think has been asked that I keep coming back to in this whole debate. Has any cost benefit analysis been done on what we get if we do put, fill in the blank, in place?

Fill in the blank, cap and trade, carbon tax, price collar, command and control, all of the terms that we get. Now what do we

get in terms of actual, economic benefit from controlling greenhouse gas emissions?

Mr. WARA. If I could respond to that, Senator?

Senator BENNETT. Sure.

Mr. WARA. I hate to cite the work of another prominent law school. But NYU Law School recently came out with a report that attempted in the best fashion that they could because they're not the EPA to apply an approach, a cost benefit analysis approach, to the ACES bill. Their outcome, and it's just one, but I think it's one of the few that's been done that really looks at the benefit side of the ledger as well as the cost side of the ledger, indicated that ACES was a highly cost effective piece of legislation.

There is significant uncertainties around the benefits of evaluating any piece of environmental legislation. I'd be the first to tell you that. But the work that's been done so far suggests that the U.S. would come out ahead on this bill.

Senator BENNETT. Alright.

Ms. CLAUSSEN. Yes, let me answer it in a slightly different way. There have been lots of different economic analysis looking at the cost side of this. There are some lessons you can learn from all of that.

Even where the inputs are different and the results are different, I think you can still take away a lot of things about how to make this less costly, how to do it an effective way. There is not the same level of analysis on the benefits side. There's a lot of stuff that's anecdotal. There's a lot of stuff that's region specific. But there is no either global or national assessment of the benefits looking at it in dollar terms.

I mean, we've actually done a lot of work. We've brought in a lot of people to talk about how you might do it. While I believe based on the anecdotes and the work that has been done that if you do it in a relatively intelligent way, don't try to do too much too fast and so on and so on. The benefits far exceed the cost, but I don't think you can say we've got really good data on the benefit side that matches the quality of the data on the cost side.

Mr. YACOBUCCI. Then Senator, it's just worth noting that on the benefits side those ranges of value if we're talking about $20 a ton or $30 a ton are the numbers that have been put out here. The range of benefits is anywhere from zero to hundreds of dollars a ton depending on whose analyses——

Senator BENNETT. A fairly wide delta, you're saying.

Mr. YACOBUCCI. You could say that.

Senator BENNETT. Alright. Ok. I've tried to ask myself or tried to discover for myself what the environmental benefits are. Those become even more difficult to discover. Trying to turn it into temperature change you end up with projections of the amount of less warming that you would get in 100 years. You want to talk about a wide delta this is about as difficult as it can be.

Every analysis I have seen says that the impact on temperature change is basically diminimus. Now is there any evidence to say, no? That's it's going to be dramatic if we do this?

Mr. GRUMET. Senator I guess—and this question comes up a lot. I think it's an important one. That analysis requires understanding kind of the dynamic nature of a global collective action problem. I

think you could isolate the U.S.'s actions in the drug war and trying to fight poverty and trying to get rid of global extremism.

Senator BENNETT. Yes.

Mr. GRUMET. Terrorism and say the U.S. alone can't solve that problem. That is absolutely clear here. If you believe that U.S. action is a predicate for meaningful action by other countries that are big emitters and going to get bigger. You believe that the consequences of an action are potentially tremendously negative for our own population.

Then that argues—and I think what Eileen correctly points out is an anecdotal way that we should get started. But I think one of the reasons that many of us are talking about the price collar is that we shouldn't be silly. We should get started in a way that we have confidence, is not going to undermine our own economic strength and hope that that gives us the authority to negotiate internationally.

If it doesn't then I don't think you'll see many people advocating for second and third steps. But it's a, you know, probably unsatisfactory, but the most honest answer I can give you.

Senator BENNETT. No, it's very satisfactory because it is an honest answer. My fear is that we put this in place, discover that it does not produce any significant change around the world and then leaves us stuck with it. If that happens then the anecdotal evidence that is good for our economy better be right because we will have paid a very significant price.

Yes.

Ms. CLAUSSEN. Maybe I can just make one point. I think it is absolutely clear that without us taking some steps the rest of the world will not. It is more of a question as to whether if we do, will everyone else at a level that we think is important.

But I think the opposite is absolutely true. If we don't take some steps in this there is no way that the rest of the world will do it. We will be faced with, I think, very serious impacts even if we can't quantify them all.

Senator BENNETT. Mr. Chairman, I had a brief discussion on this with people who are running the cap and trade in the United Kingdom. I sat in the room where they were trading carbon credits. It was about 20 pounds for a ton of carbon emissions, at about $35. Is that? Yes, that was the price.

I said do you have any advice for us in America? He said, yes. Go slow and go small and described all of the difficulties that they had had. So——

The CHAIRMAN. We're following that advice.

Senator BENNETT. Good. Thank you.

[Laughter.]

The CHAIRMAN. Senator Murkowski indicated she had another question or two and why don't we just have a very short 3 minute round here. See if that doesn't satisfy everybody.

Senator Murkowski.

Senator MURKOWSKI. Thank you, Mr. Chairman. I'll be very brief. As I've been talking to people back in my State and they bring up the issue of climate change and the cost and it always comes down to what it is going to cost.

My constituents say the economy is in trouble right now. We're in the midst of some really serious economic times. We've had great discussion here about the price collar and particularly the price floor and how that will help to incent investments in technologies.

But is there any allowance or any consideration of how this works when we have a strong economy, when we have the ability to invest in the technology. But do you think that there should be some allowance or recognition for economic recovery prioritizing that when we're in a time of economic recession, particularly when we're talking about the mechanism and a price floor. I direct that to you, Jason.

Mr. GRUMET. Senator, I think it is unmistakably clear that the recession has changed the debate here on Capitol Hill and as has the kind of implosion of our confidence in the markets. I mean I think we are having a very different discussion than we were having last year. A response that I think is wildly unhealthful politically, but I think somewhat important substantively is that this program if passed this year, by most estimations would take effect in 2014.

The good people in the White House have told us basically today that the recession is waning. But if we're still stuck in 2014, I would have a very strong confidence that you and your colleagues would be making a number of adjustments to the law. I think in some ways it is within of course, your prerogative to be adjusting this going forward.

But I'm quite optimistic that by 2014 we'll be in much better economic shape. There are some, and you should, you know, speak not to me, but to the major energy companies who are arguing that the uncertainty in climate regulation legislation on top of the current uncertainty in capital markets generally is just making it impossible for them to get any investment, any liquidity. They would argue that while they don't want what they would call an overly onerous system, having some predictability going forward might in fact free up capital as opposed to constrain it.

But when you go back home I don't think any of that is particularly helpful to you.

Senator MURKOWSKI. Our difficulties when we put in place a new system, a new regime, it's a new system. It's a regime and we live with it. That's what we're talking about here with the health care reform and the discussions there.

This is not just about spending money like we did in the stimulus. This is a whole new system. So whether or not we build in that level of flexibility that allows for reprioritization, I don't know.

Dr. Wara.

Mr. WARA. I think the health care analogy is actually an apt one in this—thinking about this question as well in a sense that a big part of what motivates the health care discussion is that it's not as if we're starting from scratch. We have a system. It's evolving in a particular trajectory that some parts of our society have concluded is not a good one.

Similarly EPA is charged with enforcing the Clean Air Act. It's looking very much like part of doing/accomplishing that mission is going to be regulating this new pollutant class that they have been charged with, greenhouse gases, under the existing statutory

framework. So it's not as if there's nothing else there that is the alternative.

You know, doing nothing is not the alternative. Doing something that I think most regulated entities and most economists who think about it believe would be far more costly is the alternative.

Senator MURKOWSKI. Thank you, Mr. Chairman.

The CHAIRMAN. Senator Cantwell.

Senator CANTWELL. Thank you, Mr. Chairman. I want to go back to international offsets for a minute because I think my colleagues are talking about the complexity of the House bill in a way that—you know, I believe, Mr. Grumet, what you were saying about predictability and wanting to make the transition that we absolutely need to have that predictability. We need to make the transition.

But it's my understanding that EPA's analysis of the House bill is that through 2050 we'd be spending $1.4 trillion on international offsets. I mean what could we be buying for $1.4 trillion? Doesn't that offset just, I mean that's money that could instead go to helping us stimulate the investment that we need to see in green technology here in the United States instead of spending $1.4 trillion abroad?

Mr. GRUMET. I can't speak on behalf of everybody on the panel. But we think EPA's estimates are pretty unrealistic in terms of the volume of offsets. I think they are making as they, you know, kind of, good engineering judgments about what is the kind of theoretical volume of offsets.

But what they're not dealing with, you know, is what I guess the oil industry calls the above ground risk. So in theory there are those lower cost reductions around the world. In practice I think you've heard Dr. Wara, myself and others say we think it's very unlikely that those will be captured.

So EPA's analysis because they're presuming about a billion tons a year monetizes those then into about a trillion dollars. Our sense is that they're going to be a small fraction of that. So that the, you know, money going overseas would be a small fraction of that trillion.

Senator CANTWELL. Dr. Wara or Dr. Mason, would you like to comment on that?

Mr. MASON. Thank you. It's interesting that you raise this question after some of the discussion of offsets and your earlier question about special interests. Because I'd just like to pose a puzzle to the committee of who owns the land that's producing much of the offsets from restrained deforestation in foreign countries?

You have to remember other countries don't have property rights like we do. One of the problems in the Brazilian rain forest is the lack of a fee simple, structure of land ownership. When you don't have to pay property taxes on land, you own as much land as you can afford. You just keep it for whenever you might need it, so large companies own this land. Individuals don't have a chance to buy this.

What you're doing is you're assigning them more value to the large companies. These are the special interests and they're foreign special interests at that. So I think that you may be missing an opportunity to impose a tax right now or a fee, if you will, to get immediate benefits. But also use at least a domestic offset system to

lower costs of businesses to U.S. businesses meeting those tax demands.

Where I come from in Louisiana I have to say, we are grinding up new growth cypress forests to pelletize the wood and ship it off to the EU to burn in power plants to help meet their carbon goals. Where does that make sense at all? I think that we could benefit from some of these offsets directly in Louisiana.

Senator CANTWELL. Thank you, Dr. Mason. You made my point better than I could.

Thank you, Mr. Chairman. I know we're out of time. So I appreciate your indulgence.

The CHAIRMAN. Thank you very much.

Senator Corker.

Senator CORKER. Mr. Chairman, thank you. Again, I think all of you have been outstanding witnesses. I would say to the gentlemen about not having enough international offsets to meet the demand with trillions of dollars available.

I assure you there are plenty of hucksters around this world that will figure out a way to take that in. As is existing today where in China people are doing projects that cost $100 million and charging $4 billion. So I assure you that with trillions of dollars running around there are hucksters all over this world that can figure out a way to benefit off of our taxpayers.

But let me just ask this question. Would everybody agree in a perfect world that if in fact there ends up being some kind of regime to deal with carbon that the very best way to have a carbon regime would be for it to be revenue neutral so that there's no net, not one penny that comes out of the economy? That in the event there is a cap and trade, I would call it a scheme, or in the event there's a carbon tax that at least one principle we ought to adhere to is that not any of that leaves the economy that there are reductions or dividends or some other mechanism to put that same, exact amount of money back into American's pockets in the event that something like this is pursued.

I'd love to have comments from all of you briefly.

Mr. GRUMET. Senator, I think that's exactly the right goal. It's simply a question of how you accomplish it since different people living in different regions with different lifestyles will experience different costs from that program. The challenge is how do you in fact, give the money back to people in a way that is in fact, equitable? So you're going to have to take a kind of rough justice approach.

I think, you know, the effort in the utility sector to allocate the permits not to the companies, but to the local distribution companies moves in that direction because it has State regulators trying to push that money back into the pockets of rate payers. But the idea of cap and dividend and a number of those other ideas I think deserve real attention. If you can tax bad things like pollution and reduce taxes like on good things like labor and savings, you've done a good thing for the environment and the economy.

Senator CORKER. Dr. Mason.

Mr. MASON. I would just like to say I'm in full agreement. My problem with cap and trade is that markets don't know boundaries. Taxes do.

Senator CORKER. That's right. In essence much of the flow would be to other countries.

Mr. MASON. With markets you can't control where that flow goes.

Senator CORKER. Dr. Wara.

Mr. WARA. I think how we distribute the revenue that is raised is a very complicated question that draws. It's a political question. Firms have some claim on those revenues because we want businesses to flourish as well as our taxpayers. Taxpayers also have a valid claim.

I think one thing that's worth adding is that we're looking at the complexities here of an emissions trading scheme. Taxes have been talked about in a theoretical way today, but the reality of tax policy and tax law in this country is it is not simple. An important consideration and important benefit that an emissions trading scheme provides is a single price of carbon across the market.

In practice, for carbon taxes around the world that have been implemented that has been a very tough goal to achieve. Different emitters get different rates. That's an important thing to bear in mind as we make this comparison.

Ms. CLAUSSEN. I mean I like things that are simple. But I think this is not simple. For example I think some of the money that is raised here should be used for adaptation.

I'm not just back to consumers. But to deal with the consequences of climate change which I'm not sure would fit into the way you said that. I really have to agree with Dr. Wara here on the complexities of a tax scheme,it's not as if you're going to not have people wanting to be exempted from the tax to pay a lower tax. It's not as if you're going to end up with a scheme where it's just, you know, a straight tax for a unit of carbon across the board.

So I mean, I think it's fine if you want to explore a tax. But I think it's wrong to assume that the cap and trade is really complicated and the tax is going to be really simple. Because I don't think it will be.

Senator CORKER. I'll stop. I know my time is up. The Chairman has been very patient.

It would appear to me that one of the ancillary goals of people who craft legislation like we saw in the House is though, to consume, to take money into government. Then make decisions on behalf of people. It does cause one to wonder about what the real goals, the true goals of much of this legislation is about.

I mean the bill last year on the Senate floor was $6.8 trillion if you just used present day carbon cost. It was the mother of all ear marks. I mean every bit of that money was pre-spent through the year 2048.

So I just hope that there will be some clarity in this debate. I think that our Chairman has helped us with that today. I think each of you have been outstanding witnesses. I thank you.

The CHAIRMAN. Senator Bennett.

Senator BENNETT. Thank you very much. Senator Corker covered most of the ground I had in mind. You talked Ms. Claussen about you want it to go for remediation or some kind of diminution of some good environmental purpose.

Of course, that does take you in the direction that Senator Corker was talking about as an ear mark. As an appropriator I

don't like trust funds because they begin to distort the appropriations process. Here's money coming into the government. We desperately need it for this purpose. But it has been blocked only for that purpose.

That gets us back to the discussion of fees. I do like the Highway Trust Fund because the Highway Trust Fund is a user fee. The people who are using the highways are paying for repair of the highways. That's fair.

But if now the people that are using the utilities or whatever it might be are seeing the money go for bike trails because everything else in remediation is properly funded. They've got so much money in the trust fund they have to find some way to spend it in an environmentally friendly way. It's not the best idea for the government to building bike trails.

Ok. That's the theoretical problem. Let's take that to the other thing I was told when I was in Europe. As I looked at the cap and trade system there I discovered to my surprise that the only thing they were dealing with were utilities.

I said, you don't have a transportation factor in here. In the United States everybody is excited about the automobile as being the No. 1 polluter and so on. They said, yeah, we only do carbon emissions on utilities. I said, why? He said that's the only place we have any accurate data. Everything else is a guess. Now talk about the impact on a marketplace if we do decide that we want to go where you don't have accurate data with respect to the polluters.

I'll close it with this very, very targeted anecdote. I saw a bumper sticker on a very serious pickup truck. It said the carbon emissions from this pickup truck are offset by and then it gave a data base and a website.

As somebody pointed out to me it may be that I said how much is he paying? How does he know what the emissions are from his truck? What is he buying? Someone said, he may have only bought a bumper sticker. So there is that situation.

But talk about this question of accurate data and how do you come up with this. Yes?

Ms. CLAUSSEN. Yes. Let me just make a quick point. I mean one of the reasons that the first phase of the EU system, I mean the experimental phase failed, is because in fact they didn't have good data. They over allocated.

I mean, I think they figured out how to fix that. I think we're seeing real improvement there. But I think part of the problem is no data. It's really important that we have data from a reporting system in place so we actually know what we're doing.

Mr. WARA. I'll respond to the——

Senator BENNETT. Are you comfortable with the present data level?

Mr. WARA. I think actually we're doing something as a Nation that's very smart which is that EPA is currently in a rulemaking process to design a greenhouse gas reporting rule, so that we will have the data if and when we decide to implement a tax or a cap and trade. On the issue of mobile sources in Europe and the U.S. a big factor—a big reason, one main reason that they were not included in the cap and trade is the equivalent carbon tax or the gas

tax in most European countries is several hundred dollars per ton carbon. I know the number for Germany is $228 per ton.

So effectively because of the high gas taxes motor fuels are already facing a very high carbon price. In the U.S. the approach that's being taken in the current bill before Congress and at the State level is to regulate fuels at the refinery where there's real certainty at something called the rack. I'm not quite clear on what that is at a refinery, but at the rack, about the volume of petroleum, refined petroleum products that are being sold.

It's there that we can get the good data we need to do this well. Certainly at the pickup truck we're not going to get that data. You're absolutely right.

Senator BENNETT. You do it at the refinery you're automatically raising the price at the pump to get to where the Germans are.

Mr. WARA. Not even close to where the Germans are.

Senator BENNETT. But it's the same idea. You do it at the refinery you're raising the price of gasoline at the pump.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you all very much. I think it's been a very good hearing. Good testimony. We appreciate your taking time to talk with us.

[Whereupon, at 4:45 p.m. the hearing was adjourned.]

APPENDIXES

APPENDIX I

Responses to Additional Questions

RESPONSE OF BRENT YACOBUCCI TO QUESTION FROM SENATOR BINGAMAN

Question 1. EPA projections have indicated that there will be a very limited supply of offsets coming from projects based in the U.S., and that the vast majority of the offset supply will be coming from overseas. Are there policy choices we can make to increase the supply of high-quality domestic offsets, so a greater amount of funds spent purchasing offsets stays in the U.S.?

Answer. The supply of international vs. domestic offsets will largely be driven by two factors: 1) the total potential for sequestration and other offset projects; and 2) the cost of those projects. Even if offset projects are widely available within the United States, there may be little interest in pursuing those opportunities if the allowance price and/or the international offset price is low relative to the domestic project cost. Therefore, key to increasing the supply of domestic offsets is to reduce their overall cost, and their cost relative to emissions reductions from covered sources and from offset projects overseas. One possible option would be to provide supplemental financial incentives for the development of such domestic projects; however, amendments to offset provisions in proposed legislation would likely be necessary so that those incentives do not negate the additionality[1] of the projects. A second option is to effectively raise the cost of international offsets. H.R. 2454 does this by discounting international offsets after 2017. After 2017, 1.25 international offsets are needed in lieu of one ton of emissions—there is no such discounting for domestic offsets. Raising this discount rate or applying it early could make domestic offsets more competitive (by effectively raising the cost of international offsets). Other factors that could play a role include: 1) limiting the quantity of international offsets, thus creating more demand for domestic offsets; and 2) requiring less stringent verification or other protocols for domestic vs. international offsets.

RESPONSES OF BRENT YACOBUCCI TO QUESTIONS FROM SENATOR CANTWELL

Question 1a. What role does the compliance period play in reducing price volatility?

Question 1b. Are there any substantial differences in price volatility between rolling compliance periods and fixed compliance dates?

Question 1c. To minimize price volatility, how much time should firms have between the emissions of greenhouse gases and the acquisition (and surrender) of allowances? One year or less? Two years? Three years? Five years?

