Robert Socolow

It's a great honor to be here, this wonderful committed community. It's a community that I've not addressed before. I have not tailored my remarks for you. I have a general way of thinking about the climate problem. I'm a science teacher; that's the designation I'm most comfortable with.

I want to tell you some of the ways I think about the climate problem. I want to pick up on the phrase that Mr. Ed Ott used at the beginning. "Transition to the new" is a much better title than the one I chose. The word "new" is in mine also, "Climate Change Mitigation: A New Source of Wealth and Jobs."

The atmosphere is not a very complicated thing from the viewpoint of carbon. We put carbon dioxide into the air when we burn fossil fuels. Half of it stays in for a very long time – centuries. The amount of carbon in the atmosphere can be weighed. It's a certain number of kilograms or pounds. It's 800 billion tons right now, if you just took all the carbon, isolated it and weighed it. It was 600 billion tons two centuries ago in the so-called "pre-industrial" period. It was 400 billon tons in the depth of the Ice Ages. It oscillated between 400 and 600 billion tons, with hundred thousand year cycles for half a dozen times, as we have learned.

A target that people talk about often is double the pre-industrial concentration. That would be 1200 billion tons. Those are the lines on that curve there. We're adding carbon to the atmosphere, and we see the consequences. It's not very complicated. The 1200 number is by many people's views not tough enough.

Not too many years ago, it was said in Washington in the Clinton Administration, "We're going to sail past 1200. Forget about controlling it at that number." There's a completely different view now. Maybe we actually can take charge of this problem, and *far greater* concern for what it means not to.

You say, “Is there science behind all of this?” This is a piece of ice taken out of a cylinder going down a couple of miles in Antarctica. It’s like tree rings. The deeper you go, the older it is, and there are bubbles trapped in that ice. One of my colleagues at Princeton, within a one or two-minute walk of my office, does kind of work. He slices these things. He dissolves the bubbles. He stares at what the content of the gas is, and he knows what the atmosphere was like in a previous time. This is science-based work. It’s got its uncertainties. It’s a vigorous community. It’s an under-funded community, but it gets on with the job and we know more every year.

One of the most interesting graphs is this graph here. How many of you have seen the Mt. Aloha graph? Well under half but getting to about a third of you. This is the poster child of the subject, in a way. This is annual readings; this is weekly and monthly reading of carbon dioxide concentration high on the mountain of Hawaii. Started in 1958 by scientists not at all sure they would find anything interesting, and prior to that, almost no understanding of how the carbon dioxide problem worked, within a year or two, they realized they had something very interesting. They had an annual cycle and they had a climbing curb. The curb has been going on like this and will go on like this.

The annual cycle is the exchange of carbon dioxide between the trees, the forests and the atmosphere. When the trees are growing and the leaves are coming out, the atmospheric concentration goes down. This is in the Northern Hemisphere. You’re seeing the Northern Hemisphere forests. In the winter, the leaves are decaying and the atmospheric concentration goes up. That oscillation, either going up or down, would have been seen ten thousand years ago if anyone had looked for it. The climb is because carbon dioxide is going into the atmosphere because we are pulling carbon dioxide out of the ground that wouldn’t have gotten there on its own in the form of coal, oil and gas. Again, this curve has been intensely studied and a lot is known about it. That’s all I’m going to say about climate and science.

Then there’s the question of the impacts. Again, I’m going to go very fast because this is not where I’m focusing the talk. The United Nations, in 1992 in Rio, developed the Framework Convention on Climate Change, FCCC. We signed that, the US. The Kyoto Protocol came much later. It’s in the Framework Convention on Climate Change that it is decided, it is announced what the global goals should be without a number, that we should stabilize greenhouse gas emissions. That meant the concentration should plateau in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Those words flow off the tongue of many of us, “Prevent dangerous anthropogenic interference with the climate system.” It didn’t say where that was, that point of prevention, *on purpose*. The diplomats knew they weren’t ready to do that. It is a very hard decision. It has to take into account both how hard the job is, and how dangerous it is to go higher. There isn’t an “on-off” threshold somewhere that one can just identify.

