CLIMATE CHANGE: LESSONS LEARNED FROM EXISTING CAP-AND-TRADE PROGRAMS

HEARING

BEFORE THE

SUBCOMMITTEE ON ENERGY AND AIR QUALITY

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COMMITTEE ON ENERGY AND COMMERCE

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CONTENTS

	Page
Hon. Rick Boucher, a Representative in Congress from the Commonwealth of Virginia, opening statement	1
Hon. J. Dennis Hastert, a Representative in Congress from the State of Illinois, opening statement	2
Hon. Mike Doyle, a Representative in Congress from the Commonwealth of Pennsylvania, opening statement	3
Hon. Joe Barton, a Representative in Congress from the State of Texas, opening statement	4
Prepared statement	5
Hon. Jane Harman, a Representative in Congress from the State of California, opening statement	7
Hon. John D. Dingell, a Representative in Congress from the State of Michigan, prepared statement	8
Hon. Michael C. Burgess, a Representative in Congress from the State of Texas, prepared statement	9
WITNESSES	
Brian McLean, Director, Office of Atmospheric Programs and the Office of Air and Radiation, U.S. Environmental Protection Agency, Washington, DC	10
Prepared statement	88
Ralph Izzo, chairman and chief executive officer-elect, the Public Service Enterprise Group Incorporated, Newark, NJ	11
Prepared statement	75
Jill Duggan, head of International Emissions Trading, U.K. Department for Environment, Food, and Rural Affairs, London, England	13
Prepared statement	67
Richard Sandor, founder, chairman, and chief executive officer, Chicago Climate Exchange, Chicago, IL	15
Prepared statement	104
Dallas Burtraw, senior fellow, Resources for the Future, Washington, DC	16
Prepared statement	50
Anne Smith, vice president, CRA International, Washington, DC	18
Prepared statement	111

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THURSDAY, MARCH 29, 2007

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON ENERGY AND AIR QUALITY,
COMMITTEE ON ENERGY AND COMMERCE,
Washington, DC.

The subcommittee met, pursuant to call, at 10:05 a.m., in room 2123 of the Rayburn House Office Building, Hon. Rick Boucher (chairman) presiding.

Members present: Representatives Butterfield, Barrow, Markey, Wynn, Doyle, Harman, Gonzalez, Inslee, Ross, Hooley, Weiner, Matheson, Dingell, Hastert, Upton, Shimkus, Shadegg, Walden, Sullivan, and Barton.

Also present: Representative Gilchrest.

Staff present: Bruce Harris, Lorie Schmidt, Chris Treanor, Margaret Horn, Kurt Bilas, Peter Spencer, David McCarthy, and Peter Kielty.

OPENING STATEMENT OF HON. RICK BOUCHER, A REPRESENTATIVE IN CONGRESS FROM THE COMMONWEALTH OF VIRGINIA

Mr. BOUCHER. The subcommittee will come to order.

In 1990, the Energy and Commerce Committee under Chairman Dingell's leadership pioneered the cap-and-trade concept as a regulatory means of achieving air quality control. We applied, in 1990, cap-and-trade for the first time to the control of sulfur dioxide emissions from stationary sources. And that was done with highly positive results.

Based largely on that successful experience, the Environmental Protection Agency and the States have established other cap-and-trade programs for fine particulate matter, for mercury emissions, and for emissions leading to ground-level ozone formation.

Today the subcommittee will begin its consideration of whether cap-and-trade should be chosen as the preferred method for a nationwide, economy-wide, program of greenhouse gas controls. It is noteworthy that in order to comply with the Kyoto Protocol, the European Union adopted cap-and-trade to control greenhouse gas emissions from a wide range of emission sources.

We intend to gain the full benefit of the European experience with cap-and-trade in this context as we design a mandatory control program for the United States. In today's hearing and during an upcoming European visit, we will ask those who have had this firsthand experience to advise us on what the European Union did

properly and perhaps what could have been done better, were that program to be designed from the outset today.

We will ask similar questions about the experience to date of the voluntary greenhouse gas cap-and-trade program that is coordinated by the Chicago Climate Exchange, and we are pleased to have the chief executive officer of that exchange with us this morning.

We also note the decision of the Northeastern and mid-Atlantic States comprising the regional greenhouse gas initiative to use cap-and-trade to reduce CO^2 emissions from power plants and the announcement by five western States that cap-and-trade will also be employed in a regional greenhouse gas controlled initiative on the Pacific Coast.

I would stress that in this subcommittee, we have to date, made no decisions about the method that we will adopt for a U.S. greenhouse gas controlled program, but obviously cap-and-trade is a major candidate for consideration for that program. During today's hearing and through further inquiries, we will be examining closely cap-and-trade as a possible choice for the U.S. program.

I want to welcome today's witnesses and thank them for preparing and submitting their testimony and being here in person in order to offer oral summaries and give us advice. And I would announce that pursuant to the rules of the committee, any member who chooses to waive an opening statement will have the time for opening statements added to that person's period for asking questions.

With that said, I am pleased now to call on the ranking Republican member of our subcommittee, the gentleman from Illinois, Mr. Hastert, for an opening statement.

OPENING STATEMENT OF HON. J. DENNIS HASTERT, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF ILLINOIS

Mr. HASTERT. Well, thank you, Mr. Chairman, for calling this important hearing. I look forward to hearing from today's witnesses about the lessons learned from the European experience from the carbon cap-and-trade program and the U.S. expertise and experience with acid rain program, which was enacted prior to the 1990 Clean Air Act, a bill that I was pleased to support.

The key lesson, I think, that we can draw from the acid rain program is that the state of commercially available technology is critical. In 1990, technology to control sulfur dioxide emissions from coal-fired power plants was readily and commercially available. Congress determined that the most economic way to encourage the deployment of this technology was to put a cap on this emission of this pollutant in law, provide time to comply, and allow utilities to acquire, bank, and trade allowances.

Unfortunately, no commercially available technology exists at this time to remove CO^2, which I would like to point out is not a pollutant from electricity generation, vehicles, and industry that rely upon carbon-based fuels. Because no technology exists to remove CO^2 emitted when we turn on the lights, start our cars, or manufacture goods, a cap-and-trade system, such as the one in place in Europe, is not an effective mechanism to control the greenhouse gas emissions. I have described such a system in the past as

cap-and-pray, since a cap without technology requires one of several bad choices. We could turn off the power. We could switch fuels, which threatens our energy security and future economic well-being, or we simply tax a generation and use electricity. In fact, that latter is what the European system has done. It is no surprise to me that the price of carbon credit is closely correlated with the price of electricity.

And finally I would note while Europeans are paying these costs, almost none of these countries are on pace to meet their Kyoto obligations. I have always believed good energy policy is good environmental policy, and the reverse is also true. Good environmental policy should be good energy policy. I believe the key to our future energy security is technology. We need to drive technology to reduce our carbon profile when we burn coal to generate electricity. We need to get more out of our motor fuels from clean, renewable fuels like ethanol and soy diesel, and we need to increase our reliance on nuclear power.

I would like to take a second to talk about a phone call I had yesterday with a fellow by the name of Dean Kamen, which I think illustrates the point that technology and innovation are the key to the world's energy and economic future. Everybody knows Dean Kamen. He is famous for inventing the Segue, but I was surprised to learn that he has invented several devices that can help those underdeveloped countries provide electricity and clean water. Imagine a device that continuously outputs a kilowatt of electricity, enough to light 70 energy-efficient light bulbs, all on an abundant local fuel, cow dung. In a village that has never had electricity, this is life-altering technology.

In short, Mr. Chairman, I think we can all learn from such examples by encouraging the development and deployment of technologies that we can overcome in a relatively short period of time. Our energy issues, whether it is dependence upon the unstable foreign sources of energy or the emissions of greenhouse gases. Once these innovations are in place, then it is time to discuss measures such as cap-and-trade to make sure that these technologies are deployed in the most economic and expeditious fashion.

Mr. Chairman, I thank you for having this hearing, and I thank you for the opportunity to speak.

Mr. BOUCHER. Thank you very much, Mr. Hastert. The gentleman from Pennsylvania, Mr. Doyle, is recognized for 3 minutes.

OPENING STATEMENT OF HON. MIKE DOYLE, A REPRESENTATIVE IN CONGRESS FROM THE COMMONWEALTH OF PENNSYLVANIA

Mr. DOYLE. Thank you, Mr. Chairman. I would like to welcome each of you to our committee as we discuss the risks and benefits associated with cap-and-trade programs, both here and in Europe. I think it is an extremely important hearing as it will provide us with valuable insight as we consider whether we will or will not include cap-and-trade program as part of our global warming legislation.

As I have stated in the past, I stand ready to work closely with Chairman Boucher and others on this committee to legislate the best possible solution as America moves forward in addressing

global warming. I think it is critical that we work to ensure that we have all the facts so that we can be sure that the policies we pass do not put our country at a competitive disadvantage with our trading partners or lead to the exportation of jobs from this country as businesses move overseas to avoid restrictions or requirements we pass. From the Clean Air Act Amendments of 1990 and Care Act, which we authored in this committee, the European Union's Emission Trading scheme, there is no lack of empirical evidence about cap-and-trade regimes.

I think it is critical that members of this committee understand the pros and cons of these systems before we move forward, both to address global warming and protect American jobs. This hearing will be very valuable in that regard. While this hearing is on cap-and-trade programs themselves, I think our committee needs to also look at what other options we have for achieving similar reductions in the emission of greenhouse gases.

Although most of our panels would express a strong support of a cap-and-trade system, I believe it is critical that all options and all combination of options are considered as we move forward.

Again, Mr. Chairman, I welcome each of the panelists to the discussion. I will consider all sides of this debate, and I look forward to rolling up my sleeves and working with you to craft the most realistic, transparent and cost-effective solution to the question posed by global warming, and with that, I yield back.

Mr. BOUCHER. Thank you very much, Mr. Doyle. The gentleman from Texas, Mr. Barton, ranking member of the full committee, is recognized for 5 minutes.

OPENING STATEMENT OF HON. JOE BARTON, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF TEXAS

Mr. BARTON. Thank you, Mr. Chairman. I listened to your opening statement with great interest as I always do, and I sense that you have begun to move somewhat slightly towards the position that I have been espousing. So I am going to begin to move somewhat slightly towards the position that you are espousing. So we are here, but we are now kind of starting the process. So I want you to know that I do listen. Our former Speaker, also in his opening statement, I think moved.

I want to submit my written opening statement for the record. I am going to speak extemporaneously for a few minutes because today we are here to talk about cap-and-trade systems. Now, I am very skeptical that a cap-and-trade system would be of any benefit to the true environmental situation, and I am fairly certain that it would be of no benefit, in fact, it would probably be a harm to our economy.

One of the reasons that many people have talked about using a cap-and-trade system for CO^2 emissions is because of the success that we had in the mid–90s and continue to have to this day with a cap-and-trade system with SO^2, sulfur dioxide. There are major differences between those two compounds. SO^2 is a harm to health. There are known quantities at which it affects human health. Prior Clean Air Acts had regulated the amount of SO^2 emissions, and we had a health standard that was set by the EPA. We put the cap-and-trade program on for SO^2 in the Clean Air Act Amendments

of 1991, I believe, because President Bush made an executive decision that he wanted to cut SO^2 emissions in half by a certain date. And the most cost beneficial way to meet that target was to go to a cap-and-trade.

Well, SO^2 is a known pollutant. It is a criteria pollutant. It is a harm to health. We already had regulations on it. CO^2 is not. CO^2 is a naturally occurring compound. There is no quantity that is known to impact health in a negative way. There is a theory that in high concentrations in the upper atmosphere, it somehow impacts the infrared scale and makes energy less likely to escape the upper atmosphere. Hence, it leads to global warming. That is a theory. It is not a fact.

We also know from historical records that CO^2 concentrations in the past have been much higher. So I dispute that cap-and-trade for CO^2 is somehow a good thing because cap-and-trade for SO^2 worked. Those are two entirely different situations.

Having said that, today we are going to look at cap-and-trade, and that is a good thing. We are also going to begin to look at solutions that make sense if we agree, for whatever reason, that we need to lessen the carbon intensity of our economy. We have several zero-emissions electricity generation options available right now, one being nuclear power. I am not aware of any group that says a nuclear plant is not a zero-emitter in terms of carbon. Well, there is a lot that we could do to accelerate the permitting process and the construction process for new nuclear plants, which is being done everywhere but in the United States.

We could also expand our solar energy issues. We could expand our wind energy. We could accelerate R and D on our hydrogen initiative the President started several years ago. So there are many, many things that we can do in a positive way to work together to begin to move to a less carbon intense economy in the United States.

And so today is the step to look at the cap-and-trade systems. I hope nobody tries to say that what has been tried in Europe is a positive. I am going to be very skeptical if we go down that trail since it has raised wholesale electricity rates in Germany 30 to 40 percent.

Having said that, Mr. Chairman, this is another substantive hearing, and I am extremely pleased that you and Chairman Dingell are trying to really develop a positive record about what the true facts are. With that, I yield back.

[The prepared statement of Mr. Barton follows:]

PREPARED STATEMENT OF HON. JOE BARTON, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF TEXAS

Thank you, Mr. Chairman, for continuing this series of hearings on global warming.

Today we will focus on the question of a "cap-and-trade" program to control our CO^2 emissions. If you recall, at the outset of these hearings I voiced my opposition to a unilateral cap-and-trade program. I said then that I see it harming the U.S. economy without helping the environment.

We haven't seen evidence to the contrary in the 10 hearings we have subsequently held. First, with respect to economic harm, we heard testimony that electric rates in Germany went up 30 to 40 percent when the cap-and-trade program was implemented. No witnesses contradicted that, not even the utility CEOs from our own country at a later hearing.

We shouldn't be surprised because the whole point of rationing CO^2 emissions is to change behavior. Sure many rent-seeking companies—including ones represented at our hearings—will be enriched if the program is written their way, but consumers and workers will pay in their energy bills and with their jobs.

Our economic analysis has hardly begun. I look forward to future hearings on the impact of a carbon cap on coal prices, on rising gas prices due to fuel switching, on cancellation of new power plants fueled with clean coal, and most importation people's jobs.

The migration of so many manufacturing jobs offshore over the past 5 years of rising natural gas prices should give us all pause. Exporting those jobs may make shrewd financial sense to many CEOs, but not to the workers I represent.

Losing American jobs to poor competitors doesn't help the global environment either. Developing countries always swap clean air for economic growth and as we heard this week, China is no different. China's economic growth is explosive, and so is China's coal combustion. We heard that decisions in China about where and what kind of power plants to build are decentralized, effectively uncontrolled.

We learned that less than 5 percent of China's coal-fired electricity plants are even fitted with ordinary sulfur dioxide control equipment, and that those with the equipment may or may not actually use it.

But, Mr. Chairman, I cannot believe that the answer is to tell American consumers that they can't buy foreign-made goods anymore because some countries won't knuckle under to our demands that they ration CO^2. As one of our witnesses said, "the greatest threat to the environment is poverty." Using our economic might to hold hundreds of millions of foreigners in poverty and deny U.S. consumers the freedom to buy what they choose is not a solution worthy of America.

What are the solutions? We have many.

These are some proposals that make economic sense and provide environmental benefit, without harming our economy:

- We should expand ZERO emissions electricity generation, including nuclear power. We must solve the problem of waste storage. We know what to do, it is time to act. We need to expand wind and solar energy. We heard testimony about what it takes to facilitate wind projects. It turns out it wasn't capping carbon, it is siting transmission so that remote wind and solar projects can serve loads miles away.
- We need to protect the hydroelectricity that we have now and look for ways to increase hydro output with efficiency improvements and new projects, including ones in the ocean.
- In partnership with industry, we need to fund research, development, and demonstration of carbon capture and sequestration. This includes Future Gen and coal-to-liquid projects, as well as fully funding technology to retrofit existing plants

Mr. Chairman, we need to step up efforts on energy efficiency.

- We should accelerate efficiency improvements for commercial and residential energy users. Better building codes and smart metering are just two examples.

Mr. Chairman, we also need efficiency improvement in transportation. Mobile sources must contribute to any effort to lessen carbon intensity.

- We reported a strong bill last year to reform automobile fuel efficiency standards and the President wants to work with us on it this year.
- We can also do more to fund and encourage advanced alternative fuels and advanced vehicles such as plug-in hybrids.

All these steps are good for our energy security, and at the same time reduce greenhouse gas emissions. CO^2 is not a pollutant, and we should not allow ourselves to be stampeded into pretending that something we exhale is now our sworn enemy. CO^2 is also in the breath of the American economy. It makes good sense to reduce it where we can, but no sense to overreach and kill jobs in the process. These are significant steps that we can take now to diminish carbon intensity and protect our economy and consumers from increased electric costs.

Thank you, Mr. Chairman.

Mr. BOUCHER. Thank you very much, Mr. Barton. The Chair recognizes the gentlewoman from California, Ms. Harman, for 3 minutes.

OPENING STATEMENT OF HON. JANE HARMAN, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF CALIFORNIA

Ms. HARMAN. Thank you, Mr. Chairman. Listening to Ranking Member Barton, I am starting to believe that maybe the political polar ice cap on this committee is starting to melt. At least the beginning of his statement implied that. But I just wanted to know, and I was chatting with my colleague, Mr. Doyle, that some of us all the way over here also think we need to do what we can with hydrogen and build the infrastructure. And we need to explore safe uses of nuclear power in our future. So just maybe we will move along smartly here.

I do however want to endorse the cap-and-trade idea strongly for CO^2. We heard from former Vice President Gore last week that cap-and-trade program is a time-tested means of harnessing the market to reduce emissions, and reduce emissions we must. I think there is growing bipartisan support on this committee about that, but I agree too that how we design a cap-and-trade program for CO^2 is crucial.

I can envision a carbon market that is rigid, unpredictable, and inefficient. That would be bad. But I can also envision a market that is liquid, flexible, and allows our economy to cope with emissions reductions in a way that makes us the example to the rest of the world. The decisions made in this room in the coming months will make the difference, and the stakes are huge.

On Tuesday I said we should use the power of the American economy as the engine for our cap-and-trade system. Opening our carbon market could be the carrot that brings the developing nations to the cap-and-trade table. The upside is obvious. Last year, much to the chagrin of many Republican and Blue Dog colleagues in this body, the U.S. had a trade deficit of over $800 billion. A carbon market could mean that our Nation could fill that gap by exporting carbon credits. If developing nations want to sell us credits and American businesses want to sell their own credits overseas, American ingenuity can win and so can our fragile environment.

I just want to close by saying that I am bullish on American ingenuity and bullish on the potential of this committee to get it right if we work together, have open minds, and learn from the experience on cap-and-trade. I yield back the balance of my time.

Mr. BOUCHER. Thank you very much, Ms. Harman. The gentleman from Utah, Mr. Matheson, is recognized for 3 minutes.

Mr. MATHESON. I will waive.

Mr. BOUCHER. The gentleman from Utah waives his opening statement. The gentleman from North Carolina, Mr. Butterfield, is recognized for 3 minutes.

Mr. BUTTERFIELD. Thank you very much, Mr. Chairman. I too want to thank you for convening this important hearing today. I do not have a formal opening statement to give or to place into the record. I simply want to thank the six witnesses for coming forward today to give us the benefit of your testimony, as I see that all six of you are ready to go. And so I am not going to unduly interfere with that.

I will say to you, however, that in so many of our hearings, we have witnesses who come forward, and the Members really have already made up their mind about the issue. But this is not the case

today. What you say today will make a difference. It certainly will make a difference with me because I don't have any fixed views on cap-and-trade, and I am sure many of the other Members feel the same way. And so what you say will be critically important. I thank you very much for coming. I yield back.

Mr. BOUCHER. Thank you very much, Mr. Butterfield. The gentleman from Massachusetts, Mr. Markey, is recognized for 3 minutes. Gentleman from Massachusetts waives.

The gentleman from New York, Mr. Weiner, is recognized for 3 minutes.

Mr. Weiner waives his opening statement. All Members having now been recognized for opening statements; any other statements for the record will be accepted at this time.

[The prepared statements of Messrs. Dingell and Burgess follow:]

PREPARED STATEMENT OF HON. JOHN D. DINGELL, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF MICHIGAN

From the outset of our climate change hearings, witnesses have been recommending a cap-and-trade program as an important element of a climate change program. Today we will hear from experts about existing cap-and-trade programs and how those experiences should inform our response to climate change.

In the 1990 Clean Air Amendments, Congress took a bold step when it adopted the Acid Rain Trading Program to reduce sulfur dioxide emissions from power plants. At that time, the cap-and-trade approach was largely untested and very controversial. We sit here almost two decades later having frequently heard witnesses praise this extremely successful program. Power plants have reduced emissions faster than required by law and at far less cost than projected. Based in large part on the success of the Acid Rain Trading Program, a number of other cap-and-trade programs have been established to address environmental problems.

Many of these programs have been quite successful, but some have had rocky times. Witnesses and members have noted some problems experienced during the first phase of the European Union's Emissions Trading System. This first phase was designed to be a learning period for the EU, and I hope to hear what lessons they have learned and whether those lessons are applicable here. If the United States decides to adopt a cap-and-trade program to address climate change, many decisions will need to be made to ensure that we tailor the solution to address our policy goals. In addition to questions about the timing and level of reductions that would be required, there are structural questions that must be answered, such as:

- Which greenhouse gases should be covered? Just carbon dioxide?
- Who should be covered by the program? Should it be economy-wide or cover just certain sectors?
- How should the allowances be distributed? Should the Government auction them? Should Congress allocate them by statute, as with the acid rain program? If not, what Government entity should be given that responsibility? Should they be given away for free as we did with most of the Acid Rain allowances? If we give them away, to whom should we give them?
- Should we allow covered entities to use offsets to meet their requirements? If so, what offsets?
- Should we have a safety valve that fixes a maximum price on allowances?
- What must be done to ensure that the program operates openly, fairly and honestly?
- What should we do with any revenues generated by safety valves or auctions?
- Are there ways to design the program to encourage technological development?
- How many of these decisions should Congress make and which should we delegate to another entity?

These are all very important questions. The answers will have critical environmental and economic consequences. It is crucial that we understand these consequences so that we can avoid those that are unintended.

I look forward to hearing from today's experts so that we can better understand the choices before us.

PREPARED STATEMENT OF HON. MICHAEL C. BURGESS, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF TEXAS

Thank you, Mr. Chairman.

I'd also like to thank our expert witnesses for appearing before us today. Your experience and perspective is especially valuable to us as we debate a potential carbon cap-and-trade system.

Mr. Chairman, I found it troubling that the first hearing that we held in this subcommittee began with a discussion of private sector cap-and-trade proposals—it appeared that we were pre-supposing the solution before we even examined the problem.

Since that time, we have held a hearing on the science behind climate change, and still others to gather perspectives from various constituencies. But we have still yet to discuss approaches other than cap-and-trade.

While I absolutely believe that we should take into account lessons learned about the cap-and-trade mechanism, I believe that this discussion should wait until we have completed gathering information and have turned to evaluating legislative options.

I also want to make a couple of points before yielding back. First, I am concerned about the possible size and complexity of a cap-and-trade to regulate carbon dioxide. The Sulfur Dioxide Program involved only about 120 emitters, whereas a CO^2 regime could involve thousands of different entities.

And second, I continue to be concerned about the increased costs in the United States, relative to the rest of the world, should we implement this program. As we've heard over and over again, it does not matter where the CO^2 is emitted—just that it is emitted at all. If we implement a cap-and-trade regime, and the result is that American manufacturing—and American manufacturing jobs—could move somewhere else that does not cap carbon emissions and as a result, overall emissions will not decrease.

Again, I'd like to thank the witnesses for appearing before us today. We greatly appreciate your thoughts on this important subject.

With that Mr. Chairman, I yield back.

Mr. BOUCHER. I am pleased to welcome our panel of witnesses, and I will say a brief word of introduction about each.

Mr. Brian McLean is the Director of the Office of Atmospheric Programs and the Office of Air and Radiation at the Environmental Protection Agency. He has been a career EPA employee for more than 30 years and has been involved in the development, implementation, and oversight of all of EPA's cap-and-trade programs for stationary sources, starting with the acid rain trading program. He is here as a technical expert on cap-and-trade programs and is not here today to discuss administration policy. And we are very pleased to have you, Mr. McLean. Welcome.

Dr. Ralph Izzo is the chairman and chief executive officer-elect of PSEG, the Public Service Enterprise Group Incorporated, a large public utility for the State of New Jersey and other areas.

Ms. Jill Duggan is the head of International Emissions Trading in the United Kingdom's Department for Environment, Food, and Rural Affairs. We are particularly honored that you have traveled to the United States to share your experience with us this morning, and we welcome you, Ms. Duggan.

Dr. Richard Sandor is the founder, chairman, and chief executive officer of the Chicago Climate Exchange, and we very much look forward to hearing about the Exchange's experience.

Dr. Dallas Burtraw is the senior fellow at Resources for the Future, and Dr. Anne Smith is vice president of CRA International. We welcome all of our witnesses. Without objection, your prepared written statement will be made a part of the record. We would very much welcome your oral summary and would hope that you could

keep that within the range of about 5 minutes. And, Mr. McLean, we will be happy to begin with you.

STATEMENT OF BRIAN MCLEAN, DIRECTOR, OFFICE OF ATMOSPHERIC PROGRAMS AND THE OFFICE OF AIR AND RADIATION AT THE ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC

Mr. MCLEAN. Mr. Chairman and members of the committee, thank you very much for inviting me to testify today on EPA's experience, designing and implementing cap-and-trade programs. While at EPA, I have worked on both traditional regulation and emissions trading, and in my remarks this morning, I will focus on what cap-and-trade is, what it has achieved, and why it works, the basic principles that we have followed.

Cap-and-trade is a market-based mechanism for addressing environmental problems and contains several key elements that distinguish it from other regulatory approaches. First, it seeks to reduce emissions by setting a mandatory cap or limit on the aggregate emissions of an entire category of sources. The cap both establishes the emission reduction goal and provides predictability for the allowance market. All significant sources, existing and new, of a particular industry or sector should be included in to minimize the shifting of production and emissions to uncovered sources.

Once the size, the timing, and scope of the cap are defined, allowances equal to the cap are then distributed. How the Government distributes allowances is an important policy and economic design decision. Emission allowances are valuable assets. Keep in mind though that whether they are distributed for free or by auction, it does not affect the total quantity of allowances under the cap, nor the environmental outcome of the program, nor the total cost of the program. It does, however, affect how the costs are distributed across the economy and who ultimately pays for the program.

Allowances can be traded, bought or sold, and banked and saved. Unrestricted trading and banking allows companies to choose, and importantly, change compliance options and minimize compliance costs. Banking also encourages early reductions and provides liquidity, which can be a cushion against price volatility and unforeseen market events.

The fourth element of these programs is monitoring. It is important that all sources accurately measure and report all their emissions. Along with complete transparency of data, this provides the foundation for ensuring both the emission reduction goal and the credibility of the allowance market. At the end of each control period, sources must surrender allowances equal to their emissions.

And finally, there must be clean consequences for non-compliance known up front to the participants. This provides certainty for both the environment and for the sources. Unlike other trading programs, cap-and-trade has a cap which ensures achievement of the emission reduction goal. Unlike traditional command and control regulation, individual source control requirements are not specified. So sources have the flexibility to experiment and the opportunity to choose and change control strategies without needing Government approval.

The allowance system also rewards companies for achieving greater control through, for instance, technology innovation. As a utility vice president once said to me, the beauty of cap-and-trade is that I can explain it to my CEO in 15 minutes.

The results from our acid rain and NOx budget programs have been impressive. SO^2 emissions from power plants are down 40 percent. Acid rain is down 30 percent across the eastern United States with costs that turned out to be less than one-third of what we had predicted. Summertime NOx emissions under our NOx budget program are down 70 percent, as are the number of areas exceeding the ozone standard. And compliance in both these programs is over 99 percent.

Cap-and-trade is also efficient to run. We work with more than 7,000 sources and have completed over 70,000 allowance transactions involving over 230,000,000 allowances. Yet the acid rain program takes only 50 EPA employees, and the NOx program 20. Given this success, in 2005, we chose this mechanism for the Clean Air Interstate Rule to reduce SO^2 and NOx emissions further.

So why have these programs worked? For the acid rain program, the answer is simple. We had good legislation, and I want to thank you for that. But second, in developing that law and its implementing regulations and in designing other programs, and then in the day-to-day program operations, we have tried to adhere to the following principles.

First, keep your eye on the prize. Above all, Government needs to focus on achieving the emission reduction goal and letting the market work to keep costs down. Second, keep it simple so it is understood by all, particularly those who must comply with it. Third, be transparent. Transparency builds public support and market confidence.

Fourth, provide certainty both in what is required and what the consequences will be for non-compliance. And fifth, be accountable. Measure and report results, including the impact on the economy and the environment.

In closing, let me reiterate that cap-and-trade can be a cost-effective, flexible and efficient instrument for achieving and sustaining environmental benefits. And its success depends greatly both on the sound design as well as effective implementation. Thank you.

[The prepared statement of Mr. McLean appears at the conclusion of the hearing.]

Mr. BOUCHER. Thank you very much, Mr. McLean. Dr. Izzo.

STATEMENT OF RALPH IZZO, CHAIRMAN AND CHIEF EXECUTIVE OFFICER-ELECT, THE PUBLIC SERVICE ENTERPRISE GROUP INCORPORATED, NEWARK, NJ

Mr. IZZO. Mr. Chairman and members of the subcommittee, I am pleased and honored to appear before you today on behalf of Public Service Enterprise Group, or PSEG. PSEG distributes electricity and natural gas to more than 2 million customers in New Jersey and owns and operates approximately 16,000 megawatts of electric generating capacity into eight States. Our generating fleet includes about 2,400 megawatts of coal-fired capacity and almost 3,500 megawatts of nuclear capacity. We believe that global climate

change represents a real environmental threat and a significant business challenge, but we also view it as an opportunity.

We support mandatory greenhouse gas reductions on a national level and a cap-and-trade mechanism to achieve the necessary reductions. I have confidence that our Nation has the intellectual capital and innovative spirit with which to meet the climate change challenge.

Numerous options already exist for reducing our emissions. These options include end-use efficiency, supply-side efficiency, renewable energy technologies, nuclear energy, and a wide range of greenhouse gas offsets. Many technologies within these categories can be implemented now, and the pace of technology development and deployment will pick up dramatically when the United States reduces regulatory uncertainty, adequately incents innovation, and establishes a market price for carbon.

As noted, we believe that national climate change policy should be structured around a cap-and-trade mechanism that will deliver meaningful reductions at a reasonable cost. Our view is based on considerable experience with other cap-and-trade programs that have been successful in reducing emissions of sulfur dioxide and nitrogen oxide.

A key question is how to best structure a national cap-and-trade program and establish a CO^2 market that will efficiently spur investment in new low and zero-carbon technologies. This will require that we improve upon the existing models. Under the Acid Rain Program, for example, virtually all SO^2 allowances were distributed at no cost to power plant operators on the basis of historic emissions.

Some would advocate that we continue this approach in a CO^2 cap-and-trade program. We disagree. This grandfathering approach, as it is commonly known, rewards technologies with lower efficiency and higher emission rates while providing no incentives for investment in new, clean technologies. We support a performance-based approach also known as an updating, output-based allocation.