Answer. Allowing entities to spread their compliance over multiple years allows those firms to avoid purchasing allowances on the market when they perceive prices as temporarily high. A longer compliance period gives them more time to wait out

[1] A key component of any offset program is that the projects awarded offsets be additional—i.e., they would not have been undertaken in the absence of the incentive provided by the offset. For example, actions taken to comply with other environmental laws (e.g., air quality or water quality regulations) would likely not be considered additional even if they had an ancillary greenhouse gas benefit because the project is not optional. Likewise, financial or other incentives above those provided by the offset program could negate the additionality of a particular project. Supporters of multiple incentives, including offsets, prefer to allow "stackability," that is, the ability to combine ("stack") multiple incentives for the same project. For more information on offsets, see CRS Report RL34436, The Role of Offsets in a Greenhouse Gas Emissions Cap-and-Trade Program: Potential Benefits and Concerns, by Jonathan L. Ramseur.

perceived volatility in the market. There seems to be no consensus on how long that compliance period should be, or how much the length of the compliance period affects volatility. However, a period of at least a few years would seem necessary to mitigate against short-term allowance price shocks such as those driven by a hot summer (with greater demand for air conditioning) or a cold winter (with greater heating demand). For example, the Regional Greenhouse Gas Initiative (RGGI)[2] employs a three-year compliance period, while the American Clean Energy and Security Act (H.R. 2454) effectively creates a rolling two-year compliance period for entities that would receive free allowances under the bill's allocation scheme. The current sulfur dioxide (SO_2) cap-and-trade program established by the 1990 Clean Air Act Amendments has a one-year compliance period, and allows covered entities three months after the end of the year to settle their accounts.

Question 2a. What is a reasonable number of allowances, as a percentage of yearly emissions, that firms would be able to bank for future emissions and compliance dates?

Question 2b. How long are firms likely to retain allowances for future use? Is there likely to be a limit to their willingness to keep these assets on their balance sheets?

Answer. Various bills would allow different limits on the amount of allowances that could be banked, and for how long. H.R. 2454 would allow unlimited banking—i.e., entities could bank an unlimited[3] number of allowances for as long as they choose. Experience with previous cap-and-trade systems shows that firms will bank allowances in early years when emissions reductions are inexpensive relative to expected future costs, and to spend those banked allowances later as costs rise. For example, under the SO_2 cap-and-trade program, at its peak the total bank among all firms reached roughly one-and-one-half times annual emissions for covered entities (it has since declined). Covered entities are apparently comfortable banking allowances over long periods of time—at least a decade in the case of the SO_2 program.

Similarly, the Environmental Protection Agency's (EPA's) analysis of H.R. 2454 using its Intertemporal General Equilibrium Model (IGEM) found that the total allowance bank is projected to reach nearly 20 billion allowances in 2029—roughly five times the allowance cap in that year.[4] Under the various analyses of H.R. 2454, the number of allowances banked varies depending on expected compliance costs and allowance prices, as well as assumed discount rates—a lower discount rate results in greater banking, while a higher discount rate results in less banking.[5]

Question 2c. To reach the 2050 emissions targets that scientists agree are necessary to avert catastrophic climate change, is there an affordable option at mid-century that does not incorporate either a significant amount of coal with carbon capture and sequestration technology or a substantial expansion of nuclear power?

Answer. It is impossible to predict what technology development will occur to make different compliance options in the electric power sector affordable by the middle of the century. Analyses of H.R. 2454 that assume carbon capture and storage (CCS) and new nuclear power are not substantially available by mid-century generally result in high consumption of natural gas—and to a lesser extent, renewable resources—for electric power generation. In limiting other options, those analyses generally result in significantly higher allowance prices, and overall costs to the economy.[6]

Question 3a. From a strictly economic viewpoint, how can the pathway of the emissions reductions or the trajectory of the cap's emissions reductions affect the costs of a climate policy?

Question 3b. For a fixed amount of cumulative emissions, what might the optimal shape of that emissions pathway be?

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[2] For more information on RGGI and other state and regional programs, see CRS Report RL33812, Climate Change: Action by States to Address Greenhouse Gas Emissions, by Jonathan L. Ramseur.

[3] H.R. 2454 gives the Federal Energy Regulatory Commission (FERC) the authority to establish position limits on allowance holdings. For example FERC could determine that no entity could hold more than 10% (or some other amount) of allowances in the market. However, it seems unlikely that an individual entity's banking decisions would be affected by such a position limit unless the limit were set at a very low level.

[4] EPA Analysis of the American Clean Energy and Security Act of 2009: H.R. 2454 in the 111th Congress (June 23, 2009). EPA/IGEM "Data Annex" available on the EPA website at http://www.epa.gov/climatechange/economics/ economicanalyses.html.

[5] Some analyses assume—as an input—that no banking occurs.

[6] For a comparison of different analyses of H.R. 2454, see CRS Report R40809, Climate Change: Costs and Benefits of the Capand-Trade Provisions of H.R. 2454, by Larry Parker and Brent D. Yacobucci.

Answer. In terms of the environmental benefit from reductions, the trajectory of emissions reductions (i.e., the shape of the emissions curve) is arguably immaterial,[7] what matters is the total aggregate emissions over time (i.e., the area under the emissions curve). There are generally two camps on the optimal shape of the emissions curve: 1) those who argue that the curve should be relatively steep early (and flatter later on) to force the development of technology more quickly, reducing overall compliance costs in the future; and 2) those who argue that it will take time for technology to develop, and that requiring fewer reductions early on will allow entities to delay reductions until more cost-effective options are available. To some degree, entities' individual decisions on banking reflect their view of technology. A firm that believes low-cost technology will be available in the future will be less likely to bank allowances early, while a firm that believes low-cost technology will not develop would be more likely to make early reductions and bank those for the future.

Question 3c. Why do you regard the inclusion of a price floor as particularly important for investment in new energy technologies under a climate policy?

Answer. CRS holds no position on this or any other policy. Those who support a price floor argue that, in the absence of a price floor, technology developers may be unwilling to invest due to the risk of an allowance price below the cost of the technology in question. A price floor allows technology developers certainty that their technology will always be competitive if it is less expensive than that floor. Opponents of a price floor tend to argue that it unnecessarily raises the cost of the program—if allowance prices are below expectations, that shows that the cap-and-trade system is working effectively and efficiently.

Question 4. Since cap-and-trade programs are so inherently complex and far-reaching:

a) How can we be sure that any scheme is workable and can be implemented by the executive branch?

b) How great are the risks of unintended consequences—for the economy and the environment?

c) What sort of growth are we likely to need in federal agencies, particularly EPA, if the House-passed bill became law?

Answer. Like any other regulatory policy, the regulating agency will need budget and other resources to implement the policy. EPA has some history implementing cap-and-trade programs such as the SO_2 program. While it is unclear how much additional capacity EPA or other government agencies will need, it could be significant. As CRS states in our report on H.R. 2454:

> Compared with the complexity of implementing a greenhouse gas cap-and trade scheme, the SO_2 program was simple. Conceptually, a CO_2 tradable permit program could work similarly to the SO_2 program. However, significant differences exist between the acid rain process and possible global warming factors that affect current abilities to model responses. For example, the acid rain program involves up to 3,000 new and existing electric generating units that contribute two-thirds of the country's SO_2. This concentration of sources (and the fact that they are stationary) makes the logistics of allowance trading administratively manageable and enforceable. The imposition of the allowance requirement is straightforward. The acid rain program is a "downstream" program focused on the electric utility industry. The allowance requirement is imposed at the point of SO_2 emissions so the participant has a clear price signal to respond to. The basic dynamic of the program is simple, although not necessarily predictable.
>
> A comprehensive greenhouse gas cap-and-trade program would not be as straightforward to implement. Greenhouse gas emissions sources are not concentrated. Although over 80% of the greenhouse gases generated comes from fossil fuel combustion, only about 34% comes from electricity generation. Transportation accounts for about 28%, direct residential and commercial use about 11%, agriculture about 7%, and direct industrial use about 19%.[8] Thus, small dispersed sources in transportation, residential/commercial, agriculture, and the industrial sectors are far more important in controlling greenhouse gas emissions than they are in controlling SO_2 emis-

[7] The key exception is if there are "tipping points" beyond which changes become irreversible.

[8] U.S. Environmental Protection Agency, U.S. Inventory of Greenhouse Gas Emissions and Sinks: 1990-2007 (April 15, 2009), p. ES-14.

sions. This greatly increases the economic sectors and individual entities that may be required to reduce emissions.[9]

To some degree, the potential complexity of H.R. 2454's program is limited through decisions made on the point of regulation. For example, instead of requiring emissions monitoring of over 200 million motor vehicles, the bill requires roughly 400 petroleum refiners and importers to report their emissions and submit allowances.[10] In total, the Congressional Budget Office (CBO) estimates that roughly 7,400 entities would be covered under H.R. 2454's cap-and-trade program.[11]

To implement a program such as that in H.R. 2454, new government capabilities would likely include: monitoring and reporting of emissions from currently unmonitored sources (currently, only electric power plants are required to report their carbon dioxide emissions); a system for counting and awarding offsets under the cap-and-trade program (and certifying third-party verifiers); systems for determining the imbedded carbon content of imported goods; and procedures for determining that allowances allocated to non-covered entities are disposed of in accordance with the requirements of the bill.

Question 5. Given the complexity and intricacy of some of these policy proposals, I am particularly concerned about the opportunities they might create for market manipulation, fraud, and for the development of arcane financial instruments that will lead us to the next major global financial crisis. Do you believe that these concerns are justified? How might opportunities for market manipulation be reduced through climate policy design?

Answer. Currently emissions allowances (e.g., SO_2 allowances) are regulated as commodities. H.R. 2454 contains provisions to more stringently regulate all commodities (not just allowances).[12] Provisions include limits on the amount of allowances any single entity can purchase at a given auction, a limitation that only covered entities may participate in strategic reserve auctions, and the authority for the FERC to set position limits on overall market holdings. Other broad commodity regulation provisions include a requirement that over-the-counter swaps and other derivative transactions be settled and cleared through a clearinghouse. Whether those provisions would be sufficient to prevent market manipulation is unclear.

Question 6. I understand that last December, the European Union made auctioning the default future allocation method for its emission trading system.

a) Was that a tacit recognition that the best way to allocate carbon permits or emission allowances is by auction?

b) What other ways is the European Commission working to correct the windfall and overallocation it experienced in the early years of the European emission trading system?

c) What lessons can Congress learn from the European experience to avoid pitfalls in designing and implementing a carbon trading system?

Answer. Currently, in the European Union's Emissions Trading Scheme (ETS), the vast majority of allowances are given to covered entities at no cost. In later periods, the EU has determined that a larger share of allowances will be auctioned.[13] Problems encountered in the early phases of the ETS were largely driven by an over-allocation of allowances caused by poor data which overestimated the EU countries' emissions. Arguably, the key lesson from that experience is that good emissions monitoring data is necessary to implement the program.

Question 7. One of my concerns is that, as far as I can tell, allowances that are given away under cap-and-trade could be sold on the secondary market at a price that would undercut the government auction reserve price.

a) Is this accurate, and do you see this as a potential problem for energy investments under such price uncertainty?

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[9] CRS Report R40809, Climate Change: Costs and Benefits of the Cap-and-Trade Provisions of H.R. 2454, by Larry Parker and Brent D. Yacobucci, p. 17.

[10] CRS Report R40242, Carbon Tax and Greenhouse Gas Control: Options and Considerations for Congress, by Jonathan L. Ramseur and Larry Parker, Table 2, p. 31.

[11] CBO, Congressional Budget Office Cost Estimate: H.R. 2454 American Clean Energy and Security Act of 2009, Washington, DC, June 5, 2009, p. 4, http://www.cbo.gov/ftpdocs/102xx/doc10262/hr2454.pdf.

[12] For more information on the regulation of allowances in a cap-and-trade program, see CRS Report RL34488, Regulating a Carbon Market: Issues Raised By the European Carbon and U.S. Sulfur Dioxide Allowance Markets, by Mark Jickling and Larry Parker.

[13] For more information, see CRS Report RL34488, Regulating a Carbon Market: Issues Raised By the European Carbon and U.S. Sulfur Dioxide Allowance Markets, by Mark Jickling and Larry Parker, and CRS Report RL34150, Climate Change and the EU Emissions Trading Scheme (ETS): Kyoto and Beyond, by Larry Parker.

b) What happens if or when strategic allowance reserves run out in a cap-and-trade program?

c) If a strategic reserve is used instead of an explicit price ceiling, then what happens if the strategic reserve is continually depleted? Do costs skyrocket at that point?

Answer. If low prices in the secondary market undercut the reserve price in the primary market, then presumably firms would choose not to purchase allowances through the government auction. This seems unlikely to be sustained in the long run, as this would reduce total allowance supply since the number of new allowances entering the market would decline. Eventually the reduced supply of allowances should cause prices to rise above the reserve price, restoring demand for allowances from the primary auction.

H.R. 2454 employs a strategic reserve as a sort of "relief valve" for allowance prices. If allowance prices run up too quickly, firms could tap into an additional supply of allowances at a relatively high reserve price. Under H.R. 2454, this emergency supply has been skimmed off the top of each year's allocation. Under a strategic reserve system, once the reserve has been depleted, its ability to mitigate against high allowance prices is eliminated. Thus, the strategic reserve is not an explicit price ceiling, and may be used to mitigate against volatile allowance prices, but is unlikely to affect the long-run costs of the program.

RESPONSE OF JOSEPH R. MASON, PH.D., TO QUESTION FROM SENATOR BINGAMAN

Question 1. EPA projections have indicated that there will be a very limited supply of offsets coming from projects based in the U.S., and that the vast majority of the offset supply will be coming from overseas. Are there policy choices we can make to increase the supply of high-quality domestic offsets, so a greater amount of funds spent purchasing offsets stays in the U.S.?

Answer. It is surprising to me that domestic offset opportunities are thought to be so limited compared to those available internationally. Necessary preconditions for genuine and reliable offsets lie in property rights of the country of origin, such that ownership of the rights can be perfected and recompense mandated in the event of violation of the offset contract. While we take such property rights for granted in the US, such property rights are relatively rare in developing countries targeted for offset supply.

Many of the countries of origin for proposed and actual offsets such as China, India, and Brazil, are less politically stable than the US, have weaker ownership rights over intangibles such as offsets, and otherwise present contract rights, labor rights, and human rights challenges that make them poor candidates for offset earnings subsidies created in the largest carbon program in the world.

International sourcing of offsets seems to be more of a development allocation that is designed to keep those countries from pursuing high-carbon projects that can otherwise fuel their economic growth. Unlike even the traditional "Dutch disease" problem, however, it is doubtful in such unstable political environments that the gains from offsets will trickle down to economic development and growth even in the short term.

Moreover, in the long term struggles for the cash flows in perpetuity can make political regimes ripe for conquest, both internally and externally. Internally, countries may rationally default on previously agreed offset deals in order to extract higher rents from developing countries that need those offsets for their carbon goals. Such strategies are akin to current too-big-to-fail problems in the financial industry, and present substantial holdup problems for US economic growth. Externally, military struggles for "passive" value can create further political instability in regions that are the proposed main sources of offsets.

Those international dynamics, as well as the current economic and financial crisis, suggest that it may be wise to pursue more forcefully a credibly verifiable domestic offset supply that can provide a substantial share of offsets necessary for proposed policy. Such a policy can fuel domestic growth and conservation efforts, and will be necessary to provide an offset "bank" that can buffer shocks to international sources of offset supply, ranging from tsunamis, earthquakes, and forest fires, to military incursions to domestic unrest.

In summary, it is imperative to construct a domestic offset system that can provide a sizeable portion of offset demand before pursuing a cap and trade policy relying crucially upon such terms.

RESPONSES OF JOSEPH R. MASON, PH.D., TO QUESTIONS FROM SENATOR MURKOWSKI

UTILIZATION OF REVENUES

Question 1. We should be honest about what a cap-and-trade program for reducing greenhouse gas emissions will do. Such a policy would essentially create a new form of currency and generate massive amounts of revenue through auctions, or financial largesse to be doled out in the form of free allowances.

What do you think those revenues should be spent on and who should receive that money?

Answer. As an economist, my reply is that it does not matter what the revenues are used for. Once the revenues are injected into the economy, they flow through individuals and financial institutions and feed economic growth. Along the way, they become available for investment in carbon-reducing technology or other projects valued by business and society.

For example, let's say the revenues are dividended to taxpayers. Every individual recipient now has more money to spend or save. If individuals spend the money, it is (eventually) saved by the recipient of the funds in the chain of transactions. Savings is motivated into investment through the US financial system. A carbon project entrepreneur, needing investment funds, now goes to her bank to borrow and receives a lower interest rate resulting from the increased supply of funds available to be lent. The carbon entrepreneur, faced with favorable business prospects, is likely to face an advantage over a carbon producer, who now faces higher costs of production. Hence, the carbon entrepreneur is likely to have an advantage in the market, exactly as intended.

If desired, tax or interest subsidies can be targeted to carbon technology projects to further incentivize investment. Nonetheless, the total economic effects of the revenues have already cascaded through the economy. Only if the new investment is less productive than the one that would occur take place if the money were returned to taxpayers, it would be a net economic negative. Of course, it is difficult to tell whether this is the case with any one policy. Hence, the system is best kept simple.

As an individual, and recognizing the boundaries of economic theory, there exists a fairness criterion that must be addressed in the allocation. That is why, in economics, we refer to a "helicopter drop" of money into the economy. Hence, policy options run the gamut from dividending the funds to individual taxpayers (along what distributional criterion that must, again, satisfy a fairness test), funneling those to social programs, or targeting those to clean energy projects. Barring the identification of an obvious market failure that prevents a hyper-productive industry from receiving funding and using the funds to address that shortcoming, the economic effect is the same for any allocation: only the fairness criterion is important, no matter what the distribution.

TRANSPARENCY IN COMPLIANCE COSTS

Question 2. Price volatility in any climate policy—outside of a carbon tax—is inevitable, and may not be reflected transparently in bills or fees, but embedded in the price at the pump, the grocery store, and elsewhere.

Should we require these additional costs to be identified and printed on utility bills and elsewhere, so that consumers know exactly how much their contributing to climate change mitigation efforts?

Answer. I see no economic value to requiring the additional costs to be identified and printed on utility bills and elsewhere.

In contrast, such a requirement—multiplied by hundreds of millions of bills and receipts printed annually—will impose substantial compliance costs on firms with little obvious benefit. Just, for instance, multiply the average number of terminals at each gas station (as I recall, about twelve) by the number of gas stations (115,223 (in 2008)) times the cost of the terminals (about $200 each) to get the cost of terminal replacement. The numbers are familiar to me because the industry went through a similar replacement when the credit card associations restricted the card number information from being printed in full on each receipt, necessitating such a change. The cost to a single large oil company for that change was in the billions of dollars. Compliance costs (do you have to report today's carbon price or an average, where do you get the data from, etc. . .) will add to that bill.

Moreover, such policy will undoubtedly contribute to waste of ink and toner (which contain trace heavy metals) and paper (we want save the trees to produce the carbon) in ways that are contrary to the intent of environmental consciousness, in general, and carbon reduction, in particular.

SUSCEPTIBILITY OF OFFSETS TO FRAUD

Question 3. A recent UK Telegraph article highlighted the value-added tax (VAT) fraud that has recently occurred in their offset market. A total of 7 arrests were made and many more investigations into carbon credit fraud are underway.

How can the United States prevent a similar type of fraud from occurring if we were to adopt a mandatory cap-and-trade program that includes widespread use of international offsets?

Does the considerable volume (up to 1 billion tons per year, or more) envisioned by the House bill lend itself to an offset market that is even more difficult to control?

What organization do you think is capable of regulating that large of a market?

Answer. Good question. I recently had a dialog with one of the largest VAT refund firms in the world on just this topic. They view the issue of pursuing fraud in the growing market as a valuable business opportunity.

