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Panel II Shaping Energy Markets to Reduce Greenhouse Gas Emissions

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PANEL II: SHAPING ENERGY MARKETS TO REDUCE GREENHOUSE GAS EMISSIONS

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PROFESSOR FOSTER: We have a very distinguished panel this afternoon. Our panelists are Barry Rabe, Tseming Yang, Jake Werksman, and Karl Coplan.

First, Barry Rabe is a Professor of Public Policy in the Gerald R. Ford School of Public Policy[1] and a Professor of Environmental Policy in the School of Natural Resources, both at the University of Michigan-Ann Arbor. His 2004 Brookings book, *Statehouse and Greenhouse: The Emerging Politics of American Climate Change Policy,*[2] received the 2005 Lynton Keith Caldwell Award from the American Political Science Association. He holds a Ph.D. from the University of Chicago.

He is going to discuss today "Renewable Politics and Policy: The Evolution of the Renewable Portfolio Standard as a State Climate Policy Tool."

PROFESSOR RABE: Thank you.

Like some of the other speakers, I would like to begin by noting my thanks to Carol, Scott, and their colleagues. This is an incredibly important topic. It is one that the scholarly community of many disciplines has been late to arrive at. I really want to applaud them for all of their hard work and efforts to bring all of this together. Thank you for the invitation.

As was mentioned in the introduction, about two years ago I published a book that examined the issue of expanding state involvement on climate concerns. I won't replay all of that here, other than at the time, again two years ago, I argued that there was a clear and growing trend toward more active state involvement on a whole range of climate and greenhouse gas policies, that we were looking at a fairly diverse set of states — indeed, states along the coasts, but other states that one might not have necessarily expected to become involved — and that this was an area that was particularly ripe for folks working within state government, what I called "policy entrepreneurs," to begin to play with and push in the areas of innovation and actually build coalitions from the inside out, rather than the more traditional notion of external pressure groups bringing powers to bear and forcing the policymaking process.

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1. One of the leading schools of public policy in the United States, the Gerald R. Ford School of Public Policy was established at the University of Michigan in 1995. Http://fordschool.umich.edu/.

2. BARRY G. RABE, STATEHOUSE AND GREENHOUSE: THE EMERGING POLITICS OF AMERICAN CLIMATE CHANGE POLICY (2004).

We have talked about a number of tools today, but one of the tools I would like to talk about is a renewable portfolio standard, a renewable energy mandate. Two years ago, there were thirteen states that had some form of this in place. What I would like to do is sort of pick up the story two years later because, indeed, as we have seen in other areas of climate policy today, the plot has thickened and the beat goes on.

The basic design features of a renewable portfolio standard are fairly straightforward. There is some form of legislation that defines what a renewable energy source is and sets a level or a percentage of the amount of electricity that providers in a particular state must provide at a given time period. There is some degree of market trading or flexibility, what are called renewable energy credits, which allow traders of different kinds of energy sources to interact.

What we are seeing (1) is continued proliferation. Two years ago, thirteen states; if we had convened in this room at this time last year, seventeen states; now there are twenty-two states that have renewable portfolio standards (RPS) in place. If a presidential candidate were to win only states with an RPS in 2008, he or she would win handily in the Electoral College, about 287 Electoral College votes.

While this is a tool that is in use in the European Union, in Australia, and in Canada, in various provinces, states, and nations, the United States can actually lay claim quite convincingly to have the largest percentage of its population covered by a renewable energy mandate of any Western democracy because of this level of state action.

We are also seeing, in terms of trends, elevation of the bar. The early RPSs talked about one percent, two percent, 2.2 percent. And yet when we look at either new legislation enacted in the last year or revised in the last year or so, we are looking at states like Nevada, which are talking about 20 percent, mandating twenty percent of their electricity coming from renewable energy by 2015; New York, twenty five percent by 2015; Texas, which if it were to secede from the United States would be the seventh largest greenhouse gas source in the world, greater than the United Kingdom, has a renewable energy mandate to get to about eight percent by 2015; Pennsylvania, a big coal state, eighteen percent by 2020 — and on it goes.[3]

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3. *See* The Pew Center on Global Climate Change, States with Renewable Portfolio Standards, http://www.pewclimate.org/what_s_being_done/in_the_states/rps.cfm (last viewed on Oct. 3, 2006).

We are also seeing in this area some interesting linkages between a renewable energy mandate and some of the programs that were talked about this morning: energy efficiency, funding support for different kinds of renewable technology or renewable technology developments.

In addition, interestingly, I think this is a policy tool — and it is true of some other climate policy tools — that has tended to win a fairly bipartisan base of support. Of the twenty-two states that have RPSs, sixteen of them at the point of enactment were in states that were governed by Republicans, the slight majority of states with RPSs slightly tilted toward Democratic legislators. It does not mean that there is not interest group politics or partisan differences on this issue; but to the contrary, interestingly, this is a kind of a policy tool that tends to cross traditional partisan divides.

And, interestingly, the primary reason I found — and this is a report that will be released in another month or so by the Pew Center on Global Climate Change,[4] of which I would be happy to provide a copy to anyone who would be interested — the primary driver for states moving in this direction is not really greenhouse gases and not climate change; it is primarily a confluence of arguments, including economic development and the perceived job benefits and job boosters of moving from importing fossil fuels, or whatever the fuel source is, to developing so-called homegrown renewable initiatives; electricity supply reliability; concerns about possibly tying this to reduction of conventional air emissions; in some cases, very explicitly, a focus on greenhouse gas reductions. But in other states, one can see states passing renewable portfolio standards, a climate policy tool, where there is virtually no reference at all to the greenhouse gas impacts, even though they may be fairly significant.

So the cases differ quite substantially, but clearly the trendlines are there. And I would venture to say that if we were to reconvene in a year, we might be looking at twenty-five or twenty-six states and a number of early adopters going back and raising the bar even further. These are policy tools that tend not to have a lot of controversy attached to them, although that may be changing as well.

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4. The Pew Center on Global Climate Change is a non-profit advocacy organization that was established in 1998. The Pew Center argues that enough is already known about global warming to require more restrictions on the use of fossil fuels. For more information, visit The Pew Center on Global Climate Change Homepage, http://www.pewclimate.org.

Now, looking ahead, I would like to talk a little bit about some of the challenges of implementation and challenges in moving this policy tool ahead in the coming years.

One is the issue of how the market works in this area. Of course, one of the great arguments for the RPS historically has been governments that are neutral on the competition between varying kinds of renewable technologies — geothermal, hydro, solar, wind, however you might define it. The idea is the state government would set a level or a percentage — *X* amount of megawatts, *Y* percentage — and let the market forces work.

What we are beginning to see in many state capitals are the relative losers in the early battles in the marketplace — namely, solar, which is especially interesting given Professor Sachs'[5] comments about the role of solar. Solar is turning out to be the big loser in many states. So we are actually seeing states going back to amend and modify their RPSs to carve out a certain amount of guaranteed market share for solar, or to give certain kinds of benefits or advantages to solar versus other sources.

And one sees some very, very interesting definitional issues. What is a renewable source? Small hydro? Large hydro? Should energy efficiency count the same way that a new source of renewable energy source does? Could waste coal be a renewable energy source? It is in Pennsylvania. Could poultry waste, large quantities of it, be a renewable energy source? Again, it is in Pennsylvania.

We will be talking about nuclear energy later on. Can uranium and nuclear energy be argued, especially depending upon the kind of technology that would be used, to be a renewable source? To this point no, but the debate is beginning to emerge.

So I think what we are beginning to see, as this moves forward and as the level of renewable commitment increases, is a very interesting market battle between proponents of different kinds and types and technologies of solar, which is an interesting challenge in moving all of this ahead.

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5. Jeffrey D. Sachs is the Director of The Earth Institute, Quetelet Professor of Sustainable Development, and Professor of Health Policy and Management at Columbia University. He is also Director of the UN Millennium Project and Special Advisor to United Nations Secretary-General Kofi Annan on the Millennium Development Goals, the internationally agreed goals to reduce extreme poverty, disease, and hunger by the year 2015.

A second interesting challenge, I think, is what I would call the "renewable field of dreams." If you mandate it, will the supplies be provided; will the turbines go into place?

I thought it very appropriate that the cover photo for the program involves a bunch of wind turbines. But I noted with interest this morning a brief comment referring to the controversy in Massachusetts, the Cape Wind Project.[6]

There are at least four or five states that may have difficulty meeting their RPS targets, largely because of local opposition and resistance to siting of renewable energy facilities. Massachusetts is probably the primary example. Again, I won't dwell on the details, but if you're familiar with the one issue that probably unifies Senators Kennedy,[7] Alexander,[8] Voinovich,[9] and Warner,[10] it is the idea that wind turbines should not be placed in Nantucket Sound. When you combine that with opposition to biomass and other Winn proposals that are being carried forward in Massachusetts, I think it is fairly safe to say that Massachusetts — which also may or may not become part of the RGGI agreement that we talked about this morning — may be the first state to basically fail to meet its RPS targets. There is uncertainty as to how that is going to develop.

Related to this, though, is the question of transmission and transmission capacity, which was discussed at length in the 2005 Energy Bill.[11] One of the great challenges for renewable energy development is getting it from remote sources to areas where there is high electricity demand. How do you run, for example, in Texas that long electricity cord from west Texas to the more populous parts of the state? Who pays for it? And how do a wide range of advocacy groups and local groups respond to the idea of the land disruptions that will emerge accordingly?

So this is beginning to emerge as a challenge as well. I think it is one thing when we are saying one or two percent renewables; but when we are actually looking at fairly heavily populated jurisdic-

6. The Cape Wind Project is designed to build the first offshore wind energy plant in the United States. The proposed site for the controversial $900 million renewable energy project is Horseshoe Shoal in Nantucket Sound off Cape Cod in Massachusetts. For more information, visit Cape Wind Homepage, http://www.capewind.org.

7. Senator Edward M. Kennedy of Massachusetts.

8. Senator Lamar Alexander of Tennessee.

9. Senator George V. Voinovich of Ohio.

10. Senator John Warner of Virginia.

11. Energy Policy Act, 42 U.S.C. §15801 (2005).

tions, large energy consumers, talking about five, ten or fifteen percent renewables, that is a lot of towers, that is a lot of transmission capacity, and it raises some interesting siting issues.

