

SOIL CARBON SEQUESTRATION

FIELD HEARING
BEFORE THE
SUBCOMMITTEE ON SCIENCE, TECHNOLOGY
AND SPACE
OF THE
COMMITTEE ON COMMERCE,
SCIENCE, AND TRANSPORTATION
UNITED STATES SENATE
ONE HUNDRED EIGHTH CONGRESS
FIRST SESSION

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JUNE 6, 2003
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SENATE COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION

ONE HUNDRED EIGHTH CONGRESS

FIRST SESSION

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SOIL CARBON SEQUESTRATION

FRIDAY, JUNE 6, 2003

U.S. SENATE,
SUBCOMMITTEE ON SCIENCE, TECHNOLOGY, AND SPACE,
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,
Manhattan, KS.

The Subcommittee met, pursuant to notice, at 3:15 p.m. in the Alumni Center at Kansas State University in Manhattan, Kansas, Hon. Sam Brownback, Chairman of the Subcommittee, presiding.

OPENING STATEMENT OF HON. SAM BROWNBACK, U.S. SENATOR FROM KANSAS

Senator BROWNBACK. It is good to be here. Thanks for all of you coming out today for this field hearing. I know some had to travel some great distances. Mr. Hohenstein came in from Washington, D.C. last night. A number of others did as well. Others—Dr. Rice—had to walk across the street—

[Laughter.]

Senator BROWNBACK.—so he had to come a great distance, too, to be able to participate in this. I appreciate all of you being here.

Particularly, we have got a couple of staff members who traveled for the Senate Commerce Committee, Margaret Spring and Ken LaSala. I want to thank both of them for coming out from Washington for this field hearing on soil carbon sequestration.

When I was Secretary of Agriculture for Kansas, I learned quite a few lessons, and I met a lot of good people, some of them here in the audience today. One of the lessons I learned was to wear good cowboy boots, so that you can clean up easy. There are a lot of acres to walk in Kansas, and you are not exactly sure what you might step in in the process.

Now, a close second is, there are not a whole lot of issues where you can get a very broad consensus; between the agriculture community, the environmental community, the conservation community, but I think here we have found one. I think you are going to hear some more about it this afternoon, on how soil carbon sequestration works for everybody.

We had the Secretary of Agriculture in this state this morning, announcing a major USDA initiative on soil carbon sequestration. And I said at that time that I consider carbon farming, or carbon sequestration—we have got to find a better name for this—a “three-fer.” Number one, it is an income for U.S. agriculture, for Kansas agriculture. Second, it improves the soils by putting more carbon in the soils. And third, it is good for the environment. It cleans up the environment. This is a “three-fer,” and it is one that

you will hear a lot of broad support from a number of different sections.

We will hear today from Ms. Carey. She is with one of the environmental groups, and they are looking at the productivity of soils in Kansas and around the country, seeing the vast potential to bring carbon dioxide out of the atmosphere for ground storage. Carbon dioxide is perhaps the most difficult of the so-called greenhouse gases with which we are faced. Now, there are other emissions that scientists believe contribute more per ton of emissions to climate change. However, what makes CO₂ so tricky is that it is everywhere. As I drove here, my car emitted CO₂. As I speak, I am emitting CO₂. So some people would say, "Speak a little less"—

[Laughter.]

Senator BROWNBACK.—for that or other reasons.

People talk a lot about silicone these days. But if you really look at it, our economy is based on carbon. The tricky balance that we have to figure out, if we are to address the issue of climate change, is how to influence our net carbon output without hurting the economy, and that is the tricky issue to cover.

Many in the environmental community are going to be looking toward our agriculture producers to help with this by storing more carbon in the soil. For our producers, this notion of storing carbon by improving their land management practices has the potential to be a whole new market.

We are at a critical stage in the development of carbon sequestration, or carbon farming, and we need to encourage this emerging income source and environmental benefit to ensure that it manifests itself. And I think we will be hearing from USDA today on how we can encourage this along.

Today, we will hear from all of our witnesses on what we are currently doing and what we need to do; what we need to be focusing on. Dr. Rice will speak about what science is telling us about the potential for carbon sequestration. Mr. Walsh and Mr. Hartsig will tell us about their project at the Chicago Climate Exchange, which is now becoming functional. Ms. Carey will explain the details of a project Environmental Defense played a key role in facilitating.

Somebody who is not testifying, but I have traveled with, is the Nature Conservancy. Another interesting aspect of this is they have got projects in South America, in Brazil, where a number of groups, nonprofit business groups, have gone together, bought large tracts of land, and then turning it back into forest and measuring the carbon, as a huge carbon sink, which is good for the environment, good for the soils there, and good for soybean producers here to put some of the land back where it should be in rain forests and not broken out in soybean production.

In addition to the work which is going on in the Administration and the private sector, we are on the energy bill right now in the Senate floor, with our last vote for the week last night. Senator Craig, from Idaho, Senator Wyden, a Democrat from Oregon, and myself are working to include language on carbon sequestration in the Senate energy bill, which is the current business on the floor. This amendment will encourage both forest and soil sequestration. We have a broad bipartisan coalition sponsoring this amendment. We have been working with the Energy and Agriculture Commit-

tees on both sides of the aisle, and we think we have a good shot of sending a bill to conference that includes our language. Building on the language we were able to include in last year's farm bill and the positive steps announced by Secretary Veneman this morning, I believe we are looking at a solid boost for the sequestration movement.

One final note. In recent years, this issue of global climate change has been very divisive. One of the important features of the issue of soil carbon sequestration is that it does not require anyone to presuppose the importance of climate change. The change in land management that increased the carbon load had many other environmental benefits. Better management will mean decreased soil run-off, improvements in water quality, and, in some cases, improved productivity.

One other side note, we just had 2 days of debate and votes on ethanol on the Senate floor in the energy bill, and we passed, overwhelmingly, a ethanol—we beat the ethanol amendments back, and we kept in the bill an ethanol package that will more than double the use of ethanol in the United States. And I am hopeful that we are going to be able to shepherd that the whole way through the process. There is also a renewable fuels title in it, to increase the use of renewable fuels—bio-diesel and some others.

The reason I mention that here is that that is also a contribution that agriculture makes on CO₂ emissions. It does not have a net contribution on CO₂s, and it is not a release; it is cyclical CO₂ work that ethanol and bio-diesels contribute, and it was something the Secretary cited this morning.

I, once again, want to thank you for being in attendance. I want to thank the witnesses for being here, and I look forward to their statements.

We have two panels that will be testifying today. The first panel will be Mr. William Hohenstein. He is the director of Global Climate Change Program Office with the U.S. Department of Agriculture in Washington, D.C. And our own Dr. Chuck Rice, he is a professor at Kansas State University, the lead researcher on carbon sequestration, and heads an overall committee that is working on this topic.

Mr. Hohenstein, we will hear your testimony first. Appreciate very much your being here to testify.

**STATEMENT OF WILLIAM HOHENSTEIN,
DIRECTOR, GLOBAL CHANGE PROGRAM OFFICE,
U.S. DEPARTMENT OF AGRICULTURE**

Mr. HOHENSTEIN. Mr. Chairman, thank you for the opportunity to be here to discuss the Department of Agriculture's carbon sequestration programs and to outline the steps within USDA to address the long-term challenge of global climate change.

The issue of climate change cuts broadly across the Department, involving several agencies and mission areas. I would like to start my testimony by explaining how we are organized.

We coordinate the day-to-day management of the Department's activities through the staff-level Global Change Task Force. To provide policy guidance, the Secretary created a Climate Change Working Group that is chaired by the deputy secretary and in-

cludes the undersecretaries for all the relevant mission areas—Foreign Agriculture Service; Natural Resources and Environment; Research, Education, and Economics; and the Rural Development—as well as the general counsel and the chief economist.

The Department plays an active role in government-wide activities to address climate change as well, including scientific research, technology development, international, bilateral, and multilateral cooperation, efforts to encourage actions of the private sector, and policy development and implementation.

Earlier today, Secretary Ann Veneman announced a series of actions that the Department will take to increase carbon sequestration and reduce greenhouse-gas emissions from forest and agriculture. The actions announced today represent a major step for the Department. For the first time, USDA will consider the reduction of greenhouse gases in setting priorities and in allocating resources within the portfolio of conservation programs we administer. The actions announced today build on the foundation of ongoing research and technology development conducted by our researchers and our cooperatives, including the CASMGS Consortium that you will also hear from today.

Coupled with increases in overall conservation spending, these actions to increase carbon sequestration and reduce greenhouse-gas emissions will increase them by over 12 million tons of carbon equivalent in 2012, which represents approximately 12 percent of President Bush's goal to reduce greenhouse-gas intensity of the American economy by 18 percent in the next decade.

USDA's conservation programs were designed to offer assistance and incentives to farmers and other landowners in addressing multiple conservation and environmental challenges. Historically, programs have focused on reducing soil erosion, improving water quality, creating wildlife habitat, reducing air pollution, and protecting sensitive areas.

While maintaining these priorities, the programs will now include explicit consideration of greenhouse gases. We can accomplish this without compromising our other objectives, because, in many cases, the technologies and practices that reduce greenhouse-gas emissions and increase carbon sequestration also address other conservation priorities. For example, planting trees and other natural covers can increase the amount of above- and below-ground carbon. However, land does not need to be taken out of production to sequester carbon. For example, conservation tillage reduces soil organic matter, oxidation, and decomposition; thus, more organic matter is maintained in the soil.

There are many opportunities to apply these practices in the U.S. Most U.S. crop-land soils have lost at least a third, and some up to 60 percent of the carbon since they were first converted to crop production about 200 years ago. This diminished carbon pool can be replenished by improving land management.

Under the EQIP program—the Environmental Quality Incentives Program—Natural Resource Conservation Service Chief Bruce Knight provided guidance to states to reward actions that sequester carbon and reduce greenhouse gases within EQIP's ranking system. These practices can include the conservation practices already

mentioned and technologies to reduce methane emissions from livestock waste.

Earlier this week, Chief Knight hosted a summit of one of these promising technologies, anaerobic digesters. Anaerobic digesters can reduce odors and pathogens and methane, a powerful greenhouse gas, from manure. The methane from digesters can be captured and used as fuel for power generation or direct heating on the farm.

At the summit, NRCS unveiled three new conservation-practice standards specifically for digesters. These new standards will have two major benefits. They will make it easier for producers to fit anaerobic digesters into their EQIP contracts as part of comprehensive nutrient-management plans, and they will make it easier for producers to use the technical service providers to plan and construct the digesters.

The Conservation Reserve Program and Wetlands Reserve Program can provide significant amounts of carbon sequestration. On Earth Day, Secretary Veneman announced that FSA will target 500,000 acres of continuous sign-up enrollment toward bottomland hardwood trees, an action that will increase the amount of carbon stored under the CRP. Bottomland hardwoods are among the most productive ecosystems for carbon sequestration in the U.S.

In another step to provide incentives for carbon sequestration, FSA modified the Environmental Benefits Index used to score and rank bids within the program. The revised EBI will give points specifically for practices that sequester carbon, giving these practices a higher priority under the program than they otherwise would have.

The Forest Service also has responsibilities in implementing the actions announced today by the Secretary. Using new authority established under the Farm Security and Rural Investment Act of 2002, carbon sequestration will be one of the formal objectives of the Forest Land Enhancement Program, or otherwise known as FLEP. Through FLEP, the Forest Service, working with the states, can provide carbon sequestration with tree planting, forest stand improvements, and agro-forestry. Forest and agriculture can also be the source of domestic renewable energy. USDA recently announced the availability of \$44 million in grants for energy efficiency, biomass energy, and bio-products.

USDA is working with partners in the private sector. This February, Secretary Veneman announced commitments from the American Forest and Paper Association and the National Rural Electric Cooperative Association. These organizations and the other companies in industrial sectors are making commitments under the Administration's Climate Vision Program. Companies with an interest in forest and agriculture carbon sequestration are looking to USDA to give them the tools they will need to measure and report their actions.

Last year, USDA was directed to develop new accounting rules and guidelines for reporting greenhouse-gas emission activities on forest and agricultural lands for use in the Department of Energy's Voluntary Greenhouse Gas Reporting System. The DOE reporting program is undergoing revisions that are expected to be completed in January 2004. The Forest Service and NRCS have taken respec-

tive leads for the forest and agricultural components of these guidelines.

USDA has undertaken an extensive public-comment process that included two well-attended workshops in January 2003. We have solicited written comments from the public on our process, and we will provide additional opportunities for public input before the accounting rules and guidelines are finalized.