When we look at the consequences of climate change, increasingly one is realizing the critical significance of sea level rise, which itself is very uncertain. But these images are pretty provocative of what happens to Florida with one meter, two meter, four meter and eight meter temperature rise, Louisiana too, and the Carolinas. It’s not pretty. It already is affecting real estate values in Florida. One meter at the end of the century may be too high. At least it was thought so a couple of years ago. Now people are beginning to wonder whether one meter and even two meters *might* be possible.

My colleague [Stephen] Picala, with whom I wrote these *Wedges* papers, calls this one of the examples of “monsters behind the door; monsters behind the door, rattling the doorknob.” I like to think of it as several rooms, each with a doorknob, each with a monster, because they are acting independently. We don’t really know how tight those latches are. And we're talking about buying insurance far more than we are talking about avoiding a certain bad outcome.

The carbon that is going into the atmosphere is being dug out of the ground. It’s very simple. The biological carbon is in equilibrium, back and forth between the atmosphere and the forest. The carbon we’re seeing in the atmosphere is coming from fossil fuels. If we look at this curve, we realize that until 1950 this wasn’t growing very quickly. Coal was the dominant fossil fuel, that’s the brown line. By the time we’re at 2000, far more carbon is going into the atmosphere being dug out of the ground and the globe, than say fifty years ago.

I want to take that number, this is in a weird unit that I don't want to use, but instead talk about billions of tons of carbon, which is what I've been talking about so far. We're putting 7 billion tons of carbon into the atmosphere, taking about the same amount out of the ground each year, and about 4 [billion tons] are staying there. The oceans are picking up some, which by the way, is acidifying the surface ocean as it goes there. The forests are in fact growing somewhat even though we are deforesting. The net is actually into the forest today.

Take this number, 7 billion of tons of carbon a year, and take that number away with you. That's the amount of carbon going out of the ground and going into the atmosphere each year. Take a look fifty years back as we did a moment ago. Roughly 2 billion tons of carbon were going into the atmosphere then.

We have a present problem, which in some sense we don't have to fault ourselves too severely for not attacking fifty years ago. It's a three times bigger issue now. It would have been good to get started further back, but we have enough time if we get started now.

I've drawn this picture with a lot of white space to the right to pose two questions, and in the process to tell you what our *Wedges* paper is all about. One question is, if we do nothing about carbon, if we simply decide that Senator Inhofe is right and that this is a "hoax," (some audience laughter), then we would have the carbon climbing at some rate. There are thousands of papers from people who are called econometricians, about giving the various growth rates and introductions of new technology, development of the developing world at this or that rate. What amount of carbon would be pulled out of the ground and placed into the atmosphere fifty years from now?

The other question is, if we really care about the carbon problem, how fast should we work, how much lower should the carbon emissions be fifty years from now? Again, at least a thousand papers, completely different set of authors, people concerned about environmental affects like sea level rise, like changes in storm patterns, and so forth.

What Pacala and I did was to say that it's so complicated that we could make it simple. Let's draw two lines. 1.) Double the emissions fifty years from now if we do nothing. 2.) Keep it flat and feel proud of yourself. That in-between space is called the stabilization triangle. It's fifty years out. We've haven't had much of the literature fifty years out. Most of it was about one hundred years out. There are some people in this audience who are going to be around fifty years from now. Not many are going to be around one hundred years from now. We really *can* think this problem though in fifty year chunks. At least that's our proposal, identifying the interim goal of admitting no more carbon globally fifty years from now than today. That is a tough interim goal! Let's keep it in mind.

The criticisms of this figure have been of the same affect. The people who see this steep rising line say that, "It isn't rising steeply enough; we're going to do worse than that if we do nothing." The people looking at the flat line say, "That's not good enough; that's too much temperature rise and climate change. We ought to do better than that." Keep that in mind as I describe what it would take to achieve this particular triangle.

Let me make one other comment about this number, 7 billion tons of carbon, now and in fifty years. That's pretty close to the number of people that we have on the planet today and are likely to have in fifty years. 6 [billion people] might turn into 8 billion people. It's roughly a ton of carbon per person per year, if we identify our share. I'm going to try to tell you a few examples of what a ton of carbon per person, per year amounts to, so we can get our bearings.

First, let me consider why we could be optimistic. We should be optimistic about the interim goal. There are three reasons. First, the world has a terribly inefficient energy system today. I always look at the ceiling when I say that, except in very few places. I have no trouble confirming that we have an energy inefficient system. The lighting in our room, in this room, is typical American lighting of the1960s, '70s, '80s, and '90s. We like this kind of décor, but it is much less efficient than we can do.