A third interesting challenge is how states work cooperatively. I was delighted to hear Dale's comments earlier today about RGGI. Less attention has been paid, I think, to the fact that we have at least two de facto regional RPSs. If you go from, in effect, California through Texas, all of the states in that part of the Southwest have their own homegrown renewable portfolio standards. If you go from Maine down to Maryland and across to Pennsylvania, you have a de facto, not just New England, but Northeastern renewable portfolio standard. Each has a little different definition, a little different level, but basically the same policy.

We have an interesting question here of whether or not states can work cooperatively to share credits, to share technologies, to trade credits, to trade ideas, to play nice; or whether they circle the wagons and try to capture the economic development benefits by taking all kinds of legal and political steps to make sure that any new renewable energy that is brought online that could satisfy a given state's RPS is done so within the confines of that particular state.

We are beginning to see some very interesting state strategies to maximize the likelihood that any economic development benefits that would accrue to an individual state are structured into that policy and structured into that legislation, which I think could raise some very intriguing issues concerning the Commerce Clause and challenges of that sort.

A couple of final pieces I would just note.

One is the issue of how ultimately the states and the federal government weave things together. There has been a lot of discussion this morning about, at some point in time, the federal government acting. When that happens, if in fact that happens, whatever year that might happen, how ultimately does the federal government interact with this tapestry of existing state policies?

I would say, from what I am seeing at the state level, there is actually a fair amount of concern about this. States are concerned that as Congress has begun to think about a national portfolio standard, for a variety of reasons, there has been relatively little consultation with the states, there has been relatively little study about what does and does not work as states design and put into place their own programs. There is concern that Congress may respond to interest group pressure, act with a very heavy hand, and obliterate the tapestry of state innovations that are underway, and in the process of do-

ing so wipe away early credit. There is a longstanding tension in environmentalism federalism and regulatory federalism of states acting early, ultimately followed by some form of preemption. To what extent should states get credit for early action and for early emissions reduction?

And while it is often discussed, especially in discussions of market and market trading and emissions trading, and the SO_2 experiment through the Clean Air Act Amendments of 1990,[12] clearly one problem that emerged from the implementation of that emissions-trading scheme was a form of discrimination, in effect, against renewable energy. The replacement credits were set so low in that legislation for the benefit one would get from moving from a thermal source to a renewable source and the credit that one could take into those credit-trading markets, that renewable energy in some respects lost out in the competitive battle with scrubbers, which were favored in the way that formula was put together.

So it can't be underestimated the extent to which folks who were working on these issues at the state level — and I go into this in some detail in my Pew Center report — are concerned about how ultimately they are working with, are responded to, and are allowed to continue. Do you see ultimately a two-tier system where there is a federal RPS and a sequence of different state policies? Do you credit early action? From what I have been able to discern thus far, they really are separate tracks, where there has been very little consultation, very little conversation, and very little planning.

By the way, the European Union is having exactly the same issues right now. For the five jurisdictions in the European Union that have RPSs, how does that ultimately get woven into their emissions trading system for carbon?

Relatedly, most states, like most other governments that run RPSs, have not really wrestled with the issue of how you provide carbon credits for renewable energy. If New York State triples its amount of renewable energy over the next five years, how much credit in evolving the carbon markets should New York receive? What is the level of thermal displacement?

One, there are interesting methodological issues there, depending on the power source that is being replaced, whether you are actually

12. Clean Air Act, Pub. L. No. 101-549, 104 Stat. 2399 (1990) (codified at 42 U.S.C. §§ 7505-7671 (2000)).

replacing power or responding to new demand. The methodological debates are absolutely extraordinary. There has been very little serious discussion at the federal level, by academic researchers, or among states, coming up with any kind of a common denominator. This is really a large international issue as well, as we look at other jurisdictions that are exploring this.

Finally, a last point, if I might. There has only been one reference made, and it was a passing reference this morning, to Canada. Now, if this conference was being held at the University of Michigan, my home base, I can assure you that at least some of the electricity that would be coming into the campus and fueling the conference would be crossing over from Canada. I have looked a little bit at New York markets, and you get some of your electricity from Canada as well.

Think about the Canadian case. We are both outliers. The United States and Canada produce about the same amount of greenhouse gases per person. One big difference is Canada is on the side of the angels, the moral superpower in North America on climate, because they ratified the Kyoto Protocol in 2002.

However, whereas U.S. greenhouse gas emissions are up about fifteen percent from 1990 levels at present, Canada's emission levels are up about twenty five or twenty six percent from 1990 levels. One possibility for a next round of North American climate policy is literally for provinces and states to begin to work cooperatively.

Prince Edward Island, the home of Anne of Green Gables, has exactly the same renewable portfolio standard in place as do the New England states. For the province of Manitoba, which gets ninety seven percent of its energy from hydro power and is sitting on a massive amount of new hydro energy — Manitoba is the only province in Canada, by the way, that actively supports the Kyoto Protocol — the cheapest way for them to expand their renewable markets is not for them to send their renewable power east to Toronto or west to western Canada, but to send it to the Twin Cities in Minnesota.

To what extent can a province and a state work cooperatively? They already trade economically, they already trade electricity and energy, but under current law, under current policy, obviously there are all kinds of constraints on that conversation between Prince Edward Island and Maine or Manitoba and Minnesota.

I think a challenge looking ahead is drawing lessons from all of these jurisdictions — the fifty states of the United States, the ten provinces of Canada — and beginning to weave some of those pieces and some of those themes together. This is only the beginning of some of the challenges of fitting together this one little pol-

icy tool, the renewable portfolio standard, across states, across jurisdictions, much less thinking of the interlap between what we are talking about right now, the RPS, with the RGGI and all of the other possible tools that are increasingly in the arsenal of state governments.

Thank you very much.

PROFESSOR FOSTER: Our next speaker, Tseming Yang, is a Professor of Law at Vermont Law School, where he specializes in environmental law and international law, as well as civil rights. Prior to coming to Vermont, he was at the U.S. Department of Justice's Environmental Natural Resources Division. He has also served on a number of committees at the EPA. Last semester he was serving as a Fulbright Scholar in China and engaged in comparative environmental law research.

Mr. Yang will talk about "The Prospect of U.S. Carbon Markets After the Rejection of the Kyoto Protocol."

PROFESSOR YANG: Thanks, Sheila.

First, I would like to thank Scott and also Carol and the organizers of the Symposium for inviting me.

Secondly, I would like to, since I am from Vermont, stand up for the honor of Vermont and point out that even though we live close to the earth, or at least we are perceived that way, that we enjoy it that way.

My focus today here is on the prospect of the possibility of carbon markets. The issue, I think, is significant broadly because, of course, the Bush Administration has rejected the Kyoto Protocol and EPA has indicated that it does not have the legal authority to regulate carbon dioxide emissions under the Clean Air Act.

I am focusing here on how we might think about carbon markets, given the lack of federal intervention or federal regulation.

The markets here that I am talking about are markets of carbon where broadly carbon emission allowances are traded. In other words, carbon emissions are a commodity, as opposed to programs that are very specific to projects that reduce carbon emissions.

One final note here before I start. In general, I am actually not that huge a fan of markets in pollution for a number of reasons. One of them comes directly from what I do otherwise as a scholar, which is: I do a lot of environmental justice work.

Some of the issues that one could point out, which I won't talk about but that are relevant to thinking about markets, even in carbon emissions, include, just by way of example, two things.

The first is biomass burning. Biomass burning, burning of wood and other fuels from animal waste, is carbon-neutral. It doesn't contribute to increases, or it is part of the global carbon cycle, yet it has disproportionate impacts in the Third World on the poor, because they are the ones who rely on those types of biomass for daily heating or cooking. The kind of indoor air pollution that it generates creates very, very significant public health impacts.

The second is that, in general, carbon markets are equity ignorant in some ways, or equity neutral. So the question, of course, is if you have full-cost pricing, as I think was raised in the earlier session, what about the impacts on the poor and the impacts of the cost of markets on those who cannot necessarily afford to pay more.

But at the same time, pollution markets are here to stay. Given that as an alternative to inaction to an important environmental problem markets seem to be an important tool, that is what I will be talking about, the challenge to creating workable markets and how one might get around a couple of these challenges.

Arguably, the most important ingredients in such a market are embodied in what we have already heard quite a bit about this morning already, the shorthand description of cap-and-trade. In order for a cap-and-trade program to be effective and workable, first you have to have an overall emissions cap for the program participants; and then, secondly, the participants who have been assigned allowances have to be able to trade them with each other and be able to engage in some economic exchange.

The second part of this, the trade portion, has been the subject of a lot of commentary and discussion by scholars and practitioners alike, much of it based on EPA's Acid Rain Trading Program.[13] The 1990 Clean Air Act gave EPA the authority to allow businesses to engage in the trading of sulfur dioxide emissions, and that then has created a market that has made it a lot cheaper for companies to comply with their sulfur dioxide emissions limits.

Past experience by EPA, including the Acid Rain Program, has shown that emissions trading rules have to satisfy certain requirements in order to work. These rules include fungibility of the allowances, transparency of the program, consistency of rule application,

13. For more information on the EPA Acid Rain Program, visit the Environmental Protection Agency Acid Rain Program, http://www.epa.gov/airmarkets/ (last visited Sept. 30, 2006).

et cetera, et cetera. I won't get into those, but there is a well explored literature.

What has had much, much less discussion is emissions caps, that first part of the cap-and-trade. Now arguably, if you have a central regulatory agency, like EPA or the federal government, imposing a cap, it is really not an issue; it is irrelevant to consider.

When a company does not have the requisite allowances for its emissions, when it arguably then blows the cap of overall emissions, under the Acid Rain Program, EPA can take enforcement action. So there is a way to bring a company, a wayward sheep, back into the fold.

We are unlikely to see that kind of federal intervention for carbon markets. Hence, how do we think about caps when we do not have federal involvement? How can one ensure that emissions do not go above a prespecified limit under this kind of circumstance? The issue raises questions of enforcement, but the questions I think are broader than just the traditional questions that are asked about enforcement, such as legal authority and the like.

There are two general alternatives, I think, to federally created carbon markets: first, markets created primarily by private entities; and second, those created by state and local governments. Now, the former, markets created by private entities, we see in the Chicago Climate Exchange.[14] I will spend actually a little bit more time explaining how it works and some of its attributes. The second, state and local government creation of a market, has already received quite a bit of discussion earlier this morning on RGGI, the New England Regional Greenhouse Gas Initiative.[15] How can either of those create a workable and effective cap for a cap-and-trade carbon program?

