THE BROOKINGS INSTITUTION

A CLIMATE OF CHANGE:

ECONOMIC APPROACHES TO REFORMING ENERGY AND PROTECTING THE ENVIRONMENT

- - UNCORRECTED TRANSCRIPT --

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Opening Remarks:

ROBERT E. RUBIN
Citigroup Inc.

JASON FURMAN
Director, The Hamilton Project
The Brookings Institution

Hamilton Project Policy Innovation Prize Presentations

Special Presentation:

An Economic Approach to Energy Security and Climate Change

LAWRENCE H. SUMMERS
Harvard University

PANEL ONE: CREATING A GREEN MARKET: HOW TO BEST PRICE CARBON

Moderator:

SEBASTIAN MALLABY
Council on Foreign Relations

Panelists:

GILBERT E. METCALF
Tufts University

ROBERT N. STAVINS
Harvard University

Discussants:

KATHLEEN MCGINTY
Pennsylvania Department for Environmental Protection

JASON FURMAN

PANEL TWO -- WARMING UP TO NEW TECHNOLOGIES: INNOVATING OUR WAY TO A STABLE CLIMATE

Moderator:

ROGER C. ALTMAN
Evercore Partners

Panelists:

JOHN DEUTCH
Massachusetts Institute of Technology

JOHN PODESTA
Center for American Progress

RICHARD NEWELL
Duke University

Discussants:

KELLY SIMS GALLAGHER
Harvard University

DAVID SANDALOW
The Brookings Institution

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P R O C E E D I N G S

MR. RUBIN: (In progress) -- energy, and then we'll have a discussion with and amongst the authors.

Before getting to that program though, I would like to make two very special presentations. About a year ago the Hamilton Project released a paper by Tom Kalil from the University of California at Berkeley on the use of prizes to help spur technological advance. That got us thinking about the same possibility of using that same mechanism, a prize competition, to spur creative thinking about policy by our leaders of the future, today's students. In that context, we announced the Hamilton Project Policy Innovation Prize, and we delighted today to announce the winners of our first competition. We had both a graduate level and an undergraduate level category, and in both categories we had a goodly number of very strong proposals.

These proposals were evaluated by an exceedingly well-qualified evaluation committee chaired by Chris Edley and Laura Tyson, which also included well-known scholars such as Alan Blinder, Alice Rivlin, and Peter Diamond. Roger Altman, Jason Furman, and I also reviewed the papers, and I think it is fair to say on behalf of all of us that it was a truly gratifying experience.

Let me now turn the program over to Jason Furman, the Executive Director of the Hamilton Project, who will briefly describe the winning proposals, and then I will make the presentations to the winners. Jason?

MR. FURMAN: Thank you, Bob. What we were interested in were proposals that were about important topics, that were original ideas, and that like every Hamilton Project paper, really brought sound evidence to bear. The undergraduate winner was a good example of all three of those. It talked about the problems that rural hospitals in our country face and the underprovision of rural health care. It had an economic diagnosis of that problem and the extent of it, and proposed a set of remedies around subsidizing medical education and doctors in rural areas.

The winner of our graduate proposal, and Bob will be announcing all of the names for you so we're keeping you in suspense on that, was also a proposal very much in the spirit of the Hamilton Project about how to make the government more effective and do what it does better without spending any additional money. In this case, the proposal takes the $70 billion a year of student loans that we have today and without spending any new money, advances the money on those loans so students would get it earlier because students are attracted to getting money earlier and the government can make it a wash in terms of the repayment later on. This proposal estimates an additional 17 percent increase in the number of students going to college just by changing the timing of the way that we make our student loans. The second paper will be going through a rigorous review process and will be released as an official published Hamilton Paper like the ones that you have today and that we will be discussing today.

And now to announce the names and institutions, I turn it back to Bob.

MR. RUBIN: It is now my pleasure to announce the winner of the undergraduate category, Chase Nordengren .

(Applause)

MR. RUBIN: Chase is a student at Catholic University of America. Chase is being awarded with the check in the amount of $10,000 from the Hamilton Project, and Chase's proposal will be posted on our website. Chase, congratulations on a job exceedingly well done.

(Applause)

MR. RUBIN: And Chase's father who teaches in the area of health care is with us, and I think found much to his surprise that his son was interested in the same things he was interested in.

(Laughter)

MR. RUBIN: The winner of the graduate-level prize is Sima Gandhi , a J.D. candidate at New York University Law School.

(Applause)

MR. RUBIN: Sima is being awarded a check in the amount of $15,000. Sima will have the opportunity to work with Hamilton Project staff to turn her proposal into a Hamilton Discussion Paper. That will involve a full-blown author's conference and what will be the equivalent of a peer-review process in the academic world, and then that paper too will be posted on the

Hamilton Project website. Congratulations, Sima, and congratulations to both of you. Thank you all very much.

(Applause)

MR. RUBIN: Let me also announce that we are now opening the 2007-2008 Hamilton prize competition. Guidelines are available or will be available on our website, and we look forward to another set of truly interesting proposals.

Turning to energy and the environment, as all of you will know, climate change and America's dependence on oil are critical issues for our society, separate but related. To accompany the program, the Hamilton Project has put out an issues paper on energy. It's in your packet. I can say this because I had no role whatsoever in preparing it, I think it's an exceedingly interesting discussion of this subject and very well-worthwhile reading even in a world in which there are too many papers. I was actually surprised at how good it was.

(Laughter)

MR. RUBIN: I wasn't going to say that because it would reflect badly on Jason to say surprise, but nevertheless, it really was an extraordinarily interesting paper, at least in my view.

The strategy paper suggests a three-part approach. First, putting in place pricing mechanisms to reduce carbon emissions combined with tax rebates to help lower- and middle-income families. Second, increasing and redirecting

public investment with respect to basic research. And third, leading by example to engage the other parts of the global community in this critical mission.

Our first panel will discuss two alternative approaches, a cap to pricing, a cap-and-trade system, presented by Rob Stavins, and a carbon tax presented by Gib Metcalf.

The discussion will be on the merits of these two proposals. The Hamilton Project itself has no view with respect to which is preferable, but it does have the view that pricing is an exceedingly important part of dealing with this very important set of issues.

Our second panel will focus on a federal strategy for investments in energy research. The panel will consider two alternative approaches, one from the Center for American Progress co-authored by Peter Ogden, John Podesta, and John Deutch, and then a forthcoming Hamilton Project paper from Richard Newell. The panel will be moderated by Roger Altman, the Chairman of Evercore, and former Deputy Secretary, United States Treasury.

Both panels will focus on this question of how to involve the developing nations in addressing climate change. And let me add that on that question we have been enormously helped by a number of people who are here today, most particularly Todd Stern and Bill Antholis.

One final note before I turn to our first speaker, today's event has been certified as carbon free by Carbonfund.org. It is actually very interesting. We asked Carbonfund.org to estimate the total carbon footprint of today's event.

The Hamilton Project then funded an offset to those carbon emissions with the funding going toward renewable energy, energy efficiency, and reforestation projects. We estimated there will be somewhere in the neighborhood of 450 to 500 people here today, that one-third got here by public transportation, one-third by car or taxi, and the remaining one-third split evenly between walking and air. Based on these rough assumptions, and I guess we assume the ones who came by air came in some reasonably carbon-efficient way, but that may not have been true in every case, based on these rough assumptions, today's event will result in roughly 11 tons of carbon being admitted from a diverse range of sources, and that is what we offset. Somebody said to me that instead of doing that, why didn't we just cancel the event and we could have saved 11 tons.

(Laughter)

MR. RUBIN: But in any event, we chose not to go that route.

Now let me introduce our opening speaker, former Secretary of the Treasury and current Charles W. Elliott University Professor at Harvard University, the former President of Harvard University, Larry Summers.

(Applause)

MR. RUBIN: Larry will kick off our program with remarks on economic approaches to addressing climate change and to promoting energy security. The two panel discussions will follow Larry's remarks. Dr. Summers?

MR. SUMMERS: Thanks very much, Bob. Others when they introduce me choose as the highest distinction I've had to mention former deputy to the greatest Treasury Secretary since Alexander Hamilton.

(Applause)

MR. SUMMERS: On behalf of the Hamilton Project, based on absolutely no consultation with anyone within the project, I wish to make an additional Hamilton Project policy proposal, that henceforth, prizes given by the Hamilton Project to worthy students be tax-free. It would make the world a better place.

I think it will be interesting to do a calculation of who here had the highest personal carbon footprint in getting here. One way to do that would probably be to focus on people who flew by air, and then once one had focused on those who flew by air, one could take the fuel it takes to fly to Washington and divide it by the number of people on the plane, and I wonder who that would turn out to be, Mister Secretary?

(Laughter)

MR. SUMMERS: I am glad to be here. I have in mind a public-policy issue where there is a widespread consensus that America's current path is unsustainable. The issue has grown substantially in political salience in response to important events. The suffering felt by individual Americans from the issue is not dangerous and imminent, but almost everyone when asked believes that something has to be done. The issue affects every sector of the America

economy, and policy impacts are complex and difficult to evaluate. There is more agreement that something needs to be done than on the precise details of what should be done.

The primary impetus for progress on the issue comes from progressives and Democrats, but there is a significant Republican recognition that something needs to be done and that action is overdue. It is confidently predicted by political observers that something will happen following the next presidential election and that that is particularly likely if a Democrat is elected.

I could be describing global warming in 2008 or 2009. I also could be describing health care in 1992, a complex issue where America was on an unsustainable path and everybody agreed that something needed to happen. In the end, what everyone agreed needed to happen didn't happen in 1993. I am an expert on neither health care nor global warming, but aspire to have some general economic policy perspective. With the 1993 experience in mind as we ponder the best policy approaches to this issue, I'd like to raise what seem to me to be five very important questions.

First, how will we minimize the number of losers from whatever policy change we adopt? We economists are fond of computing the total sum of benefits and the total sum of costs and saying we should do things where the benefits exceed the costs. The political process tends to work differently. Sometimes I think it adds together the absolute value of the benefits and the costs. What can be done to reduce the number of perceived losers? To be sure, we have

impressive distributional analyses that demonstrate how every income class can be made to be a winner from important policy changes, but anyone who has worked on tax reform knows that if there are a significant number of losers from any policy who know who they are, they are likely to be very vocal and carry disproportionate weight.

It is not hard to understand why. It has hard to see how anyone will say I'm in the lower middle-class and I use very little energy, so this policy of rebates to all people like me in higher energy taxes is a terrific policy and I'm going to go out and fight for it. It just doesn't feel like something will happen. But there will be many, many people who because of the climate where they live, the length of their commute to work, the industry in which they are employed, who will worry about whether they will lose. In the case of health care reform, one hears that no small part of the problem was the perception that many individuals thought that was a better system for America, but proposed reforms would complicate their lives. How can we best minimize the number of perceived losers?

The question is what is the right horizon and what is the right degree of vision in the goals? The view in 1993 that to be truly successful and to have a chance of achieving real reform on cost reduction, health care had to be universal was right factually and economically, was compelling as a vision, but proved a complication in launching an effective approach to health care reform. What is the right degree of vision to include in reforms? How perfect should the

goals be? How long should the horizon be? These are very complicated questions. If you're not doing truly important, why bother? If you're doing something that's only a long-run goal, is it really going to happen? There is a natural tendency in the political process when action in the short-run is difficult to lengthen the horizon and expand the goals, that as those who remember calls for the free trade area of the Americas within a decade in 2003 know, the strategy doesn't always prove to be availing. What is the right horizon and the right vision for us?

A third question is how can uncertainty be minimized? David Brooks's column in today's *New York Times* makes a point that seems almost universal in many America public-policy areas. If you ask people what they think about their situation, they think it's pretty terrific. If you ask people what they think about the country's situation, they think there is vast scope for improvement and that it's quite unsatisfactory. How do we manage the degree of uncertainty people feel about the environment in which they will find themselves? I wonder if this consideration doesn't bear somewhat more than is sometimes suggested on the much-discussed issue that we'll hear a lot about this morning of the use of price instruments versus quantity instruments. Quantity instruments give you certainty about in some year how much U.S. emissions will be reduced as part of the global total if the policies are in fact followed. They give you uncertainty about what the price of electricity will be for your factor or what the gasoline will be at the pump. Price instruments give you certainty about what the government

will be doing to the price that you pay, and they give you uncertainty about just how much progress will be made in this first stage of what will be a century-long effort to combat global warming. I can't help but wonder whether the second kind of uncertainty is not going to be significantly more frightening to the polity than the first type of uncertainty and whether that shouldn't be considerable weight in thinking about the distinction between these two policies.

A fourth issue is a very difficult one where I don't know what the right answer is, how should we quantify and include in a policy process benefits which cannot be rigorously measured or calculated, but it is very likely that they will be there? An important aspect of the health care debate was the great reluctance of those with responsibility for maintaining our fiscal probity to give any credit for the benefits that would flow from increased competition or the benefits that would flow from various efforts to improve the way in which the system worked. One can understand their perspective. All too often plug figures have interfered with meaningful progress against the budget deficit. On the other hand, if those benefits can't be counted, they won't count in the political process and they are very important. I suspect, and this is probably not the view I would have had 3 years ago, but one learns, that this aspect is really quite important with respect to environmental regulation. I have asked myself the following question, Why is it that whenever the government proposes to undertake a major project, build the Big Dig in Boston, purchase a new bomber, send a man to the moon, provide for prescription drugs for everybody, the costs always end up vastly

greater than was originally estimated? Yet whenever the government attempts, and this is the case not just in sulphur oxides but in many, many examples going back, to achieve a given environmental objective, somehow the costs and the burden on the economy end up being much less than everybody suspected they would be when the program was launched, and that's been demonstrated again and again. Taking the smog out of Los Angeles is another example; command-and-control regulation during the Second World War is another example. I suspect that the answer to the question is that the people who provide the information want to low-ball it to make the new government initiatives happen and so you end up with underestimates, and the people who provide the cost estimates want to avoid the policy and so you get the estimates overestimated in the environmental area. I don't pretend to know the answers here, but I think there is every reason to suspect that strong policy will produce unexpected reductions in costs, but the question of how we factor that into the policy process and policy analysis, one that was handled in a way that made reform much more difficult in the case of health care, is I think a very large issue with respect to the environment.