As mentioned in my reply to Sen. Bingaman, China, India, and Brazil, the three main countries of origin for proposed and actual offsets, are generally less politically stable than the US, have weaker ownership rights over intangibles such as offsets, and otherwise present labor and human rights challenges that make them poor candidates for offset earnings subsidies created in the largest carbon program in the world.

The undeveloped legal and political institutions in those countries are the lynchpin of an economically and environmentally meaningful role of offsets in US carbon policy. Hence, I would not expect to proceed without substantial frictions.

More importantly, as you bring up here, there currently exists no international body of law that can settle sovereign contract disputes. We felt the effects of that shortcoming in the recent financial crisis, when the inability to pursue international assets of US firms in bankruptcy necessitated bailouts of several large international financial institutions. At best, treaties and agreements could eventually be worked out to cover some of the difficulties among developed countries, but developing countries would most likely abrogate treaty terms in the event of a shock sizeable enough to be of economic importance.

Hence, we need to assume—even with treaties in place with developing countries—that there is no body of law to rely upon to enforce offset contracts in the event of a major dispute. Sovereigns default on debt and expropriate assets in other realms—to expect carbon offset markets to develop without similar shocks would be heroic.

TRANSFER OF WEALTH

Question 4. The European Union's Emission Trading Scheme began implementation in 2005. In the first phase, emissions covered under the Scheme rose by 0.8% across the EU as a whole. Additionally, the price of carbon fell to almost zero.

Since not all member countries had the same requirements, the European Scheme acted as a transfer of wealth. It simply forced countries with higher requirements to pay more to countries with lower requirements to purchase their credits.

If the U.S. takes a 'go at it alone' approach, are you concerned that the same transfer of wealth will occur from our American businesses to foreign entities as they purchase carbon credits?

Answer. While I am not sure from the form of your question whether you are referring to requirements in terms of allocation levels, carbon limits, or initial price levels, I think I can get to the root of the economic principle that you seek.

We would expect prices and permits to gravitate from where those are less valuable to where they are more valuable in the short term. In the long term, if factors of production (of which carbon permits are intended to be one) are inflexible, production may flow abroad, as well.

But whether we are talking about production, financial flows, or carbon permits, all markets work to allocate products efficiently, defined as flowing from those who value the good relatively less to those who value the good relatively more. While international economics takes this flow as a fundamental condition of labor availability, resource allocations, and productivity (among other things), carbon policy inherently applies a value to abatement that is unobservable until held in comparison to that of other countries through the market mechanism. Get the value too low, and your carbon permits merely flow out of the country. Get the value too high, and others' permits flow to you. If we value carbon abatement "too low" in the US, we fully expect to fail to achieve the reduced domestic production of carbon that is sought under the policy.

RESPONSES OF JOSEPH R. MASON, PH.D., TO QUESTIONS FROM SENATOR CANTWELL

Question 1a. What role does the compliance period play in reducing price volatility?

Question 1b. Are there any substantial differences in price volatility between rolling compliance periods and fixed compliance dates?

Question 1c. To minimize price volatility, how much time should firms have between the emissions of greenhouse gases and the acquisition (and surrender) of allowances? One year or less? Two years? Three years? Five years?

Answer. In my view, it is not the compliance period construct that reduces volatility so much as market liquidity. The compliance period, in contrast, is merely a method of restraining the costs of recordkeeping and regulatory compliance efforts. That said, real time compliance is the most economically efficient and meaningful, but also the most costly, compliance paradigm. Let me explain.

The reason for my view of the relationship between price volatility and compliance lies in the fact that in order to meet compliance requirements firms will keep a stock or permits to meet expected production demand and then an "excess" reserve to meet unexpected demand. Excess reserve demand will be a function of price volatility, not a cause of that volatility. If volatility is high or markets are illiquid, excess reserve demand will be high. If volatility is low and or markets are liquid, excess reserve demand will be low.

As for the efficiency of real-time compliance, longer compliance periods need to address the problem of what happens if a firm enters bankruptcy between the reporting and compliance deadlines? Such an occurrence (and one will occur, even intraday), will have to be dealt with by regulators and bankruptcy courts, especially since no one will lend to the bankruptcy entity for compliance and it may have sold its own permits to raise cash prior to default.

In summary then, the compliance period should be as short as practical after the reporting period and has little to do with price volatility.

Question 2a. What is a reasonable number of allowances, as a percentage of yearly emissions, that firms would be able to bank for future emissions and compliance dates?

Question 2b. How long are firms likely to retain allowances for future use? Is there likely to be a limit to their willingness to keep these assets on their balance sheets?

Answer. Similar to my response above, it is important to allow firms to bank excess reserves that meet their own needs and management preferences. Some firms will choose to manage permit needs aggressively, preferring to borrow to meet idiosyncratic needs when they arise. Others will choose to keep a large stock of reserves on hand. Choices of management styles will probably break down according to industry and economic conditions, varying over time as well as across the economy. One size of policy cannot, therefore, be expected to fit all.

As for how long permits should remain valid, I don't think you want to force them to be used, but you may wish to know how may remain outstanding year to year. Hence, while you may wish to force last years' permits to be redeemed for this years', in my opinion you would want to reward, not punish, the firm for economizing on carbon output.

Question 3. To reach the 2050 emissions targets that scientists agree are necessary to avert catastrophic climate change, is there an affordable option at mid-century that does not incorporate either a significant amount of coal with carbon capture and sequestration technology or a substantial expansion of nuclear power?

Answer. I am not an expert in this area. My lay reading of the literature is that renewable such as wind, wave, and solar cannot make up a substantial portion of production assuming reasonable growth in productive capacity per installed unit or operation. I defer to the climate scientists for a more detailed and informed explanation.

Question 4a. From a strictly economic viewpoint, how can the pathway of the emissions reductions or the trajectory of the cap's emissions reductions affect the costs of a climate policy?

Question 4b. For a fixed amount of cumulative emissions, what might the optimal shape of that emissions pathway be?

Answer. We know little about the projected pathway from an economic standpoint. Given what we know about the costs and availability of major carbon reducing tech (new nuclear capacity, carbon capture and storage) plus the time frame for turnover of capital we would expect a reduction curve that's flatter in the near term (i.e. less aggressive) and steeper in later years (i.e. past 2030) to be less costly overall.

The whole point of cap and trade theory is to let the market decide the most efficient path, allowing markets to bid up permit prices to the highest marginal value

of emissions, incentivizing firms that are best able to cheaply economize on emissions to rationally do so. The expense of carbon permits prevents additional investment where emissions are difficult to restrain, leading to reductions in carbon emissions from those most expensive sources. Without the market, only an omnipotent central planner can come close to the efficient path of adjustment in lieu of the market mechanism.

Hence, cap and trade without the cap—that is cap and trade with an overlaid carbon market efficiency board used to manipulate prices—can only deviate from the most efficient path of adjustment, hindering the creative destruction created by market forces to stanch the creativity and mitigate the destruction, which effectively draws out the adjustment for longer than need be the case.

Question 5. Why do you regard the inclusion of a price floor as particularly important for investment in new energy technologies under a climate policy?

Answer. I think it is important to place a price on carbon emissions in order to even begin to price the externality of carbon emissions and nudge firms to investment decisions consistent with policy decisions. A tax, in this regard, is a price floor and works toward policy goals.

Moreover, it appears that Europe is headed toward a hybrid tax and cap and trade system, whereby France is moving to set a tax-based floor in parallel with the existing cap and trade framework. It seems to me that, knowing what we know now about price volatility and market dynamics, if setting up a system today we would start with a nominal tax to set that floor and then gradually implement the cap and trade market structure on top of the tax overlay. That way you get immediate benefits and can learn about the intricacies of cap and trade in a controlled fashion as implementation proceeds. In a way, you don't have all of your climate change policy eggs in one basket, helping to ensure economically and environmentally meaningful results.

Question 6. Since cap-and-trade programs are so inherently complex and far-reaching:

a) How can we be sure that any scheme is workable and can be implemented by the executive branch?

b) How great are the risks of unintended consequences—for the economy and the environment?

c) What sort of growth are we likely to need in federal agencies, particularly EPA, if the House-passed bill became law?

Answer. The first part of this question is exactly the point: we cannot be at all certain that the type of cap and trade-program we are developing will work at all, due in combination to the less-than-perfect fitting externality that is carbon, the complexity and dynamics of the contract design, and the management of the carbon market efficiency board.

We are discussing the issue of carbon emissions reductions because we believe such reductions are important to the environment. Hence, I think it is wisest to rely to various degrees on a mix of policies, weighing more on traditional taxes and less on innovative cap and trade schemes, to ensure an environmentally meaningful solution.

The risks if a carbon market crisis are very real, and the costs of regulation of that market and its participants, as well as carbon emissions, is likely to be very high. Moreover, while much discussion has centered around how to distribute revenues from initial allocations of carbon permits, I do not recall any discussion of paying for monitoring and infrastructure needs before distributing revenues to the public.

The costs of the regulation and monitoring system—which will span firms emitting carbon as well as carbon markets—are likely to dwarf those of something like the existing banking system, and those costs are likely to be incurred through multiple regulatory agencies, including but not limited to EPA. The reason for my opinion is that the system will require multiple layers of "carbon examiners" to verify monitoring technology, "collections officers" to verify the forms of payment for emissions, and "market regulators" to police trading market participants. All of those tasks will be carried out according to an, as yet, unknown body of regulatory rules that will have to be constructed and will evolve through decisionmaking with comment periods and review. We are creating an entire industry by government fiat, from the instruments of value through the mechanism of trade. That will not be cheap.

Question 7. Given the complexity and intricacy of some of these policy proposals, I am particularly concerned about the opportunities they might create for market manipulation, fraud, and for the development of arcane financial instruments that will lead us to the next major global financial crisis. Do you believe that these con-

cerns are justified? How might opportunities for market manipulation be reduced through climate policy design?

Answer. While it is difficult to say a priori how market manipulation and fraud may evolve, one can be sure that millions of traders with dollars at stake will examine the contract and trading rules thoroughly and discover loopholes no relatively small (in comparison) set of policymakers can detect. The concerns are very justified, and a system will have to be set in place to police nefarious activity and modify the system quickly in response, where needed. Hence, even a carbon market efficiency board will not be a passive entity, merely looking after the permit supply, but passive in addressing market dynamics as they evolve.

Question 8. I understand that last December, the European Union made auctioning the default future allocation method for its emission trading system.

a) Was that a tacit recognition that the best way to allocate carbon permits or emission allowances is by auction?

b) What other ways is the European Commission working to correct the windfall and overallocation it experienced in the early years of the European emission trading system?

c) What lessons can Congress learn from the European experience to avoid pitfalls in designing and implementing a carbon trading system?

Answer. As state previously, auction mechanisms or "free" allocations are equal in the mind of an economist, barring overt redistributional policy goals. To an economist, the money moves through the economy either way. The only difference being whether it starts in the hands of the government as a result of the auction or in the hands of businesses as a result of the "free" allocation.

The windfall and overallocation problems are related to the inability to set a hard "cap" for the cap and trade to regulate. I reiterate, the essence of cap and trade is that cap—which forms benefit certainty—and the lack of price limits that discipline firms to work within the cap. Without agreed upon scientific evidence to properly identify the size of cap necessary in any one period or any one country to achieve long term environmental goals, there will always be debate about moving that cap, creating price volatility from the policy variance.

Question 9. One of my concerns is that, as far as I can tell, allowances that are given away under cap-and-trade could be sold on the secondary market at a price that would undercut the government auction reserve price.

a) Is this accurate, and do you see this as a potential problem for energy investments under such price uncertainty?

b) What happens if or when strategic allowance reserves run out in a cap-and-trade program?

c) If a strategic reserve is used instead of an explicit price ceiling, then what happens if the strategic reserve is continually depleted? Do costs skyrocket at that point?

Answer. The concern you voice is nothing more than the difference between spot and future prices. The only permits that would sell on secondary markets are those not immediately needed for compliance. Until it is established that they are not needed, they must be "carried" at a positive opportunity cost, the interest rate representing the cost of capital. Hence, the all-in futures price should be the spot price plus storage cost.

Sometimes, as is common with commodities, the futures price is persistently more than the spot price plus storage, representing the "convenience yield" of having the spot contract on hand if needed. This process, known as backwardation is a common characteristic of many commodities contracts where the underlying is a production input and seems to be the focus of your question. Such market conditions are normal for production inputs and should not be a concern.

The opposite of a backwardation structure is contango—where futures prices are less than spot prices plus storage. Empirical evidence from the EU carbon market shows that the carbon futures market illustrates characteristics not of backwardation, but of contango But the financial economics literature suggests that commodities with contango structures usually have readily available inventories that are easily accessed and stored and stable supply and demand functions. Those conditions contradict the performance of carbon markets to date. Even if cap and trade contracts have no cost of storage and are easily accessed, levels of supply and demand for carbon emissions are not easily predicted. In addition, the level of inventories for cap and trade contracts is dependent on current emission levels and availability of offsets, which are stochastic and unpredictable.

What happens when strategic reserves run out is a policy question. If more reserves are added, nothing need happen. If policy prevents reserves from being

added, prices necessarily rise. Only uncertainty around the chosen policy path will dictate the degree of price volatility along the adjustment curve. That is why central banks often precommit to policy rules that can smooth adjustment in undue circumstances.

Question 10. Under the House bill, I understand that the strategic reserve fund in H.R. 2454 is replenished using international forestry offsets. But with all of the other offsets proposed in the House bill are these likely to be available in sufficient numbers to rebuild the reserve, especially in the longer-term? What would this imply for cost control and for the overall viability of the cap-and-trade policy?

Answer. If the system is implemented before sufficient offsets are available the lack of such offsets could induce substantial disruptive price dynamics. As discussed above, it is imperative to construct an offset system that can provide a sizeable portion of offset demand before pursuing a cap and trade policy relying crucially upon such terms.

Question 11. Could you please summarize the pitfalls of carbon market design that you have observed in the EU ETS and other emissions trading systems that you would want to avoid in U.S. climate policy architecture?

Answer. First, as discussed previously, it appears that price volatility and continued price pressures in Europe has resulted in its heading toward a hybrid tax and cap and trade system, whereby France is moving to set a tax-based floor on top of existing cap and trade framework. It seems to me that, knowing what we know now about price volatility and market dynamics, if setting up a system today we would start with a nominal tax to set that floor. Later, if desired, we could experiment with limited applications of a cap and trade market structure on top of the tax overlay. That way you get immediate benefits and can learn about the intricacies of cap and trade in a controlled fashion as implementation proceeds. In a way, you don't have all of your climate change policy eggs in one basket, helping to ensure economically and environmentally meaningful results.

Second, our own experience with the SO_2 system in the US has taught us the perils of policy uncertainty. When a court case challenged the validity of the system prices plummeted, only to rebound when the case upheld the existing policy approach. Nonetheless, the uncertainty led to a lengthy disruption in price dynamics in the market.

Third, policy implementation periods and targets need to be linked to smooth implementation over time.

Overall, however, the biggest lesson is that we really don't know what to expect, given the demonstration of contango price dynamics with policy and weather volatility, trending ever lower until necessitation a flat tax to maintain even the spectre of a reasonable user fee. The important thing to know is that there is still a lot we don't know.

Question 12. Is it even possible to avoid creating a carbon market that is so vulnerable to manipulation?

Answer. Probably not. The only markets traders don't try to manipulate are the ones that don't matter. Even if policymakers create the perfect market, there will always be fraud. We will have to stay forever vigilant to maintain this market if we are to see it confer meaningful economic and environmental benefits.

RESPONSES OF JASON GRUMET TO QUESTIONS FROM SENATOR BINGAMAN

Question 1a. In your testimony, you discuss using allowance revenue to directly fund offset projects and other projects that will reduce greenhouse gas emissions.

Do you expect that this will deliver greater reductions at lower cost than through the use of an offsets market? In other words, are offsets necessarily the most cost-effective way to obtain reductions?

Answer. Offsets reduce program costs and increase regulatory flexibility by allowing companies to take advantage of low-cost abatement opportunities outside the cap-and-trade system. Offsets are an effective way to obtain reductions. Domestic offsets also promote innovation in offset markets and ensure that money moves to agriculture and forestry projects even if the bureaucracy moves slower than hoped. However, any offsets program must balance the need for investor certainty, reasonable transaction costs, and administrative simplicity (all of which can affect offset price) with assurance that offset projects have environmental integrity.

The crucial difference between offsets and allowance set-asides is that whereas offset credits are additional to the cap, set-aside allowances are taken from under the cap. Since set-aside allowances are already part of the cap, total emissions from regulated sources do not rise above the cap level under the set-aside approach. Con-

versely, in certain instances, offsets may allow regulated entities to increase their emissions.

The advantage of a set-aside approach is that it would allow for a less rigorous demonstration of emissions reductions: while applicants for a share of the set-aside pool would still need to document emissions reductions commensurate with the quantity of allowances they wish to claim, there would be less pressure to precisely measure these reductions. Likewise, reliance on allowance set-asides rather than offset credits could allow for a less rigorous approach to issues like additionality and permanence.

Question 1b. Are there certain types of projects that this method of funding is more suited to that an offsets market would not deliver?

Answer. Many agricultural and forestry sequestration projects in the U.S. require complex carbon accounting. A cap-and-trade program that provides for both offset credits and set-aside allowances will give agricultural producers the flexibility to choose different levels of rigor in documenting emissions benefits and will help to deliver maximum economic and environmental benefits from low-cost mitigation opportunities in the agriculture sector. Offset credits should be available for agriculture-based mitigation projects—including soil carbon sequestration projects—that can meet rigorous standards for assuring measurement, additionality, and permanence. Set-aside allowances taken from under the cap provide a particularly effective mechanism for rewarding these types of projects that provide important carbon benefits, but that may have more difficulty meeting these tests, such as no-till practices undertaken before the cap-and-trade program goes into effect (so-called 'early action' projects). A hybrid approach can respond effectively to the twin imperatives of (a) ensuring overall program integrity and (b) allowing for maximum participation by the agricultural sector.

Question 2. EPA projections have indicated that there will be a very limited supply of offsets coming from projects based in the U.S., and that the vast majority of the offset supply will be coming from overseas. Are there policy choices we can make to increase the supply of high-quality domestic offsets, so a greater amount of funds spent purchasing offsets stays in the U.S.?

Answer. Since offsets come from sources outside the cap, exempting more sectors from the cap would increase the potential supply of domestic offsets. But there are countervailing policy considerations that must be weighed against such an approach. EPA's analysis of H.R. 2454 (Waxman-Markey) indicates that the majority of domestic offsets will come from domestic afforestation, forest management, utilization of animal waste methane, and other agricultural methane and nitrous oxide management strategies. Agriculture and forestry sector offsets share many of the inherent challenges of offsets in other sectors, and several additional ones.

Dedicating—or "setting aside"—a percentage of allowances from within the emissions cap or overall budget under a cap-and-trade program could allow the U.S. to essentially undertake a large-scale demonstration program aimed at resolving some of the issues specific to awarding offset credits for carbon sequestration in agricultural soils, while both allaying concerns about program integrity and creating new economic opportunities in rural communities. A variation on this approach would be to have provisions for both regular offset credits and set-aside allowances for soil carbon sequestration. Regular offset credits would only be available for soil carbon projects that can meet rigorous standards for measurement, additionality, and permanence. Set-aside allowances that are taken from under the cap could reward projects that provide important carbon benefits, but that may have more difficulty meeting these tests. A requisite for awarding set-aside credits would be careful monitoring and evaluation so as to determine benefits with more confidence and learn from the experience.