Now, first, the Chicago Climate Exchange (CCX). It has really received a lot of publicity since it was created. It is commonly referred to as the brainchild of Richard Sandor,[16] who is a former

14. For more information on the Chicago Climate Exchange Program, visit Chicago Climate Exchange Program, http://www.chicagoclimatex.com/about/(last visited Sept. 30, 2006).

15. The Regional Greenhouse Gas Initiative ("RGGI") is a cooperative effort by nine Northeast and Mid-Atlantic states to discuss the design of a regional cap-and-trade program initially covering carbon dioxide emissions from power plants in the region. For more information on this institution, see http://www.rggi.org/about.htm (last visited Oct. 4, 2006).

16. Richard L. Sandor, Ph.D. is Chairman and Chief Executive Officer of the Chicago Climate Exchange, Inc.

economist with the Chicago Board of Trade. The CCX began trading in 2003, and as I said, it is a privately arranged trading system. Companies that have joined it include Ford, du Pont, BP America, and also the City of Chicago and the State of New Mexico.

The CCX also allows nonbusiness entities, in particular environmental organizations, to join and purchase emissions allowances as a way of retiring those allowances. This is basically the same type of arrangement that we see having taken place within the sulfur dioxide trading programs, where nonprofits, including some law school environmental law societies, have raised money and purchased allowances and retired them as a way of speeding up acid rain reduction.

The original members of the CCX at the time that it was created accounted for approximately 700 million tons of carbon dioxide annually. Compare that to the carbon budget of RGGI, which has a carbon budget of 121 million tons. So the CCX is a very significant actor here. It is a program that really needs to be considered, given that other comparable programs have an arguably significantly lesser potential impact.

For 2003, the initial year that the CCX capped emissions, emissions were supposed to be at one percent below a baseline, and each year thereafter the emissions caps were reduced by an additional one percent from the baseline until 2006. For 2006, the reduction level or emissions caps were at 4 percent below baseline.

Now, what is the baseline? The baseline was the average of annual emissions from 1998 to 2001. So essentially what you do is you figure out what the average of emissions was for your particular company between 1998 and 2001, and then you subtract 1 percent, 2 percent, 3 percent, etc.

Even though the CCX is technically called a carbon exchange, it really covers all greenhouse gases that are also included within the Kyoto Protocol, for example, methane, along with a list of other gases. But all of the accounting, just like in the Kyoto Protocol, is done in carbon equivalents.

There is an annual "true-up" period. "True-up" is a term that is used in a lot of pollution trading systems. Basically, when companies are audited for how much they have emitted in terms of greenhouse gases and how many allowances they hold, if you are over the number of allowances that you are holding, you have to go and purchase additional allowances. This is the idea of a market. But there are limitations to that. I will not get into those details. There is quite a bit more there.

Beyond 2006, there are no caps because technically the CCX is really a pilot trading program; that is, it is a four-year program up until 2006, so technically it will expire after that. But the terms specifically provide that members can choose to extend the operation of the market beyond 2006.

So enough of some of the details of the CCX.

The most important aspect here of the CCX for my purposes is the way it caps emissions. What happens if there is noncompliance? Under those rules, it is actually not at all clear. The CCX does have the authority to impose fines, to suspend trading privileges, and also ultimately to terminate membership — its' most Draconian sanction. Is that enough? Is that really enough to keep companies in compliance, so that when they are over their emissions, they will go and actually purchase additional credits?

Now, a first response one might have is: "This is all nonsense. The CCX is simply a 'voluntary' arrangement." But I think that really would mischaracterize what this is about. Even though the act of joining is voluntary, once you have joined, the compliance measures are not at all voluntary. You have made yourself subject to the system by contract, and therefore there is a private enforcement process that is applicable. In other words, the CCX is probably better described as a private trading arrangement.

If one takes the idea of such a private trading arrangement seriously, do the CCX compliance provisions really provide the relevant equivalent of government enforcement? This is, I think, the critical question to ask, whether a private cap-and-trade program can work: Are the sanctions mechanisms really enough to make it environmentally effective? There are at least two issues that I think one can see here: first is sanctions sufficiency; and secondly, the certainty of sanctions application.

First, with respect to sanctions sufficiency, it is not really clear — and I have not really been able to find much information, because the CCX is a private organization; it does not come so readily forward with information, therefore it is not so clear what the range of the fines are. There are questions as to whether the punishment can actually be sufficient to deter and to induce compliance.

At some level, it might not really be an issue, because the price at which carbon has been trading on the CCX for the last year has been around $1.00 to $2.00 per ton. Since CCX members have joined voluntarily and since most of these companies are more environmentally conscious, you could expect them to be fairly close to their targets. As a result, the kind of money they would have to pay in order

to true-up, in order to comply with those emissions targets, would generally seem to be low. Of course, part of the reason why these companies are joining is for the reputational value. They want to be known as environmentally conscious and want to be able to use that as a marketing tool. Hence, the publication of, or being known for, failing to comply would damage that kind of reputation.

But even if one assumes that the fines and any reputational harm are insufficient to induce compliance, I don't really quite see why suspension of trading privileges or expulsion from the CCX should be a deterrent. Given a situation when purchasing carbon credits might be too expensive, why is the additional threat of a trading suspension, or being terminated from membership, a further deterrent. The question of the adequacy of sanctions here seems unresolved.

Assuming that sanctions are adequate, will the CCX in fact impose significant fines and strongly punitive sanctions? Say, for instance, if you decide $1,000 per excess ton of carbons, would such sanctions actually be imposed? You might say in the abstract, "Why not? It doesn't cost the CCX anything to do so. It is a deterrent on the member."

But consider that the CCX is run like a stock exchange, which means that it is the members whom actually police each other. So, if you create a rule whereby you are going to fine members huge amounts – and the people who are in charge of determining what that huge amount will be are also potentially being subject to those fines – you can figure out what the incentives or conflicts of interest are.

Alternatively, the imposition of such very harsh punitive sanctions could also trigger two other consequences: firstly you would expect that the company comes into compliance; but the company doesn't necessarily have to — or there are two other consequences. You could cause the company to resign after you impose the fine or you could essentially sort of scare away all of your current members. Alternatively, if you are really serious about that, you will deter future companies from joining. That is, of course, again not in the self-interest of the exchange. So the question here is whether you can really truly expect full and consistent application of such sanctions.

Could such enforcement problems be circumvented? One might think about a system where individual members could bring private enforcement actions against noncompliance, similar to securities class action lawsuits, maybe under breach of contract theory, such as a third—party beneficiary. But again, I think one has to ask whether that is a realistic possibility, given the costs and expense of litigation

and the theory of damages. What have you actually lost? Is it the reduced value of carbon allowances due to the defendant's failure to purchase sufficient allowances for compliance?

The second model that arises is state and local regulation. The most significant, as I mentioned, has been RGGI, with the purpose of focusing primarily on the electric power industry.

RGGI has tried to circumvent the problem of capping by involving state authorities. But it has really only done this incompletely, because, as was pointed out this morning, RGGI only anticipates binding emissions caps within each particular state. Among this regional organization, there is no possibility of imposing a binding cap, because if you did so you would probably run foul of the Compact Clause.[17] So the entire regional arrangement is designed to be voluntary.

That raises then a question of what happens when the carbon price goes too high and you end up having impacts on each individual state's economy? Will they somehow then bust the cap or opt out of the system? Many of the same problems of enforcement of the cap arise as in the private trading scheme.

There is one other set of efforts that I have not included here but that one might think of. That is international efforts at creating carbon markets, such as the Kyoto Protocol.

Now, the problem here is, of course, that the United States has rejected the Kyoto Protocol. The Kyoto Protocol specifically, and traditional international law more generally, does not apply to private individuals. So the best relevancy of international markets would be in the context of private trading schemes, like the CCX.

I have one last thought, with respect to the involvement of states. There has been so much focus on state-created carbon markets, state trading systems, that I think there has been insufficient effort or thought given to how else one might promote markets related to carbon dioxide emissions reductions.

Short of creating an independent trading regime or short of these private regulatory efforts, one could think of strengthening the oversight, for instance, by states of private carbon exchanges, something that would make them less of a P.R. tool and establish a real commitment to cut carbon emissions. So that is one way states could

17. U.S.CONST. ART. I, § 10, CL. 3 ("No State shall, without the Consent of Congress . . . enter into any Agreement or Compact with another State, or with a foreign Power . . . .").

actually be involved in private regulatory schemes, as opposed to trying to set up completely new, separate structures here.

Alternatively, I think there are markets here with respect to the reputation that companies are trying to cultivate (that of being environmentally friendly) similar to the organic foods label.[18] Why not have state intervention for strengthening the use of such labels, or the use of companies that want to be environmentally conscious or proactive regarding their climate change actions and ensure that those companies that are making such representations in fact are doing so accurately? Strengthen those who are really being honest about this and make it easier for them to profit or to make this a business advantage.

In the end, traditional markets for environmental amenities are an important tool. However, even without the federal government taking the lead, I think there are opportunities for other arrangements to promote those goals. Those arrangements are not easy to implement because of these enforcement and cap issues, but they are basically challenges that, I believe, can be overcome.

Thank you.

PROFESSOR FOSTER: We are pleased to have Jake Werksman of the Rockefeller Foundation,[19] where he is a Senior Advisor to the Global Inclusion Program.[20] He is also an Adjunct Professor of Law at NYU. In the past, he served as Environmental Institutions and Governance Adviser[21] to the UNDP,[22] and prior to that he spent nearly a decade at the Foundation for International Environmental

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18. The U.S. Department of Agriculture has a set of national standards that food labeled "organic" must meet, whether it is grown nationally or imported. United States Department of Agriculture, Agriculture Marketing Service, http://www.ams.usda.gov/nop/Consumers/brochure.html (last visited Oct. 4, 2006).

19. For more information, *see* http://www.rockfound.org/AboutUs (last visited Oct. 4, 2006).

20. Through the Global Inclusion Program, the Rockefeller Foundation supports the broadening of benefits and reduction of the negative impacts of globalization on vulnerable communities, families and individuals around the world. See http://www.rockfound.org/Grantmaking/Globalization (last visited Oct. 4, 2006).