The final issue I would raise is the question of competitiveness. It's interesting, when trade issues are discussed to the first approximation, most of the political debate pays no attention to the consumer. The political debate pays attention to all the producer interests and people's interests as employees of producers. The analyses we have here, focusing on the consequences, are all

about the consumer interest and not at all about the various producer interests and how will they be factored in. I don't think we can underestimate the importance of the global dimension of these policies. The arguments made in these papers that U.S. leadership is necessary if there is going to be serious action in other parts of the world are surely right, they don't fully establish the sufficiency of U.S. leadership, and there are two remaining questions that I think we all need to give a great deal of thought to.

One is the issue that is referred to in the papers somewhat euphemistically as leakage. One way in which you can reduce your U.S. energy consumption is outsource your production to another country that has lower-priced energy. If that happens, notice that there is no progress in reducing global emissions and, indeed, if the other country uses more carbon-intensive fuels than the United States would, you can even see some negative progress. How large will those effects be? How high do prices in the United States have to become before those become serious issues? These are issues that I also think need a great deal of analysis.

Finally, as important as it is to do something in the United States, we do need to remember that there are huge opportunities for carbon abatement at prices of $1 or $2 or $5 or $7 a ton in the developing world today that are not being taken advantage of. How we are going to induce those changes will have as much impact on the global supply of greenhouse gases 50 years from now as the policy choices we make with respect to our own economy, and given that one new

coal-fired power plant a week is being opened in China, this is an issue that has considerable urgency.

I am convinced as I suspect most of you are that we as a country have paid a very high price for not having acted more strongly sooner on health care, I suspect that we will pay a very, very high price as will the world if we do not act strongly soon on issues related to national energy policy, and I very much hope that these discussions this morning and beyond will help to push the process in that very important direction. Thank you very much.

(Applause)

MR. MALLABY: I am Sebastian Mallaby. I work on the Council on Foreign Relations, and I direct a thing called the Center for Geoeconomic Studies. We are going to be discussing a copy which as others have already said has gone from 0 to 60 in terms of his prominence and the sense of its political durability. We've got a great collection of people, first of all, with two authors of the papers that the Hamilton Project has published. Over there we have Gilbert Metcalf, Professor of Economics at Tufts University who is the author of the paper on the carbon tax. Next to me is Rob Stavins, Professor of Business and Government at Harvard and also wrote the cap-and-trade paper. Next to me here is Kathleen McGinty, a former Clinton Administration on the environment and now at the Pennsylvania Department for Environmental Protection. Then Jason Furman who you have already met who is the Executive Director of Hamilton

Project, and also the main author I think on the subject which the Hamilton Project has put out on climate change.

We are going to start off with two 5-minute presentations from the two authors of the papers, and then we are going to engage in a bit of back and forth with them and bring in the other two speakers as discussants after that. Let me turn it over to Gib Metcalf.

MR. METCALF: Thank you very much. It is a pleasure to be here and I want to thank the Hamilton Project for providing the opportunity to write this paper and great feedback as I wrote it.

My paper focuses on using a U.S. carbon tax as the form of carbon pricing and describes a carbon tax swap, so let me turn right to the proposal. The paper has a good deal of background information on the relative merits, advantages and disadvantages, of a carbon tax vis-à-vis cap and trade. I am going to focus more on issues of distribution in this presentation, and we can talk about some of these other issues during the discussion.

The proposal is for an upstream tax on carbon starting at a rate of $15 per ton of carbon dioxide and also on some of the other greenhouse gases that can be brought into the system. We start at a rate of $15 per ton and gradually over time. An important point to make is that it is important to have an upstream tax for administrative reasons, Rob's paper talks about an upstream cap-and-trade system, and I think everyone who looks at this understands that this is a much

better way to go than having a downstream system as is used in Europe with the emission trading scheme there.

A rebate of the tax is allowed for sequestered greenhouse gases, so carbon capture and storage from coal-fired power plants, there would be a tax credit for that, as well as for other approved sequestration activities. If this tax were in place in 2005, it would have raised on the order after some short-term behavioral responses $80 billion a year, and the last part of the proposal is an environmental earned income tax credit linked to payroll taxes. This would provide using data from 2003, it would provide a maximum tax credit workers of $560, offsetting the first $560 of payroll taxes that they pay.

Let me turn directly to some distributional remarks. What I've done is I've used data from the Bureau of Economic Analysis to trace through the price impacts on consumer goods of a carbon tax using the assumption that's found in most of these analysis that nearly all of the carbon tax or the price impacts of cap and trade would be passed forward into higher consumer prices, and I can use data from the Consumer Expenditure Survey to look into consumer purchasing patterns to see what the impact is on households.

What this chart shows is I have bars for different households ranging from the lowest 10 percent, poorest 10 percent of the population of households, to the richest 10 percent on the right-hand side. What we see is that the carbon tax by itself is quite regressive. The poorest 10 percent of the households in the population have a reduction in their disposable income on the

order of 3-1/2 percent. This is because of the higher prices of electricity, heating oil, gasoline, as well as goods that are purchased that have energy embedded in their production, nearly 3-1/2 percent in the lowest decile, and around 0.8 percent in the top decile. So the tax by itself is regressive. This would be the same with looking at the price impacts of the cap-and-trade system.

If we then look at the environmental earned income tax credit, this gives money back in a progressive fashion so that the lowest 10 percent of the households see an increase in their disposable income from the tax credit portion of about 2-3/4 percent, falling to about 0.8 percent in the top decline, so that when you put it together you have a reform that is essentially distributionally neutral as well as being revenue neutral. There is some negative impact in the bottom two deciles and this is because here we have people who are not working, some of whom are retired and receiving Social Security benefits, and I will just note that I have not taken into account the fact that Social Security benefits are indexed for inflation and that they would respond to some extent because of the higher prices because of carbon pricing.

In the paper I do look at a couple of alternatives, so the blue bars in this chart show the policy that I just showed you before, but then I consider an explicit supplement to Social Security that equals the maximum environmental earned income tax credit. So in the first analysis the maximum was $560 using data from 2003, it falls to about $420 if you give an explicit benefit to Social Security recipients, and when you do that, the middle red bar is somewhat

progressive, and if we do a per capita lump sum rebate we find even more progressivity. What's demonstrated here a bit is there is a slight tension between efficiency and equity. Even though I have focused primarily on the distributional aspects of the reform, there are some efficiency benefits to providing the tax credit as an earned income tax credit in terms of encouraging work at the margin, not so much additional hours working in the intensive margin but, rather, the decision to work in the extensive margin. There is some evidence on that in the literature. A quick slide just showing that if we have a cap-and-trade system as the European Union has with grandfathered permits, this is a distinctly regressive policy, and we can talk more about this.

Let me conclude with key points to take away, that this proposal emphasizes distributional neutrality as well as revenue neutrality, but there is a broader point that the revenue from a carbon tax, and equally, revenue from a cap-and-trade system with fully optioned permits provides fiscal flexibility that is lost if you have free distribution of permits. You may not like this particular proposal, you may have other taxes you would like to reduce, the alternative minimum tax for capital income taxes, or maybe you would like debt reduction, but you need revenue in order to have the fiscal flexibility to address those kinds of issues.

This is an example not of a tax increase but, rather, a shift in the composition of the tax system, a shift away from taxing things we like, labor supply, capital investment, to taxing things we don't like, carbon emissions, and I think that is a good direction to take our tax code in. Thank you.

(Applause)

MR. MALLABY: Rob Stavins?

MR. STAVINS: Thank you, Sebastian. I am very pleased to be here also to participate in this discussion and to provide a very brief description of my paper instead of Gib's, so let me do that, to provide a brief description to you of the proposal I've developed for the Hamilton Project of what I believe is a scientifically sound, economically rational, and ultimately politically pragmatic means of achieving meaningful reductions, and I want to emphasize meaningful reductions, of emissions of greenhouse gases in the United States, namely, a cap-and-trade system, to address global climate change.

There is obviously a growing impetus for a domestic U.S. climate policy that provides meaningful reductions in carbon dioxide and other greenhouse gases, and I think there is something of a general consensus among policy analysts that a market-based instrument targeting CO2 emissions should be a central element. While there are tradeoffs between the two instruments, a cap-and-trade and a carbon tax, in my view, the best and for that matter the most likely approach in the short- to the medium-term for the United States is a cap-and-trade system. I say this on the basis of three criteria, environmental effectiveness, cost-effectiveness, and distributional equity.

SPEAKER: Use the right arrow.

MR. STAVINS: Pardon me?

SPEAKER: Just use the right arrow.

MR. STAVINS: The right arrow. Thank you. Being from Harvard rather than from MIT, I'm a little challenged by technology. Later John Deutch will show us how it's done.

The key merits of the cap-and-trade approach that I propose are simply as follows. First, the program can provide cost-effectiveness while also offering certainty about emissions levels. Second, it offers an easy means of compensating for the inevitably unequal burdens imposed by any climate policy. Third, it provides a straightforward means to harmonize with other countries' climate policies. Fourth, it avoids the current political aversion in the United States to taxes and new taxes. Fifth and finally, this approach has a history of successful adoption and successful implementation in this country over the past two decades.

I have proposed an upstream, economy-wide CO2 cap-and-trade system with gradual inclusion of other greenhouse gases and with offsets for carbon capture and storage. This implements a gradual downward trajectory of emissions ceilings over time in order to minimize economic disruption and allow firms and households time to adapt. Included are mechanisms to reduce cost uncertainty, that price volatility we have heard about, namely, banking, borrowing, and a sensible cost-containment mechanism. Initially, half of the allowances would be allocated through auction and half through free distribution, moving to 100-percent auction within 25 years. And note that in terms of present discounted value, that is equivalent to a 15-percent free distribution in perpetuity

which is what virtually all of the economic analyses have pointed to in this domain.

The free-allowance distribution should be targeted to entities most burdened by the policy. This both helps limit potential inequities, and it also increases political support. And the auction revenue generated can be used for worthwhile public purposes, including, importantly, compensation for low-income consumers, research and development, something we will hear about later this morning, reduction of the federal deficit, and reduction of distortionary taxes.

Note that what I have proposed and what you can read about with abundant tables, charts, and quantitative estimates in the paper, is a meaningful policy because it will reduce carbon dioxide emissions fully by 50 percent below 1990 levels by the year 2050. That is within the range of the targets proposed by USCAP, the broad-based industry and environmental coalition that is quite centrist in this area. The costs are significant, but they are affordable. They are less than 1 percent annually of GDP. Also included is linkage with international emission reduction credit systems and gradual harmonization over time with cap-and-trade systems in other countries which would bring down costs even more, very importantly, imports of highly carbon-intensive bulk products from countries that have not taken action comparable to the United States, and this is only for particular carbon-intensive bulk products, cement, bulk glass, rolled steel, et cetera, would be required to purchase allowances that establishes a level playing field for domestically produced and imported products, it reduces emissions

leakage which we heard about from Larry Summers, and it helps induce, importantly, key developing countries to join an international arrangement which ought to be eventually what we are all aiming toward.

The alternative to a carbon dioxide cap-and-trade system which is really most frequently considered in the real world by policymakers is a standards-based policy, technology standards and performance standards, and such policies are inferior to cap and trade and inferior to carbon taxes in terms of environmental effectiveness, in terms of cost-effectiveness, and in terms of distributional equity. But in addition of course among some economists and some policy analysts, there is considerable interest in the use of the carbon taxes. Unfortunately, many if not most of these critiques of cap-and-trade systems by advocates of carbon taxes really utilize what are straw man caricatures of a cap-and-trade system, i.e., the most simple or the craziest cap-and-trade approach. I am pleased to say that that is not something that characterizes the work that has been done for the most part by Gib Metcalf within the framework of the Hamilton Project, and I celebrate the Hamilton Project for that.

MS. MCGINTY: For the most part.

MR. MALLABY: For the most part.

MR. STAVINS: Pardon me, by Gib Metcalf. Sorry.

Instead, what I want to do therefore because I do not have time to try to address the straw man critiques is to comment on a couple of real differences and similarities between taxes and cap and trade.

First of all, environmental effectiveness. A tax obviously does not guarantee achievement of emissions targets, but on the other hand, it does of course provide greater certainty regarding costs, and that is a fundamental tradeoff. Likewise, taxes provide automatic temporal flexibility. This needs to be built into a cap-and-trade system as I said through banking, borrowing, and other mechanisms. But, and here is a difference, political/economy forces strongly point to much less severe targets if carbon taxes are employed than if cap-and-trade systems are used. This is not a tradeoff, and I assume that's why all environmental NGOs are unanimously opposed to the carbon tax approach.

In principle, both carbon taxes and cap and trade can achieve cost-effective reductions, and also the distributional consequences of the two approaches can be identical. But, and this is absolutely key, political pressures on a carbon tax system will most likely to lead to tax exemptions of sectors and firms that reduces environmental effectiveness and it drives up costs, it reduces cost-effectiveness, but taking some low-cost emission reduction opportunities off the table, that is, it reduces social efficiency. Whereas, political pressures which also will exist within a cap-and-trade system lead to different allocations of allowances which affect only distribution, not environmental effectiveness, and not aggregate costs, not cost-effectiveness. Another way of stating the same thing as it has been stated in fact by the Hamilton Project is that some observers seem to worry about the propensity of the political process under a cap-and-trade system to compensate sectors through free-allowance allocations, but a carbon tax is

sensitive to the same political pressures and may be expected to succumb to those pressures in ways that are ultimately more harmful.

The authors of the Hamilton Project overview strategy paper which, which I agree with Bob Ruben is excellent, I read it last night after I received it, states that the ultimate choice between the two instruments should come down to one, which is more politically feasible, and, two, which is more likely to be implemented in a sound manner, and I heartily agree. My shorthand for that is that it is important to design policy that is optimal in Washington rather than simply optimal from the perspective of Cambridge, New Haven, or Berkeley. Thank you.

(Applause)

MR. MALLABY: So you have heard a brief version of the case for the carbon tax and a brief version of the case for cap and trade. I want to do some back and forth with the authors now before getting into the discussions just to see if we can stipulate to a few points and get some clarity on the pluses and minuses of each of these approaches.

I will start with Gib Metcalf. As I understand it, in your view the advantage of a tax first of all is that you are generating these revenues which you can use either for your proposed EITC for the redistributive agenda or for some other agenda if you wanted to do that, but you would concede I think that under a cap-and-trade system in which you have auctioned permits, you would also have the revenue and therefore that difference would go away.