USDA's research program plays an important role in the Government's efforts, as well. The budget for USDA's participation in the U.S. Global Change Research Program and Climate Change Research Initiative has increased in each of the last 2 years. USDA's Fiscal Year 2003 budget for the CCRI and U.S. GCRP combined is \$63 million, up from \$57 million in 2002. In Fiscal Year 2004, USDA is requesting an additional \$7.1 million for President's CCRI priorities.

The increases requested in 2004 fall primarily in the following areas: improving methods for measuring and estimating above- and below-ground carbon storage in forest and agricultural systems; collecting carbon-flux measurement data at specific locations that can be scaled to regional and national estimates; developing management practices and techniques for increasing carbon storage sequestration and reducing greenhouse-gas emissions; demonstration projects to facilitate the incorporation of sequestration into USDA's programs; and finalizing the new accounting rules and guidelines.

As we continue our research and improve our understanding of how crops, livestock, trees, pests, and other facets of ecosystems will respond, either positively or negatively, to higher levels of greenhouse gases in the atmosphere, we are now moving forward to harness the portfolio of conservation programs to build carbon back into the soil and vegetation, increasing greenhouse-gas considerations in our conservation efforts.

Thank you for the opportunity to address the Subcommittee. I am now available to answer your questions.

[The prepared statement of Mr. Hohenstein follows:]

PREPARED STATEMENT OF WILLIAM HOHENSTEIN, DIRECTOR, GLOBAL CHANGE PROGRAM OFFICE, U.S. DEPARTMENT OF AGRICULTURE

Mr. Chairman and Members of the Subcommittee, thank you for the opportunity to discuss the Department of Agriculture's carbon sequestration programs and outline the steps being taken within USDA to address the long-term challenge of global climate change. The issue of climate change cuts broadly across the Department, involving several agencies and mission areas. We coordinate the day-to-day management of the Department's activities through the Global Change Taskforce, which I chair. To provide policy guidance, the Secretary created a climate change working group that is chaired by the Deputy Secretary and includes the Under Secretaries for all of the relevant mission areas: Farm and Foreign Agricultural Service; Natural Resources and the Environment; Research, Education, and Economics; and Rural Development, as well as the General Counsel and Chief Economist. The Department plays an active role in the government's activities to address climate change, including: Scientific research, technology development, international bilateral and multi-lateral cooperation, efforts to encourage actions in the private sector, and policy development and implementation.

Earlier today, Secretary Ann M. Veneman announced a series of actions that the Department will take to increase carbon sequestration and reduce greenhouse gas emissions from forests and agriculture. The actions announced today represent a major step for the Department. For the first time, USDA will consider the reduction of greenhouse gases in setting priorities and in allocating resources within the portfolio of conservation programs we administer. The actions announced today build on

a foundation of ongoing research and technology development. USDA researchers and our cooperators are improving our understanding of climate change and its implications for managed and unmanaged natural systems, the potential risks to agriculture and forests, and effective ways to sequester carbon and reduce greenhouse gas emissions from agriculture and forests.

The actions announced today include financial incentives, technical assistance, demonstrations, pilot programs, education, and capacity building. We are also setting out to improve our ability to measure and monitor changes in carbon storage and greenhouse gas emissions so that we can accurately track our progress in implementing these actions.

Coupled with the increases in overall conservation spending, these actions are expected to increase the carbon sequestration and greenhouse gas emissions reductions from the conservation programs by over 12 million tons of carbon equivalent in 2012, which represents approximately 12 percent of President Bush's goal to reduce greenhouse gas intensity of the American economy by 18 percent in the next decade.

USDA's conservation programs were designed to offer assistance and incentives to farmers and other landowners in addressing multiple conservation and environmental challenges. Historically, programs have focused on reducing soil erosion, improving water quality, creating wildlife habitat, reducing air pollution, and protecting sensitive areas. While maintaining these priorities, the programs will now also include explicit consideration of greenhouse gas reductions and carbon sequestration. We can accomplish this without compromising our other objectives because, in many cases, the technologies and practices that reduce greenhouse gas emissions and increase carbon sequestration also address other conservation priorities. Planting trees and other natural covers can increase above and below-ground carbon. However, cropland does not need to be taken out of production to sequester carbon. For example, conservation tillage (reduced, minimum, or no-till) reduces the extent of soil organic matter oxidation and decomposition by soil microorganisms that occur with plowing and tillage. Thus, more of the organic matter added to the soil remains, leading to increases in soil carbon.

There are many opportunities to apply these practices in the U.S. Most U.S. cropland soils have lost at least a third and some up to 60 percent of their carbon since they were first converted to crop production beginning about 200 years ago. This diminished carbon pool can be replenished by improvements in land management.

Under the Environmental Quality Incentives Program (EQIP), Natural Resources Conservation Service (NRCS) Chief Bruce Knight provided guidance to states to reward actions that sequester carbon and reduce greenhouse gases within the EQIP ranking system. These practices can include the soil conservation practices already mentioned and technologies to reduce methane emissions from livestock waste.

Earlier this week, Chief Knight hosted a Summit on one of these promising technologies—anaerobic digesters. Anaerobic digesters can reduce odors and pathogens and methane (a powerful greenhouse gas) from manure. The methane from digesters can be captured and used as fuel for power generation or direct heating. The Summit, held in Raleigh, North Carolina brought together farmers, Federal and state conservation officials, representatives from the power industry, inventors and technology developers, and the conservation and environmental organization representatives.

At the summit, NRCS unveiled three new conservation practice standards specifically for digesters. The performance standards lay out standard expectations for the technology but do not prescribe or endorse a particular vendor's product. One of the standards is for covers for new and existing lagoons; the second standard is for new ambient temperature digesters; and the third standard is for new controlled temperature digesters. These new standards will have two major benefits. They will make it easier for producers to fit anaerobic digesters into their EQIP contracts as part of a comprehensive nutrient management plan. They will also make it easier for producers to use technical service providers to plan and construct digesters.

The Conservation Reserve Program (CRP) and Wetlands Reserve Program (WRP) can provide significant amounts of carbon sequestration. Conversion of cultivated lands back into forests, grasslands or wetlands, which occurs on CRP and WRP lands, fosters the accumulation of carbon in soils and vegetation. On Earth Day, Secretary Veneman announced that the Farm Services Agency (FSA) will target 500,000 acres of continuous signup enrollment toward bottomland hardwood trees, an action that will increase the amount of carbon stored by the CRP. Bottomland hardwoods are among the most productive ecosystems for carbon sequestration in the United States. In another step to provide incentives for carbon sequestration, FSA modified the environmental benefits index (EBI) used to score and rank bids into the program. The revised EBI will give points specifically for practices that se-

quester carbon, giving these practices a higher priority under the program than they otherwise would have.

The Forest Service also has responsibilities for implementing actions announced by the Secretary today. Using new authority established under the Farm Security and Rural Investment Act of 2002, carbon sequestration will be one of the formal objectives of the Forest Land Enhancement Program (also known as FLEP). Through FLEP, the Forest Service, working with States, can promote carbon sequestration with tree planting, forest stand improvements, and agroforestry practices.

Forests and agriculture can also be the source of domestic, renewable energy. USDA recently announced the availability of \$44 million in grants for energy efficiency, biomass energy, and biomass products development. Twenty-three million dollars of this will be available from USDA's Rural Development for the Renewable Energy Systems and Energy Efficiency Improvements program to assist farmers, ranchers, and rural small businesses to develop renewable energy systems and make energy efficiency improvements to their operations. Farmers and ranchers are eligible for loan guarantees for renewable energy systems, including anaerobic digesters under the Rural Business and Industry Programs administered by Rural Development.

Through the Biomass Research and Development Initiative, in cooperation with the Department of Energy, \$21 million in grants are available to carry out research, development and demonstration of biomass energy, biobased products, biofuels and biopower processes. USDA also recently announced key revisions to the Commodity Credit Corporation Bioenergy Program to expand industrial consumption of agricultural commodities by promoting their use in the production of ethanol and biodiesel.

USDA is also working with partners in the private sector. This February, Secretary Veneman announced commitments from two industry groups with strong natural resource ties. The members of the American Forest and Paper Association have committed to actions that they expect will improve their greenhouse gas intensity by 12 percent by 2012. The members of the National Rural Electric Cooperative Association agreed to work with USDA to break down the barriers that farmers and ranchers face in generating renewable power. America's rural landowners can be a source of solar, wind, and biomass power. These opportunities can be win-win partnerships for the rural utilities and farmers.

Companies and industrial sectors are making commitments under the Administration's Climate VISION program. Companies with an interest in forest and agricultural carbon sequestration are looking to USDA to give them the tools they need to measure and report on their actions.

Last year, USDA was directed to develop new accounting rules and guidelines for reporting greenhouse gas activities on forests and agricultural lands. The new accounting rules and guidelines will be used by companies and individuals to report their activities to the Department of Energy under their voluntary greenhouse gas reporting system. The DOE reporting program is undergoing revisions that are expected to be completed by January 2004. The Forest Service and NRCS have taken the respective leads for the forest and agriculture components of the guidelines. USDA has undertaken an extensive public comment process including two well-attended workshops in January 2003. We solicited written comments from the public on our process and will provide additional opportunities for public input before the accounting rules and guidelines are finalized.

USDA's research program plays an important role in the government's efforts to understand climate change. The budget for USDA's participation in the U.S. Global Change Research Program (USGCRP) and Climate Change Research Initiative (CCRI) has increased in each of the last two years. The USDA Fiscal Year (FY) 2003 budget for CCRI and USGCRP combined is \$63 million, up from \$57 million in FY 2002. In FY 2004, USDA is requesting an additional \$7.1 million for the President's CCRI priorities. The increases requested for FY 2004 fall primarily in the following areas:

- Improving the methods for measuring and estimating above and below-ground carbon storage on forest and agriculture systems;
- Collecting carbon flux measurement data at specific locations that can be scaled to regional and national estimates;
- Developing management practices and techniques for increasing carbon sequestration and reducing greenhouse gas emissions;
- Demonstration projects to facilitate the incorporation of carbon sequestration into USDA programs;

- Finalizing the new accounting rules and guidelines for estimating and reporting carbon sequestration and greenhouse gas emissions from forest and agricultural activities.

Finally, USDA continues to invest in research to improve our understanding of how crops, livestock, trees, pests, and other facets of ecosystems will respond, either positively or negatively, to higher levels of greenhouse gases in the atmosphere. We are seeking cost-effective ways to make agriculture and forests more adaptable to any changes in climate and weather, should they occur. We are pursuing an improved understanding of the role of natural and managed ecosystems in the global carbon cycle. We are developing technologies and practices to reduce emissions of greenhouse gases and increase carbon sequestration. We are now harnessing the portfolio of conservation programs to build carbon back into the soil and vegetation, integrating greenhouse gas considerations in our conservation efforts.

Thank you again for the opportunity to address this Subcommittee. I am now available to answer your questions.

Senator BROWNBACK. Thank you, Mr. Hohenstein. I do have questions that we will go to afterwards, particularly falling on what the Secretary announced this morning. But thank you, and I am delighted to have you here.

Dr. Chuck Rice, thank you for joining us.

**STATEMENT OF CHARLES W. RICE, PROFESSOR OF SOIL
MICROBIOLOGY, DEPARTMENT OF AGRONOMY,
KANSAS STATE UNIVERSITY**

Dr. RICE. Thanks. Thank you, Mr. Chairman.

I am Dr. Chuck Rice, Professor of Soil Microbiology here at K-State. Welcome. I am a member and fellow of both the Soil Science Society of America and American Society of Agronomy, and I am pleased to testify on behalf of soil carbon sequestration.

I have personally been involved in soil organic matter and carbon research for nearly 25 years. In addition to my own research, I am responsible for directing the Consortium for Agriculture Soils Mitigation of Greenhouse Gases, or pronounced "chasms." This consortium brings together some of the Nation's top researchers in the area of soil carbon, conservation practices, modeling in economic and policy analysis. CASMGS is funded by a grant from the USDA Cooperative States Research Education Extension Service.

Concern has been mounting about the rapid buildup of carbon dioxide in the atmosphere and the potential implications for climate and the environment. However, as we discussed this morning with Secretary Veneman, agriculture can play a key role in solving some of these issues. Crops and other plants remove carbon dioxide from the atmosphere; and, as they are harvested, their residues and roots are deposited in the soil where they can remain for long periods of time, hundreds or even thousands of years. That is truly sequestered.