Under this system, allowances would be distributed based on a facility's recent electricity output measured in kilowatt hours. New facilities, like IGCC and Ultra Super Critical Coal-Fired Plants, would be entitled to compete for allowances with existing plants. Companies would have an incentive to improve the efficiency of their existing plants and the economics of investing in clean coal and new nuclear would be improved.

Another alternative could entail the auctioning of allowances instead of distributing them. Proceeds from an auction could be used for a variety of public benefits, including consumer rebates, research and development, and energy efficiency credits will reduce taxes. And many economists agree that an auction is the most efficient and transparent method for distributing allowances.

We believe that existing coal-fired power plants continue to be an important energy resource in the United States. Therefore we think it makes sense to limit the auction of allowances in the early years of the program. We support auctioning 25 percent of the allowances at the outset of a national cap-and-trade program and transitioning

to a full 100 percent allowance auction system over a 10-year period.

It also will be critical to include emissions offsets both as a cost control measure and a source of innovative compliance solutions. These measures can include methane capture from coal mines and landfills and other options as well. A robust offset program can reduce the cost of a cap-and-trade program.

Mr. Chairman and members of the subcommittee, on behalf of PSEG, I thank you for the opportunity to offer these comments, and I will be pleased to respond to your questions later.

[The prepared statement of Mr. Izzo appears at the conclusion of the hearing.]

Mr. BOUCHER. Thank you very much, Dr. Izzo. Ms. Duggan, we will be happy to hear from you.

STATEMENT OF JILL DUGGAN, HEAD OF INTERNATIONAL EMISSIONS TRADING, UNITED KINGDOM'S DEPARTMENT FOR ENVIRONMENT, FOOD, AND RURAL AFFAIRS, LONDON, ENGLAND

Ms. DUGGAN. Thank you, Mr. Chairman and members of the committee, for inviting me to describe the UK's experience of cap-and-trade programs. I head the International Emissions Trading branch at the UK Department of Environment, and I have worked with emissions trading programs since 2003, both on the UK's voluntary program and as policy lead developing the UK's allocation plan for the second phase of the EU program.

My current responsibility is to help extend cap-and-trade programs beyond the EU whilst allowing others to learn lessons for the EU experience. To give some context, in the UK, all major political parties accept the science of climate, and climate change mitigation is therefore not a contentious issue, only insofar as how we go about it and how far we go how quickly.

Emissions trading is the central plan but not the only measure to mitigate climate change in the UK Government's portfolio of measures. It is favored because it guarantees an environmental outcome through the cap, and it maximizes the incentives to reduce emissions at least cost through the flexibility to buy and sell allowances.

Turning to the first phase of the EU program, that runs from 2005 to 2007, designed as a learning phase to ensure that when we got to the first Kyoto period, we had a successful, fully implemented scheme up and running. It was necessary to have this learning in order to collect and verify emissions data, and many of the facilities covered by the program did not collect emissions data up until that point; to put in place the institutional framework that is required for a cap-and-trade program so the electronic registries that monitor the holdings, track the holdings of emissions allowances and allow electronic surrender of those allowances the monitoring reporting protocols, the verification; and not least, to gain experience trading.

Our experience in the UK voluntary program is that sometimes it takes a couple of years for trading to really get going, and I think that was the experience in the SO^2 program in the U.S. And so it was important to have the 3-year period to get trading underway

and for participants to understand how they could benefit from this program.

What phase 1 has done is provide a very good basis for member states into the European Commission to develop and assess their plans for phase 2, and that is the process that is currently underway, with the commission assessing, to date, 17 of the 27 plans for the second phase of the EU program. And I have included in my written testimony the summary of those allocation plans and the allowances that will be issued for those member states. And I think that they demonstrate both the commission's determination to ensure real scarcity in phase 2 of the program, and also member states' determination to learn from their 2005 mission state that they now have.

As an example, Germany initially proposed an annual cap in phase 2 of 482,000,000 allowances, and that has not been cut back to 453,000,000 allowances whilst increase in the emissions that it covers. And Spain has set its phase 2 cap at 16½ percent below its 2005 verified emissions. The UK indeed has set its phase 2 cap at 13 percent below 2005 verified emissions.

And in doing so, we had a number of considerations. First, the environmental impact of the scheme, but also the impact on electricity prices and the competitiveness of UK industry. And I know there has been some discussion of electricity prices, but our assessment for phase 2 for setting the cap for UK industry at that level was that in a central case, electricity prices would rise by 1 percent by industrial users and by half a percent for domestic users.

We have learned some real lessons from phase 1 of the EU program. First, the most important lesson is that markets need real scarcity, but also that in order to ensure that scarcity, you need very good data. And what phase 1 has done is provide us with verified emissions data from many of those facilities for the first time.

We have also learned that you need more harmonization of rules and allocation processes to mitigate against competitive distortions that may happen intrastate and to make sure that we are undertaking as fairly as possible the effort that we do. Industry, we also know, needs certainty on targets and framework to make sure that it makes the low-carbon investments that we want it to do. And the European Union has recently announced its 20/20 target to cut emissions by 20 percent below 1990 levels.

But we have also have done some really good things in phase 1. We have put the institutions in place, and it was often quite a painful process in which to do so, but those registries, those allocation methodologies, were among the most important protocols.

And trading is happening. Point Carbon, the market analysis news service to the carbon market, estimates that a billion tons were traded in the EU program in 2006, and that a billion tons was worth around 18 billions euros. There is still a positive carbon price. The phase 1 price is very low. The phase 2 price is currently around 17 euros a ton, and that has been reasonably steady over the past few months.

Lastly the UK Government retains its commitment to cap-and-trade as the most cost effective way of achieving the emissions reductions we need to avoid catastrophic climate change, and I would be very happy to answer your specific questions later.

[The prepared statement of Ms. Duggan appears at the conclusion of the hearing.]

Mr. BOUCHER. Thank you very much, Ms. Duggan. Dr. Sandor.

STATEMENT OF RICHARD SANDOR, FOUNDER, CHAIRMAN, AND CHIEF EXECUTIVE OFFICER, CHICAGO CLIMATE EXCHANGE, CHICAGO, IL

Mr. SANDOR. Thank you very much, Mr. Chairman. I am delighted to be here to share our experiences with you, and also noting in looking around the room that there are four of our members, Smithfield Foods, Meadwest Bako, Roanoke, and Rolls Royce all in your district. And Illinois, I am proud to say we have 32 members, not including hundreds of traders and 75 members of the board who trade in the Chicago Mercantile Exchange. We have 4 from Pennsylvania, 14 from New York, 9 from Texas, 6 from Massachusetts, 2 from Georgia. Every single member here has member firms in our district.

We bring to bear our experience of 40 years in academia off and on and 35 years as a professional investor. We have been involved in the development of financial futures, interest rate derivatives at the Chicago Board of Trade. I had the privilege of working with Brian in the design of the SO^2 program. We did the first register trade in the EPA, and we have traded carbon throughout the decade of the 1990s, giving us an experience set.

The Chicago Climate Exchange is a cap-and-trade allowance from project-based systems. It is very important to indicate it has 300 members. They range from IBM, DuPont, Motorola, American Electric Power, Tamper Electric, four of the companies in the Dow Jones, Intel included, many, many companies that are America's leaders. In sum total, the emissions baseline of the Chicago Climate Exchange is 330 million tons, representing 10 percent of the United States stationary source emissions. So it is not a small sample.

And what have we learned? What is our architecture? Number 1, we start with the baseline of year 2000, and our members are required to cut emissions by 6 percent by 2010. This is as stringent as any bill that you have pending before you. The system allows, as I indicated, emissions reductions and most importantly project-based offsets. The Illinois Farm Bureau, the Iowa Farm Bureau, North Dakota Farmers Union, National Farmers Union. And one of the major things we have learned is the role of agriculture could be very, very significant in reducing greenhouse gases at the most efficient levels.

We, for example, have seen farmers, dairy people, rangeland management all included in our protocols. The 6 percent reduction is independently verified by the NASD and monitored. Even though we were granted a letter of regulatory exemption, we chose to be regulated in order to ensure the integrity of our data.

How has our volume proceeded? A year and 2 years ago, we traded 1.5 million tons of carbon. Last year, we traded 10.3 million tons, and in the first 90 days, we have traded 6.5 million tons roughly. That is a sign of companies being able to enter and exit without disturbing prices.

The price history is phenomenal in that we started at 80 cents a ton, got up to $5 a ton, and ultimately went down to about 3.75, where we are.

One thing I think is a common theme among all of us is price. And that volume history is important because of entry and exit, but the price is the driver.

Let me give you a few small examples. A professor from MIT called up when the price was $2, ultimately with a biodiesel invention. He was able to raise $10 million, and now that system is in practice, licensed to MIT, used by Arizona Public Service.

Intrepid, which is in the animal waste digestive program, taking methane in, raised $17 million based on a $2 or $3 price. Once you put price out there, invention is automatically spurred, and we have seen in just this little pilot with very, very low prices, professors from MIT, people in the northwestern part of the United States, doing biodigestors in Iowa, raising tens of millions of dollars all to bring the low-cost solution.

So this is very, very important as far as where we are concerned. Craig Vennor, who matched the genome project, raised $100 million to look for genetically altered microbes that eat pollutants. So even with this tiny price, we are beginning to see some things.

The Chicago Climate Exchange, in the last 2 minutes that I have, basically has a family of exchanges. We are very, very privileged. There are seven exchanges in Europe, and the European Climate Exchange has an 85 percent market share. We trade the mandated system there and do about $60 to $70 million of trading a day. We run the SO^2 futures market, which is also mandated, centrally located.

One of the lessons that we have learned. It is not daunting. There are no showstoppers. The bad news is there are data gaps and inefficiencies. We think, in summary, to distribute the allowances free is important. To credit early action is critical to have the maximum number of offsets, domestic and international. Thank you.

[The prepared statement of Mr. Sandor appears at the conclusion of the hearing.]

Mr. BOUCHER. Thank you very much, Dr. Sandor. Dr. Burtraw, we will be happy to hear from you.

STATEMENT OF DALLAS BURTRAW, SENIOR FELLOW, RESOURCES FOR THE FUTURE, WASHINGTON, DC

Mr. BURTRAW. Thank you, Mr. Chairman and members of the committee. My name is Dallas Burtraw. I am a senior fellow at Resources for the Future, a 54-year old research institution here in Washington, DC. RFF takes no institutional positions. All my comments represent my own views.

I have studied cap-and-trade programs in existence today from a scholarly and practical perspective for several years. An early lesson of these programs is that they can almost always be counted on to deliver their expected environmental results. That is whenever an emissions cap is articulated, that cap will be attained as long as there is credible monitoring, strong data systems, and credible enforcement.

The exceptions when the environmental cap has not been achieved are anachronisms, and they can be easily avoided. The more important issue from an environmental perspective is what should be the level of the cap, and the responsibility for that is a social decision that falls your way. However, given a well-articulated environmental goal, a cap-and-trade approach is a reliable tool to achieve that goal. A primary motivation for choosing this tool is to achieve cost savings relative to traditional prescriptive regulatory approaches.

In general, we can identify substantial accomplishments and cost savings here as well, but we might say the glass is only half full. Substantial cost savings fall short of the economically feasible because the programs, as they sometimes are adopted, depart from transparent market design in an attempt to accommodate a variety of special considerations that are important to one party or another.

This leads to a first lesson that rises above others that we could offer. The key to a successful program is simple rules and transparent design. This is the best assurance of efficiency and that fairness is achieved. The SO^2 trading program that was established by the 1990 Clean Air Act amendments perhaps comes closest in many ways to achieving this ideal.

The second observation that rises above the others is the importance of allocation. That is the initial distribution of emission allowances. In the case of even a modest policy affecting just the electricity sector in this country, there will be created an outset worth $30 to $40 billion per year, and that wealth will be distributed into the economy. Complicated rules for allocation can provide a clock for unfair wealth transfers of huge portions.

Where does this wealth come from? Emissions allowances are an intangible property right that is created by the program where no property rights existed previously, just as the legal systems in the 19th century created a property right in the Great American West. And it is of comparable magnitude.

For the most part, it is consumers who fund this wealth creation. It is important to note that emitters do not bear all, or necessarily even most, of the cost of the program. Those costs are borne by consumers and by other businesses. So the free distribution of allowances to emitters, especially in the electricity sector, can lead to gross overcompensation, that is extra-normal profits at the expense of consumers because the value of allowances greatly exceeds the compliance costs of investments that emitters would be expected to put in place in order to comply with the program.

By way of guidance, there are not many things you can get a group of economists to agree on, but one is the virtue of an auction for the initial distribution of emission allowances. Virtually all public finance economists support an auction of allowances because it can, for technical reasons, result in dramatic efficiency gains. Also an auction yields a source of revenue that can be used to achieve a variety of complementary policies, including research and development or direct compensation for consumers or severely affected industries.

In summary, I am a strong advocate for efficiency and climate policy because it is possible that so much will be asked of the

American people in this century that it is essential that we adopt policies that are efficient. cap-and-trade is a tool to achieve that outcome. I ask you to keep two principles in mind. One is a determined focus on simplicity and transparency in the design of the program. That means a presumptive no to many bells and whistles that may be suggested. Second, remember the crucial role of allocation. An auction should play the most important role at the beginning of the program and a growing role over time.

Despite these lessons from experience, you will be deluged with suggestions for fixes to potential or imagined problems. Those fixes are then likely to incur a whole new set of problems. In order that we learn our lessons from history and not from the school of unintended consequences, I emphasize the importance of principled market design.

There could be obtained a point where it is just not worth it to use cap-and-trade. We have other policies such as prescriptive regulation to help us get started. In moving to cap-and-trade, it is essential that we adopt a strong architecture because this is an institution that may be with us for the better part of a century. A badly designed cap-and-trade system can erode political will until there is a cloak for huge transfers of wealth. However, done right, cap-and-trade is the preemptive choice for broad-based climate policy. Thank you.

[The prepared statement of Mr. Burtraw appears at the conclusion of the hearing.]

Mr. BOUCHER. Thank you, Dr. Burtraw, and my apologies for mispronouncing your name. Dr. Smith, we will be pleased to hear from you.

STATEMENT OF ANNE SMITH, VICE PRESIDENT, CRA INTERNATIONAL, WASHINGTON, DC

Ms. SMITH. Thank you, Mr. Chairman and members of the committee. Thank you for inviting me to participate in today's hearing. I am Anne Smith, a vice president of CRA International. My testimony today represents my own research and opinions. It does not represent any positions of CRA.

Cap-and-trade is one possible form of a market-based approach to regulation. These approaches can be very effective for reducing emissions at the lowest possible cost, but to be effective, cap-and-trade must be tailored, not worn off the rank. I will explain why a good greenhouse gas cap-and-trade program should not look just like an SO^2 program on steroids.

If we design it that way, we will run into at least three serious problems. First, emissions allowance prices are notoriously volatile. Emissions traders love that volatility, but consumers do not. For SO^2, the volatility had little effect on final costs passed through to consumers. Prices on CO^2 emissions, however, will more readily appear in consumers' costs of living.

For example, the carbon price swings that have occurred in the EU ETS so far have caused the cost of coal-fired electricity generation to rise and fall by almost 200 percent. It is not entirely coincidental that the average EU business's electricity rates, across the whole EU, rose by 16 percent in 2005. So clearly a well-designed cap-and-trade program must eliminate such price spikes. This can

be done by letting the Government sell extra permits at a pre-established affordable price to anybody who wants to buy them. It can be done even more easily and simply using other market-based approaches such as emission fees.

The second problem of copying the SO^2 model relates to the international dimension of greenhouse gases, which is not a concern for SO^2. The fact that a price on CO^2 directly increases costs of productions means that domestic businesses will see their costs increasing as the price of carbon is added. And it will make them less able to compete with their competitors in uncapped countries.

If we reduce our greenhouse gas emissions domestically but they are offset by increases elsewhere in the world, large sums of money could be spent by us on controls with no actual environmental benefit. The bottom line, any domestic cap-and-trade program that is implemented in advance of internationally coordinated efforts should be designed with permit price caps, and low ones at that.

Third, in contrast to SO^2 and NOx, greenhouse gas sources come from a wide vast array of sources. Covering all of these sources is not possible with a cap that is imposed at the point where emissions occur, as we do with SO^2. Imagine imposing a cap on all automobile tailpipes. Fortunately, there is actually a very simple way to achieve nearly universal coverage of greenhouse gases: cap them upstream before they are ever even emitted.

How? By capping carbon in the fossil fuels rather than capping the emissions as those fuels are burned. The EU ETS program followed the SO^2 model by capping CO^2 at the point of emission or downstream, rather than upstream. As a result, that cap covers less than half of EU's greenhouse gas emissions. The other half continues to grow, making it very likely that the EU may not meet its emissions targets.

An upstream approach could have covered those other emissions too. The upstream approach is neither radical nor novel. It was used successfully in two of our earliest cap-and-trade programs for the phase-down of lead in gasoline and the phase-out of chlorofluorocarbons.

Some are concerned about an upstream approach because they think that it will affect their permit allocations. You can completely separate the decision about the point of regulation from any decisions about who should receive the permit allocations. And I think that you should make this separation very clearly.

In summary, there are reasonable approaches that will work for a greenhouse gas cap, but they look very different from the widely touted SO^2 and NOx cap-and-trade programs. Unfortunately, many policymakers want to run away from the market-based approaches and go back to prescriptive regulations.

This would be very costly. For example, I have estimated that a renewable portfolio standard, as an alternative to a cap, would cost four times as much as any simple pure cap-and-trade program to produce the same amount of emissions reductions.

I close on the need for more and better R and D. Market-based policies stimulate innovation that is incremental in nature and deployment of emerging new technologies. But sadly and contrary to widespread belief, cap-and-trade programs cannot stimulate the kinds of technological progress that are necessary to enable the

much, much deeper emissions cuts that are required to achieve climate stabilization. And the current preoccupation with how to impose near-term greenhouse gas controls is crowding out attention to this much more important bottleneck for reducing climate change risks. Thank you very much for your time. There are more details in my written comments, which will be in the record, I hope.

[The prepared statement of Ms. Smith appears at the conclusion of the hearing.]

Mr. BOUCHER. Thank you, Dr. Smith, and I want to say thank you to each of our witnesses for their well prepared and presented testimony this morning. This is one of the more interesting hearings that we are having in our series on climate change, and I truly appreciate the information that you provided to us.

We just received a notice for a recorded vote on the floor of the House, and we have approximately 10 minutes before we have to leave for that. What I am going to attempt to do is keep this hearing going throughout the entire recorded vote. Mr. Hastert and I are going to ask our questions and then depart, while other members propound theirs.

Let me begin, Ms. Duggan, with you. And again thank you for traveling here from a long distance to share your experience with us. The testimony we have received about the European Union's experience with cap-and-trade has not been uniform. Some have suggested that it has been a good experience. Others have said that it could have been a better designed system, that there have been significant flaws in that first phase. Would you care to respond to that? How would you characterize the overall experience? Specifically, I understand your first phase was designed to be somewhat experimental. How would you say the experience has been with that first phase? What have you learned from it? What do you intend to do differently in the second phase?

Ms. DUGGAN. The first phase, as you rightly point out, was designed as an experimental phase. And I mentioned in my opening statement, there are good reasons to actually have that experimental phase prior to the 2008–12 Kyoto period where member states do have obligations under Kyoto. And therefore it was very rushed. Implementation was rushed. Trading was due to start on the first of January 2005. The UK, although it worked hard and put a lot of resources into this, did not have its final approval and its registered life until May of that year, and we were one of the earliest States to achieve that milestone.

And so one of the things that happened in 2005 and early 2006 was that final decisions were made on allocations. Registries came live, and allocations were made. So volatility in the market in the first phase was essentially due to the decisions of allocation and the availability of allowances. And I think if we had more time, then clearly all of us would have preferred to have had that happen in more harmony prior to the start of the scheme. So I think that one thing is that trading schemes do take quite a long time to design, and getting that institutional framework in place is time consuming and often difficult.

We have had, in the first phase, 95 percent free allocation. That does not mean that facilities get 95 percent of need. It means that

as a minimum, States, once they made their allocation decision, should give 95 percent of that allocation for free. But different States made different allocation decisions, and I think that one of the things that came apparent last May, when the first results were announced, was that some States had either cut their emissions or they had set those allowances. Other States didn't. UK, having had experience of its own voluntary trading program and more emissions data, I would suggest than many, actually our cap was 35 million below what the electricity power sector needed, and 27 million below need altogether. So we were one of the ones that was buying in from elsewhere.

Mr. BOUCHER. Let me ask this other question if I might because I only have 2 minutes left.

Could you describe the effect from the vantage point of industry in the United Kingdom of the implementation of cap-and-trade there? Has there been disadvantage to industry? And if so, to what extent? And have particular industrial sectors suffered unusual disadvantage in comparison with others? And describe, if you would also, the effect of the implementation of cap-and-trade to the average consumer of energy in the United Kingdom. So from the vantage point of both industry and consumers, what has been the experience?

Ms. DUGGAN. The experience—the UK industry, we made a decision to put the burden on large electricity producers for phase 1 and for phase 2 of the program because they are insulated from international competition, and they have an ability to pass through costs so that they would be less impacted, if you like.

Other sectors of industries that were covered by the program were allocated at predicted need, and in fact, in that very first year, as I said, the electricity producers with, I think, 37 million short of allowances and the rest of the UK industry was in aggregate 10 million long in allowances. So that although they faced some increase in electricity prices, they also had allowances that they could sell in the market. They could mitigate against that by reducing their energy use and selling the allowances back to the electricity producers.

Clearly, some sectors are more subject to international competition than others, and the analysis that we have done to date shows that of all the sectors that potentially could be covered by the scheme, the aluminum sector is the most vulnerable to international competition. In the UK, they have only been included insofar as they have combustion installations that meet the definition of the program. And they therefore have had a free allocation to cover that. There is clearly a need for a more analysis, but they are the most vulnerable sector that we have seen. Other sectors are relatively insulated from international competition. Some are regionally traded. It is one of the things that we are looking at, but we only have one year's data to date. The second year's data will come through soon.

Mr. BOUCHER. And finally, the price of electricity at the retail market, how has that been affected?

Ms. DUGGAN. The price of electricity did go up during 2005.

Mr. BOUCHER. By how much?

Ms. DUGGAN. I don't have the exact figures. I will get back to you. The largest part of that increase was due to the rise in natural gas prices, and I think the U.S. also saw increases in electricity prices over the——

Mr. BOUCHER. For unrelated reasons, yes.

Ms. DUGGAN. Yes.

Mr. BOUCHER. OK. Well, my time has expired. Thank you. And let me recognize now the gentleman from Illinois, Mr. Hastert, for 5 minutes.

Mr. HASTERT. Thank you very much. A couple questions I want to ask and very quick answers if I could. Ms. Duggan, in European Union, and is it intra- or inter-trading? Do you trade within a country, all the trading with UK, or will you trade with Germany for instance?

Ms. DUGGAN. Both. We trade with any facility or any trader, and Europe can trade with any other facility anywhere in Europe.

Mr. HASTERT. All right. So to me, I am just trying to look through this thing. So the environmental benefits goes to those people who are low emitters under the cap. So their customers aren't necessarily benefited from the low emissions if they sell the credit. If they sell the credit then to somebody who emits more CO^2 over the cap, then that cost is passed on to that company. They buy those credits so there is a cost, and then that money is passed through to the consumer, right? So electricity prices go up?

Ms. DUGGAN. Electricity prices go up.

Mr. HASTERT. And emissions basically stay the same, right?

Ms. DUGGAN. It depends on the overall cap.

Mr. HASTERT. Well, let us say in your country itself. Say the new plant that you brought in on T-side, the big plant that burns natural gas off the North Seal. It is huge, and so it has very low emissions. And you take and sell those credits then to somebody down in Wales that has a coal plant that is not very modern. So you have somebody trading caps or trading credits here, and so people with coal costs go up to those people who buy that energy at the same time the price is set, plus the emissions are set at T-side. Is that correct?

Ms. DUGGAN. Yes.

Mr. HASTERT. Very good.

Mr. HASTERT. Then let me ask the gentleman, Mr. McLean. When we put in the SOx and NOx emissions and we did when the EPA and others did this clean air thing, was the commercial ability to clean up SOx and NOx available?

Mr. MCLEAN. There were several options available.

Mr. HASTERT. So the commercial ability to do that was available. How about the commercial availability today across this Nation to take CO^2 and sequester it?

Mr. MCLEAN. Those options are becoming available. It depends on where you set the cap. If you don't make it a stringent cap, there are plenty of options to reduce 5 percent. If you set a cap at a 50 percent reduction, yes, you would have difficulty.

Mr. HASTERT. All right. And then, Ms. Smith, basically you said prices on CO^2 cause a cost of coal-fired increase of almost 200 percent. So is that the cost of putting this on the facility itself? Or is

it the cost of buying the credits and passing them onto the consumer?

Ms. SMITH. That is the price of buying the credits when they were at the highest level that occurred in the EU ETS system, which was about $35 a ton of CO^2.

Mr. HASTERT. Have you done any projections on let us say the coal-fired plants in the south central part of the United States, Virginia and West Virginia and Ohio and Indiana and southern Illinois, the coal coming from those plants? What kind of increase in cost might there be? Any idea at all?

Ms. SMITH. It depends, as Mr. McLean was saying, on the stringency of the cap, but if you set a cap at about a 50 percent reduction, such as we did do under the SO^2 market, you would probably see prices very much in the range of, well, tens to hundreds of dollars a ton of CO^2 to get a 50 percent reduction, if we were trying to do it with current technology in today's world.

Mr. HASTERT. So what, for instance, would that cost be when you pass that onto a customer per kilowatt hour?

Ms. SMITH. Well, the price increase in coal-fired generation doesn't translate—say it is a 200 percent increase. That does not translate into a 200 percent increase in the cost of electricity.

Mr. HASTERT. I didn't say that.

Ms. SMITH. Right, but when you say try to say what would happen across the whole electricity system at the same price, it would be perhaps a 20 percent, 30 percent increase in the price of electricity?

Ms. SMITH. Yes.

Mr. HASTERT. Thank you. My time is up. Thank you, Mr. Chairman.

Mr. BOUCHER. OK, thank you very much, Mr. Hastert. There being no majority members in the room, other than the chairman, and the chairman having to go vote, I am going to exercise the option of recessing the committee momentarily. I think our vice chairman of this committee, Mr. Butterfield, will be returning shortly. So stay where you are. We are going to recess until he returns, and when he returns, he will be in the Chair and will propound his questions, as will other members in order. With that said, the committee stands in recess.

[Recess.]

Mr. BUTTERFIELD [presiding]. The committee will come back to order. Let me thank the witnesses for your extreme patience this morning. We had a roll-call vote, and most of the members are now on the floor. The chairman had asked that I leave early and cast my vote and get back to the committee to resume these deliberations.

It is now time for the questions from the various committee members, and I am going to start. And I think I am going to address this question to you, Mr. McLean, if you would. Sir, I feel very strongly that climate change is a global issue, which must be addressed by our country as a whole and in cooperation with the world. If the Federal Government fails to make the responsible choice in crafting a solution to this problem, is it possible that our States could develop mandatory greenhouse gas reduction programs that would be effective enough? And could there be some

major problems with this type of patchwork approach to regulation?

Mr. MCLEAN. Sir, I understand your question, and it raises sort of an overall policy question about how to proceed, the timing to proceed, the relationship between the Federal Government and the States. And it sort of getting beyond my area of expertise to sort of call that judgment, but I understand what your concern is. And I think it is a legitimate concern that ought to be weighed in your deliberations as to when to act and how to——

Mr. BUTTERFIELD. Dr. Burtraw, you want to take a stab at that one?

Mr. BURTRAW. Sir, I think that for a meaningful policy that addresses climate issues, it really is fundamentally a Federal and international issue. But I think there is an important role for leadership in the States, and if ever there was a case where the States are a laboratory of new ideas, this is where we are seeing it today. And there are some important architecture design issues that—they merged in RGGI and California, I think they can be very useful for you to consider for a national model.

Mr. BUTTERFIELD. Dr. Izzo?

Mr. IZZO. We would agree with you that it is critically important that it be a national cap-and-trade program. While we have been very supportive of what has gone on in the RGGI states, I would be less than accurate if I didn't admit that we have been challenged with many of our coal investments to recognize how to proceed given that several of the RGGI states have different points of view of what the future will hold, yet many of those States have a common clearing price for wholesale electricity. So you have uncommon cost structures, common clearing price, and some huge competitive dislocations with those disparities.

Mr. BUTTERFIELD. There are some people who argue that a cap-and-trade system to reduce greenhouse gases will lead to much higher energy cost and job loss. We heard testimony earlier this week that in India, for example, there is a strong resistance to employ any environmental protections which might slow economic growth. Is it possible that a cap-and-trade system could actually spur technological innovation as businesses seek to reduce their greenhouse gas output, thereby creating new jobs in industry? Dr. Sandor?

Mr. SANDOR. I do think a cap-and-trade system will spur new technology. Every experience that we have had with regard to inventors, we probably see, I would say, 50 to 150 proposals from inventors, be they small firms or large firms. And I do believe ultimately there will be a green tech revolution from the date that we see, and the processes will come from the small inventors, as they did in the Web. This price discovery allows individuals and people that finance in private equity firms to raise capital and to do things out of the box that might not be done otherwise.

Mr. BUTTERFIELD. Thank you. Finally, Dr. Burtraw, let me ask you my final question. Sir, in the past, efforts to curb emissions and pollution have often left poor communities and minority communities far behind. One concern with a cap-and-trade system is that it may be easier to reduce emissions in the newer factories located in affluent areas rather than undertake the more costly effort

to deal with the older factories that are often in low-income communities and tend to have high emissions of greenhouse gases. Do you have any suggestion on how we can help to ensure environmental justice, as we call it, in our low-income communities?

Mr. BURTRAW. Sir, I take that question very seriously. I am serving on the market advisory committee in the State of California as they look at designing and implementing AB 32 in that State. And this issue is very sharp and keen in that context.

The CO^2 is not a local pollutant, but the reason that it becomes such a key issue with the subject of environmental justice is that its emissions of CO^2 are correlated with the emission of other toxic pollutants that can have a local effect. And so advocates who want to see a reduction on these other types of hazardous air pollutants use any tool that they can grab a hold of to try to achieve the benefits for their local community.

I think the more appropriate thing to think about is designing the CO^2 policy, rather than trying to constrain the way that you would achieve CO^2 reductions, and a cost-effective way, is to recognize what can be done to achieve economic justice as a superset for what includes environmental justice.

And one of the most interesting models in this regard is, again I will point to the RGGI example, the Regional Greenhouse Gas Initiative, which is mandating a significant portion of emission allowances, at least 25 percent, should be set aside for strategic energy investments. And modeling what we have done for the State of Maryland, we showed that by putting that allowance revenue into end-use efficiency investments, electricity prices could restabilize even as Maryland joined the Regional Greenhouse Gas Initiative.

Mr. BUTTERFIELD. Thank you very much. At this time, the Chair recognizes the ranking member of the full committee, the gentleman from Texas.