MR. METCALF: Absolutely that would go away. I think it is important though to speak to one point that Rob focused on which is the relative uncertainties of emission reductions under a carbon tax because this is one area where there is a big difference. I want to make two points here. The first is what we care about are the concentrations of greenhouse gases in the atmosphere. The specific path of emissions reductions is both less important as well as less known as to what is optimal. So I think to give primacy to say that we like cap and trade because we know we are going to get a 50-percent reduction in emissions is suggest a greater certainty in the climate science than currently exists. We really want to be balancing reductions and in emissions to get to the cost of achieving these reductions and a carbon price is where that balance occurs and that is where I think a carbon tax is a way to get the right balance.

Let me just make one last point which is that if we have a safety valve in the system, then we are not going to have a certainty of emission reductions, and if we look at the National Commission on Energy Policy's safety valve of $10 a ton, we have a carbon tax.

MR. MALLABY: I think part of Rob Stavins's proposal is not just that there should be a safety valve within a cap-and-trade system, but that there should be this provision for borrowing credits from the government if that makes sense when the economic is going very fast, the cost of not emitting carbon when you've got a fast-growing economy is higher in terms of full-brown growth, and so in that part of the business cycle you would borrow credits. Just to sort of

clarify for everybody where the differences lie, as Rob would say, in a non-straw-man cap-and-trade system of a sort that he is describe, this advantage of a carbon tax which is that you can smooth your carbon reduction over the business cycle goes away. Is that right?

MR. METCALF: Because of the ability of borrowing you're saying?

MR. MALLABY: Yes. In a straight cap-and-trade system you've capped the amount, it doesn't matter if the economy is booming or if the economy is in recession, it's the same cap, that's unflexible that foregoes the opportunity to smooth your carbon mitigation over the business cycle.

MR. METCALF: That's right. So banking and borrowing then begins to give you some of the advantages of a carbon tax.

MR. MALLABY: Yes.

MR. METCALF: Assuming that you can really set up borrowing in a credible fashion that will repay the permits.

MR. MALLABY: So far we've got a consensus that in terms of generating revenue, if the cap-and-trade regime auctions the permits, you get the revenue as well, so that is potentially neutralizable as an advantage for a carbon tax.

Second of all, there is a business cycle smoothing advantage in a carbon tax, but that could also be addressed within the cap and trade if it is implementable.

MR. METCALF: To some extent. It is not clear how well that will work.

MR. MALLABY: So there are design complications. A tax automatically provides this smoothing over the cycle, whereas with a cap and trade you have to design fancy borrowing of carbon credits which may or may not work.

MR. METCALF: That's right.

MR. MALLABY: Then there is the point, referring back to what Larry Summers was saying, that it is more costly to be wrong about the price than about the quantity because the quantity of carbon in the atmosphere is something which you can course correct since we only care about the effects over many, many years. Whereas, getting the price wrong can have an immediate economic impact on the economy which we will feel right away, and that is another advantage of a tax.

Then my question is, how big is that effect? If I read one of the papers right, the total cost to economic growth, the amount by which you would economic growth to be reduced, is on the order of 0.01 percent a year. That's in your paper.

MR. METCALF: That's a bit low, actually.

MR. MALLABY: What would you project as growth rate?

MR. METCALF: The growth rate, yes.

MR. MALLABY: Let's suppose that in this world of uncertainty we get it wrong by a factor of 10. So now the price of carbon has gone up in a cap-and-trade system. You've fixed the quantity, you don't know what the price is going to do, the price goes up much more than you expected, so now the effect on economic growth is 10 times worse than we expected. So instead of 0.01 percent of growth, you've got 0.1 percent points of growth. The question is, is that order of magnitude of uncertainty something that one really loses sleep over?

MR. METCALF: I think that's really not focusing on the right issue. What we want to look at if carbon prices are much, much higher than expected is to look at the localized impact on the industries that are energy intensive, and then we want to look at the likely reaction in terms of pressures to loosen those constraints to bring prices down and that I think will be a much larger political force to cope with.

MR. MALLABY: Let's talk about the politics a bit and switch to Rob Stavins. One advantage of cap and trade it seems to me from reading your paper is that you can sort of bribe the companies and the industries that are going to lose under some kind of carbon constraint. So the insight is that it's not just individuals who need to be compensated as in Gib Metcalf's paper, it's also companies that need to be compensated. Do you want to elaborate on that?

MR. METCALF: To begin with, the fact that bribe is not a pejorative term in economics.

MR. MALLABY: Correct.

MR. METCALF: Does anyone think that it was a mistake that the way we got the SO2 allowance trading program in 1990 is that we "bribed" Senator Glenn? We have bonus allowances, extra allowances went to the State of Ohio because it was going to be hideously costly for Ohio because of its high-sulphur coal to reducing emissions that were going to be affecting Upstate New York and Maine. The point is that that was a distributional impact, it had absolutely no effect whatsoever on the environmental integrity of the program, and it had absolutely no effect on the cost-effectiveness of the program. That's the beauty of a cap-and-trade system actually, that no matter how the permits are allocated, we nevertheless get to the same equilibrium allocation afterwards, we get cost-effectiveness, and we get environmental integrity.

MR. MALLABY: It seems to me that the tax advocates have a point that although you can engineer the ability to smooth your mitigation over the business cycle with your carbon-borrowing mechanism, in the real world this is a difficult design program and it may or may not work. However, is there a counterpoint to that, which is that smoothing over the business cycle may work more simply with a tax, but smoothing of mitigation geographically across the regions might work better with a cap-and-trade system because you can graft other countries onto your cap-and-trade system more easily than you can with a tax?

MR. METCALF: There are two different points there. First of all, let me say that with regard to your ultimate point, I think that one of the merits at this

point in history in the real world where we exist of a cap-and-trade system is that clearly that is the way the other nations of the world are going. So the European Union has a system which in my judgment and Gib's judgment, all economists' judgment, might work better with a cap and trade system because you can graft other countries onto your cap and trade system more easily than you can with a tax.

MR. STAVINS: Well, there are two different points there. First of all, let me say that with regard to your ultimate point I think that one of the merits at this point in history, in the real world where we exist, of a cap and trade system is that clearly that's the way the other nations of the world are going.

So the European Union has a system which, in my judgment and Gib's judgment, all economists' judgment, is highly flawed, but that's the system that they have. Canada is going to use such a system. Japan has a system that's voluntary which will soon not be voluntary. So other countries of the world are going with the cap and trade system. Hence, there is a natural currency for exchange and for bringing countries together and for lowering costs. So I agree with that.

In regards to the issue of does banking and borrowing and, for that matter, cost containment mechanisms do everything possible that brings you to perfect equivalence with what a tax would do in terms of cost uncertainty, no, I'm not going to claim that. A tax is, in theory, superior in that dimension. A tax controls the price, and a permit system controls the quantity.

The question, to me, is that given all the other tremendous advantages, clear advantages, of the cap and trade approach, can we design a cap and trade mechanism to minimize that cost uncertainty to the degree that the other advantages of the cap and trade system outweigh the small cost that will still be involved. It seems to me that that could be done through banking, not necessarily needing borrowing but certainly through banking, and with a cost containment measure and one which still maintains environmental integrity.

Remember, the reason that the environmental community has been so opposed to that phrase, a safety valve, is that it looks like a tax. You don't limit emissions.

But, if instead, the government does what I suggest in the discussion paper, that is whenever the price of permits hits the trigger amount which I would set a very high level, not a low level like in the National Commission on Energy Policy but a very high level. When that is hit -- we are only worrying about huge price spikes -- the government sells permits. It takes 100 percent of that revenue, 100 percent, and it uses that to buy offsets in areas that are not covered such as non-carbon dioxide but greenhouse gases, that are not covered by the system to reduce emissions, and so you maintain the cap.

You can, therefore, maintain environmental integrity and address that price volatility which I would otherwise agree is a legitimate concern with a cap and trade system.

MR. MALLABY: So the judgment here is whether the political system is

going to take a sophisticated recommendation which says not only we should have a safety valve but it shouldn't be too low a price. Now, the political system might not go with your advice.

Secondly, you should take the revenue from this safety valve and introduce it for other types of carbon mitigation. Again, the political machine may or may not take your advice, but there is some risk involved in a complex proposal. Is that a fact?

MR. METCALF: No. There's a risk in any of these proposals. The alternative is to remain in one's office in one's economics department or the Kennedy School of Government, do research and teach and not make proposals at all. So there is risk in any of the proposals.

The reality is that going forward, actually, the politics is moving in the right direction with cap and trade. Compared to where we were five years ago, compared to where we were three years ago, compared to where we were two months ago, auctions are vastly more likely now than they were then. That's where things are going in the Congress. That's exactly where ReGGIe is in the Northeast. California AB 32 is 100 percent auction. In terms of safety valves, that's also where things are going.

I would hope that, in fact, and I think the political forces because of the power of environmental advocacy groups, if there is a safety valve, the only way we will get one is if, indeed, it's the type that maintains environmental integrity. So the politics actually works for that.

MR. MALLABY: But you're not willing to concede that granted if we stipulate that you're venturing out of your office at the Kennedy School and engaging in the real world, you have a choice between advocating a complex proposal to the political system or a simple one which they may be less likely to mess up. You don't think that the tax is simpler?

We know how to collect taxes. We've collected them for years. You don't worry about borrowing carbon and the safety valve. Isn't it simpler?

MR. METCALF: Well, Jason has referred to this as a cheap shot, but if you look at the number of pages in the Federal Tax Code, I'm not sure that that's the key to simplicity. So it's not clear that a tax approach will ultimately be as simple as it starts out to be, but nevertheless I will grant the point: A tax approach requires less parts. That's why Gib's paper is admirably brief and mine is terribly long. It takes more pages to describe the cap and trade approach.

That doesn't mean that it's complex. It means it does have some more elements, but it's not as if we haven't done them. We did them with leaded gasoline in the 1980s; it succeeded. We did it with SO2; it succeeded. We did it under the Montreal Protocol; it succeeded. It can be done.

MR. MALLABY: Do you want to come back on that?

MR. METCALF: Well, I think the simplicity issue is all bets are off once we get to policymaking in Washington, but I think clearly, at one level, taxes are simpler, though I'm not going to be naïve enough to suggest that there's never lobbying around tax issues.

I think the harmonization point is really an important one. There is a sense that because the European Union went with cap and trade, that therefore we have to go with cap and trade, and I think just two comments.

The first is initially many people in Europe did not want to go with cap and trade. They would have preferred to go with a carbon tax, but the rules of the E.U. that require unanimity on tax rules really forced them down the cap and trade path, something that doesn't affect us in this country.

The other point to make is that we don't know. Well, maybe Canada and Japan are going to go with cap and trade, but we don't know what other large countries are going to do, and there's no reason we can't have harmonization where we have tax system in some countries, cap and trade in other regions. What we want is harmonization around the price, roughly speaking. That will address the leakage issue.

MR. MALLABY: I want to put one other issue on the table for the authors before I get to the discussants which is this: It seems there's a political forecast, likelier than not, that the big emerging markets will stick to their current position of saying you must be crazy if you think I'm devoting a lot of resources to doing anything about carbon emissions.

They are just going to argue: Look, the stock of carbon up there is not us, and we didn't do that. So you, the rich countries, who put all the stuff up there, you should be paying for mitigation.

So when it comes to bringing Brazil, India and China into some sort of

system, you have to do it in a way which doesn't require them to incur costs, quite likely. If you don't bring them in at all, then you get the effect of pushing carbon-intensive industries into those countries and, as Larry Summers pointed out, this could not really fail to reduce carbon emissions. It could actually increase those carbon emissions if the other countries use more carbon-intensive technologies.

Now, it seems to me that it's precisely, though, that the tax is simple and clear, and you can see where the money flows out. The money comes in from taxpayers. You give it out to poorer households so you can blunt some of these regressive effects. It's beautifully transparent but, in a way on this international dimension, maybe apathy is good because foreign aid. If you say to the American public, first of all, we are going to tax you for carbon emissions.

Secondly, we'll tax you but extra, so we can give foreign aid to the Chinese, so that they do something about carbon in their country. That seems like a pretty difficult political sale. Whereas in a disaggregated cap and trade system, which the Europeans already are doing some of through the clean development mechanism, the subsidization of China takes place by a European company paying a Chinese company to reduce emissions.

Maybe I should go to you first.

MR. METCALF: Well, I think we are going to have, in the discussion around allocation of permits in a worldwide cap and trade system, I think we're going to have similar discussions about foreign aid that we had in the run-up to Kyoto. I don't think we really eliminate that issue.

If anything, I think having a system of carbon taxes around the world where China has a carbon tax and keeps the money in their own country is, in some sense, cleaner than trying to figure out, well, how many free permits are we going to give to China and how much more of a burden are we going to take on. I think in some way that might actually make it simpler.

MR. MALLABY: Robert, do you want to add?

MR. STAVINS: Well, I think you're right to turn the discussion before we move to the discussants to the global challenge of China, India and other key developing countries. I think something on which Gib and I would probably agree is that the first step that's required for that is the United States to reestablish its international credibility by taking action at home, whether that's with a carbon tax approach or that's a cap and trade system.

The mechanism that I have proposed to establish a level playing field for U.S. industry in terms of imports of key bulk products from countries that don't have commensurate climate policies domestically, namely they have to hold allowances, is a way not only of establishing that level playing field but of placing pressure on those countries to eventually join an international agreement because that's what we should be aiming towards. In the meantime, I agree with you.

People talk about these international transfers, but the international transfers under a cap and trade system are source-source or firm-firm. They're very small in each individual one. Although Gib is correct that you could have harmonized carbon taxes in different countries where all the revenue stays at home, you can't

believe, you can't expect that China and India are going to place carbon taxes on themselves at the same level as we would. So either you're assuming that they're going to have a lower tax rate, i.e., you're not going to get global cost-effectiveness as you would with the cap and trade, or you have to have international transfers of revenues from government to government.

So, in general, I do see superiority in this domain as was suggested by your question for a cap and trade approach where the trading is not government-government, God knows. It's firm-firm.

MR. MALLABY: Okay, well, let's go to the discussants.

Katie, you work on all these issues from a different perspective, the state level. The states have led in some respects in terms of climate policy. Perhaps you could say a few words about what you think of the discussion.

MS. MCGINTY: Yes. Well, thank you very much. Just to kind of add to the discussion, I'm going to do a little bit of both-and, and that is tying some of the macro policies that we're talking here to some of the realities of the wholesale and retail electricity markets and where does that lead us in terms of actually seeing cleaner power generating those electrons in the United States.