Carbon accumulation in our culture cells can be greatly improved by various forms of conservation management, such as no-till planting, different crop rotations, and replanting depleted soils with grasses. Recent estimates of the potential for U.S. agriculture to sequester carbon using existing technologies are on the order of 200 million metric tons of carbon per year, which represents 15 percent of the current carbon emissions in the United States, and this does not even include the potential for biomass production for renewable fuels, such as ethanol production that was mentioned by

the Secretary this morning, and it also does not include any additional advancements in soil and agriculture sciences.

Economic analysis suggests that soil carbon sequestration is among the most beneficial and cost-effective options available for reducing greenhouse gases, particularly over the next 30 years, and this buys us time for cleaner energy development. Therefore, the goal of our consortium is to provide the tools and information needed to successfully implement soil carbon sequestration programs so that we may lower the accumulation of greenhouse gases in the atmosphere, while, at the same time, providing in-common incentives for farmers and improving the quality of the soil.

To achieve this goal, the objectives of our consortium are to conduct research into mechanisms controlling carbon sequestration. For example, our team is looking at plant breeding as a means to improve the quantity and quality of carbon entering the soil; thus, ensuring longer stability of the soil carbon. And that research is being conducted here at K-State.

A second objective is to evaluate and make recommendations for best management practices to sequester carbon in the soil. I think this is one of the key short-term objectives of this consortium, as it will provide critical science-based information for the land managers, so that they know which practices they should use to improve the carbon in the soil. And if markets develop for carbon, these scientifically derived rates of carbon sequestration will provide the land manager and the buyer with accurate information so they can develop and negotiate contracts. This is really important.

In addition to the estimation of rates, we are assessing the economic and environmental benefits of improving soil carbon. We are determining the cost and returns from different management practices to help the producer make wise economic decisions, as well as the carbon decisions, and we are also documenting those other benefits associated with enhanced soil carbon. And this includes improved water and soil quality, wildlife benefits, and this is important to sustain this country's most important natural resource, the soil.

The third objective is to provide the necessary tools for quantifying and verifying soil carbon sequestration. This tool kit includes specifications for sampling of reference points on farm sites, and utilizing existing data bases, such as those developed by the Natural Resource Conservation Service, the soil survey and other information. It will also include, in verifying, the use of remote sensing and sophisticated computer models.

At Kansas State, we are partnering with USDA and Department of Energy in field testing a new laser instrument which can make measurements of soil carbon faster and more efficient; thus, reducing cost. This kind of research and technology development will support a carbon accounting system that will be verifiable and transparent for reporting changes in soil carbon stocks and be also able to withstand the reasonable scrutiny by an independent third party.

In fact, we are also developing collaboration with other countries to provide international consensus on the science behind carbon monitoring and verification so that it will be consistent worldwide.

And just to note, we will be hosting a forum at K-State here next fall to look at those issues and sharing that information worldwide.

Finally, a major outcome of the consortium is to provide information to stakeholders, including policymakers, so that we can devise sound policy, but also to the agriculture sector and the energy and transportation industries, to share that information among those industries.

CASMGS has much to offer, but needs to continue support for research and education. CASMGS is working in partnership with the Federal agencies, such as the USDA's Agriculture Research Service, Economic Research Service, and Natural Resource Conservation Service, and with private organizations, to provide the support for producers' participation and to develop reliable carbon offsets. This is a great opportunity for agriculture, the environment, the U.S. citizen, and the producer.

And I would like to thank you, Senator, for your initiative and leadership on these issues, and I would like to thank you for allowing me to testify.

[The prepared statement of Dr. Rice follows:]

PREPARED STATEMENT OF CHARLES W. RICE, PROFESSOR OF SOIL MICROBIOLOGY,
DEPARTMENT OF AGRONOMY, KANSAS STATE UNIVERSITY

Thank you Mr. Chairman and members of the Senate Subcommittee on Science, Technology, and Space of the Committee on Commerce, Science, and Transportation. I am Dr. Charles W. Rice, Professor of Soil Microbiology in the Department of Agronomy at Kansas State University. I am a member and Fellow of both the Soil Science Society of America and the American Society of Agronomy. I hold membership in several other professional organizations including Ecological Society of America and American Association for the Advancement of Sciences. I am pleased to be invited to testify on soil carbon sequestration. I personally have been involved in soil organic matter and carbon research for nearly 25 years. In addition to my own research I am responsible for directing the Consortium for Agricultural Soils Mitigation of Greenhouse Gases (CASMGS). The Consortium brings together the Nation's top researchers in the areas of soil carbon, greenhouse gas emissions, conservation practices, computer modeling and economic analysis, and is funded by a grant from the USDA-Cooperative State Research, Education, and Extension Service. The scientists are from major land-grant universities and a national laboratory. Participant institutions are: Colorado State University, Iowa State University, Kansas State University, Michigan State University, Montana State University, The Ohio State University, Purdue University, Texas A&M University, the University of Nebraska, and the Battelle-Pacific Northwest National Laboratory.

Concern has been mounting about the rapid buildup of carbon dioxide (CO₂) in the atmosphere and the potential implications for climate and the environment. Currently, the amount of CO₂ in the air is increasing by over 3 billion tons of carbon per year, mainly through the burning of fossil fuels (coal, oil and natural gas).

However, agriculture can help solve these problems. Crops and other plants remove CO₂ from the atmosphere and convert CO₂ into organic carbon. After harvest, the organic carbon in residues and roots is deposited into the soil, where portions can remain for long periods. Carbon accumulation in agricultural soils can be greatly improved by various forms of conservation management, such as no-till and re-planting with grasses.

Recent estimates of the potential for U.S. agricultural soils to sequester carbon, using existing technologies, are on the order of 200 MMT C per year which represents 15 percent of carbon emissions in the U.S. This does not include biomass production for renewable fuels nor advancement in soil and agricultural sciences. Economic analysis suggests that soil carbon sequestration is among the most beneficial and cost effective options available for reducing greenhouse gases, particularly over the next 30 years until alternative energy sources are developed and become economically feasible.

Under a private emission trading strategy, U.S. farmers, practicing appropriate conservation practices, could offer greenhouse gas or carbon credits to carbon emitters. Several companies have begun investing in carbon sequestration projects

in the U.S. and abroad, on a voluntary basis. Early estimates indicate that the potential for a carbon “credits” market for U.S. agriculture is \$1–5 billion per year for the next 20–40 years. Alternatively, government programs might be implemented to directly support farmers for adopting conservation practices. Either strategy would help mitigate the atmosphere’s greenhouse gas buildup while the needed long-term technical solutions are found for producing clean energy.

Carbon sequestration also benefits the soil. Increasing the organic carbon content of our agricultural soils greatly improves the quality and sustainability of our agricultural production systems. Higher organic carbon contents are directly tied to improved soil fertility and crop production capacity. The former Chief of USDA’s Natural Resource Conservation Service, William Richards, estimates that a percentage point increase in soil organic matter content (*e.g.*, going from 2 percent to 3 percent organic matter) translates into a \$250/acre increase in the value of Ohio farmland. Conservation farming practices and increased soil organic carbon provide other collateral benefits by reducing soil erosion and improving water quality and wildlife habitat.

Therefore the goal of our consortium is to *provide the tools and information needed to successfully implement soil carbon sequestration programs so that we may lower the accumulation of greenhouse gases in the atmosphere, while providing income and incentives to farmers and improving the soil.*

To achieve this goal our objectives are to:

1. Conduct research to better understand basic processes and mechanisms controlling carbon sequestration and greenhouse gas emissions. For example our team is looking at plant breeding, prairie management, and the mechanisms of carbon storage in soil as a way to enhance the long-term stability of soil C.
2. Evaluate and make recommendations for ‘best management practices’ to sequester carbon and reduce greenhouse gas emissions from soils. This information is critical to providing science based information to land managers so they know what practices they can use to improve the carbon in the soil. If markets develop for carbon these scientifically derived rates of C sequestration will provide the land manager and the buyer with accurate information to develop and negotiate contracts. In addition we are assessing the economic and environmental benefits of improving soil carbon. We are determining the costs and returns from different management practices to help the producers make wise economic decisions. We are also documenting other benefits associated with enhanced soil C, such as improved water and soil quality which will sustain this country’s most important natural resource, the soil.
3. Predict and assess carbon sequestration and greenhouse gas emissions at multiple scales, from field and farm-level decisions support tools to analyses of national economic and policy strategies using integrated models.
4. Provide the necessary tools for quantifying and verifying soil carbon sequestration rates and greenhouse gas emissions. Our team is developing such tools, which can be used nationwide. This tool kit includes specifications for sampling at specific reference points and utilizing existing soil surveys and databases, such as those developed by the USDA Natural Resource Conservation Service. It also includes the use of remote sensing and sophisticated computer models. We here at Kansas State University are partnering with USDA–NRCS and DOE Los Alamos National Laboratory to field test a new laser instrument which could make measurements of soil carbon faster and more efficient, thus reducing costs. It is this kind of new technology and research that will support the development of a monitoring network. A carbon accounting system must be verifiable and transparent for reporting changes in soil carbon stocks. That is, it must be able to withstand reasonable scrutiny by an independent third party. It must also be cost-efficient and based on the best science possible.
5. Provide information to stakeholders, including: policy makers, the agricultural sector, and the energy and transportation industries. We are collaborating with other countries to provide the best international science behind carbon monitoring and verification.

CASMGs has much to offer but needs continued support for research and education. CASMGs must continue to develop partnerships with Federal agencies, such as the USDA’s ARS, ERS, and NRCS, and with private organizations to provide support for producers’ participation and develop reliable carbon offsets. Thus, this is a great opportunity for agriculture, the environment, and the U.S. citizen and

producer. For more information see: <http://www.oznet.ksu.edu/tek/http://www.casmgs.colostate.edu/>.

CHARLES W. RICE,
*Professor of Soil Microbiology
 and Director of CASMGS,*
 Kansas State University.

Senator BROWNBACK. Thank you for your great work in this field.

Also a note—this morning, with the Secretary and myself, is Pat Roberts, my colleague in the Senate, and Pat has done a great job of being able to get research funding, funding for your group, to move this science on forward to a very practical implementation phase, and I know is very supportive of this overall push and has done a lot of great work on it already.

I want to ask a follow up on something that the Secretary announced this morning, Mr. Hohenstein. She said that people would be able to use—and maybe this is not anything new, but I want to make sure I am clear on it—be able to sell carbon credits off of CRP land. Is that correct? And could you elaborate on that?

Mr. HOHENSTEIN. Sure. The announcement this morning—and, actually, the decision to allow the private sale of carbon on CRP land codifies an existing decision that was made by FSA and NRCS, and it was codified in the interim rule. And essentially what it does is, it provides that the sale of carbon credits is an exempted use, an allowable use, under CRP contracts. And what that will allow is for farmers that are part of CRP contracts to enter into private third-party agreements with a company or an individual who is interested in purchasing carbon credits.

Senator BROWNBACK. Without any sort of penalty or reduction in payments under CRP, the current CRP program.

Mr. HOHENSTEIN. That is correct.

Senator BROWNBACK. OK, good. Because I think with the amount of acreage we already have in CRP in this state and across the country, this is a very practical initial place that the carbon is being stored in some significant way.

Dr. Rice, I have been meeting with you a number of years about this topic, and one of the key areas we have had needing work on development is just the measurement of carbon in the ground. It seems as if we are further along on being able to measure carbon in forest projects than we are in cropping projects. How far along are we on being able to develop the data so that a trading system could develop with the knowledge of a reliable system of—here is a carbon unit; it is fixed in the soil in Riley County, and this is available for trading? Are we close?

Dr. RICE. Yes, Senator, I think we are much closer to developing a system. It depends how you approach it. Certainly, there will have to be reference sites—or at least my feeling is there should be reference sites, or benchmark sites—to document change, but we cannot afford to document every acre or every farm. So it is going to take a combination of physical measurements, some sites that monitor and measure soil carbon, and we can do that relatively cost-effective and with a degree of accuracy. We just completed a research project here at K-State, looking at developing how you sample a GPS'd or benchmarked site, and that could be done very efficiently.

The question then is, How do you extrapolate from those reference points? Well, how many of those do you need? And then how do you extrapolate up to larger scales that would be projects or regional or national level? And again, part of the consortium is working on those techniques. But I think certainly the models and the remote-sensing techniques are there. We just need to apply them. And with the new technology, such as this laser instrument, that will make the system even more efficient.

Senator BROWNBACk. Now, how far are we away from the laser system that you were talking about?