Mr. BARTON. Thank you, Mr. Chairman. Thank you for coming back early so we could keep going. I want to ask Ms. Duggan my understanding—I don't know that this is a fact. That is why I am asking it—that Great Britain primarily made a decision to meet its targets under Kyoto by really eliminating domestically produced coal or reducing the amount of coal and going to a Norse Sea gas and maybe even LNG from Norway. Is that true or not true?

Ms. DUGGAN. I think there was certainly a move to use gas in the 1990s, though one of the things I wanted to say in 2005, even under the EU emissions trading program, there is a switch that year from gas to coal in the UK. There has been a number of measures, and the UK is constantly looking at ways in which to reduce its carbon emissions. And that work continues, and so there has been a variety of means to do so.

Mr. BARTON. Is it fair to say that the use of coal has declined?

Ms. DUGGAN. I cannot categorically answer that. I will get back to you and put something in the text.

Mr. BARTON. Fine. I just asked because you are from Great Britain. Ms. Smith, our EPA witness in his prepared testimony, and I am told in his verbal testimony, talks about leakage. If you don't design the system well, people move to where it is not regulated. Do you have any evidence that would indicate that if we really put

a significant cap-and-trade system on in the United States that we wouldn't just have a lot of industry migrate to places like China, where they have shown no inclination at all to limit their carbon emissions? And no. 2, do you think China would ever join an international group that would actually be effective at reducing air emissions?

Ms. SMITH. Regarding leakage, we can't say we have hard evidence because we haven't tried the experiment. But there has been a lot of modeling exercises that we had done and others in our modeling community have done, which do indicate that there is a great potential for leakage. It is not 100 percent leakage, meaning every ton reduced in a capped country does not reappear as a extra ton in another country that is uncapped. But leakage does seem to have a potential to occur at the level of maybe 5 to 15 percent of the emissions, and that is pretty significant when it is occurring at the cost of industry within one's own country.

We also see that even in State programs where a unilateral state might impose a cap unilaterally on self without the States surrounding it doing that within the U.S. And we see that kind of leakage number occurring across State numbers.

Mr. BARTON. OK.

Ms. SMITH. The second question was whether China would ever follow us in a cap-and-trade program. I am not an international lawyer. I really don't have an answer to that, but I will say that I don't believe, by putting a cap on our own Nation, that we will get the countries such as India and China to follow us. I don't see any incentive for them to do that.

Mr. BARTON. OK.

Ms. SMITH. Though I do think we need to coordinate the policies before applying the caps.

Mr. BARTON. OK, Mr. McLean, I am told that you are the director at the EPA of the office that has actually implemented the SO^2 cap-and-trade. Correct me if I am wrong. SO^2, we primarily regulated and capped at smokestacks at the stationary sources. I don't think we did anything for mobile sources. Is that true?

Mr. MCLEAN. That is correct. Utilities were about 70 percent of the SO^2 in this country, and so that is the sector we focused on. Transportation for SO^2 is a very small portion of it.

Mr. BARTON. Now, if we are going to cap-and-trade CO^2, my information is that it is about a third generated by stationary sources, about a third by mobile sources, and then about a third by so-called natural sources. How do you cap-and-trade mobile sources and natural sources?

Mr. MCLEAN. Well, first of all, yes, utilities are about a third and then other industrial sources are another 20 percent or so. So about 50 percent are utilities and industrial sources, and about a third are mobile sources. The rest tend to be commercial, residential, sort of making up that 100 percent.

We have not used this technique to deal with the mobile source sector and what I can say is when we dealt with NOx, we focused on utilities and industrial sources which were about 30 percent of the total NOx emissions in the eastern United States. And that was the focus of the cap-and-trade.

So 70 percent wasn't even covered under cap-and-trade. We used other tools to——

Mr. BARTON. My time is expired, but Mr. Chairman, if we are going to seriously review cap-and-trade, I would stipulate that the entire totality of the emissions has to be capped and trade, and that is something we need to pursue.

Thank you for your time, and I thank the witnesses for being here.

Mr. BUTTERFIELD. Thank you very much, Mr. Barton.

The gentleman from Pennsylvania, Mr. Doyle, is recognized for 5 minutes.

Mr. DOYLE. Thank you, Mr. Chairman.

Mr. Sandor, I am very concerned that we ensure that any legislation we enact includes provisions that encourage our trading partners, especially in rapidly developing countries like China and India, to also make significant reductions in their greenhouse gas emissions.

Now, in your testimony you stated that you have engaged the leaders of both of these countries on the issue of market-based initiatives that address environmental concerns. I am interested to hear more about that, specifically, what have you talked to them about and how would you gauge their level of interest, and more importantly, their desire to actually start pursuing these strategies?

Mr. SANDOR. Let me share with you my experience. I have been to China three times in the last 5 months, and I have been to India two times. We have started forming something similar to CCX called the Indian Climate Exchange, and it involves the same caliber of companies that the Chicago Climate Exchange, some of the leading industrialists, et cetera.

We found that at least in the private sector—now, I can't speak for their leaders, OK, and the policy people. I can tell you that there are the counterparts to my members like DuPonts, IBMs, Safeway stores, Duquesne Power and Light, that there is many of those that are over there that say we want to learn what you are doing and we would like you to help us establish an exchange.

Our experience is that in the industrial sector—now, make no mistake, even in China, there is a lot of wealth being created by the private sector, and those folks, not their leaders—again, I can't speak to the leadership, but I can tell you we sense the same latent demand for action among the industrialists there that we sense here. Everybody said without the absence of a law, you would never get anybody to join a legally binding private sector agreement to reduce greenhouse gases. And we have engaged 10 percent of the United States in that debate with no law. And it is my business view that we can duplicate our efforts in Asia and then track them in. We have five Chinese companies. We have two Indian. We have seven Brazilian companies that have taken on reduction targets. So our experience, again one small piece of data.

And then third, I had the pleasure of being invited to speak at Beijing University. I happen to be a professor at Northwestern University. At that talk at Beijing University, I would say the students were every bit as literate, if not more, about cap-and-trade and emissions trading. They actually asked me, the 21-year old,

why the price in Chicago was this, and how come it differed from the price in Europe. So the universities there are teaching cap-and-trade to the students in China as we speak.

Mr. DOYLE. I will bet you not many students in American universities know what cap-and-trade is.

Mr. SANDOR. Well, the other thing, which I think is just incidental to this, I came with Mandarin slides and threw them out after one presentation because everybody was bilingual.

Mr. DOYLE. Thank you, sir. I want to ask Mr. McLean probably my last question. Mr. McLean, as Congressman Barton said, carbon poses different challenges than does SO^2. And given your experience administering the acid rain program, how would you structure this program to meet these challenges? And do you think that we should take an economy-wide approach, as others have testified? Or do you believe the committee should just focus on specific industries to meet the reduction goals?

Mr. MCLEAN. OK, I will try to give you an answer based on experience that we have had. As I said, there are many policy instruments out there. cap-and-trade is one of the market-based instruments. There are traditional regulation, and my office also runs voluntary programs.

We have not applied cap-and-trade to the entire problem, either for SO^2 or for NOx. We have applied it to those sectors where we thought it would work well, where it could be run effectively, and we could get reduction.

Mr. DOYLE. So let me ask you this because my time is almost up. What do you believe is the real world achievable reduction that a perfect cap-and-trade program could bring about in the next 5 years?

Mr. MCLEAN. I can't really give you an answer to that question.

Mr. DOYLE. You don't want to wing that one?

Mr. MCLEAN. No, thank you.

Mr. DOYLE. Thank you, Mr. Chairman. I see my time is up.

Mr. BOUCHER. Thank you very much, Mr. Doyle. The gentleman from Michigan, Mr. Upton, is recognized for 3 minutes.

Mr. UPTON. Three minutes or 5 minutes?

Mr. BOUCHER. I am sorry. Five minutes. You are worth every second of 5 minutes.

Mr. UPTON. I know I wasn't here to get the additional three, and I do want to apologize for being late. We had a meeting downtown, and it was very difficult to get back. So I missed your testimony and some of the questions here, but I appreciate your willingness obviously to be here this morning.

Mr. SHIMKUS. Same meeting I was at.

Mr. UPTON. I was at the same meeting as you were, Mr. Shimkus. We tried to get an early bus to leave, and we couldn't do it. We commandeered it, but it didn't work. They had guns. It was the President.

Ms. Duggan, I think you answered about the UK meeting its Kyoto targets, and I just wonder what percentage of their electricity production comes from natural gas, nuclear, and coal. Do you know?

Ms. DUGGAN. I believe that nuclear counts for about 20 percent. I don't have the figures on coal and gas.

Mr. UPTON. So about the same nuclear as it is here. And do you know if the UK is expanding its nuclear capability to provide electricity?

Ms. DUGGAN. We published an energy-wide paper last year, looking at the future of energy for the UK, and a bill will be published shortly. I am not sure exactly when. And that will set out the UK strategy for energy policy going to the future.

Mr. UPTON. OK, Dr. Izzo, your company currently produces about 45 percent of its electricity from nuclear, as I understand it. Do you have any plans to increase your nuclear energy production as a way to reduce CO^2?

Mr. IZZO. Yes, we do. In fact, this autumn coming up, we will complete a 120-megawatt upgrade at one of our nuclear facilities, and we are actively considering——

Mr. UPTON. And where is that facility?

Mr. IZZO. That is in Salem County, New Jersey, and we are actively considering the submission of a license for a new facility in New Jersey.

Mr. UPTON. And how long did it take, as you looked at this facility in Salem Country, how long did it take you, from the point that you decided that is where you wanted to go, how long did it take to get through the regulatory process to actually get to where you are today? How long ago did you start?

Mr. IZZO. The upgrading process took about 2 years. A new nuclear plant, from decision point to production of a kilowatt hour, will probably take 10 years.

Mr. UPTON. Dr. Sandor, we appreciated your testimony, and there are a number of us from the Midwest that are not too far from Chicago. So you may get a call from us in the next couple weeks wondering if a couple of us might come by and visit your exchange.

Mr. SANDOR. We would be very pleased. As you know, some of our significant members are in Michigan. Dow Corning, Michigan State University.

Mr. UPTON. I am a Wolverine, I want you to know.

Mr. SANDOR. OK. Well, we are talking to the university here in Michigan, plus I have a home on Lake Michigan so——

Mr. UPTON. Which town?

Mr. SANDOR. Halfway between St. Joe and Southaven.

Mr. UPTON. So you are in my district. So you are in one of the fire lanes?

Mr. SANDOR. Yes.

Mr. UPTON. Which fire lane?

Mr. SANDOR. Fire lane nine.

Mr. UPTON. Nine, OK.

Mr. SANDOR. Wilderness Dunes.

Mr. UPTON. I know exactly where it is. Look forward to seeing you, and I think Mr. Shimkus and Mr. Hastert intend to come to try and visit. I live in St. Joe, Dr. Sandor. I live just north of the river. Dr. McLean, as we talk about monitoring greenhouse gases accurately, we heard earlier in the week about both China and India. China, of course, putting on line literally two new coal-fired plants literally every week. India, we heard some very disappointing information as it relates to the Indian part, I guess you could

say, in terms of where they are and what they might likely do. How difficult is it to monitor the emissions in either one of these two countries? And what type of cooperation do you might see coming ahead as we look at some possible legislation moving?

Mr. MCLEAN. Well, there are several parts to that. First of all, in the U.S., we monitor CO^2 from power plants. We have, since the 1990 amendments, put that in. So that is a third of the emissions in the United States. For the last several years, we have been working with China on several projects, one of which is to introduce and help them implement a cap-and-trade program for SO^2 and hopefully NOx-modeled on the U.S. program.

Part of that is monitoring, and we have been working specifically with them on the monitoring areas because they recognize that that is going to be critical. So they are starting to put in place pieces that will build a solid regulatory base to——

Mr. UPTON. And in my last 5 seconds, what are we doing with India?

Mr. MCLEAN. We are also working with India. India is a more difficult country to engage with structurally, but we do have work that we are doing there in different areas, different pollutants. We are working with them on methane and other issues.

Mr. UPTON. And India is getting the hydroelectricity, right, from Bhutan?

Mr. MCLEAN. I am not familiar with their electrical structure.

Mr. UPTON. OK, thank you. I yield back. Thank you, Mr. Chairman.

Mr. BOUCHER. Thank you, Mr. Upton. The gentleman from Michigan, Mr. Dingell, the chairman of the full committee, is recognized for 5 minutes.

Mr. DINGELL. Mr. Chairman, thank you for your courtesy. Welcome to our panel. Ladies and gentlemen, I have three statements which I would like to make here, and if anyone disagrees, please indicate so by the sign of no.

One, there was not a comprehensive emissions baseline to begin with, so as a result, the market was overallocated with emissions allowances. I am referring to the European Union's adoption of a cap-and-trade program. Is that true? All right, the second question again refers to the European Union's adoption of a cap-and-trade program. Ladies and gentlemen, the 3-year emission reduction period in phase 1 and even phase 2 of the program from 2008 to 2012 is too short to allow for long-term capital planning and emissions reduction strategies. Do you agree, ladies and gentlemen, or do you disagree?

Ms. DUGGAN. In terms of target, I agree that business certainly needs long-terms targets, but if we had the allocation plans for phase 1 for 10 or 15 years, we would have been in real trouble.

Mr. DINGELL. Thank you. Now, I am referring again to the same situation. EU members propose caps that varied widely in stringency. Is that correct or not?

Ms. DUGGAN. I think that is probably true for phase 1 because there wasn't good emissions data. I don't think it is true for phase 2; although, they have different targets for Kyoto.

Mr. DINGELL. All right. Now, we are getting down to the point that I am concerned with. And, ladies and gentlemen, again re-

member I have only 5 minutes to do this business. In your opinion, ladies and gentlemen, do any of the concerns which I have raised represent insurmountable problems that could not be addressed in a U.S. cap-and-trade system? Can these be dealt with?

Mr. SANDOR. I think they can all be dealt with and with a great deal of ease.

Mr. DINGELL. Very well. Now, Ms. Duggan, it is my understanding that one of the reasons the EU adopted a test period from 2005 to 2007 was to allow the EU to develop the kind of hindsight that has just been exhibited. Is that a correct statement?

Ms. DUGGAN. That is correct, yes.

Mr. DINGELL. Now, I think we can say then that the benefit of hindsight is that you will enter the Kyoto compliance period of 2008–12 with these problems resolved. Is that correct?

Ms. DUGGAN. Many of them resolved as far as possible, yes.

Mr. DINGELL. Now, would any of the members of our panel want to make further comment? Dr. Burtraw?

Mr. BURTRAW. Thank you. One of the problems in the EU going forward, I think, is a legacy of in the EU, you have 25, now 27, participating sovereign nations at a level of sovereignty that doesn't exist among States in the United States, and a lot of accommodation had to be made due to that sovereignty. You have less harmonization in the policies in the different member states, and one of those kinds of rules has to do with the treatment of new sources and treatment of sources that retire. This introduces a lot of unexpected and perverse incentives in terms of investment behavior within the EU. That is a kind of policy that could not be fixed going into phase 2. I know that it is on the agenda to be looked at going forward beyond 2012.

Mr. DINGELL. Ms. Duggan, you had a comment.

Ms. DUGGAN. I would like to respond to that. One of the differences that Dr. Burtraw refers to is that the Germans had intended to guarantee new entrants 100 percent allocation for 14 years. The commission have not allowed that, so there is indeed more harmonization on new entrant rules of phase 2.

Mr. SANDOR. I would just like to add one thing. In our experience in financial inventions, whether it is mortgage-backed securities, interest rate derivatives, the initial start of the invention rarely looks like the sophisticated product 10 years at a time. Our belief is you can't let the perfect be the enemy of the good. Many of the things that we have, we chuck the things that don't work. We try to enhance the things that do work, and in invention, it is very dangerous to have the perfect. It is often the enemy of the good, so our experience, whether it is the Web or anything like that, final looks at inventions don't look like the initial ones.

Mr. DINGELL. Thank you. Now, would it be fair for me to observe then that we could use a cap-and-trade system similar to the EU system or similar to some of the programs we have in this country, but it would require some very careful attention in terms of trying to learn from the inadequacies of those programs and then try and come up with proper mechanisms to address them so that we would have a good workable program. Do you agree with that, ladies and gentlemen? Thank you. Ma'am, you have been very patient, yes.

Ms. SMITH. I would just like to say that the design of that program does not provide coverage that is really needed. So within that cap in the EU, it may function well going forward once some of the kinks have been worked out of the system. But it will not be providing sufficient coverage of all emissions of greenhouse gases across the EU because it doesn't deal with 50 percent or more of the sources at this point in time. So a different architecture in the U.S. would allow us, with a very simple system, to get that coverage and therefore not have the runaway emissions outside of the cap that are dogging and will continue to dog the EU, I believe.

Mr. DINGELL. Thank you. Ladies and gentlemen, I appreciate your patience. Mr. Chairman, I thank you for your courtesy.

Mr. BOUCHER. Thank you very much, Chairman Dingell. The gentleman from Illinois, Mr. Shimkus, is recognized for 5 minutes.

Mr. SHIMKUS. Thank you, Chairman. Appreciate the panel. I think Mr. Hastert, Mr. Upton, and I will probably make it up to the Chicago Climate Exchange. We are trying to do that soon. I did read the article in Newsweek. I think it was in Newsweek. There was a soybean grower in Wisconsin, who was part of the exchange, which I find interesting. I do have a large agricultural district. There are questions that you don't need to address right now, but I think when we come up there, it would be basically issues such as how can producers sell credits so that they might have—I know no-till farming is an issue. How do they measure how much they sequester? So I will look at some of those things when we come up.

A cap-and-trade system will undoubtedly mean for electricity generation in this country, fuel switching. And we saw it before in the SO^2 debate, and I am from southern Illinois, and I had numerous mines closed down. There is a place called Kincaid, Illinois. Commonwealth had a coal-fired generating plant and a mine across the street. For this power plant to meet its new clean air guidelines, they shipped in western coal, and they closed down the coal mine. Not real efficient, and that happened in all of southern Illinois. And so that is why a lot of us are skeptical, especially if there is not an international agreement that would ensure that the world community addresses climate and a carbon standard.

And I also find it curious that my colleagues on the other side are now such great believers in exchanges when, let the buyer beware. The first time financiers use the market, based upon the fluctuation and the risk, why do we have people with capital going to these markets? They want the big fluctuation of prices because the financiers want to make the profits through this market. That is what they like, and my friends on the other side will say they are reaping excessive profits by using NYMEX. Or they are using the energy exchanges or the Mercantile Exchange. It is the real rich people of the world, and they are extorting these markets. So be careful. You may be safer having a market based on private sector people wanting to do good things, versus having us help dictate, direct, and determine a carbon exchange.

And it will happen. We have seen it on this committee ever since I have been here. When the energy prices go whacko—I mean we did it on the gas issue. Blame the marketer. Blame the guys who are in these exchanges. So I just find it curious. Now it is going to be the salvation to the global warming debate.

Dr. Smith, great point. I would like to elaborate just briefly because we are also going to address RPS stuff here. And did I hear you say that if we are going to go in this direction, which I am not sure we need to do, there are four times more benefits trying to do a legitimate cap-and-trade system versus mandating the RPS?

Ms. SMITH. I did say something close to that.

Mr. SHIMKUS. Not bad for a layman. I paid attention.

Ms. SMITH. Achieving the exact same emissions reductions that an RPS could provide will cost four times more if it is done only within RPS and not with the cap-and-trade program. And the reason is because a cap-and-trade program needs to be a comprehensive, economy-wide cap-and-trade program. It allows incentives to take on far more types of reductions that are cheaper than some of the renewables that we force by the——

Mr. SHIMKUS. Thank you. And I want to get Dr. Izzo real quick because the same people who want cap-and-trade and decreased carbon are not supporters of nuclear power, and we have to have nuclear power. So you are expanding, and I applaud that. Would addressing your onsite storage of nuclear waste help you? And would moving to interim storage in the desert be helpful? And is it safe to say that Yucca Mountain, which would be a long-term repository that is under a mountain in a desert, is a better location to store high-level nuclear waste than onsite in New Jersey?

Mr. IZZO. The answer to all three of those questions are yes.

Mr. SHIMKUS. Thank you very much. I yield back my time.

Mr. BOUCHER. Thank you very much, Mr. Shimkus. The gentleman from Utah, Mr. Matheson, is recognized for 8 minutes.

Mr. MATHESON. Thank you, Mr. Chairman. I appreciate the panel's testimony. Dr. Smith, in your written testimony, you talked about how to achieve real reduction, there needs to be a lot of technological advances beyond what is going to be easy to do. If we are going to move down the path of creating a cap-and-trade system, how should we incorporate consideration of the rate and pace and time of technological innovation in terms of how that cap-and-trade system is designed?

Ms. SMITH. Well, the simple answer is that if you tighten the cap to a point where you are starting to push beyond what you can do at low cost with current technologies, then you perhaps have a cap that is getting ahead of the game on the technologies. So it argues for far less reduction in the near term and making much more rapid and deeper cuts later in time to get a lower cost outcome out of the same kind of overall approach. This takes into account that to get stabilization of atmospheric emissions and to stabilize climate risks, we need to look at the cumulative amount of emissions over a very, very long period of time, out through the next century. We don't need to worry about exactly what the emissions are this year or in 2015 or even through 2020 per se if we can make up those reductions later when the technologies come in.

But the problem is nothing is sitting out there in the way of incentives to make those technologies appear, and the cap-and-trade program doesn't provide sufficient incentives for those kinds of massive revolutionary types of technological change to occur. The cap-and-trade program only incentivizes incremental innovation

with nearly marketable technologies, and it will do that well. But that is not enough to get us to climate stabilization.

Mr. MATHESON. And is it fair to say that the concept that over the long run technology has got to take us to a different place to achieve significant reductions, and so you are suggesting that a cap-and-trade system should have caps that are not so onerous in the short term and maybe ramped up to more stringent caps in the long term? Is there any rational way for us to figure out how to design that structure over time for how caps are implemented over time?

Ms. SMITH. My personal view is the rational way to go about that is to think about what price we should be willing to pay now and in the future and to link and integrate that thinking with what we believe we can do technologically on the cost of technologies in the future. How can we bring their costs down to an affordable price? What is that price target? What is the timing of that? And that allows us to back out to what we ought to be spending today, simply by applying simple present value type rules that economists use all the time. So it is not about where you set the cap in any year. It is about what is the right price to be paying over time now and into the future.

Mr. MATHESON. And would you suggest that, in terms of we are in the public policy setting position and we are considering cap-and-trade as an option, that if that option is considered the part and parcel of that, we also need to take a look at if there are incentives that we can create in the public policy arena to generate this greater emphasis on development and technology? Because you said in the current marketplace and even with the cap-and-trade, we are not setting up necessarily the best incentives for this development of new technology?

Ms. SMITH. We need specific policies aimed specifically at the challenge of figuring out how to design R and D incentives correctly and to target them so that they will be productive at what we need, which is new energy systems that are zero or low carbon. That is different than the cap-and-trade program.

Mr. MATHESON. Right, I understand.

Ms. SMITH. It is a separate policy.

Mr. MATHESON. And would you say that for all the R and D programs that Congress has voted for in the last few years, and we are all looking to develop new technologies, you would suggest that the current set of public policies in place to incentivize research to develop new technologies are inadequate for the type of reductions that you think probably need to be achieved?

Ms. SMITH. I believe that they are inadequate. I think the issue is perhaps less about funding and more about getting the incentives right and the targeting of the program so that the money is going to the right kinds of activities, the ones that will be successful and produce the right kinds of solutions too.

Mr. MATHESON. OK, Ms. Duggan, Dr. Smith's testimony talks about the notion of an upstream application of cap compared to a downstream. In the EU system, it is a downstream cap. Have you considered any ramifications? Or has it been considered where the EU system should transfer to more of an upstream cap than capture it broader economy-wide focus?

Ms. DUGGAN. I think certainly the UK voluntary program looked at that, and there is constant consideration particularly when looking at new sectors, such as surface transport and others, that perhaps the current approach may not be the one that is most appropriate for other sectors. I think there is always a balance between simplicity and complexity in capturing the behavior changes that you want. But it certainly is something that is under consideration for other sections.

Mr. MATHESON. I would think that when you are looking at those different balances, one of the other factors is one-half of your emitters are not subject to the system. That would be another factor in looking at balancing simplicity and complexity.

Ms. DUGGAN. Indeed, but just because they are not covered by the EU program doesn't mean to say that they are not covered by other measures. And the UK recently announced another domestic program with a full auctioning, mandatory program that will cover commercial concerns, such as retail and some others. So we are constantly looking at where the emissions are and how we should deal with them. But whilst we favor cap-and-trade, it is looking at how best to incorporate those into cap-and-trade systems.

Mr. MATHESON. OK. Dr. Sandor, do you see any implications from the exchange perspective between upstream and downstream? Do you think your exchange could accommodate either type of focus?

Mr. SANDOR. Yes, we would operationalize any policy. Our experience though suggests that, including Wasuch in your district, that the further downstream you go, the more you are going to affect behavior change. And that is the tradeoff. You want to get to the individual who won't be responsive to behavior change, and that is a hard balance. As you say, some aren't covered, some are. But our belief is we can cover and will cover. No matter what you provide, we will operationize the law that you, the leaders, make.

Mr. MATHESON. OK, and you actually anticipated the last question I wanted to give to Dr. Smith. I understand where the upstream is preferable in terms of capturing all the carbon emitters. But, as Dr. Sandor pointed out, the downstream tends to give price signals to individual users to most accurately affect behavior. How do you balance those two competing approaches?

Ms. SMITH. Both approaches give the same price signal. It is just a question of where the price signal appears in the system. So if you set the price signal at the time when you sell the gasoline, it will move its way right on down to the consumer just as easily as if you tell him he has to pay for every ounce of CO^2 that comes out of his tailpipe and make him find the permits for it. One is more complex and difficult to implement, but both of them give the same price signal as long as the market price of carbon is the same. And that is more dependent on the stringency of the cap than it is on how you have implemented it.

Mr. MATHESON. So you are not too concerned about this issue of individual users seeing price signals if we do an upstream approach?

Ms. SMITH. They should see price signals.

Mr. MATHESON. Yes, OK. That is great. Mr. McLean, I just wanted to finish with you. I have 10 seconds. I will make this quick.

You have been involved with the other programs the EPA has implemented. Do you foresee, if there was an upstream approach, that that creates unique challenges for EPA in terms of—compare the experience you have had so far.

Mr. MCLEAN. No, it would be different. As people have said, we would look at each sector and think about what would be the best way to address that particular sector and take into account the things that Dr. Smith said as well as Dr. Sandor, that we don't have a firm view at this point.

Mr. MATHESON. OK. Thank you, Mr. Chairman.

Mr. BOUCHER. Thank you, Mr. Matheson. The gentleman from Oregon, Mr. Walden, is recognized for 5 minutes.

Mr. WALDEN. Thank you very much, Mr. Chairman. I apologize to the panel for not being able to be here to hear your testimony; although, I have been trying to work my way through it and will take and read it later today.

I represent a district out on the west coast. Our State of Oregon has 7 percent of its energy, I believe was the figure, derived from coal production. Most of ours comes from hydroelectric with a pretty good and growing amount of wind energy. And I think one of the questions my constituents would have in any cap-and-trade program is who gets capped? And at what level do you start? And certainly based on how many megawatts your output is versus your CO^2 emissions makes a big difference. And so I would be curious to hear from the panel, as we look at a cap-and-trade system, how do you deal with a region of the country that starts with very, very low emissions? And do we end up getting placed here along with the coal emitters here and then everybody is told to go down and we can't?

I mean these are things that my constituents want to know. We hear about price signals. To them, that means how much is my bill going to go up because somebody is going to get paid in this deal. We have had folks from Wall Street here who can't wait to have a new trading system in place. Well, somebody is going to make money on that, and I am all for a private sector guy. But I also pay a lot of electric bills in my business and personally, and so do my constituents. So perhaps somebody could enlighten me. Dr. Izzo?

Mr. IZZO. We would agree with you. Our proposal is that the allocation method be tied to the number of kilowatt hours that an electric generator produce, so as to constantly incent people to produce more kilowatt hours and fewer tons of CO^2 for the very reasons you outlined. If you simply grandfathered all the emissions credits, you are rewarding people who have produced the greatest amount of CO^2 and not creating an incentive for them to then lower their CO^2, should they choose not to.

Mr. WALDEN. Other panelists, do you want to talk to me about how you deal with hydro or what you recommend?

Mr. SANDOR. From a balance point of view, I do think that this has got to be all six gases. I might say Portland, Oregon is a member of the Chicago Climate Exchange.

Mr. WALDEN. Right, and has actually reduced their carbon footprint.

Mr. SANDOR. Yes, fantastically.

Mr. WALDEN. We are trying to do our part. In this business of government, no good deed ever goes unpunished. We are trying to avoid getting punished.

Mr. SANDOR. I have two points of view, and I know some of my fellow panelists don't agree. There are those who would not be in favor of Portland getting credit for what has been done. Members of this panel state that they shouldn't because there are bad people as well. I would say you have got to have credit for early action. That is No. 1.

Number 2, you have got to have six greenhouse gases so the low-hanging fruit that can be accomplished by changes that reduce other greenhouse gases like methane or NOx, any of those, the hydrofluorocarbons, et cetera, can help get rid of it. And I do think if you take the other questions where you have modest targets to begin with, you can achieve them with a great deal of project-based credits. And then if you tighten it later on, you are going to induce the technology. And our experience is even low prices, as I said with the MIT professor, they go that way.

Mr. WALDEN. I only have a minute left. Let me ask you a different question, and that is this. In the West, we have—like my State is—more than 55 percent Federal land. And I have disputed with others about how those forests get managed. One forest fire in my district in 2003 emitted double the amount of carbon into the atmosphere, in the matter of weeks that it burned, as the entire State of Oregon in a year. We are always going to have fire, but they don't have to be catastrophic. Trees can be carbon sinks if forests are managed properly. And I am curious if there is any discussion in a cap-and-trade, carbon reduction discussion for how Federal policy over management of Federal lands should come into play.

Mr. SANDOR. We have dealt with the forest service on that, and we have also talked about water markets as well because these are not separable. And I think that there can and will be more interaction with the Federal agencies. I would hope so. We have an open door and would like to educate them, and we face this project with parks management in Costa Rica and in other areas. So it is not a unique problem.

Mr. WALDEN. Any other comments from panelists just on that question? I realize my time has expired.

Mr. IZZO. I would encourage that to be part of any offset program consideration.

Mr. WALDEN. All right. Mr. McLean?

Mr. MCLEAN. Just one comment on how we deal with forests because when they burn, then they grow back. And then they absorb. So that sector you have to think of in sort of over time how it operates.

Mr. WALDEN. I do. I clearly do, and in fact, I would like them to grow back faster. And the House approved a bill to do that after a fire, but the Senate, well you know, didn't quite get around to it.

Mr. IZZO. I won't comment on that.

Mr. WALDEN. I wish you would. Mr. Chairman, my time is expired. If other panelists have quick comment, if not, thank you Mr. Chairman.

Mr. BOUCHER. Thank you very much, Mr. Walden. The gentleman from Massachusetts, Mr. Markey, is recognized for 8 minutes.