RESPONSES OF JASON GRUMET TO QUESTIONS FROM SENATOR MURKOWSKI

UTILIZATION OF REVENUES

Question 1. We should be honest about what a cap-and-trade program for reducing greenhouse gas emissions will do. Such a policy would essentially create a new form of currency and generate massive amounts of revenue through auctions, or financial largesse to be doled out in the form of free allowances.

What do you think those revenues should be spent on and who should receive that money?

Answer. As you note, allowance allocation is a highly contentious issue in the climate debate due to the significant value of emission allowances at stake. Yet despite the intense debate, we believe it is possible to design an allocation program that includes an equitable distribution centered on the principle of mitigating economic

harm. We believe that the focus of free allocations should be to help enable the transition by entities and communities to a lower carbon future.

An allowance allocation program should:

- Protect households, especially low-and moderate-income households, from adverse economic impacts as a result of higher energy prices under a climate program;
- Support energy-intensive industries in making a viable transition to a lower carbon footprint without resulting in the significant export of jobs and emissions to our trade competitors;
- Provide incentives for increased investment in the research, development, and deployment efforts needed to advance critical no-and low-carbon technologies and for investment in needed adaptation measures;
- Phase out quickly, with most of the funds raised through the allowance auctions then going to the general treasury.

There are compelling arguments for using a portion of the allowance value (whether through a free allocation or the use of auction revenues) to compensate for the economic impacts on utilities and industry, in particular energy-intensive industries. These firms will undoubtedly bear a significant portion of the cost of the program, and mitigating energy price impacts in the early years of the program would allow firms needed time to invest in new capital and adjust to changes in relative energy prices. Allowances should be distributed to impacted sectors, including end-use consumers, according to relative cost burden. After the allocations have phased out, auction revenue could serve a similar purpose.

EFFECTIVENESS OF REGULATION VERSUS INCENTIVES

Question 2. The bill sent over to us from the House not only caps emissions from sources emitting more than 25,000 tons annually, but imposes command-and-control style regulation of sources below that threshold.

Do you think it is better to provide incentives for the reduction of these smaller emissions, through offset projects and other means, than to subject relatively insignificant sources to complicated and inflexible regulation?

What ability would these newly regulated sources, under the House bill, have to contain costs?

Answer. It is quite possible that there is a good economic/environmental argument for excluding sources under 25,000 tons altogether. There are a couple of ways, however, to address sources smaller than 25,000 tons (but above 10,000 tons). Your 2007 Bingaman-Murkowski-Specter cap and trade bill solved that problem by taking an upstream approach for regulating the carbon content of fuels.

Another option is to lower the emissions threshold for stationary sources to 10,000 tons so those smaller sources would be able to trade allowances just like the larger sources, rather than being included under an EPA mandated command and control program. You can simply allow such sources to participate in the offset market.

EFFECTIVENESS OF LDCS FOR COST CONTAINMENT

Question 3. Under the auspices of cost containment, the House bill relies heavily on a requirement that savings associated with free allowances given to Local Distribution Companies be passed on to their customers. The Center for Budget Policy and Priorities has pointed out that more than 60% of the LDC customers are business, not residential consumers. And CBO has concluded that businesses receiving this relief as a fixed rebate on their bill would retain that relief as added profit, rather than pass it on to their own customers in the form of lower prices for their products.

Do you believe this is a flawed approach to cost containment and, if so, how can we more explicitly limit the exposure of Americans to the costs of a cap-and-trade regime?

Answer. NCEP supports a price collar (with either a hard price cap or a properly designed strategic allowance reserve) as a robust cost containment mechanism for overall program costs. As a related but separate provision, NCEP also supports use of allowance allocation to protect consumers from the economic impacts of higher energy costs. The value of allowances allocated to electricity LDCs can help offset higher energy costs without dampening incentives for efficiency and conservation. All classes of electricity consumers (households, business, and industrial entities) will experience price increases—small businesses and U.S. manufacturers are particularly vulnerable—and should receive the value of allocated allowances. You raise an important question with respect to LDC pass-through and we would encourage

the Energy Committee to hold a hearing focused on how LDC allocations would work in practice.

NCEP also supports added protection for low-and moderate-income families. The CBPP actually proposes several suggested mechanisms to reach these consumers, particularly those who would not benefit from tax rebates.

RESPONSES OF JASON GRUMET TO QUESTIONS FROM SENATOR CANTWELL

Question 1a. What role does the compliance period play in reducing price volatility?

Answer. In general, longer compliance periods for regulated entities could help marginally in reducing volatility, but should not be relied upon to play an integral role in reducing price volatility. A price collar or safety valve is a stronger means of reducing volatility.

Question 1b. Are there any substantial differences in price volatility between rolling compliance periods and fixed compliance dates?

Answer. Rolling compliance periods create the equivalent of banking, which would help to smooth volatility.

Question 1c. To minimize price volatility, how much time should firms have between the emissions of greenhouse gases and the acquisition (and surrender) of allowances? One year or less? Two years? Three years? Five years?

Answer. We fully support unlimited banking. We don't believe that drawing out the surrender time will have that great of an effect on volatility. The SO_2 program has achieved success with a twelve month compliance period followed by a 90 day true up period. We strongly believe that a price collar or well-functioning strategic reserve would provide a more comprehensive solution to volatility.

Question 2a. What is a reasonable number of allowances, as a percentage of yearly emissions, that firms would be able to bank for future emissions and compliance dates?

Answer. We don't see a rationale for limiting banking, as a limit will simply discourage early action.

Question 2b. How long are firms likely to retain allowances for future use? Is there likely to be a limit to their willingness to keep these assets on their balance sheets?

Answer. A firm's willingness to hold future vintage allowances is based on its assessment of regulatory risk and the future supply/demand balance for the commodity. As long as a firm is confident in the long term sustainability of the climate program, there is no reason it should not be willing to keep allowances on its balance sheet.

Question 3. To reach the 2050 emissions targets that scientists agree are necessary to avert catastrophic climate change, is there an affordable option at mid-century that does not incorporate either a significant amount of coal with carbon capture and sequestration technology or a substantial expansion of nuclear power?

Answer. The role of a cap-and-trade program is not to pick technology winners, but to put a price on carbon that allows the market to make informed decisions about which technologies to deploy. It is impossible to predict exactly what technological breakthroughs may occur between now and mid century. Based on current knowledge, large amounts of nuclear or coal with carbon capture and sequestration, or a combination thereof, are likely necessary to achieve emissions goals while preserving abundant, affordable and reliable electricity.

Question 4a. From a strictly economic viewpoint, how can the pathway of the emissions reductions or the trajectory of the cap's emissions reductions affect the costs of a climate policy?

Answer. One of the reasons the Commission believes that U.S. action on climate change is needed now is that sustained inaction creates a situation whereby the emission cuts needed over the next few decades to avoid dangerous levels of warming must be that much deeper and costlier. Under a well-designed climate bill, emissions limits would be initially modest and ramp up in a gradual and predictable way over multiple years, with effective mechanisms in place from the outset to (a) guard against high or excessively volatile allowance prices and (b) protect low-income households and trade-sensitive, energy-intensive businesses. This approach will provide time and a favorable investment environment for robust low-carbon technology alternatives to become available, thereby reducing climate-related costs to the economy in the long run. It will also help ensure that the transition to a low-carbon economy provides a steady impetus for the creation of durable new industries and employment opportunities.

Most importantly, a successful bill will deliver clarity about U.S. climate policy and certainty about carbon costs going forward. This is the critical issue for busi-

nesses attempting to make strategic investments in new energy technology and long-lived infrastructure. It is also the central priority from the standpoint of engaging major developing countries in a re-invigorated international process.

Question 4b. For a fixed amount of cumulative emissions, what might the optimal shape of that emissions pathway be?

Answer. Because it is cumulative global emissions that are critical, determining whether there is a single optimal shape of the emissions pathway from an economic perspective is complex. The Commission has long advocated beginning in a moderate and achievable manner to begin reducing emissions, which will provide more flexibility later on as uncertainties around necessary cumulative emissions limits are reduced. It will also send a clear signal to speed technology development and then steepen the slope as those technologies take hold.

Question 5. Why do you regard the inclusion of a price floor as particularly important for investment in new energy technologies under a climate policy?

Answer. Along with a cap on allowance prices at the high end, the Commission supports the concept of a floor, or lower limit, on allowance prices in case abatement costs prove significantly lower than expected. A price floor along with a price ceiling should be considered because allowance prices in past market-based regulatory programs have more often proved to be lower than expected, rather than higher than expected—in some cases because emissions budgets were inflated, in some cases because other factors (such as slower-than-expected economic growth) temporarily reduced demand for allowances.

Some price stability at the low end, as well as at the high end, would assure that there are sufficient—and sufficiently consistent—incentives for investment in low-carbon technologies over time (along with sufficient disincentives to new investment in long lived carbon-intensive infrastructure). Combining a price floor with a price ceiling could thus be quite important to the successful development of new climate-friendly industries and could help ensure that artificially low prices in the short term don't lead to significantly higher costs in the long run, when deeper emission reductions are needed to achieve program goals.

Question 6. Since cap-and-trade programs are so inherently complex and far-reaching:

a) How can we be sure that any scheme is workable and can be implemented by the executive branch?

Answer. It has been the Commission's considered view for some time that the benefits of prudent but imperfect action profoundly outweigh the arguments for further delay. Debate on the critical substantive issues has narrowed. In fact, viable solutions to six of the most contentious features of a national climate policy—cost-containment, state/federal harmonization, international participation and competitiveness, offsets, allowance allocation and revenue recycling, and market oversight—can be found in existing legislative proposals. We also have confidence in the ability of Congress to oversee the program and make necessary adjustments.

b) How great are the risks of unintended consequences—for the economy and the environment?

Answer. With appropriate program design and particularly cost control, the risks of considerable ecological and economic consequences from inaction are far larger than any risk from acting. In recent testimony before Congress, Dr. R.K. Pachauri, Chairman of the Intergovernmental Panel on Climate Change (IPCC), noted that evidence for warming of the climate system is now "unequivocal" and warned that "[d]elayed emission reductions significantly constrain the opportunities to achieve lower stabilization levels and increase the risk of more severe climate change impacts." Already, experts warn that the more protective stabilization goals often discussed in recent years are moving rapidly out of reach. Moreover, the latest developments in climate science lend greater urgency to the case for action: effects on natural systems are already being observed and recent findings concerning the potential scope and magnitude of damages from future warming are increasingly worrisome.

A diverse group of stakeholders that includes military experts, CEOs of major oil companies and electric utilities, labor leaders, state governments, religious leaders, sportsmen, and environmental advocates recognize that the intolerable (and probably far more costly) alternative to a clear federal policy is continued uncertainty, international paralysis, and reliance on highly imperfect regulatory mechanisms such as those triggered by EPA's recent finding that greenhouse gases endanger human health and welfare under the Clean Air Act.

c) What sort of growth are we likely to need in federal agencies, particularly EPA, if the House-passed bill became law?

Answer. In June, the Congressional Budget Office (CBO) estimated that fully funding federal agencies' administrative costs for implementing the House-passed bill would require gross appropriations totaling $540 million in 2010 and $8.2 billion over the 2010-2019 period. Their estimate is based on historical information on how large regulatory programs have been implemented and on information provided by EPA, FERC and other federal agencies with significant administrative responsibilities under the House bill.

Question 7. Given the complexity and intricacy of some of these policy proposals, I am particularly concerned about the opportunities they might create for market manipulation, fraud, and for the development of arcane financial instruments that will lead us to the next major global financial crisis. Do you believe that these concerns are justified? How might opportunities for market manipulation be reduced through climate policy design?

Answer. We share your concerns about the need for market oversight and, in the coming months, NCEP will release a set of recommendations addressing this issue in detail. We believe It is possible to limit opportunities for market manipulation without implementing excessive regulations that compromise the efficiency of a cap-and-trade program. A carbon market shares both the benefits and potential pitfalls of financial markets in general. Therefore, carbon market controls will be addressed in the context of broader market reforms being considered today and, once created, may require additional regulatory oversight.

The design of climate policy can significantly reduce the opportunity of market manipulation. NCEP strongly supports a robust cost containment mechanism—such as a price collar or strategic allowance reserve—that will limit price volatility in addition to controlling overall program costs. An upper and lower bound on allowance prices can limit opportunities for market speculation.

Question 8. I understand that last December, the European Union made auctioning the default future allocation method for its emission trading system.

a) Was that a tacit recognition that the best way to allocate carbon permits or emission allowances is by auction?

Answer. The allocation approach taken in Europe—where national governments distributed nearly all allowances for free to entities directly regulated under the EU trading system—does not provide a good model for an economy-wide U.S. program. Rather, to address equity concerns and avoid excessive windfall profits in some industries, a much larger fraction of emissions allowances or permits should be auctioned. It is worth noting however that much like Europe's transition from phase 1 to phase 2, we propose beginning with a large allowance program and ending with a full auction.

Given that both energy producers and the general public bear some burden under a greenhouse-gas trading program, an allocation approach that auctions all allowances and recycles the proceeds in the form of tax relief will have the overall effect of transferring some wealth from energy producers to the broader public (in this case taxpayers). Conversely, an allocation approach that gives all allowances for free to directly affected industries will have the overall effect of transferring some wealth from the broad public (in this case consumers) to those industries.

An allocation that does both could end up leaving both groups roughly equally well off. In other words, compared to either a pure auction or pure grandfathering, a mixed strategy—in which some allowances are auctioned and others are given away for free—may create opportunities to realize broader public benefits while also addressing legitimate industry concerns about cost impacts. Moreover, a phased approach, wherein a substantial portion of allowances is grandfathered in the early years of program implementation but that share gradually diminishes in subsequent years to allow for a larger auction, may offer particular advantages in terms of creating a transition period for energy-intensive industries (especially those with a long-lived capital assets), while eventually securing the social welfare and efficiency-maximizing benefits of an auction.

b) What other ways is the European Commission working to correct the windfall and overallocation it experienced in the early years of the European emission trading system?

Answer. The EU-ETS is proceeding in three stages:

Phase 1, from 2005-2007, was a pilot phase, which was focused on generating data for establishing an accurate price on carbon, developing infrastructure such as emissions registries, and gaining valuable experience with regulating a carbon market.

Phase 2, from 2008-2012, involves a tightening of the cap and fewer allocations to industry and the power sector. The price of carbon has fluctuated, but mainly mirrored global markets. To reduce the number of free allowances given to industry and power sectors, larger amounts of international offsets were made available.

Phase 3, from 2013-2020, will involve moving toward a 20% emissions reduction goal for 2020. All utilities, unless they are at risk of carbon leakage, will face 100% auctioning.

c) What lessons can Congress learn from the European experience to avoid pitfalls in designing and implementing a carbon trading system?

Answer. One important lesson is the need for accurate emissions data so that over-or under-allocation of allowances does not occur. We have better data and a new reporting rule in the U.S., which should hopefully inoculate us from some of the troubles experienced in the first phase of Europe's program. Another lesson is that a trading system must provide enough certainty to allow technology investment. Third, the EU-ETS experience highlights the important effects of allowance allocation.

Question 9. One of my concerns is that, as far as I can tell, allowances that are given away under cap-and-trade could be sold on the secondary market at a price that would undercut the government auction reserve price.

a) Is this accurate, and do you see this as a potential problem for energy investments under such price uncertainty?

Answer. Allowances (whether initially auctioned or freely allocated) can be traded on the secondary market at a price below the price floor but this would assume drastically lower prices than current projections. It would of course be good news if technological breakthroughs are so effective that regulations become unnecessary.

However, this would have no long-term effect on the emissions price floor and thus does not present a significant problem for energy investment certainty. A price floor is enforced through the periodic regular auctions, where no allowances will be sold below the specified minimum price. If allowances are trading on a secondary market below the floor price, bids at the regular auction would not reach the floor price and allowances would not be sold. As long as there is a sufficient number of auctioned allowances, prices would rise again in response to the tightened supply of allowances in the market.

b) What happens if or when strategic allowance reserves run out in a cap-and-trade program?

c) If a strategic reserve is used instead of an explicit price ceiling, then what happens if the strategic reserve is continually depleted? Do costs skyrocket at that point?

Answer. In our recent paper addressing economic risk in a cap-and-trade program, NCEP made several suggestions to strengthen the design of the strategic allowance reserve included in the Waxman-Markey legislation. These recommendations address both the size of the reserve and the proposed mechanism to replenish the reserve.

A strategic allowance reserve differs from an explicit price ceiling in that only a limited number of allowances are available at the trigger reserve allowance price. Therefore, there is no guarantee that the pool of strategic reserve allowances will not be depleted. If this pool is depleted, the prices can rise above the trigger reserve allowance price. We believe that roughly 6 billion tons of allowances should be available in the first ten years of the program. We are undertaking additional analysis regarding the reserve size required to manage long-and short-term cost concerns.

The Waxman-Markey allowance reserve is structured to be replenished annually through government purchases of international forestry offsets. NCEP is uncertain about the availability of international offset credits, particularly in the early years of a program, and does not recommend that the size and effectiveness of the reserve be fully reliant on the offsets market. An alternative may be to have the government purchase offsets to "pay back" the allowances borrowed from future years.

RESPONSE OF EILEEN CLAUSSEN TO QUESTION FROM SENATOR BINGAMAN

Question 1. EPA projections have indicated that there will be a very limited supply of offsets coming from projects based in the U.S., and that the vast majority of the offset supply will be coming from overseas. Are there policy choices we can make to increase the supply of high-quality domestic offsets, so a greater amount of funds spent purchasing offsets stays in the U.S.?

Answer. We believe it is important to encourage cost-effective domestic offset projects from uncapped and unregulated sectors, particularly in the early years of a cap-and-trade program. There are several policy choices that can be made to increase the availability of these domestic offsets.

First and foremost, directing the administering agencies to start now to develop the foundation of an offset program in anticipation of legislation is important. Foundational issues which can be addressed in advance of program implementation include establishing:

- A clear and consistent definition of key GHG offset quality criteria;
- A priority list of offset project types to be considered by the program;
- A framework for methodology review and approval;
- A review and approval process of existing offset methodologies;
- A scientific advisory board; and
- A review of the quality of offsets from existing programs.

Some types of offsets projects are easier to do than others. Reducing emissions from coal mines, landfills, and natural gas systems provide some of the most readily-available offset opportunities. In fact, EPA has said that including these types of actions as offsets would increase the domestic offset supply by 45%. We recommend that these types of reductions be included as offset projects rather than utilizing the House proposed NSPS for small sources. In addition, another potential type of offset credit could be the "destruction of Ozone Depleting Substances (ODS)". In the House bill, these credits could only be used in the separate HFC cap, and not in the main capped system until an EPA review and finding after the market has already been operating for a number of years.

RESPONSES OF EILEEN CLAUSSEN TO QUESTIONS FROM SENATOR MURKOWSKI

UTILIZATION OF REVENUES

Question 1. We should be honest about what a cap-and-trade program for reducing greenhouse gas emissions will do. Such a policy would essentially create a new form of currency and generate massive amounts of revenue through auctions, or financial largesse to be doled out in the form of free allowances.

What do you think those revenues should be spent on and who should receive that money?

Answer. At the Pew Center, we use the term "allowance value" to mean the economic value of either auction revenues or free allowances. As part of USCAP, we believe that the distribution of allowance value should achieve the following overarching objectives:

- enable a smooth transition to a low-carbon economy by providing financial relief to consumers and businesses who bear the costs of climate change mitigation
- transform technology and the nation's workforce to support a new energy economy by subsidizing the early deployment of climate-friendly technologies and the creation of clean energy jobs
- enhance our resilience and ability to adapt to climate change impacts by funding adaptation planning and investment at all levels of government.

With regard to transition assistance we recommend helping those who actually bear the cost, and not those who can easily pass those costs on to others, and to concentrate assistance on those consumers and businesses who are the most vulnerable to the secondary price cost impacts effects of a cap, such as low-income consumers. We also recommend providing this assistance without undermining the cap-and and-trade program's incentive to reduce emissions. This free distribution of allowance values would be phased out over time.