Carbon emissions have just begun to be priced. In Europe they are priced. In America, they are not yet priced, but it's very close. We want to talk throughout these two days about what the alternative ways are of pricing carbon. It will cost money to solve this problem. This is an externality. It is an un-priced quantity today.

Finally, and this I think this is especially relevant to some of you here. Most of the 2055 physical plant is not yet built. We will build it badly or well. If we build it well, it may even cost somewhat more money just on first cost, to spend less than operating costs. These are the three reasons for optimism.

Then Pacala and I did one other thing. Because we were using units which went from zero to seven to fourteen, we said suppose we talk about 1 billion tons of carbon per year, not admitted to the atmosphere fifty years from now as a result of a campaign, of a strategy, of a coordinated effort, globally coordinated effort probably. Then call that, give that a name, there was no name, call it a "wedge." Seven wedges fill the triangle. Now go on a "wedges" hunt. Find out what quantities of "stuff" make a wedge. Talk about a portfolio of wedges, a coordinated strategy, alliances. That's one of the reasons we're here. It's about alliances; that very picture is about alliances.

Where do we find wedges? A little further back than today, there were 6.2 billion tons of carbon going into the atmosphere. Here's a way of disaggregating by fuel, gas, oil and coal. You see that gas and oil are about in a tie, with gas about half as much as the other two.

Going the other way, electricity is about 40 percent of the carbon emissions. 40 percent of the carbon dioxide that goes into the atmosphere is leaving at power plants. Not less than 40 percent, which would say it's unimportant, nor way above 40 percent, which would say that everything else is unimportant. It's a big player, but it's not the only player.

The second biggest block there is transport from oil. Between the two, they're only half.
This is a disaggregated job. This is a multi-component job. On the right, these white rectangles are direct use of fossil fuel in stationary applications in a steel foundry, in a direct use of gas and

oil in your home for heating, in coal distributed to a Chinese village for indoor cooking and heating, in little packages.

We put down fifteen ways to make a wedge. This is from our *Scientific American* article of September 2006. It wasn't a complete list, and we said so. The big categories were end use, energy efficiency and conservation, which I do believe is the single most important place to look for wedges; power generation, carbon dioxide capture and storage, which I'll say more about, alternative energy sources, both renewables and nuclear, and then the agriculture and forestry sector. We left out many things; we didn't try to have a complete list. I have to pick some priorities in this. Initially, our view was we're just putting this list together. Let other people debate. Over the last three years, I more and more realize that I have preferences. It's time for me to enunciate them.

Number one is the efficiency area. We have to invent a "smart carbon post-industrial society." This carbon is coming from wealthy, middle class, lower middle class people, working people. It's not coming from the villages. It's not coming from the absolutely poor people. It's as we get wealthier, how we consume, and how we use that carbon. 60 percent of the oil today in the world is used in vehicles. I think it's 70 percent in the US. 60 percent of the electricity is used in buildings. It's over 70 percent in the US.

We have to think about fundamental ways in which we affect the way in which we consume carbon. All the way back to things like property tax systems that today encourage sprawl. We would change them to invigorate cities. New norms of business and professional face-to-face contact that enable reduced work-related travel, video conferencing. We have challenges to do less unwanted travel. We have to identify the things that we are doing, that we're just doing because we haven't tried very hard to do something else.

In the case of efficient use of fuel, here's one of your tons of carbon. If you have a 30 mile a gallon car and drive it 10,000 miles a year, you're putting your ton of carbon in the atmosphere just doing that, if you don't share it with anyone else. Okay. That's a ton of carbon. I, by the way looked at my own home bills in New Jersey, not a "McMansion." I put about a ton of carbon into the atmosphere in my natural gas, heating the house. There are lots of tons of carbon in our lifestyles. I can split that one with my wife, so it's only a half. (Some laughter.)

We work around this. Princeton University did a study of its own use and we split that among 10,000 people. It's 3 ½ [tons]; it's in the laboratory buildings and things like that.
1 ton of carbon a year is not a lot. Yet, that's the global average we're aiming for
before we bring it down further than that. By the way, I neglected to say, keeping emissions constant is not going to do the job of atmospheric stabilization. It's the first fifty-year job. It's the following fifty years, by cutting below that maybe by a factor of two or three below, that emission level to get really the stabilizion.