Mr. MARKEY. Thank you, Mr. Chairman. See, the Republicans are the opponents. The Senate is the enemy. That is the point that——

Mr. WALDEN. On that, we agree.

Mr. MARKEY [continuing]. Oregon was making, yes. And I apologize to everybody, but I am in this national competition, the Luca Brasi sound-alike contest, so I apologize for my voice today. Ms. Duggan, last week the subcommittee heard testimony from several electric utility CEOs who recommended that we create a cap-and-trade program in which virtually all of the emission credits were allocated flaw-free to the generations of greenhouse gas emissions based on their historic emissions with as little as 5 percent of the credits actually being auctioned. Such a structure was sharply criticized in a recent report by the National Commission on Energy Policy that is stating that the allocation of most of these allocations for free to energy producers creates the potential for large windfall profits. What was the experience in Europe?

Ms. DUGGAN. The experience in phase 1 was not dissimilar, except there wasn't 95 percent of 100 percent of need.

Mr. MARKEY. Not dissimilar meaning windfall profits——

Ms. DUGGAN. There were indeed windfall profits in phase 1, and one of the things that is happening in phase 2 is that, although, there is a maximum of 10 percent auctioning in phase 2, that still means that we can set the cap below need for electricity producers. And indeed in the UK, we have set the cap at about 30 percent below need for electricity producers, and they will face some auctioning. But there have been windfall profits.

Mr. MARKEY. Windfall profits. Mr. Burtraw, could you comment on that?

Mr. BURTRAW. Well, yes, I agree directly that there is evidence there were windfall profits. House of Commons report found that in the UK and similarly in Germany. That is extranormal profits, the change in revenues is greater than the change in their costs.

Mr. MARKEY. How big were the windfall profits?

Mr. BURTRAW. These reports are suggesting they are in order of 2 to 3 billion Euro per year in each of those cases.

Mr. MARKEY. In each country?

Mr. BURTRAW. Yes.

Mr. MARKEY. In each country for the utilities?

Mr. BURTRAW. The power sector, yes.

Mr. MARKEY. The power sector. Yes, Ms. Duggan.

Ms. DUGGAN. I just wanted to come back on that. It depends on the assumptions you make and the assumption of the price of allowances at the time, and UK Government assessment of the size of windfall profits recognizes that indeed they were windfall profits. That those full costs pass through to industrial users but not to domestic users during 2005. And they were in the region of 800 million. Nevertheless, they were there, and it is one of the things that we are considering allocation methodology for the review for future phases.

Mr. MARKEY. Yes. Well, a recent study on how the German Government allocated credits, reports that the German utilities were set to make windfall profits, and between 31 and 64 billion Euros up until the end of 2012. Does that experience suggest that regulators may have a hard time ensuring that all of the financial windfall associated with the allocations of free credits to the utility industry are actually passed along to the ratepayers? And you were mentioning this point about consumers, Dr. Burtraw. Could you get into that please?

Mr. BURTRAW. Well, yes, the source of those so-called windfall profits are changes in product prices that consumers are the ones that are paying, and so these costs rise, the opportunity costs, the emissions allowances are passed through in product prices. The question is who is going to be the recipient of this wealth transfer. And that is one of the reasons that people point to an auction as equitable as well as efficient mechanism to implement the program.

Mr. MARKEY. OK, Ms. Duggan, based on the European experience, do you think that we should be auctioning off most of these credits and use the resulting revenue for public benefits, such as accelerated R and D on new technologies, energy efficiency, or even reducing taxes on businesses or individual consumers that might be faced with higher energy prices?

Ms. DUGGAN. I think the use of auctioning for future phases is under discussion this year as the commission and member states review the directive for emissions trading. I know Sweden has stated publicly that it believes that there should be full auctioning for large electricity producers. The UK Government's position is there should be more use of auctioning, but I wouldn't want to preempt the outcome of any cross government discussions on that. We have looked with interest at the RGGI proposals.

Mr. MARKEY. The RGGI proposals meaning the proposals in eastern United States with the nine States that are now moving towards an auctioning system as opposed to this allocation to the utilities giving them 95 to 100 percent of the credits. Do you agree with that, Dr. Burtraw? Let me go to you, Dr. Sandor. What do you think makes the most sense?

Mr. SANDOR. We would propose less auctioning and more insurance and reliance through pass through provisions and windfall gains going to the electricity users.

Mr. MARKEY. Going to the consumers?

Mr. SANDOR. To the consumer, right, to make sure it is passed on. The auction limits the price discovery process.

Mr. MARKEY. How would we ensure that it goes to the consumer or to the businesses that consume electricity?

Mr. SANDOR. I will get back to you after the hearings with some thoughts on that without getting too laborious here, but that is what we would favor because we think it is continuous price discovery and efficiency that is important and do recognize the need to pass on benefits to consumers, but market efficiencies are better served by—well, 100 percent auction would be perfect price discovery, as you know. But you have these other equities. I appreciate that.

And we have to factor that in, but moving on the system that led to this German mess and other countries' messes is something we won't replicate.

Mr. MARKEY. Thank you. Let me go quickly to Mr. McLean. When this committee drafted the Clean Air Act Amendments of 1990, it set up the cap-and-trade program for sulfur dioxide emissions. I was able to add a provision to the bill that allowed utilities to obtain allowances for qualified energy conservation measures that were determined by the EPA to increase the efficiency of the use of electricity provided by an electric utility to its users. Under the provision, for each ton of sulfur dioxide emissions avoided by an electric utility during the applicable period through use of these qualified energy conservation measures, the EPA would allocate a single allowance on a first-come-first-serve basis up to a cap of 300,000 allowances.

How has that provision of the law worked out over the years, Mr. McLean? And what lessons would you say that the experience with that provision of the 1990 bill would have for us in the subcommittee today, were we to try to add a similar provision to the cap-and-trade bill for carbon?

Mr. MCLEAN. Yes, a couple points about that. First of all, that was the first time that we had ever done that, that you had done that, and we had implemented it. So there is something to be learned. I think when we spent the incentive in that you get one allowance for roughly an equivalent ton reduced from conventional power. Our experience was that we expected that reserve to be overwhelmed, and it was not. And I think the reason was that we probably had set it too much in balance. That we probably should have, and to encourage more, would have set a higher ratio.

Mr. MARKEY. So we set it too low. We should have set it higher if we wanted to——

Mr. MCLEAN. If you wanted to incentivize the transfer, but I think the idea of setting a specific reserve is a way to deal with that particular issue.

Mr. MARKEY. And are you nodding your head in agreement, Dr. Sandor?

Mr. SANDOR. Yes.

Mr. MARKEY. And how high should it have been? Could you give us quickly?

Mr. SANDOR. I would have to relook at that, but clearly setting it at that level was not enough.

Mr. MARKEY. If you, Mr. McLean and Dr. Sandor, could tell us how high you thought we—looking back at that sector, that would help us. I thank the chairman.

Mr. BOUCHER. Thank you very much, Mr. Markey. Gentleman from Arizona, Mr. Shadegg is recognized for 5 minutes.

Mr. SHADEGG. Thank you, Mr. Chairman. Let me start by asking you, Dr. Sandor or Dr. Burtraw. Mr. Markey has just asked a series of questions having to do with the market and a series of questions focusing on the windfalls that occurred. I am concerned that this isn't really a valid market, and I am concerned that whenever we decide to try to create a market, which is what we are trying to do, somehow we have to figure out how to create it correctly, or

we do create windfalls. Obviously Mr. Markey is deeply concerned about those windfalls.

And I guess I am concerned that it is the Government price setting at the outset which results in the creation of such windfalls. And I don't know how I can explain to my constituents something like occurred in England where, as I understand it, two things happened at once. One, the price of electricity goes up by 16 percent. I can assure you that my constituents are going to be extremely unhappy if their electricity goes up by 16 percent. If the cost of their electricity goes up by 16 percent and they don't know why, or they believe it is greenhouse gases, and then they read that somebody is saying this is a windfall profit.

But I have some pretty smart consumers, and they are going to say well, wait a minute. Why were there windfall profits? And somebody is going to say well, Congressman, it is because you created this cap-and-trade program, and I believe that there is going to be, pardon my expression, heck to pay for me creating, and I guess some argument is made that, Dr. Sandor, you say well, just do it. It may be a mistake. You may cause a problem. We heard that same testimony 2 days ago. Well, just do it. I think that just do it doesn't work very well for an elected official who has to go home and say the cost of electricity just went up by 16 percent, and somebody is making a windfall profit, neither of which would have occurred had you figured out a better way to achieve this in. Go ahead, Doctor.

Mr. SANDOR. Number 1, if we take a look at the SO^2 program with bonus allowances——

Mr. SHADEGG. Look, the SO^2, I think, is simply not applicable. SO^2 came from a limited number of sources. This comes from a vastly greater numbers of sources. This SO^2 is a discrete pollutant as compared to carbon dioxide.

Mr. SANDOR. No, I am not suggesting—the analogy I am making is there were windfalls in SO^2.

Mr. SHADEGG. No, I am making the analogy that there were windfalls in Europe.

Mr. SANDOR. Both of those. But let me just say from my point of view, as a professional economist, OK, and putting on that hat, the allocation of what you do doesn't matter. A man by the name of Ronald Cose won a Nobel Prize for that and says for the efficiency of the market, it doesn't matter. OK, that is leading to the right price. It is not my particular role, as from in the equity point of view, from an exchange thing, to really bring the expertise. I can tell you I would look to find a way that that windfall, through the regulatory process, is going to the consumer. But that is more the expertise that you have as politicians than I have as a trader and an economist.

Mr. SHADEGG. I can tell you from a standpoint of economics, it may not matter initially, and I understand the witness from England is saying look, in phase 1, here is what we suffered through. But in phase 2, we went to an auction process, and in the auction process, we resolved that. You are shaking your head. Expand on your point, ma'am.

Ms. DUGGAN. I think there are two things. One, the 16 percent increase in electricity price—and I am not sure if that was the

right figure—was due to an increase, largely, two-thirds of it at least, was due to an increase in gas, not because there was an increased demand because of the carbon price in gas. In fact, there was switching from gas to coal in the UK during that time, but because of supplies of gas for other reasons. And, as I pointed out earlier, I believe that for other reasons, you had increases in electricity prices in the U.S. in the year as well.

But I think the point that you can actually deal with windfall profit through allocation methodology—I am shaking my head because we are not going to full auctioning in phase 2.

Mr. SHADEGG. I think the 16 percent price increase was, in fact, linked to the imposition of the cap-and-trade system in Europe. Dr. Smith, they occurred at the same time, so it is going to be hard to explain to voters or to constituents that they are not a result of one of the other. Dr. Smith, you talked about increased impacts as a result of price uncertainty and price volatility. Would you expand on that?

Ms. SMITH. Well, price volatility, because the prices will be passed through into electricity and other energy prices, if the system is actually economy-wide as it ought to be, then that will translate into volatility in the prices of goods and services throughout the economy. It will be a little bit dampened. It will be a little bit, with time lags, et cetera. But nevertheless, as long as you have a system that gives you a huge amount of uncertainty about where prices will be for carbon, you have got a huge amount of uncertainty about what the cost of living is going to be very soon thereafter.

Mr. SHADEGG. Let me just ask one last question. If we were to implement this, would you suggest that it have a lead time during which it was advisory and not obligatory? That is it was, in some way, to allow it to fluctuate before it actually damaged the market, before it actually did that, a period of years to let it function before it was implemented, or is that not a possibility?

Mr. BOUCHER. Very quickly, Dr. Smith. Very quickly please.

Ms. SMITH. That is impossible to do. The only way to manage that volatility is to put a price cap on the market directly.

Mr. BOUCHER. Thank you very much. The gentleman's time has expired. The gentleman from New York, Mr. Weiner, is recognized for 8 minutes.

Mr. WEINER. Thank you. I appreciate it. I won't use all my time. Lest we be lest with, I believe, what people who know Latin would call an ad hoc ergo propter hoc facility, could you just clarify again what you think in your experience—this is hearing about what experiences we have and how we can learn from them—from your experience and from the data you have collected as a professional who looks at this, not as someone who occasionally steps in and looks at it, accounted for that rise in cost?

Ms. DUGGAN. The main reason for the rise in electricity prices in Europe and in particular in the UK during 2005 was an increase in the price of gas. The price of gas increased so much that actually, rather than having fuel switching as we had hoped from fuel to gas, there was fuel switching from gas to coal. And that was even when the price of carbon was at 30 Euros, and it was estimated at that time that the price of carbon would need to have

been about 70 Euros a ton to actually begin to have price switching from coal to gas.

That is not to say that is an example of success of the scheme. It is saying let us get the facts right on that. That was not the reason for the rise in electricity prices. It has been estimated that of the increase in electricity prices, perhaps up to one-third might have been caused by the carbon price at its highest.

Certainly the carbon price for phase 1 is now significantly lower. It is around one Euro to one and a half Euros, and therefore it would be surprising if that was causing an increase in electricity prices at the moment. I accept that there were windfall profits due to the design of the allocation methodology, which was designed in that way to recognize the costs of industry and therefore to give them free allocation when they hadn't known a carbon price was about to be imposed on them.

Mr. WEINER. Right. Well, we have a vote. I just have one brief question. It seems that the greatest threat to any system working would be anything that impinges on the transparency of the marketplace here. Is technology, as it advances, making it harder to cheat? Is it making it easier to cheat in terms of how much emissions are being recorded or being reported? Do we need to create a giant regulatory scheme in order to make sure we know what emissions are being put out there? Or is the system pretty much been tried and true to where we have the transparency the market demands? Dr. Sandor?

Mr. SANDOR. We do have 14 members in New York including IBM and Kodak, so we appreciate your support. Let me say we have a more comprehensive system in the U.S. than the EU with six gases in the pilot program versus one initially. And so we have been measuring all six gases, and I would say that technology has been very, very easy.

Mr. WEINER. And the marketplace has voted with its feet in that if there were a sense that they were trading on things that weren't fully accountable, then the marketplace wouldn't succeed. You wouldn't have traders who were willing to step in there and do this transaction if they weren't confident that it was being done in a fair way?

Mr. SANDOR. Number 1, I think that is unambiguously correct, and No. 2, we have market evidence of that. The credits that are traded on the exchange in Chicago are priced four times higher than those that are not verified and traded in the over-the-counter markets. So the markets are already distinguishing where there is better verification, there is a higher price.

Mr. WEINER. Thank you. Thank you, Mr. Chairman. I yield back.

Mr. DOYLE [presiding]. I thank the gentleman. The Chair recognizes the gentleman from Oklahoma, Mr. Sullivan, for 5 minutes.

Mr. SULLIVAN. Thank you, Mr. Chairman, and I want to thank the panelists for being here today. And I was out for a little while, and I am sure maybe you have been asked the questions I may ask, but I would like to ask them myself if I can.

And this is for everyone on the panel. Based on the models provided by the acid rain program and the European experience, what will a cap-and-trade program cost the United States in dollars per year do you estimate?

Mr. IZZO. We have run several models, and the answer is it depends on where that cap is set. There are probably seven gigatons of CO^2 reduction that can take place that are economically wise to do even if the emissions were priced at zero dollars. However, to get to some of the 400 to 500 PPM levels that people have talked about, prices could get as high as $40 to $50. So the answer is it really depends. There are some that are prudent to do today. Others that will need price signals upwards of $40 a ton.

Mr. SULLIVAN. Anyone else?

Ms. SMITH. Yes.

Mr. SULLIVAN. Yes, Ms. Smith.

Ms. SMITH. We have done some modeling work as well, and to answer it in terms of dollars per year, the SO^2 market costs a couple billion. And what we are finding, it is true. It depends on what your cap is, but what we are finding is even with the very loose types of caps that are sort of the high end of what is being proposed, you are looking at tens to maybe $100 billion a year. And, of course, with the much tighter caps such as the high end of what is being proposed, we are looking at hundreds to thousands of billions a year in costs.

Mr. SULLIVAN. Anyone? Mr. McLean?

Mr. MCLEAN. Yes, the comment was that the stringency of the cap determines everything. We analyzed Senator Carper's bill last year, and it had a modest cap with offsets.

Mr. SULLIVAN. Yes.

Mr. MCLEAN. And the cost was less than half a billion dollars a year. It was relatively small, had virtually no price impact. We are currently looking at the McCain/Lieberman bill, which is a much more significant reduction, and we will be analyzing that bill. So I think it very much depends on the shape and size of the bill.

Mr. SULLIVAN. Anyone else?

Ms. DUGGAN. I clearly can't comment on the cost to the U.S. What I can say is the UK Government believes and is committed to cap-and-trade as the cheapest way, the least costly way, to achieve the emissions reductions we need. I would point to the Stone Review commissioned by the UK Government that says that action is cheaper than inaction.

Mr. SANDOR. Just as a matter of information, as in the exchange, we are forbidden from commenting on prices and costs. It is not within the law. I might say that [former Senator] David Boren was a member of the advisory committee for the Chicago Climate Exchange, and OU was the first public sector university in America to join the exchange.

Mr. SULLIVAN. That is good.

Ms. SMITH. I would just like to respond to the statement by Mr. McLean about the cost of the Carper bill being extremely low. We have done some analyses and studied, in fact, that analysis that EPA did. And I just want to point out that the costs were very low based on some assumptions that we would disagree with, but most importantly, it was driven low by a presumption that there would be a lot of purchasing of what is called Russian hot air by the Europeans et cetera in that marketplace for international permits, and that that was a very significant part of the reason they came

up with a very low-cost estimate. But that is not viewed as politically acceptable at this point in time.

Mr. SULLIVAN. OK, and I have one more question. On Tuesday, we heard testimony that we cannot expect China and India to reduce their greenhouse gas emissions at any point in the near term or the near future. Do you support including developing countries in any type of cap-and-trade program adopted by United States? Dr. Burtraw?

Mr. BURTRAW. I believe there is an architecture in the proposal by Representatives Udall and Petrie that is very innovative. I want to encourage you to look further at, and there is a slice of allowance value that is set aside for some programs for the developing world, including technology transfer. But the allocation of those resources to the developing world is contingent on a finding that they are taking steps towards joining an international carbon regime, same kind of funding the State Department does with respect to making progress on human rights.

Seems like a mechanism such as that could be an onramp for expanding participation from the developing world.

Mr. SULLIVAN. Ms. Duggan?

Ms. DUGGAN. I would point out that China does, in effect, participate in the EU trading program because credits from the clean development mechanism, of which there is a significant investment in China, are allowed with certain limits in the EU program.

Mr. DOYLE. Gentleman's time has expired. And last but not least, the gentleman from Washington, Mr. Inslee.

Mr. INSLEE. Thank you. If I do my math right, Ms. Duggan, if one-third of the price increase of 16 percent may be attributable, worst case scenario, for about a 6 percent increase in cost. I just want to ask you each individually are there any of you that would not pay 6 percent more on your residential electrical bill to prevent the loss of the Arctic, the substantial desertification of a substantial part of the globe, and the loss of the Baltimore oriole? Are there any of you who would not pay 6 percent to prevent that from happening to the planet? Dr. Izzo?

Mr. IZZO. Not only would I be willing to pay for it, but I would suggest that it is an important price signal to send to consumers to encourage conservation.

Mr. INSLEE. I appreciate that. I don't see anybody saying they would not be willing to pay that. Dr. Izzo, I think you have suggested moving to essentially a complete auction in about 10 years, as I understand your testimony. Could you describe why you think that is about the appropriate period of transition?

Mr. IZZO. For a couple of reasons. Number 1, as I talked about before, there are quite a bit of reductions that need to take place which are not economically viable today. Even though seven gigatons should be done right now, there is a substantial amount in the renewables area and in the nuclear area that requires some additional technology and advancement.

We believe nuclear is a part of that solution. If we made a decision to build a nuclear plant today, it would probably take 10 years before a kilowatt hour could come from that plant, so that was how we picked the 10-year period.

Mr. INSLEE. And I am intrigued, Dr. Izzo, about your discussion of the output-based system because, as I understand your testimony, it would create the best incentive for efficiencies as opposed to just a grandfathering permanently. Could you again describe why you think that is pivotal to give the right incentive for efficiencies?

Mr. IZZO. Sure, what consumers are looking for from us as producers are kilowatt hours. They are not looking for CO^2. So what we think makes sense is to then reward companies that produce more kilowatt hours with less CO^2. And by updating that every year and determining how to allocate those resources, you are encouraging new entrance to provide new technologies that are low-carbon or zero-carbon emitters.

Mr. INSLEE. Anybody else like to comment on that on the panel?

Ms. SMITH. Yes, I would like to comment on that. The problem with that sort of updating approach is that it actually incentivizes businesses to stay in business and to continue to produce even when they may be high emitters. And so you end up with an extremely high inefficiency. The cost of a cap with that kind of updating can be much higher than the cost of a cap without that kind of updating, so it does create inefficiencies in the system.

Mr. INSLEE. I am not sure I understand that. I am going to have to call you at some point and talk about that. Dr. Burtraw, did you want to——

Mr. BURTRAW. Well, I would just like to add to this that there are a variety of ways that you can give emission allowances away for free, and some of those ways have incentives embedded in them. And some of the ways can suppress the change in electricity prices that would otherwise occur. And the proposal by Dr. Izzo would accomplish a lower electricity price in the first years of the program and create some incentives for switching to lower emitting technologies.

But doing all of that, I would also subsidize electricity consumption and lead to more electricity consumption in the early years of the program. The part of Dr. Izzo's proposal that I particularly enjoyed hearing him say was that he is suggesting this is a transition to a full auction, and so the decision of what path to take to a full auction is one where you are making tradeoffs over equity and compensation goals in the program.

Mr. INSLEE. Dr. Izzo, you had proposed, as well, that there be allocations to non-emitting technologies. As I understand, it would include hydroelectric. And I have a parochial interest coming from Washington State in that regard. I will disclose that. But on the other hand, if you don't do that—isn't there a counter argument? People argue that that is sort of a gift or giveaway or some type of snow on your hat as my economist professor used to call it? But if you don't do that, essentially I would argue the reverse. I mean this is a national asset which is a carrying capacity of the atmosphere. Why should one user who happens to have clean electricity not be given some portion of that national asset just because they happen to use a clean energy source?

Mr. IZZO. I agree completely. I mean we have to make sure that we distinguish two factors. The environment benefit is achieved by setting the cap. How you allocate them is determined through pace.

I agree with Dr. Burtraw that over time we want to go to an auction system that gives complete transparency. We could talk about the use of those proceeds.

But in the interim, we want to reward and further incent people who have made decisions to go with non-emitting technologies and update that so that new entrants can enjoy those benefits as well.

Mr. INSLEE. I appreciate that both because it is economically sound and quite popular out in the State of Washington as well. Thank you very much.

Mr. DOYLE. I thank the gentleman. I see we have a minute and 38 seconds to get to the floor to vote. I understand there are some members coming back. We are going to recess shortly, and then reconvene the hearing as soon as a member comes back in the chair.

[Recess.]

Mr. WYNN [presiding]. We have the requisite two members for a quorum. I believe it is a Democrat's turn for questioning, and I believe that means the questioning turns to me. I would like to thank all the witnesses for their testimony today. I want to inquire about this question of cost because I seem to be in somewhat of a conflict.

Ms. Duggan seems to indicate that the EU experience was based on increases in natural gas, but Dr. Smith said that we have to be very cautious about price spikes. And Dr. Burtraw cautioned at the end of his testimony what we have to do is be careful that this doesn't become a cloak for a transfer of wealth. So all of that puts me in a little bit of a quandary. Maybe I will start with you, Dr. Smith. You were concerned about price spikes. Can you tell me why? Or do you disagree with Ms. Duggan?

Ms. SMITH. I don't fully disagree with her. I will explain that point, but the first thing I want to say is no matter what you do in the way of grandfathering or auctions, there is going to be a price passed through to consumers. Whatever the price of carbon is, the system will allow that price to pass through. And changing the way you move the wealth around isn't going to alter that.

Now, on the point about price volatility. Price volatility creates some difficult planning costs for businesses. In a sense, you are really just asking people to plan against a tax but not telling them what the tax rate is. And so that creates actually costs inside businesses to manage that. Traders love it, but it is really not beneficial to the economy as a whole to have that volatility if you don't need it. And we don't need it because this is a regulated system. So you can put on a safety valve or a price cap on the system, or you can just directly impose a price with an emissions fee and get away from all of that volatility and still have the price signal that you want coming through to incentivize the emissions reductions.

Mr. WYNN. So it is safe to say we don't have to have these price spikes. They are not inevitable in a cap-and-trade system.

Ms. SMITH. They are just waste.

Mr. WYNN. Is that your conclusion? Does anyone disagree with that? Dr. Sandor?

Mr. SANDOR. I just want to say one thing for the record, and that is traders don't unambiguously like volatility. It is very dangerous to traders who trade options. The most successful futures markets in the world are Euro dollars and bonds, and they have a very significant lower volatility than the energy complex, No. 1. Number 2,

I do very much agree with Ms. Duggan that whether an irrelative price of fuels are drivers of that volatility more than anything else. If we ask any energy trader, they will tell you that is the first thing that they look at. And volatility per se is caused by those, and those are the drivers.

Mr. WYNN. OK. Well, thank you. Now, in light of that comment, Dr. Burtraw, what about this transfer of wealth that you seem to be concerned about?

Mr. BURTRAW. The creation of a cap-and-trade program creates this new property right, and the question is to whom is that property right going to be distributed. Giving away the emission allowances is one form of compensation that companies could receive or that consumers could receive or could be kept in the public sector through an auction.

There is another form of compensation where it is just changes in the electricity prices or product prices generally. If you give away all of these emission allowances, this new property right, to emitters, the possibility exists for dramatic overcompensation to those companies.

Mr. WYNN. Is that what happened in Europe?

Mr. BURTRAW. That is what has happened in Europe.

Mr. WYNN. Was that a miscalculation that can be avoided, or is that an uncertainty that we will have to deal with, should we adopt that in this country?

Mr. BURTRAW. Sir, I have great respect for what happened in Europe, and they put together a program at a breakneck pace that is of historic magnitude. But they had to make some decisions in doing so that I think we would not want to replicate here.

Mr. WYNN. OK. Well, hopefully we can avoid it. Is there any sense that there would have to be a Federal subsidy to offset consumer costs? We tend to treat this rather cavalierly. We describe it as volatility and other things. To the consumer, it is great heartache. Yes, Dr. Burtraw?

Mr. BURTRAW. The changes in energy prices would be a heartache to consumers. In the long run, economists firmly believe that changes in prices are what is needed to officially implement carbon policy in the United States. In the short run, there could be measures, such as suggested by Dr. Izzo, that could help mitigate that. But in the long run, I think we want to see the transition to a time when people recognize the social cost of carbon emissions and the decisions that they make on a daily basis.

Mr. WYNN. My last question. Off ramps and safety valves, are they conducive to stability, or do they interject further instability? Dr. Burtraw?

Mr. BURTRAW. Yes, this is like Jeopardy. Thank you. Dr. Smith mentioned that the SO^2 program had departed in one way, and that there is more dramatic price volatility in the CO^2 market. In fact, if you look at all the markets, there has been a lot of price volatility. And the most important consequence previously has been the dramatic price fall in the SO^2 market, which meant that Congress did not get everything it paid for, and a lot of investments maybe weren't as worthwhile as people had hoped they would be.

But the point is that you could have cost management on the low side and on the high side that could dramatically improve the per-

formance of the program in terms of achieving goals without unnecessarily surprising investors and making them look stupid either on the low side or on the high side.

Mr. WYNN. Right. Well, my time is up, and although there is no one else that hasn't asked questions, I will not abuse the time. I want to thank all the witnesses.

Mr. SHIMKUS. Mr. Chairman.

Mr. WYNN. I am sorry.

Mr. SHIMKUS. No, just for a point of clarification just because my 5 minutes was pretty quick. I believe in the markets, and I believe in exchanges. My point was that not everyone does, and they do think there is manipulation. And they do think there is price gauging. I believe in raising capital, assuming risk, rewarding that, and I just put that on the record.

The other thing is that there is an assumption here that, because of all our numerous hearings, that if we go down this route, there is going to be increased cost, whether we can manage that effectively through our U.S. Government cap-and-trade program. First of all, we can't assume we are going to affect China and India.

The other thing is if we dramatically change our economy and we impose great cost increases—the concern is in 100 years, does the global temperature's climate change 5 degrees or 3 degrees. Now, you do the math and effect cost benefit analysis of this. I think many of us are going to say that this is not the way to put our dollars, $180 billion, in a program that is of questionable scientific benefit to us. And I yield back.

Mr. WYNN. All right. I thank the gentleman. Again, I thank the witnesses for their testimony, and we appreciate your presence here today. There are no further requests for time for questioning, the hearing is adjourned.

[Whereupon, at 1:05 p.m., the subcommittee was adjourned.]

[Material submitted for inclusion in the record follows:]

Written Testimony of Dallas Burtraw

Climate Change: Lessons Learned from Existing Cap and Trade Programs

Mr. Chairman, thank you for the opportunity to testify before the House Committee on Energy and Commerce. My name is **Dallas Burtraw,** and I am a senior fellow at Resources for the Future (RFF), a 54-year-old research institution, headquartered here in Washington, DC, that focuses on energy, environmental, and natural resource issues. RFF is both independent and nonpartisan and shares the results of its economic and policy analyses with members of environmental and business advocates, academics, members of the press, and interested citizens. RFF neither lobbies nor takes positions on specific legislative or regulatory proposals. I emphasize that the views I present today are my own.

During my 17 years at RFF, I have studied the performance of emission cap-and-trade programs from both scholarly and practical perspectives. I have focused especially on the sulfur dioxide (SO_2) emission allowance trading program created by the 1990 Clean Air Act Amendments and the nitrogen oxide (NO_x) trading program in the northeastern United States. I also have studied the European Union Emission Trading Scheme (EU ETS). I have conducted analysis and modeling to support the Northeast states in the design of the Regional Greenhouse Gas Initiative (RGGI). Currently, I am serving on California's Market Advisory Board for implementation of the state's Assembly Bill 32, a centerpiece of the its greenhouse gas initiative.

I have been asked to comment briefly on the lessons from existing cap-and-trade programs, looking across experiences in the United States and the EU. The lessons we can learn depend on remembering what it is we are trying to accomplish with

cap-and-trade programs. The point of emission allowance trading is *not* to trade allowances. Rather, it *is* to achieve emission reductions at less cost than might occur with other types of regulatory approaches. When we implement environmental policy efficiently, more money is available for families and for businesses, or even further environmental improvements can be achieved at the same cost as those that would be achieved without a cap-and-trade system.

Historically, we have relied primarily on prescriptive regulation as the workhorse of environmental policy. This type of an approach has been successful in that it has reduced emissions significantly. It makes sense in situations where control options are obvious, and costs are reasonable. As I have heard my companion on this panel, Brian McLean of the U.S. Environmental Protection Agency, say before, prescriptive regulation establishes *what* needs to be done and *how* and *when* each source has to do it. In contrast, cap and trade relies on the government to articulate a specific social goal with respect to environmental quality, but it enables firms to decide how, where, and when to make emission reductions. This approach is especially compelling when the firms in the regulated industry have equipment of different types and vintage, and they face a complicated array of investment options. In this context, a one-size-fits-all approach does not work well. If the government regulator were to try to prescribe the technology choice in such a situation, it would have great difficulty achieving a cost-effective outcome, because it could not account for all the idiosyncratic conditions facing individual facilities and firms. Cost savings provide a primary motivation for turning to emission trading. One can look at the experiences with trading and discern some important lessons about the design of these programs and how well they achieve their intended goals.