Dr. RICE. Well, we are working under a project with NRCS. Over the next 2 years, we will be field testing that instrument. Basically, we will be able to go around the country and field test that to talk about errors or things it should or should not be measuring—for example, roots versus soil carbon, some things that are more temporary that would not be considered sequestered. So I think 2 years from now we will have a better view of this instrument. But the technology exists right now to measure carbon, as is.

Senator BROWNBACk. You feel we have the technology today to accurately measure fixed carbon in the ground for agricultural systems? That you feel like we are in good shape, even today? Maybe not as efficient in the measurement, but we can measure it and get it accurately measured today.

Dr. RICE. We can measure reference-point samples that we can come back to every three to 5 years, and we can definitely measure that, yes.

Senator BROWNBACk. Say, on a typical 160-acre tract of farm land in Kansas, how many reference points are you talking about? Or has there been any recommendation made from your group as to the number of reference points that would be needed?

Dr. RICE. Well, that is one thing we are working on. And the consortium, members of the consortium, are working on selecting those sites. One key thing will be determining the number of samples, but also stratifying that sample, based on landscape and soil type. But certainly we know that soils in a landscape will vary in the amount of carbon they can hold.

Right now, the research is—the information on carbon sequestration is using baseline rates for a particular practice, and then we are monitoring that practice and then going back in and verifying ground truthing; that after x number of years, 5 years, that those rates have been achieved. And I think that is where some of the other demonstration projects going on are working that system out right now.

Senator BROWNBACk. OK. But the consortium has not said, “OK, on 160 acres tillable land, cropping practices, regular annual cropping practice you have to have eight “verified sites.” Is that—I am sure that is an area of active discussion in your group.”

Dr. RICE. Yes, we are, and it is probably a little too early to answer that question. There are different ways to handle that. Using a good ground base of century model, which is—and some other models, but century seems to be one of the industry standards—and I know NRCS/USDA is using that model—that we can use the point samples to verify that the model is working. And then you can monitor the landscape with that model.

Senator BROWNBACk. Mr. Hohenstein, the same line of questioning. You have noted that you will need some funding, and will be doing some testing on the measurement issue. How far along are you? And how confident are you, in the system we have today for farmland cropping carbon fixing.

Mr. HOHENSTEIN. Sure. And this question of measurement and uncertainty is tremendously important. But it is not unique to agriculture. I think it is important to recognize that there are other sources of greenhouse gases, methane emissions from coal mines and from landfills, that also have some of the same issues about measurement uncertainties. I know agriculture oftentimes gets singled out as a source of uncertainty, but there are other components of the greenhouse-gas inventory that are uncertain. So that as a caveat, we are making improvements in our measurement systems.

And in many cases, when we are looking at developing these project-level guidelines, we are working back from the national inventory methods that we already have in place. And for crops-land soils, that involves a combination of default guidelines that were established by the Intergovernmental Panel on Climate Change, as well as the modeling approach that is used in the U.S., based on the century model.

And so using these national statistics that we have and the national estimates we have, in essence what we are doing to develop the project-level guidelines is disaggregating them into their base units so we can provide coefficients and estimates for carbon that is stored in particular areas for particular management types.

Also important to note when it comes to uncertainties is that the carbon that is sequestered in soil stays there. So, over time, it is almost an inherent ability to verify the carbon is there, and that carbon builds up over time and is easier to measure. So the year-to-year fluctuations of carbon are sometimes—have greater uncertainties than the buildup over longer periods of time. And that is something that is a unique attribute of sequestration practices that tend to reduce their uncertainties over the longer term.

Senator BROWNBACk. It is less uncertain over a long period than it is year to year.

Dr. HOHENSTEIN. That is correct.

Senator BROWNBACk. Well, do we have reliable measurement systems today that if—let us say we have got a tract of 160 acres, Riley County, Kansas, this soil type, this cropping system, this crop—that we can say today, “This is the amount of carbon we believe this will fix,” with some degree of certainty? Or is that still pushing the envelope?

Dr. HOHENSTEIN. Well, that is essentially what we have been asked to develop, by January 2004. And the researchers in the Ag Research Service and in NRCS are working on that. Now, we are doing that by disaggregating the data that is in these models that contains some assumptions, but also information about the carbon that is sequestered on particular sites or particular regions for particular practices that could be used as defaults.

In addition, we intend to provide measurement protocols. So if a farmer or a landowner or a project developer would not want to use the default methods and the default approaches, there would be a

set of guidelines for how to do site-specific estimation, potentially in the future using a tool like the one that Dr. Rice described.

Senator BROWNBACk. So you would have the option of either—we could go with this national set, which has a fair degree of modeling involved with it, or you can do an actual set of measurements on the particular site that you have, and you would offer these as either alternative in a likely future system?

Dr. HOHENSTEIN. I think the guidelines are still under development, but that is what we are anticipating we will be doing.

Senator BROWNBACk. OK.

Dr. Rice, from your perspective, what are some of the missing pieces we still need to jump start the carbon sequestration trades? What are the pieces?

Dr. RICE. Well, I think you mentioned one is the confidence in the accounting and monitoring and verification, and I think we are headed a long way toward that. There are some misconceptions that we cannot measure soil carbon, and I think we can. But I think once the guidelines come out, there will be some clear standards or signals of how you measure carbon. There is consistency across the country. Projects are developing their own standards or process, and there needs to be some consistency so that the industry has confidence, when you go from Kansas to Nebraska to Maryland, that there are going to be consistent guidelines for that so carbon in Kansas is equivalent to carbon in Maryland. I think that will be really key.

Part of it is just an education effort, some confidence that the carbon in the soil will stay there. At least some members of the public are concerned that if you store carbon, and then you go in and erode it away or till it up, you would lose that. But I think the industry has less concern about that, in the meetings I have been involved in with that.

So I think it is just developing that understanding that the carbon will stay there and that there are other benefits, so management will not switch from year to year.

Senator BROWNBACk. Mr. Hohenstein, the same question from your perspective. What are some of the missing pieces we need to jump start the carbon sequestration trades?

Mr. HOHENSTEIN. Well, in order to have——

Senator BROWNBACk. I want you to pull that microphone closer to you.

Mr. HOHENSTEIN. Sure.

Well, in order to have trades, you need, really, three things. You need a willing buyer, a willing seller, and a commodity. And what we are trying to accomplish through these accounting rules and guidelines is to define what this commodity, indeed, is.

Is it going to be perfect? No, there is additional research that needs to be done. And we are going to learn a lot by doing this that we would probably like to apply maybe 5 years down the road after we have some experience with these projects.

Now, when it comes to the sellers, I think, just during this day, we have seen a significant amount of interest from the farm community in the potential of carbon sequestration.

On the buyer side, the President has announced a goal of an 18 percent reduction in greenhouse-gas intensity by 2012 and has

challenged the private sector to meet that commitment. And he has challenged DOE to develop a revised greenhouse-gas reporting system to track progress in meeting those targets.

It will be interesting to see how this market evolves. Is it there yet? No. The market, right now, for carbon sequestration credits is speculative and fairly small. But we are putting together the building blocks for how this might operate.

Senator BROWNBACK. Do we have anything we can learn from other countries working on this topic to date? Are there others that are ahead of us or have gone a slightly different path that we can learn from?

Mr. HOHENSTEIN. Well, in fact, I think what I have found is that many other countries look to us on this area of carbon sequestration and in terms of the basic science and the default coefficients and the information on rates of sequestration. And we are very active through the Intergovernmental Panel on Climate Change in developing new reporting methodologies for forests and agriculture.

But, obviously, there is research going on in Australia and in Europe on these issues, as well, and we do work collaboratively on these scientific issues.

Senator BROWNBACK. Good.

Gentlemen, thank you very much, and we will look forward to this continuing to develop and grow. And I appreciate your testimony. Mr. Hohenstein, I particularly appreciate you traveling out to be here with us in Kansas.

We will go to our next panel. On that panel will be Ms. Peggy Blackman, with Kansas Coalition for Carbon Management; Dr. Michael Walsh, Senior Vice President, Chicago Climate Exchange; and Mr. Ted Hartsig, Senior Project Manager, SES; and Ms. Melissa Carey, Climate Change Policy Specialist, Environmental Defense; and we look forward to all of your testimony.

Thanks for joining us today.

STATEMENT OF PEGGY BLACKMAN, PRESIDENT, STATE ASSOCIATION OF KANSAS RC&D COUNCILS, ON BEHALF OF KANSAS COALITION FOR CARBON MANAGEMENT

Ms. BLACKMAN. Thank you. It is my privilege.

I want to thank you, Senator Brownback, for offering Kansas this excellent opportunity for the announcement that was made today for the continued vitality of rural America—and Kansas, in particular—with Secretary Veneman and with the legislation that you and Senator Roberts have been a part of. We thank you very much, and we congratulate you for your success.

Senator BROWNBACK. Thank you.

Ms. BLACKMAN. I am going to be testifying briefly on our Kansas Coalition for Carbon Management. I am going to start out with giving you just a brief definition of the Kansas RC&D Program. Of course, it is a part of the unique program, that USDA program, nationwide, and it is led by local volunteer councils and administered by the Natural Resource Conservation Service.

The purpose of RC&D is to promote conservation development and utilization of natural resources to improve the general level of economic activity and to enhance the environment and standard of living in all communities. RC&D councils, organized and directed

by local people to address local concerns, are grassroots decision-makers who adopt projects to address community needs. NRCS provides the technical support to operate an RC&D area.

The Kansas Coalition for Carbon Management is a direct result of RC&D focusing on an opportunity to ensure promotion of best management practices while seeking economic opportunity for the agricultural producers and communities of Kansas in meeting the challenge of improving the environment through atmospheric carbon levels.

The Kansas Coalition for Carbon Management is a loosely structured organization with memberships from various organizations and individuals and agencies with an interest in carbon management, enhancing renewable energy supplies, and to provide economic opportunity to the good stewards of our Kansas lands.

The Kansas RC&D partners in this endeavor are the NRCS, Kansas Electric Power Coop, Farm Bureau, Kansas Alliance for Wetland and Streams, Kansas State Extension, Kansas Wheat Growers, Corn Growers, Kansas Grazing Land Association, and the list goes on and on.

Our goals and objectives of KCCM are to inform and educate land managers on carbon management practices. We set up displays across the state at different conferences and so forth to make everyone aware of the opportunities that are in the future and, very excitingly, happening right now. The State Association of Kansas RC&Ds are excited about the challenge of expanding the Nation's overall supply of clean and affordable energy also, with new biomass opportunities and renewable energy sources available.

The State Association goal of RC&D is to cover Kansas with RC&D councils by 2005. We are on our way. We cover 70 percent of our state. And in 2002, Kansas RC&D councils leveraged 900,000 in Federal investment coming into our state into \$16.9 million to support community projects across Kansas.

We have a proven track record of partnering with other groups. Our councils of State associations of Kansas are all 501(c)(3) non-profit entities.

The viability of rural Kansas in America is threatened. RC&D is recognizing and capitalizing on new opportunities. Energy is one of the many areas that presents tremendous opportunities for economic gains and improved quality of life.

We, the grassroots volunteers, are ready and willing to serve our communities through RC&D. We are willing and ready to give the necessary support, to provide the necessary funding for continued research through Kansas State University and our other universities across our Nation, which we feel is an absolute necessity in order to continue to be the new surge to our looking for new energy sources.

We have worked with Dr. Chuck Rice in participating in a pilot project with the Chicago Climate Exchange to further the study of marketing the carbon credits. We are participating on State and county levels with a carbon study, using funding from USDA, conducted by John S. Brenner, our air quality cooperating scientist for biomass research development and demonstration projects, to be completed over a 3-year period.

We are concerned about the funding. None of this is going to happen without funding to get all of these activities started. The research, again, as I said, is an important factor in our ability to further study our energy opportunities, our biomass, our alternative energy opportunities. We need to recognize that the collection of data, the verification of carbon credits across our state and across our Nation, is going to play an important role, which is going to require some support. Volunteers are out there ready and able, through our conservation districts and our RC&D councils, to take on that challenge, but there will be some costs involved in that. So funding is something that is of great consideration for us. And we are looking at every avenue to address those needs.

We want to be able to explore and disseminate marketing opportunities they develop, to provide fact sheets and—on developed markets as they come to our attention, to develop a list of industries and companies taking advantage of carbon management so that our producers and our partners in the carbon management are aware of all the opportunities.