I'm breaking the problem into two fifty-year segments. The world is probably going to have 2 billions cars, fifty years from now. At least that's what the auto industry expects, about three times the present number. If those are 10,000 mile-a-year cars, and they go 30 miles a gallon, that will put 2 billion tons of carbon into the atmosphere, just that way. If they're 60 mile-a-gallon cars instead, that's a wedge. The campaign to get 60 mile-a-gallon cars in the world is a wedge. It also is a wedge if they're 30 mile-a-gallon cars, but they go 5000 miles a year because we've reorganized our cities, and people drive essentially less to get things done. If you do both, that's a wedge and a half.

Similarly, with electricity, bearing in mind that so much of electricity is used in buildings, the way to find wedges is to reduce electricity consumption in buildings. Roughly, a quarter reduction of where we're heading, I think would be a wedge. Commercial and multi-family buildings; it's mostly, by the way, half residential and half commercial. The growth is faster in the commercial sector. That means shops, government buildings, hospitals and schools over-lit, poor quality air-conditioning. There have got to be different designs. There's got to be opportunities all over the place to pick up some carbon in this direction.

The second priority is to deal with something, which has surprised many of us, the rush to coal. If you go back four or five years in this country, a rush to coal was not expected. There was an enormous construction of natural gas power plants on the grounds that natural gas was going to be for several decades – the fuel of power, electric power. Then it turned out that that was a *great* misjudgment, one of the most amazing lemming-like behaviors of businessmen one can find in recent times. We now understand that coal is going to be cheaper. At least until one has externalities applied to it, which brings its costs up, which may be appropriate.

There's now an expectation that there will be 1800 large coal plants, a thousand mega watt or one giga watt coal plants. That's a typical large coal plant. Sometimes they are somewhat smaller, a thousand mega watt coal plants, 1800 of them built between now and 2030. This is the European projection, and it's been raised relative to 2 years ago. 700 of such plants will put a billion tons of carbon into the atmosphere. A campaign, a strategy that doesn't let 700 of those plants get built, and builds something else instead, is a wedge. I'll be showing you some coal avoidance wedges. More generally, I focus on coal plants because they're going to be around a long time. They're going to be around fifty years or more.

This graph was suggested to me by David Hawkins of the Natural Defense Council. He started saying, "How much carbon is a commitment when we build a coal plant?" The left-hand blue barrel is all the coal we've taken out of the ground since we've started taking coal out of the ground. The right-hand barrel is all the coal we're going to have to take out of the ground to handle those power plants I just mentioned, that are likely to be built in the world between now and 2030. They're about equal.

We don't talk about carbon commitments of new construction, but we need to start thinking that way. We don't report those numbers. We don't estimate those numbers. They require a decision about what the likely lifetime is, but that isn't all that uncertain.

I also want to identify, especially for this audience, how old our coal and nuclear plants are. This is a wonderful little graph, which I got recently from the Energy Information Agency, which shows the power plants we have in this country, by the year in which they came online. The 1965 to '90 period is where we did all of that work. Then we stopped building power plants until we went through this binge about natural gas power plants at the far right. Both our coal and our nuclear plants are twenty to forty years old, as you know better than I. All through there are judgments to be made about retirement, re-licensing, grandfathering, a policy called “scrap and build.”

You guy and gals in this room have an enormous role to play in thinking through how to deal with our existing stock. I don’t know if you plan to have a discussion of that, but I really recommend that you do.

What are the non-coal alternatives? Renewables are very exciting. Wind displacing coal can probably produce a wedge, globally, and a lot of wind in the US. It’s a huge amount of wind that is a wedge. It’s one million, two mega watt windmills. A two mega watt windmill is about one hundred meters high, as this one in the picture is. It’s got about a one hundred meter blade diameter. It’s five hundred feet to the top of the blade, and it’s going straight up. We’ve gone about four percent of the way so far.

This is a big job. It’s a real job, and there’s wind in the Central Great Plains in the US sufficient to make a wedge, or our share of a wedge in the US. And then high voltage transmission lines to bring it to Chicago or Denver or where ever it makes sense to bring it.