I want to touch on the following issues:

1. Cost Savings
2. Monitoring and Reporting
3. Time Horizon
4. Banking
5. Allocation
6. Adjustments to Allocation Rules
7. Cost Management

I close with a summary that highlights the two guiding ideas for program design at this point in the legislative debate: simple and transparent market design, and efficient and fair allocation.

Cost Savings

Convincing literature indicates that important savings have been achieved in cap-and-trade programs compared to the cost of prescriptive regulations. In some cases these results hinge on statistical work and sometimes they are simulation models that indicate expected costs savings. I will cite two examples pertaining to the SO_2 trading program.

Carlson et al. (2000) statistically estimate that the potential cost savings attributable to formal emissions trading, compared to the counterfactual of a uniform emissions rate standard, were $250 million (1995 dollars) during Phase I of the program.[1] They estimate the savings are $784 million per year during Phase II, or about 43 percent of total compliance costs under a uniform standard regulating the rate of emissions at a facility. When compared to an alternative counterfactual policy that forces scrubbing to achieve the same level of emissions, cost savings of the program are estimated to be almost $1.6 billion per year.

[1] Carlson, CP, Burtraw, D, Cropper, M, and Palmer, K. 2000. "SO_2 Control by Electric Utilities: What Are the Gains from Trade?" *Journal of Political Economy*, 108, pp. 1292-326.

Ellerman et al. (2000) provide another estimate of cost savings that is based on an extensive survey of the industry, with extrapolation to estimate long-run compliance cost.[2] The authors estimate the cost savings from emission trading, inclusive of savings attributable to banking, to be about 55 percent of total compliance costs under a command-and-control approach. Hence, two major studies of cost savings (Carlson et al. 2000 and Ellerman et al. 2000) are in general agreement on this estimate.

The sources of cost savings under the SO_2 program are numerous. These studies and others point to the important role that the emerging availability of low sulfur coal played in attaining emission reductions at less cost than many anticipated would be the case at the time of passage of the 1990 Clean Air Act Amendments. Some have suggested this explains away the estimated cost savings. However, the important thing to appreciate is that every other title in the 1990 Amendments employed prescriptive policies to achieve their goals. A prescriptive policy would not likely have enabled firms the opportunity to capitalize on the changing dynamics in coal markets. A prescriptive approach would have constrained the flexibility of firms, and it would have significantly raised the cost of the SO_2 program.

Another feature of the SO_2 and NO_x programs is that cost savings have involved some patentable innovations and discoveries, but they have also involved non-patentable process changes that were not anticipated prior to the program.[3] In some cases, this was simply a matter of looking under the lamp post for cost savings; however, prior to the cap-and-trade program the incentive to look under the lamp post was missing. The cap-

[2] Ellerman, AD, et al. 2000. *Markets for Clean Air: The US Acid Rain Program*. New York: Cambridge University Press.

[3] Burtraw, D, 2000. "Innovation under the Tradable Sulfur Dioxide Emission Permits Programme in the U.S. Electricity Sector," *Innovation and the Environment*, Proceedings from OECD Workshop, June 19, 2000. See also: Resources for the Future Discussion Paper 00–38 (September).

and-trade approach puts an incentive in place to continuously find opportunities to reduce emissions.

Monitoring and Reporting

In the area of monitoring and reporting, the SO_2 and NO_x programs in the United States receive outstanding marks. The use of continuous emission monitoring coupled with electronic data reporting help maintain strong confidence that emissions are properly accounted for. In contrast, Phase 1 of the EU ETS performed weakly in this area because many Member States lacked accounting and monitoring systems at the outset of the program. This led to some of the problems that have been cited with respect to the low stringency of the program in Phase 1. At the outset of the program there was little information about emission baselines, so efforts to establish a cap turned out to be too generous.

However, were we to give out trophies for most improved, the EU ETS would probably win. The purpose of Phase 1 was to develop systems that would enable the EU to meet its commitments under the Kyoto Protocol beginning in 2008, which is the start of Phase 2 for the EU ETS. A major accomplishment of the EU ETS is that it developed a coherent market among 27 Member States using 20 official languages and sharing little in the way of common regulatory approaches before the start of the program.

A lesson for the United States for climate policy should be that only sectors of the economy with clear emission data baselines and accurate monitoring should be included in a trading program. If the program were to be implemented upstream, where fuels enter the economy and can be regulated on the basis of their carbon content, it would simplify the administrative problems. If the program were to be implemented at the point where

fuel is combusted and emissions enter the atmosphere, a litmus test should be the quality of monitoring and data reporting for each sector that would be included. The U.S. electricity sector strongly satisfies such a test, but other sectors are more uneven. The program might have an "on-ramp" to allow for an expanding coverage of additional sectors as adequate monitoring is established, and it might benefit from including incentives to improve monitoring or from requiring the compilation of emission inventories throughout the economy, which would be a precondition for expanding the program.

Time Horizon

In this area, the SO_2 and NO_x programs in the United States again receive high marks because their programs have an indefinite time horizon. In contrast, the EU ETS is problematic. The trial period in Phase 1 in the EU ends in December 2007. Plans for the second phase are still being finalized, yet that phase will extend only through 2012. The authorizing legislation for the EU ETS requires that the program should continue indefinitely, but the rules governing its implementation have been broken up into periods matching Kyoto compliance periods. Consequently, firms face tremendous uncertainty about the future. This places difficulties on high emitters, which must develop strategies to try to reduce emissions. It also places difficulties on investors in low-emitting technologies, who cannot be certain about the long-run stringency of the policy.

The SO_2 program provides a useful model for how adjustments can be made in the future as new information about benefits and costs becomes available. Although changes in the SO_2 program were unfortunately slow in coming, due to its original design (which I mention again below), when changes finally occurred, they were implemented in

a way that strengthened the trading market and reinforced investor confidence. This change occurred through the Clean Air Interstate Rule (CAIR), which tightens the allowable SO_2 emissions in a large portion of the country beginning in 2010. Without addressing the question of what is the right change or ultimately the right emission target, what is important is the way in which CAIR implements this change. The rule preserves the value of banked emission allowances, thereby reinforcing the value of previous investments. In fact, by not starting until 2010, the rule provides an incentive for early investments to achieve early emission reductions that have value beyond 2010. The owners of these banked allowances will have an incentive to see the CAIR rule meaningfully enforced after 2010. Meanwhile, allocations after 2010 are devalued relative to those received before 2010. Overall this approach to revisiting the emission goal and adjusting that goal provides one useful model for how to adjust a program while maintaining incentives over a long time horizon.

Banking

Banking refers to the ability to save unused emission allowances for use in future periods. The ability to bank emission allowances is expected to save money and reinforce the trading program by offering incentives for early reduction and flexibility with respect to the timing of investments, as well as creating a constituency of those who hold emission allowances and become advocates for a coherent program going forward. Banking is especially important for a program for CO_2 control because CO_2 is so long-lived in the atmosphere that it matters little whether emissions occur in one year or the next; what matters are aggregate emissions. Banking can provide significant cost savings to firms while imposing little environmental effect.

Allocation

In previous writing and speaking, I have often been eager to shine a bright light on allocation because it is so important to the performance of the program. My fear was that an approach to allocation would slip into a program design without sufficient vetting as a centerpiece of the legislation, when in fact, I feel allocation *is* a centerpiece of the architecture of a cap-and-trade program.

This is an area where the EU ETS receives barely passing grades. The approach in the EU was to leave the choice about how to initially distribute emission allowances to the discretion of Member States. However, the EU placed a maximum ceiling of 5 percent on the number of allowances that could be distributed by auction. This is surprising because many observers felt there would be a competition to give allowances away for free to compensate domestic industries or to attract new investment, so the ceiling on the portion that can be auctioned was not relevant. Rather a floor establishing a minimum to be auctioned would help overcome the incentive of Member States acting individually to give away allowances. In fact only five Member States chose to auction any allowances.

There are not many viewpoints you can get economists to agree on, but one exception is the role of an auction. The vast majority of public finance economists would recommend an auction as the most efficient way to allocate emission allowances. With this as a point of departure, there are at least three principled reasons why government might chose not to auction all of the allowances. One would be to provide compensation to the affected firms.

An important finding in this regard, however, is that if firms are given a substantial portion of the emission allowances for free, this could lead to dramatic overcompensation of those firms at the expense of workers and consumers who would face an increase in product prices that was much greater than the costs incurred by firms. There is ample evidence that this has occurred in the EU ETS, where various national studies and industry interests in countries including the United Kingdom and Germany found that electricity generators earned extra-normal profits of several billion euros due to the EU ETS.[4] One German study suggested that in Germany in Phase I of the EU ETS, the program was a continuation of energy subsidies by other means.[5] Our work at RFF finds that if allowances were given away for free in the U.S. electricity sector, it would yield tremendous overcompensation. We modeled the implementation of a policy analogous to that proposed by the National Commission on Energy Policy and found that if the goal of a policy was to provide complete compensation to the electricity industry, it would be sufficient to dedicate 6 percent of the allowance value to free allocation. The remainder of allowances would be available to auction. If the goal were to fully compensate the worst-off firm, then compensation would require 10 percent of the

[4] The House of Commons, Fourth Report of Session 2004-05, March 16, 2005, found "Windfall profits for power generators" in the United Kingdome totaling 1.3 to 3.6 billion euros in 2006. In Germany, "'The utilities get a huge amount of windfall profits, and the energy users get windfall costs,'" complains Markus Weber…at steelmaker ThysseKrupp AG," reported Jeffrey Ball, September 11, 2006, *Wall Street Journal.* A March 6, 2007 report by Deutsche Bank Research, *EU Emission Trading: Allocation Battles Intensifying*, finds, "Power generation companies reap hefty windfall profits."

[5] SRU German Advisory Council on the Environment, April 2006. *National Implementation of the EU Emissions Trading Scheme.*

allowance value and would leave substantial extra-normal profits among those firms that benefit from the program. The remaining allowances would be available to auction.[6]

Two other reasons to give emission allowances away for free might be to promote preferred technologies, or to protect industries that are especially vulnerable to competition from firms that operate outside of the regulatory program. Even though these justifications provide cause for free allocation of some degree, these purposes are dangerous because they open the door for innumerable special pleadings. Complicated allocation rules provide a cloak under which massive transfers of wealth are possible in a CO_2 cap-and-trade program. The principle of simplicity and transparency in the market design for CO_2 applies nowhere more strongly than in the rules governing allocation.

The principle of simplicity and transparency is satisfied by an auction, and the revenues from an auction can be used to achieve other goals as well. Our modeling indicates that the group most affected by climate policy will be consumers. An auction provides an important source of revenue that can be used to achieve broad-based compensation through reductions in taxes or other options. An auction also provides revenues that can be used for research and development, and to provide incentives for investment such as an investment tax credit aimed to promote innovative technologies or to modernize industries that are especially vulnerable to the policy. Another candidate for investment is energy efficiency. In a study for the State of Maryland, we found that the

[6] Burtraw, D, and Palmer, K. 2006. "Compensation Rules for Climate Policy in the Electricity Sector Compensation Rules for Climate Policy in the Electricity Sector," presented to the National Bureau for Economic Research summer meeting. This finding assumes that in regions with cost of service regulation regulators guarantee recovery of costs.

dedication of 25 percent of the allowance value to investments in end-use efficiency could offset any price increase from the state joining RGGI.[7]

A lesson from the voluminous literature in economics and public policy would support an important role for an auction and expanding that role over time, aiming for a complete auction. This lesson is articulated well by a recent report from Deutsche Bank Research (cited above) that found:

> "As emissions trading is developed further, attention should be focused on, among other things, the auctioning of allowances....Greater transparency and a simplification of the system would be the consequences, possibly triggering a more rapid changeover to lower carbon fuels."

The Member States of the EU seem to be moving in this direction, with now roughly one-half of the 27 nations proposing a role for an auction in Phase 2. Nonetheless, the maximum size of the auction in the EU remains constrained during this next phase to be no more than 10% of the allocation. In contrast, the states in RGGI, launched by Governor Pataki and joined by nine other states, will require each state to auction a minimum of 25 percent of their allowances. As of now, five states have declared their intended approach to allocation, and all five have indicated they will auction 100 percent.

Adjustments to the Allocation Rules

The second way that allocation matters is the treatment of sources that retire or new sources that enter the program. Should there be adjustments made to allocation rules? Common sense suggests yes, but economic theory says no. Common sense suggests it is

[7] Center for Integrative Environmental Research, University of Maryland. January 2007. *Economic and Energy Impacts from Maryland's Potential Participation in the Regional Greenhouse Gas Initiative.*

crazy to allow a source to continue to receive allowances it does not need if it shuts its doors. Economic theory suggests that the policy that would remove such an allocation in this circumstance creates perverse incentives to keep the doors open and avoid retirement of what are the most inefficient and dirtiest sources. Similarly, allocation to new sources constitutes a subsidy that can easily draw from the school of unintended consequences. Reviews of the rules in the EU suggest that, indeed, the law of unintended consequences is prevailing, and potentially in a big way.[8]

In contrast, the SO_2 program makes no adjustment for retirements and makes no allocation to new sources. Some have argued this is unfair, but it clearly has contributed to the transparency and success of the program. The problem with the SO_2 design, and I believe there is one, is that the free allocation of SO_2 allowances continues indefinitely. At this point, facilities are identified to receive free allocation after the year 2040 based on their economic activity 60 years previous in the 1985–1987 base years. This free allocation should have been phased out over time in favor of an auction. At the time of the 1990 Amendments the entire electricity industry in the United States was under cost of service regulation. That meant that regulators would make sure that companies did not charge customers for something they received for free. Since that time we have seen the emergence of widespread competition in wholesale power markets and in many retail markets. The stage is set for a very inequitable outcome depending on how allocation rules are established in a CO_2 program.

[8] Åhman M, Holmgren K. 2007. "Harmonizing New Entrant Allocation in the Nordic Energy Market," *Energy Policy* (forthcoming); and Åhman M, Burtraw D, Kruger J, and Zetterberg L. 2007. "A Ten-Year Rule to Guide the Allocation of EU Emission Allowances," *Energy Policy* 35: 1718-1730.

Cost Management

Events in fuel markets, technological innovations, discoveries in science and evolution of public opinion impose great uncertainty on the future of climate policy. In turn, this imposes uncertainty on the cost of a policy. In the long run, policy may adjust. In the short run, however, uncertainty may cause unnecessary volatility in prices in allowance markets. This kind of volatility would serve little useful purpose except to benefit those who make their living off such price uncertainty. For others of us, excessive volatility can undermine confidence in the program and erode investor confidence and even public support. The attached Figure 1 shows that price volatility has been a common feature of emission programs in general.

Looking over previous cap-and-trade programs, the most important case, by far, of unanticipated price movements was in the SO_2 program, in which prices fell dramatically below what was anticipated at time of adoption of the program. As a consequence, for well over a decade until implementation of the CAIR rule, Congress and the American people were not getting what they paid for. The delicate political compromise in the 1990 Clean Air Act Amendments balanced benefits and costs, but shortly after passage of the amendments the precipitous fall in costs meant that balance was lost. Even though benefits far exceeded costs, our feet were "stuck in cement" and no adjustment to the emission cap was available. As a consequence, we have estimated that the American people are losing $8 billion a year compared to a program that would have managed costs and adjusted to signals that were coming from the allowance market. [9]

[9] Burtraw, D, Kahn, D, and Palmer, K. November 30, 2006."Dynamic Adjustment to Incentive-Based Policy to Improve Efficiency and Performance," unpublished working paper.

In the case of CO_2, the natural way cost management could occur would be through the use of a reservation price in that portion of the allocation that is distributed through an auction. A reservation price is a common feature of good auction design; it is even a common feature on eBay. If the willingness to pay of bidders in an auction falls below the reservation price, that item is not put onto the market. Such a mechanism as part of a CO_2 trading program would ensure that precipitous declines in price would not erode the value of investments and the efforts of innovators to push forward with emission-friendly technologies.

The volatility in the EU ETS shown in Figure 1 is interesting because it points out a number of imperfections in the program design. One is simply that the first phase was a test period, which ends in December 2007. There is no bridge between Phase 1 and Phase 2. Consequently all allowances held in December 2007 will have zero value. Moreover, because of the weak institutions for monitoring and reporting emission data at the outset of the trial period, allocations were generous. These problems appear to be corrected for the beginning of the second phase in 2008.

On the other hand, a leading concern of many business groups is that allowance prices could rise to levels that are unanticipated. The nearly six-fold change in natural gas prices over the last eight years shows how volatile energy markets can be, and potential amplification of that volatility through interactions with the allowance market could cause unnecessary economic harm and erode political support for climate policy. A symmetric mechanism to a reservation price on the low side for allowances would be a high-side price ceiling. If that ceiling price is triggered, some additional allowances could be introduced into the market. One source of those allowances might be allowances that

previously have been withheld due to the reservation price. Another source might be to borrow from the allocation for a future year. If the high price persists, leading to continued borrowing from a future year, this might trigger an administrative review of the program and recalibration of emission goals and cost limits.

Summary

As one looks across the performance of the previous programs and across the scholarly literature that has studied those programs, **two observations rise above the rest**. One is the proposition that the best market design is a simple and transparent. This is the best guarantee that a cap-and-trade market is fair and efficient. If, as they say, the devil is in the details, then the more details there are, the more places there are for the devil to hide. In many cases, details that seem compelling to appease one group or to fix to one problem only beget other problems, opening the door for unintended consequences.

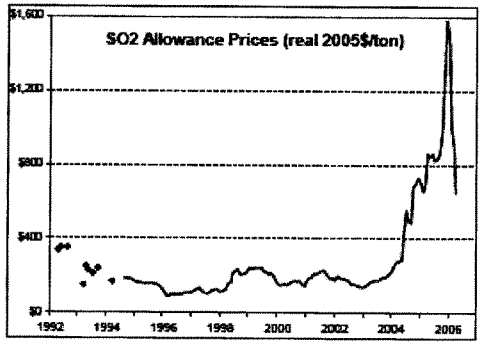
The SO_2 trading program is interesting because in many ways it is an ideal program, beginning with the establishment of a well-defined emission cap that represents social goals. Emission monitoring is accurate and complete, data is transparent, and enforcement is certain. Government's role is minimal, but effective to establish the confidence of investors that rules will be credibly enforced. The remarkable success of the SO_2 program, all observers seem to agree, is its simplicity and transparency. Criticisms of the EU ETS have one common theme, which is that its weakness stems from unfortunate complexity. The organization of the EU ETS is a remarkable political accomplishment involving 27 Member States. To achieve that accomplishment required compromises. The United States should be able to adhere more closely to the SO_2 model. This approach established clear rules, with a strong role for monitoring and enforcement

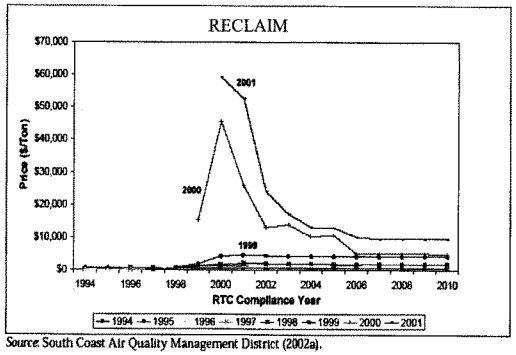
by the government, and then the government stepped out of the way and let the market perform.

The second observation that rises above the others is the importance of allocation. The allocation matters to political success of program, to its efficiency and its distributional outcome. A complex allocation system is one that can cloak unfair and dramatic transfers of wealth. A transparent allocation system will do more to build public confidence in the institution. There are many reasons why an auction should play the dominant role in the allocation, with a growing role over time

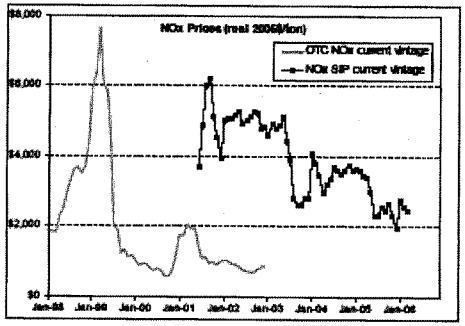
I respectfully submit this testimony as one of the strongest advocates for cap and trade. But, I insert a word of caution. There comes a point where political compromise is the undoing of successful market design. We can do a lot in this country with good, old prescriptive regulation. If we get to the point where a CO_2 cap-and-trade policy begins to resemble the Chicago phone book, it is probably better to move away from this kind of approach. However, done right, with an emphasis on simplicity and transparency, the lessons from previous programs indicate that a cap-and-trade program can help us achieve our environmental goals at dramatically less cost than other types of regulatory approaches.

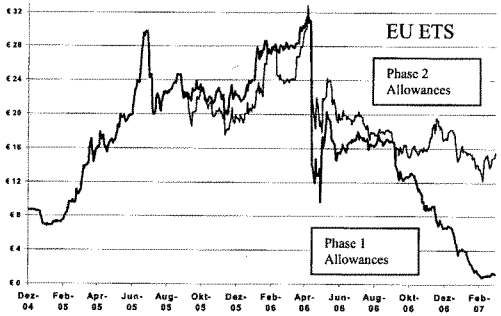
Figure 1. Volatility in Emission Markets





Source: South Coast Air Quality Management District (2002a).





EU Cap and Trade Programme
Jill Duggan
Head of International Emissions Trading
UK Department for Environment Food and Rural Affairs

In 2001 the European Commission adopted a proposal to introduce emissions trading in Europe. This proposal was then negotiated, and the Emissions Trading Directive was approved by the European Council and the European Parliament in 2003 for transposition in National legislation in Member States and implementation across Europe by January 2005.

The first phase of the programme (2005-2007) was intended as a learning phase prior to the first Kyoto commitment period (2008-2012).

The EU ETS is one of the key policies introduced by the European Union to help meet the EU's greenhouse gas emissions reduction target under the Kyoto Protocol. The EU is required to make an 8 per cent reduction in emissions compared to 1990 levels by the first Kyoto Protocol commitment period (2008 to 2012).

The programme is entirely different and separate from the voluntary pilot UK ETS, which involves only UK-based companies and ended in December 2006 for direct participants.

The EU ETS uses a market-based mechanism to incentivise the reduction of greenhouse gas emissions. The programme operates through the allocation and trade of greenhouse gas emissions allowances throughout the EU – one allowance represents one metric tonne of carbon dioxide equivalent.

An overall limit, or 'cap', is set by each Member State on the total number of allowances to issue to installations in the programme, based on the Member States' emission reduction targets (Kyoto and/or national). The caps are assessed by the Commission to ensure their compliance with the 12 criteria of the Emissions Trading Directive.

The allowances are then distributed by Member States to the installations in the programme. At the end of each year installations are required to ensure they have enough allowances to account for their installation's actual emissions.
They have the flexibility to buy additional allowances (on top of their free allocation), or to sell any surplus allowances generated from reducing their emissions below their allocation. The buying and selling of allowances takes place in an EU-wide market.

The programme is divided into periods (phases) for which Member States must develop a **National Allocation Plan (NAP)**, which requires Commission approval. These plans must set out how free allowances will be issued to installations included in the programme, and for Phase II they must show that the total number of allowances to be issued is consistent with Member States'

individual emission reduction targets under the EU's burden sharing agreement for the Kyoto Protocol.

There are around 12,000 installations in Europe covered by the EU ETS which are responsible for almost 50% of Europe's CO2 emissions. Installations covered by the programme include:
• energy activities (e.g. boilers, electricity generations, Combined Heat and Power plants);
• production and processing of ferrous metals;
• mineral industries;
• pulp and paper industries.

All installations carrying out any activity listed in Schedule 1 (such as combustion installations, production and process of ferrous metals) are required to hold a greenhouse gas emissions permit. The conditions of the permit will require installations to monitor and report emissions in accordance with the monitoring and reporting plan approved by the Regulator. Each year emissions data for the previous calendar year must be verified, and the equivalent number of allowances surrendered. All transfers and surrenders of allowances take place on electronic national registries.

Phase I of the programme runs from 1 January 2005 to 31 December 2007 and was designed as a learning phase, with a review process, in order to get the programme up and running and to learn early lessons in time for operation of the first Kyoto period from 2008 -2012 when Member States and the European Union would have obligations to meet their Kyoto targets. The Commission is currently reviewing the scheme, and expect to bring forward an amendment to the Directive by the end of 2007.

Carbon dioxide is the only greenhouse gas covered by the EU ETS in Phase I. Other greenhouse gases or activities can be covered from Phase II (2008 to 2012) if Member States choose to opt-in additional gases or activities, or if the EU ETS Directive was to be amended for future phases.

How were allowances calculated in Phase I?

For Phase I Member States were required to allocate at least 95% of allowances for free. The Directive also required that allocation could not be made in excess of need, ie emitters could not be given more allowances than would be needed to cover their expected emissions with the expected levels of growth (i.e. not more than Business As Usual). This recognised the 'sunk costs' of business covered by the programme, who had made investments in a world without EU ETS and without a carbon price.

The UK allocated 93.7% of the total quantity of allowances to existing UK installations, which were to be issued in three equal annual instalments for free. The remaining 6.3% forms a new entrant reserve (see below). If there are any allowances remaining in the new entrant reserve in Phase I, these will be auctioned or sold. For installations which were in operation before 1 January 2004, the allocation of allowances followed a two-stage process.

Firstly, the total quantity of allowances was distributed among sectors covered by the EU ETS – e.g. power stations, iron and steel, cement etc. The sector totals were intended to reflect the projected production growth over the phase. The allowances within sectors were then distributed to installations proportionate to their share of baseline emissions. Baselines for Phase I were calculated on the average emissions for 1998 – 2003, dropping the lowest year.

Experience of Phase I to date

In the first Phase the Commission cut back the proposed allocations by 220 million per year. Given the very tight timetable for developing National Allocation Plans and the institutions required to run the programme, not all plans were approved, nor emissions trading registries live on 1st January 2005. In fact the UK plan was finally approved and the emissions trading registry went live in May of that year. Many plans were approved and allocations made throughout the remainder of 2005 and into 2006. This stream of approval and allocation in the first year caused shocks to the fledgling market as decisions were made on total allocations and allowances became available to trade.

In May 2006 the results of the first years trading were made available. These results demonstrated that allocations were, overall, in excess of emissions – by around 80 million allowances for that year, against predictions of a annual shortage of around 50 million. In fact the percentage of excess allowances is small - about 4%, since the total market is about 2,000 million. However against this there was a very high degree of compliance (more than 99%).

The first two years of trading have been characterised by a good deal of volatility in the price with the cost of allowances rising to over €30 a tonne in June and July 2005 and then again in April 2006, dropping sharply to around €8 following the release of the first year's results. As noted above the volatility was, in large part, generated by the stream of approvals and availability of allowances as registries came online.

According to Point Carbon, 2006, the second year of Phase 1, " global carbon markets saw transactions of 1.6 billion tonnes of CO2e, worth €22.5 billion. The EU's emissions trading schme (EU ETS) accounted for 62% of the volume and 80% of the value in 2006, which equates to 1 billion tonnes of CO2 transacted, worth €18.1 billion." Point Carbon estimates that this was 2.5 times high than in 2005.. They predict the international carbon markets will grow to 2.4 billion tonnes of CO2e and that the EU ETS trades will be worth in the region of €18.5 billion in 2007.

The first year's results made clear that good baseline data was necessary to set allocations and this early learning phase ensured that states and the European Commission have reliable data on which to base the allocations for the first Kyoto period. The learning phase also ensured that the institutional framework was put in place. This required the development of national and

community emissions trading registries. Each installation in the programme has an account in its national registry. The account tracks the allocation and holding of allowances and sufficient allowances must be held in the account to cover the verified emissions of an installation. The accounts also allow the electronic transfer of allowances from any installation in the programme to any other, with a series of checks and balances to ensure the security of the system. Individuals or other companies may also open accounts in the registries in order to hold, trade or cancel allowances.

Factors influencing the cost of carbon

In addition to the allocation decisions of Member States there are many influences on the cost of carbon including the relative cost of gas, coal and oil, weather, economic growth, improvements in energy intensity, the price and limit on the use of credits from the Clean Development Mechanism, or Joint Implementation.

Costs to industry and domestic users

Many states, including the UK, allocated allowances in order to require the large electricity producers to bear the burden of any 'effort'. This recognised that this sector was reasonably well insulated from international competition, that in general there was better emissions data available, and that where the electricity markets were competitive, they were able to pass on costs. In implementing the programme in the very short space of time, it was difficult to get a good assessment of the competitive impacts of allocating at less than need for many other sectors. Further, any price impact on electricity would provide an incentive for other energy intensive industries to reduce their energy use. Other sectors in the UK were allocated at predicted need. This reflected the difficulty within a short period of time of undertaking a full competition assessment and the extent to which these sectors could pass through costs.

Electricity Prices

The electricity price increase from internalising the cost of carbon in the UK was assessed as being much smaller than the increase due to the increased price of gas during the period. In fact the high cost of gas meant that fuel switching did not take place in that year.

Analysis undertaken in the UK indicated that the electricity sector had largely passed through costs to wholesale electricity prices, and hence large industrial users, in the first year, but that there was evidence that costs have not yet been fully passed through to domestic users.

Competition Issues

Some industries covered by the ETS are clearly more open to international competition than others. However, there are a number of factors, alongside

the cost of carbon, that will influence investment decisions by industry including long term regulatory certainty, the availability of a skilled labour force, and the proximity of markets. Tata Steel recently announced its acquisition of Corus the UK's largest steel company, showing that multinationals are still willing to invest in this competitive industry within the EU. From an energy perspective, the Kingsnorth plant – 1.6 gigawatts of clean coal which is 'capture ready' was announced in October last year, showing that companies are willing to build new coal fired power plants in the UK.

Has there been an environmental response from industry?

Anecdotal evidence from industry shows that the consideration of a carbon price has led to them making some of the easier energy efficiency measures, but also that they are starting to invest in R&D for new technologies. Industry have called for long term clarity over future carbon constraints, so they can make the right low carbon investments.

In their study of the ETS published in November 2006 Denny Ellerman and Barbara Buchner found "the refutable presumption must be that the EU ETS succeeded in abating CO2 emissions in 2005 based on three observations.

> 1. **A Positive EUA Price**. A significant price is being paid for CO2, which reason suggests would have the effect of reducing emissions as firms adjust to this new economic reality.
> 2. **Rising Real Output**. Real output in the EU has been rising at the same time that the rate of improvement in CO2 intensity has been declining, which has led to rising CO2 emissions before 2005.
> 3. **Historical Emissions Data** that indicate a reduction of emissions even after allowing for plausible bias. The amount of emission reduction in 2005 may be modest, but so is the ambition of the 1st period cap. Given the problems of getting the system started and the changes in management and regulatory practice implied, even a modest amount of abatement mayseem surprising, but the available evidence makes it hard to argue that there was none."[1]

Second Phase – 2008 -2012

The Second Phase of the EU ETS runs from 2008 – 2012, coinciding with the first Kyoto Commitment Period where the EU has a commitment to reduce greenhouse gas emissions by 8% below 1990 levels. Within this bubble agreement States have individual commitments – for example the UK has a target to reduce its emissions to 12.5% below 1990 levels.