We are concerned and are looking into the legal boundaries around carbon sequestrations, to define legal ownership of a carbon—is it really a mineral? What is it, exactly? What are the landowner and tenant implications, and how can we work with our producers out there to maybe decipher what exactly needs to be done and what type of contracts need to be in place to give the best benefit to both the producer and the owner? To investigate, also, the tax implications, just exactly where will this fit into the overall picture? And to set up an aggregate for collection of the data and payment of credits to the producers. These are our goals within the Kansas Coalition for Carbon Management.

We want to continue to encourage the research for greenhouse-gas-emission reduction and alternative energy uses, and we particularly want to educate the public on the benefits of using ethanol. We want to particularly investigate biomass conversion through the Kansas Bio Energy Workshop that has been conducted in our state, and investigate emission reduction and sequestering of greenhouse-gases alternatives as part of our goals and missions within our coalition.

It is going to take a partnership out there. It is going to take the public-private partnership to get this to be an effective venture for our country. And I know it will work, with everyone networking and communicating at a level that will benefit all.

And I thank you, again, for this opportunity and for this great day that you have provided the state of Kansas.

[The prepared statement of Ms. Blackman follows:]

PREPARED STATEMENT OF PEGGY BLACKMAN, PRESIDENT, STATE ASSOCIATION OF KANSAS RC&D COUNCILS, ON BEHALF OF KANSAS COALITION FOR CARBON MANAGEMENT

Kansas Resource Conservation & Development Councils (RC&D) are part of the unique, national USDA program, led by local volunteer councils and administered by the Natural Resource Conservation Service (NRCS). The purpose of RC&D in Kansas is to:

- Promote conservation development, and utilization of natural resources;
- Improve the general level of economic activity; and
- Enhance the environment and standard of living in all communities.

RC&D Councils are organized and directed by local people to address local concerns. Councils are the grassroots decision makers who adopt projects to address community needs. NRCS provides the technical support to operate a RC&D area.

The Kansas Coalition for Carbon Management is a direct result of “best management practices”, while seeking economic opportunity for the agriculture producers and communities of Kansas and meeting the challenge of improving the environment through atmospheric carbon levels.

The Kansas Coalition for carbon management is a loosely structured organization with membership from various organizations, agencies, and individuals with an interest in carbon management enhancing renewable energy supplies and providing economic opportunity to the good stewards of our Kansas lands. The Kansas RC&D’s partners in this endeavor are Natural Resource Conservation Service, Kansas Farm Bureau, Kansas Electric Power Co-op, Kansas Alliance for Wetlands and Streams (KAW), Kansas State University, Kansas No-Till on the Plains, Kansas State Cooperative Extension, Kansas Grazing Lands Coalition, Kansas Wheat Growers, Kansas Corn Growers Kansas Livestock Association and many more agencies, organizations and individuals.

Our Vision Statement is “Reduce atmospheric carbon levels through sound carbon management.”

The Mission of KCCM is “To inform, educate and motivate land managers to apply management practices that result in reduced atmospheric carbon levels.”

Goals and Objectives of KCCM are:

1. Inform and educate land managers on carbon management practices.
Displays were set up at Kansas Association of Conservation District Conference, No-Till on the Plains Conference and Kansas State Extension Agronomy Day.
2. Explore and disseminate marketing opportunities as they develop.
Provide fact sheets as markets develop.
Develop list of industries and/or companies taking advantage of Carbon Management.
3. Investigate the legal boundaries around carbon sequestration.
Define legal ownership of carbon: 1) Is carbon a mineral? 2) Landowners/tenant implications, contracts.
Investigate tax implications.
Research contract options.
4. Encourage research of greenhouse gas emission reduction and alternative energy uses.
Educate the public benefits of using ethanol.
Kansas Corn Growers Association has sponsored ethanol promotion rebate days.
Investigate bio mass conversion research.
Kansas Bio-energy Workshop
Investigate emission reduction and sequestering green house gases alternatives.
Support continuing research in the development of carbon management.
The Kansas RC&D provided assistance to Dr. Chuck Rice, Professor, Agronomy Department, Kansas State University, organize a tour for the U.S. Congress, to see first hand, carbon management practices, within the Washington, D.C. area.
KCCM is participating in a pilot project with the Chicago Climate Exchange to further the study of marketing Carbon Credits.
Kansas NRCS, RC&D and Conservation Districts are participating in a state/county level Carbon Study using funding from USDA, conducted by John S. Brenner, Air Quality Cooperating Scientist, for Biomass Research, Development and Demonstration Projects to be completed over a three year time frame with the Natural Resource Ecology Laboratory (Colorado State University), National Renewable Energy Laboratory and Oak Ridge National Laboratory to be conducted in three states including Kansas. Kansas RC&D and Conservation Districts with support from NRCS will provide collection of local data by completing the “Carbon Sequestration Rural Appraisal” for the area they serve.

It will take funding for technical assistance, continued research, verification of carbon management practices, collection of data, education, public relations, training and etc. . . . KCCM's public/private partnership can acquire and administer the government and private funding to achieve our mission, vision and goals.

The State Association of RC&D goal is to cover Kansas with RC&D Councils by 2005. We are well on our way. 70 percent of Kansas is currently being served by RC&D Councils. In 2002 Kansas RC&D Councils leveraged a \$900,000 Federal investment into \$16.9 million to support community projects across Kansas. We have a proven track record of partnering with other groups. Our councils and the state association are all 501 ©3 Non-Profit entities. KCCM and RC&D are interested in putting the largest percentage of money from the sale of Carbon Credits into the hands of the producers. We are willing and able to participate in the study projects across this Nation as we strive to make the Carbon Credit a viable commodity or product.

The viability of rural Kansas and America is threatened. KCCM and RC&D are recognizing and capitalizing on new opportunities. Energy is one of many area that presents tremendous opportunities for economic gains and improved quality of life. We the grassroots volunteers are ready and willing to serve our communities. Help us develop the tools necessary to accomplish our vision.

Senator BROWNBACK. Thank you, Ms. Blackman. I appreciate that very much.

Dr. Walsh, with the Chicago Climate Exchange, we are delighted to have you here, and we wish you many happy returns. You are always welcome. So thank you for being here, and I look forward to your testimony.

**STATEMENT OF MICHAEL J. WALSH, Ph.D., SENIOR VICE
PRESIDENT, CHICAGO CLIMATE EXCHANGE**

Dr. WALSH. Thank you, Senator. The red light has been broken, so I brought my own here.

[Laughter.]

Senator BROWNBACK. OK.

Dr. WALSH. What a glorious day to be in Kansas, especially after last night's soaker.

[Laughter.]

Dr. WALSH. You know, this drought is getting a bit old.

Senator BROWNBACK. Yes.

Dr. WALSH. And as you well know, Kansans always welcome visitors and are so kind, and I feel like there is a little extra special here, in my case, as an Illinois native. I notice that Abraham Lincoln is not only enshrined in the Agriculture Hall of Fame, but there is an absolutely wonderful statue of President Lincoln on the grounds of the State Capitol. So I feel a little extra connection—

Senator BROWNBACK. Well—

Dr. WALSH.—here.

Senator BROWNBACK.—now that you have started me, we—
[Laughter.]

Senator BROWNBACK.—you know, this state was settled by abolitionists who formed the basic building blocks, first building blocks, of the Republican Party that Lincoln was the first nominee for, and so this State, born in the battle of the Civil War, really identified greatly, at the very outset, with Lincoln and his great mission.

And then, on a sidebar, there was a house about three blocks from here that his brother helped build. It is an old stone house. I should take you by there to show it to you sometime.

Dr. WALSH. Well, hopefully I will get a chance to chat with you later about a fun story of my son in school and his Civil War les-

sons this past week. It has really been a great school year for our family, so we are very lucky.

Senator, the Chicago Climate Exchange is trying to answer some of the questions that you raised to the prior panelists of what is it going to take to make this a reality? So we began, a few years ago now, to form a voluntary, self-regulatory carbon-reduction program for emissions sources throughout North America and in tandem with mitigation projects in the agricultural sector and in Brazil. It is a rules-based exchange. It has got standards. It has got a very modest phased-in reduction schedule over the next 4 years. And we have got some traction. We have a critical mass of founding members that includes some household corporations here, international corporations, like Ford Motor Company, American Electric Power, International Paper, DuPont, Motorola, Waste Management. You will find it interesting that Manitoba Hydro is a member of the exchange. So we have a bit of an international emphasis.

It is a good-sized market. It is a good starting point for us to test this concept out. And the concept is that those members who take on the commitment, who find it difficult or costly to cut their own emissions, can hire somebody else to make that reduction for them. And it could be another industrial, or it could be a farmer here in Kansas, who does the low-till or no-till or other qualified practices.

Now, we are inviting businesses and institutions throughout Kansas, throughout the country, to take a look at volunteering into this program. And one of the institutions is right here. We have invited Kansas State to look at becoming a member of the exchange for the learning opportunity. Now, I will note that there is a bit of a race among Midwestern Universities of who is going to be the first founding member of a university of our exchange. And I am cheering for Kansas State here, for any number of reasons. There are going to be some world-class learning opportunities.

Senator I think we are ahead of the rest of the world here in the United States, for some of the—based on a lot of the talent that I am about to reference that we have incorporated into our market.

This concept gives farmers in Kansas a chance to provide an environmental service, for payment, that really addresses a global issue, so one can imagine that farmers in Kansas can capture, on behalf of Kansas' businesses, some of their greenhouse gases and offset those.

We think this is the basis for a new export for the U.S. farm community. And some people say, well, that sounds kind of crazy. But let me tell you that several years ago my colleagues and I helped arrange export deals for carbon credits from Native American reforestation projects, and for methane projects in the United States, to European and Canadian investors.

Now, this program, this Chicago Climate Exchange Market, was funded, the research and development phase, by the Joyce Foundation, and we have incorporated our own personal experience with emissions trading with the Chicago Board of Trade and the EPA and lots of other work we have done in agricultural and financial markets. We have had a huge amount of input. There is a huge and deep talent pool on this topic—in the agricultural coops, some

farm bureaus, NGOs, like the Nature Conservancy of Advisors, on the design.

And we assembled, so that we could get some high-level strategy, an advisory board. And some of the gentlemen and ladies on there are quite well known. You will know, of course, David Boren, former Senator and Governor from Oklahoma, and Mr. Bill Curtis, who is a native Kansan, who is an internationally famous broadcast journalist. In addition, Chuck Rice—who is not only a top-notch researcher, but is a practical fellow, who can translate this; it is a very rare skill—served on our Soil Carbon Technical Advisory Committee. Your staff, Glen Chambers and Sara Hessenflow, have been very encouraging to us all along, and we really appreciate that. Over at NRCS, Joel Brown, one of the other top experts in the world, Bruce Knight, Maury Mausbach, we have had an interesting conversation, where we have indicated to them that we could lever this, this voluntary pilot, and take a lot of learning opportunities with a little of external financial support. So Maury and Bruce have been extremely encouraging to us as well.

As you mentioned, if we are going to manage this issue, we need to do it smart. We need to keep our economy growing and strong to keep raising living standards. And the right way to go on this and other issues is to use a market. Well, markets do not just arrive on their own; you have to build them. And we are trying to get the first-generation market to get the process started.

And so what we are trying to do, Senator, is really to provide proof of concept. The private sector knows how to do this. We are trying to develop infrastructure and skills, and we are trying to get a little more knowledge on what it might cost to mitigate these greenhouse gases. And we are trying to show that the private sector can do this in a self-regulatory structure. And we think this is entirely consistent with the President's calls for leadership in the private sector.

And finally, it is time to provide some standardization, so everybody knows that a ton is a ton is a ton. And Ted's shop is going to be, I think, very helpful in helping us do that.

Let me quickly review the basic structure. This is a bit of a new environmental-management method, Senator. We have struck a legally binding contract with the 15 founding members of the exchange, that they are going to agree to reduce or offset their emissions at a declining rate of 1 percent per year over the next 4 years. We are going to include all the greenhouse gases and ask the Ford Motors and these other companies to really focus first on their major emissions sources. And if they would like, they could bring in their facilities in Canada and Mexico.

Now, they have to follow the rules on monitoring and reporting of emissions. And annually we are going to hold them to account. In addition, for public credibility and for a real market, we have to have an auditor, and we have engaged the NASD to provide auditing services. And for the agricultural projects, we are in a great conversation with Ted's shop at SES Corp., to make sure that the projects are being done and the standards are being met.

Now, those companies that cannot reduce their own emissions at low cost can engage somebody else. And the others that they can

engage include the Midwestern section of the United States agricultural community.