21. For more information, see http://www.undp.org/about/ (last visited Oct. 4, 2006).

22. The United Nations Development Programme is the UN's global development network, advocating for change and connecting countries to knowledge, experience and resources to help people build a better life. U.N. Development Programme, Ann. Rep. 2006, http://www.undp.org/publications/annualreport2006/english-report.pdf (last visited Oct. 2, 2006).

Law and Development,[23] where one of his projects involved importing the Alliance of Small Island States in the context of negotiations of the UN Framework Convention on Climate Change and the Kyoto Protocol.

He is going to talk about today "The Kyoto Protocol and the Art of Compromise: Balancing Greenhouse Gas Emissions Reductions Against Other Environmental Objectives."

Mr. Werksman.

MR. WERKSMAN: Thank you very much, Sheila, and thanks to the organizers.

I think if we take the task that the organizers have set up seriously, which is to take the problem of climate change seriously, and then add on the task of taking the role of international law seriously, we set ourselves an agenda that is no less ambitious than seeking to stabilize the concentrations of greenhouse gases in the atmosphere at levels that are safe to life on this planet. That is an extremely ambitious, broad, complex, and long-term agenda.

As such, it lends itself to capture — capture by short-term agendas. So, for example, we can see people using climate change as yet another reason to move to renewables, on the positive side; to think about energy security, perhaps on the negative side from some perspectives; to move towards nuclear energy, as we will discuss shortly; and, perhaps most insidiously — and this, I think, was reflected in Tseming's presentation — to look for ways to appear to be doing something, to appear to be responding to this challenge, but not taking it as seriously as we are asked to do. This requires a great deal of balancing, trying to respond to the serious challenge but also to balance the other short-term interests that come to support us in this task, but that can also, similarly, undermine us.

What I want to do is to focus on the design, and now the implementation outside of this country, of the Kyoto Protocol as an example of how we set high standards for ourselves but then also have to constantly recalibrate and rebalance our ambitions in light of that very large challenge that we have set.

I focus on the Kyoto Protocol, though I realize that it may be somewhat of an academic interest in this country, in part because many of the designs of the Kyoto Protocol, the mechanisms that are built into it, were in fact inspired by, pushed by, demanded by the

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23. Also known as FIELD. For more information, see http://www.field.org.uk/.

United States, based upon U.S. models such as the acid rain regime that we just had described briefly to us, and hopefully will form a source of lessons for ourselves as the United States begins to design legislation in the future.

In particular, the Kyoto Protocol and the Clean Development Mechanism,[24] which I will focus on in the next few minutes, is the only example that we have for us at the moment of policymaking that specifically engages in that challenge of ensuring that developing countries as well as industrialized countries participate in the solutions and the responses to climate change.

To briefly recall the Kyoto Protocol, who for those of us for whom it may now be a distant or irrelevant memory, it is essentially, as was described, a cap-and-trade regime. We have a cap that was agreed amongst rich industrialized countries; they agreed to a cap on their emissions of six greenhouse gases, focusing primarily on carbon dioxide but methane and four other gases are also included. They collectively agreed in 1997 to reduce their greenhouse emissions 5 percent below 1990 levels between the years 2008 and 2012. They then negotiated individual caps that range from an eight percent reduction amongst the European countries to a ten percent increase for countries like Iceland. So there is a range of obligations that they take within that cap. However, as the Bush Administration and the U.S. Congress have pointed out, there is no limitation on the greenhouse gas emissions of developing countries, including large and rapidly industrializing and fossil fuel-burning countries, such as India, China, or Brazil. So that is essentially the cap.

The trade part of the equation, as we got a brief introduction to, allows for the exchange of offsets amongst countries under that cap. So, industrialized countries that find that they do not need to use up all of that space within the cap allocated to them are, essentially, free to trade those unused permits essentially in a market, as long as all of the parties within the industrialized countries remain within that five percent reduction cap.

But an additional twist was added to the Kyoto Protocol as part of the negotiating process, as part of that first tradeoff, that I want to focus on. That was an additional mechanism, known as the Clean Development Mechanism, which allowed uncapped countries to also

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24. For more information, visit Clean Development Mechanism http://unfccc.int/kyoto_mechanisms/cdm/items/2718.php.

participate within emissions trading, and with an effort to achieve the Kyoto Protocol's objectives.

This essentially allows the trade of offsets generated outside the cap on a project-by-project basis with those countries that require additional offsets in order to meet their obligations under the Kyoto Protocol. So a project based in a developing country outside the Kyoto Protocol cap can demonstrate through an individual project that they have reduced emissions that they would not otherwise have reduced, and those emissions basically get converted into credits, and those credits can be sold to an industrialized country looking for extra space in which it can emit, and that essential certified emissions reduction is then calculated on a case-by-case, project-by-project basis, traded into the industrialized world, and it becomes an internationally tradable commodity as a result.

This is the first tradeoff worth noting; a tradeoff essentially that was aimed at bringing in developing countries, allowing industrialized countries to look for low-cost opportunities for emissions reductions outside of the cap, outside of their energy-intensive industrialized country economies, and it was a means of promoting technology transfer, wealth transfer, and of course promoting investment in the developing world. Those were essentially the gains that negotiators calculated when they agreed to engage in a trading system outside of the Kyoto cap.

However, there were also, obviously, risks involved. Allowing credits to come in from outside the cap on the basis of a hypothetical calculation — in other words, each project before it can generate an emissions reduction unit under the Clean Development Mechanism has to somehow show that the reductions that are being generated by that project would not have occurred otherwise, without that additional incentive of the Kyoto Protocol being in place. If they can establish that, if they can demonstrate that as a result of that additional incentive emissions had been reduced, that baseline had been departed from, then credits will be awarded, and those credits can then be used by an industrialized country to then in turn increase their emissions.

So the essential tradeoff that takes place through the introduction of this mechanism is the hypothetical — that against a business's usual scenario — essentially, a counterfactual — that a developing country on a project-by-project basis has made an additional effort — that hypothetical, that something has happened that would not otherwise have occurred as a result of that investment, is being traded off against the near certainty that once that is calculated in

terms of number of tons reduced and sold into the market of industrialized countries, the near certainty that that additional credit will be used for increasing emissions within the capped countries. That was the essential tradeoff that was made when the Clean Development Mechanism was introduced to the mix of mechanisms within the Kyoto Protocol process.

This was the risk that was recognized by the negotiators, by the designers of these mechanisms, a risk, that we had to sort of ensure that a mechanism that was essentially designed to benefit the environment didn't then create one of the largest loopholes in the process, that an agenda aimed at promoting a healthy environment and halting global warming didn't become a mechanism simply to allow people to appear as though they were doing something when in fact they were doing nothing at all in order to respond to this challenge.

So what did the negotiators do? Similar kinds of challenges that Tseming pointed out, of people trying to do something good, trying to design rules that aren't quite rules, trying to combine binding with nonbonding systems. What additional safeguards did we build into the Clean Development Mechanism to avoid the possibility that something designed to do good would in fact undermine the integrity of the very regime that we were designing? I think we can split up these safeguards into substantive safeguards and institutional or procedural safeguards.

First of all, the Clean Development Mechanism substantively was designed to avoid the negative impact of efforts to promote greenhouse gas emissions reductions on other competing environmental objectives, something that clearly comes up as a theme in this conference: that when you seek to do something about climate change, it is possible that you have increased the risk, for example, that you do something negative about biodiversity. For example, if one of your responses, as one way of cheaply reducing greenhouse gases, is planting more forests (the most rapid way of doing that is by choosing a monoculture of rapidly growing trees, that do not allow for ecosystems to develop or flourish within them), then you can undermine efforts that many others are undertaking to promote a rich and biodiverse globe.

So the first safeguard that was built into the Clean Development Mechanism was to ensure that project eligibility would screen out greenhouse gas emissions reduction projects that might have a negative environmental impact on other environmental objectives. So essentially, the negotiators agreed to allow projects that would promote reforestation of areas that had become deforested – aforesta-

tion, adding forests to barren lands – but would not be used as an incentive to prevent deforestation. It was too tricky to create an incentive for generating greenhouse gas credits to basically allow countries to claim that by not cutting down their trees that they already had in place that they could claim credit for benefits with regard to greenhouse gases.

Similar constraints were put in place with regard to nuclear energy. Environmentalists were concerned that the obvious environmental benefits from a greenhouse gas perspective of investing heavily in nuclear fuel would not allow for the rapid spread of nuclear power, particularly in the developing world.

They also sought to limit use of the Clean Development Mechanism. There are provisions within the CDM rules that basically require industrialized countries to demonstrate that any efforts that they make through a Clean Development Mechanism investment are supplemental to domestic actions. There was a concern that if countries like China and India began to rapidly generate offsets through these projects by cheaply reducing greenhouse gas emissions and then selling them to the industrialized countries, that there would essentially be very little pressure or incentive for industrialized countries to take any domestic action at home. And so qualitative limits were placed on the extent to which countries could use extraterritorial emissions credits to achieve what were essentially domestically binding targets.

On top of those substantive commitments, they then added many procedural institutional safeguards. If you run through the details of the rules that have since been negotiated on how the CDM will operate, you will see many institutions that are in place, many methodological constraints that are in place, that require in particular countries and project proponents to demonstrate on a case-by-case basis that in fact the investments are yielding greenhouse gas emissions reductions that would not have taken place except for the existence of the Kyoto Protocol and the potential to use these credits.

Other special-interest groups then piled on to place additional constraints on how the CDM could operate. There was a concern, for example, about smaller countries, African countries in particular, that because China and India would offer such potential for these investments, that smaller countries that couldn't reduce greenhouse gas emissions on the same scale and as cheaply as a smaller African country could, that those African countries would essentially be left out of the equation. So incentives were built in to get countries to

focus on small projects, not just large projects but small projects as well.

Then the Small Island Countries entered into the equation. Deeply skeptical that the CDM would actually yield global emissions reductions, they wanted to attach to each of these transactions an adaptation surcharge, so money would be generated each time an emissions trade took place, put in the fund, and be available to help countries deal with the potential impact of global warming, when that in fact or if that in fact occurred.

So in that effort to balance greenhouse gas objectives with other environmental objectives, to balance the need to include developing countries with the need for a solid cap on emissions, many compromises were made. Looking back, many were concerned that we had essentially over-regulated, that the kinds of concerns that I am presenting here and that other presenters have made, about the potential to guess wrong about what the right policies are with regard to climate change, had erred too much on the side of security and safety and had not allowed the market to sufficiently flourish, that we had attached too many conditions, a massive bureaucracy, we weighed it down by rules and extra taxes for things like adaptation, that we made it too expensive, and essentially the environmentalists had shot themselves in the foot and produced a mechanism that could never become up and operational.