For example, we recommend providing allowance value to energy-intensive, trade-exposed industries that cannot easily pass on their compliance costs due to lack of action by other countries whose businesses compete with ours. Such assistance should be structured so that it rewards improved environmental performance in comparison to a benchmark for each particular industry, and should be phased out as other nations adopt comparable climate policies. It is important to help such industries not only for competitiveness reasons, but also for environmental reasons—if compliance costs for such industries cause them to shift production overseas, we will "leak" not only economic activity, but also emissions, thus hurting the environmental integrity of the cap cap-and and-trade program.

We also recommend providing assistance to regulated local electric and gas distribution companies, to condition that assistance on their providing relief to their customers, and to require that state Public Utility Commissions certify that the al-

lowance value is indeed being used to help customers. Providing relief in this way takes advantage of existing business and institutional arrangements, creates incentives for utility-based energy efficiency programs, and tends to target more relief to regions that are harder hit by the program.

With regard to technology transformation, we recommend providing allowance value to emerging technologies that are not sufficiently incentivized by the cap cap-and -trade program itself, such as energy efficiency and carbon capture and storage. With regard to workforce transformation we recommend providing both transition assistance for those who must change their jobs as well as support for businesses to create new jobs.

Finally, we recommend proving support for activities to enhance both human and ecological resiliency to future climate change and for government at all levels to take steps to adapt to the impacts of climate change that we are already beginning to experience. This includes impacts on public health, infrastructure, fish and wildlife habitats, and other affected communities in the United States. In addition, we support the use of allowance value as a mechanism to promote international engagement and cooperation to help developing countries adapt to unavoidable climate change.

ELIGIBLE OFFSET PROJECTS

Question 2a. There is a great variety of offset projects that can be undertaken, some more reliable than others. We risk creating an incentive for loosely constructed offset rules given the cost containment objectives we have and the extent to which some would have us rely upon offsets to meet it.

Should there be a list of allowable offset project types spelled out in legislative text, or not?

Answer. In order to ensure early supply, offset project developers need guidance on the types of offset projects that will be eligible to produce emission reductions and the standards that will be used to evaluate those projects. A positive list of eligible project types would help to provide developers with such guidance, and provide further incentive to invest in projects early on in the program.

Question 2b. What standards should apply whether there is such a list or not?

Answer. The Pew Center has published a Congressional brief on offsets, available at our website (http://www.pewclimate.org/policy-brief/Offsets), and we are also a member of the Offset Quality Initiative, which has published a brief on this issue titled "Ensuring Offset Quality: Integrating High Quality Greenhouse Gas Offsets Into North American Cap-and-Trade Policy" (http://www.offsetqualityinitiative.org/pdfs/OQI_Ensuring_Offset_Quality_7_08.pdf). In those documents and elsewhere, the following criteria are often cited as essential to ensure that offsets are of high enough quality to be credibly included in a cap-and-trade program. Offsets should be:

- Real.—GHG emission reductions should represent actual emission reductions and not simply be artifacts of incomplete or inaccurate accounting.
- Measurable.—Emission reductions from offset projects must be accurately quantified. In some cases direct measurement may be difficult, but imprecise and/or unreliable accounting will impinge on the integrity of the offset.
- Additional.—Offset project reductions must be shown to be "in addition to" reductions that would have occurred without the offset project or the incentives provided by offset credits. This criterion is often considered not only the most important attribute, but also the most difficult to determine. To be considered additional, the revenue gained from selling the project's emission reductions should be the main fiscal incentive behind the project's implementation. Determining additionality is an essential but imperfect process. No single approach is the best for all project types. A standardized methodology for this determination is usually considered the best approach.
- Permanent.—Offset emission reductions can sometimes be reversed either by human activity and/or by acts of nature (the most common example being a forest fire). Because offset credits in emission trading programs will be used for compliance in lieu of an on-site reduction, it is important to ensure that the offset credits either represent a permanent reduction or contractually require replacement if they are reversed. Alternatively, there are other mechanisms to address permanence, including pooling, aggregation, and insurance. A standardized methodology for this determination is usually considered the best approach.
- Monitored.—Offset projects must be monitored to ensure that emission reductions are occurring. Each project must have a unique monitoring plan that defines how, when and by whom data will be collected and emissions quantified.

These plans should be developed with experts familiar with the specifics of a project and should use established standards.

- Independently Verified.—All GHG reductions should be verified by either a third party or a government agency according to accepted methodologies and regulations. Monitoring reports issued after the emission reductions have occurred (ex-post) should be used as the basis for issuing offset credits. For credibility purposes, verifier compensation should not in any way depend on the outcome of the verifier's decisions.
- Measured From a Credible Baseline.—A credible baseline, or "without-project" emissions, must be established in order to measure an offset project's reductions. The difference between this baseline case and the actual emissions level represents the reductions achieved by the offset project, and determines the amount of offset credits issued.
- Protected From Leakage.—Leakage is defined as an increase in GHG emissions outside of the project's boundary that occurs as a result of the project. For example, avoiding deforestation through an offset project in one area could simply push the deforestation (and resulting emissions) to a different region or country. Leakage minimization through monitoring and verification plans and protocols should be addressed in offset program design. A standardized methodology for this determination is usually considered the best approach.
- A Clear Property Right.—Clear and uncontested title to offset credits is necessary, and transfer of ownership must be unambiguous and documented. Once sold, the original owner must cede all rights to claim future credit for the same reductions in order to avoid double counting. Offset credits should be serialized and accounted for in a registry or other approved tracking system.

DECERTIFICATION OF AN OFFSET PROJECT

Question 3a. It is all but inevitable that at least some offset projects, if allowed as part of a climate program, will be exposed as flawed or useless as it relates to verifiable greenhouse gas reductions. Forests can burn down, fraud can take place, and countries could even nationalize these projects for their own financial gain. In the event that this occurs, a process of de-certification will need to be developed.

How should such a process work, and under what circumstances should it be done?

Answer. Changes in the overall program design, as well as details of assessment protocols for different project types, should be evaluated and incorporated regularly to ensure the environmental integrity and effectiveness of an offset mechanism. Policy and regulatory reviews should occur at long enough intervals to allow for investment certainty. Except under extreme circumstances, policy changes should not be applied retroactively or without ample warning, in order to avoid leaving market participants with stranded investments that were made in good faith under existing rules.

Question 3b. Should we be concerned that the need to contain costs may provide an incentive to look the other way and fail to pursue de-certification?

Answer. A centralized authority that will administer and implement an offset program should be established, and decisions of this sort should be done by regulation, using a transparent process with public input. This authority should have the ability to make necessary decisions, such as those regarding any de-certifications, and should be capable of doing so in a timely and transparent fashion.

DIFFICULTIES OF CERTIFYING INTERNATIONAL OFFSETS AND ENSURING COMPLIANCE

Question 4. It is apparent that many difficulties ay emerge in attempting to develop an accurate tracking system for a worldwide carbon market. The House bill creates a litany of requirements that must be met before international offsets can be used. In order to host offset projects, a developing country must meet several criteria:

- They must negotiate a treaty with the U.S. to assure certain, minimum requirements are met;
- They must establish an emissions baseline and set targets to achieve zero net deforestation within 20 years;
- They must design offset projects to account for the interests of communities, indigenous peoples, and vulnerable groups with equitable profit-sharing; and
- The U.S. must certify the establishment and enforcement by the host country of laws, processes and standards to assure these rights.
- The developing country must develop a strategic plan for addressing the drivers of deforestation and identify reforms to national policies.

There is nothing wrong with these criteria, per se, but they make timely availability of international offsets impossible. It is also unclear if foreign governments would acquiesce to these conditions or not.

How do we ensure that American entities are buying legitimate carbon credits without creating an impenetrable, bureaucratic process like we've seen in the House bill? Is it even possible?

Answer. The criteria above are challenging to meet but represent a core set of requirements that have developed over years of from international discussions aimed at making international offsets a reality. With respect specifically to international forestry, some key developing countries have, or are close to having, deforestation policies and the necessary institutional capacity to establish national baselines, change national policies, and move to net-zero deforestation over time. Deforestation accounts for approximately 20% of global emissions and putting domestic policies in place that drive private investment towards reducing international deforestation our planet benefit us all.

Forestry projects, however, are not the only type of international offset project that are possible. Similar to domestic offsets, international offsets projects can be done in a number of categories outside of the forestry sector, including agriculture, energy fuel switching, and transportation—to name just a few. Measured against the same quality criteria as domestic offsets, i.e. additional, permanent, monitored, independently verified, and addressing leakage—international offsets can be assessed by an international body if our program administrator determines that this international body has a thorough and credible assessment process. The role of international offsets in containing the cost of a cap-and-trade program is significant, as EPA modeling shows that without these offsets, costs may be as much as 89% higher. Therefore, it is crucial that international offsets be a part of our cap and trade system. It is also critical that international offsets be of high quality for our program and for others. U.S. involvement in the international process can help ensure this high quality and if it is not forthcoming we can require additional measures and be selective.

LONGEVITY OF TREES AS CARBON OFFSETS

Question 5. Scientists tell us that carbon dioxide remains in the atmosphere for roughly a century before it fades away. If a tree claimed as a source of offset credits were cut down even a few decades after that occurring, then the carbon credits it had produced would be environmentally worthless.

How can anyone realistically ensure that a tree that creates a carbon offset credit isn't later destroyed anyway, particularly in foreign countries in which the U.S government has no say in the way those resources are managed?

Answer. First, it is important to understand that a carbon offset credit is not tied directly to a particular tree in a forest. Forests generating offset credits may have trees dying and growing back at all times, and on the whole still be a net sink for carbon. The key is avoiding large scale degradation or deforestation over a reasonable period of time.

The issue of permanence is a difficult one for offset projects but there are options to address reversals to ensure the environmental integrity of offset credits from forestry. One option would include establishing an offsets reserve. Here the offset Administrator could simply subtract and hold (from the credits that would have been issued for a project) a quantity of credits that account for the risk that the biological sink was destroyed. These "reserve" credits could then be retired if necessary to fully account for the tons of carbon that are no longer sequestered. Alternatively, the offset Administrator could create an insurance mechanism that provides dollars to purchase replacement carbon tons if a sink is destroyed.

Other ways to address permanence could include discounting the credits that are issued for offset projects (reducing the value of the credit to reflect carbon that is measurably sequestered in a given year); explicitly requiring project developers to surrender credits in the event of reversals; and providing strong contractual and liability arrangements.

Internationally, the same options to deal with permanence apply—the key difference being that the U.S. government may not be the regulator. Depending on how the program is structured, the party responsible for issuing credits (and ensuring permanence) could be a multilateral organization (UN) or potentially the U.S. program administrator. In the international context we believe it is especially important to build robust measuring and monitoring capacity and good governance practices in developing countries as this can help prevent reversals from occurring in the first place. Moreover, encouraging such things as the development and implementation of strong, long-term contract design with liability provisions, effective au-

thorities to implement and enforce forest governance, and clear incentives for landowners to maintain carbon stocks on their land will be important elements of any international carbon offset program.

RESPONSES OF EILEEN CLAUSSEN TO QUESTIONS FROM SENATOR CANTWELL

Question 1a. What role does the compliance period play in reducing price volatility?

Answer. Although only one factor, the length of the compliance period can affect volatility—a multiyear compliance period (say 24 months instead of 12 months) would reduce price volatility by giving firms a greater number of allowances (2 yrs worth) and more time flexibility to deal with any short-term price fluctuations and the ability to optimize their reduction schedule and minimize their compliance costs over time

Question 1b. Are there any substantial differences in price volatility between rolling compliance periods and fixed compliance dates?

Answer. Market volatility in part depends on supply availability (see above answer). To the extent that a rolling compliance period gives greater flexibility to the program and access to greater supply, (in comparison to a fixed compliance period), the result should be less price volatility.

Question 1c. To minimize price volatility, how much time should firms have between the emissions of greenhouse gases and the acquisition (and surrender) of allowances? One year or less? Two years? Three years? Five years?

Answer. Time and experience with the program will improve (lessen) volatility but too many years between emissions and surrender of allowances may reduce the effectiveness of the program. We think that a multiyear year compliance period (e.g., 2-3 years) would decrease volatility. However, if the compliance window is too long, a scenario could arise in which large numbers of buyers are in the market for allowances at the same time (as the compliance deadline is reached). If firms have delayed taking action until the end of the long compliance period, the result could be a large temporary spike in the price of allowances, and potentially even an increased risk of non-compliance. In addition, we think that it is important to allow firms a short window of time or "true-up" period following the end of the compliance period, during which they can reassess their emissions compliance obligations and ensure that adequate surrender of allowances has occurred.

Question 2a. What is a reasonable number of allowances, as a percentage of yearly emissions, that firms would be able to bank for future emissions and compliance dates?

Answer. Firms should be able to bank all allowances not used in each period. There should be no limit. Banking is likely to be utilized by firms if they believe that the price of allowances or offsets will be higher in the future or that the quantity of available allowances will be lower. There is no reason to limit banking because it has multiple benefits: it reduces allowance price volatility, provides firms with the flexibility to optimally time their investments, and encourages early reductions.

A significant benefit of this approach is that it motivates early action by encouraging sources to make larger emission reductions in the near-term than needed to satisfy compliance requirements, thereby advancing environmental objectives. In periods with relatively low allowance demand (e.g., a mild winter, an economic down turn, low technology costs), banking will prevent prices from falling too far, helping to alleviate volatility on the lower end and preserve incentives for innovation. Over the longer-term, this intertemporal flexibility results in lower economy wide impacts because firms are able to optimize their reduction schedules over time.

Question 2b. How long are firms likely to retain allowances for future use? Is there likely to be a limit to their willingness to keep these assets on their balance sheets?

Answer. As long as firms understand that there is a declining cap and expect prices to go up in the future, firms will make a calculation on the value of holding allowances or using them. As with any financial decision, a part of this calculation will be a discount or interest rate that allows firms to compare the value of an allowance today with the expected value in the future.

Question 3. To reach the 2050 emissions targets that scientists agree are necessary to avert catastrophic climate change, is there an affordable option at mid-century that does not incorporate either a significant amount of coal with carbon capture and sequestration technology or a substantial expansion of nuclear power?

Answer. Delaying the availability of new nuclear power and CCS will increase the cost of achieving mid-century GHG emission goals, though perhaps not to a level that is "unaffordable." Multiple scenarios for future low-carbon U.S. and global en-

ergy systems that rely to varying extents on energy from new nuclear power and fossil fuels with carbon capture and storage (CCS) have been explored. If major low-carbon technologies prove technically, economically, or politically infeasible, the cost to society of achieving a given GHG emission reduction goal will be greater than in the case of a broader portfolio of mitigation options. A significant body of unbiased analyses indicates that a broad portfolio of low-carbon technology options is required to meet U.S. and global GHG emission reduction goals at the lowest cost to society. Below we discuss results from some of these analyses.

The U.S. Energy Information Administration's (EIA) recent analysis of H.R. 2454, the American Clean Energy and Security Act (ACESA) [see http://www.eia.doe.gov/oiaf/servicerpt/hr2454/index.html] modeled a core "Basic" policy case and a sensitivity policy case (called the "Limited Alternatives" case) that restricted the deployment of new nuclear power, coal with CCS, and biomass power generation to the very low levels projected under "business as usual." EIA projected that severely limiting the deployment of these technologies increased the cost of complying with the GHG cap-and-trade program. In particular, cap-and-trade allowance prices were projected to be 14.5 percent higher in all years in the Limited Alternatives case. While the overall economy was projected to grow robustly in both policy cases, the GDP impact in 2030 of the Limited Alternatives case was projected to be more than 40 percent greater than that of the Basic policy case. When restricting new nuclear and CCS, EIA projected fewer GHG emission reductions from sources under the cap and a greater reliance on offsets. For electricity, compared to the Basic policy case, EIA projected lower total electricity demand in the Limited Alternatives case and a greater reliance on natural gas (generation almost 80 percent greater in 2030) and renewables (13 percent greater generation in 2030), with national average electricity prices projected to be about 11 percent higher in 2030.

A 2009 analysis from the Massachusetts Institute of Technology Joint Program on the Science and Policy of Global Change (Paltsev, Reilly, Jacoby, and Morris, 2009, The Cost of Climate Policy in the United States, MITJPSPGC Report 173) modeled a generic carbon emissions pricing policy (e.g., cap and trade) with an emission reduction pathway consistent with an 80 percent reduction below the 2008 emissions level by 2050. The researchers analyzed several technology scenarios out to 2050 including one that assumed no nuclear or fossil fuel with CCS technology was available for deployment at all. The MIT report found that excluding nuclear and CCS as abatement options led to carbon prices that were 15-16 percent higher than in the core policy scenario across the model run years while the impact on aggregate economic welfare in 2050 was about 18 percent greater. The MIT researchers reported that:

> The exclusion of CCS and nuclear rule out two big low-carbon options, which should make the task of achieving these goals much harder. While excluding these options raises the cost substantially the simulation results suggests it does not make the target unachievable. Since raising the price of one option, or even making some options unavailable, just leads to use of other options, the cost impact is moderated. If neither advanced nuclear nor the CCS technologies are available then renewables and gas provide about two-thirds of the generation. (p. 18-20)

The MIT researchers also make the point, however, that extending the analysis timeframe beyond 2050 makes the heavy reliance on natural gas, which has lower GHG emissions than coal but is still a significant source of emissions, "probably not tenable" given that climate stabilization requires even greater emission reductions post-2050. The MIT analysis suggests that if the availability of new nuclear or CCS is delayed the cost of achieving mid-century GHG emission reductions may still be moderate or "affordable" but that if both of these technologies are forever precluded as economically, technically, or politically infeasible, achieving mid-century GHG emission reduction goals would likely prove much more costly.

Question 4a. From a strictly economic viewpoint, how can the pathway of the emissions reductions or the trajectory of the cap's emissions reductions affect the costs of a climate policy?

Answer. For a given cumulative emissions cap, the more rapid the reduction in emissions—in other words, the steeper the decline of the emissions trajectory—the higher the economic costs of climate policy. This is because early reductions will likely take place before advanced low-and zero-carbon technologies have been developed and deployed. Also, under the standard convention of discounting, the costs of emissions reduction occurring today are valued more than the equivalent reduction occurring at some point in the future.

Question 4b. For a fixed amount of cumulative emissions, what might the optimal shape of that emissions pathway be?

Answer. In general, a smoothly declining emissions trajectory leads to lower overall costs. The optimal shape of the emissions pathway will on the one hand take into account the likelihood that early reductions may increase costs (see 10a), but on the other hand, will need to ensure the technological feasibility of meeting the cumulative target. A trajectory that entails a later peaking point in emissions will make it more difficult to meet the cumulative emissions target. Delaying the timing of peak emissions will require greater annual reductions in years following the peaking point. If the peak occurs sufficiently late in the pathway, this may require negative emissions in some years.

Question 5. Why do you regard the inclusion of a price floor as particularly important for investment in new energy technologies under a climate policy?

Answer. A price floor is important because it ensures that the strength of the carbon price signal is maintained at a sufficient level to stimulate investment in new energy technologies. These investments are made with a long planning horizon. If the carbon price signal routinely falls to too low a level, this will create an uncertain return for long-term investments and decrease the likelihood that those investments are undertaken in a timely fashion.

Question 6. Since cap-and-trade programs are so inherently complex and far-reaching:

a) How can we be sure that any scheme is workable and can be implemented by the executive branch?