Photovoltaic power is somewhat different from wind because it comes in both the centralized and the decentralized form. I love this picture of the PV on the camel’s back. I’m not sure what the Bedouin is doing with the power, maybe powering a radio. But there it is, as well as a modern home, as well as centralized deployment, as much as with the wind.

Concentrating solar power is not getting as much attention today, but watch for it. It’s being tried out now in some new ventures. It was tried in the 90s; it worked. It made it until some subsidies were drawn. When they were withdrawn, the company went bankrupt**,** but the plants kept operating. And this is the scale, again, desert scale deployment, another place to get a major renewable energy source to substitute for coal.

And then there's nuclear. Our paper would not have gotten the attention it got, if we had dropped nuclear on an ideological ground. We wanted to say, "Let's make a complete list, let's tell the truth." Nuclear is an option; it's a problematic option. We have major decisions to make about it in every country. If we were to substitute seven hundred giga watts of coal with seven giga watts of nuclear, that's twice as much as we have right now, as we triple the nuclear fleet globally. We have a hundred in this country, two hundred and fifty in the rest of this world in this unit. They're roughly the size of the plants. If we phase out nuclear power, that's going backwards by half a wedge, and we might decide to do that.

We don't have to do everything on the list, but we have to do most of the things on the list. When I say every wedge can be done badly or well, I really don't have favorites without discussion of the details. Every one of these technologies, including efficiency, can be done in a very counter-productive fashion.

This is a cascade of centrifuges, reminding us that we now enrich uranium on the way to making nuclear power. This is essentially what Iran is building right now. It is driving us all nuts! It is unfortunately legal. We don't have the right legal system to govern nuclear power internationally; we have to change that if we're going to go forward.

Then there's carbon dioxide capture and storage. The coal industry does *not* have to fold its tent. This is a terribly important fact. We have an option, as far as we can tell, that will work to put gigantic quantities of carbon dioxide below ground, associated with the emissions of a coal power plant. It may determine where the coal power plants are cited. It will certainly raise the cost of coal electricity, but it does give the coal world a chance to compete if they can make it work.

I want very much to tell the coal industry, "You have a chance here." They are *now*. It's changed a lot in the last six months in this country. To say, "Okay, those are the rules, give us a chance. Let's discuss how we share the risks of the early projects," and so on.

This is a picture of a plant that isn't capturing this carbon dioxide. It is a coal gasification power plant, built in the late '90s by the US Department of Energy, as a demonstration plant in Wabash Indiana. The other one is in Tampa, Florida. These two demonstrate that you can degasify coal and make electric power, and with somewhat further downstream processing could capture this carbon dioxide, make power from hydrogen, the left-over of the separation process, and put the $C0_2$ somewhere below ground. This is an image of the carbon moving into a formation, a porous formation below ground. It's going to be about a mile down, this carbon dioxide, large quantities of it.

To think about costs, I made this little image. It is, I think, two cents a kilowatt hour extra cost, for capturing this CO_2 at a coal plant. The coal itself is about a penny a kilowatt hour. The plant capital is about three cents. If you're in the coal industry and the tax is applied to you, it's tripling the cost of your coal. Not a pretty prospect.

If you're in the power industry, the bus bar cost as it leaves in the high voltage lines for our homes, is four cents a kilowatt hour, and that's a fifty percent increase. When we're buying the electricity at home, its ten cents a kilowatt hour. As you know, New Jersey's more like fifteen, but let's say ten cents is a national average, and then it's a twenty percent increase. The same carbon price is an entirely different phenomenon, if you're looking at it from these three different perspectives. That is another part of the politics of this subject.

There is a demonstration project in California that Schwarzenegger has blessed. BP and Mission Energy are building together, at an old refinery in Long Beach, California where not coal, but petroleum coke, the residue of the refinery, will be gasified, coming on line in a couple of years. Four years I think. Then the carbon dioxide will be separated and put into an old oil field for enhanced oil recovery. Five hundred mega watts of electricity, 4 million tons of $C0_2$, sent off-site.

Where it's going off site, is for something called "enhanced oil recovery." This is an interesting coalescence of both the security concerns and the carbon concerns. The $C0_2$ has value in a limited number of places. One of them is at the oil field of an older field. The carbon dioxide can increase what's pulled out of ground, as oil. If we want more domestic oil production, this is a very important way do it. Generally, CO_2 has been expensive. The costs are coming down. The option of bringing CO_2 from a coal power plant, properly cited, to the oil industry is very real.