Well, I think if you look at what has happened since those Protocol rules have been proposed and you begin to see what kinds of projects are actually now being developed and implemented around the world, you will see that there are still plenty of incentives left and plenty of opportunities that people are taking to design projects that could fit into the rules that the Kyoto Protocol designers came up with.

If you take just one recent case, if you look at some of the most interesting cases are on the World Bank Website for Carbon Finance[25] — the carbon finance entity that the World Bank has established, you will see examples of projects that have now been put forward by project proponents for approval for emissions reduction offsets for operation under the Kyoto Protocol. You will see some very inter-

25. *See* The World Bank Carbon Finance Unit Home Page, http://carbonfinance.org/ (last visited, Oct. 4, 2006).

esting and very impressive, and somewhat troubling, projects that are coming forward.

If we just take one recent case from China, which I think some environmentalists would look at as a somewhat model case, a large chemical plant, Changshu, in China, is basically producing refrigerants and coolants and solvents that produce a byproduct, HFC-23 [trifluoromethane], which is a very powerful greenhouse gas. Normally, as part of the production process, tons of this gas would be produced and released into the atmosphere. This is a very powerful global warming gas. One ton of HFC-23 generates the same as 12,000 tons of carbon dioxide and its equivalent. And so getting rid of these gases, essentially incinerating them, would have a benefit. It would help prevent the escape of that additional 12,000 tons of carbon equivalent for each ton of HFC-23 that would be generated.

A $5 million investment in incinerators attached to this plant is predicted to generate 50-to-90 million tons of carbon equivalent in terms of gases that would not be released into the atmosphere. What the World Bank has essentially done is it has promised in advance to buy those tons in the form of offsets. That promise to buy has allowed the local company to invest in that incinerator and to put that technology in place. So they have agreed to pay up to $250 million for those tons, the offsets associated with the reduction of those tons, essentially the World Bank and its investors have promised, at roughly (US) $5.00 per ton of offsets generated.

Sixty-five percent of that $250 million will go to the government of China, which has promised then to set that money aside for sustainable development projects. Thirty-five percent of that will go to the company, the Chinese company that is in fact actually hosting the incinerator. Then, of course, the World Bank will have these 50 million tons of carbon dioxide, which it will then give to its investors, and those investors will then sell into the industrialized countries market. By some calculations, when the European market, for example, is up and running, we are talking about roughly by some calculations $20 per ton of the value of an offset. We have the potential to generate $1 billion worth of value in sales of those offsets. For an initial investment of $5 million to buy that incinerator, we have the potential profit of $1 billion in terms of selling those into the European market. Well, we can certainly begin to get a sense of the kinds of incentives that we are now creating around this kind or scale of project.

Additionalty? Would this project have taken place outside of the availability of this potential to profit, these potential investments?

Probably not. China has sufficiently demonstrated that it has no interest from a local environmental point of view to take on that additional $5 million cost of incinerating those chemicals. They have no local environmental impact at all. The only reason that you would wish to do so would be to save those tons from entering into the atmosphere and contributing to global warming.

Is there good generated by the project? Well, China is going to put aside a significant part of that $250 million for what it calls sustainable development projects. There may be a benefit there to the local Chinese environment as a result. We will have very close World Bank supervision of the project.

But will it create the kinds of changes that Professor Sachs was looking at today as being essential to this long-term global solution of moving, for example, the Chinese economy and energy sources to those that will actually make a genuine long-term contribution to climate change? Probably not.

So once again we have a tradeoff, once again we have a calibration, once again we have short-term interests trading off against long-term interests, and you can see why policymakers are in a bit of a muddle. There is so much potential there — potential interest from investors, potential interest from those who seek to achieve goals other than purely climate change goals. But how to actually harness that in such a way to solve that initial challenge that I set out – set by both the Kyoto Protocol and a recognition of what the real problem is – the stabilization of concentrations of greenhouses gases in the atmosphere. We don't seem to be quite there yet in the many experiments that we are running at the moment.

Thank you.

PROFESSOR FOSTER: Thank you. That was fascinating.

Professor Coplan has been an Associate Professor of Law at Pace Law School and also a Co-Director of its Environmental Litigation Clinic.[26] He is also the principal outside counsel for Riverkeeper,[27] and one of the cases that he worked on was Riverkeeper's challenge to the Nuclear Regulatory Commission's refusal to order basic secu-

26. For more information, see Pace Law School, Pace Envirnomental Litigation Clinic, http://www.law.pace.edu/envclinic/index.html (last visited Oct. 4, 2006).

27. Riverkeeper is an advocacy group that monitors the Hudson River ecosystem since 1966. For more information, see http://riverkeeper.org (last visited Oct. 4, 2006).

rity measures to protect the Indian Point nuclear power plant, just thirty miles north of Manhattan, from terrorist attacks.

Today he is going to talk about "Future Generations and Future Civilizations: The Hobson's Choice of Nuclear Energy."

PROFESSOR COPLAN: Thank you. I would also like to thank Scott and Carol for putting this conference together. I am learning a lot today, and I am sure everybody else is.

I do have a PowerPoint, because it is late in the day and I think the little pictures would help get people's attention. Also, given the topic, it is one where it is hard to visualize, but it helps to try to visualize it.

I apologize in advance. I am not an expert on doing PowerPoint presentations. I see already that the slides don't even line up the way I expected them to. And I guarantee you are not going to be able to read all the writing, but that's okay.

Question — show of hands: How many people think the United States will be around as a political entity in 100 years to deal with the impacts of global warming, be around as a government 100 years from now?

[Show of hands]

Good. I see pretty good confidence in our nation here. It didn't get unanimous.

VOICE: A different government.

PROFESSOR COPLAN: A different government, but it will be the continuity — we will be a country, a nation, that will be dealing with the impacts of global warming.

How many people think that the United States will be around 1,000 years from now as a government, as a nation, as an economic system?

[Show of hands]

Okay. Some people have real faith in our country.

That is in a nutshell the choice between carbon issues and nuclear issues. At the end of the day — I actually may surprise you a little bit on where I come out on this, but I think we have to go in with our eyes open – we are talking about what really are nuclear waste impacts that will last thousands to millions of years. So that is why I call them "inter-civilizational impacts." The people we are going to be hurting are not just somewhere else; they are different people, different civilizations. Who knows, given the timeframes we are talking about? I was originally going to fade from Indian Point into Mayan ruins to kind of get the point across, but I think you get the point anyway.

[Slide] I know Jeffrey Sachs said the thing he is worried about is proliferation, and that is what I worry about too. But even just looking at the things that are certain, which is the waste, it is a huge issue.

This is what the D.C. Circuit, that noted liberal bastion, had to say about nuclear wastes: "Having the capacity to outlast human civilization as we know it and the potential to devastate public health and the environment, nuclear waste has vexed Congress, scientists, and the regulatory agencies for the last half-century. After rejecting disposal options ranging from burying nuclear waste in polar icecaps, to rocketing it to the sun, the scientific consensus has settled on deep geological burial as the safest way to isolate the toxic material in perpetuity."[28]

This, of course, is a decision that dealt with the Yucca Mountain proposed waste repository,[29] and I will talk about that a little later on.

My second quote here, to kind of set the stage, is just one of the few articles supporting nuclear power out there, just the common thing that nuclear proponents kind of throw away and say: "The pressing concerns over the disposition and reprocessing of spent nuclear fuel must be addressed."

When I read something like that, I think of the very old joke about the economist stranded on a desert island. Everybody know that joke? Does anybody not know that joke? Anyway, the economist is on a desert island, a physicist, etc. There is a case of canned goods. Punch line is the economist says: "Gentlemen, assume we had a can opener."

That is the story of nuclear power generation in the world. They built it, they started putting the plants up, and they said, "Assume we have something to do with the waste and we'll be fine." We are still assuming.

[Slide] This makes it a little easier to read here. The half-lives we are talking about: some are relatively short — Cesium-137 is thirty years. As you can see, we get up to Iodine-129, 17 million years; Plutonium-239, 24,000 years. Half-life doesn't mean after the half-life "okay, everything's safe." It means you've got a humongous

28. Nuclear Energy Inst., Inc. v. EPA, 373 F.3d 1251, 1257 (D.C. Cir. 2004), rehearing denied by Nuclear Energy Inst., Inc. v. EPA, 2004 U.S. App. LEXIS 18780 (D.C. Cir., Sept. 1, 2004).

29. *Id.* at 1251.

problem that has turned into a huge problem, because you've still got half as much of a problem as you had 24,000 years before, and in another 24,000 years you're down to only a quarter as much of a problem. So really, before it can be considered safe, you may be talking about twenty or thirty half-lives, and the time periods get to be simply mind-boggling.

[Slide] Human health effects of radiation exposure, I don't really need to remind everybody of that. There are acute effects. If there is enough of it, you simply drop over dead because the radiation kills your internal organs, kills your cells immediately.

Longer term, radiation causes cancer; there is no dispute about that. Lower doses interfere with DNA, and can cause mutations, birth defects, and developmental defects.

And there is no safe dose of radiation. Scientists all agree that there is no safe dose. At any exposure at all there is an impact; there is a statistical increase in cancers and mutation. It is not that everybody who is exposed is going to get cancer, but there is no level you can say "okay, that's okay."

[Slide] Where is this stuff now? Right now, pretty much all the nuclear wastes generated by this country in the fifty years of nuclear power generation in this country is right at the nuclear plants that generated it. They built the plants assuming they had a can opener.

They assumed that the spent fuel pools would hold the fuel for five years. For the first five years after you take the spent fuel out of the reactor, it is so physically hot, just temperature hot, in addition to radioactive hot, that you actually have to keep it under water. They built these pools saying, "Okay, we've got to hold them for five years, and then we will send it off to a reprocessing facility, a deep geological repository" — whatever can opener we are going to come up with, right?

Well, as it turns out, there has been no place to send them. So these spent fuel pools that were designed to hold just five years' worth of fuel they have jammed forty years' worth of fuel into them.

They put the rods closer together, which has vastly increased the security risk for these spent fuel pools, because if there is anything to drain the water out of them, they are now so close together that the heat will actually cause a fire, a zirconium clouding fire, and there is a reaction between the steam and the heat that generates hydrogen, and you have a fire which then could disperse the entire radioactive inventory in aerosol into the air. That is a huge risk.