Answer. There is a growing body of national and international work supporting the case that the proposed cap-and-trade program can be successfully implemented. In the United States we have learned from the acid rain trading program the key ingredients to making trading work and believe it is possible to scale up that program to cover more sources and sectors as required to address greenhouse gas emissions. We have also watched closely and learned from the European Union's experience—from both the success they have had and the problems they have encountered. For example, one major problem they encountered in their initial trading period had to do with a lack of baseline emissions data for many sources. EPA is about to finalize a rule that will collect that data for the United States and make sure we avoid this problem.

b) How great are the risks of unintended consequences—for the economy and the environment?

Answer. Allowance prices under a cap-and-trade program will be influenced by a wide range of factors including the rate of growth of our economy, the pace and costs of new technologies, how consumers and industry respond to putting a price on carbon, shifts in the relative prices of fuels, and even such factors as the weather. None of these can be predicted with certainty. Nonetheless, a cap-and-trade program can be designed to provide safeguards to prevent unintended consequences. Smart program design can avoid unintended economic consequences by allowing greater flexibility to minimize compliance costs through the use of banking, borrowing and multiyear compliance periods. In addition, a minimum allowance price provides needed certainty for those investing in new technologies. A strategic reserve can provide insurance against a spike in allowance prices while at the same time preserving the environmental integrity of the program.

c) What sort of growth are we likely to need in federal agencies, particularly EPA, if the House-passed bill became law?

Answer. We do not have and are not aware of any specific estimates of the added resources that would be required at EPA and other federal agencies for implementing the House-passed bill. We do believe, however a cap-and-trade program requires fewer agency resources than achieving similar reductions through traditional command and control regulations.

Question 7. Given the complexity and intricacy of some of these policy proposals, I am particularly concerned about the opportunities they might create for market manipulation, fraud, and for the development of arcane financial instruments that will lead us to the next major global financial crisis. Do you believe that these concerns are justified? How might opportunities for market manipulation be reduced through climate policy design?

Answer. At the heart of any successful cap-and-trade program is a well-functioning market for the trading of emission allowances and related financial instruments. The recent high-profile market crises highlight the critical need for appropriate market design, transparency and oversight. A number of lawmakers and the Administration have introduced proposals that would tighten oversight of commodity markets in an effort to reduce excessive risk taking, and more generally ad-

dress what they view as weak spots in market regulation. These proposals would establish a legal framework for overseeing financial markets in general and by extension, carbon trading activity.

As with any regulation, this oversight must strive for a balance between regulating and over-regulating. Policymakers should encourage transparency, seek to prevent excessive speculation that can drive large swings in commodity prices and further seek to restrain efforts to interfere with and manipulate market activity. We believe that these goals should be achieved in large part through tightening of regulation directed at financial markets as a whole and not by regulating carbon market separately. More extensive reporting by market participants (including those buying and selling carbon commodities), position limits and collateral requirements (which both can be used to reduce excessive risk taking), and even restrictions on who can buy and sell in a market are options that can be applied to "exchange-based" transactions (e.g., NYMEX, Green Exchange, et al.) and to some extent to transactions that occur between parties not through an exchange. We know that a carbon market can be a cost effective mechanism for reducing GHG emissions and spurring innovation in low carbon technologies, but like any financial market, they need oversight to ensure that they are effective and efficient.

Question 8. I understand that last December, the European Union made auctioning the default future allocation method for its emission trading system.

Answer. The EU plans to increase auctioning in Phase III (2013-2020) of their GHG trading program with a move towards much greater auctioning over time. From 2013 onward, the EU anticipates that overall more than 50% of allowances will be auctioned but this percentage will vary by sector (and by country). Notably in the power sector, the intent is to have 100% auctioning by 2020. For industrial sectors not at high risk of carbon leakage (because of their carbon intensity and international competition) the intent is to have 20% of allowances auctioned in 2013, 70% by 2020, increasing to 100% by 2027. However, in the industrial sectors at high risk of carbon leakage, the intent is to give these companies free allocation equal to 100% of allowances needed by the best performers in each sector. The EU is now working on developing benchmarks for determining these allocation levels. Thus while there is a move toward more auctioning, less than 100% auction is anticipated.

> a) Was that a tacit recognition that the best way to allocate carbon permits or emission allowances is by auction?

Answer. The decision concerning the initial allocation of the emission allowances is very important to the design of a cap-and-trade program. However, this decision will not affect the environmental effectiveness of the program-this is primarily a distributional question. Therefore the important question that any government enacting a cap-and-trade system will have to grapple with is how to distribute the value associated with the allowances. In the U.S. Acid Rain program, policy makers distributed most of the allowances to regulated entities based on their historical fuel use multiplied by a benchmark emission rate. The EU decided to base allocations on historical emissions in the initial (trial) phase of their ETS. However, because good data on emissions were not yet available, more allowances were distributed than necessary to cover emissions and there were reports of excessive windfall profits, particularly in the electricity sector. In order to avoid these concerns, EU officials have decided to shift to a greater use of auction in Phase III (2013-2020) and to prohibit the use of free allowances in the electricity sector.

Most of the U.S. domestic cap-and-trade proposals (including USCAP's Blueprint for Legislative Action) propose some free allocation of allowances in the early years of the program that phases out over time to an auction. The free allowances would initially be distributed to capped entities and consumers particularly disadvantaged by the secondary price impacts of a cap.

> b) What other ways is the European Commission working to correct the windfall and overallocation it experienced in the early years of the European emission trading system?

Answer. Based on experience in the first phase, the EU commission made several modifications in the second phase (2008-2012) including a significant reduction in the cap and, less free allocation, both of which result in significantly fewer allowances issued to facilities. Current emission targets in the ongoing second phase are designed to reduce total emissions in covered sectors more than 6% below 2005 levels by 2012. Going forward in the period 2013-2020, the target is 20% below 1990 levels by 2020 (equivalent to 14% below 2005 levels by 2020). The target can decrease to 30% below 1990 if other industrialized nations take comparable action.

Likely the most significant issue that contributed to the allowance price collapse of the first phase of the program was that the EU did not have good emissions data prior to program start up and as a result they subsequently issued too many allowances.

c) What lessons can Congress learn from the European experience to avoid pitfalls in designing and implementing a carbon trading system?

Answer. The EU-ETS has succeeded in setting up the infrastructure, determining country specific and industry specific targets, defining the commodity, implementing a fairly consistent set of rules and verification requirements such that carbon trading of billions of allowances among 12,000 regulated facilities and other market players has become a reality. Carbon emissions in the EU now have a recognized price—which will go up and down as happens in all markets.

The creation of this market though has not been free from difficulties and many lessons can be learned:

- First and foremost, the EU experience demonstrated the importance of good data on which to base cap-setting and allowance allocation decisions.
- Free allocation does not necessarily protect consumers from price increases; allocation must be targeted to those who bear the costs and not to those who can simply pass their costs on to others.
- Allocation decisions do not impact the environmental outcome of the program.
- The rapid development of carbon markets is facilitated by a rapid dissemination of information about emissions and allowance demand and price.
- Allowance price volatility can be dampened by including allowance banking and borrowing and allocating allowances for longer trading periods.
- The interaction between allowance allocation, allowance markets, and the unsettled state of electricity sector liberalization and regulation must be confronted as part of program design to avoid mistakes and unintended consequences—-especially where 50% of the electricity is generated with coal as it is in the United States.

Question 9a. One of my concerns is that, as far as I can tell, allowances that are given away under cap-and-trade could be sold on the secondary market at a price that would undercut the government auction reserve price.

Is this accurate, and do you see this as a potential problem for energy investments under such price uncertainty?

Answer. Prices in the secondary (as well as primary) market will reflect the overall state of supply and demand, decisions about banking and expectations about program duration and ambition. As long as program targets are expected to continually get more stringent, carbon prices would be expected to rise over time. As long as firms can bank unused allowances, future expectations about higher prices will ensure that price does not go too low.

In the U.S. Acid Rain program, for example, concern about higher future prices actually pushed firms into earlier deployment of scrubbers than required by the program and resulted in a sizable "bank" of SO2 allowances. Prices in this market did not go too low though because banking was allowed and firms expected the program to become more stringent (and they expected higher future prices).

Question 9b. What happens if or when strategic allowance reserves run out in a cap-and-trade program?

Answer. We do not expect a strategic reserve to run out if it is designed well; in particular if it includes sufficient quantities of both offsets and allowances borrowed from the future. If allowances and offsets in the strategic reserve were auctioned, the price would act as the distribution mechanism, meaning that the allowances would go to the highest bidder. Program flexibility, including ample offsets (domestic and international), the ability to borrow from future allocations, multiyear compliance and multiyear distribution of allowances, can help to contain the costs of a cap-and-trade program. The strategic reserve should act as an insurance against sustained higher price and to do so there must be sufficient supply in the reserve and there must be sufficient ability to "borrow" more from the future should the need arise.

Question 9c. If a strategic reserve is used instead of an explicit price ceiling, then what happens if the strategic reserve is continually depleted? Do costs skyrocket at that point?

Answer. See above.

RESPONSES OF MICHAEL WARA TO QUESTIONS FROM SENATOR BINGAMAN

Question 1a. In your testimony, you discuss using allowance revenue to directly fund offset projects and other projects that will reduce greenhouse gas emissions.

Do you expect that this will deliver greater reductions at lower cost than through the use of an offsets market? In other words, are offsets necessarily the most cost-effective way to obtain reductions?

Answer. Offsets are not necessarily the most cost-effective way to obtain reductions. This is true because of the additionality problem—not all reductions that are paid for will be real, and because of the high transaction costs associated with producing offsets. It is also true because the price of offsets is set by the allowance price in the cap-and-trade market. The difference between allowance price and the costs of offset production (inframarginal rent) is captured by the offset producer (or offset value chain). Using a Carbon Truse Fund to reduce emissions outside the cap might in the net, produce lower costs per ton because a market mechanism, such as a reverse auction, could be used to disburse funds. This would keep most inframarginal rents for the fund while paying offset producers enough to induce them to produce reductions but no more. In addition, because the program would not be linked to the cap-and-trade, additionality concerns, while still present, would be less central and so transaction costs could be much lower. In combination, these two effects might lead to lower average costs per ton of CO_2e reduced.

Question 1b. Are there certain types of projects that this method of funding is more suited to that an offsets market would not deliver?

Answer. Offsets are ill suited to delivering reductions that are achievable by improved policy design or implementation, by correction of market failure, or where differentiation of marginal from BAU projects is in practice impossible. An example of the first type of project is improved building standards that produce energy efficiency improvements in new construction. An example of the second is energy retrofits of rental housing. An example of the third is finance of renewable energy projects in China, where other policies are already supportive of new wind and solar builds and the energy tariff paid to generators is set by opaque agency decision rather than by markets or a public rate making procedure.

Question 2. One primary benefit of an international offsets market is that it engages developing nations in the process of achieving global emissions reductions. Are there better ways to spend money internationally that could achieve even greater reductions and engage these nations in a similar manner?

Answer. There are far better ways to spend these revenues that would both achieve reductions in global emissions and build greater levels of international cooperation on climate change. Some of the best examples of the type of work that could be funded by a Carbon Trust Fund are capacity building activities to promote energy efficiency. McKinsey has estimated that reductions from energy efficiency are enormous in developing countries, especially China, and assuming relatively conservative discount rates, will pay for themselves. Examples of small scale experiments in implementing these types of programs include the China Program of the Natural Resources Defense Council, the 1000 Enterprises Program in China, which grew out of a collaboration between one province and the Energy Foundation. These energy efficiency opportunities are the true low-hanging fruit but they do not make good offsets because ownership of the carbon reduction is unclear, because monitoring is difficult, and because additionality is hard to prove since they have a positive NPV.

Question 3. EPA projections have indicated that there will be a very limited supply of offsets coming from projects based in the U.S., and that the vast majority of the offset supply will be coming from overseas. Are there policy choices we can make to increase the supply of high-quality domestic offsets, so a greater amount of funds spent purchasing offsets stays in the U.S.?

Answer. Most US emissions are under the cap in the current US proposals. What is left—the 15.5% of GHG emissions not associated with fossil fuels—is relatively difficult to reduce using offsetting methods. Capturing a greater fraction of the revenue for domestic producers will be very tough because the best potential offset types also lend themselves to being capped—and so they are within the US under the current legislation. In contrast, these types of emission sources are uncapped in developing countries. This dynamic is likely to be exacerbated by relatively high environmental integrity in the offsets program. Indeed, the only way I can imagine the US capturing most of the offset revenue would be by largescale crediting of non-additional agricultural or forest practices and/or overcrediting of same.

RESPONSES OF MICHAEL WARA TO QUESTIONS FROM SENATOR MURKOWSKI

UTILIZATION OF REVENUES

Question 1. We should be honest about what a cap-and-trade program for reducing greenhouse gas emissions will do. Such a policy would essentially create a new form of currency and generate massive amounts of revenue through auctions, or financial largesse to be doled out in the form of free allowances.

What do you think those revenues should be spent on and who should receive that money?

Answer. Ideally, this revenue would be used to reduce other distortionary taxes within the US system. Probably the lowest hanging fruit here would be the payroll tax. Using revenue from allowance auctions to offset payroll tax revenue would increase both the willingness of US firms to hire new workers and of the US labor force to work. Using a cap-and-trade (or carbon tax) to reduce other distortionary taxes, especially when these taxes directly reduce behaviors that we want more of in our economy, is the best use of revenues. This produces what my colleague Larry Goulder has famously called a "double dividend." Society benefits both by avoiding climate changes and by increased rate of economic growth.

A second best option would be to directly rebate these revenues to consumers (note that the LDC rebate in Waxman-Markey is not the same as this). Direct rebates of revenues raised by allowance auctions would at least not distort economic activity, would offset the costs of the program for at least the lower 40% of income earners in the US (see Dallas Burtraw's work on this issue for RFF), and would give citizens a direct incentive to reduce their energy consumption relative to the average.

There is some justification for grants of free allowances to firms. Studies indicate that somewhere between 5 and 10% is required to fully compensate firms for the costs of a cap-and-trade program for greenhouse gases (again see Burtraw's work on this issue). Anything in excess of this value is windfall profit for shareholders that is produced by higher energy costs for everyone.

SUPPLY OF INTERNATIONAL OFFSETS

Question 2. In the long-term, the supply of international offsets is finite. As these offsets become more important, there will be fewer of them. Furthermore, as time goes by, I suspect that a desire to see other countries take action will be hampered by Americans having used up many of the affordable offsets, and particularly in developing countries.

Do you see this as a problem going forward, if we adopt an approach to cost containment that is similar to that contained in the House bill?

Answer. I believe that the supply of international offsets may well be constrained both in the near term, by the administrative constraints in the system, and in the long term, by developing countries accepting caps. My understanding is that assumptions along these lines are built into the EPA supply curves that underlie its analysis of HR 2454. That being said, it is highly likely that a large number of so-called least developed countries will not accept caps for some time, potentially not before 2050. If these countries begin to develop at an accelerated rate, then it is possible that they might become important sources of offsets as the key source nations (China, India, Brazil) accept commitments that are similar to developed countries. In any case, you are absolutely right that the source nations for offsets will have to evolve over the length of the program if key developed countries are to accept caps.

DIFFERENTIATING BETWEEN INTERNATIONAL AND DOMESTIC OFFSETS

Question 3. I am concerned that a full appreciation of the differences between international and domestic offsets has not sunk in with many of us involved in the climate change debate.

Can you please elaborate on the similarities and differences between domestic and international offset projects, with an emphasis on the effectiveness of them, the availability of them, and the logistical issues associated with approving/monitoring them?

Answer. International offsets typically come (with the exception of forestry) from sources that would be under the cap in the US. These offsets can be challenging to administer, as my testimony indicates, because telling the difference between crediting of business as usual and real reductions is challenging, even for well resources and intentioned regulators. Nevertheless, once baseline and additionality issues are resolved, monitoring and verification are generally relatively straight-

forward (this is the reason that these sources tend to be under the cap in a US program).

Domestic offsets (and international forestry) face all of the challenges of baselines and additionality plus important monitoring and verification challenges. Accurately estimating the amount of carbon stored in soil or in a forest is simply not possible with the accuracy at which power plant emissions are measured. Furthermore, the risks of reversal are real and difficult, as yet, to quantify and hence insure against (although this should get better as we gain experience with these offsets). If anything however, domestic offsets, because of their sources, will be intrinsically more challenging than international offsets.

DIFFICULTIES OF CERTIFYING INTERNATIONAL OFFSETS AND ENSURING COMPLIANCE

Question 4. It is apparent that many difficulties may emerge in attempting to develop an accurate tracking system for a worldwide carbon market. The House bill creates a litany of requirements that must be met before international offsets can be used. In order to host offset projects, a developing country must meet several criteria:

- They must negotiate a treaty with the U.S. to assure certain, minimum requirements are met;
- They must establish an emissions baseline and set targets to achieve zero net deforestation within 20 years;
- They must design offset projects to account for the interests of communities, indigenous peoples, and vulnerable groups with equitable profit-sharing; and
- The U.S. must certify the establishment and enforcement by the host country of laws, processes and standards to assure these rights.
- The developing country must develop a strategic plan for addressing the drivers of deforestation and identify reforms to national policies.

There is nothing wrong with these criteria, per se, but they make timely availability of international offsets impossible. It is also unclear if foreign governments would acquiesce to these conditions or not.

How do we ensure that American entities are buying legitimate carbon credits without creating an impenetrable, bureaucratic process like we've seen in the House bill? Is it even possible?

Answer. I would argue that there is no way to assure both adequate supply, or at least supply commensurate with expectations, and environmental integrity. Supply requires efficient, low-cost administrative practices; environmental integrity requires time-consuming and costly analysis of each and every project.

VERACITY OF FORESTRY AS OFFSETS

Question 5. When we look at the offset credits envisioned by so many here in Congress, it is difficult to get a clear picture of how it is all supposed to work. If a tree would have remained standing despite the enactment of climate legislation that allows offset credits, then any emission reduction attributed to that tree would be false. Despite that fact, just having "bought" it as an offset would allow the holder of an offset credit to put more greenhouse gases into the atmosphere.

What should the burden of proof be for someone generating or selling offset credits that a tree really would have been cut down were it not for the sale of a carbon credit?

Answer. Something approximating the clean and convincing evidence standard (the party with the burden must prove that the fact asserted is substantially more likely than not) seems appropriate for establishing that a credit is backed by a real reduction. It is my belief that this standard will be impossible to meet for individual projects for the reasons that you allude to but may be possible to meet for provincial or national programs that focus on deforestation rates across large areas.

TRANSFER OF WEALTH

Question 6. The European Union's Emission Trading Scheme began implementation in 2005. In the first phase, emissions covered under the Scheme rose by 0.8% across the EU as a whole. Additionally, the price of carbon fell to almost zero.

Since not all member countries had the same requirements, the European Scheme acted as a transfer of wealth. It simply forced countries with higher requirements to pay more to countries with lower requirements to purchase their credits.

If the U.S. takes a 'go at it alone' approach, are you concerned that the same transfer of wealth will occur from our American businesses to foreign entities as they purchase carbon credits?

How can we prevent this from happening?

Answer. The international transfers that would occur under a US system along the lines of HR 2454 would likely be substantial but it must be remembered that both sides benefit from trade in this circumstance. The presence of international credits lowers allowance price so that all domestic firms benefit while the seller of the offset receives revenue he would otherwise not have obtained.

I am less concerned about the magnitude of wealth transfers under the bill than that the money we spend overseas be effective in reducing emissions rather than simply subsidize activities that would have occurred anyway.

EFFECTIVE ENGAGEMENT OF DEVELOPING COUNTRIES

Question 7. You have said that you doubt the Clean Development Mechanism (CDM) is an effective means of engaging developing countries due to the CDM's general ineffectiveness and that it rewards exactly the opposite behavior.

In your opinion, what is the best way to encourage these developing countries to participate in a global reduction of GHG?