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[1] **Over-Allocation or Abatement? A Preliminary Analysis of the Eu Ets Based on the 2005 Emissions Data** Denny Ellerman and Barbara Buchner NOTA DI LAVORO 139.2006 **NOVEMBER 2006** CCMP – Climate Change Modelling and Policy Denny Ellerman, *Massachusetts Institute of Technology, Senior Lecturer at Sloan School of Management*
Barbara Buchner, *Fondazione Eni Enrico Mattei*

In assessing Member States plans for the second phase, the European Commission has therefore looked at their progress towards the Kyoto target, the other policies and measures in place to help meet this target and importantly, the verified emissions data for 2005. A starting point for assessment is the proportion that ETS installations 2005 emissions contribute to a state's total greenhouse gas emissions, and its distance to its Kyoto target.

The first year's compliance results have provided Member States and the Commission with much more robust emissions data than was available in Phase I. The plans assessed by the Commission so far demonstrate its commitment to using that data to ensuring real scarcity in the programme in Phase 2. Table 1 shows the adjustments made by the European Commission to the 17 proposed plans assessed to date, cutting approximately 101 tonnes from 2005 verified emissions once increased scope is accounted for.

Table 1: Assessment of Phase 2 National Allocation Plans

Summary information on the 17 plans assessed to date:

Approved allowances for 2005-2007, verified emissions in 2005, proposed caps for 2008-2012, approved caps for 2008-2012 and additional emissions covered in 2008 to 2012

Member State	*1st period cap*	*2005 verified emissions*	*Proposed cap 2008-2012*	*Cap allowed 2008-2012*	*Additional emissions in 2008-2012*[2]
Belgium	62.08	55.58[3]	63.33	58.5	5.0
Czech Rep.	97.6	82.5	101.9	86.8	n.a.
France	156.5	131.3	132.8	132.8	5.1
Germany	499	474	482	453.1	11.0
Greece	74.4	71.3	75.5	69.1	n.a.
Ireland	22.3	22.4	22.6	21.15	n.a.
Latvia	4.6	2.9	7.7	3.3	n.a.
Lithuania	12.3	6.6	16.6	8.8	0.05
Luxembourg	3.4	2.6	3.95	2.7	n.a.
Malta	2.9	1.98	2.96	2.1	n.a.
Netherlands	95.3	80.35	90.4	85.8	4.0
Poland	239.1	203.1	284.6	208.5	6.3
Slovakia	30.5	25.2	41.3	30.9	1.7
Slovenia	8.8	8.7	8.3	8.3	n.a.
Spain	174.4	182.9	152.7	152.3	6.7[4]
Sweden	22.9	19.3	25.2	22.8	2.0
UK	245.3	242.4[5]	246.2	246.2	9.5

SUM	**1751.38**	**1613.11[6]**	**1758.04**	**1593.15**	**51.35**

[1]. Directive 2003/87/EC, as amended by Directive 2004/101/EC. [2] The figures indicated in this column comprise emissions in installations that come under the coverage of the scheme in 2008 to 2012 due to an extended scope applied by the Member State and do not include new installations entering the scheme in sectors already covered in the first trading period.

[3] Including installations which Belgium opted to exclude temporarily from the scheme in 2005

[4] Additional installations and emissions of over 6 million tonnes are already included as of 2006.
[5] Verified emissions for 2005 do not include installations which the UK opted to exclude temporarily from the scheme in 2005 but which will be covered in 2008 to 2012 and are estimated to amount to some 30 Mt.
[6] The sum of verified emissions for 2005 does not include installations which the UK opted to exclude temporarily from the scheme in 2005 but which will be covered in 2008 to 2012 and are estimated to amount to some 30 Mt.

There are some differences to the programme for Phase 2 that were written into the Directive. These are that Member States may auction or sell up to 10% of allowances, and that they must set a limit on the use of project credits generated by developing country projects in the Clean Development Mechanism and Joint Implementation. consistent with the international obligations on supplementarity (that require states to ensure that any effort that is purchased from developing countries through the Kyoto Mechanisms is additional to domestic action to reduce emissions). There has been no change to the Directive for Phase 2 but there has been greater harmonisation of the scope and interpretation of the Directive facilitated by additional guidance from the Commission.

There is no sunset clause in the Directive, therefore the scheme will continue to run. However, during 2007 the Commission, in consultation with Member States and stakeholders, is reviewing the Directive. The Commission are expected to bring forward a proposal to amend the Directive later this year, which would become effective from 2013 (Phase III).

This is intended to strengthen the scheme by analysing its functioning and design with respect to a number of specific issues, evaluating the impact of expanding the EU ETS to other sectors and gases, and understanding the impact of the EU ETS on competitiveness.

The key issues that are under consideration are:

1 The scope of the Directive – including the consideration of inclusion of other sectors and gases
2 Further harmonisation and increased predictability that will address the issue of cap setting, and whether this should be centralised, and the length of trading periods and target setting
3 Robust compliance and enforcement

4 Linking with emissions trading programmes in third countries, and appropriate means to involve developing countries and countries in economic transition

The UK will push hard for greater clarity on certain issues, such as caps, for implementation of the EU ETS beyond 2012, as the EU ETS is considered the most important mechanism for stimulating UK and international investment in low-carbon technology.

At the launch of the Stern Review the Chancellor of the Exchequer announced the UK's proposal for a new European-wide emissions reduction target of 30% by 2020 and then at least 60% by 2050.

At the Spring European Council on 9 March 2007, EU Heads of Government agreed an ambitious, independent binding target to reduce Europe's greenhouse gas emissions by at least 20% by 2020 (compared to 1990 levels) and to increase this commitment to a 30% reduction as part of an international agreement. They also decided to:

- ensure that a minimum of 10% of EU transport petrol and diesel consumption comes from bio-fuels by 2020;
- promote energy efficiency by reducing overall EU energy consumption by 20% by 2020;

and stimulate the use of new technology on clean coal power stations, with the aim of bringing environmentally safe carbon capture and storage (CCS) to deployment with new fossil-fuel power plants, if possible by 2020.

CLIMATE CHANGE: LESSONS LEARNED FROM EXISTING CAP-AND-TRADE PROGRAMS

TESTIMONY OF RALPH IZZO
CHAIRMAN AND CEO-ELECT
PUBLIC SERVICE ENTERPRISE GROUP INCORPORATED

BEFORE

HOUSE SUBCOMMITTEE
ON
ENERGY AND AIR QUALITY
ENERGY AND COMMERCE COMMITTEE
MARCH 29, 2007

Chairman Boucher and members of the Subcommittee, I am pleased and honored to appear before you today on behalf of Public Service Enterprise Group Incorporated (PSEG).

PSEG is a diversified energy company with more than $28 billion in assets and more than $12 billion in annual revenues. Our family of companies distributes electric and natural gas energy to more than two million utility customers in New Jersey, and owns and operates approximately 16,000 megawatts of electric generating capacity in New Jersey, New York, Connecticut, Texas, Pennsylvania, New Hampshire, California, and Hawaii. This is a diverse generating fleet in terms of fuel source and technology and includes about 2,400 megawatts (MW) of coal-fired capacity and almost, 3,500 MW of nuclear capacity.

Let me state at the outset that PSEG believes that global climate change represents a real environmental threat and significant business challenge, as well as opportunity. We support mandatory greenhouse reductions on a national level and a cap-and-trade mechanism to achieve necessary reductions.

PSEG has been an active participant in the on-going policy debate on how our industry can best contribute to achieving our nation's environmental objectives. We have advocated independently, and through a coalition of companies known as the Clean Energy Group, for our industry to make further reductions in air pollutants traditionally associated with the production of electricity – sulfur dioxide (SO2), nitrogen oxide (NOx), particulates, and mercury and to begin mandatory carbon dioxide reductions. We've been actively engaged in the climate change policy debate for more than a decade.

In 1993, PSEG set a voluntary goal through EPA's Climate Challenge program to stabilize its CO2 emissions at 1990 levels by 2000. PSEG reached this goal. In continuation of this effort, in 2002, we joined EPA's Climate Leaders program, and made a voluntary commitment to reduce our greenhouse gas emissions rate 18% from 2000 levels by 2008. Through investments in clean and highly efficient new generation sources and the retirement of older, higher-emitting generation, PSEG is well on the way to meeting this goal.

We've established a greenhouse gas emissions inventory and voluntarily report our greenhouse gas emissions to the U.S. Environmental Protection Agency. We worked with the World Resources Institute to develop accounting protocols for registering greenhouse gas emissions and measuring reductions. PSEG participated in the development of the Edison Electric Institute's (EEI's) climate change policy principles calling for federal action to reduce greenhouse gas emissions. We continue to be an active stakeholder in the development of the Regional Greenhouse Gas Initiative (RGGI)—a CO_2 cap-and-trade program in the Northeast (A comprehensive list of PSEG's greenhouse gas reduction initiatives is included as Appendix 1 to this testimony). We spend a significant amount of time thinking about the design and implementation of these programs and we appreciate the opportunity to share our insights with you today.

Climate Change Principles

Before I comment on our experience with existing cap-and-trade programs for SO2 and NOx, I would like to outline the principles that guide my thinking and my company's position on the issue of global climate change.

First, global temperatures are rising and human activities are very likely contributing to this change.

Second, the risk to our economy and to our civil society warrants an immediate and aggressive federal policy response, including enactment of a mandatory program to limit greenhouse gas emissions.

Third, I have confidence that our nation has the intellectual capital and the innovative spirit that will allow us to meet this challenge while providing new economic opportunities. What we need now is the political will to take those necessary first steps toward a lower-carbon economy.

Climate change poses an enormous challenge to our industry, and I am under no illusions as to the magnitude of the task ahead. However, with the right combination of policies and the establishment of a national market for greenhouse gas emission allowances, I am optimistic that we can reverse the current emissions trend and position our nation as a leader in the fight to combat global climate change.

The point was made at last week's hearing that we have no "back-end" control technology with which to retrofit a fossil-fired power plant for the capture of CO_2 emissions. Some take this as a reason for delay. I disagree. We have, in fact, many options available to reduce our emissions, all of which are commercially available; many more will emerge as we reduce regulatory uncertainty by enacting a market-based climate change policy that establishes a price signal for carbon and other greenhouse gases.

These options include: (1) end-use energy efficiency; (2) supply-side energy efficiency; (3) renewable energy technologies; (4) nuclear energy technology; and (5) a wide range of greenhouse gas offsets. There is no silver bullet – no single solution to this problem. But I can assure you that we have options that can be implemented now and that the pace of technology development and deployment will hasten dramatically when the United States—the largest economy on the planet—establishes a market price for carbon. Until

this happens, however, the electric industry and other capital-intensive sectors of the economy will be forced to make business planning decisions in a state of regulatory uncertainty; technology innovators and entrepreneurs will be hampered in their efforts to secure capital as they pursue low carbon technologies; and we risk exposure to a growing patchwork of overlapping and inconsistent regional and individual state carbon reduction requirements.

Lessons Learned from Existing Cap-and-Trade Programs

As I indicated at the outset, PSEG has been involved in the development and implementation of several national and regional cap-and-trade programs for SO_2, NOx, and CO_2. Prior to 2000, our electricity generation business participated in these markets as part of a vertically integrated, regulated utility, and since 2000 our generation business has operated as a merchant electric generator in competitive wholesale electricity markets, predominantly in the Northeast.

To summarize, we believe that cap-and-trade based regulation provides the best option for regulating greenhouse gas emissions from the electric power sector and other segments of the economy. Second, despite the success of existing NOx and SO2 programs in delivering cost-effective reductions, we would argue that we should improve upon the existing models in our efforts to control greenhouse gas emissions. The most important is that the methodology used for distributing allowances should be adapted to address the unique challenges associated with the control of greenhouse gas emissions. We recommend using an output-based approach for allocations in the early years of the program as the best way to encourage efficiency upgrades and the deployment of new, clean technologies. We further recommend an initial allocation or distribution of allowances to affected industries accompanied by a transition to an auction system over a period of 10 years.

We have watched cap-and-trade programs develop and mature and we have become a strong advocate for these mechanisms. The details matter—a lot—but our overall assessment is that a cap-and-trade system works. Electric generators, regulators, and environmental advocates have come to accept that cap and trade systems for NOx and

SO_2 have, in fact, worked very well. The cap-and-trade systems for NOx and SO2 have encouraged least-cost compliance solutions by allowing the market to select a variety of compliance strategies. Overall electric industry SO_2 emissions have been reduced about 44% and NOx emissions have been cut about 36% since 1990. SO2 emissions were reduced at a cost well below the $1,800/ton that was originally anticipated.

The success of existing cap-and-trade programs provides an ample basis on which to support enactment of federal legislation to establish a CO_2 cap-and-trade program for the electric power sector. Ideally, while we would like to see an economy-wide system adopted, there are some good reasons for the electric sector to lead the transition to a lower carbon economy. Our industry is the largest source of CO_2 emissions in the United States, and we need an appropriate price signal to guide capital planning and investment decisions.

I would caution, however, that there are important distinctions between the existing NOx and SO_2 markets and a possible CO_2 program.

First and foremost is the potential scale of the CO_2 compliance market which will dwarf the SO2 and NOx markets. Under an economy-wide cap-and-trade system, it's estimated that the value of emissions allowances will exceed $40 billion annually (assuming a CO2 price of $7/ton). It is because the potential value of these emissions permits is so large, that decisions Congress makes regarding their distribution will have far greater implications than for NOx or SO_2.

The other important distinction between the existing NOx and SO_2 markets and a CO_2 program stems from the compliance solutions that will be needed. Under the Acid Rain program, there were basically two compliance options used: (1) switching to lower sulfur coals; and (2) the installation of SO2 scrubbers. In order to achieve significant greenhouse gas reductions, we need to create incentives for the rapid deployment of existing renewable and energy efficiency technologies and for the development of new compliance options such as carbon capture and storage. In short, we need to transform the ways in which we use and generate electricity.

Both of these distinctions speak to the need for a well crafted, carefully considered, nationwide, uniform system for distributing emissions permits. The key questions in this regard are: (1) on what basis should permits be distributed among the affected industry sectors and companies; and (2) to what extent should the emissions permits be auctioned, rather than distributed at no cost.

Under the Acid Rain program, virtually all SO_2 allowances were distributed at no cost to power plant operators. Since relatively few allowances have been auctioned, new generating facilities are generally required to purchase their permits from companies that were included in the initial distribution of allowances. A number of the witnesses before this Subcommittee last week suggested we continue this approach in a CO2 cap-and-trade program when they recommended an allocation to electric generators based on historic emissions (or fuel adjusted heat input which effectively translates to historic emissions).

We disagree. This grandfathering approach, as it is commonly known, creates a perverse incentive that should be avoided under a CO_2 cap-and-trade program. New generating technologies, like integrated coal gasification/combined cycle (IGCC) and ultra supercritical coal-fired power generation, would be completely excluded from the no-cost distribution of allowances because only existing facilities would be entitled to an allocation. This doesn't make sense from a public policy perspective because it rewards technologies with lower efficiency and higher emissions rates and provides no incentives for innovation and investment in low emission technologies.

PSEG, along with a coalition of companies, supports an alternative to grandfathering—a performance-based, efficiency approach—also known as an updating output based allocation. Under this system, allowances would be distributed based on a facility's proportionate share of recent electricity output measured in kilowatt hours. Both new facilities, like the IGCC and the ultra supercritical coal-fired power plants that I mentioned above, and existing generating plants, would be entitled to compete for allowances, and companies would have an incentive to upgrade the efficiency of their plants to reduce their compliance costs and increase the number of allowances they receive. In the electric industry, low-cost, higher efficiency power plants are generally

dispatched more than high-cost lower efficiency facilities. Under an output based allocation, because CO2 permits are distributed based on actual production of electricity, there is an incentive to invest in high efficiency generating technologies. This could mean upgrading an existing facility or constructing an entirely new power plant.

An output based allocation can also be used to encourage investment in non-emitting technologies by making all forms of electricity generation eligible for an allocation. Several states have done this with their NOx allocations by providing allowances to renewable energy projects.

I recognize that there are those within the electric industry who are opposed to this approach. They suggest that distributing allowances to non-emitting facilities represents a windfall to these generators. My response is that we need to encourage efficiency in all forms of generation, which is precisely what an output based allocation method will accomplish. This might result in a turbine upgrade at a hydroelectric facility or the replacement of a condenser at a coal-fired power plant. Both strategies are equally valid in the effort to reduce electric industry CO_2 emissions.

In the 2005 Energy Policy Act, Congress enacted a number of provisions designed to spur the construction of new nuclear and clean coal technologies. And, the combination of federal research and development, tax incentives and loan guarantees has sparked a certain level of interest in these technologies. We believe that Congress can, and should, build on this foundation as it develops its carbon reduction strategies and believe that the updating output based methodology we support is the best means of improving the economics of both new nuclear, and clean coal, generation and will result in actual investment decisions on these, and other, new, low and zero-carbon technologies. The choice is between preserving the status quo or providing incentives that will move our industry forward.

The other lesson that I would offer from our experience with existing cap-and-trade programs and an issue that I think policymakers should understand is: who bears the costs under a cap-and-trade system? Power plant operators will seek to recover their CO2

compliance costs when they bid into the wholesale electric energy markets. Depending upon the structure of the electricity markets and the fuel mix of generation serving those markets, some portion of these costs will be recovered by generators in the form of higher wholesale electricity prices that ultimately impact electricity consumers.

Because electricity consumers ultimately bear these costs, you can argue that consumers should be entitled to a portion of the emission allowances – really the value inherent in the allowances. This can be accomplished by auctioning the allowances and returning the proceeds to consumers in the form of rebates, energy efficiency credits, or reduced taxes. Economists also generally agree that the auction approach is the most efficient and transparent method for distributing allowances.

However, while economic theory may suggest this course, PSEG believes that as a matter of public policy, existing coal-fired power plants must continue to be an important energy resource in the U.S. Therefore, we think it makes sense to limit the auction of allowances in the early years of the program.

As a case in point, PSEG is currently evaluating whether to make an investment of approximately $600 million on a 600 MW coal plant in New Jersey for selective catalytic reduction (SCR) for NOx control, and a scrubber and baghouse for SO2, particulate, and mercury control. The Northeast as you know is moving forward with implementation of a regional greenhouse gas cap-and-trade program. A number of states in the Northeast have been considering adopting a 100% auction system when the program is implemented in 2009. For this particular investment, given our assumptions about forward prices associated with natural gas, energy markets, and CO2 allowances, for every 10% auction of allowances, this plant loses about $15 million of Net Present Value (NPV). Therefore, a 100% auction makes this investment a very questionable decision and one that will have a direct bearing on whether we continue to operate this facility.

I should point out that this investment analysis assumed that CO2 allowances would not be grandfathered and that in order to qualify for an allocation this specific unit had to be

operating and producing electricity. Under a grandfathering allocation system, I would be granted an allocation regardless of whether I make the capital investment.

Moving too quickly to a full auction system may also create problems for facilities with contract obligations that would prevent them from recouping auction costs until their contracts could be renegotiated.

These economic realities suggest that we are best served by transitioning to a full auction process over a reasonable period of time. PSEG supports auctioning 25% of the allowances at the outset of the program and transitioning to full 100% allowance auction over the course of 10 years. In the short term, I would advocate using an output based allocation for allowances as a tool to encourage power plant efficiency and the deployment of low and zero carbon technologies. Auction proceeds can be used to fund research and development into advanced energy technologies and to compensate households and companies that are disproportionately burdened by the costs of a cap-and-trade program.

Another important distinction for CO_2 program is the critical need for "offsets," both as a cost control measure and as source of innovative compliance solutions. Offsets are reductions generated at sources that are outside of the emissions cap. Offsets can include forest sequestration, agricultural sequestration, methane capture and destruction from coal mines and landfills, repair of gas leaks associated with electric circuit breakers that use sulfur hexafluoride (SF6 is a greenhouse gas 10,000 times more potent that CO2), and other measures. Engineering assessments by EPA and experience with existing greenhouse gas markets suggests that offsets can dramatically reduce the costs of a cap-and-trade program. PSEG, in conjunction with Entergy and three other energy companies recently issued a request for proposal (RFP) seeking 10 million tons of high-quality greenhouse gas offsets that we hope to acquire and use for RGGI compliance. We would advocate the inclusion of both domestic and international offset categories in the context of a national cap-and-trade program.

In addition to offsets, a safety valve limiting the price of emission allowances may be warranted as well. By controlling the maximum price of allowances, it is possible to limit the financial exposure of affected sources to unanticipated spikes in the cost of allowances. In establishing a safety valve trigger; however, we must ensure that allowance prices are high enough to drive innovation and the deployment of advanced energy technologies.

Conclusion

Mr. Chairman and Members of the Subcommittee, on behalf of PSEG, I thank you for the opportunity to provide these comments today.

To summarize my comments, I believe the time has come to enact national legislation that will reduce the environmental and business risks associated with global climate change and spur investment in the new technologies that will move our economy toward a less carbon-intensive future.

I would be pleased to respond to your questions.

Appendix 1 – PSEG Greenhouse Gas Related Actions

Emission Reductions
PSEG maintains a comprehensive company-wide greenhouse gas inventory for its participation in EPA's Climate Leaders program. In addition, the company has also been reporting greenhouse gas emissions to the Department of Energy Voluntary Greenhouse Gas Reporting program for over a decade.

In 1993, PSEG set a voluntary goal through EPA's Climate Challenge to stabilize its CO2 emissions at 1990 levels by 2000. PSEG reached this goal. In continuation of its efforts to reduce greenhouse gas emissions, in 2002, PSEG joined the EPA's Climate Leaders program, and made a voluntary commitment to reduce its GHG emissions by 18% from 2000 levels by 2008. Through investments in clean and highly efficient new generation sources and the retirement of older, higher emitting generation, PSEG is well on the way to meeting its goal.

PSEG is also reducing emissions across the company's operations. For example, it has reduced emissions of sulfur-hexaflouride (SF6), a highly potent greenhouse gas, through an aggressive leak detection program. It has also reduced CO2 emissions from its vehicle fleet through its use of biodiesel for all of its diesel vehicles. It has also made significant improvements in its nuclear generating fleet, which reduces the need for electricity generated using fossil fuels.

Emissions Benchmarking
PSEG has worked in partnership with the Natural Resources Defense Council (NRDC) and CERES on a series of benchmarking reports comparing the emissions of the 100 largest generators in US. In the latest report that was published in April 2006 PSEG is identified as the 19th largest US electric generator and the 30th largest electric power emitter of CO2. That same report highlights that seven electric power producers contribute to 25% of the industry's total CO2 emissions, and the top 19 account for approximately 50%. The top 100 power producers account for 85% of all electricity generated in the US.

Resource Conservation
PSEG is a Hall of Fame winner of EPA's Wastewise voluntary waste reduction program. The company has been recycling over 90% of its solid waste for more than a decade resulting in greenhouse gas reductions. PSEG also participates in the voluntary Natural Gas Star and is making steady progress in reducing leakage throughout our natural gas distribution operating system.

Vehicle Emission Reductions
PSEG's uses 1.5 million gallons annually of a biodiesel blend in its vehicle fleet. Biodiesel is made from renewable sources such as soybeans and recycled oils from restaurants. Because the carbon in biodiesel comes from renewable sources, it does not contribute to global warming. As a result, PSEG has been able to reduces its greenhouse gas emissions from diesel vehicles by 20%.

Re-forestation
PSEG is a member of the PowerTree Carbon Company. The PowerTree Carbon Company is currently investing in 6 reforestation projects in the United States. These projects involve planting a total of 3,609 acres of trees, which are projected to capture and sequestration of over 1.6 million tons of CO2 over the project lifetime.

PSEG is also an equity owner in Clean Air Action that is investing in tree plantings in Africa. The program is called the TIST program which empowers small groups of subsistence farmers in countries such as Tanzania, Kenya, Uganda and India to reverse the devastating effects of deforestation, drought, and famine while capturing and reducing CO2 in the atmosphere. Over 3 million trees have been planted to date and will result in the sequestration of up to 3 millions tons of CO2 over 30 years.

Energy Master Plan
PSEG is actively supporting Governor Corzine's Energy Master Plan and has proposed various initiatives that if adopted by NJ policymakers would result in realization by 2020 of approximately a 10% reduction of electric consumption across the state, 50 trillion Btu's of natural gas savings, 9.5 million gallons of gasoline savings annually, and approximately 500 MWs of photovoltaic solar energy.

Appendix 2 - PSEG Principles for Sound Climate Change Legislation

Emissions Reduction Requirement

- Incorporate a science-based, long-term emissions reduction requirement with a goal of avoiding dangerous anthropogenic interference with the climate system. Based on current state of the science, legislation should stabilize and begin to reduce greenhouse gas emissions within the next ten years, and achieve emissions reduction of 60 to 80% below relative to current levels by 2050.

- Legislation should institutionalize a periodic review of climate science and allow for a revision of emissions reduction requirements based on the current state of the science.

Policy Approach

- Assures stable, long-term public/private funding to support the development and deployment of needed technology solutions;

- Establishes a long term price signal for carbon that is moderate, does not harm the economic competitiveness of U.S. industry and that stimulates future investments in zero or low-carbon technologies and processes;.

- Addresses regulatory or economic barriers to the use of carbon capture and storage and increased nuclear, wind or other zero-or low-GHG technologies;.

- Minimizes economic disruptions or disproportionate impacts on sectors of the U.S. economy;.

- Recognizes early actions/investments made to mitigate greenhouse gas emissions;.

- Provides for robust use of a broad range of domestic and international GHG offsets;.

- Provides certainty and a consistent national policy;.

- Recognizes the international dimensions of the challenge and facilitate s technology transfer;.

Design Process

- Pursue a portfolio approach to reducing emissions, acknowledging that a cap-and-trade program is appropriate for large stationary sources, and that other policies may be more appropriate for addressing emissions from other sectors. Such a portfolio approach should also recognize the unique of role of states in relative to setting policies and measures for development of in-state energy production resources, energy efficiency, transportation, waste management, agriculture, and other economic sectors. Also adopt policies that encourage electric and gas utilities to use their so-called "patient capital" for making investments in cost-effective energy efficiency and

renewable energy supply .that other invsestors with less patient capital have passed over.

- Seek to harmonize Federal legislation with policy work already completed or underway at the state level.

Cap-and-Trade Program Design

- Provide a safety valve so that investors have regulatory certainty. They need to be able to assess the full extent of liability, and to provide assurance to the public that electric market prices are not going to be allowed to skyrocket. The mechanism to provide this is the use of a safety valve. The safety valve should be periodically readjusted to market experience and to allow for needed price signals to stimulate future investment in new low and zero carbon technologies.

- In the electric power sector, allowances should be allocated for the electric power sector on an updating output based allocation methodology with 25% initially withheld for auction. The percentage that is auctioned should be gradually increased up to 100% over 10 year time period. The proceeds from an auction should be dedicated to development and deployment of new zero or low carbon generating technologies and carbon capture.

- Grant allowances for new investments made in zero carbon generating technologies in order to stimulate investment in these technologies.

- Encourage unlimited use of verifiable domestic and international emissions offsets. Offsets should be encouraged to meet compliance obligations of the capped sector or sectors. Design robust requirements to ensure that emissions offsets are of high quality and represent incremental emissions reductions beyond business-as-usual reductions. Requirements should include strong additionality criteria to avoid crediting of "anyway tons" and provide a reasonable assurance that the cap-and-trade program is what is actually driving emission reductions achieved through offsets. Quantification and verification protocols should be rigorous and detailed, and apply conservative assumptions when appropriate.

TESTIMONY OF
BRIAN MCLEAN
DIRECTOR, OFFICE OF ATMOSPHERIC PROGRAMS
OFFICE OF AIR AND RADIATION
U.S. ENVIRONMENTAL PROTECTION AGENCY

BEFORE THE
COMMITTEE ON ENERGY AND COMMERCE
SUBCOMMITTEE ON ENERGY AND AIR QUALITY
UNITED STATES HOUSE OF REPRESENTATIVES

March 29, 2007

I. Introduction

Mr. Chairman and members of the Subcommittee, thank you for the opportunity to testify today on the Environmental Protection Agency's (EPA or Agency) experience designing and implementing cap and trade programs, and the key features that have contributed to their success. My name is Brian McLean and I am the Director of the Office of Atmospheric Programs within EPA's Office of Air and Radiation. EPA is proud of our use of market-based tools, particularly cap and trade programs, to deliver sustained emission reductions, cut compliance costs, and promote technological innovation. I welcome the opportunity to discuss these important programs with the Subcommittee.

The Acid Rain Program, our first experience with cap and trade, which has now measured twelve years of implementation and results, is widely accepted as one of the most effective air pollution programs ever adopted. Much of my testimony focuses on our experience and lessons-learned from this program.

II. What Is Cap and Trade?

Traditional environmental regulation in the U.S. is sometimes referred to as "command and control." This regime may reduce emissions significantly, typically by relying on a technology- or rate-based method with periodic inspections and limited emissions monitoring.

In many situations, command and control has been very effective; however, it provides limited flexibility for sources to experiment with less-costly alternatives and control strategies and little incentive to control beyond the levels required in the rules. Command and control establishes what needs to be done and usually prescribes how and when each source is to do it. Limiting the flexibility of firms in how and when they meet the standard proved expensive.

Several decades ago, EPA began experimenting with emissions trading programs to provide flexibility to regulated sources. The first programs were project-based, and included "bubbles," "offsets," and credit trading within a rate-based regulatory framework. In general, sources could earn credit for actions that reduced emissions more than was required by the applicable permit in order for other sources to use those credits to emit more than their applicable permit. The decision to generate these credits was voluntary; however, credits needed to be certified, normally by the appropriate regulatory agency, before they could be used. These programs were built on the command and control regulatory structure. While they provided some flexibility in how a source could comply, i.e., by getting reductions from another source, credits generated required government approval to determine whether they, in fact, represented "real" emission reductions, and this approval could be time-consuming, costly, and uncertain.

Emissions cap and trading is an alternative to traditional regulation and credit trading, not simply a trading feature added to existing regulation. A cap and trade program sets a mandatory cap, or maximum limit, on the aggregate emissions of all affected sources to achieve broad, regional reductions. The government distributes emission allowances (either freely or by sale) that total no more than the cap. Allowances may be traded (purchased and sold) creating a market for allowances and establishing a price. Individual source control requirements are not specified, but each source must surrender allowances for compliance equal to its actual emissions.

The cap ensures achievement of the emission reduction goal while also providing flexibility to sources and predictability for the allowance trading market. Cap and trade works best on a regional or larger scale to address emissions from multiple sources that exhibit a range of control costs.

Some of the demonstrated benefits of cap and trade programs are: certainty that a specific emissions level is achieved and maintained; regulatory certainty for affected sources; compliance flexibility as sources may choose from many alternatives for reducing emissions (including installing pollution control equipment, switching fuel, or buying allowances if that appears to be less costly than abating); and lower permitting and transaction costs. To date, these programs have required fewer administrative resources by both industry and government, allowing government to focus on setting environmental goals and assuring results, rather than on reviewing and approving individual compliance actions. Cap and trade programs can also be designed to work with local air pollution control efforts. It does not have to be an either-or situation. Finally, by placing an economic value on reducing emissions, cap and trade rewards innovation and early reductions, and can make further environmental improvements economically feasible.