One of the things that makes me not sleep at night is knowing that Indian Point is only fifty miles north of here. If anybody noticed

which way the wind was blowing this morning, it is blowing out of the north, around fifteen miles an hour. If there was a zirconium fire at Indian Point now, it would be in Manhattan in about three or four hours. That's what you have.

Fifty thousand metric tons is the amount of spent fuel inventory in the United States, increasing by 2,000 metric tons per year.

[Slide] What are the solutions? Yucca Mountain is currently the solution that is the official policy of the United States. It was originally supposedly scheduled to open in 1998. It obviously didn't happen. The earliest possible opening has been slated in 2012; that is now unlikely. Last month Energy Secretary Bodman[30] was quoted as saying that they don't have a date when they expect it to open.

But you know what? Yucca Mountain is a sideshow in a way, because Yucca Mountain is already full. In the fifty years we have had nuclear power, we have not quite come up with a place to put fifty years of nuclear waste. But the day it opens it is full. It has a capacity of a total of 70,000 metric tons. Seven thousand of that is already reserved for military nuclear waste. That leaves 63,000 metric tons for civilian nuclear waste. As of 2003, we already had 50,000 metric tons. We are doing 2,000 metric tons a year. I am actually wrong when I said "used up by 2015." You figure it is used up by 2010. The day it opens there is already more waste than we know what to do with.

[Slide] Another word about *Nuclear Energy Institute vs. EPA*,[31] where the D.C. Circuit actually upheld the choice of Yucca Mountain, but struck down the EPA standard for the containers that the waste would be put in because EPA only considered a 10,000-year storage period in assessing human health effects of exposure. That was contrary to the explicit direction by Congress in the Nuclear Waste Policy Act,[32] which said that the EPA had to take into account what the National Academy of Sciences[33] said about it.

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30. Samuel W. Bodman, Secretary of Energy, sworn in on Feb. 1, 2005.

31. 373 F.3d 1251 (C.A.D.C. 2004).

32. Nuclear Waste Policy Act of 1982, 42 U.S.C. §§ 10101-10270 (2000).

33. The National Academy of Sciences (NAS) is an honorific society of distinguished scholars engaged in scientific and engineering research, dedicated to the furtherance of science and technology and to their use for the general welfare. *See* National Academy of Science Homepage, http://www.nasonline.org/site/PageServer (last visited Oct 4, 2006).

The National Academy of Sciences in their report had said 10,000 years is just the beginning of the problem, that actually the worst impacts can be expected beyond 10,000 years when the containers can be expected to erode away and the stuff is going to be possibly exposed to the environment. They proposed a risk period more like a million years. EPA has not come up with new regulations yet, and that is one of the factors that is still stalling Yucca Mountain.

[Slide] I know this is a little hard to see, but this is out of the National Academy of Sciences Report. It basically shows different risk pathways, even at Yucca Mountain, for the waste to be exposed to the environment. There are, obviously, both local pathways through the water table and vadose zone into local populations, but there are also world pathways, in that gaseous emissions will eventually be expected to get out and possibly be exposed to the entire world.

[Slide] I have already mentioned that the current waste storage situation is all kept in the spent fuel pools at the nuclear power plants. They are now running out of space, even with the tighter configurations, so the nuclear power plants are moving to this dry cask storage.

You see these cylinders? I have a lot of pictures of them because there are going to be a lot of them around.

[Slide] This is supposed to be the interim solution while they wait for Yucca Mountain to open up. This is a map. The little green dots are the locations of nuclear power plants, where these wastes are currently stored. Basically, this is where it is going to stay, if they don't find anyplace else to put it.

Given the fact that in fifty years we have not been able to open up any system to take care of the last fifty years of waste, even if Yucca Mountain opens up and is filled up, then the next fifty years of nuclear waste generation is going to stay right where it is.

These casks that they are being put into, by regulation, by the regulatory scheme, are only supposed to be designed to last twenty years — once again, just like the spent fuel pools, which were only designed to hold the waste for five years and are now holding them for forty. You read the NRC regulation, and it says: we will give you design approval as long as your casks are designed to last twenty years.

Without the text, there you can see where all those green dots are. A lot of them are close to metropolitan areas. Many of them are in coastal areas. That does not bode well.

[Slide] Of course, the nuclear energy industry is really hot on reprocessing. That's the alchemy, that's the silver bullet for the indus-

try, because if you could actually come up with reprocessing, in theory, nuclear energy would be renewable, because you would actually generate more fuel than you used; and, in theory, you would take care of the waste problem too. This is the theoretical can opener.

In theory, it works. Ninety-seven percent of nuclear waste is uranium, which if you could clean it up and separate it out, which nobody has been able to do yet in an economically viable way, it could either be disposed of as low-level waste or reused in reactors. The problem is if you separate out the uranium, the other 3 percent is plutonium and neptunium and a bunch of other radionuclides, which have the longest half-lives, are the most highly toxic, and are nuclear weapons material, which is why basically in the 1970s this country banned reprocessing of nuclear waste, because what you are doing is you are making bomb-making material. The more you make nuclear energy, the more bomb-making material you make.

And yes, they are saying, "Okay, well if you had the right reactors, you could take that plutonium and you could burn it up in another reactor." But you would generate more plutonium that way.

[Slide] At the end of the day — again, if you are talking about long periods of time, if you are talking about "this is our solution to global warming for the next five centuries" — well, plutonium piling up for five centuries is eventually going to mean somebody is going to set off a plutonium bomb in a city somewhere. Again, if you wait long enough, it is going to happen.

Reprocessing, even though it is the Holy Grail for the industry, has had a very, very negative history. The one commercial reprocessing site in the United States was a demonstration project that Getty Oil put together in West Valley, New York. It has already cost $1 billion in cleanup. Some estimates I have seen are $15 billion to clean up. It was never economically viable. It has basically created a nuclear waste site and nothing else.

The newest proposal by the industry and the Department of Energy — and Congress has just allocated something like $500 million to help support research — would be a new generation of reactors, transmutation reactors, that would basically somehow make the plutonium fuel safer and get rid of the long-lived radionuclides that are the most dangerous to get rid of. But basically, you would have to have the dedicated reprocessing facility and a nuclear power plant to burn the fuel sited right next to each other, because the stuff is going to be too dangerous to transport. Until you've seen the community that steps forward and says, "Yes, we want it in our community," it is really more theoretical than real.

It is also more theoretical than real in that it has got to be decades away before they can even prove it on a demonstration basis. It is not going to happen in a timeframe that is going to let us use nuclear power to help solve the very real issues of carbon emissions and global warming.

[Slide] We are talking about markets today, we are talking about carbon trading and using markets to get better efficiencies in reducing carbon emissions. Like Tseming, I am skeptical in general on many levels of pollution rights and pollution rights trading.

But there is another risk here, which is that if you set up a system where you try to capture the externalities in one market, the market for carbon-based energy generation, but then you encourage another industry that has its own externalities that you are not capturing, which is true of nuclear power generation, you are simply creating distortions that are going to cause you bigger problems in the long run.

So for nuclear power there is a huge externality, a cost of nuclear power that is not paid by the nuclear power plants or their customers. Of course, one of the biggest ones is the Price-Anderson Act,[34] which limits liability for any single incident to $10 billion, which is a small fraction of what might happen if you actually had a severe nuclear power plant accident.

When you talk about the risks and the long-term risk of nuclear power, the industry and the nuclear regulatory agencies trot out this figure of "it's safe; we have calculated that the risk of a severe nuclear power plant accident is about one every 10,000 reactor years."

You say, "Ah! One out of 10,000 reactor years, that's not going to be a problem for me or my children or my children's children."

Except for every reactor, that's a reactor year. We have a hundred reactors operating in the United States. That gets you down to an expectation of one meltdown every hundred years.

If you want to make enough nuclear reactors to actually make a dent in global warming and end up with, say, 1,000 reactors around the world, well now your expectation is you are going to have one meltdown every ten years statistically. That is a consequence that you would have to be willing to take if you want to say that nuclear power is a solution to the problem of global warming.

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34. Atomic Energy Act, 42 U.S.C. §§ 2011-2281 (2005).

There is the proliferation risk, and that is also unquantifiable. We don't know, but you know that the more nuclear material there is out there and the more nuclear technology gets shared — the same technology that lets you enrich uranium to use it for nuclear generation lets you enrich uranium to use it to make a nuclear bomb. That is the big issue that we are fighting in trying to keep Iran from having their own uranium enrichment program.

And just as a side note, these proliferation risks, these terrorism risks — and this is the issue we fought on Indian Point — are simply not taken into account in our regulatory scheme in the United States right now.

Decades ago, NRC made a conscious decision to not consider terrorism risks in siting nuclear power plants or in considering the environmental impacts of where they site them. It was upheld by the courts back then, which said: "No, you don't have to consider the chance of somebody flying an airplane into a nuclear power plant."

Well, that may have sounded good in the 1970s and the 1980s, but even now, even since September 11th, the Nuclear Regulatory Commission still says: "It is our policy that we do not take intentional acts like this into account in siting and licensing nuclear power plant facilities, and we are not going to start now."

As far as terrorism protection for these facilities, the attitude is: "It is the responsibility of the armed services to protect the plant. It is not up to the Nuclear Regulatory Commission."

And it is not really left to the licensee. If you read the regulations for licensees, it specifically says they are not required to protect against enemies of the United States, whether they be governments or individuals.

[Slide] Just an example with Indian Point. Seventeen million people reside in a fifty-mile radius of Indian Point. Around the United States, 161 million people reside with seventy-five miles of nuclear power plants or fuel storage sites. In terms of the amount of radiation there, the spent fuel pools at Indian Point have enough radiation to render 95,000 square kilometers of land uninhabitable, which is about 75 percent of the land area of New York State.

Riverkeeper has done a lot of work on this and had Dave Lochbaum[35] from the Union of Concerned Scientists[36] run the com-

35. David Lochbaum is one of the nation's top independent experts on nuclear power.

puter program. He came up with an estimate of what a nuclear reactor meltdown at Indian Point could cause, and came up with 70,000 early fatalities, 500,000 cancer fatalities, $2 trillion of property damage, and eleven million people relocating.