A couple of key considerations says to me, one, getting the price on carbon is essential. It is necessary. I'm not sure it's sufficient.

Why? The three things I'll describe have this effect: They give great advantage to the incumbent fleet of power plants which means if it's just about price, the price of that carbon will have to be enormous not only to take account

of the climatic impact but to take account of these incumbent advantages to the current fleet.

So the three things, very quickly, I'll just share with you in the wholesale and retail electricity markets, lots of alphabet soup. LMP is the first, locational marginal price.

What is it? It is a wholesale pricing construct pursuant to which every electron is priced at the cost of the most expensive electron. You walk into your closet. You have 10 suits. Nine of them you bought at Sears. One is an Armani. In electricity markets, every one of the suits has the Armani price.

What does that mean? Why is that a challenge here? It means that there is a huge price premium earned by the current fleet. Even if you jack up the price of carbon-based generation through a tax or other policies, that does not come out of the pocket of the generator because the most expensive electron sets the price.

Does it matter? Here are the numbers. When we're in a period of peak demand, which is some 30 to 40 percent of the time, usually electricity is priced at $60 a megawatt hour. With LMP, it means at peak time, August 6th this year, for example, that same electronic sold for $1,000 a megawatt hour. Same electron, current fleet of power plants, implication: to displace that carbon-based power plant, the carbon price would need to not only account for the atmosphere but that price premium, 60 bucks earning 1,000 bucks a megawatt hour.

Second alphabet soup, RPM, reliability pricing mechanism, what is that? It's a new add-on on every rate payer's bill put in place a year and a half ago.

Why? Because there's a legitimate concern about reliability in the system, folks. We're not building new power plants. We've got a fleet that's 50, 60 years old, and the reserve margins are on those fleets are ever declining. The idea was put an additional charge on everyone's bill so the market would say there is money in power generation and have an incentive to build new plants.

Why is that a challenge in this context? It's a challenge because the details matter, and the detail that was either forgotten or, more accurately, was opposed was that while the new price is now imposed, there was no requirement that the check received actually go to building something new to address the reliability problem.

What are the numbers? The numbers are, in Pennsylvania alone last year, that new charge on every rate payer's bill was $1.5 billion, and this year it's $2.5 billion, and in two years, $4 billion of additional cost except for it is just a windfall. It is a check that goes to that current fleet of power plants. So, again, that carbon price is going to have to be sufficient not only to make Mother Nature whole but to take account of these enormous incumbent advantages.

The last of my alphabet soup is LTKs, long-term contracts. That's about 10 to 20-year power purchase agreements against which new power generation can be financed and built, that new commercial-scale solar power array or wind farm.

Problem and challenge is that even in non-deregulated states, PUCs, public utility commissions, look askance at long-term contracts because they remember PERPA -- they think it's bad -- and the rest of the system is lined up against the

LTKs also. The current owners of power plants don't necessarily want to see something newer or cleaner built that they have to compete against, and the wholesalers-retailers don't either because for them if you've got a long-term contract, contracts and customers are locked in and their ability to compete and pull those customers away is diminished.

What's the challenge or what does it matter here? It matters because even if you can get the price right on carbon-based power generation, we still have to get the newer, cleaner stuff built. If you can't have long-term contracts, which today are very difficult to have in retail and wholesale power markets, it's very difficult to get the cleaner generation built.

Last point, what are the numbers? Well, if the new plant isn't defeated completely because you don't have a credit-worthy counterparty signed up to buy the power, one plant that we're working, the markets charge a 50 percent equity price premium in order to see that plant built.

So the three things to me add up to a huge incumbent advantage for the current fleet, and it leads me to say getting the price right is essential, but on top of that, because we'd need such an enormous price to overcome all of these incumbent advantages, we need policy also, policy that either absolutely reduces carbon and/or absolutely requires that cleaner generation to be built.

MR. MALLABY: You mean regulatory policies, not just prices?

MS. MCGINTY: That's what I mean, yes.

MR. MALLABY: Okay. Well, that's a nice segue actually because I was

going to ask Jason, aside from what your reaction was to the earlier discussion, you commissioned two papers here. One was about tax; one was about cap and trade; and there wasn't a third one about regulation which is what Katie is telling us we need some of. Why not?

MR. FURMAN: We had a great debate and discussion between Rob and Gib, and I'm still trying to decide who I think is the winner of it, but the important thing is that these two positions in many ways are very close to each other.

If we had this debate 15 or 20 years ago, on the one side, you'd have people who wanted market mechanisms where the main role of the government was to get the price right and then let the genius of the private sector figure out who best could reduce emissions. Maybe somebody could switch to carpooling. Somebody else would still want to drive to work. Somebody would still want to take their plane to this event. That would be on the one hand.

On the other hand, you'd have people who would want to specify. We want to do this much more nuclear or this much more in renewable or this regulation on the efficiency of your dishwasher or what have you. These would be the two schools of thought.

I think it is a reflection of a big advance in the debate and a big advance in the economics of the debate, that we're now at a position where pretty much everyone that wants to do something about this problem wants to do it through a market mechanism. We have quite a number of cap and trade bills in Congress. We have a few carbon tax bills. It's not clear that they're all intended as sincerely

as the cap and trade bills are, but we have both types up in Congress.

I think the next important question and debate is not going to be should we have a market mechanism or should we have command and control but once we have a market mechanism, should we also have command and control in addition to it or is the market mechanism, by itself, sufficient?

I think this second part of the debate has, to some degree, been underappreciated. The way you think about a lot of the different questions in this area is different if you have a market mechanism in place than if you don't have a market mechanism in place.

So, for example, we need to balance the economy against the environment in deciding if we go down the cap and trade route. I'll just use a cap and trade example. We need to balance the economy against the environment in deciding how many permits to issue. Once we've chosen how many permits to issue, after that, there's a single thing we can do to make emissions any lower or the climate any better through regulatory action. The only way to judge regulatory actions is then does it lower the cost of hitting your target or does it raise the cost of hitting your target.

For example, if we issued eight billion permits for eight billion tons of carbon, we will get eight billion tons of carbon in the atmosphere. You can then subsidize hybrid cars. You can subsidize cellulosic ethanol. You can subsidize 20 different things, and you will still have eight billion tons of carbon going up into the atmosphere.

So, all of those policies, the question you want to ask yourself is not are they good for the environment, not do they reduce emissions, but do they make it easier and cheaper for us to get that eight billion tons that we have agreed to up in the atmosphere or do they make it more expensive and complicated and get in the way of the clean market mechanism?

I think when you answer that question, if you're asking do we know better than a power company how to produce electricity in a carbon-efficient manner, I think the answer is we probably don't. We need to get the price right, and Katie needs to get the regulation right, and I will delegate that responsibility to her because I know I certainly don't know how to do that.

If you have the regulation right and the price right, the utilities will do it. For example, most people think the best way to make electricity in a more carbon-efficient manner is renewables. Renewables certainly have a role. It turns out that one of the most carbon-efficient ways is actually to shift from coal to natural gas in the short term and, in the long run, shift from coal to coal with carbon capture and storage.

A regulator is not going to be able to figure out is it better to do renewables or better to do natural gas. Only the utilities will do that. So I think that's an example of where if we try to substitute the government's knowledge for industry's knowledge, we'll just make it more expensive.

For consumers, I think it is more plausible that consumers are not as far-sighted as they should be. In fact, that was one of the points of CIMA's paper in a

different context. So, for example, green labeling and informing consumers, I think, could reduce the cost. Sometimes you have misaligned incentives between people who build buildings and people who inhabit them. I think the government regulation could play a role.

Then, finally, our second panel on basic research will clearly be underprovided by the private sector, and so the government has an important role to play there as well.

MR. MALLABY: You're basically advocating a sort of shortlist approach to climate change. Price it through cap and trade or carbon tax and, secondly, long-range research and, thirdly, minimal signaling for consumers but don't go down a route of having a long list of other regulations as well.

MR. FURMAN: I think the price mechanism gets you 90 percent of the way there. I'm making that number up. It gets you most of the way there. I think the other things, done well -- and there is small to medium-size list of the other things -- can then lower the cost of you achieving that target but, done badly, they will actually raise the cost of you meeting it.

MR. MALLABY: Do you want to come back on that?

MS. MCGINTY: Well, just to be clear, the kind of policies that I guess I was talking about aren't necessarily the laundry list of smaller-scale regulations.

Cap and trade, I think, is exactly and the combination of the two approaches really is what I was talking about because if the objection here is to see penetration into the generation of electricity of stuff that's less carbon-intensive, if

you're just looking at a carbon tax, the price would have to be so enormous in order to overcome all of those inherent advantages that I talked about, that I think it's not supportable. Therefore, in addition to that market mechanism, Rob's market mechanism I think is an essential component if again the name of the game is to see a changed mix in electricity generation towards something that is less carbon-intensive.

MR. STAVINS: Let me first comment on Katie's focus on electricity generation. It is an area that's much more complex than certainly other sectors of the economy. Although I'm going to comment, the main thing I'd say is that I urge you, if anyone is interested, look at my discussion paper because I actually went on at length about the way the cap and trade, but the same would apply to the carbon tax in terms of the mechanisms, how they play out in a restructured as opposed to a regulated jurisdiction.

Having said that, I think that Jason asked the right question about having command and control regulations, and that is that a market-based instrument -- I'd favor cap and trade -- but a market-based instrument ought to be the centerpiece. One will get a huge amount of the potential emissions reductions in the short term. but this is a long-term problem, and I don't think that's necessary true for the long term, and let me explain that.

What we want to do is to supplement this market-based approach where areas where we think individuals and firms don't response to price signals. Where will they not respond adequately? Well, it's almost tautological, where

there are other market failures present, and Jason has named some those:

Where there are principal agent problems such as with landlords and renters on energy efficiency;

Possible myopia among consumers figuring out and thinking about the long-run energy costs of energy-consuming durable goods, something that Gib and I have both done research on in the past;

And, vastly, the most important one for the long term, because this is a long-term environmental problem and we need to focus on the long term, the technological change because of the public good's nature of research and development, namely that a firm cannot capture all the benefits, so there are incentives to underinvest by individual firms.

I'm not saying, therefore, the government should get involved in financing the diffusion of carbon-intensive technologies. That, the price signals will handle very well.

But backing up from that, in terms of innovation, i.e., commercialization from the laboratory to the showroom floor and indeed invention, basic R&D, now that is all described so well, so beautifully and so much more competently than I can do it by both Richard Newell's paper and John Deutch's paper that I won't say more on that. I'll leave it them.

But what about the bad news? Are there kinds of regulation that in fact would, as Jason said, drive up costs? I think there, that is what we have to be very careful of because if we're carrying out regulations within the context of an

existing cap and trade program, for example, and it is not for an additional market failure, then they'll do one of two things. If it's not binding, it will simply reshuffle emissions. It will have some distributional effects in terms of emissions locations and costs. But if it is binding, it's going to drive up costs because we'll no longer be doing the cost-effective thing, and that's what needs to be avoided.

MR. MALLABY: Let's take the example where you have a cap on you're talking about carbon emissions as Jason was suggesting, and at the same time somebody wants to have something which is designed to drive down gasoline usage through emission standards, fuel standards or whatever it is. Now, this drives up the cost of hitting your target for carbon emission because you've foreordained, before the market gets to the question, where you bring down emissions. That's your point.

But couldn't it be the case -- and I think your paper actually listed this in the beginning -- that part of what is going to politically drive this debate is the search for not energy independence, which is a pipedream, but some lesser dependence on external powers? The desire to bring that political constituency with you, that you're not only dealing with climate, you're also dealing with oil dependency, you might need to distort your climate policy slightly to get the political constituency that you need.

MR. FURMAN: Both of the discussion papers that we have focus on the climate problem, and that's one externality. You put a ton of carbon in the atmosphere, and that costs the whole planet something that is not reflected in the

cost of the person putting that ton up in the atmosphere.

Oil has a whole set of other externalities associated with it in terms of our national security, potentially in terms of the volatility of our economy although our economy is much, much less subject to oil volatility than it was 30 years ago. With the price approaching $100 a barrel, I think it's actually surprising how little that's affected the economy. Then, finally, a set of externalities associated with driving like congestions and accidents.

Some people think if you address these two problems, the carbon problem and the oil problem, they're the same. They're actually somewhat different. Coal, for example, 4 percent of our fossil fuel budget goes to coal, but 25 percent of our carbon emissions come from coal. If you look at the types of plans we're talking about today, 50 percent of the emissions reductions we'd get from those plans are from coal.

A carbon tax is disproportionately a coal tax, not a gasoline one. So if you want to worry about gasoline, you need to have a set of other measures in place. You either need another price mechanism there -- Greg Mancuous proposed a gasoline tax and Marty Feldstein has actually proposed a tradable permit plan for consumers for gasoline -- or else you need to say we're going to do the carbon price. That's going to get us partway to where we should be on oil, but we need to do more steps and consider some steps that may not be the first best but might be a decent approximate.

MR. MALLABY: So then your short list of recommendations starts to get

a little bit longer when you confront the political need to bring both constituencies along.

MR. FURMAN: It would get a little bit longer, but it would only have things that reduced oil.

MR. MALLABY: I want to put a question to Gib before we go to the audience, and it gets back to what Jason was talking about. It's the parable of the carbon-intensive table. If you imagine that there are two tables, one of them is made out of some carbon-intensive material and the other one is not. At the moment, people buy the carbon-intensive table is a little bit cheaper.

Now, we have a carbon tax which is designed to change that, so people will switch to the less carbon-intensive table. But because China is not part of the regime, instead of shifting to the other kind of table, we just shift to Chinese tables which are carbon-intensive. They have a carbon tax, so they don't have to worry about that.

One response to this is you tax the Chinese table or you have a tariff. I believe that's in your paper. You allude to that. Of course, that might make sense from a climate perspective, but it will wind up in the World Trade Organization dispute-solving mechanism and it will put a lot of strain on the international trading system if it has to digest this argument.

Another option, to go back to Jason's point, is that you say, okay, we're just going to regulate tables. We'll say, don't buy this carbon-intensive table. You don't need to. The other table is just as good. It costs fractionally more. We'll

do it through regulation, not because we like regulation but because if we do nothing the table will come from China. If we address that through a tax on the Chinese table, it will end up in the World Trade Organization. Those are nasty options, so we'll end up with a third least bad option which is regulating tables.