Answer. The best way to engage developing countries currently involved in the CDM in reducing emissions is to fund (via allowance allocation) investments in energy efficiency (industrial, buildings, appliances) and in the capacity to identify and implement domestic energy efficiency programs. This approach has the advantages that (1) the reductions produced are less expensive than in the CDM and (2) they are in the national interest of the developing countries and (3) they leverage funds by increasing developing country capacity to produce such reductions on its own.

LOGISTICAL HURDLES TO EFFECTIVE OFFSET VERIFICATION

Question 8. The European Union's Clean Development Mechanism (CDM), has run into problems approving projects that qualify for credit. Not only is their Executive Board extremely under-staffed and forced to rely on third party verifiers, but it also would be very time consuming to properly investigate each request.

Is there any way that this type of situation could be resolved if the U.S. were to implement a cap-and-trade system?

Answer. The logistical hurdles to proper implementation of an international or a domestic offset program are substantial. The rulemakings will be protracted and contested. The actual implementation of the program will require substantial and sustained attention from whichever agencies (EPA/USAID/USDA) are tasked with implementation. In general, the stronger the environmental integrity of the program, the greater the scrutiny required by regulators, and the more challenging the logistical hurdles. My basic perspective is that US entry into the system will actually make this problem worse because US demand will be so large relative to current supply. That being said, there are certainly process reforms that the US might push for in an international program that would lead to reduced workload. One would be a greater reliance on benchmarking rather than project by project evaluation of additionality. This is only a good idea if benchmarks are set conservatively enough that they guarantee that the credits are real. A good proposal is to set benchmarks such that they undercredit projects but to provide the option for project developers to prove an additionality case that would then allow full crediting of reductions. Probably the most important way to reduce the workload, at least for EPA and other US implementing agencies, will be to implement sectoral programs that do not rely on any sort of project-by-project implementation. These programs have the potential to produce enormous numbers of credits that, so long as sector baselines are set conservatively, will be additional. Sectoral programs are still 5 to 10 years away from being ready to grow to scale so this is really a medium term solution to the logistical issues that plague the current CDM.

RESPONSES OF MICHAEL WARA TO QUESTIONS FROM SENATOR CANTWELL

Question 1a. What role does the compliance period play in reducing price volatility?

Answer. Its important to distinguish between compliance period and banking. The ability to bank emissions across periods, provided that there are allowances to bank, can significantly reduce price volatility. This has been proven in the current EU ETS, where the 5-year trading phase (thus allowing 5-year banking) has reduced the price volatility that otherwise would have occurred due to the recession. At the same time, there is no reason that banking can't coexist with relatively frequent compliance—annually or even subannually. For example, the EU requires annual compliance but allows banking for 5 years during the current period. Frequent compliance in the US is important because environmental liabilities are given low priority in bankruptcy proceedings.

Question 1b. Are there any substantial differences in price volatility between rolling compliance periods and fixed compliance dates?

Answer. Without a model, I think this question is difficult to answer with any confidence. Also, it will depend on how effectively both physical and paper positions are communicated to the market. My suspicion is that rules on banking and/or borrowing would totally dominate as sources of volatility relative to the choice of a rolling or fixed compliance period. My major concern with a rolling compliance period would be the costs to firms and the regulator of compliance and enforcement.

Question 1c. To minimize price volatility, how much time should firms have between the emissions of greenhouse gases and the acquisition (and surrender) of allowances? One year or less? Two years? Three years? Five years?

Answer. For an industry covered by a cap-and-trade market, allowances are just like any other input used in the production process. It takes this much coal, that much payroll, and this many allowances to produce 1 megawatt hour of electricity, etc. Therefore, I think the most sensible option is to set relatively frequent true-ups for firms. The longest I would recommend is 1 year but I would encourage you to consider quarterly true up. This will force firms to think about and account for allowance costs as just another input in the production process, which is exactly how we want firms to respond to the incentives created by cap-and-trade. The danger with long periods between true-ups is that there will be volatility at the end of the period as covered entities scramble to acquire the needed allowances, and many derivatives contracts expire in a short time frame.

Question 2a. What is a reasonable number of allowances, as a percentage of yearly emissions, that firms would be able to bank for future emissions and compliance dates?

Answer. My belief is that there is no convincing justification for limiting firms ability to bank allowances. I would allow firms to bank as many allowances as they want to given their other choices regarding capital allocation.

Question 2b. How long are firms likely to retain allowances for future use? Is there likely to be a limit to their willingness to keep these assets on their balance sheets?

Answer. The honest answer is that it depends. It depends on the expectations that firms have about increases in the value of allowances, it depends on the firms' financial structure and state, it depends on firms' access to credit, it depends on who in the firms is responsible for compliance—energy firms with trading desks behave differently from industrial firms where environmental compliance departments are responsible for handling acquisitions and surrender of allowances.

Question 3. To reach the 2050 emissions targets that scientists agree are necessary to avert catastrophic climate change, is there an affordable option at mid-century that does not incorporate either a significant amount of coal with carbon capture and sequestration technology or a substantial expansion of nuclear power?

Answer. I don't think that we really know the answer to this question. It may be that new solar and wind technologies, combined with smart grid, will allow for us to achieve the deep reductions that will be required to avoid catastrophic climate change. On the other hand, if these new technologies do not emerge, then certainly nuclear and/or CCS will be required. Since we don't know what will work, we should set clear technology neutral incentives and fund research into all areas.

Question 4a. From a strictly economic viewpoint, how can the pathway of the emissions reductions or the trajectory of the cap's emissions reductions affect the costs of a climate policy?

Answer. The optimal pathways are those that start immediately but very gradually increase the level of effort to high levels at later stages of the program. The actual rate of reduction is subject to a number of uncertainties, most notably, the rate of technology development and deployment.

Question 4b. For a fixed amount of cumulative emissions, what might the optimal shape of that emissions pathway be?

Answer. The optimal shape will balance net present value of costs and benefits. In practice this is hard to do because both are quite uncertain. In practice, sending credible market signals may be more important than a theoretically optimal path. Credible commitment requires strong political support, long-term pathways that require immediate action now rather than deferring effort until late in the day, and some mechanism to insure that costs don't get out of control.

Question 5. Why do you regard the inclusion of a price floor as particularly important for investment in new energy technologies under a climate policy?

Answer. A price floor is particularly important under a cap-and-trade approach in order to create a guaranteed rate of return for low-carbon investments. Without some minimum but certain value for carbon, in the phase of the regulatory uncertainty that ultimately drives the carbon price, many firms have opted to assume a

carbon price of $0 in their planning. Moreover, sources of debt or equity financing for these startups assume a price of zero in considering their financing proposals and business plans. Thus regulatory uncertainty leads to price uncertainty which leads to a barrier to investment. The way around this is to provide certainty on the low end of the carbon price spectrum. This proposal has the added advantage of potentially increasing the environmental performance of the program if there is a miscalculation on the part of the regulator as to how large the allocation should be (for this see EU ETS Phase 1).

Question 6. Since cap-and-trade programs are so inherently complex and far-reaching:

a) How can we be sure that any scheme is workable and can be implemented by the executive branch?

Answer. Cap and trade programs are not inherently more complex than traditional command and control regulation and might be much simpler. The key advantage, and one reason that EPA favors them, is that they avoid the complexity and contention associated with designing and implementing technology standards for each class of regulated polluters. They then also avoid the costs and contention of permitting each and every facility. All that is required is monitoring and reporting—and this would be required anyway under a command and control system. It is the optional offset component that adds the regulatory complexity. My own view is that the way to implement successful cap and trade is the way that the EPA has historically done it under the Acid Rain Trading Program—to do so without the inclusion of a complicated and administratively costly offsets program.

b) How great are the risks of unintended consequences—for the economy and the environment?

Answer. Unintended consequences, both good and bad, are likely for a US cap and trade program, especially one as complex as that proposed under HR 2454. With so many different sources, actors, and interactions with other regulatory structures, both financial and environmental, predicting the performance of the system is impossible. This is not a bad thing. Unintended positive consequences—for instance discovery of low cost abatement opportunities—is a very positive effect of a system like the one proposed. The key to managing the negative unintended consequences is to create structures that can both detect and respond to them as they develop. The EU ETS does this very well for its cap-and-trade system via periodic review and revision; the CDM less well, mostly because it is a creature of international law and multilateral agreement and so difficult to change without the consensus of nearly 200 nation states. The US system design should focus on building both the detection mechanisms and the ability to respond to new information about unintended consequences into its structure. See my March, 2009 testimony before House Energy and Commerce for more on this issue.

c) What sort of growth are we likely to need in federal agencies, particularly EPA, if the House-passed bill became law?

Answer. Substantial growth. The largest staffing demands will likely fall to EPA and USDA as they both develop and then implement and enforce the offset components of the bill. The cap-and-trade provisions will also require additional FTEs but will likely be less cumbersome in the long run, similar to the ARTP under the Clean Air Act, which relative to the number of sources regulated, is not terribly staff-intensive.

Question 7. Given the complexity and intricacy of some of these policy proposals, I am particularly concerned about the opportunities they might create for market manipulation, fraud, and for the development of arcane financial instruments that will lead us to the next major global financial crisis. Do you believe that these concerns are justified? How might opportunities for market manipulation be reduced through climate policy design?

Answer. The concern that market participants might exploit weaknesses in the regulatory system to manipulate prices is potentially justified. The solution to this concern is to encourage participation in the markets by as many firms as possible and to insure, via well resourced and tough market oversight, that abuses do not occur.

Question 8. I understand that last December, the European Union made auctioning the default future allocation method for its emission trading system.

a) Was that a tacit recognition that the best way to allocate carbon permits or emission allowances is by auction?

Answer. The EU ETS has made auctioning the default allocation mechanism for electricity generators but not for industry. Industries that are subject to international competition will still receive substantial free allocation of allowances during Phase III of the EU ETS. Auctioning makes sense for sectors that can pass through the costs of permits to consumers—primarily electricity generators. For those who, either because of regulation or competition with firms in uncapped jurisdictions, cannot pass through costs, there is at least some justification for free allocation.

b) What other ways is the European Commission working to correct the windfall and overallocation it experienced in the early years of the European emission trading system?

Answer. It's important to distinguish between the windfall profits issue and the overallocaiton issue. Windfall profits are best corrected by reduced free allocation of permits. Overallocation in the EU ETS has been corrected by the European Commission in two ways. The first is by collection of better monitoring data. The key to successful startup of a cap-and-trade program is high quality data to base the first cap and allocation upon. After the first compliance deadline, good data is available via the reporting of covered installations. The second is by lowering the cap. Overallocation occurred partly because the cap was so close to business as usual emissions. Once the cap fell 8% in order to assist the EU in meeting its Kyoto Protocol obligations, overallocation was far less likely because permitted emissions were substantially below what they otherwise would have been. Overallocation will always be a possibility, even with excellent data, when the cap is set close to expected emissions, because variation in business activity can influence the actual level of emissions relative to what was expected. This is especially true when the cap is set far in advance of compliance.

c) What lessons can Congress learn from the European experience to avoid pitfalls in designing and implementing a carbon trading system?

Answer. I believe that the single most important lesson is to expect the unexpected. No system, however carefully thought out, is likely to avoid both positive and negative unintended consequences. The take away from this is that institutional structures that can learn from experience and implement mid-course correction are important to a good design for an emissions trading market.

Question 9. One of my concerns is that, as far as I can tell, allowances that are given away under cap-and-trade could be sold on the secondary market at a price that would undercut the government auction reserve price.

a) Is this accurate, and do you see this as a potential problem for energy investments under such price uncertainty?

Answer. This is possible; but in this circumstance, no allowances would be sold at auction until the market clearing price rose above the reserve price. Market expectations would likely price in this reduced supply, thus leading to higher prices in the spot market because of expectations of higher future prices.

b) What happens if or when strategic allowance reserves run out in a cap-and-trade program?

Answer. It depends on the design of the strategic reserve. Under the Kerry-Boxer proposal, prices in the cap-and-trade would be allowed to rise above the price set for the strategic reserve once the reserve was depleted. Under a true safety-valve, since there would be no limit on the number of allowances that might be sold at the safety-valve price, this would not occur.

c) If a strategic reserve is used instead of an explicit price ceiling, then what happens if the strategic reserve is continually depleted? Do costs skyrocket at that point?

Answer. The strategic reserve is not intended to limit the long-run price of allowances. Instead, it is intended to reduce short-term price spikes in the allowance market. If the system as designed, produces a long-term price of abatement that is higher than the strategic reserve, then the reserve would be depleted relatively quickly and prices would rise to balance the supply of allowances (the cap) and their demand (the cost of abatement).

Question 10. Under the House bill, I understand that the strategic reserve fund in H.R. 2454 is replenished using international forestry offsets. But with all of the other offsets proposed in the House bill are these likely to be available in sufficient numbers to rebuild the reserve, especially in the longer-term? What would this imply for cost control and for the overall viability of the cap-and-trade policy?

Answer. My sense is that a large supply of strategic reserve forestry offset is unlikely to be available in the short-term. It will take 5 to 10 years to develop the necessary regulatory and enforcement infrastructure to bring a large supply of REDD credits to market. That being said, it's not clear that the strategic reserve will actually be needed in the near-term. By the time that the level of abatement under the cap might produce high enough carbon prices to trigger the reserve, I believe that there will likely be REDD credits available.

Question 11. In your testimony you seem to suggest that a price collar with a dedicated climate trust fund to finance additional climate mitigation projects outside the cap could serve as a more effective cost control mechanism than an offset program, both in terms of price certainty and environmental integrity.

a) Could you explain how you view these two mechanisms as potential substitutes?

Answer. Offsets serve to lower prices within the cap and to, if they work as intended, lead to cost-effective reductions outside the cap. A price-collar accomplished the first objective with greater certainty than offsets because it sets hard limits outside which the regulator will not allow prics to vary. A climate trust fund would accomplish the latter by creating incentives for those outside the cap to apply for funding to reduce emissions. Using a technique such as a reverse auction to select proposals for climate trust fund funding would insure that only cost-effective reductions occurred. By delinking the outside the cap reductions from those occurring inside the cap, the program would insure that if reductions outside the cap weren't real and/or permanent and/or verifiable, no harm to the cap would occur. To the extent that the safety valve was triggered, thus effectively raising the cap, the trust fund could be used to lower outside of cap emissions, thus counterbalancing the increase in emissions.

b) Are additional emissions reductions through agricultural and forestry projects, for example, more efficient as offsets against the cap or as subsidized projects funded by a climate trust fund that are outside of the cap?

Answer. I believe that agriculture and forestry projects could be carried out more cost-effectively via a climate trust fund than via offsets. That is, more reductions could be generated for less money—because farms and forests would be paid for the marginal cost of reductions outside the cap rather than for the marginal price inside the cap. Furthermore, because the transaction costs of a subsidy program would be lower than for compliance grade offsets, more of the revenues would go to the farmer or land owner actually producing the reduction, rather than being captured by lawyers, consultants, and brokers at other levels of the offset value chain. One recent study shows that just 31% of CDM revenues actually reach the entity producing the reduction while 69% are kept by other parties. Thus reductions could be more cost-effective AND farmers and land-owners might receive more revenue under a Climate Trust Fund.

Question 12. Given the current state of the offset market, and the 45 pages of requirements governing offsets in the House passed bill, do you think there will be sufficient offsets available -domestically and internationally-to contain costs under a cap-and-trade bill over the next 20 years?

Answer. This is very difficult to predict at the present time—before the rules governing offset creation have been written. That being said, my best guess is that the rules will be written to insure that there are sufficient offsets available. If this means sacrificing the environmental integrity of the program, my evaluation of the political economy of the offsets rule making process is that it will be sacrificed. There is simply too much discretion on the part of the agency writing the regulations and too much pressure to keep costs down to avoid this outcome.

Question 13. I was struck by your testimony that we would need to process offsets 20 times faster than the CDM. How did you arrive at this conclusion?

Answer. This estimate is based on the fact that the CDM currently issues approximately 10 million tons of offset credits per month or about 120 million credits per year. The US system, in order to issue 2.4 billion tons per year (including for the 4/5 write down of international offsets), would need to issue 20 times this amount, including all of the additional regulatory process required to create higher environmental integrity than currently exists within the CDM.

APPENDIX II

Additional Material Submitted for the Record

DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, DC, September 10, 2009.

Hon. DEBBIE STABENOW,
U.S. Senate, 133 Hart Senate Office Building, Washington, DC.

DEAR SENATOR STABENOW: Thank you for your letter of June 1, 2009, cosigned by your colleagues, in support of the Department of Agriculture's (USDA) efforts to encourage farmers, ranchers, and forest landowners to address climate change and provide ecosystem services. USDA is uniquely positioned to provide farmers, ranchers, and forest landowners with the information needed to evaluate their options and quantify the benefits of greenhouse gas reduction alternatives and other services. We also have the technical capabilities to construct a robust, environmentally sound system that ensures real and lasting greenhouse gas benefits.

We are preparing to conduct a rigorous technical and science-based process to develop guidelines for quantifying the greenhouse gas benefits of agricultural and forestry practices. I have asked a newly formed Climate Change Program Office, within the Office of the Chief Economist, to coordinate this effort, working with the Natural Resources Conservation Service, the Agricultural Research Service, the Economic Research Service, the Forest Service, and the newly formed Office of Ecosystem Services and Markets.

In 2006, we released guidance to farm and forest landowners to allow them to estimate their greenhouse gas footprints. This work relied on the support of the research and program agencies across USDA. We continue to work on this front and are developing user-friendly tools that can help farmers and landowners make these calculations. The Department of Energy adopted USDA's technical greenhouse gas methods for use in its Voluntary Greenhouse Gas Reporting Registry.

Looking forward, we envision a process that can engage the public and the technical experts at every step to ensure that the most recent information is included and that there is high confidence in the emissions reductions produced through agricultural and forestry offsets.

The specifics of the plan are being finalized. In general, our plan is that these methods will be stand-alone and will be designed to: 1) quantify the emissions and sinks associated with specific source categories; 2) quantify emission reductions and carbon sequestration from conservation and land management practices and technologies; 3) support the development of entity and farm-scale greenhouse gas inventories; 4) develop prototype reporting systems; and 5) ensure compatibility with any new Federal incentive-based or offset-based greenhouse gas reduction system to the extent possible.

We would like to make these guidelines available for use in public and private registries and reporting systems. We plan to use them in assessing the performance of conservation and renewable energy programs. Finally, the guidelines will be prepared to facilitate their adoption and use in a Federal regulatory greenhouse gas offsets market The guidelines will be designed to provide reliable, real, verifiable, estimates of on-site greenhouse gas emissions, carbon storage, and carbon sequestration, They also will be designed so that they can be applied to quantify on-site greenhouse gas reductions and increases in carbon storage due to conservation and land management activities.

Thank you again for your interest and commitment to working with USDA as we move forward on these important efforts. We will make every effort to keep your offices and staffs informed of our progress. Please do not hesitate to contact us if

you have any questions or would like additional information, l am sending a similar letter to your colleagues.

Sincerely,

THOMAS J. VILSACK,
Secretary.

STATEMENT OF ROGER WILLIAMS, VICE-PRESIDENT OF BLUE SOURCE, LLC, AND CHAIR OF CARBON OFFSET PROVIDERS COALITION, SALT LAKE CITY, UT

INTRODUCTION

Mr. Chairman, my name is Roger Williams, and I am a vice-president of Blue Source, LLC based in Salt Lake City, Utah. I also serve as Chair of the Carbon Offset Providers Coalition ("COPC"). On behalf of Blue Source and the Carbon Offset Providers Coalition, I thank you, the Ranking Member, and the Committee for this opportunity to provide written testimony for the record of proceedings.