Critical features of a cap and trade program are the cap, accurate and complete measurement of emissions, and clear consequences for noncompliance. Markets also tend to function better when the rules are simple and easily understood by all participants. The cap puts a ceiling on emissions and provides environmental certainty that aggregate emissions do not rise as new sources come online or existing sources are used more. The cap is ensured by requirements for accurate emissions monitoring and reporting using verifiable measurement. Complete and consistent emission measurement and reporting by all sources provide the basis

for ensuring that (1) an individual source's emissions are no higher than the allowances held, and (2) aggregate emissions do not exceed the cap. Decision makers at affected sources understand compliance expectations, because cap and trade programs include clear consequences for noncompliance from day one. Furthermore, allowing sources to save or bank unused allowances for use in future years provides an incentive for sources to decrease emissions below allowable levels earlier than required, resulting in earlier human health and environmental benefits.

III. What Is Title IV?

The EPA has almost twenty years of experience designing, implementing, and assessing the results of cap and trade programs, most notably, the Acid Rain Program and more recently, the NO_x Budget Trading Program.

The Acid Rain Program was established under Title IV of the 1990 Clean Air Act Amendments to decrease acid rain and improve public health by dramatically reducing emissions of sulfur dioxide (SO_2) and oxides of nitrogen (NO_x). For SO_2, Title IV uses the cap and trade approach to achieve reductions, setting a cap on the total amount of SO_2 that may be emitted by electric power plants in the 48 contiguous states. The cap is set at 8.95 million tons, or about one half of the 17.4 million tons of SO_2 emitted in 1980, and the trading component provides sources with the flexibility to select their methods of compliance. For NO_x, Title IV sets NO_x emission limitations for coal-fired power plants using a rate-based regulatory program to achieve a two million ton reduction from levels projected for the year 2000. Because the NO_x component of the program is rate-based, however, emissions may increase as power generation increases.

Regional cap and trade mechanisms, such as Title IV, the NOx SIP Call, and the Clean Air Interstate Rule (CAIR), do not replace the requirement to meet the National Ambient Air Quality Standards (NAAQS) at the local level, but rather help achieve those standards through

significant reductions in the pollution that is often transported across state boundaries. Thus, state and local governments, along with EPA, continue to have the obligation and the authority under the Clean Air Act to assure that the NAAQS are met everywhere. This means that state and local governments may impose additional source-specific emission limits, as warranted.

IV. Results of Title IV

Overall, the results of the Acid Rain Program have been dramatic — and unprecedented. Compliance has been greater than 99 percent every year. Now, with over a decade of implementation experience, we know that the greatest SO_2 emission reductions were achieved in the highest SO_2-emitting states; acid deposition dramatically decreased over large areas of the eastern United States in the areas where reductions were most critically needed; trading did not cause geographic shifting of emissions or increases in localized pollution; and the human health and environmental benefits were delivered early and broadly. Compliance flexibility and allowance trading (and banking) have reduced compliance costs by more than two-thirds from initial EPA and industry estimates.

Studies revealed that the flexibility of the program allowed companies to take advantage of numerous cost-saving opportunities as multiple methods for reducing SO_2 emissions competed with one another.[1] For example, competition among railroads shipping low-sulfur coal led to significant reductions in transport costs, a major component of coal cost; flexibility in the operation of flue gas desulfurization equipment ("scrubbers") coupled with design and equipment advances significantly reduced the cost of scrubbing; and medium-sulfur coal became marketable in the absence of an arbitrary sulfur content for "compliance coal" that existed under the traditional regulatory program. Also, the ability of sources to bank allowances earned from

[1] Ellerman, A. Denny, Joskow, P.L., Schmalensee, R., Bailey, E., and Montero, J-P., "Markets for Clean Air the U.S. Acid Rain Program," Cambridge University Press, 2000.

extra control actions allowed them to reduce future expenditures as requirements grew more stringent. Finally, the allowance market, in addition to providing a compliance option for sources, provided a benchmark price against which companies could better evaluate compliance alternatives. By embracing markets, allowing flexibility, and requiring accountability, the Acid Rain Program has been a great success with only minimal impacts on electricity prices.

In April 2000, Resources for the Future had this to say about the Acid Rain Program: "The flexibility of the trading program has encouraged utilities to capitalize on advantageous trends, such as changing fuel prices and technological innovation that might have been delayed or discouraged by traditional regulatory approaches."[2]

Flexibility under the Acid Rain Program has not adversely affected attainment of national air quality standards. Independent analyses of the program by Resources for the Future,[3] Environmental Defense,[4] and the Environmental Law Institute[5] demonstrate that trading has not created "hotspots," or increases in localized pollution. In fact, the greatest SO_2 emission reductions were achieved in the highest SO_2-emitting states, acid deposition decreased, and, consistent with projections, the environmental benefits were delivered in the areas where they were most critically needed.

Perhaps the most important lesson from implementing the 1990 Clean Air Act Amendments is how powerful a tool cap and trade programs can be for protecting public health and the environment. When the acid rain legislation was under development, the proposal for a cap and trade approach was new, untested, and viewed with skepticism. Many questioned

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[2] Carlson, Curtis, Burtraw, Dallas, et. al., "Sulfur Dioxide Control by Electric Utilities: What are the Gains from Trade?" In *Journal of Political Economy*. 2000, vol.108, no.6, pp. 1292-1326.
[3] Ibid.
[4] "From Obstacle to Opportunity: how acid rain emissions trading is delivering cleaner air." *Environmental Defense*, 2000.
[5] Swift, B. "Allowance trading and potential hotspots: good news from the Acid Rain Program." *Environmental Law Institute Environment Reporter* 31: 954-959, 2000.

whether it would deliver the promised environmental protection, whether the trading system would operate as advertised, and whether costs would be reasonable. Today, it is clear that the answer to all these questions is a resounding "yes."

The emission reductions from the acid rain cap and trade program translate to impressive environmental results. As of 2006, emission reductions from power plants were about 8 million tons, or 46 percent below 1980 levels. Because of the incentive to over-control in the early years of the program, cumulative reductions of SO_2 since 1995 have exceeded statutory requirements by over 7 million tons. Due to the drop in SO_2 emissions, the acidity of deposition in the eastern United States has been reduced by about 30 percent. As a result, some sensitive lakes and streams in New England are showing signs of recovery. Furthermore, ambient sulfate concentrations have been reduced by over 27 percent, leading to improved air quality and public health, and to improved visibility, particularly in areas where some of our most scenic vistas are found, such as the Shenandoah National Park.

[View Figure 1: National SO_2 and NO_x Emissions from Power Plants]

[View Figure 2a and 2b: Acidic Deposition (Wet Sulfate)]

These emission reductions and environmental results have been achieved at a much lower cost than anyone expected. When the Clean Air Act was being amended in 1990, EPA projected the full cost of implementation of the SO_2 portion of the Acid Rain Program would be about $6.9 billion per year (in 2006 dollars). In 2005, a study in the *Journal of Environmental Management*[6] estimated annual costs of the Acid Rain Program in 2010 will be $3.5 billion (in 2006 dollars) with the SO_2 program accounting for about $2.3 billion. The estimated value of the program's annual benefits in the year 2010 now totals nearly $142 billion — more than a

[6] Chestnut, L.G., Mills, D.M. A fresh look at the benefits and costs of the U.S. acid rain program. Journal of Environmental Management. Vol. 77, Issue 3, pp. 252-256, November 2005.

40:1 ratio of benefits to costs. These benefits result mostly from the prevention of health-related impacts, such as premature deaths, illnesses, and workdays missed due to illness, but also include ecosystem improvements and improved visibility in parks and other recreational areas.

These substantial benefits are being achieved by the work of a surprisingly small number of government employees. Because of the simplicity of the program and clarity of its requirements, and because it does not require the review and approval of credit creation, offsets, or trades, we were able to take full advantage of advances in information technology and operate the program with fewer than fifty EPA employees.[7] Most of them are responsible for certifying and auditing monitoring equipment and data. The rest handle allowance transfers where over 98 percent of the transactions are done online by the market participants. Since 1994, we have recorded over 44,000 transfers involving over 225 million allowances, and we could easily handle a thousand times that volume of activity. The ability to monitor emissions easily and accurately has been a key factor in minimizing government involvement and has kept transaction costs low.

V. Applying Cap and Trade to the Ozone Nonattainment Problem

In the mid 1990s, as the SO_2 cap and trade program began showing success, the question was posed as to whether the approach could be applied to the regional ozone problem in the eastern United States. The ozone problem differed from the acid rain problem in several respects. First, whereas acid rain was primarily caused by transported pollution (mostly SO_2), ozone was caused by both transported pollution and local pollution, and by both NO_x and VOCs (volatile organic compounds). Second, whereas acid rain was primarily attributable to power plants, ozone was attributable to a wide range of sources with power plants contributing only about 25 percent of the NO_x emissions and virtually none of the VOCs. Third, whereas acid rain was a

[7] Covering Acid Rain Program in EPA headquarters and regions.

problem of total environmental loadings over a period of years, ozone was a summertime problem with peak concentrations of concern measured in hours. We thought that cap and trade could work for this problem, or more appropriately, could make an important contribution to addressing it.

In 1998, EPA issued a regulation calling on states in the eastern United States to revise their State Implementation Plans to reduce summer season NO_x emissions that contributed to ozone nonattainment in other states. This was referred to as the NO_x SIP Call, and its goal was to reduce summertime NO_x emissions from a diverse set of sources including mobile sources, power generators, and large industrial boilers and turbines. It did not mandate source-specific emission limits; rather, it required states to meet emission budgets, and gave states flexibility to develop control strategies to meet those budgets. One control strategy was an EPA-implemented cap and trade program for large power generators and large industrial sources. All nineteen affected states and the District of Columbia chose to adopt trading rules implementing the cap and trade program, called the NO_x Budget Trading Program. One notable difference between the Acid Rain Program and NO_x Budget Trading Program is that the NO_x program allowed states to include other source categories in the trading program, such as large industrial sources (industrial boilers), cement kilns, and/or process heaters. However, states had to include all sources in a category to ensure that emissions were not shifted to non-covered sources. In addition, the sources were required to accurately monitor and report all of their emissions. The NO_x Budget Trading Program comprises power generators, industrial sources, and three cement kilns in New York State.

[View Figure 3: NO_x Budget Program Emissions]

As of 2006, summer season NO_x emissions under the NO_x Budget Trading Program were reduced by more than 1.3 million tons, or 73 percent, below 1990 levels. The program has also reduced emissions on peak emission days even though there is only a seasonal cap. Most importantly, it is lowering average ozone levels in the NO_x Budget Trading Program region. Based on 2003 to 2005 air monitoring data, the program was the major factor in ozone air quality improvement in all 103 areas designated nonattainment in 2004 in the eastern United States.[8] In fact, nearly 70 percent of these areas at the end of 2005 had air quality that is better than the level of the standard.

VI. Capturing the Cost Savings for Greater Environmental Protection

In 2005, EPA extended the benefits achieved through the Acid Rain and NO_x Budget Trading Programs by promulgating the Clean Air Interstate Rule (CAIR). When implemented, CAIR will use the cap and trade mechanism to reduce emissions of SO_2 in the eastern United States by an additional 73 percent from 2003 levels and, for the first time, set an annual cap for NO_x in the eastern United States. The first cap for NO_x is in 2009 and the first cap for SO_2 is in 2010. In 2015, both caps are lowered. Together, the Acid Rain Program and CAIR are estimated to provide annual quantifiable benefits of close to $350 billion (2006 dollars) by 2020,[9] at an annual cost comparable to the original 1990 estimate for the Acid Rain Program alone. EPA believes that this demonstrates how more efficient approaches can lead to greater environmental protection.

The cap and trade mechanism was also applied to another rule EPA finalized in 2005, the Clean Air Mercury Rule. Mercury comes from many sources and has local, regional, and global

[8] *NOx Budget Trading Program 2005 Program Compliance and Environmental Results*, EPA-430-R-06-013, September 2006, http://www.epa.gov/airmarkets/progress/docs/2005-NBP-Compliance-Report.pdf.
[9] *Acid Rain Program 2005 Progress Report*, EPA-430-R-06-015, October 2005, http://www.epa.gov/airmarkets/progress/arp05.html.

components. The Clean Air Mercury Rule, when fully implemented, will reduce mercury emissions from United States coal-fired power plants by about 70 percent. It offers states the flexibility to adopt a cap and trade program as a compliance option. Several states are moving to adopt the cap and trade approach. The rule takes effect in 2010.

VII. Why Have These Cap and Trade Programs Worked?/Lessons Learned

In addition to these programs, EPA has consulted with several states as well as representatives of over 50 countries on the design and implementation of cap and trade systems. From these experiences we have identified several principles and program elements that are critical to the success of cap and trade programs.

Key principles:

- Keep your eye on the prize — above all, government should focus on achieving the emissions reduction goal cost-effectively; not on reviewing individual compliance decisions or trying to manage the market.
- Keep it simple — the program and its rules and obligations should be easily understood by all participants.
- Be transparent — all emissions and allowance data should be easily accessible to build public and market confidence.
- Be accountable — sources and governments should regularly measure and report results, including environmental outcomes, programmatic assessments, and compliance.
- Provide certainty — emission reduction requirements (and the allowance distribution mechanism) should be established for as far into the future as reasonably possible, and consequences for noncompliance should be clear and predictable.

Key program elements:

- Full sector coverage — all significant sources (existing and new) of a particular industry or sector should be included to minimize "leakage," i.e., the shifting of production and emissions to uncovered sources.
- The cap — the aggregate cap on an entire sector's or region's emissions, defined through government issuance of a fixed quantity of allowances, establishes the emission reduction goal and provides predictability for the allowance market.
- Monitoring — accurate measurement and reporting of all emissions from all sources, as well as complete transparency of allowance and emission data, provides the basis for ensuring the emission reduction goal and underpins the credibility of the allowance market.
- Trading — unrestricted trading and banking (with source-specific limits, where necessary to protect local air quality) allows companies to choose (and change) compliance options and minimize compliance costs. Banking also encourages early reductions and provides liquidity, a cushion for price volatility and a safety mechanism for unforeseen market events.
- Allowance distribution — the particular method for distributing allowances is generally not critical to the environmental success or total cost of the program. However, it is critical to the distribution of economic impacts, and therefore, is an important design feature. We have learned much since the 1990 Clean Air Act Amendments, and our thinking on allowance distribution continues to evolve with help from the experiences and analyses of many, both inside and outside of government.

In 1990, when we were developing the first cap and trade program, we gave limited consideration to the economic value of allowances. In fact, the allocations were primarily a result of setting emission limits and then allowing one ton increments of those permitted emission levels to be tradable.

To set these emission limits for the Acid Rain Program, we used the historic level of activity of a facility (measured as heat input in million British thermal units (mmBtu)) and multiplied it by an emission rate (measured in pounds (lbs) of sulfur dioxide per mmBtu) to obtain a mass emissions limit in tons of SO_2. Most plants were given an emissions limit based on a rate of 1.2 lbs/mmBtu, with cleaner plants having their limit based on a rate that was slightly higher than their actual rate. This ensured that the plants with the highest historic emission rates would be encouraged to reduce the most, while plants that had already reduced emissions would need to do less (or nothing). Using the formulas provided in the law, we found that the total allocations exceeded the statutory cap by about 10 percent, so, as directed by the law, we ratcheted them down pro rata to match the program cap.

New units were given no allocation and were required to purchase allowances for compliance either in the marketplace or directly from the government in the annual auction. Non-emitting units were also not given an allocation; but, of course, they had no need to purchase allowances. There were special set-asides of allowances for encouraging early installation of scrubbers, for undertaking energy conservation and renewable energy projects, and for holding the annual auction. Since the government had never created an asset quite like this before, and some thought the program might not even work, we did not compare the aggregate value of the allowances created to the aggregate cost of the program.

For the Acid Rain Program, Congress chose an SO_2 program cap that was about half of what the power plant sector was emitting in 1980. This meant that the allowances we were allocating for free equaled about half of the electric utility sector's emissions. The Clean Air Interstate Rule will reduce SO_2 emissions by an additional 73 percent (from 2003 levels in the CAIR region), which means that allowances will then cover less than 20 percent of 1980 power plant emissions. During the rulemaking process, our analysis demonstrated that we were not significantly increasing consumer electricity prices, hurting our electricity-driven economy, substantially changing the fuel mix, or causing significant closures of electric capacity. The aggregate value of the CAIR SO_2 and NO_x allowances in 2015 is similar to the direct compliance costs of the rule. Therefore, due to the level of control and the nature of the industry involved, the program's allocation of free allowances is roughly in balance with the direct compliance costs to the regulated industry.

The allocation for the NO_x Budget Trading Program was similar to the Acid Rain Program, but states could utilize varying methodologies in apportioning allocations to sources. States were provided a model trading rule they could adopt but had the flexibility to devise their own allocation approaches. States typically made allocations three to five years in advance for the seasonal NO_x program, although, like the Acid Rain Program, they could allocate in perpetuity. Most states included a set-aside account carved out of the state's allowance budget to provide allowances for the addition of new sources or as incentives for renewable energy and energy efficiency projects.

Let me make one final comment about Title IV. The legislation did many things right: there were few legal challenges to the rules EPA had to issue and none delayed implementation of the cap and trade program. I believe litigation was limited under Title IV for two reasons.

First, in most cases the legislative language was clear. In fact, the Phase I allocations were printed in the law, so there was no question about them. What little litigation did occur all revolved around interpretations of those statutory provisions that were overly complex or unclear. Second, the law made it clear that if the rules were delayed, every source would have to meet a source-specific emission limit and there would be no trading. There would be a real cost to delaying the environmental improvement promised by the legislation.

VIII. Conclusion

EPA has almost 20 years of experience designing, operating, and assessing cap and trade programs, most notably, the Acid Rain Program and more recently, the NOx Budget Trading Program. This experience clearly demonstrates that market-based cap and trade programs are an effective means of achieving broad improvements in air quality by reducing emissions of regionally transported air pollutants.

For other air pollution problems, command and control (or direct regulation) may be the best course. For example, where a specific facility can be identified as the source of a public health problem, limiting its emissions may be the simplest and most effective solution. However, specificity of requirements may also inhibit innovation, in which case economic instruments such as cap and trade may be preferred to encourage more efficient solutions. If properly designed, economic incentives can harness market forces to work toward environmental improvement. By internalizing pollution control costs, they can make pollution reduction in the interest of the firm and promote innovation. An emissions cap simply requires that sources consider the emission implications of their business decisions; and, if they plan to increase production (and emissions), they must either reduce their emission rate commensurately or purchase allowances from other sources sufficient to offset their increased emissions. This

internalization of environmental consequences can most likely be achieved at lower cost to sources than iterative (and less predictable) command and control requirements intended to achieve the same effects.

The Acid Rain Program and the NO_x Budget Trading Program have reduced SO_2 and NO_x emissions faster and at far lower costs than anticipated, yielding wide-ranging health and environmental improvements. The results of these programs show that a combination of emission-reducing mandatory caps, a viable allowance trading market, rigorous emission monitoring and reporting protocols, and clear consequences for noncompliance ensure success.[10] We have learned through our experience that, for certain regional or larger scale air pollution problems, a well-designed cap and trade program is cost-effective, flexible, and easy to implement with clear benefits that can be sustained into the future.

[10] For more information on EPA's market-based programs, see www.epa.gov/airmarkets.

Testimony by
Dr. Richard L. Sandor
Chairman and CEO
Chicago Climate Exchange

To the U.S. House of Representatives Committee on Energy and Commerce
Subcommittee on Energy and Air Quality
Hearing on "Climate Change: Lessons Learned from Existing Cap and Trade Programs"

March 29, 2007

Chairman Boucher, Congressman Barton, Congressman Hastert, and members of the Subcommittee. I want to thank you for your invitation to be with you today. I congratulate your leadership on the vexing problem of climate change. In view of your interest in emissions trading as a possible mitigation pathway, I would like to share with the Subcommittee the experience of developing, launching and implementing the Chicago Climate Exchange (CCX), which is a cap-and-trade system that has been trading emissions allowances derived from real emissions reductions and offset projects in the United States since 2003, and the context in which it was created.

The debate over appropriate actions to address the risks arising from changes in the Earth's climate—the "greenhouse effect"—suffers from two major information gaps. The first is a lack of consensus regarding the damages that could occur to the environment without action to reduce greenhouse gas (GHG) emissions. The scientific process may not precisely predict the nature and implications of climate changes that would occur if society does not make significant changes in energy and land use patterns associated with higher levels of GHG emissions. That is, the costs of inaction and the benefits of taking mitigation actions are uncertain.

The second information gap is lack of understanding of the monetary costs associated with undertaking mitigation to reduce greenhouse gasses. The absence of hard, proven data on greenhouse gas mitigation costs reduces the quality of the climate policy debate.

The nature of the implied cost-benefit analysis underlying the climate debate suggests that for any particular level of benefits accruing from action to mitigate climate change, a high cost of mitigation will lead policy makers to take less action. If mitigation costs are proven to be low, it appears policy makers would support stronger action to address climate change. At this time, however, we lack the data for realizing the costs involved in pursuing climate mitigation actions.

However, a variation of "Gambler's Ruin" says that one should never make a bet that would ruin oneself, no matter how favorable the odds are. Well-designed markets can help put the costs and benefits in perspective and assist us in addressing this risk in a more informed way. It is time for a well-designed national cap-and-trade program.

One of the main objectives of the Chicago Climate Exchange was to generate price information that provides a valid indication of the cost of mitigating greenhouse gases. By closing the information gap on mitigation costs, society and policymakers will be far better prepared to identify and implement optimal policies for managing the risks associated with climate change. CCX experience demonstrates that a GHG cap-and-trade system that allows emitters to manage annual reduction commitments – a design used in other proven trading systems (US SO_2 and NO_x, EU CO_2) – gives clear signals that lead to direct internal action and trading responsibility and attendant opportunities. This design:

- Maximizes the benefits of emissions trading, as proven in the SO_2 program, and allows carbon pricing and trading to stimulate financing of capital improvements.
- Maximizes entrepreneurial response and rewards environmental innovation.
- Can cover a major portion of emissions from all six types of greenhouse gases, can be integrated with upstream systems for other emissions, and allows opt-in by small sources. Can bring significant benefits to the agriculture and forestry sectors, assuming carefully screened and specified rules with attendant scientific validity and verification.

CCX is a financial institution that exists to advance economic, environmental and social goals. We are the world's first, and North America's only voluntary but legally binding rules-based greenhouse gas emission reduction and trading program, as well as the only global emissions trading system handling all six greenhouse gases with a multi-sectoral emissions reduction requirement. Designed in 1999 and 2000 as a pilot project based in the Midwest, CCX began trading in 2003, and has grown to almost three hundred diverse entities including some of the most significant names in the American economy. Emissions of CCX Members represent 10% of stationary emission sources in the United States. CCX members execute legally binding commitments to meet annual emission reduction goals of 4% below baseline for 2006 and 6% below by 2010, at minimum. Members who exceed their reduction commitments may sell allowances; those who do not make the required cuts must buy allowances to come into compliance. CCX Rules require that all emission baselines, annual reduction commitments and Offset projects undergo a standardized third party audit by the NASD (the leading financial

regulator in America) and authorized experts, and this is the only 3rd party standardized audit system operating in the United States at this time for greenhouse gas emissions reductions.

CCX Membership includes representatives from a diverse array of economic sectors, both domestically and abroad. Among these sectors, CCX has agricultural products (Cargill and Smithfield Foods), automotive (Ford Motor Co.), utilities (American Electric Power and Tampa Electric), chemicals (DuPont, Bayer and Dow Corning), forestry (International Paper and MeadWestvaco), academic institutions (Michigan State, Iowa, Minnesota and Oklahoma) and coal companies (PinnOak Resources, CNX Gas and Jim Walter Resources), and public sector entities such as the States of New Mexico and Illinois, seven municipalities and three counties (King, Sacramento and Miami-Dade). Around 25 million people live and work in the cities, counties and states which are members of CCX and another 2 million are employed by its corporate members. CCX international membership includes a city and utility in Australia (Melbourne and AGL), and eight companies in South America which have taken on a legally-binding commitment to reduce their emissions even though they are not yet required to do so. We have also engaged the interest of both Chinese and Indian policy leaders on the issue of market-based initiatives to address environmental concerns. We have approved and registered offset projects from both China and India, as well as Costa Rica and Brazil.

Members report that the baselines, audits and annual commitments represent concrete goals that help them focus on internal efficiencies and attendant financial opportunities. They reduced their emissions through increased energy efficiency, expanded use of renewable fuels, and realization of low-cost reductions in non-CO_2 greenhouse gases through use of direct abatement equipment,

and many members have exceeded their reduction targets. As an important aside, another benefit of the price discovery mechanism provided by an organized market is the ability to spur inventive activity. Entrepreneurs in areas related to clean energy were able to raise capital from both fixed income and equity investors after factoring in CCX prices in their business plans. Capital was raised to finance a renewable energy source that can be used as a substitute for coal and biodiesel and an anaerobic manure digester.

Members join for disparate reasons, but all for at least one reason: to better master their emissions data and gain early mover benefits with price discovery for carbon, and all aspects of risk mitigation, including financial, operational, and reputational. To date, CCX Members have reduced their emissions by almost 11% beyond their annual commitments, representing 23.5 million tons of reduction of CO_2.

In addition, the CCX Offsets program is proving successful at rewarding emissions mitigation through sustainable farming and forestry, while also providing a new income source for U.S. agriculture. Entities such as the Iowa Farm Bureau and the National Farmers Union are leading the way in building the infrastructure for the agricultural offsets program. To date, more than 2 million acres of conservation tillage and grassland in multiple U.S. States have been registered, verified and sold through the exchange. From 2005 to 2006, over 1.2 million acres have been enrolled in the U.S., with producers earning over $3 million from the sale of CCX Carbon Financial Instruments. The same growth was experienced in the tonnage enrolled under the agricultural methane program, which went from 24,100 tons to 207,200 tons during the same period. These offsets provide a least cost avenue for society to reduce greenhouse gas emissions

in addition to enhancing farm profitability and income diversification. American agricultural producers are taking a leadership role in promoting long term sustainability of U.S. agricultural soils through the CCX. The CCX Offsets Committee has also recently approved protocols for rangeland management soil carbon offsets, which will soon be registered in the Exchange. A Member of this Congress, Senator Richard Lugar, has registered reforestation credits from trees planted in his Indiana family farm, which is helping set the example to many other farmers. CCX is also pleased to inform the Committee that it is working on a grant supported by the US Department of Agriculture to further the goals and objectives of the CCX agricultural offset program. Expansion of this program can help minimize the need for additional subsidies, lower the tax burden required to finance them while encouraging behavioral change and innovative practices. It is also important to note that the potential for offsets coming from coal mine/coal bed methane is substantial, and protocols have been approved and projects will soon be registered.

CCX has also created exchanges for US SO_2 and NO_x emission allowances (Chicago Climate Futures Exchange) and the European Climate Exchange, the leading marketplace for carbon emissions in Europe. In a note of irony, we have American ingenuity and financial know-how being exported to Europe. Jobs are being created and an entire generation of practioners of the field is being developed in both the U.S. and around the world. These financial institutions advance social objectives and economically efficient environmental protection by providing rules-based markets with low transaction costs and transparent prices.

CCX Chicago Climate Exchange

CCX experience suggests a workable national system should:

- Include the maximum diversity of sectors using simple, percentage reduction schedules.
- Employ very small allowance auctions to provide price information. Like the SO_2 auctions, returning auction proceeds *pro rata* to emitters reduces compliance burdens.
- Fully recognize standardized and verified early reductions, as this will maximize ongoing capital investment, avoid undermining prior investment, and boost market liquidity.
- Include project-based mitigation activities, such as methane capture, and carbon sequestration by farms, forests and ranchlands, which produce multiple global and local benefits, help finance sustainable agricultural practices, and have proven workable.
- Maximize innovation by allowing the market to work unencumbered by price constraints. Flexibility from trading, offsets, banking and borrowing can contain compliance costs.

Effectiveness of cap-and-trade with the above design features is being demonstrated every day by CCX members, now across the globe. The environmental and economic benefits being generated are of national and global significance. Thank you again for your interest.

Prepared Statement of
Anne E. Smith, Ph.D.
on
"Climate Change:
Lessons Learned from Existing Cap and Trade Programs"
before the
Subcommittee on Energy and Air Quality,
Committee on Energy and Commerce,
United States House of Representatives
Washington, DC
March 29, 2007

Mr. Chairman and Members of the Committee:

Thank you for your invitation to participate in today's hearing. I am Anne Smith, and I am a Vice President of CRA International. Starting with my Ph.D. thesis in economics at Stanford University, I have spent the past twenty-five years assessing the most cost-effective ways to design policies for managing environmental risks, including cap-and-trade systems. For the past fifteen years I have focused my attention on the design of policies to address climate change risks, with a particular interest in the implications of different ways of implementing greenhouse gas (GHG) emissions trading programs. I thank you for the opportunity to share my findings and climate policy design insights with you. My written and oral testimonies reflect my own research and opinions, and do not represent any positions of my company, CRA International.

The topic of today's hearing is to review the experience with existing (and past) cap-and-trade programs, and to determine what lessons these experiences provide for effective design of a possible U.S. GHG cap-and-trade program. The most fundamental point that I would like to make is that cap-and-trade should not be treated as an off-the-shelf technique.[1] It can be extremely effective at delivering efficient emissions reductions for any type of emission, but to do so, it must be tailored to fit the particular features and complexities of each emissions problem. Direct and unquestioning adoption of the cap and trade design used in any previously successful cap-and-trade program is likely to sow the seeds of failure in a new application, such as greenhouse gases. The SO_2 program under Title IV of the Clean Air Act has clearly been a success, but some of the most widely recognized features of that program are not desirable features of a cap-and-trade policy tailored to address the much greater complexity of greenhouse gases.

Therefore, in my testimony I will describe the specific challenges and complexities that a GHG cap-and-trade policy needs to address, and offer suggestions for how these issues can

[1] I have made a more complete exposition of this point in A. E. Smith, "The Challenges Ahead for Emissions Trading Programs: Nitrogen Oxides and Greenhouse Gases," report prepared for Edison Electric Institute (CRA No. 1656-00), March 1999.

best be addressed through the design of such a program. In doing this, I will relevant "lessons" to be found in existing and previous cap-and-trade programs, as well as the contrasts.

KEY DESIGN CHALLENGES FOR GHG CAP AND TRADE

There are three key issues that make a GHG cap-and-trade program significantly different from the U.S. SO_2 program: (A) the multiplicity of types of sources of GHGs, (B) potential economic impacts of carbon permit price uncertainty and volatility, and (C) international competitiveness implications of a GHG cap. If these issues are to be effectively addressed, a GHG cap-and-trade program will be very different in its design from the SO_2 cap-and-trade.