What do you think of that?

MR. METCALF: I think that's hard to see how we're going to do a regulation in a way that's going to be cost-effective and get us where we want to go. I do address the issue of importing carbon in products in my paper. I think both Rob's and my proposal are similar in that we are trying to get at some of those imports.

Whether we can have a carbon tax on selected products that are particularly carbon-intensive, whether it be steel and aluminum or automobiles, I'm not a World Trade lawyer, a WTO lawyer, but it strikes me if we have a carbon tax in place in this country, then you're on slightly stronger footing for thinking about taxing embedded carbon on a few particular products.

I guess the concern in thinking about how we do this with cap and trade is are we using domestic permits for imported goods, so we're then sending some of the permits out of the country? This then has an impact on domestic production. I'm not quite sure how that would work out either.

I think either for a cap and trade system or a carbon tax, there are ways to address the border issue that are better than going to a regulatory approach as you're describing.

MS. MCGINTY: Just one thought strikes me in some of this discussion. I think there's a degree of rigidity, if you will, between what's being talked about here as a market mechanism or a regulatory approach that maybe has softened over the years. I'm not so sure that that stark contrast is as much there.

Take, for example, a renewable portfolio standard. It's very much command and control. It's very much of a mandate. Thou shalt use X percent of Y types of electricity, renewable electricity. On the other hand, it's completely implemented through a market mechanism. It's implemented through renewable energy credits that are fully and freely traded.

So what I, again, think that means is there might be more of a degree of harmonization of policy here that enables us to see beyond the previous stark contrast between a purely regulatory approach and a purely market-based approach and blend the strengths of both, and I think there's been something of a natural evolution in that direction towards much of policy.

MR. MALLABY: Questions? Do you have a question over there?

Okay, the microphone is behind you. Please identify yourself.

MR STONE: Hi. I'm Chad Stone from the Center on Budget and Policy Priorities.

I have a question for Gib Metcalf about his proposal for offsetting the regressivity of price impacts that would occur under either a carbon tax or cap and trade, and my question will be: How much attention have you paid to the specific difficulties that you would have actually delivering the rebates to the low income

population?

I raise this because our own research -- and I think a copy of our paper is available here today -- shows that no single mechanism can reach everybody and that a suite of proposals is probably necessary. For a tax-based approach, there are a large number of non-filers. These are particularly low income people, and they would not be covered by Social Security alone or by COLAs.

So my question is: How much have you looked at how any specific proposal would cover the low income populations and whether you would see merit in looking at a suite of approaches in order to cover it more fully?

MR. METCALF: Well, I started my research by reading your very excellent paper the other night when Jason sent it to me, and I thought you all did a very nice job of illustrating some of the issues.

It is difficult to get at. Under a cap and trade system or a carbon tax, it is difficult to get at some of the low income groups. We know that the tax system works to some extent with the earned income tax credit though that's imperfect. We can think about indexing benefits for programs beyond Social Security.

I think you're correct that if we want to try to get to all impacted groups at the lowest end of the income distribution, it will require more outreach. There's not one simple, single tool that's going to help us do that.

MR. STAVINS: If I could just add a small thing to that answer, I think this is an important example. I mean Larry Summers had said our papers are very focused on the consumer side, and that's true. If you look at how this debate has

evolved, historically, producers were the ones who paid a lot of attention to these questions, and they wanted to make sure that climate change policies were designed in a way that didn't hurt them, in fact, ideally gave them a windfall of tens of billions of dollars.

I don't think any climate change policy will become law before people who are focused on consumers and before consumers themselves really focus on it. So I think it's in the interest of anyone who wants to get a climate policy done to figure out how to address these questions.

I think Gib's paper has a number of ideas, and the Center on Budget paper has a number of important ideas. The relative weight of producers and consumers in this debate is going to shift as more groups that historically never looked at climate like the Center on Budget and Policy Priorities and the Tax Policy Center realize this is a major budget and distributional issue and start to turn their attention to it and look at it through that lens.

MR. MALLABY: This is an important point, isn't it, for one's political prediction about which is going to work better, a cap and trade system or a tax, because at the moment, as Rob was saying, cap and trade is way ahead in the race in terms of what people talk about, what goes around Congress. But if people focus in on it more and they perceive the cap and trade mechanism as being partly a way to distribute free vouchers to industry, as consumers wake up to that, they may prefer the tax system with a rebate that Gib is talking about. So the political dynamic could flip when consciousness goes up.

MR. FURMAN: It is absolutely the case that today a cap and trade system is more politically feasible than a carbon tax system. I think you're right that the political dynamic would suggest that a cap and trade at least will become more difficult as time goes on. I don't know whether or not the political feasibility would flip or not, but it would move in that direction.

MR. STAVINS: We have a gentleman in the back. There, that's right. Please say who you are.

MR BURNHAM: My name is Jeff Burnham. I'm in the Department of Government at Georgetown University, but I also worked for many years in the Senate and the State Department. So I'd like to interject a little politics here.

I was kind of sympathetic to the carbon tax because I think it works in some sense internationally to have a price on carbon because you get the finance ministers involved. I think Secretary Paulson, for example, is having a dialogue with the Chinese which I think is very important. In think, internationally, if you don't get the foreign ministers or the finance ministers and even the presidents involved, it's not going to happen.

So I'm wondering if, in an international agreement, setting some sort of price on carbon might be a good idea. The countries could perhaps come together on that concept.

Domestically, I don't see the House Ways and Means Committee or the Senate Finance Committee tackling this issue. I mean if it's a carbon tax, it's going to go to two committees who, as far as I can see, have no particular

expertise or interest in resolving this.

I'll leave aside the first question if no one wants to address it, but the question would be: In terms of committee jurisdiction, isn't a carbon tax kind of a non-starter to start out with because it goes to the Finance Committee and the Ways and Means Committee instead of the committees which really seem to be interested in this which are the Environment and Energy Committees?

MR. MALLABY: Who feels they have some Congressional insight? Go ahead.

MR. METCALF: Well, we do have one proposal for a carbon tax from a member of the Committee on Ways and Mean, Congressman John Larson, H.R. 3416.

In fact, I would kind of flip this around. If we want to avoid spending money from auctioned permits on energy pork barrel, then you're better off putting the jurisdiction into the Ways and Means and the Senate Finance Committee because they're going to want to use the revenue, not to spend it on stuff that's not in their committee jurisdiction but to spend on stuff that is in their jurisdiction which means lowering taxes. So I think there actually is better hope for a distributional reform that we like, going that route.

MR. MALLABY: We've had several people with hands up. I think the earliest was right there. Yes, you.

MR AMMEN: Hi. I'm Marcus Ammen from the Swedish Environmental Research Institute. So I guess I'm one of the guys who flew to this event,

spending about half the footprint. I've spent the last five or six years, working with the design of the European trading scheme, and I had one observation and then one question.

My observation is that I'm very sympathetic to, I think what you said, Sebastian, that before you consider a proposal, the lesson we've learned in Europe now is that one of the major criterion that we should have used is what is the risk of politicians stuffing it up. Even how good the idea could be, they have a tendency to change it along the way and that is sort of an important consideration of the design.

The second observation from the European context is that the distinction between a quantity instrument like a cap and trade and a price instrument tend to be less obvious after a few years of having it in place. In Europe, we see, for example, that a year and a half ago when the prices of the allowance were around 30 euros -- that's about $40 or $45 a ton -- there were a lot of serious calls of scrapping the whole system or at least revising the cap significantly to make it less stringent whereas now we have prices that are very close to zero. So the whole debate changed from being very focused on how to reduce the price on suddenly to ensuring the environmental integrity of the scheme.

What we see in Europe is that what we thought was a quantity instrument really, through the revision mechanisms that we put in place, has become a price instrument in disguise, if you wish. That's sort of a general observation from the European context.

Then I turn my question to Mr. Stavins regarding the border issues. They are very central, I think, in the European debate considering that Europe is proposing to at least reduce emissions by 20 percent by 2020, possibly going as far as 30 percent. That's already, obviously, created a lot of worry in some of the stakeholder groups about how to handle competitiveness issues.

One of the proposals that's been prevalent over the last few years, not least regarding the relationship between Europe and the U.S., is the introduction of border tax adjustments. I'd be really interested in hearing your views, whether you think that BTAs could be in line with the WTO standards. That is if there's a problem introducing the tax adjustments that we would like to see in order to ensure competitiveness under the WTO. Thanks.

MR. MALLABY: Go ahead.

MR. STAVINS: Well, first of all, let me comment briefly on your observation, and then I'll respond to your question.

My comment on your observation about the European trading scheme, I think it's a combination of the political forces. I think those political forces are irrelevant for the U.S. context -- I'll explain why -- but it's also a consequence of faulty design coming out of the European Commission.

Many of us had argued to the European Commission, Josh Delbecque and many others, for years, that it should be an upstream program. That's what Gib and I have been talking about all morning as an upstream program. They went with a downstream program. That's one of the major reasons for what's

happened in Europe. There are also other reasons with regards to poor data and uncertainty.

The other factor that's very different is the power of the individual states which is what you were describing, the member-states. But the power of the member-states and how that plays out in terms of decision-making through the European Parliament and the E.U. in general through the Commission, that's more equivalent to the Articles of Confederation which my son is studying now in high school. It's not equivalent to the U.S. system today. This is not at all relevant in my opinion for the situation here. We're much more centralized.

On the question you did raise which is the border issue, on the border tax, whether or not it is WTO-compliant, I will comment on that only in the sense that what I recommend in my paper is a quantity mechanism, which is essentially equivalent to a border tax. That is a requirement to hold domestic allowances.

I discussed that both with economists who have great expertise in international trade and my colleague, Jeff Frankel who is an international trade economist, as well as some people over at Harvard Law School who work on these issues. They think that it is that mechanism. They think that is WTO-compliant.

That's not to say that there would not be complaints from other countries. Just as the United States only, was it 12 months ago, was up in arms when France had the nerve to suggest a mechanism to be used against us because we're not ratifiers of Kyoto. Now we are having the gall to, of course, suggest such a thing

that we would use but not against the European Union, namely against other countries instead.

The fundamental point is that any kind of linkage is up to the individual parties, and they don't have to get together to decide it. The linkage is written into domestic programs. The United States indicates whether or not it will accept allowances from other countries.

The point which I wish to make with that is that there might be issues and problems with E.U. linkage with the United States. For example, the E.U. is unalterably opposed to any notion of a safety valve. The U.S. might have a safety valve.

What's important to recognize is that if the E.U. links with CDM and the United States links with CDM, both of which would be highly likely, then there's an indirect linkage between the two. You get the cost-effectiveness gains of the E.U.-U.S. linkage in terms of equilibrating prices in the two systems, but you get the propagation, undesired propagation, of those design elements such as the safety valve. So all through the CDM, it can work.

MR. MALLABY: We have run out of time. There were still some hands up which is as it should be in a rich discussion like this, but the next panel will be just as rich. So stay where you are, and we will hand over. Thank you.

(Applause)

…In Progress MR. ALTMAN: Finally, to my immediate left, Richard Newell is Associate Professor of Energy and Environmental Economics at Duke University,

a Fellow at Resources for the Future. He formerly served as Senior Economics on the President's Council of Economic Advisors, and he is the author of a forthcoming Hamilton Project paper on Inducing Innovation for Climate Change.

Before turning this over to John Podesta and John Deutch to start it, I just want to make two simple introductory comments. In my own view, climate change is on its way to becoming the greatest threat to our country and to the world, greater than terrorism, greater than the so-called clash of civilizations. Second, the only true long-term solution, in my view, lies in technology.

We see governors tripping over themselves to adopt renewable standards for their states. In almost case, however, those pledges are not accompanied by either the resources to invest in those renewables nor the enforcement mechanisms to make those standards a reality. We have heard a lot from presidential candidates on reductions in emissions levels including very severe ones.

But one of the things I hope this panel will talk about is how we might actually do that from the point of view of innovation and technology, especially when the Energy Information Administration and all the other respected private sector forecasters estimate that in 25 years the total supply of renewables produced in this country will aggregate about 10 percent of our energy supply. The other 90 percent -- this is 25 years from now -- will be supplied by oil, natural gas and coal.

I have not seen a really serious private sector forecast, and many of them

adjust for price signals along the lines of the earlier panel, which calls for or envisions a materially different outlook with the composition of U.S. energy supply than that one. I hope we'll discuss that here.

And so, that forbidding outlook is why technology is the only ultimate solution to improve efficiency, to improve conservation and, of course, to develop alternatives to fossil fuels, but the amounts we'll need to invest in technology are exponentially greater, in my own view, than those which generally have been discussed.

That leads me to John Deutch and John Podesta who produced a terrific paper under the aegis of the Center for American Progress, discussing the federal role in energy innovation.

MR. DEUTCH: Thank you very much, Roger. I hope I can be heard by everyone here.

There's widespread agreement that the long term, in the long term, meeting the two great energy challenges we face, climate change and making a transition from a petroleum-based economy, will require significant acceleration in our pace of technical innovation.

First, let me start with a comment about economics. Now, it may either be a matter of relief or concern to you that I'm not an economist. I'm a technical person, but I do want to say that none of the innovation will take place unless there are stable regulatory and economic policies in place to guide both private and government investments in energy technology, for example, a carbon

emission charge. So you must start with getting the policy and the economics right, and I leave that to the Hamilton Project to establish for us technologists.

The second point that I want to make is that successful technology, innovation in energy, requires more than long-term basic research. There's a classic economic argument about appropriatability of innovation of new ideas. Usually, economists like to say, well, the government's role is only to sponsor long-term research and maybe some development but leave everything else aside to the market.

I want to argue to you here today that while, of course, there is a very important role for the government on the front end, the problem of energy innovation is much more complicated than that. It requires more than new ideas. It requires, in fact, more than new technology. The innovation process requires it gets carried into the system, into the economic system, into the market by a complicated process of adaption.

Well, let's take, for example, Secretary McGinty's statements about the challenges to electricity generation in Pennsylvania and elsewhere in this country. It would be of great benefit to Katie if we were able to provide her with a smart grid, an efficient and intelligent way to produce, to take the electricity which is generated and distributed in an economically efficient fashion. In fact, it might be of even greater benefit to India and China to do so.