This played a major role in the discussions *not* to build a Texas coal plants just a few months ago. They were not going to be built with carbon dioxide capture and storage. If they are, it's a very different picture from a Texas perspective. A thousand mega watt coal plant will produce about 6 million tons of carbon dioxide a year. Our estimate it that 30 – 80 thousand barrels a day, additional oil production can be brought about.

Coal-based synthetic fuels is being discussed a lot in Washington right now. Senator Obama is very fond of this, from the state of Illinois. It didn't take him long to catch onto the idea that if he didn't *also* talk about carbon dioxide capture and storage at the coal-to-liquids plant, it was not going to go anywhere. Governor Schweitzer, from Montana, made the same discovery about the politics of the problem when he talked about the same subject. There is a Blue-Green Alliance around synthetic fuels from coal and CO_2 capture and storage below ground. We don't know that the whole package will work, but at least we can say that "We'll only do it if it does work." Then we are moving in the right direction.

I want to say just one word about the poverty issue. We've heard about environmental justice. Global environment justice means dealing with the 2 billion people who have no access to electricity who are burning dung or twigs for cooking fuel, often indoors with the worst indoor air pollution problem. The worst environmental problem, from a public health point associated with energy, is indoor air pollution in villages where people are burning solid fuels. There are record levels of pollution in those spaces. I decided to understand how much additional carbon would be going into the atmosphere if we brought to the poorest people, carbon in the form of propane canisters, so-called "liquid petroleum gas," which is what the lower middle class burns in an Asian city. Get that into the villages, and it would be more carbon dioxide going into the atmosphere. When it came to electric power, maybe it would be a diesel engine instead of a PV. It isn't a lot of carbon when you deal with 2 billion people because you're getting them from abject poverty to standard poverty. You're getting them onto the first or second rung of some ladder.

There would be an extra two tenths of a wedge, the way I was calculating, to deal with 2 billion people.   It isn't about poverty, abject poverty and the millennium goals, this global climate change.   Their problems are separate. We can do both, and they don't get in each other's way. In fact, I think an international commitment helps; one helps the other.

Finally, next to finally, here's picture of a US analysis done by David Hawkins and Dan Lashof at the Natural Resources Defense Council. This is the image that was in Gore's movie, by the way. Although our names are attached to the wedge concept, they did the work for the US. The most important difference between this triangle and the triangle you saw before. The global triangle had a flat bottom. This has a descending bottom. Why? Because the US share of a global goal, in keeping carbon emissions constant, has to be to reduce our own carbon in order to make room for some amount of growth of the carbon emissions in the developing world.

Tony Blair enunciated an eighty percent cut for Britain. Governor Corzine, of New Jersey, has identified an 80 percent cut for New Jersey, fifty years out. Those are tough. 60 percent would be somewhat easier. This is a 60 percent view. It has electricity and use efficiency, industrial end use efficiency, vehicle efficiency, renewable energy, and carbon capture and storage as the chosen elements of this particular exercise. Somebody called our *Wedges* analysis the IPod of this field. You fill it with your favorite things. (Laughter.)

So finally, messages for labor. First of all, welcome this challenge. It is a new source of wealth and jobs. We are bringing something into the market that wasn't there before. We are saying there is a price on carbon emissions. That means there's money to be made and jobs to be had dealing with that problem.

Press for forceful technology enabling domestic policy to get started soon. My single greatest worry about what the next few years is – that we'll settle for something called "mitigation light." Mitigation light is the "right" policies with the "wrong" numbers.   We feel good, but the business is paid just as a cost of business, they don't do anything different in the way of investments. Investments don't follow, and that often takes the form of a very low safety valve in a cap and trade system, which essentially means that nobody has to feel enough pressure to build something new. We don't want that. We want forceful policy.

The number I use is thirty dollars a ton of carbon dioxide as a price, as a target price for say ten years out. That would make a lot happen in the renewables world, and the efficiency world, and in the carbon capture and storage world. It can't be on its own. It has to be accompanied by policies that we're getting to know, like renewable portfolios standards and appliance standards. It can't be on its own.

Finally, internationally, we have to press the US leadership**,** we have to press for US leadership to assure that the US is a major exporter of carbon smart technology, not a country that buys all the stuff from somewhere else. Thank you very much.