A. Multiplicity of Types of Sources.

GHGs include not just CO_2, but also such diverse compounds as nitrous oxide, hydrofluorocarbons, methane, and sulfur hexafluoride. These all come from very different types of economic activities, ranging from industry to agriculture. CO_2 emissions mainly result from the burning of coal, natural gas, gasoline and other petroleum products to extract the energy from these fuels. This is done not just by large industrial sources, but by hundreds of millions of individual commercial entities, households, and automobile driving. In fact, large industrial sources of CO_2 account for only about half of all CO_2 emissions, and a cap on these emitters alone would encompass tens to hundreds of thousands of sources. (For example the EU ETS, which is not known for offering comprehensive coverage of emissions, includes over 10,000 sources.) Higher coverage of the emissions that need to be reduced is simply administratively infeasible with a cap-and-trade program, as it would require monitoring of individual tailpipes and end-user appliances in homes and businesses.

There are two ways of responding to this dilemma:

1. The most common suggestion is to accept that the cap-and-trade program's coverage will be severely limited and to start to regulate all of the other, smaller sources with technology standards, regulatory mandates, and other forms of command-and-control regulations that emissions trading is supposed to outperform. This is the path that the EU ETS has taken. While emissions under the EU ETS cap may be held in check successfully, the majority of the EU emissions remain uncapped and continue to grow unchecked. These emissions are the real reason that the EU continues to risk failing to meet its Kyoto Protocol targets. Even if outright failure to achieve national GHG targets were unimportant, the inefficiency of this approach is a serious concern.

   I have performed a number of cost modeling exercises to compare this kind of approach to the ideal of a single comprehensive cap over all emissions sources, large and small. In my modeling study, I first estimated the cost of meeting a U.S. GHG target with a cap that offered 100% coverage. I then considered what it

would cost to meet the same emissions target by capping all sources large and small except for personal automobile use. The latter category was instead placed under a more stringent fuel economy standard (e.g., a tighter CAFE standard). This second approach was estimated to be 50% to 155% more costly than the idealized cap-and-trade program over a range of reasonable alternative possible fuel economy standards.[2] Subjecting more of the many small emissions sources in addition to personal automobiles to regulation outside of the comprehensive cap-and-trade program would only further increase the total costs. The report of the Energy Information Administration on the costs of the 2005 "Bingaman Amendment" (which contained a provision for a CAFE standard as well as a GHG cap) similarly found that the CAFE provision was a very costly way of achieving larger emissions reductions than under a cap.[3]

2. An alternative suggestion is not to impose the cap on emitters, but rather to impose it on sellers of fuels that, when burned, will cause CO_2 emissions. This is sometimes called an "upstream" cap-and-trade approach because the point of regulation occurs on economic activities that occur before, or "upstream of," the economic activity that burns the fuel and produces the actual emissions. (Similarly, caps applied at the point-of-emission are often called "downstream" approaches.) I, and other analysts after me, have pointed out that this approach will allow for nearly 100% coverage of CO_2 emissions with fewer than about 10,000 regulated companies.[4] This means that an upstream system offers a nearly ideal freedom from the inefficiencies of technology mandates and other non-market forms of regulation within the bounds of administrative feasibility.

   The upstream approach can also be applied to some of the other non-CO_2 GHGs, including sulfur hexafluoride and HFCs, thus minimizing the need to monitor the actual emissions of these gases as well (which also come from many very small sources, such as electrical transformers and refrigerators). Finally, an upstream approach for the former sources can be seamlessly combined with a "downstream" point of regulation for those GHG sources that cannot be anticipated in an upstream product sale. Thus, emissions of nitrous oxides and methane can still be capped just as effectively under an upstream approach as under a system that regulates solely at the point-of-emission.

Most economists studying efficient designs for cap-and-trade program concluded many years ago that the upstream approach is the most appropriate design for the GHG

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[2] E. J. Balistreri, P. M. Bernstein, et al., Analysis of the Reduction of Carbon Emissions through Tradeable Permits or Technology Standards in a CGE Framework," AERE/Harvard Workshop on Market-Based Instruments for Environmental Protection, Harvard University, Cambridge, MA, July 18-20, 1999.
[3] EIA, *Impacts of Modeled Recommendations of the National Commission on Energy Policy,* SR/OIAF/2005-02, April 2005.
[4] A. E. Smith, A. R. Gjerde, et al., "CO_2 Trading Issues: Choosing the Market Level for Trading," Final report prepared for Office of Policy, Planning and Evaluation, U.S. Environmental Protection Agency, under Contract No, 68-CO-0021, May 1992.

application.[5] Throughout the 1990s, the upstream approach was widely dismissed as not politically acceptable because its effect would be to place an explicit price of carbon on the cost of fuels. However, the impossibility of constructing a realistic cap proposal that provided meaningful coverage of the emissions of concern eventually became clear. The McCain-Lieberman Bills of 2003 and 2005 addressed vehicle emissions by capping the carbon content of gasoline sales. A pure upstream approach was central to the National Commission on Energy Policy's proposal, and also was incorporated into Senator Bingaman's 2005 and 2007 draft Bills. Despite resistance to the upstream approach in the GHG policy debate, it is noteworthy that the upstream approach is not at all untested in past programs. In fact, two of the first emissions reduction programs that used cap-and-trade methods were upstream. These were the programs prior to 1990 to phase lead out of gasoline, and to phase-out chlorofluorocarbons under the Montreal Protocol. Both programs to limit emissions were applied to the point-of-sale rather than the point-of-emissions. In both cases this was done because it would have been administratively impossible to regulate the many small sources of emissions, yet it was just as effective in meeting emissions goals to regulate the sales of the product that would eventually result in emissions. The exact same situation applies to CO_2 and other GHGs, and thus the same type of design of the cap-and-trade program makes sense.

The only thing that has changed since the time the upstream approach was originally (and successfully) used is that the SO_2 cap-and-trade program was introduced, riding on the coat tails of the successes of the earlier lead-in-gasoline and CFC trading programs. The SO_2 cap could *not* have been implemented as an upstream program, but only at the point-of-emission, simply because one of the key forms of emission reduction was a post-combustion control technology. At the same time, it was quite administratively feasible to monitor emissions at sources and still achieve very high levels of coverage. The situation was different, and so a point-of-emissions ("downstream") approach was applied for SO_2. The earlier successes using an upstream approach were not held up as reasons to avoid using a downstream approach for SO_2; in turn, it makes no sense to claim that recent successes with a downstream approach for SO_2 (and NO_x) are reasons to avoid using an upstream approach for GHGs. Cap-and-trade should not be used as an "off-the-shelf" panacea: it must be tailored to the particular features of each particular emissions reduction need. In seeking "lessons" for GHGs from past policy experience, we should recognize that this experience did not begin only in 1990 with the Title IV SO_2 cap, but to look at the full history with market-based tools, dating back to the 1970s. When we do that, it becomes clear that the case for an upstream approach to a GHG cap is just common sense and not radical or even novel.

Despite the growing recognition of the strong case for capping GHGs using an upstream approach, concerns about how the point of regulation may affect each company's allocation of emissions still generates some resistance to the upstream approach. This is due to a common, but mistaken, belief that allocations should be made to the parties that are regulated, and not to any of the unregulated parties. Under past cap and trade programs, allocations have always been made this way. However, allocations of permits under a cap

[5] For example, the upstream approach was a central feature of a policy proposal by researchers at Resources for the Future in 1999.

may be made according to any of a very wide range of formulas, yet have no effect on the efficiency or functioning of the market. Further, there is no sound reason to expect that allocations to the regulated party are somehow "more fair." In fact, the financial impacts under any cap on GHGs (a widely accepted notion regarding who should receive valuable allocations) are more likely to be concentrated on fuel producers and transporters than on downstream parties. This is because the primary forms of CO_2 control at low to moderate carbon prices involve fuel switching. A cap on emitters may cause them to switch the fuels they use while continuing to supply their customers with their own product–effectively passing most of the burden of their cap back to fossil fuel suppliers. We can and should clearly separate the decision about the point of compliance from any decisions on who should receive free permit allocations. Until this misunderstanding is eliminated, it will only stand in the way of designing an efficient and effective cap-and-trade program suitable for GHGs. The fact that allocations were given solely to companies at the point of regulation in the existing and past cap-and-trade programs should *not* be considered a "lesson learned" from any past experience, but only a political convenience that has not yet been sufficiently challenged by other parties whose financial fortunes were likely to be affected by the imposition of the cap.

B. Potential Economic Impacts of Carbon Permit Price Uncertainty and Volatility.

Prices in all previous and existing permits have exhibited substantial volatility, and this can be expected of GHGs as well.[6] Price volatility, however, is likely to have much greater generalized economic impacts with a CO_2 cap than for caps on SO_2 and NO_x. CO_2 is a chemical that is an essential product during the extraction of energy from any fossil fuel. As long as fossil fuels are a key element of our energy system (which they are now, and will remain for many years even under very stringent caps), any change in the price placed on GHG emissions will alter the cost of doing business throughout the economy. This is because all parts of the economy require use of energy to one degree or another.

In contrast, under the Title IV SO_2 cap, a fluctuating SO_2 permit price would only affect emissions from coal-fired electricity generation. In deregulated electricity markets, coal-fired electricity does not always affect the wholesale price of electricity, and even significant fluctuations in SO_2 permit prices might have almost no effect on electricity prices. Even in regulated electricity markets, the impact of the SO_2 price on the cost of all electricity generation would be diluted by the unaffected costs of all other sources of generation before it reached customers. Also in contrast to an economy-wide GHG cap, no other sources of energy in the economy are affected at all by SO_2 price changes. Finally, under the Title IV SO_2 cap, price variations during the past year that range from $400/ton to $1500/ton (the range observed in the past year under Title IV) have a modest effect on

[6] Some have argued that banking reduces price volatility. While it may reduce it, it certainly does not eliminate it. For example, the Title IV SO_2 market has experienced high volatility over the past two years, even though it has a large bank already in place. During 2005, SO_2 permit prices rose from about $600/ton to above $1600/ton, then plummeted to below $400/ton by the beginning of 2007. Additionally, banking offers little price stability at all during the start up of a new cap, simply because no bank yet exists, and this initial-period volatility can be very large if the first-period cap requires a substantial amount of reduction and/or has a relatively brief regulatory lead time. The experience of the first year in the NO_x cap of the Ozone Transport Region of the northeastern U.S. is a classic example.

the majority of coal-fired units that are already either scrubbed or burning low-sulfur coal. Such units might see the cost adder due to its SO_2 emissions vary between 7% and 26% of its base operating cost,[7] and (as noted) the impact on consumer's cost of electricity would be much smaller, if anything.

Variation of CO_2 prices such as that observed in the EU ETS market over the past two years (approximately $2/ton to $35/ton) would cause *all* coal-fired units to see additional costs varying between about 10% and 175% of their base operating costs. Further, even gas-fired units would experience absolute cost increases equal to about half those of the coal-fired units.[8] Since gas-fired units do frequently set the wholesale market price of electricity, consumer electricity prices would also vary markedly with the price of GHG permits. Retrofits would not be available to attenuate these costs (at least, not until even higher permit price levels would be achieved and *sustained* at those levels.) At the same time, all other key energy demands in the economy (e.g., for transportation, industrial process heat, building heating and air conditioning, etc.) would also experience similar fluctuations with varying GHG permit prices. Clearly, the effect on the economy could be disruptive.

These are not just theoretical calculations. The EU's statistics bureau, Eurostat, reports that electricity prices rose significantly throughout the EU in 2005. Household rates rose by 5% *on average* over all 25 EU countries, and industrial rates rose by 16% on average.[9] The high prices of GHG permits under the EU ETS during that period is widely viewed as having contributed to this price increase, and indeed, wholesale electricity prices have fluctuated in step with the wide swings in ETS permit prices. It is not clear yet how or whether the wide variations in permit prices may begin to contribute to the variation in economic activity. However, it should also be noted that the EU ETS does not cover all sources of GHGs, or even a majority of sources of CO_2 emissions in the EU. (This may dampen the impacts of CO_2 permit price volatility on the EU economy, but is also a widely observed flaw in that cap-and-trade system's potential to produce sufficient cuts in GHG emissions necessary for the EU to meet its GHG targets.)

To sum up, price uncertainty and price volatility will impose impacts in the case of GHG emissions limits that are completely different in scale and scope from those under previous emissions trading programs. Their potential to increase variability in overall economic activity thus should be viewed as a core concern in designing a GHG cap-and-trade program. At the same time, the nature of climate change risks associated with GHG emissions is such that it is possible to design price-stability into a GHG cap-and-trade program without undermining its environmental effectiveness. In the case of a stock pollutant such as greenhouse gases, there is no need to absorb high costs in return for great

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[7] By "base" operating cost, I mean the cost of generating a unit of electricity before accounting for the emissions price. The majority of this cost is the cost of the fuel.

[8] However, the percentage increase in the base operating cost would be much smaller (i.e., about 30% compared to 175%) because natural gas is so much more expensive than coal.

[9] Eurostat, "News Release – July 14, 2006" (Revised version 93/2006), available at http:/ec.europa.eu/eurostat

specificity in achieving each year's emissions cap.[10] Economists widely agree that the cost to businesses of managing the price uncertainty of a hard cap is not worth the greater certainty on what greenhouse gas emissions will be from year to year.

There are various ways to provide much greater price certainty under a cap-and-trade program, although none have been used in any trading programs to date. One of the simplest concepts that has gained substantial attention for GHGs has been called a "safety valve." Unfortunately, this term has begun to be used loosely (e.g., under the rules of the Regional Greenhouse Gas Initiative, and in California's AB32 program) for a variety of mechanisms that do not actually provide the price certainty originally intended. To be quite specific, the cap-and-trade program mechanism that provides the requisite price cap is one where the government offers to issue any number of additional permits to regulated companies at a pre-specified and fixed price per permit. This price is set low enough that it is not considered punitive, but rather as an assurance by the government that it would not consider control costs above that level to be desirable as a normal course of events.[11] This is the mechanism that has been incorporated into the draft bill of Senator Bingaman.

Because regulated entities know that they need not ever pay more for a permit than the established safety valve price, it functions as a price ceiling. No company would ever pay more to purchase a regular permit in the emissions market if it knows that it can always obtain sufficient permits at that price from the government, if necessary. Permit prices may fluctuate at levels below the safety valve price, but by judicious selection of an appropriate safety valve price, policy makers can ensure that these variations would not rise to a level that might be viewed as potentially harmful to the economy at large. If the safety valve price is hit on an occasional basis under a cap, then the goal of achieving long-term reductions in emissions is not harmed, given that the primary environmental risk of GHG emissions is a long-term, cumulative one. If the safety valve price is hit on a perpetual basis, this suggests an important need for policy makers to consider how we should address the evidence that meeting targets that are more difficult than hoped; however, this policy deliberation will be possible without the urgent need to throw "band-aid" solutions onto the cap-and-trade program, and with concrete evidence of the degree of economic pain that is associated with the initially-established maximum permit price. A higher price might then be deemed acceptable, but if not, the safety valve will have helped us avoid the greater pain of learning that fact through a hard cap approach.

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[10] Richard G. Newell and William A. Pizer 2003, "Regulating Stock Externalities Under Uncertainty," *Journal of Environmental Economics and Management,* Vol. 45, pp. 416-432.

[11] Outside of the U.S., further confusion about the notion of a "safety valve" has been created by application of this term to the traditional notion of a penalty for noncompliance. The EU ETS has a penalty for noncompliance that is €40/ton CO_2 in Phase I and will be €100/ton in Phase II, starting in 2008. This is often described as a price cap, but its very high level relative to the price at which the cap is expected to be met makes it extremely ineffective. Further, its role as a penalty rather than as an additional compliance mechanism clearly would undermine the willingness of companies to resort to its use for planning purposes. The same confusion of penalty and safety valve appeared in the proposal for an Australian emissions trading scheme released in 2007 by Australia's National Emissions Trading Taskforce. The notion of a "safety valve" should be clearly separated from the role of a noncompliance penalty, with the former being set at a price that is considered an acceptable level of policy implementation cost, and the latter being set at a much higher level that is considered "punitive" and not acceptable as an indicator of the cost of meeting the policy goals.

Some researchers also have spoken of creating price floors along with price ceilings as part of a cap-and-trade system for GHGs. This would certainly offer even greater price certainty, with attending benefits. It can be done by creating a direct rule by which the government (or an authorized entity that would act like a "central banker" for the permit market) would buy back permits if prices fall below a particular level (or to reduce the number of permits available through auction). All of these proposals, however, point to the fact that the truly appropriate market-based mechanism to address climate change risks, which accepts the long-run, cumulative nature of this risk is an emissions price-setting approach, not an approach that limits emissions to ad hoc but rigidly defined levels, which is the fundamental feature of a pure cap-and-trade program. Once one accepts this notion, policy development attention can shift to the question of what that carbon price level should be, and impose it directly as a carbon tax. This would be far simpler for government to administer, and far less subject to *ex post* manipulation or unintended consequences than any cap-and-trade program with a complex set of price-controlling features.

C. International Dimension.

It is thus a quite manageable task to design a cap-and-trade program to address the great multiplicity of domestic sources of GHG emissions – the only challenge in doing so is to overcome the widespread but erroneous notion that any effective cap must be imposed at the point-of-emission. It is an equally manageable task to design a cap-and-trade program to mitigate the most severe effects of price uncertainty and price volatility – the only challenge is in embracing the fact emissions targets for GHGs need not be rigidly achieved in each individual time period of a program that will strive over multiple decades toward an ultimate goal of near-zero emissions. However, it is a far more difficult challenge to manage the complexities created by the international dimension of GHGs and climate change through design of a domestic cap-and-trade program.

As noted above, the cumulative manner in which GHGs affect climate change risks gives us flexibility to modify our emissions targets in individual periods in order to manage costs. Similarly, this cumulative manner implies that emissions from any part of the globe have comparable impacts on climate risks, as they all first accumulate together in the global atmosphere to have their combined and joint effect on the global greenhouse effect. On the one hand, this offers important flexibility to reduce emissions anywhere in the globe that has cost-effective opportunities to do so, and not to confine domestic efforts to actions within US borders. On the other hand, it also means that any GHG cap we impose domestically, and its attending domestic reductions, may be undermined by offsetting increases in nations that do not have comparable caps on their own economies. Large sums of money could be spent with no actual global environmental benefit.

This latter adverse possibility is made a real concern by the point I made in Section B above that setting a price on CO_2 emissions will inevitably create a widespread increase in the costs of production throughout the entire economy, because it will affect the cost of all the basic forms of energy services that are essential to nearly all economic activities. As

domestic costs of production rise under a GHG cap-and-trade program, our economy loses some of it competitive edge to countries not undertaking similar emissions control efforts. Unfortunately, the loss of competitive edge will tend to be greatest in those industries that produce the largest domestic CO_2 emissions, and so some of those highly-emitting productive activities will be offset by increases in the same activities abroad. Domestic emissions may fall to meet the domestic cap, but global emissions will not fall as much.

The higher the price of permits under the domestic cap, the more serious this "leakage" is likely to be. Thus, the international dimension of GHG emissions provides an important additional reason for directly managing the price of permits that may occur under a domestic GHG cap-and-trade program to a relatively low level. This relationship between higher permit prices and increasingly ineffective environmental outcomes has not been a concern for any previous cap-and-trade program addressing emissions such as SO_2, NOx, volatile organics, or particulate matter. It is not even a concern for the coming US cap on utility mercury emissions, even though mercury emissions are much more of a global issue like GHGs.[12]

The only way to design a domestic cap-and-trade program to address this international competitiveness risk is simply to keep the carbon price low enough that such losses remain within acceptable bounds. This, naturally, limits the amount of domestic emissions reductions that will be achieved as well. The international dimension of GHG emissions cap can only be managed by somehow engaging the participation of all countries that compete or have the potential to compete with our key industries. Until that issue is resolved, ambitions to make significant reductions through any domestic cap-and-trade program will be thwarted. At the same time, this concern also implies that any domestic cap-and-trade program that *is* implemented in advance of internationally coordinated efforts should be designed with clearly defined permit price caps.

It is worth returning to the positive side of the international dimension, which is that cost-effective emissions reductions can exist anywhere in the globe. Without an international set of caps, the only way for a domestic cap program to tap into these opportunities would be through a project-by-project "offsets" provision in the domestic program. The Clean Development Mechanism (CDM) was established under the Kyoto Protocol to offer nations with caps under the Kyoto Protocol to obtain such offsets from nations without caps under the Kyoto Protocol. The experience with the CDM so far has been mixed, at best. Any scheme to allow individual projects to be approved by the regulators to offset emissions under a cap will be fraught with transaction costs and other types of hurdles that either raise the cost of the project above its actual technological cost, or actually hinder the ability to access certain types of control opportunities. These concerns have been made widely documented in the first few years of the CDM. Although some of the issues may disappear or be eliminated with more time, it is clear than a projects-based approach does not

[12] Mercury risks to US residents are created largely by mercury emissions in aggregate around the globe, but leakage of mercury emissions under a cap on US electric generating emissions is not a concern because (a) the costs of achieving a given degree of mercury emissions reduction are not nearly as high as comparable percentage reductions of CO_2, and (b) these costs will be imposed only on coal-fired generators, which are not themselves subject to international competitiveness changes that create leakage of the direct emitters.

generate the degree of opportunities to reduce near-term costs of compliance that would materialize if all the international emissions sources were under the cap themselves.

Another point is being made frequently in the emerging reviews of the CDM experience, which is the extent to which this mechanism serves as a conduit to shift large amounts of wealth to a few individual parties in developing countries, to achieve reductions in GHGs that could actually be required at minimal cost by the developing countries.[13] In essence, the bureaucratic delays of approving CDM projects have created a shortage of supply of such credits to meet the large demand for them in the EU and other nations seeking to purchase such credits to meet their Kyoto limits. This shortage gives the few suppliers that have successfully emerged from the CDM certification pipeline with saleable credits in time for the first commitment period (i.e., 2008-2012) to be able to sell those credits at a premium well above their cost, and very close to the much higher cost of emissions reductions within the capped countries.[14] Although these CDM projects do reduce the global cost of meeting the developed countries' targets, only a very small fraction of those cost savings are being experienced by the companies (or governments) that are facing the caps. All of the cost savings are being translated into wealth transfers to the project owners and to the lawyers and other parties that are facilitating the contracts.

AVOIDANCE OF CAP-AND-TRADE IS A WORSE POLICY RESPONSE

The challenges of designing a GHG cap-and-trade system that has the promise of being functional and fair may seem daunting. As I have tried to explain above, there are reasonable approaches that will work, albeit with limitations on how much can be done before there is any internationally coordinated policy. Application of these policy options could result in an efficient and streamlined cap-and-trade program, but it would have very little resemblance to the widely touted Federal SO_2 and NOx cap-and-trade programs.

The policy difficulty lies in the persistent effort to force the design that made sense for utility SO_2 and NO_x emissions onto the very different (and more complex) situation for economy-wide, multi-specied GHG emissions. Another part of the problem, in my opinion, lies in the persistent and mistaken belief that the only market-based approach available is cap-and-trade. In fact, emissions fees are technically the more appropriate policy tool for the GHG situation. Efforts to design a program that is cap-and-trade by name, but has all the important merits of an emissions fee lead to some of the apparent differences (and complexities).

Unfortunately, the response of many in the policy community who are facing this complex discussion about the pros and cons of extremely different types of cap-and-trade approaches appear to be opting out of the effort altogether. Many are suggesting that we

[13] M. Wara, "Measuring the Clean Development Mechanism's Performance and Potential," Working Paper #56, Program on Energy and Sustainable Development, Stanford University, July 2006. available at http://iis-db.stanford.edu/pubs/21211/Wara_CDM.pdf.

[14] Capoor, K. and P. Ambrosi, 2006, "State and Trends of the Carbon Market 2006," report prepared for World Bank and International Emissions Trading Association, Washington, D.C., (May), available at http://carbonfinance.org/docs/StateoftheCarbonMarket2006.pdf.

should take a number of initial small steps in the direction of emissions reductions while waiting until the time is ripe for a true cap-and-trade program. This approach can only worsen the situation, as it amounts to an incremental implementation of a full scale command-and-control approach. Each individual policy measure will usurp the flexibility of decisions that are offered by market-based approaches like cap-and-trade. Once the flexibility is removed, it cannot be entirely regained if and when a cap-and-trade program is later implemented – too many compliance-related investments will have become sunk costs in the interim. Further, each of these incremental policies will result in not just higher, but hidden costs, as regulatory approaches are good at doing. The net effect may be emissions reductions starting in advance of the potential implementation of a sound market-based approach. However, the costs to our economy, and the losses in potential incremental innovations that are associated with market-based approaches, will be large.

One insight about the magnitude of difference in the efficiency of cap-and-trade compared to some of the leading regulatory alternatives comes from analyses I and my colleagues have done regarding renewable portfolio standards (RPS). In a recent analysis for Australia's National Generators Forum, CRA International modeled the costs and emissions reductions that would be obtained from caps of various stringencies, and we also modeled several technology mandates, one of which as a national RPS of about 10%.[15] This analysis found that the 10% RPS would produce the emissions reductions consistent with a CO_2 price of just above about $AU10/ton, but at the cost of a carbon policy that would reduce emissions by about four times more. We also found that the same CO_2 emissions reductions that the RPS would create could be achieved at about one-third of the cost if achieved via a pure cap-and-trade policy than via the RPS. We have performed similar analyses more informally for a national RPS standard in the U.S., with even more striking results. In our unpublished U.S. analysis, we estimated the cost and CO_2 emissions under a national RPS of 2.5% in 2012 increasing to 10% by 2024 (following a standard much like that of the Bingaman RPS Proposal in 2003.) We then estimated the cost of meeting a CO_2 emissions target equal to the CO_2 emissions levels achieved by the national RPS. The same emissions reductions under the RPS approach cost four times as much as if they were accomplished with a utility-wide cap. The savings would be greater still if the cap had been imposed economy wide rather than just on utility sources.

CONCLUSION

My entire testimony has been focused on the specific question of this hearing, how to design an effective cap-and-trade program for GHGs. My key point, which I started with, is that cap-and-trade programs can be very different in their design, and the design should be tailored to the specific nature of the emissions control situation. This leads to a very different design than that of the SO_2 and NO_x programs, which are viewed by many as the role model for GHGs. The EU ETS has been designed to follow much of the SO_2 model, and some (but not all) of its difficulties can be attributed to that fact. The US can and should do better with US-made market-based approaches for addressing GHGs.

[15] A Smith, G Thorpe, D Chattopadhyay, "Analysis of Greenhouse Gas Policies for the Australian Electricity Sector ", report to the National Generators Forum, September 2006. (The RPS is labeled "MRET" in this report.)

With those central points in mind, I want to close by noting that even a highly effective and efficient market-based approach for GHGs will have a serious limitation that should not be forgotten. An adequate national climate policy must consist of more than a system of efficient GHG controls. Actual stabilization of climate change risks will require that GHGs be reduced to nearly zero levels. Although this goal may be possible to achieve at some point in the later part of this century, it can only be done through truly revolutionary technological progress and the resulting changes in the structure of how our energy systems.

Hoffert *et al.* report that "the most effective way to reduce CO_2 emissions with economic growth and equity is to develop revolutionary changes in the technology of energy production, distribution, storage and conversion."[16] They identify an entire portfolio of technologies requiring intensive R&D, suggesting that the solution will lie in achieving advances in many categories of research. They conclude that developing a sufficient supply of technologies to enable near-zero carbon intensity on a global scale will require basic science and fundamental breakthroughs in multiple disciplines. Therefore, Herculean technological improvements beyond those that are already projected and accounted for in cost models appear to be the only hope for achieving meaningful reduction of climate change risks. By inference, no cap-and-trade system should be placed into law that does not simultaneously incorporate specific provisions that directly support a substantially enhanced focus on energy technology R&D.

Placing a price on carbon emissions, as a cap-and-trade program would do, would affect the pattern of private sector R&D. However, this so-called "induced-innovation effect" would be small. Economic analysis shows that market forces produce a less than socially optimal quantity of R&D. Once a private sector innovator demonstrates the feasibility and profitability of a new technology, competitors are likely to imitate it. Copycats can escape the high fixed costs required to make the original discovery. Therefore, they may gain market share by undercutting the innovator's prices. In that case, the initial developer may fail to realize much financial gain. Foreseeing this competitive outcome, firms avoid investment in many R&D projects that, at the level of society as a whole, would yield net benefits.[17]

The task of developing new carbon-free energy sources is likely to be especially incompatible with the private sector's incentives. With no large emissions-free energy sources lying just over the technological horizon, successful innovation in this area will require unusually high risks and long lead times. As Hoffert *et al.* pointed out, developing the needed technologies will entail breakthroughs in basic science, placing much of the most essential R&D results beyond the boundaries of patent protection. These are precisely the conditions under which for-profit firms are least likely to rely on R&D as an

[16] M. I. Hoffert *et al.*, "Advanced Technology Paths to Global Climate Stability: Energy for a Greenhouse Planet" *Science*, Vol. 298, Nov.1, 2002, p. 981.

[17] These points are developed in a more rigorous fashion in W. D. Montgomery and Anne E. Smith "Price, Quantity and Technology Strategies for Climate Change Policy," in M. Schlesinger *et al* (eds.) *Human-Induced Climate Change: An Interdisciplinary Assessment*, Cambridge University Press, forthcoming 2007.

approach to problem-solving. Thus, greenhouse gas caps on their own would insufficiently increase private sector R&D directed toward technological solutions to abatement.[18]

Market-based policies can very effectively stimulate incremental innovation and deployment into the market place of emerging new technologies. They cannot, however, stimulate the kinds of technological progress necessary to enable meaningful emissions reductions later on. Realistically, then, government must play an important role in creating the correct private sector incentives for climate-related R&D, as well as in providing direct funding to support such activity. This role must be built into any cap-and-trade policy, in order to avoid establishing an emissions policy that cannot fulfill expectations, and to avoid wasteful diversion of key resources for the requisite forms of R&D.

Merely establishing cap and trade cannot meet the crucially important need for enhanced emphasis on basic research rather than additional subsidies for specific technologies that are already far along in the development process. It also does not clearly define government's role or an appropriate division of labor or risk between the public and private sectors in the development of new technologies, whether as commercialization and incremental improvement of existing low-carbon technologies, or R&D for new, breakthrough technologies. Creating an effective R&D program will not be easy, but it ultimately has to happen if climate risks are to be reduced. The difficult decisions are how much to spend now, and how to design programs to stimulate R&D that avoid mistakes of the past.

In conclusion, the current policy debate about how to impose near-term controls through cap-and-trade programs is encouraging policy makers to neglect much more important, more urgently needed actions for reducing climate change risks. The top priority for climate change policy should be a greatly expanded government-funded research and development (R&D) program, along with concerted efforts to reduce barriers to technology transfer to key developing countries. Neither of these will be easy to accomplish effectively, yet they are receiving minimal attention by policy makers.

[18] Further, the "safety valve" in the Proposed Policy is designed to provide assurance that the price of emission allowances will not reach economically unsustainable levels. But that causes the carbon prices to be set at a level far too low to provide an adequate incentive for private investors to develop radically new technologies. Removal of the safety valve provision also is not an option, as a hard cap would impose a degree of market risk that would be unsustainable politically.