But this doesn't come from a single idea of a long-term research nature. It comes from a complicated problem of system integration of many technologies

which address, simultaneously, technical advance, cost and environmental regulation. That really is the subject of what John Podesta and Peter Ogden and I seek to address in our paper.

Now, energy technology change will involve many different technologies from photovoltaics to nuclear power, and it involves many different performers: the private sector, private corporations, the federal government and venture capitalists. Here, we focus only on the federal role.

The third point I wish to make to you is that the record of the U.S. Government and, in particular, the Department of Energy at helping encourage technical change -- innovation, I should say -- both the process of new ideas and applying new ideas, is not great. You're looking at a person who had a role in managing some years ago those technology programs, and let me give you some reasons why the record isn't as good as it should be and what we need for the future.

The first is much of that technology development is linear, passing through a series of stages in orderly steps, and it's technology-driven rather than market-driven.

Secondly, we have a tendency to think of energy innovation as being the exclusive province of the Department of Energy. While surely, they are the main performers, the main sponsors in the federal government, if you're going to have an integrated approach to energy issues, the technology efforts of the Department of Energy have to be coordinated -- harmonized, if you like -- with the

Environmental Protection Agency, the Department of Agriculture, the National Science Foundation, the Department of Commerce and others.

Let me say that we have no program planning or budgeting systems for those energy technology investments by the federal government. We do actually have the in climate change, interestingly enough. If you study the pattern of how different agencies have supported technology R&D into climate change, you will see some of the weaknesses of the actual federal program, for example, in how much attention is being paid to CO2 sequestration. But absent a way of laying out a five-year program for research and development across all the developing agencies, including tax expenditures, the technology efforts will be limited.

DOE has a traditional reliance on direct funding. It has not made use of indirect mechanisms because it hasn't had the authority. There's a mixed record by the Department of Energy of integrating the efforts of the federal government with the private sector because there's an annual budget cycle and our beloved Congress, they're seen frequently as interruptions and interference in selection of special interest projects for sponsorship. There's especially a weak record of the ability to demonstrate technologies which will allow the private sector to make investment decisions and the actual deployment of those technologies into the marketplace. The demonstration aspect is, in fact, the most complicated and difficult challenge for federal sponsorship of energy innovation.

So we propose five measures to make a change in the way we do energy innovation in this country. We don't talk about general measures such as patents

which are important or R&D tax credits which are general and also important. We talk about five specific energy measures.

They are: The creation of an Energy Innovation Council with responsibility and authority to guide energy technology investments over a multiyear period, so they can be monitored of all the government agencies, and there are plenty of them, with resources to apply to energy problems.

We believe there should be a significant increase in the energy research and development budget, the budget which does have, as its objective, the creation of new ideas and new technologies.

We believe that there has to be a sustained effort on basic technologies of a wide variety of types that we report on in our paper.

We call for the creation of an Energy Technology Corporation to manage the process of demonstrating technology.

We believe that human capital is extremely important in this matter across the whole economy. Many recent studies have pointed to the absence of a disciplined and trained technical workforce, either in the private sector or the public sector, working on energy technology efforts. We believe one specific positive step that can be taken is to take a model small career service for technology, energy technology within the civil service to strengthen the ability of our government agencies to carry out these important tasks.

I want to say one word about the Energy Technology Corporation. I want to avoid being derided by economists who will say that this is like the Synthetic

Fuels Corporation of the late seventies and early eighties.

The first point I want to make is that the purpose of the Energy Technology Corporation is entirely different. The Synthetic Fuels Corporation had a mandate to produce a certain amount of oil under the expectation that the price of oil was going to 100 bucks a barrel, possibly correct today, but then not correct in 1980 when the act was passed. It was production-oriented.

The Energy Technology Corporation is designed to demonstrate to the private sector the technical performance, the economic costs and the compliance with environmental regulations of new large-scale energy technologies. Let me give you some examples: CO2 capture and sequestration, a smart grid, large-scale cellulose biomass production, first mover once through nuclear power plants.

The Department of Energy is unlikely to be able to do that today because of the absence of their authorities, because of the absence of the correct technical expertise within the department, and the idea of having it outside with the year-to-year appropriation cycle of Congress gives you some hope, absent the control of federal regulation for acquisitions and R&D contracts of demonstrating to the private sector, important technologies, their commercial cost, their technical performance and their environmental effects.

After all, what is our purpose here? Our purpose here is not to provide broad subsidies. Our purpose here is to undertake actions by the federal government that will speed the willingness and speed the rate at which the private

sector makes infrastructure investments on energy, and they are badly needed throughout the energy sector.

So what I ask you to think about is, first of all, the need to increase the pace of energy technology innovation; secondly, that this is more than a long-term R&D effort, but it also requires demonstration, not general subsidies but demonstration of technical performance, cost and environmental effects; third, we have to find a way to make the private sector become the carriers of that technology innovation into deployment.

Thank you very much. My friend, John Podesta, has some additional words.

(Applause)

MR. PODESTA: Thank you, John, and I want to begin with a couple of thanks yous. I want to thank Michael Granoff, who was a trustee of the Hamilton Project, for giving us good input on this paper.

The paper has been accepted for publication in issues in *Science* and *Technology* of the National Academy of Sciences. So I thank them for accepting the paper for publication. I expect we'll get a lot more feedback once that happens.

And I want to thank Roger for raising the stakes at the beginning of his comments.

If you'll permit me just a minute to do a poor imitation of Al Gore here at the front end, I think you can kind of get lost in, to some extent, the design

mechanisms of the tax system or cap and trade and forget about what's really at stake here, geopolitically. It's not just a huge environmental problem and a huge economic problem going forward for the global economy, but it's perhaps the most profound national security problem that the country faces. I think we gotta begin to get our heads around that.

I think if you imagine. There was some talk this morning about the role of China, the increase in CO2 production because of the Chinese economy, but I think if you think more globally, the people who contribute the least to this problem are going to get clobbered the hardest, and that's going to happen very soon -- people living in weak and failing states, if you think about East Asia and Nigeria, the people in the Middle East, the people in South Asia. The effects of climate change are going to be very real and very destabilizing.

So when Larry said that this is kind of like the healthcare crisis in 1992, I want you to think about this a little bit more like this is the Black Plague crisis in the Middle Ages. We better get our heads around doing something about it and doing it rapidly.

I raise that because I think what we're proposing here is targeted at innovation in the energy sector and particularly the federal government's role. It's function is much broader and fundamental which is to drive the transformation of the United States' economy from one that's dependent on oil for transportation and particularly for high emission coal-fired electricity to one that's low carbon or carbon-free and the enormity of that challenge. Legislation on

Capitol Hill now talks about trying to reduce carbon emissions by 80 percent by 2050.

The enormity of that, to try to keep the climate from rising two degrees Centigrade above pre-industrial levels is again sort of hard to actually even imagine and get your head around, and so these mechanisms of pricing carbon and more R&D are in service of something that I think is bigger.

I would say at the outset, there's no technological silver bullet. There's no one-off program that's going to develop the hydrogen car or do this and that. We're looking at a suite and a portfolio of change and innovation from renewables to low carbon and carbon capture and sequestration in the coal-fired electricity sector to alternative fuels to power our vehicles to obviously more efficiency in that arena.

Energy innovation demands, I think, a market-driven approach. I think that's really what's at the heart of this paper and this argument. It requires the government to work closely with the private sector and environmental regulators to develop and demonstrate technologies that can be profitable while giving existing and anticipated market conditions and environmental standards, that you anticipate those and try to get in the pattern of creating a virtuous cycle of innovation that meets up with the regulatory conditions that the economy is likely to face.

In that context, we reject, I think, something that's actually popular on Capitol Hill which is that DARPA is the right model to just be incorporated into

the Department of Energy, the so-called DARPA E-model that's quite popular on Capitol Hill. I think the reason for that, as we look at DARPA, is -- and John who served as the Deputy Secretary of Defense and many other positions in the Defense Department, I think, gets this even more directly -- the DARPA model is technology-driven, not demand-driven. The focus is on performance, not on cost. In the DARPA model, industry is an R&D contractor paid on a cost-plus basis, not really the implementer through financial incentives for commercial feasibility.

I think again some of the metaphors that people have come up with, although we work them and sometimes I even use them, like the Manhattan Project or the Apollo Project, really are aimed at technological performance. Creating an atomic bomb is not the same as distributing new technology and energy innovation across the U.S. economy and across the global economy. It did produce Tang. You know the Apollo Project did produce Tang, but I think that was really not the purpose of the Apollo Project. Really, it was a technology-driven process.

We've got to have a much stronger linkage between the private sector innovation and the rush of capital into the private sector with the federal R&D sector. We, of course, propose that to do that, we need to get the White House engaged. We propose the creation of an Energy Innovation Council.

One of the things that I think we discovered as we were working on this paper is that, with the exception of the Department of Energy, when you looked across the government for where energy R&D was taking place, you couldn't find

it. Our co-author, Peter Ogden, was sent off to go try to get those numbers, and they're really just not available. I think he talked to virtually every agency involved, talked to all the experts involved. It's very hard to measure. Again, if you can't measure, you can't manage.

So the creation of a joint program that looks at the big, hairy problems, that combines the programs that work across agencies, we think, is an important innovation and needs direction and leadership from the Executive Office of the President. I think again we argue in the paper for how that might link up with a better and stronger linkage with the private sector and private sector innovation.

Let me just say one last word which is a very daunting problem for the federal government today is creating a civil service that could actually manage these kinds of problems. The giant sucking sound into the private sector of our best talent is loud, but we do propose the creation of a different career path, a new career path for the civil service, in order to manage these, particularly the demonstration phase of these energy projects.

There are some experiments with that. I was involved with the creation of a so-called Cyber Corps to deal with cyber security issues. It's a very challenging problem right now for the federal government to get top talent on these technological issues because of the pay differential, the reward system.

But I think that young people, as I go around the country -- and I'll close with this -- are very engaged in trying to solve this problem, and I think they will see the federal government as a place, once again I think, to work in the national

interest and the global interest to solve that. So we have some hopes that we can attract the talent that will be necessary to manage these kinds of projects, both at the entry level and at the mid-career level.

Thank you.

(Applause)

MR. ALTMAN: Thank you, John.

Professor Newell is going to talk to us for a few minutes about methods of inducing increases in innovation, and then we'll have our discussion.

MR. NEWELL: We're waiting for this to boot up a little bit. While we're doing that, let me just say my presentation is going to reinforce several points that have been made throughout the morning. Thus is the fate of he who goes last. But I think there are some important contrasts particularly with the previous presentation. There is a lot of overlap but some contrasts which we can pursue in the discussion period.

All right, there we go.

It's a basic fact that stabilizing atmosphere concentrations of greenhouse gases would eventually imply driving net greenhouse gas emissions to zero. It's also the case that the vast majority or over 80 percent of U.S. and global greenhouse gas emissions come from energy production and use because we rely on fossil fuels for over 80 percent of our energy. Therefore, achieving climate stabilization goals is going to require large-scale, widespread changes in the U.S. and global energy -- (interruption) and substantial innovation in exiting suite of

options we have to bring down the cost of the technological transition. I think these points are very widely accepted but views differ, and they sometimes differ strongly about the best policy for bringing about this technological change. I therefore want to make three basic points motivated from an economic perspective on this issue:

The first is that a greenhouse gas emissions price is absolutely key to solving this technology problem.

The second point is that well-targeted science and technology policy can nonetheless make important contributions to lowering the cost of greenhouse gas mitigation.

However, my third point is the poorly designed technology policy will tend to raise not lower the cost of climate stabilization.

Let me go through each of these points. To my first point, the emissions price is key for technologies. Given the two excellent prior presentations, I don't need to belabor the advantages of the emission pricing for climate policy, but let me establish that establishing a greenhouse gas emission price through either a cap-and-trade system or a greenhouse gas tax is essential from a technology perspective for two primary reasons: a) because it guides the adoption of the most cost-effective technology for reducing emissions by sending a consistent financial signal to the private sector; and b) because it creates a demand-driven, profit-based incentive to the private sector to invest in developing new, lower-cost, low-carbon innovations.

Now, to my second point, which is the even though emission pricing is an essential part of solving this technology problem, indeed I think the single most

important part that does not mean that it's the only part, and the only important part. Science and technology policy to expand our options and reduce the future cost of mitigation is a valuable and important role to play so long as it focuses on creating new knowledge, knowledge of the public good just like a stable climate.

And it is well known that the private sector cannot therefore capture the full value of investing in innovation. That value tends to spill over to other technology producers and users thereby diminishing incentive for private R&D; therefore, well-targeted policy that boosts the level of innovation for climate mitigation technology has a potential to lower the overall cost of attaining climate goals.

I therefore suggest a four-part mitigation innovation strategy that reinforces incentives for private R&D, expands federal resources for research, improves research management, and experiments with the new research policy instruments.

The first part of the strategy recommends encouraging increased private sector R&D by making the research and expiration tax credit permanent. This would bolster private incentives for innovation that would be induced by the emission price as well as improving innovation incentives more generally. Industry performs about 70 percent and funds about 60 percent of total U.S. R&D and is absolutely central to the U.S. innovation system.

While obviously critical, over three-fourths of industrial R&D is focused on development as opposed to basic and applied research. In contrast, over 80 percent of nondefense federal funding for R&D is focused on basic and applied

research, and universities, other nonprofits, and federal labs perform over 80 percent of basic research.

This brings me to the second part of the climate innovation strategy which is to gradually double federal spending for climate mitigation R&D to about $7 billion per year over the next decade. The cost of this increase would be more than offset by a small fraction of the revenues for emission pricing, which, as we saw earlier, could be on the order of tens of billions of dollars per year.

So this is shown in the following figure which illustrates three decades of federal energy R&D spending in real 2006 dollars. The last large increase in spending that we saw was during the energy crisis of the 1970s. We have not, however, seen a substantial increase in energy R&D in response to the very large challenge imposed by global climate change. Current federal spending for energy R&D is about $3.5 billion per year, depending upon how you count, and increasing it gradually to $7 billion per year would cost an extra $20 billion over the next 10 years. That's shown by this area under this increasing trajectory here.

To put this into some perspective, health R&D doubled over the years 1995 to 2005 and now stands at roughly $30 billion annually. That's federal spending for health R&D. Energy R&D looks small and relatively flat in comparison due to the roughly 10-fold difference in these different funding scales. In other words, this is doable.