So this is potentially a new income source. And as you mentioned this morning, it is going to start small, but we think it could grow, over time. But to make this happen, we had to strip away a lot of the complexities and start very simple and use some standards. And we have established standards for the Central U.S. for continuous no-till and continuous low-till, for grass plantings, including, potentially, CRP, tree plantings, and methane capture. And in addition, renewable fuels are treated as carbon-neutral, so that is another boost for those biomass-based fuels.

Now, we think that this is potentially a new crop. It is going to take a while to build the delivery and quantification mechanisms, but while providing this environmental service, everybody is recognizing that there is another huge hidden asset here, Senator, and that is the benefits for water quality. And in this state and many Midwestern states, anything we can do to improve stream quality and water quality is critically important and may also be another source of environmental service payment at some point.

Now, let me just close on a couple of notes. To officially organize this market to deal with, hopefully, thousands of farmers, we need aggregators. And we are working with the Kansas Coalition for Carbon Management—and we have greatly appreciated their input—with State farm bureaus and insurance companies. And we hope that several organizations in Kansas will take the chance to learn in this voluntary pilot program to get us started.

As you might imagine, there are a lot of challenges. And Peggy referred to the technical and the legal challenges, the accounting and tax issues. We think the only way to really smoke those out, to really understand them, is to give it a try. And we think we have initial answers for some of those complicated questions.

As I mentioned earlier, there is going to be a huge opportunity to leverage this program to learn a lot more about how we do global positioning systems, how we do mapping, how we do direct verification. And I noted that we have been in conversations with NRCS on a discussion that a little bit of support money can go a very long way in growing the capabilities in this area.

So let me just close by noting that to try to ensure the quality and the value to the farmers and everybody else in this program, the Chicago Climate Exchange is going to register with the appropriate Government data bases—all the reductions and all the projects—so that if there is ever further recognition, we want to make sure that people get credited for their behavior and their leadership early on here.

So, to close, this is really the first program in the world to directly incorporate agricultural and other carbon sequestration into the market, and we think that this idea of both an above-ground and a below-ground crop is viable now. And there will be an announcement next week indicating when we will launch the trading, later this year. And we will include farmers from Kansas this year.

And I apologize for going over my time budget, Senator.

[The prepared statement of Dr. Walsh follows:]

PREPARED STATEMENT OF MICHAEL J. WALSH, PH.D., SENIOR VICE PRESIDENT,
CHICAGO CLIMATE EXCHANGE

Introduction

The Chicago Climate Exchange extends its sincere appreciation for the opportunity to participate in this panel. This written statement is accompanied by several background items and press clips that are germane to the efforts of the Subcommittee.

The Chicago Climate Exchange (CCX) is a voluntary pilot market for reducing and trading greenhouse gases throughout North America, and through projects in Brazil. The market is a rules-based, self-regulatory exchange that employs a phased-in emission reduction schedule for years 2003 through 2006. At this time the CCX commitments have been agreed by fourteen companies and the City of Chicago. The corporate Members include Ford Motor Company, American Electric Power, International Paper, DuPont, Motorola and Waste Management.

The CCX founding Members have combined annual greenhouse emissions that are nearly half of the United Kingdom. The pilot market Members represent the critical mass needed to provide a valuable demonstration and learning process. The full list of current CCX Members is provided in Attachment 1.

Chicago Climate Exchange members that cannot reduce their own emissions can purchase credits from those who make extra emission cuts, or can buy offsets from individual mitigation projects, such as agricultural projects, including no-and low-till farming, grass and tree plantings and methane collection at livestock operations.

CCX is inviting Kansas businesses and institutions to become Exchange Members. We are working with the Kansas agricultural community to assure they can be market participants from the outset. Both groups can enjoy world-class learning opportunities, and would realize reputational benefits and business advantages by demonstrating leadership in voluntarily acting to address a major environmental risk.

The environmental services provided by farmers offer a local solution to a global issue. Kansas farmers can profit by sequestering carbon on behalf of Kansas industrial companies.

To supplement grain exports, we believe the U.S. farm sector will be capable of exporting carbon credits to other countries through the CCX. If this sounds somewhat futuristic, I should note that before we began forming CCX in 1999, my colleagues and I arranged several carbon credit export deals involving sale of Native American reforestation credits to a London firm, and sales of methane-based credits to Canada and The Netherlands.

The research and development phases of the Chicago Climate Exchange were funded by grants from the Joyce Foundation which were administered by Northwestern University's Kellogg Graduate School of Management.

The design of CCX incorporates lessons from twelve years of experience with emissions trading, including our management of the partnership between the Chicago Board of Trade and the U.S. Environmental Protection Agency in administering parts of the highly successful sulfur dioxide trading program for reducing acid rain. We have also incorporated expertise gained in the design, launch and trading of numerous financial, agricultural and energy markets.

As you might expect, the design and pending launch of this pilot market has been a challenging endeavor. We have benefited greatly from the support, encouragement and technical input of many dozens of individuals in the corporate, university, public and non-governmental sectors. Detailed input has been provided by numerous agricultural co-ops and state Farm Bureaus, and by NGOs such as The Nature Conservancy and the World Resources Institute.

Early in the CCX design phase we convened a high-level advisory board to gather strategic input and assist with outreach. Among the dignitaries on this board are Former Senator David Boren from Oklahoma and Former Illinois Governor James Thompson; environmental leaders such as Thomas Lovejoy of the Heinz Foundation and Jonathan Lash of WRI; and notable business and international leaders such as David Moran of Dow Jones Indices, Jeffrey Garten, Dean of the Yale Business School, and Maurice Strong, convener of the 1992 Rio de Janeiro "Earth Summit" (United Nations Conference on Environment and Development). Mr. Bill Kurtis, a native Kansan and well-known broadcast journalist who focuses on major social and environmental issues, is also a Member of the Advisory Board. Attachment 2 lists the full membership of the CCX design phase Advisory Board.

We also greatly appreciate the technical input that has been provided by leading experts such as Professor Chuck Rice of Kansas State and Joel Brown of the Natural Resources Conservation Service (NRCS). We have appreciated the encouragement of your professional staff, in particular Glen Chambers and Sarah Hessenflow, and from the Kansas Coalition for Carbon Management. We are pleased to note that

we have also been encouraged by Mr. Bruce Knight, Chief of the NRCS, and his Deputy, Mr. Maury Mausbach. NRCS has been kind enough to consider our request for a modest amount of financial assistance that CCX would apply to maximize learning opportunities and technical advances for the agricultural sector.

Acting Now to Build Institutions

We will need flexibility if we are to succeed in managing greenhouse gases while growing the worldwide economy and raising living standards. It would be prudent to harness the maximum possible number of mitigation options, including carbon sequestration, and to use a market mechanism to assure we orchestrate the deployment of these options most cost-effectively.

Market institutions do not emerge overnight. A voluntary pilot market gives us the chance to begin building those institutions right away, and will let us develop and spread the needed expertise and evolve the markets over time. It is important to get started now to organize and standardize the market systems. These are the goals of the Chicago Climate Exchange. CCX aims to:

- Provide proof of concept: demonstrate that a quantified emission reduction goal can be achieved efficiently through emission allowance trading supplemented with project-based offsets from sequestration and other mitigation activities;
- Develop market infrastructure and skills;
- Dissemination of price information and other market-critical information;
- Demonstrate that a private sector, self-regulatory system can cost-effectively achieve real progress in managing global warming emissions;
- Standardize trading rules, start small and grow, provide a model.

We believe the voluntary, pilot nature of CCX is entirely consistent with President Bush's call for private sector leadership, voluntary programs, use of flexibility, and incorporation of carbon sequestration initiatives in the market.

The core elements of the Chicago Climate Exchange are:

- Each exchange Member adopts a four-year commitment to either reduce or offset their GHG emissions 1 percent per year from a 1998 through 2001 baseline (resulting in emissions that are 4 percent below the baseline in 2006);
- All six types of greenhouse gases are included; Members include all their major emission sources and can opt-in small sources and sources in Canada and Mexico;
- Emissions must be monitored and reported in accordance with exchanges rules, and each Member must annually "true-up" its total emissions by tendering allowances and offsets;
- The premier private sector regulatory agency, NASD, has been engaged by CCX to provide trading surveillance, and audits of Member emissions and project verifications;
- CCX Members who can reduce emissions beyond the reduction schedule can sell their extra allowances to those who cannot cut their own emissions, or who find it costly to do so;
- Members can also achieve the CCX reduction commitments by purchasing registered and verified emission "offsets" produced by qualifying agricultural, reforestation and methane projects, as well as projects in Brazil.

All projects and member accounts are held in an Internet-accessible registry and trading occurs on a linked electronic trading platform. CCX is currently in detailed discussions with SES Corp, a Kansas-based agricultural verification firm, for the provision of in-field inspection services for agricultural offset projects.

Participation by Agricultural Sector in the Chicago Climate Exchange

Through carbon sequestration and other low-cost emission reductions, the emerging international carbon markets introduce opportunities for farmers to realize a new income stream from provision of global environmental services. CCX has developed simple and credible standardized rules for issuing carbon credits for the following mitigation activities in the agricultural sector:

- carbon sequestration resulting from:
 - continuous no-till and low-till cropping in the central U.S.;
 - grass plantings in the central U.S.;
 - tree plantings;

- emission reductions resulting from methane capture and collection and combustion.

Importantly, the CCX accounting rules treat renewable fuels, such as crop residue and ethanol, as carbon neutral, thereby providing an additional financial incentive to use these fuels in place of fossil fuels.

Revenues from sales of agricultural carbon credits in CCX can provide a second “crop” that rewards farmers for provision of a global environmental service, while also retaining soil, and conserving and improving local water quality. This latter benefit may someday represent an additional source of environmental service payments.

In order to efficiently process the enrollment of a large number of farmers, CCX is engaging cooperatives, groups such as the Kansas Coalition for Carbon Management, State Farm Bureaus and insurance companies to serve as aggregators. To realize economies of scale, offsets are being assembled into 10,000 ton batches. We hope that several Kansas-based organizations will provide this service, thus helping grow the institutional capacity needed to eventually make the carbon credit markets an additional income source for farmers throughout the U.S.

Challenges and Opportunities

As you might imagine, introducing a new market raises numerous technical, legal and educational challenges. CCX has reached out to individual farmers, farm groups and potential aggregators to prepare the institutional components of a market that allow farmers to realize market benefits. While we have built a simplified system for agricultural carbon crediting, we will have the opportunity to gather large amounts of technical and market data in conducting the pilot market.

In order to maximize the learning value from the pilot, we would like to begin using the best available technologies, such as global positioning systems for mapping participating fields and new laser-based systems for testing soil carbon. At the same time, we hope to involve a large number and variety of aggregators, universities, Resource Conservation and Development Districts and other existing experts.

Our ability to leverage the Chicago Climate Exchange to maximize the learning and technical advances would be enhanced if we are able to immediately deploy additional financial resources, and we have had initial discussions with NRCS on this matter. The nature of that discussion is consistent with the concepts advanced by the Conservation Innovation Grants provision included in the most recent Farm Bill.

Among our efforts to boost the long-term prospects for realizing value from registered carbon credits, CCX will register all emission reductions and mitigation projects with U.S. Department of Energy voluntary reporting database. By incorporating agricultural carbon credits in a voluntary pilot market from the outset, the Chicago Climate Exchange is the world’s first large-scale program that offers farmers the opportunity to profit from both above-and below-ground “crops”.

Thank you again for the opportunity to participate in this panel.