[Slide] Quickly, RGGI and nuclear power. RGGI doesn't really say anything about nuclear power, but it does talk about "non-carbon-emitting energy production." In theory, states could use their twenty five percent set-aside to promote nuclear power and be within the Memorandum of Understanding. And, in theory, states could also give allocations to all generators, including nuclear generators, on the theory that you should get credit for generating electricity. Either one would be a direct subsidy to nuclear power.

But there is still going to be an indirect subsidy automatically, because the price of electricity goes up. The way it has been explained to me is that in the spot market for electricity, when the utilities bid in the cost of their carbon allowances, every generator that is in that market gets that increased cost when the bid clears. So the nuclear power plants, if the price goes up three cents a kilowatt to pay for the carbon allowances, get that three cents a kilowatt, even though they don't need the carbon allowances. So there is a subsidy built in for nuclear power.

[Slide] I'm sorry this is probably very illegible, but I wanted to talk a little bit about the impacts of global warming. Everything is so highly uncertain. What are the impacts, in order of magnitude?

Well, we know it is going to affect the environment for hundreds of years, possibly longer. If it is a tipping point, it could well be thousands of years. It is referred to as "intergenerational impacts of global warming."

It will disrupt the global environment. They are international in nature, to the extent that the most serious impacts occur at locations other than the worst offenders. We are the largest per capita emitters of carbon dioxide, but the biggest impacts are going to be felt in coastal areas, in the developing nations, which are going to be inundated — Bangladesh, 17 million people at risk; the Nile Delta, 6 million people at risk.[37] I think one estimate is the National Academy of Sciences put a billion people around the world living in coastal

36. The Union of Concerned Scientists (UCS) is an independent non profit alliance of concerned citizens and scientists founded in 1969 by faculty and staff of MIT.

37. Dr. Joachim Gross, *The Severe Impact of Climate Change on Developing Countries*, 96 MED. & GLOB. SURV. 7, 2 (2002).

areas that would be affected by a sea level rise with global warming, to say nothing of the hundreds of millions of people who might be affected by famine from crop fires.

[Slide] Nuclear wastes also would affect the environment for hundreds of thousands of years to millions of years. So the impact is really an order of magnitude larger, possibly. Again, it is so uncertain. If we reach a tipping point in the climate, it may well take thousands of years for the climate to recover too.

Nuclear wastes are primarily going to injure the environment where plants and waste are located. I say "primarily" because, obviously, fallout can travel between continents, and Chernobyl actually had impacts in many countries other than Russia.

But the country we wreck with nuclear wastes is our own. When you think about the international equity of it, that is something to be said for nuclear power in a very negative kind of way, which is: "Hey, the place we may render uninhabitable is exactly where we are standing right now, and isn't that a lot more fair to the people of Bangladesh, who don't even have lights in their houses and don't drive SUVs around?" Well, it is.

It could displace tens of millions of people, primarily in metropolitan areas, in developed nations.

And also, like global warming, there is a high degree of uncertainty over the long-term impacts.

[Slide] Nuclear Information Resource Service[38] has done a very nice bit of research on the practicalities. It is in the materials.

In a way, there is a big question mark here, in that in order to really have nuclear power make a difference for global warming, you would have to build about 1,000 new nuclear plants, and you would have to do it in about ten or twenty years. Keep in mind that in the last twenty years only fifteen plants have been built worldwide and the last plant in the United States was built in 1973, it is probably impossible.

If you could do it, then we are going to run out of uranium in a couple of years. This is not just Nuclear Information Resource Service. The Department of Energy has calculated that at the current rates of use, the readily accessible uranium supplies, mines, and stockpiles are going to be used up by 2014, at which point demand is

38. *See* Nuclear Information and Resource Service, http://www.nirs.org/radwaste/hlw/hlw.htm (last visited October 2, 2006).

going to exceed supply. Now, yes, there are probably some other sources that will then become economical and get mined.

But the fact is that nuclear power, at least the way it currently exists, is not a panacea.

I know I am running out of time.

[Slide] Just to put it in context, in the past 100,000 years, Neanderthals were walking around in Europe 30,000 years ago; continental glaciers have come and gone in the past 18,000 years; recorded human history started 5,000 years ago; civilizations like the Mayan civilization arose, flourished, and collapsed over a period of 2,000 years and there is hardly anything left of them.

[Slide] Again, this is where the waste repositories are now. Maybe the worst thing that could happen for the world is if we actually solved global warming with nuclear power and we have glaciers — I mean in the timeframe that we are talking about, most geologists I talk to, including my wife who is a geologist at Lamont-Doherty,[39] say: "You know what? Over 100,000 years, we can say almost certainly that there will be another Ice Age." Even possibly with global warming, the Earth could get really hot for several millennia and then get really cold again.

[Slide] In the last Ice Age, if you look at where that ice sheet is and look at where those nuclear waste sites are, and if you think about those containers, they are all going to be ground up into little pieces and spread over thousands and thousands of square miles.

[Slide] So the thought I leave you with is 300,000 years ago Europeans found the Easter Islands artifacts.

[Slide] 1,000 years from now; is somebody going to be finding the artifacts of our civilization?

[Slide] Is nuclear energy a solution to global warming? I'm not going to say absolutely not. I would be convinced if they came up with, and proved, and actually have operating, and found a place to site it, a reprocessing facility and a power plant that would burn the products of the reprocessing facility, and site it away from populated areas. Knowing that, you know what the consequence of that may be? There may be a nuclear war at some point or a nuclear terrorist incident and 10 million people may die in a city somewhere.

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39. The Lamont-Doherty Earth Observatory was established in 1949 at the Earth Institute at Columbia University in New York. For more information, see Lamont-Doherty Earth Observatory http://www.ldeo.columbia.edu/ldeo/hist/ (last viewed Oct. 4, 2006).

You might say, "Well, that's horrible and it's awful and it's a great human tragedy, but it is not as bad as a billion people being flooded out of their homes and becoming refugees."

So at the end of the day, show me the can opener and I might be convinced about nuclear energy.

PROFESSOR FOSTER: Thank you.

I want to open it up for questions for a brief period. I know we are running late, but it is not quite 4 o'clock. I think we have time for questions and discussion.

Anyone? Professor Galizzi?

QUESTION [Professor Galizzi]: I have one. One of the problems that we have with environmental law, and with environmentalists in general, is there is a lot of doom and gloom that comes out of the environmentalists — "one million years from now nuclear energy will cause problems"; "we do not trust the market to regulate it." It is negative, negative, negative, all the time, or most of the time.

Unfortunately, most people don't buy that. I think very often environmentalists just talk to each other. Ten percent of the population — maybe more — believes that this is an important issue that should be dealt with, but what about reaching out to the others, who actually want to have [inaudible] said today?

There is a risk every day — when you get into a cab, when you get into the subway, when you go out, whatever you do. I think aren't we sometimes exaggerating the risks to the point to which we lose credibility? How do we deal with that?

That is a non-green question, I think. I just wanted to raise that.

PROFESSOR FOSTER: Anyone on the panel is free to take that.

PROFESSOR COPLAN: You know, I think you are right, that there is kind of the 90 percent in this country — I don't even think it's 90 percent really, but there is a large portion of the population that doesn't want to hear about how selfish we are being in a way. I don't actually know.

You know, this is a depressing topic to think about and look at, because if you look at what is happening with global warming, there hasn't been any really good news about it lately.

Even listening to Jeffrey Sachs, he has a solution. I think he is trying to come up with a positive. And it is a solution that, by the way, means more money to General Electric and more jobs building the new generation of coal-burning sequestered power plants. I think that is a good approach, which is to sell it as a series of solutions. But nobody is going to look at the solutions until they are convinced that there is a problem.

And frankly, I don't think it is going to be environmentalists that bring the public around on this per se. I actually think, unfortunately, it is going to take a couple of disasters before we really open our eyes. I think Katrina is a start, which you can't really necessarily say is global warming or not. But I think if people begin to look at that order of magnitude of impacts, then they will begin to wake up and take notice.

PROFESSOR RABE: I really appreciate the question. I think what you say is true of many areas and arenas for environmental policy. It is the way the issue tends to get framed. It drives a lot of research and a lot of public activism.

At the same time, I think if one looks even over our conversations today, there have been lots of bits and pieces that aren't the silver bullet that necessarily will solve the climate problem or anything else. But I don't think there is going to be a silver bullet. I think there will be bits and pieces of a strategy.

If one thinks of just some of the range of state activities that seem somewhat counterintuitive but didn't even exist four or five or six years ago, we are at the very early stages of piecing this together and putting this together. Even with market-driven strategies, we are still at a very, very early stage of developing this, as opposed to other arenas or spheres of public policy.

I am not sure that I would accept Professor Sachs' interpretation of the prospects for sequestration — I am actually somewhat skeptical of that — but in terms of being a guarded optimist, I think that is reasonable.

I think a real challenge for the scholarly community — whether it is law scholars, social scientists, or natural and physical scientists — is really focusing on constructive strategies that can work. I think a pattern — I have argued this in some of my own research — is there is a tendency for scholars to find sort of the worst-case Doomsday scenario and then on the policy front move toward the optimal, try to design the perfect solution. Neither is necessarily based in reality. Reality is the hard crunching together of institutions and facts and figures, and it is a messier process than we'd like to admit, but it may lead to some progress.

But I appreciate the question.

PROFESSOR YANG: I do want to also say something about it. I think it is a matter of perspective from which community you operate in. Within the environmental community, maybe there is probably a sense of gloom and doom. Among scholars — and my sense is that I think this is a fairly accurate description — the negative tends

to predominate over the positive; you know, what is wrong with the system, what are people doing that they shouldn't be doing, and so forth.

But if you look at what the business community is doing, it is really sort of the other way around, I think. Everybody is sort of overflowing with enthusiasm about voluntary schemes, about markets, and all that. My sense is that there is sort of a point, as I think as Barry has mentioned, where the scholarly, the critical, has to meet with the constructive and positive. I think the trick is to figure out what needs to be done in order to channel the positive efforts into something that actually works.

Part of what I was addressing was the idea of markets. I think, even though as I said, I and others are not particularly great fans of it, for a number of reasons, given the current status of things, it does hold potential. But there are things that need to be done in order to make it workable.

So it is a matter of perspective, I think, and also which communities you move in, that shapes the perception of the issues.

MR. WERKSMAN: If this had been a day about ozone, protection of the ozone layer, there would have been much more positive stories to tell about efforts toward solutions, about the role of international law, or law generally. I think you would have had a more upbeat presentation by the scholars present.