The third part of the research strategy emphasizes that it's not simply a matter of increasing resources but also spending those resources wisely and efficiently. Therefore, there needs to be an improved strategy and coordination of climate mitigation technology research both within the program offices and the

Department of Energy across DOE and across DOE and the other relevant federal agencies. The current oversight structure for this research is the climate change technology program, a counterpart to the U.S. climate change science program which focuses on the natural science of global warming and climate change processes.

While the climate change technology program has an existing administrative structure and a strategic plan, it is safe to say that it could benefit from significant invigoration and increased authority to prioritize and coordinate federal R&D in this area, particularly if resources were expanded significantly.

The fourth and final part of this climate technology innovation strategy is to supplement the traditional use of research contracts and grants with inducing prizes that provide financial rewards for achieving significant advances in climate mitigation innovation. Prizes of this type can help focus research efforts and clearly defined objectives, instill a sensa of urgency in the problem, and potentially engage a set of nontraditional research actors.

That's it for the innovation strategy whose purpose was basically to outline a well-targeted climate technology policy that could help lower the overall cost of mitigation.

Now, to my third and final major point which is that poorly designed climate technology policy will raise rather than lower the societal costs of climate mitigation. To avoid this, the government should support and emphasize areas that are least likely to be undertaken by the private sector. As we discussed, this would tend to emphasize strategic basic research that advances science in areas critical to

climate mitigation as well as applied research to bring those advances closer to commercialization.

In addition to generating useful results, such funding also serves the critical function of training the next generation of scientists and engineers, who will then go on to work in both industry and in research institutions.

In conclusion, climate technology policy must compliment rather than trying to substitute fair emission pricing. On the research side, R&D without market demand for the results is like pushing on rope; it would ultimately have little impact. On the deployment side, technology's specific mandates and subsidies may have some emission reduction benefits. They will tend to generate those reduction benefits in a relatively inexpensive -- I mean expensive, inefficient way relative to an economy-wide emission approach.

The bottom line is that the climate challenge is simply too large to be addressing in a manner that is unnecessarily wasteful of resources.

Thank you.

(Applause)

MR ALTMAN: I'm going to try to distribute my questions evenly, and let me start with John. I could ask this question of either John, but I'm going to ask it of John Podesta.

It's possible to react pessimistically to your paper. You point out very effectively -- and, John, you said this in your remarks there -- that the approach we took to the Manhattan Project and the Apollo Project just does not apply to climate change; that in those cases government was the only user of the output; there

was no private market, cost was no object; and that that framework just does not apply, as I said to the challenge of alternative energy.

So my question is very simple: Is it really possible over the short term to move into a position where we actually have as you call, quote, "a different type of civil service and energy technology corporations run by the private sector? Are those things attainable over the short term?

MR. PODESTA: Well, let me start on the sort of a metaphor, and we argue again in the paper that they don't -- they don't work very well as a R&D model because what you have is -- what we need in this sector is a much more distributed system, much more a sort of portfolio of technologies that are going to be useful, has to be much more linked to his type of schedule .

Therefore, where they do apply through to the presidential leadership, that gave a name to both the Manhattan Project, obviously -- maybe not so much there as to the president level, but the focus at the government level -- and the Apollo Project, which, of course, you know, President Kennedy led and really, I think, focused the attention of the American people.

I think that's what it's going to take in order to get the doubling of R&D that we talked about in our paper and (inaudible) in his paper. That's what it's going to take to really gear, I think, as a high priority item the conversion of our economy to a low-carbon base as a key driver of economic growth and as an economic program in the White House. It's going to take a president who decides that is his or her priority. And I think that with that, then you can make change happen very rapidly.

And, as I said, I think you could go down, the track of creating that virtual cycle of innovation spurring, much as we saw, by the way, in the information technology sector, which is that for some baseline technology that needs to be pursued in the system, but then you get a creativity working, and you've got, I think to the extent you could kind of distribute the ability to kind of plug in and play in the system, you'll find innovation happening very, very rapidly.

The harder challenge is how you take that across the border of how you deal with China, how you deal with India and these other places.

MR ALTMAN: Right to John, your turn.

Let me come back to the very gloomy forecast that I talked about in my own introductory comments. One reason that the outlook for emissions control, effective emissions control, over the -- it's called the "medium term" -- is core through those forecasts, is that the technology, that the key technologies is the sole improvement. So I want to ask you about coal, and the reason I want to ask you about coal is that the best work on the outlook for coal and how to use it in an energy-efficient way I think was done quite recently by MIT. I think you coauthored that report.

And my question is pretty simple: There's enormous talk about carbon capture and sequestration. You can't read anything serious about climate change without referring to it, but at the same time that report, at least as I read it, essentially says that that technology is completely unproven, that it's not anywhere remotely near commercialization; it's really off in the wild blue yonder. And so A) Is that a fair assessment? And B) If it is, what can the federal law be, if any, in accelerating the development of that, which everyone seems to feel given our 250-

year supply of coal on the one hand and it being the biggest single pollutant on the other, at least on a unit of usage basis, to accelerate that?

MR. DEUTCH: Well, first of all, let me say that the federal government here has the key role on the sequestration part of this, and the more difficult part of the clean coal usage. We should have in this country and elsewhere in the globe several projects at scale -- and the scale is considerable -- which says:

Here's how you responsibly identify a site; here's how you operate it with the 30,000 tons per day of Co2 injection that comes from a single 500 megawatt power plant; here's how you also monitor, verify, and model the Co2 underground to know that it's not leaking and escaping; here is the regulatory framework that you will use and a national basis to demonstrate that technology.

If the private sector does not see that that is demonstrated with public information -- this is not, you know, a proprietary deal -- for the management of that Co2 storage, there is no private corporation, no bank, nobody who is going to build the coal power plant with the uncertainty of these accidentals . So the government has an absolute duty here to run such a demonstration project.

MR ALTMAN: Why haven't we done it?

MR. DEUTCH: Well, we haven't done it, in part, because there hasn't been an acceptance of the danger of climate change, in part because our Congress has set up seven regional sequestration carbon mitigation regional compacts. They've taken the budget, divided it by seven, divided it by five years, and nobody said, hear, here is what it takes to run such a project, design it and actually do it. And it is a perfect example of what is a full governmental responsibility.

So I regard it as being, when you say Co2 sequestration, you said -- somebody says to you, "You're a technical person, is it feasible?"

You say, "Yes." And the next thing you know, they're having policy deliberations with the Kennedy School in Washington saying it's ready to go. But there's a big gap there, and it's critical for the coal industry in the United States and, I might say, even more vitally in China to get this demonstrated.

One other point: We do have a model in 1980 of the Energy Security Act. The Energy Security Act did set up a synthetic fuel much derived --Synthetic Fuels Corporation did have those very high energy R&D programs in it, and it was financed by windfall profits tax. So the way you -- to say that these things can't go through Congress is not (inaudible). Historically, you know how it's done but if you have a stream of revenue to set against it, either options revenue in a capital trade system or a tax, it is possible to put together to Congress. Congress is ready for an initiative of this type.

MR ALTMAN: David, you're next. As I said, I did read your book. I won't repeat, I've read it is, and that's for sale outside, and where it is in The Washington Post by Sandalow . But --

MR. SANDALOW: Say that a third time, please.

MR ALTMAN: -- you conclude that book with a speech, a speech on energy policy which you'd like a new president to give. And this comes back to John Podesta's point about presidential leadership. And the way you lay that speech out I must say it would be an impressive one.

And, by the way, John Podesta and John Deutch point out in their paper that we have never had a coherent and effective energy policy in this country

since OPEC One, as it's called, or the Energy Crisis of 1973. So my question is: There happened to be a supplement in The Wall Street Journal yesterday on the environment -- a number you I'm sure saw it -- imbedded in that was a poll that The Wall Street Journal and I think NBC took and asked people whether they would be willing to support higher taxes of any kind to deal with the environmental challenge, and 70 percent of them responded, said no. That's yesterday.

So, since you write out the speech, the question is -- and if John Podesta would like to comment, I'd like to hear that, too -- what makes you think, or how would a new president turn around public opinion on that issue?

We had a big discussion, you know, an hour ago about carbon taxes versus cap-and-trade, and so it's a (inaudible), certainly, question.

MR. SANDALOW: Well, thanks, Roger. And one thing I do in that speech, incited more debate among the people who read the manuscript and anything else in the entire book, and that is, after giving this flowery speech, I had the president standing in the halls of Congress invite up to the podium the opposition leader and say, "Look, this is a bipartisan agenda, we're going to work this together."

And the opposition leader says, "Yes, I don't agree with you on everything but I agree we have to work together, and I promise, Mr./Madam President, that we're going to do that." And the president then concludes the speech.

And half my readers thought that was the most ridiculous thing they'd ever seen, and it clearly made everything else that I'd said seem, you know, not thoughtful. And others thought that's exactly the type of transformational thinking that we need in order to get past this, you know, this type of problem.

So, I mean I think, you know, one key point in answer to your question, Roger, is that this is the fundamentally bipartisan agenda in, you know, in a lot of ways. I mean I, about a year ago, I had lunch with Newt Gingrich, and I'd actually never been in the same room with him before. He's a brilliant guy, and he fielded questions from about 30 people. And I asked him, because I was working on this book, I asked him, "What shall be do about the problem of oil dependence?"

And within weeks I had dinner with Howard Dean, also a brilliant guy, also fielded questions, and I asked him the same question. And he gave me basically the same answer Newt Gingrich did. And those two guys are not identical twins. I mean both of them said, "Huge national security problem. That's an also big part of the answer. We need a Manhattan Project, have research offers , a fuel efficiency of our fleet must improve."

So I think the interesting poll we did on this, did you ask Americans, "Are you in favor of an increase in the gasoline tax?" Eighty-five percent say no.

If you ask them, "Are you in favor of a gasoline tax in order to help solve the global warming problem," on one poll 58 percent of the public said yes.

And if you ask them, "Are you in favor of an increase in gasoline tax in order to help solve the oil dependence problem," about 56 percent said yes.

So I think the way you do this is with some presidential leadership tying it to the suite of national security and environment and economic problems, and then to a specific set of pollutions that you would institute.

MR ALTMAN: Do you have a comment?

MR. DEUTCH: Just two comments: One is that when David starts to tell a story, I was thinking he was going to end it by saying that's why Borders put his book in the fiction section.

(Laughter)

But I do, fundamentally, agree with what he said. But I think the proof sort of is in the pudding. If you look around the country -- what's happening in California, what's happening in the Northeast, what's happening in Pennsylvania -- Katie McGinty was here, Governor Rendell way out in front on this question -- you see that there's political mileage, not a political burden to pay.

Governor Schwarzenegger essentially turned his whole governorship around by embracing the question of taking up the environmental challenge dealing with signing AD-32, embracing the tailpipe emission standard, putting forward a new technology of bases, arguing that that was going to be good for California as it has been over the last 25 years, that it was going to be the driver of growth in California and, you know, I think its popularity went sky high.

And I think that, you know, the people running for national office, you know, they have slightly different calculations. They don't just have to campaign in San Jose, they've got to campaign in Detroit and West Virginia and other places. But they all look at that and say there's good politics in this. It's critical to the future of this country, and I've got a program that is going to produce jobs, can produce economic growth. And I think on that basis you can sell it.

MR ALTMAN: Kelly. A big question throughout this entire debate that ties together the role of the developing world on the one hand and innovation on the other is a question of technology transfer. And it's been widely suggested that

one way to try to have a truly developed and developing world approach to climate change is through a very aggressive program of technology transfer from the West led by the United States to China, India, and nations like it which play such a huge role in the outlook for climate change.

And my question is very simple: How would that actually work in the real world?

MS. GALLAGHER: Well, let me try and answer that question and also make a couple of comments on some of the papers.

I think we need to step back for a second and think about what energy innovation is. It's not just research, development, and demonstrations; it's also deployment. And thinking about how that system interacts is really important. And I think that we have a tendency to divorce these two things, you know, focus mainly on R&D and forget about the deployment side, and then sort of wave our hands and way, Why do we have all these technologies on the shelf that we're not getting into the marketplace? What's the problem?

So why are we having such a big lack of deployment? I think one key answer is we just have a lack of credible incentives. We don't have the pricing that allows people to calculate a return on investment; if you want to invest in an advanced technology, if you want to invest in carbon capture and storage technologies, it's just very hard to calculate that return on investment because we don't have any kind of a policy framework that gives us a clear price. And I actually think that's one potential advantage of a tax over a cap-and-trade systems in the sense that you would have a very clear and transparent price from which you would be able to calculate a return on investment.

So when you're thinking about technology deployment, I think it's important to understand that that's not an automatic process and, particularly, with respect to international technology transfer in the context of deployment, it's really not an automatic process, befogging this notion that countries as they're developing will just adopt the most efficient, the cleanest technology available has proven, you know, very much -- it's very clear that that doesn't just automatically happen. Oftentimes these technologies are more expensive; oftentimes the developing countries don't have the intellectual capital or intellectual property to do it.

So you need to design some sort of incentive mechanism, either policies that require that you use the technologies like performance standards or a carbon tax, or some kind of financial incentive, as technology that is available has proven, you know, very much -- it's very clear that that doesn't just automatically happen. Oftentimes these technologies are more expensive. Oftentimes the developing countries don't have the intellectual capital and intellectual property to do it. So you need to design some sort of incentive mechanism, either policies that require that you use the technologies, like performance standards or carbon tacks, or some kind of financial incentive mechanism, like tax incentives or loan guarantees or both.

So, I think that what I'm really trying to step back and say is we need more of a system approach, and it strikes me, you know, even with the separation of these two panels today, that we're not thinking -- still we're not thinking holistically enough in terms of the sort of overall strategic plan of how do we get the technologies developed and then into the marketplace in a very

systematic way. How do the research development demonstration and deployment pieces all fit together? And I really like the notion of this Energy Innovation Council, but as it was proposed it really was only focusing on the research demonstration component, and, similarly, the Energy Technology Corporation mainly focused on demonstrations. So, I still think we need to have a more clear sense of how the pieces will fit together and how they will all be organized in a more strategic way.

Let me stop there.

MR. ALTMAN: Let me ask Professor Newell a related question. Among the other recommendations you made was doubling over time federal R&D spending on energy-related purposes from 3-1/2 billion to about 7 billion. Two-fold question. First, do you have a view on whether -- on what I would call the quality of the current R&D budget on energy -- quality or efficiency of it? And, second of all, what about the argument -- and some might say it's a pipe dream -- that if you set the price high enough we don't need it, the private sector will do it?