ATTACHMENT 1

Chicago Climate Exchange Members (as of June 4, 2003)

<i>Automotive</i>	<i>Chemicals</i>
Ford Motor Company	DuPont
<i>Commercial Real Estate</i>	<i>Environmental Services</i>
Equity Office Properties Trust	Waste Management, Inc.
<i>Electric Power Generation</i>	<i>Pharmaceuticals</i>
American Electric Power	Baxter International Inc.
Manitoba Hydro	<i>Semiconductors</i>
<i>Electronics</i>	STMicroelectronics
Motorola, Inc.	<i>Municipalities</i>
<i>Forest Products Companies</i>	City of Chicago
International Paper	<i>Steel</i>
MeadWestvaco Corp.	Roanoke Electric Steel Corp
Temple-Inland Inc.	
Stora Enso North America	

ATTACHMENT 2

*Chicago Climate Exchange Design Phase Advisory Board**Honorary Chairman**The Honorable Richard M. Daley, Mayor, City of Chicago*

Warren Batts, former CEO, Tupperware Corporation, Mead.
David Boren, President, University of Oklahoma; former Oklahoma governor and U.S. Senator
Ernst Brugger, President, Brugger, Hanser & Partner
Paula DiPerna, former President of the Joyce Foundation
Elizabeth Dowdeswell, former Executive Director, UN Environment Program
Jeffrey Garten, Dean, Yale School of Management
Lucien Bronicki, Chairman, ORMAT International
Donald Jacobs, Dean Emeritus, Kellogg Graduate School, Northwestern University
Jonathan Lash, President, World Resources Institute
Joseph Kennedy II, Chairman, Citizens Energy Group; former U.S. Representative (MA)
Israel Klabin, President, Brazilian Foundation for Sustainable Development
Bill Kurtis, Journalist and television producer
Thomas Lovejoy, President, Heinz Center; former Chief Biodiversity Advisor World Bank
David Moran, President, Dow Jones Indexes
R.K. Pachauri, Chairman, Intergovernmental Panel on Climate Change
Michael Polsky, President and CEO of Invenergy
Les Rosenthal, former Chairman, Chicago Board of Trade
Donna Redel, former Executive Director, World Economic Forum
Maurice Strong, former United Nations Under-Secretary General
James Thompson, Chairman, Winston & Strawn; former four-term Governor of Illinois
Sir Brian Williamson, Chairman, London International Financial Futures Exchange
Robert Wilmouth, President and CEO, National Futures Association
Klaus Woltron, Austrian entrepreneur and Vice President of the Vienna Club
Michael Zammit Cutajar, former Executive Secretary, UN Framework Convention on Climate Change

ATTACHMENT 3

Selected articles

1. "Companies Vow to Cut Emissions, Create Exchange to Trade Permits" *Wall Street Journal*, Friday, January 17, 2003. Go to <http://online.wsj.com/article/SB104276695684121184.html>
2. "Heroes: Richard Sandor: His Market Is a Gas" *Time*, August 26, 2002. Go to <http://www.time.com/time/magazine/article/0,9171,1003138,00.html>
3. "Exchange in pollution credits formed" *Chicago Sun-Times*, January 17, 2003
4. "Got Gas: Carbon dioxide-gobbling trees are one way to stay ahead of government regulators" *Forbes*, March 17, 2003. Go to <http://www.forbes.com/forbes/2003/0317/056.html>

Senator BROWNBACK. No problem. Thank you very much. It is exciting, and I will look forward to those announcements next week, as well.

Mr. Ted Hartsig, delighted to have you here, and the microphone is yours.

**STATEMENT OF THEODORE A. HARTSIG, C.P.S.SC., SENIOR
PROGRAM MANAGER/SOIL SCIENTIST, SES, INC.**

Mr. HARTSIG. Thank you, Senator.

My name is Ted Hartsig. I am a certified professional soil scientist with SES Inc. We are out of Lenexa, Kansas, a very proud Kansas firm. And we specialize in environmental and natural resource management, with particular emphasis in agriculture. Our staff have been involved with, very involved with, and integral in the development of verification procedures and policies in environmental management and agriculture, since our inception, about 5 years ago.

The role of carbon sequestration in soils as a means of reducing atmospheric greenhouse gases—specifically, carbon dioxide—has been established in the scientific literature, position papers by scientific organizations, and in testimony for this field hearing. There are many ways in which carbon is sequestered, which you have heard about many of them. And ultimately, they all involve photosynthetic conversion of carbon dioxide into biomass.

The processes include, as we have discussed, no-till farming practices, agro-forestry, wetland conversion, conversion of marginal land to prairie. There is quite a myriad of opportunities and procedures in which we can enhance—and I underscore “enhance”—carbon-dioxide uptake and sequestration. In the United States, as you have also said, our vast expanse of open lands creates tremendous opportunities for enhancing the sequestration of atmospheric carbon dioxide into soils.

As our country is preparing to enter into a new program of trading carbon-emission reduction credits, or carbon credits, carbon sequestration in soils is considered one of—the key strategy in developing and trading these credits. And because of this, great opportunities exist for people who manage the land—farmers, foresters, ranchers, and other landowners—to benefit from practical environmental conservation practices that will aid in reducing greenhouse gases through economic incentives. Industries that emit greenhouse gases will also benefit from this economically viable system in which they can maintain production while working to reduce the amount of carbon dioxide through the purchase of carbon credits.

The private sector has taken the lead in developing the market-based system for trading carbon-emission credits, as you just heard from Dr. Walsh. For example, the Chicago Climate Exchange has been in the forefront in promoting these programs and establishing commitments from some of America’s largest companies.

The carbon-trading systems that emerged this year, however, are not without critics, not without doubters. Therefore, the validity of the security of carbon-trading programs must be ensured through sound verification systems that are accepted by industry, Government, scientists, and the public. Verification is the means by which all parties can examine the results of enhanced carbon sequestration projects to determine that carbon credits are valid, measurable units that are reducing greenhouse gases in the atmosphere. The trading programs, themselves, are inherently dependent upon verification to provide financial security for the buyers of these credits and the credibility for the regulatory bodies that will govern the trading system.

Research and development of verification technology and protocols is ongoing and will require continual attention. Standards and protocols currently exist that can be implemented to conduct verification of soil carbon sequestration. These standards and protocols will be refined as the technology and science evolves to more accurately measure changes in soil carbon and to quantify sequestration of that atmospheric carbon dioxide.

Currently, our tools include utilization of remote sensing, through the use of multi-spectral satellite data and aerial photography, computerized geographic information systems to track the locations and quantities of land being used to sequester carbon, and computer-based models to calculate how much CO₂ is utilized in the production of various plant biomass and carbon buildup in the soil.

Field analytical techniques, such as Dr. Rice had mentioned, the laser-induced breakdown spectrometry instrumentation, will provide rapid means of accurately measuring soil carbon changes, and, therefore, much more accurate, reliable, and repeatable means to verify carbon sequestration in soils. We, in the private-sector companies, such as ours, look forward to working with academia, such as Dr. Rice, and with the Government to implement these systems.

To give verification results credibility, verification must be conducted by independent third-party professionals with the training and knowledge to assess carbon sequestration practices and changes in soil carbon content. Independent verifiers must not have any political or financial stake in the parties who will develop carbon-emission credits, including farmers, ranchers, foresters, or other landowners, or associations that represent these people, or parties that will aggregate credits for markets. To do so would introduce the suspicion of bias and obscure the transparency needed for assuring that those that purchase carbon credits have truly met their commitment for meeting greenhouse-gas reductions.

For the carbon-trading programs to work, sound verification is essential and necessary. Programs around the world will critically examine what the United States is doing to voluntarily reduce greenhouse-gas emissions, and they will rely on the results of verification to provide their conclusions.

The private-sector of American commerce has the initiative and the ability to develop and implement a common and consistent standard and practice for verification of carbon sequestration. It is the responsiveness of the private sector that can establish an accepted scientifically valid verification program to meet the pending timetable of program implementation, such as with the Chicago Climate Exchange. This is, by nature, a process that will involve scientists and Government regulators, as well as industry professionals in agriculture, forestry, and natural resources management. These stakeholders will need to agree upon a common set of standards and procedures for verification and for the training and certification of the professionals that will verify these credits. The private sector has great experience in responding to recognized needs for industry verification and for developing similar standards and procedures.

In conclusion, sound, scientifically based verification practices will enable carbon emission-reduction credit trading to withstand

scrutiny and challenges to productive and voluntary programs for environmental improvement and sustainability. Verification will also identify and expel faulty claims of carbon sequestration, including overstating claims of contract acreage, nonperformance of accepted and agreed-upon agricultural practices, an excess of leakage of carbon dioxide from their practices.

By verifying and validating carbon sequestration practices and, therefore, providing a warranty of carbon-emission credits, the United States Carbon Trading Program will attain national acceptance and international recognition.

Thank you, Senator, for allowing us to testify today.
[The prepared statement of Mr. Hartsig follows:]

PREPARED STATEMENT OF THEODORE A. HARTSIG, C.P.S.SC., SENIOR PROGRAM
MANAGER/SOIL SCIENTIST, SES, INC.

“VERIFICATION NEEDS FOR SOIL CARBON SEQUESTRATION”

The role of carbon sequestration in soils as a means of reducing atmospheric greenhouse gasses, specifically, carbon dioxide, has been established in the scientific literature, position papers by scientific organizations, and in testimony for this field hearing. There are many ways in which carbon is sequestered as a permanent component of soils in the United States, all of which involve, ultimately, photosynthetic conversion of carbon dioxide into plant biomass which, through degradation, will become part of the soil matrix. The processes include many anthropogenic practices that will be implemented to *enhance* carbon dioxide uptake and increase the amount of carbon in the soil, creating an integral and very important basis of reducing greenhouse gasses in the atmosphere. These practices include the implementation of no-till and conservation tillage farming practices, conversion of marginally-used lands to grasslands, recreation and/or restoration of wetlands, and reclamation of mined lands. In the United States, our vast expanse of open lands creates tremendous opportunities for enhancing the sequestration of atmospheric carbon dioxide in soils.

As our country is preparing to enter into a new program of trading carbon emission reduction credits, carbon sequestration in soils is considered one of the key strategies of developing and trading these credits. Because of this, a great opportunity exists for people who manage the land—farmers, foresters, ranchers, and other land owners—to benefit from practical environmental conservation practices that will aid in reducing greenhouse gasses through economic incentives. Industries that emit greenhouse gasses will also benefit from an economically viable system in which they can maintain production while working to reduce the amount of carbon dioxide in the atmosphere through purchase of carbon credits.

The carbon trading systems that will emerge this year are not without critics and doubters. Therefore, the validity and the security of the carbon trading programs must be ensured through sound verification systems that are accepted by industry, the government, scientists, and the public. Verification is the means by which all parties can examine the results of enhanced carbon sequestration projects to determine that carbon credits are valid, measurable units that are reducing greenhouse gasses in the atmosphere. The trading programs themselves are inherently dependent upon verification to provide financial security for the buyers of these credits, and credibility the regulatory bodies that will govern the trading system.

Research and development of verification technology and protocols is ongoing and will require continual attention. Standards and protocols currently exist that can be implemented to conduct verification of soil carbon sequestration. These standards and protocols will be refined as the technology and science evolves to more accurately measure changes in soil carbon and quantify sequestration of atmospheric carbon dioxide. Currently, our tools include the utilization of remote sensing through the use of multi-spectral satellite data and aerial photography, computerized geographic information systems to track the locations and quantities of land being used to sequester carbon, and computer-based models to calculate how much carbon dioxide is utilized in the production of various plant biomass and rates of carbon buildup in the soil. Field analytical techniques, including Laser-Induced Breakdown Spectrometry (LIBS) instrumentation, will provide rapid means of accurately measuring soil carbon changes, and therefore more accurate, reliable, and repeatable means to verify carbon sequestration in soils.

To give verification results credibility, verification must be conducted by *independent, third party professionals* with the training and knowledge to assess carbon sequestration practices and changes in soil carbon content. Independent verifiers must not have any financial stake in parties who will develop carbon emission reduction credits, including farmers, ranchers, foresters or other landowners, associations that represent those that produce the credits, or parties that will aggregate credits for the markets. To do so would introduce the suspicion of bias and obscure the transparency needed for assuring that those that purchase carbon credits have truly met their commitment for meeting greenhouse gas reductions. For the United States Carbon Trading Program to work, sound verification is essential and necessary. Programs around the world will critically examine what the United States is doing to voluntarily reduce greenhouse gas emissions and they will rely on the results of verification to provide their conclusions.

The private sector of American commerce has the initiative and ability to develop and implement a common standard and practice for verification of carbon sequestration. It is the responsiveness of the private sector that can establish an accepted, scientifically-valid verification program to meet the pending timetable of program implementation. This is by nature a process that will involve scientists and government regulators, as well as industry professionals in agriculture, forestry, and natural resources management. These stakeholders will need to agree to a common set of standards and procedures for verification, and for the training and certification of the professionals that will verify these credits. The private sector has great experience in responding to recognized needs for industry verification and for developing similar standards and procedures. Examples of these standards and procedures include environmental management, animal production, and natural resources monitoring and measurement strategies that are statistically and scientifically sound.

In conclusion, sound, scientifically-based verification practices will enable carbon emission reduction credit trading to withstand scrutiny and challenges from those that seek to discredit a productive and voluntary program for environmental improvement and sustainability. Verification will also identify and expel those who seek to cheat the system through faulty claims of carbon sequestration, including overstating claims of contracted acreage, non-performance of accepted and agreed-upon agricultural practices, and excessive "leakage" of carbon dioxide from their practices. By verifying and validating carbon sequestration practices, and therefore providing a warranty of carbon emission reduction credits, the United States carbon trading program will attain national acceptance and international recognition.