About Blue Source

Blue Source is the oldest and largest investor and developer in the U.S. of projects that reduce greenhouse gas, promote domestic energy production, and construct the physical infrastructure that will be needed to transition to a clean energy economy. Over the last 10 years, Blue Source has created the largest portfolio of emission reduction credits and projects in North America. We have offices in Salt Lake, San Francisco, Houston, New York, Calgary (Alberta), and North Carolina, and employ over 30 environmental and business professionals. We are not environmentalists, but environmental capitalists, working at the intersection of the environment and business to solve global and local environmental problems through market mechanisms and capital investment in ecosystem services, primarily low-carbon clean energy infrastructure projects. We have two primary businesses.

First, we have built an extensive portfolio of carbon credits representing over 100 million tons of greenhouse gas reductions. We invest in a wide variety of sustainable low-carbon projects such as geothermal, advanced transportation logistics, on-farm wastewater management, landfill gas energy, forestry management, and organic waste composting. We have developed the first protocols in numerous carbon categories and invested in over 20 project types in 48 states and Canada. Just one specific example is our coal mine methane project in the Powder River Basin of Wyoming, in which Blue Source provides the necessary working capital to support predraining of mine methane at a large surface mine. This project has reduced CO_2e by 1.75 million tons through the capture of otherwise wasted natural gas, which is then cleansed to pipeline quality and becomes a domestic clean energy resource. Blue Source has been very active in Federal and state carbon advocacy leadership, sharing our on-the-ground experience in environmental markets to help governments develop sensible market rules that encourage transformational changes in behavior that will accelerate America's progress to energy independence and a clean energy economy.

Blue Source also has a project development business with over $1 billion in available funds ready to deploy today in Carbon Infrastructure investments. For example, our management team has developed projects that gather approximately 340 million cubic feet per day (6.8 million metric tons per year) of industrial vent-stack-sourced carbon dioxide that delivers the CO_2 to various sites for geologic sequestration. Instead of venting into the atmosphere, Blue Source projects are transporting these emissions to Enhanced Oil Recovery projects in Canada, Wyoming, Texas and New Mexico. Our newest project will take over 250,000 tons annually of waste carbon dioxide from the LaVeta gas processing project in Colorado, separate and compress the gas, and pipe it 16 miles to connect to the existing Sheep Mountain CO_2 pipeline which supplies CO_2 for enhanced oil recovery in the Permian Basin of Texas. These kinds of projects support increased domestic energy production, recover oil resources otherwise stranded underground, and directly reduce oil imports. Our blended engineering, finance and transactional skills make such projects possible through carbon finance where traditional economics and market barriers will not. We have 60+ projects in the pipeline and intend to be a key contributor to the development of a new, national CO_2 "carbon highway" infrastructure. More information about our company is available at our website at www.bluesource.com and further examples of our projects are included in the addendum.

About the COPC

The Carbon Offset Providers Coalition www.carbonoffsetproviders.org is an alliance of the leading companies in the carbon offset market, including those involved

in financing, producing, generating, providing, aggregating and/or marketing greenhouse gas emission reductions for sale as offsets in existing and emerging voluntary and compliance greenhouse emission trading markets.

COPC members offer their collective experience from hundreds of offset projects in the U.S. and abroad that have achieved millions of tons of greenhouse gas reduction. COPC members have been actively managing climate change for the last 15 years, and are leaders in reducing greenhouse gases in the United States through carbon offsets, renewable energy, and clean tech markets. In anticipation of greenhouse gas regulation—and encouraged by states such as California and federal agencies such as EPA—our members have invested tens of millions of dollars in hundreds of offset projects in nearly all 50 states here in the U.S. and in Canada and Mexico, which collectively have helped America significantly reduce its carbon footprint. Our members are ready to invest billions of dollars more if the right public policies, market signals, and legal certainty are provided.

Many of these projects directly benefit farmers and the agricultural community by providing an additional revenue stream as payment for environmental services and greenhouse reductions achieved through advanced manure management, digesters and lagoon covers that generate green "cow power," soil management techniques that improve soil carbon stocks, precision farming and fertilizer reduction, and land management and conservation.[1] We do these projects not only as environmental investors, but also as participants, like Blue Source's CEO, Bill Townsend and his family, who are 4th generation Indiana farmers.

THE ROLE OF OFFSETS IN CONTAINING ENERGY COSTS

Blue Source and the COPC support a cap-and-trade approach that contains robust provisions for carbon offsets and low-carbon energy investments. Appropriately, most of the climate bills that have been considered in this Congress and the last have recognized the vital role that carbon offsets play in providing necessary cost containment and early investment in clean technology, carbon-reduction infrastructure and green jobs. Blue Source and COPC are ready and willing to invest in projects that serve this cost containment function, but we need investment certainty from Congress in order to do so. Both in the specific area of carbon offsets and the broader market for emissions allowances, the key to encouraging investment, managing cost and achieving price stability is for Congress to craft sensible and pragmatic regulatory structures support by clear and unambiguous market rules

A. Carbon Offsets Have Been Shown to Significantly Lower the Costs of Cap-and-Trade and Provide Other Co-Benefits

Economic analyses by the U.S. Environmental Protection Agency ("EPA") and others have shown that incentivizing a robust market in offset reductions (i.e., emissions reductions from diverse sources outside a mandatory cap) can effectively reduce the overall cost to American taxpayers and consumers of meeting the goals of global warming legislation. Conversely, failing to incentivize offsets could double the price of allowances and dramatically increase the cost of cost of cap-and-trade to American families.[2] These studies have consistently shown that the cost of compliance with a greenhouse gas cap could be up to 96% higher if there is not sufficient investment in offset projects. Accordingly, offsets provide critical costcontainment and price stability by providing flexibility to covered industries to find the lowest available cost emissions reductions across a range of options. Greenhouse gas reduction opportunities are diverse and spread across the entire economy,[3] and thus offset trading is the best means to tap these opportunities and create real change by overcoming market barriers, investment needs and misaligned incentives.

Jobs created by greenhouse gas emissions reductions projects are part of the 1.7 million jobs expected to be added by ACES.[4] As just one example, EPA estimates that a typical landfill green energy project—many of which are made possible by carbon offset revenue funded by COPC members—increases national GDP by $14

[1] U.S. Department of Agriculture, A Preliminary Analysis of the Effects of HR 2454 on U.S. Agriculture (July 22, 2009).

[2] Source: U.S.EPA Analysis of the American Clean Energy and Security Act of 2009 (H.R. 2454) (June 23, 2009); U.S.EPA Preliminary Analysis of the Waxman-Markey Discussion Draft, The American Clean Energy and Security Act of 2009 in the 111th Congress (Apr. 20, 2009); U.S.EPA, Analysis of the Low Carbon Economy Act of 2007 (Bingaman-Specter, S. 1766) (Jan. 15, 2008); U.S.EPA, Analysis of the Climate Stewardship and Innovation Act of 2007 (McCain-Lieberman, S. 280) (July 16, 2007).

[3] McKinsey & Company, Reducing U.S. Greenhouse Gas Emissions: How Much at What Cost, U.S. Greenhouse Gas Abatement Mapping Initiative (Dec. 2007).

[4] Source: US House of Representatives, The American Clean Energy and Security Act of 2009: By the Numbers.

million ($3 million local benefit) and creates nearly 70 full-time equivalent green jobs.[5] Landfill gas projects nationally generate 10.5 billion kilowatt hours of electricity and 79,000,000,000 cubic feet of biogas for direct use application—thereby displacing 177 million barrels of conventional oil.[6]

A great illustration is our Sarpy County Landfill project in Papillion, Nebraska, which captures 100,000 tons CO_2e each year from fugitive methane gas. This municipal landfill opened in 1990 and has 2.8 million tons of waste in place, but had no current revenue and was not required by EPA rules to capture landfill gas. Because the county did not have the money or access to financing or technical know-how to install a collection system, methane from the landfill was seeping out into the atmosphere, adding to global warming. Blue Source partnered with the county to overcome these barriers by using carbon credits recognized by the California Climate Action Reserve to provide the necessary revenue to finance the gas collection project. The residents of Sarpy County also benefit from improved odor control which is expected to pave the way for economic and industrial development around the landfill. We are currently evaluating a supplemental biogas-to-energy project that would sell green power to the Omaha Public Power District, which would further reduce greenhouse gas and fossil-fuel use from electric utilities.

In addition to providing cost-containment and price moderation, by energizing innovation and market forces, offset projects provide an essential bridge to a low-carbon economy. Offset projects are already providing jobs and opportunity for the U.S. economy through a robust voluntary market. Such projects have provided important incentives and revenue to many corners of the economy, including family farmers and small businesses, and have already demonstrated their ability to bring about real, positive changes in the way America generates electricity (for example, renewable energy from wind, biomass, landfill gas and solar), grows crops (though advanced farming practices and manure management), and manufactures products (through cleaner, smarter industrial processes and pollution control). In addition to reducing carbon emissions, offsets have funded the development of commercially viable methods of sequestering carbon through tree planting, agricultural advances, and long-term storage in geologic formations.

Offsets also deliver important co-benefits over and beyond combating global warming, including reduction of conventional air pollutants, improved water quality, and energy security that improve the lives of all Americans. Many offset projects directly benefit disadvantaged urban and rural communities, such as urban tree canopy projects that reduce "heat island effect" and beautify our inner cities. In addition, offset projects can incentivize the development and adoption of new, low-carbon technology developed by American industry and research institutions, which may be exported to the rest of the world.

Finally, offsets provide critical flexibility to those heavy industry sectors covered under an emissions cap as they transition to a carbon-constrained economy. If properly incentivized, offset projects are available to begin achieving greenhouse gas reductions immediately—giving regulated industry time to phase in new technology and capital investment while avoiding premature retirement of assets that could result in unnecessary economic hardship and avoidable life-cycle costs. In short, the potential of offset projects should be "unleashed" to help attain the goal of mitigating climate change and achieving America's energy independence.

Ironically, the gains achieved over the last 10 years through the voluntary carbon market are being seriously undermined by current federal legislative uncertainty, as investors who funded these projects in anticipation of federal action are now doubting whether Congress will provide the needed incentives. Accordingly, investment in low-carbon projects is dropping as a result of weak market signals. The consequence is that there will be comparatively fewer greenhouse gas reductions this year, even though investment in greenhouse gas reductions ought to be growing, and could be growing with Congressional leadership.

B. Congress Should Ensure Cost Containment Through Sensible Market Rules

We congratulate the U.S. House of Representatives for passing the American Clean Energy and Security Act of 2009, H.R. 2454, and encourage the Senate to take up similar legislation as soon as possible. Although H.R. 2454 is a major step forward, the bill as currently drafted does not fully accomplish its goal of launching America onto a new low-carbon and clean energy pathway, particularly in the near term over the next 3-5 years, due to impracticalities in the way market rules are drafted which artificially constrict the effectiveness of the offset market and create

[5] Source: U.S. EPA Landfill Methane Outreach Program, An Overview of Landfill Gas Energy in the United States.

[6] Ibid.

ambiguities that may foreclose opportunities for cost-effective emission reductions. However, this vision can be achieved with a few simple but key changes to the bill, which will allow billions of dollars of now-ready investment to start flowing immediately into the U.S. economy through low-carbon and clean energy markets. The COPC has offered detailed comments on H.R. 2454 to address these concerns, which I have included in the addendum to my testimony.

The central theme of these comments is that market rules need to be clear, predictable, and workable from an investment standpoint. The changes to H.R. 2454 proposed by Blue Source and the COPC will accomplish several important goals:

- The proposed changes will allow emission reduction projects, such as collecting methane from livestock manure or landfills for green energy, to continue capturing this methane under H.R. 2454's offsets program, without arbitrarily cutting off projects that were built prior to 2009 (or in some cases 2001), so that we don't tell the owners of these beneficial projects (who risked their hard-earned capital) that they should abandon or dismantle those projects.
- We encourage Congress to expressly recognize early emissions reductions registered with the American Carbon Registry (ACR), the Voluntary Carbon Standard (VCS), and the Climate Action Reserve (CAR), as well as other state and federal programs. These are nationally and internationally recognized, effectively governed and operated offset registries which have pedigrees of excellence with founding stakeholders such as: Environmental Defense Fund who started ACR; the States of Illinois and New Mexico, the City of Chicago and the Iowa Farm Bureau which helped establish the Chicago Climate Exchange (CCX); numerous industry, academic and nonprofit stakeholders that collaborated to develop the VCS; and state-led legislative initiatives that led to CAR and RGGI.
- The proposed changes will also allow early projects under established offset programs to continue operation under their original crediting period (which is usually 10 years) before transitioning to EPA's offsets program. Otherwise, ACES will unintentionally cause the forfeiture of millions of dollars of existing project investments. No investors will put additional money in a project that has only 3 years of confirmed economic qualification, as is the case in H.R. 2454 as drafted. The consequence is that investment is currently frozen and there will be no gains in the battle against global warming for the next 3-5 years until EPA has its program up and running.
- We have also proposed to allow covered industrial facilities the opportunity to start making emissions reductions investments now, instead of 5 years from now when compliance obligations commence, and to be awarded tradable and bankable credits for early reductions, without fear of being penalized or losing transitional assistance.
- Our proposed changes will also give limited, one-time recognition to those early actors that can prove that they reduced emissions prior to enactment of this bill. To reward these early movers, 5% of the allowances from the first year of the allowance pool (only the first year) should be set aside for pro rata distribution in recognition of this leadership, vision, and early, higher risk investment in climate change solutions that have shown that it is possible to tackle climate change and helped make serious consideration of climate legislation possible.

In short, America needs policies that start tackling climate change now—not in 5 years—with protection of existing investments and clear incentives for continued investment in early reductions, not only for the sake of the climate, but for green jobs, economic stimulus, technology advancement, revenue for farmers, small businesses, and landowners, and myriad environmental benefits including cleaner air, cleaner water, and enhanced wildlife habitat. America needs policies that will bolster, maintain and protect the early action efforts of pioneering environmental entrepreneurs; and not so easily forget or set aside their contributions.

ACHIEVING ENERGY INDEPENDENCE AND CLIMATE GOALS THROUGH ENERGY POLICY

In addition to a cap-and-trade approach, energy policy is essential for promoting investment in the clean, low-carbon economy. We encourage this Committee to seriously consider progressive changes to current energy policy that will better recognize the value of U.S. domestic energy production, better manage our domestic energy resources, and at the same time significantly reduce carbon emissions. There are several enormous opportunities for domestic energy growth that need further incentive and policy support.

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*Addendum has been retained in committee files.

A. Promote Domestic Energy Production Through Enhance Oil Recovery

First, the United States has some 85 billion barrels of stranded, domestic, onshore oil that is physically recoverable only using enhanced oil recovery ("EOR"). EOR involves injecting carbon dioxide into depleted oil and gas wells to force previously unrecoverable oil to the surface. This volume of available oil production is equal to the approximately 17 years of current total imports of foreign oil, or 42 years equivalent current U.S. production. The market value of this new production is projected to be $6 trillion at $70 per barrel, which will provide significant revenue to the U.S. Treasury. Today, EOR is produced primarily using underground CO_2. The U.S. has less than 30% of the underground CO_2 it needs to produce this oil, and at the same time, each day is venting billions of cubic feet of CO_2 from industrial facilities as a byproduct—an enormous waste of resources which many believe is also a serious environmental hazard because of its contribution to global warming. Because CO_2 injected during the EOR process can be sealed underground at the conclusion of production activities, EOR will also pave the way to commercially viable carbon capture and storage technologies that will allow hundreds of millions of tons of CO_2 to be safely stored underground in perpetuity, and thus allow the U.S. to achieve real reductions in greenhouse gas emissions.

Instead of using underground CO_2, we need to provide meaningful incentives to capture "ventstack" CO_2 and construct a "carbon highway" to transport the CO_2 to EOR fields in order to expand domestic energy production and recover these otherwise stranded natural resources. This could be accomplished through a mix of new federal (and state, where necessary) tax and nontax incentives that are targeted towards companies that develop and finance EOR infrastructure for anthropogenic CO_2. We applaud Congress for taking steps in this direction already by, for example: (1) the new Section 45Q CCS tax credit; (2) expansion of MLP rules to include the pipeline transport of anthropogenic CO_2; and (3) the CCS-related stimulus dollars that have been provided recently, all of which include EOR.

Those efforts, while admirable, are generally targeted towards industrial sources of CO_2, not the companies that are building EOR infrastructure. And to the extent that entities other than industrial sources are eligible (i.e., pipelines/MLP), the incentives are proving to be insufficient to spark the needed capital flows. We thus propose that consideration be given to a new package of incentives that might include, for example, a new investment tax credit ("ITC") for the construction of CO_2-EOR infrastructure. That new ITC, in turn, should be eligible for the recently enacted ITC/grant conversion mechanism to accommodate the current state of the capital markets and corporate revenue positions. The amount of the new ITC should be set at a sufficient level to drive projects forward while recognizing the energy independence, trade balance, national security, and green energy production benefits that such projects would deliver to the Nation.

B. Incentivize Renewable "Energy" Production of All Forms, Not Just Electricity

An estimated 1.4 trillion cubic feet of uncaptured methane emissions leak into the atmosphere every year—an amount equal to 30% of annual imports of natural gas worth $4 trillion per year at gas prices of $3 per mmBtu. Of this amount, over 300 billion cubic feet (or about 8% of U.S. imports) escapes from landfills, coal mines, wastewater treatment facilities, and potential manure management projects annually. This "biogas" is a critically important energy resource that could be captured by projects funded with greenhouse gas carbon offsets, renewable energy certificates (RECs), and/or tax incentives; however, under most state and federal energy incentive programs, if a project doesn't generate energy in the form of electricity (i.e., if the biogas is instead used to generate heat, power, or vehicle fuel), there is no incentive under most state renewable electricity programs or the federal tax credit for renewable energy.

Because biogas used in lieu of natural gas is as important to our domestic energy and environmental goals as the use of such gas to produce electricity, we need to define renewable energy more broadly to include productive use of such gas independent of electricity generation. Specifically, we recommend that Congress: (1) allow the production of such gas for beneficial use to receive the full spectrum of grant funding and tax benefits available to renewable energy, including reauthorizing the now-lapsed Section 29 biogas tax credit; (2) recognize the Btu value of biogas by expanding the current federal Renewable Fuel Standard ("RPS") to include nontransportation biofuels; and (3) include in any federal Renewable Energy Standard ("RES"), such as that proposed in this Committee's S.1462, equal credit for non-electricity energy value from biogas or other renewable sources.

In addition, Congress should recognize that methane biogas projects also deliver significant environment benefits due to the "global warming potential" of methane

which is estimated to be between 21-25 times more powerful than carbon dioxide in terms of climate change effects. In addition to the energy value of biogas projects, investments in the destruction of methane emissions should be given additional incentives to reflect this added environmental benefit. In absence of a cap-and-trade program, this could be achieved in the form of bonus credits under the federal RFS or proposed RES programs, similar to bonus credits given to cellulosic biofuels under the renewable fuels program.[7]

C. Incentivize Energy Efficiency in the Use of Fuel

The country needs additional incentives to accelerate energy efficiency, not just in the electricity sector, but also the efficient use of fuels used for heat, power, and transportation. Reducing fuel use is essentially the equivalent of expanding domestic energy production. If Congress passes a renewable energy standard, energy savings of all kinds (not just electricity) should receive a credit that would count toward renewable energy targets. Similarly, Congress should extend programs offering grants and other government support to electricity energy efficiency to cover fuel savings as well. In addition, the federal RFS program for transportation fuels should be amended to recognize avoided impacts thru vehicle fleet efficiency, advanced logistics, and other conservation measures.

Thank you for the opportunity to submit this written testimony, and we would be delighted to provide further information to the Committee.

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[7] See, e.g., 42 U.S.C. § 7545(o)(4).