MR. NEWELL: So, let me comment -- let me comment first on the second part of the question, which is that we don't need any federal R&D increase in this area, because the emission price will be sufficient to bring that about in the private sector, and I really --

MR. ALTMAN: Well, if in some wonderful future world the price was high enough --

MR. NEWELL: Was enough, yes.

MR. ALTMAN: -- which it isn't now.

MR. NEWELL: I understand, yes. So, if it was high enough -- and I tried to actually hit on this directly in my presentation, which is that the character of the R&D that is undertaken by industry versus the kind of research that is funded by the government is quite different -- industry focuses the vast majority of its research and development effort on development in bringing new ideas to market, whereas federal funding tends to go very heavily toward basic and applied R&D, and so that's -- you know, the kinds of innovative effort that will tend to be induced by an emission price are the bringing ideas to the market place -- the development type of work. And I think that that will be effectively induced by emission price, but, again, I think the role for the federal government therefore is to do the -- that would not be induced by the emission price, which is the basic strategic base of research where you provide new scientific ideas which are relevant to invading some of these climate change technologies.

Now, in terms of the current R&D budget, the one thing that doesn't show up in the levels of energy R&D spending is a change in the portfolio of different R&D things that are funded, and this has moved over time. It's been gradual, but it's been fairly thorough in terms of moving toward research that emphasizes low carbon technologies. So, if you look at the Office of Fossil, it's focused on, you know, carbon capture and storage. If you look at, you know, traditional research which was funded purely for boosting exploration and

development of oil and gas, that has been tried -- well, tried to be totally phased out but has tentative -- they reduced over time. So, there has been a greening of the DOE R&D budget, and I think that's a positive thing. Also, if you look in terms of the management practices that are used by the Department of Energy -- and the focus I think, increased focus on the basic end of the research spectrum I think are positive elements -- I would say things have improved significantly since the '70s and even the early '80s and -- but, you know, the levels need to be increased and you can always do better.

MR. ALTMAN: Okay, one last question I'm going to ask to either John Deutch or John Podesta or both, and then we'll open this up to questions from the audience.

Professor Newell pointed out that the private sector accounts for about 80 percent of what we might call energy R&D, and -- very basic question -- how do we incentivize the private sector to spend more, because you step way back, that's where the solutions are?

MR. DEUTCH: Well, I think that your point is a very good one. You know, energy is such an enormous area that it doesn't get a single answer. Let me give you an example. If you look at venture capital in the energy business -- small-scale stuff in biomass or in photable tags or the like -- there has been an absolute explosion in the levels in the amount of activity just by the expectation of where the world is going. So, on the one hand for a lot of startups, capital levels have been very large, as you know as well as I do if not better.

The second question is what about big corporations -- the big corporations which have either utility decisions to make or transportation systems to make? There it goes back to the statement that I think has been universally said by everybody today, unless they have a firm economic and policy decision -- judgment of one kind or another -- after weighing the facts -- they're not in the position to (inaudible), and the bankers won't put them in a position to make the investments.

And if I could just say one thing. We're very U.S.-centric here but recognize this climate change problem ain't gonna work, as other people have said here today, unless India, China, and Brazil and Indonesia participate in it, and there the integration that Kelly Sims Gallagher so (inaudible) called for between technology and policy is even well beyond reach, because they don't have the governmental mechanisms in China or India or ways to make those price signals work throughout the economy. So, the challenges are enormous to get the private sector what (inaudible) means to private sector in those places. With the United States you have to have the price signal and the regulator framework down before large corporations make their investments, and they're ready to do it. They want the pricing, because we have evidence from all the leading U.S. corporations. Even the ones which have traditionally been most passive say let us have some resolution that's uncertain. That's the necessary condition you give the private sector role.

MR. ALTMAN: By the way, in the vein, there's a remarkable report which is about to be formally published, but drafts have been around and available publicly, and Michael Granoff , I'm sure you've seen this, from what's called the Petroleum Council --

MR GRANOFF: Yes, National Petroleum Council.

MR. ALTMAN: Right. It's a group of chief executive officers of the largest energy companies and some of the famous hardliners --

MR. GRANOFF: Right.

MR. ALTMAN: -- like Lee Raymond, former CEO of Exxon, were leaders in this effort -- and this report is remarkably what I would call mainstream, remarkably mainstream. If we all had copies of it here today, it would -- much of it is along the same lines we're talking today, and these are the chief executives of the large oil companies in the world. They're calling for a crash effort on alternative fuels. They're calling for raising cafe standards to the max. They're calling for a whole series of steps which are very analogous to the discussion we've had today. It's a remarkable compliment.

Let's open this up to questions. Let's have some questions. Please identify yourselves. And, sir, you here in the back.

MR. SEGAL: Adam Segal, Energize America. I'd like to first compliment Kelly for -- I'm going to be sexist for a moment -- the women have really added some wonderful comments today, and I really appreciate the comments toward holistic. Might have liked to have standards added to, but two

quick questions in -- when talking about the knowledge and the knowledge corps and trying to build 200 people in the federal government, it's interesting that there's not a comment of adding office technology assessment or such into Congress, because one can argue that the technical knowledge in Congress certainly has nose dived in the past couple of decades certainly since the elimination of OTA.

And sort of related question, which might -- and OTA might help guide it -- is if $7 billion was our energy R&D 30 years ago when the challenge was just energy independence and not also global warming, why is it doubling enough, why not -- I mean why a restriction to doubling, why not 5 or 10 or some other number in terms of a driven federal effort to address both eco-oil, energy independence, and global warming challenges?

MR. ALTMAN: I know there's a big debate on the capacity of infrastructure -- we call it infrastructure -- in the United States to absorb amounts larger than that, but I'll turn the question to Professor Newell.

MR. NEWELL: Yeah, I think that that's the right answer. Given the magnitude of the cost, while small as a percentage of GDP, a kind of policy could cost on the order of, you know, a half percent up to one percent of GDP, which is, you know, something like $60-120 billion a year. If you could have research that lowered this cost even by, you know, 5 percent, the value of that is in the tens of billions of dollars, and so it's I think quite easy to justify, based on typical rates of return to R&D, the level of, you know, doubling of this R&D.

Now, the question is well, why don't you go for more? Well, I think it really is the capacity. If you look over 10-year periods historically and you look at federal R&D programs across government, the most any have increased over the last 30 years over a 10-year period is a rough doubling, and that's basically health care, and that's -- I mean, to most people who look at that, that's been quite a sizable increase in spending. So, I think the absorptive capacity of the system -- that's about it.

Now, you know, I guess the question is, you know, should you stop there? I'd say, you know, probably not, you should evaluate after 5 years and you should evaluate after 10 years and see where you are and if more is a valuable contribution, then you could do more. But I think as a starting place right now it's basically stable. So, a doubling is actually a significant increase.

MS. GALLAGHER: Could I add something to that?

MR. ALTMAN: Yeah, go ahead.

MS. GALLAGHER: I mean I think that you also need to consider that there's a presumption here that the private sector is also going to be stepping up, you know, concurrently, and if the conventional wisdom is right -- and I'm not sure that it is -- that the private sector is spending two-thirds, you know, of the total of the United States then you're going to have another 14 billion or so coming from the private sector. But I think this is exactly why we really need to be very strategic in terms of our thinking, because we need to understand what's

happening in the private sector and therefore what the complimentary role of the government is, you know, going forward.

MR. ALTMAN: Yes, sir.

MR. DIPARTEE : My name is Johit Dipartee . I am from Yang, India. Last year when the Indo-U.S. Nuclear was signed, my group was the only group in the Indian diaspora that actually opposed the deal. We felt it was scientifically and politically regressive, and since then we've been trying to explore ways to enhance collaboration between the two countries and specifically in the area of energy, and we've come across a focus on electricity using renewables as a potential area to collaborate.

I wanted to go back a little to the discussion we had on the last panel where a lot of the discussion was very tactically oriented, and going back to the holistic argument that Dr. Gallagher is pointing to. Strategically looking, it seems to me, based on what we've learned from India over the last 10 years of activism and research, a cap-and-trade system or a carbon tax system is very difficult to implement there within a generation. Given the lack of transfers even though we have the most progressive rate information act in place now, it's going to take at least a generation for us to bring the informal sector of the economy back into the formal sector to really have something implementable.

MR. ALTMAN: I know you have a question in there.

MR. DIPARTEE: Yes, I do.

MR. ALTMAN: We're running a little short on time, so could I ask --

MR. DIPARTEE: The question really is -- or it's a comment and I want to get the panel's comments on that comment -- is for us -- we've realized that for collaboration to work, for India and China to be incorporated into this global regime to address climate change, we have to address internal problems of these countries. For example, in India we're focusing on how a partnership can be built between India and the United States where entrepreneurships -- entrepreneurship is encouraged within India for the management of small-scale renewable reactors, of renewable generation reactors, and how American entrepreneurs and Indian entrepreneurs can then collaborate. So, the incentives are towards entrepreneurship rather than to getting at what tax system and what, you know, WTO negotiations we need to have.

MR. ALTMAN: Sir, with all respect, what's the question?

MR. DIPARTEE: The question is what the -- is there any research right now going on, on going beyond this dealing with the governments per se in India and the other countries and going further and dealing with some of the more internal challenges and incorporating internal challenges in (inaudible) development when it comes to thinking globally about the challenge of climate change? And that goes back to this holistic argument. Is that an element today in anyone's policy portfolio?

SPEAKER: So, I had an email from somebody in Vietnam who had seen an interview I did that was distributed on email talking about electric drive and reporting to me that in cities in Vietnam right now there's widespread use of electric motorcycles and saying that as I started talking about electric driving cars I shouldn't forget about the use of motorcycles, and it seems to me that the type of communications information technology kind of implicit in that communication is very important in terms of the dissemination of technology in the way you're talking about right now, that we -- what we need to do is create favorable policy frameworks, particularly on the intellectual property side, that allow the flow of technology in exactly the way this person is talking about.

And I should say quickly, by the way, when Secretary Rubin said at the beginning of this meeting -- he recited different ways people came here with respect to their carbon budgets -- he forgot one, which is somebody drove here in an electric plug-in hybrid car. Some of you saw it on the way in. Everybody can see it on the way out. It's a tremendous car, which I've been driving around for the past month or two. I don't own it, but I've been getting 120 miles a gallon on it. I told the owner that I was getting 120 miles a gallon, and said what, that's an outrage, I've been getting much better than that. But -- so we went around and we got about 300 miles a gallon, so there's a lot there.

MR. ALTMAN: Yes, sir.

MR. SHAUB: Walter Shaub, U.S. Chamber of Commerce. Both this morning and in this second panel, both with regard to pricing mechanisms

and technology approaches, it seems to me that these are preventative and mitigative concepts. But there is also the issue given political realities -- I don't know if you want to call it ineptitude -- and the complexities of process that inescapably go beyond a need to discuss adaptation, and I wonder what your views are on that matter.

MR. ALTMAN: Go ahead.

MR. PODESTA: Well, I think that there is a need both from a domestic perspective as well as globally to focus much more attention on the question of adaptation, and I'll give you a couple of examples. One is states ought to be planning for it today in terms of their development plans within the framework of -- and the subprovisions in the energy legislation that's pending on the Hill right now to incentivize the process of moving forward. I mean, we're not just thinking about Florida but the upper mid-western's recent story about the low levels of water in the Great Lakes, etc. People write today -- planners both on a business perspective and a governmental perspective -- on planning for that. I think that globally a lot of the development systems that we put out is not carbon sensitive. It's not climate change sensitive, if you will. More planning needs to be put into that from the World Bank and the IMF perspective in terms of the kinds of development we're doing. From a technological development perspective, I think, again, if you think about the way the world's going to be as opposed to the way the world is today, it probably leads you to some technologies that might be a little different. There is a lot of work today going on in

developing biomass-based fuels that might be useful, including in highly degraded lands and water-stressed lands that would be that kind of next generation, particular on the bio-diesel side, so I think there's a whole aspect in which -- and then one last one, which is one of the things that fell out the Lieberman-Warner Bill was using some of the money from the cap-and-trade auction to really incentivize the development program that would be both aimed at adaptation in the United States and abroad. So, I think that's a kind of rich place to work both from a R&D perspective but also, more broadly, from a governmental direction.

MR. ALTMAN: John.

MR. PODESTA: I don't know where you were going, sir, but the issue is what happens if these emission control ideas we've been talking about don't work. There is an alternative, and that, you know, goes under the rubric of geo-engineering, which doesn't have these nice soft ideas of how we will adapt, which John was talking about, but it has to do with can we titrate a global climate back to a situation where we compensate for the global warming. And then our proposals out there about how you would do that, how you would have human intervention to make this go in the opposite direction. They are ghastly, but they may be forced upon us. They may be forced upon us. And I must tell you that in a short period of time if we don't see some enormous progress here -- I'm not talking about the U.S., I'm talking about in the U.S. and in the rest of the world -- I think much more serious questions will have to be raised about this -- the issues

faced of the menu on what will happen with geo-engineering. So, it's a -- perhaps not a --

MR. PODESTA: That won't be the Hamilton project prize; that will be the (inaudible) prize.

MR. DEUTCH: Right, right.

MS. GALLAGHER: Can I add one thing? I mean, to put those two questions together, the last two questions, I think it's important to think about the scope for international cooperation on innovation, and I think, you know, one area that's a clear place where there could be a lot more international cooperation is on adaptation research. I think there's a lot of potential for R&D in terms of looking -- for example, take John Deutch's example of carbon storage and doing that together, putting some sites in China and some sites in India and some sites in the United States. Everybody would learn from that. It would be very constructive and a good way to start thinking about some of the deployment activities as well.

MR. ALTMAN: Well, we've run out of time. I want to personally thank each of our panelists. They were great.

(Applause)

MR. ALTMAN: I'm sure Jason may do this, but I also want to thank some of the folks who put this very successful event together, especially Karen Anderson, Jason Bordoff, and Mr. Furman.

(Applause)

SPEAKER: So, thank you, Roger, for moderating. Thanks all of you for attending. If I can just add to the thank-you's, on the strategy paper Jason brought up, Manasi Deshpande and Pascal Noel did really heroic work, and the next Hamilton Project event is December 12th. It's on rewarding, facilitating, and encouraging work. So, we hope you are all interested and able to attend that. And then Richard's paper will be coming out next year. Thank you.

(Applause)

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