But one of the problems with global warming is that I don't think that the interests have quite revealed themselves yet. It is still yet unclear what it means to you or to me or to anyone here that we are seeking to prevent the risk of global warming or the impact of climate change.

Where we see the optimists emerging is where people have identified a way in which they can, frankly, make some money off of the current perception of the problem. So I think a lot of the optimism around the business community is either a perception that as brokers they can make money off the transactions, or as smart strategists they can pretend that they are doing something in a way of holding off any serious activity on the regulatory side.

So I guess I remain skeptical that until we really understand what is at stake — and it is so hard to perceive what is at stake — that people are going to get frustrated by pushing ambitious agendas and getting them knocked back.

QUESTIONER [Professor Galizzi]: But if I can just come back on what was said, what is wrong with making money and solving a problem? That is the perception that it seems to — you know, there

is nothing wrong if the business community can become involved, make money, generate the income, and at the same time solve the problem, like what happened in the Clean Development Mechanism. From my viewpoint, it is a bureaucratic mechanism, which could actually have done much better had it not been for the mistrust of the people in a certain community. It seems to [inaudible]. We just constantly say we have to have all of these rules to make sure that [inaudible] because fundamentally we do not want to give back to the business community. I think that is just another [inaudible].

PROFESSOR COPLAN: But don't we have to create the system that gives the opportunity to make money solving the problem, because businesses are not going to —

QUESTIONER [Professor Galizzi]: Businesses are like me and you more or less. They are the people who probably pay our pensions. We are probably all investors.

PROFESSOR COPLAN: I disagree that businesses are people like you and me. I think that is part of the problem. You and I may have children and grandchildren and — well, they do, but they are responsible to shareholders, to maximize profit in the short term, because if they don't the market will punish them. While there may be some privately held companies that are managed for the next century, those are few and far between.

Yes, business is excited about — you know, I am sure there are people at General Electric who are really excited about being part of the solution to global warming because they see it as a huge market. But for there to be a market there has got to be the regulation, because nobody is going to buy those more expensive coal-sequestering plants, even if they do work, if there isn't somebody out there telling them that they've got to do something with the carbon.

PROFESSOR FOSTER: Let me jump in here for a second and just try to focus us on what Jeffrey Sachs talked about this morning. I was listening to your presentation and I was think that — you know, one of Sachs' main points was that the energy efficiency, the qualitative focus that we have been taking, is not going to do it in the end, and that we need a larger solution. So the renewable portfolios, perhaps the market-based solutions, and maybe even CDMs, in the end may not make that much difference.

How do you jive, I guess, some of these mechanisms or some of these strategies that we have been incentivizing and following with Sachs' argument today? Have we been incentivizing the wrong things?

PROFESSOR RABE: Also an intriguing question.

Clearly, every form — and maybe this is an effort to bridge across the two questions — every form of energy is subsidized. Every form of energy gets government assistance. Whether it is the price legislation and indemnification issues, or the production tax credit, the federal government supports all of these sources, or every hydro source that is in operation, certainly in North America. Everything gets governmental subsidies, although in some cases we may or may now want to call it that, which raises some very interesting questions with regards to incentives and the like.

My own response to Professor Sachs' point is that, clearly, the renewable/conservation/efficiency piece is only a piece. And yet, I think he understates the potential impact that it could have.

One of the things that I think is so intriguing, not just about the RPS but in concert with all of these other policy tools, is we are really sort of beginning to figure out how to make this work and what the transition is going to be and what the proper mix is going to look like. There is not one model in my mind where it works, there is not one technology that is necessarily a winner, but there is a larger transition underway, and we are beginning to kind of tinker with it. It is a mixture of command-and-control and market.

The other piece I would suggest is that everybody who works in this field is making money, whether it is academic scholars, all of us, who should probably have financial disclosure statements about grants and funding sources that we get.

PROFESSOR FOSTER: That's true.

PROFESSOR RABE: Environmental advocacy groups that do not exist unless they take a particular position to raise funding, a point that was raised this morning. Certainly, attorneys and litigators who play varying roles in these pieces. There may be incentives, and there may be perverse incentives, for states, just as we were talking this morning in terms of challenges and possible fiscal advantages that may emerge.

One last point, if I might. I would say that the nastiest, most aggressive, almost venal, behavior I have seen by business in the energy arena in the last two years is the war that is going on in several states between the solar industry — business, but on the side of the angels — and other renewable providers. Basically, solar proponents, solar technology holders, working with environmental groups, are saying, "There will not be a valid proposition for a renewable portfolio standard in this state unless there is special treatment for solar." That is nasty politics, that's business, but that is environmental progress.

QUESTION: I just wanted to respond to what you said before, as a forty-five-year environmental activist. The environmental dueling you referred to me is quite different. It's a reality check. It's a reality check on the technological optimism that is spread by government and by industry. It is a reality check on the speculative nature of technologies such as carbon sequestration, for example. It is a reality check on the reluctance of both the scientific community and the regulators and the government to admit the role of uncertainty. This is one of the worst habits of science — not good scientists; there are good scientists who up-front are uncertain and will be honest about the risks.

But if no one comes and says that the emperor has no clothes, or that the emperor's clothes are going to cause a lot of damage, then we are left at the mercy of the mass media, who don't want to spread any bad news; we are left at the mercy of the industry to promote itself and all the good news; and we are certainly left with no solution whatsoever.

So I would say that the major progress that we have had in this country, that we can have a dialogue and democratic participation in the process, and move it forward from a default position of "growth is good, more energy is good" to a different kind of dialogue and a different kind of society, is due to the environmental community that started after Earth Day in 1970. We wouldn't probably even be here today having this open discussion in a free society if it hadn't been for the environmentalists.

PROFESSOR FOSTER: A couple more questions.

QUESTION: Why would solar energy need to be incentivized? Is it because solar energy is so expensive, that in order to make it a feasible source of energy we would need some funding?

PROFESSOR RABE: My point is simply that in the case of these particular policies at the state level, the renewable energy mandates, that solar is proving to be so much more expensive per unit of electricity than had been projected and in comparison to many other sources that are available to satisfy the requirement, that manufacturers and producers and proponents of solar are seeing that they are coming out as net losers in many cases. So they are demanding, as part of the terms of throwing in their support behind these special treatments and provisions that would require basically an extraordinary expenditure, or a carve-out mechanism, or added credit — there are a number of ways to do this — to basically create an uneven playing field to increase their chances of being able to compete against whatever the particular source might be.

That is simply a response to short-term market conditions. Where initially, five years ago, the solar folks were much, much more sanguine about their prospects of competing against wind, geothermal, and other sources, they have been net losers in this short-term competitive marketplace, and now they are clearly looking for market advantage and protection. In that sense, it is not that different than the kind of protection that every fuel source is looking for or every energy source is looking for. That is simply the context I was speaking from.

QUESTION: Hi. I guess my question is really regarding large hydro. You were talking about Minnesota and Manitoba. Given that methane is a greenhouse gas, while not the CO_2, can you explain the justification for importing this large hydro from Canada as a Step 2 production method, which would increase methane, which is a greenhouse gas?

PROFESSOR RABE: Sure. It is not just in the export issue, but a fundamental question that any government has to contend with as they are looking at the definition of renewable energy is whether hydro belongs in it or not. As you point out, there are some greenhouse gases used, including methane, that relate to hydro. There are other kinds of environmental issues and concerns that emerge as well.

If you look across all the jurisdictions — not just United States, not just Canadian, across the world — no two really define hydro in the same way or put it in the same category or same classification. At the same time, per megawatt hour, per kilowatt hour, the greenhouse gas from hydro in all likelihood is far lower than certainly any fossil fuel source. It raises interesting questions of tradeoffs, balance, and all the rest.

I would only note that there have been some concerns raised by Canadian governments, most notably Quebec, which is a power source for certainly New York: that is, are those states in the Northeast that do not treat hydro as a fully fledged member of the renewable family discriminating in NAFTA against a Canadian export product?

QUESTIONER: Could I just add a point of information regarding New York State for the general audience here? New York State's RPS defines eligible hydroelectric dams as [inaudible] and nothing over 20 megawatts, which is, I think, a fair assessment of what is a damaging, unsustainable form of hydro energy. There is reference to what is a low-impact hydro on our Web site as a guide for what is small hydro. So I understand that Hydro Quebec wants to build

dams that are highly subsidized, and that should be looked at as well. But I just wanted to make that clarification for the general audience here.

PROFESSOR FOSTER: Last question.

QUESTION: Does it matter that big oil is comfortably in bed with 100 senators and administration after administration, or do we just put to the side, pockets bulging with money, that Thomas Nast would have been very excited about doing cartoons of? But maybe that is just not going to get into our conversation about decisions about energy.

PROFESSOR COPLAN: Yes. The answer is yes.

PROFESSOR FOSTER: On that note — go ahead, Barry.

PROFESSOR RABE: I think it interesting that we have been talking about different state policies. One thing economists are pretty clear about — and I am not an economist — is the cheapest way to achieve short-term greenhouse gas reduction is to increase the price. I think it interesting that, despite the very different politics across American states, the fact that ballot propositions are readily available, that you have not seen a carbon tax go forward in many of these state legislatures. To the extent it has, it has gone through on the sly. We talk about social benefit charges, this very, very small tax that goes on to electricity rates in about thirteen states, I believe including New York.

But if one really wants to be serious about it, take it to the ballot box, kick gas up to $7, $10, or $15 a gallon. It will reduce your greenhouse gases. But what is the level of political support? I think that is an interesting question and an interesting test.

PROFESSOR COPLAN: I think that one thing that Jeffrey Sachs said that troubles me is the idea that there is kind of a choice between an impoverished nation with a low standard of living and high child mortality or living like us, and that there is nothing in between, and what we should aspire to is allowing the rest of the world to come "up to our living standard."

I don't want to sound like a killjoy environmentalist, but I think that there are ways to enjoy life, have a good life, and have the basic health issues taken care of and nutrition issues taken care of, without having a 10,000-square-foot house and an SUV in the driveway.

I would hope that we find a happy medium in the ultimate solution to this that redefines what the good life is for the world's population, because I don't think we are ever going to get there with the idea that all the developing nations should aspire to use energy the way we do. I think we should aspire to use energy the way they do.

PROFESSOR FOSTER: Thank you. I'd like to thank again our panelists.