Senator BROWNBACK. Thank you, Mr. Hartsig, and I look forward to some questions in our discussion.

Ms. Melissa Carey—she is the Climate Change Policy Specialist with Environmental Defense—delighted to have you here. Welcome to Kansas. Many happy returns.

STATEMENT OF MELISSA CAREY, CLIMATE CHANGE POLICY SPECIALIST, ENVIRONMENTAL DEFENSE

Ms. CAREY. Good afternoon. Thanks for having me. And thanks for inviting us to speak here today.

Senator BROWNBACK. Sure.

Ms. CAREY. It was really fun to speak at the forum next door, earlier today, and see the amount of enthusiasm and energy that Kansans have for this subject. It was particularly refreshing to leave Washington and come to such an enthusiastic reception here in Kansas.

Senator BROWNBACK. And where the skies are not cloudy all day. [Laughter.]

Ms. CAREY. Indeed. So thank you very much.

Mr. Chairman, my name is Melissa Carey, and I am a Climate Change Policy Specialist at Environmental Defense. We are a 300,000-member national nonprofit organization, based in New York.

Since 1967, we have linked science, economics, and law to create innovative, equitable, and cost-effective solutions to the most serious environmental problems we face.

It is really exciting to see so many interested people here to learn more about carbon sequestration. And I think it really speaks to the potential for this tool to bring about real benefits to rural communities while delivering critically needed environmental protections. And thanks, again, for making this opportunity possible.

Environmental Defense sees global warming as the gravest environmental threat we face. It is a big problem. It is a complex problem. But it is also a problem that can be beaten. Throughout our history, American ingenuity has enabled our Nation to triumphs over adversity. We do not shrink from challenges. This is especially true in America's rural communities, where the demand for creativity and innovation is constant.

Our agricultural producers are world leaders, and for very good reason. They know how to get the job done. They know how to react to changing market conditions. They know how to manage risks. And they know how to recognize opportunity when they see it. Therefore, it is not that surprising that America's farmers, ranchers, and foresters are leading the way on global-warming solutions. They are seeing the future, anticipating change, and using their own initiative and ingenuity to shape our national response to this threat.

At Environmental Defense, our motto is "Finding the Ways That Work." At our core, we are committed to seeking new and creative ways to forge lasting solutions to difficult environmental challenges.

On global warming, we have made a core commitment to working for and with agricultural communities, leveraging rural America's enormous potential to bring out positive change for the health of our climate, while producing tangible and needed economic benefits in the communities that are delivering innovation. To this end, we have launched a multi-year National Sinks Initiative, designed to help farmers, ranchers, and foresters make the connections to markets that will deliver the economic and environmental benefits we know are possible. And this is detailed a lot more in my written testimony, and I will look forward to talking about it with you more in detail hopefully during your questions.

I will say that, on an initiative like this, we really cannot succeed without partners. And Environmental Defense is definitely working with the best. In different regions of the country and with diverse operations, we are working with people who are really leading the way on carbon sequestration.

These partnerships are already yielding strong results. In 2002, the Pacific Northwest Direct Seed Association, which represents 300 farmers in three States—Washington, Idaho, and Oregon—they own, collectively, about half a million acres—joined with Entergy, a Louisiana-based energy company, to promote direct seeding, a practice which enhances soil carbon sequestration and provides a host of other environmental benefits, such as improved soil productivity, reduced erosion, and better wildlife habitat.

In this partnership, which was brokered by Environmental Defense, Entergy will lease 30,000 tons of sequestered carbon over a

10-year period from the participating landowners, and there are about a hundred of them.

In addition to the carbon benefits seen by the atmosphere, the lands affected by the project will contribute less run-off to nearby waterways, helping to improve the habitat for critical steelhead and salmon runs in the Pacific Northwest. This is a huge additional environmental benefit.

The initiative exhibited by the farmers at PNDSA is a sort of energy that is really, truly changing the way that we look at global-warming policy. And make no mistake, things are definitely changing.

Today, the carbon market is quite small, and it is speculative in nature. Companies are certainly buying, but in small quantities and in fairly limited transactions. In truth, their motives are as much anticipatory as anything else. They know, as we do, that it is only a matter of time before the United States establishes a true national market for greenhouse-gas emission reductions. There are some wonderful voluntary efforts out there, underway today; and they are, in our view, a lead-up to this more comprehensive national market. But because we do not have that national market yet, today's carbon market is really defined by transactions that allow learning by doing. And this applies to both the buyers and the sellers out there today.

The learning period, of course, will not last forever, because markets have proven to be the only way we have found to generate large environmental benefits at least-cost. And these are certainly essential qualities of an effective global-warming policy.

A change is on the horizon, and positive things are happening. Building on the groundwork laid by you and others, this year, for the first time, a bipartisan bill has been introduced that would establish a nationwide market for sequestered carbon and other forms of emission reductions. This is S. 139, the Climate Stewardship Act, and it was introduced early this year by Senators John McCain and Joseph Lieberman. The bill would place a nationwide limit on global-warming pollution and allow farmers to sell sequestered carbon to companies that are over the limits established by the bill. This is the first time many legislators have proposed such an economy-wide approach, and we believe that it holds great promise for rural communities.

Just to sum up, Environmental Defense is very proud to be working with farmers and foresters to make changes to our atmospheric impacts—not only possible, but positive, for everyone involved.

Thank you, again, for allowing me to speak with you today, and I look forward to answering any questions you may have.

[The prepared statement of Ms. Carey follows:]

PREPARED STATEMENT OF MELISSA CAREY, CLIMATE CHANGE POLICY SPECIALIST,
ENVIRONMENTAL DEFENSE

“Biological Carbon Sequestration: Innovation in the Race to Slow Global Warming”

Introduction

Mr. Chairman and Members of the Subcommittee, my name is Melissa Carey and I am a Climate Change Policy Specialist at Environmental Defense, a national non-profit organization based in New York, representing more than 300,000 members.

Since 1967 we have linked science, economics and law to create innovative, equitable and cost-effective solutions to the most serious environmental problems.

I appreciate the opportunity to testify here today on what Environmental Defense considers one of the most promising opportunities available to fight the major environmental issue of our lifetime—global warming. I am very pleased to be able to share our thoughts on how you and your fellow policymakers may take advantage of this important tool to create that rarest of outcomes—a real solution that both effectively addresses the problem and is beneficial to landowners and the broader environment.

I'm particularly grateful to have this opportunity to speak here in this subcommittee, with members who were among the very first policymakers to grasp the potential of this tool. You are responsible for pioneering effort to allow farmers and foresters to fully realize the potential of carbon sequestration to improve the environment and their operations simultaneously. We appreciate your leadership. As you have seen, global warming is a big problem, but its worst effects can be prevented. We know that Americans are up to the challenge. Our country has never run short on innovation, and today, on the issue of global warming, America's heartland is leading the way.

In my testimony today I would like to explain why Environmental Defense has made carbon sequestration a priority initiative. I would also like to outline the nature of our recent activities to promote this important tool. Finally, I'll go over what we believe to be the potential for landowners to benefit from sound incentives for carbon sequestration, and what we see as the basic requirements of such a policy.

Carbon Sequestration: The right tool for an important job

Scientists have made it clear that while much remains to be learned about our future under global warming, the phenomenon is dangerous and it is under way. Though some would emphasize the views of a small minority of scientists, the debate on the existence of global warming is truly over. It effectively ended in June 2001, when the National Academy of Sciences, at the request of the current administration, analyzed two decades of research and confirmed that climate change is a real phenomenon caused by human activities. The report affirms the basic facts starkly: "Greenhouse gases are accumulating in Earth's atmosphere as a result of human activities, causing surface air temperatures and subsurface ocean temperatures to rise. Temperatures are, in fact, rising."¹

It is ironic that a problem of such complexity commands such a simple solution: ultimately, preserving our environment for future generations requires us to halt the steady upward climb of global warming pollution. Whether through decreases in emissions of heat trapping gases or sequestration and storage of those gases here on the ground, we must embrace methods of reducing our "atmospheric footprint" if we are to avoid dangerous global warming.

Every day, in many different ways, Americans are encouraged to think "outside the box" to create solutions to the problems we seek to remedy. This is a long tradition; over our history, Americans have proven our capacity to innovate and create in the face of challenges. We're known for our ability to see untapped potential and craft farsighted solutions well ahead of the competition. Things are no different here. The interaction between land and the atmosphere is often under appreciated, and American farmers and foresters are beginning to see the potential of this underused tool to change the climate change equation. Once again, American ingenuity is taking hold.

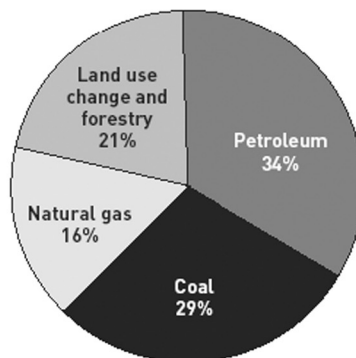
Farms and forests make a difference

Though much of the global warming trend is attributable to fossil fuel emissions, at a global level land-use change and deforestation also emit significant greenhouse gases that contribute to global warming. Figure 1 shows the contribution of deforestation and other forms of land use to worldwide global warming pollution.

¹National Academy of Sciences. *Climate Change Science: An analysis of some key questions*. National Academy Press. Washington, D.C. 2001.

Figure 1.

Mean global CO₂ emissions: deforestation vs. fossil fuels



Source: IPCC. 2000. Land Use, Land Use Change, and Forestry: A Special Report of the IPCC. Cambridge University Press, Cambridge, UK, and U.S. Department of Energy, Energy Information Administration (USDOE). 1999. International Energy Annual.

While the energy and industrial sectors burn fossil fuels that release heat-trapping greenhouse gases, the land use sector is unique in that it can serve to both increase *and* decrease atmospheric greenhouse gas concentrations. While deforestation and other land uses make our “atmospheric footprint” heavier, improvements in the management of forests and farmlands can significantly offset the growth of heat trapping gases in Earth’s atmosphere—whether these gases result from fossil fuel combustion, deforestation, or any other source. Like forests, croplands and grasslands can contribute greenhouse gas emissions to the atmosphere—or remove those emissions—depending upon how they are managed. Clearing and plowing land, for example, releases heat-trapping carbon dioxide by exposing soils to air and sunlight. On the other hand, practices such as conservation tillage, grassland restoration and use of cover crops enhance carbon storage in agricultural soils. Some of these practices also reduce direct GHG emissions from reduced use of inputs such as fuels and fertilizers. Used in this manner, agricultural lands can act as natural carbon storehouses, or “carbon sinks,” delivering benefits to the atmosphere as well as to the local environment. These additional benefits, which include protection of open space, air and water quality improvements, and protection of vital wildlife habitat, provide a another powerful incentive for landowners to pursue land use practices that benefit the atmosphere.

U.S. Lands: Important potential

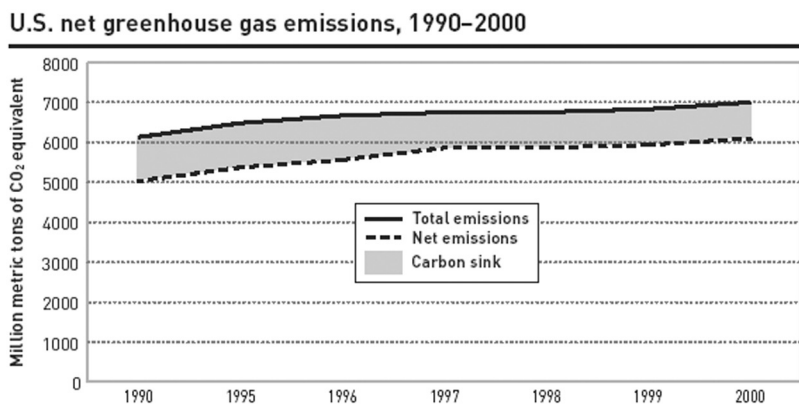
Despite intensive clearing of native forests and grasslands during the 18th and 19th centuries, natural storehouses of carbon have substantially rebounded. As a result, today, the U.S. land base is a sizeable net carbon sink.² As shown in Figure 2, the Environmental Protection Agency estimates that lands in the United States annually offset over 900 million metric tons of carbon equivalent. This is equivalent to approximately 13 percent of total U.S. CO₂ emissions caused by the combustion of fossil fuels.³ Other scientists have estimated an even larger role for carbon sinks in the United States.⁴ Though estimates may differ somewhat, it is clear that even a modest expansion of the existing U.S. sink could substantially boost efforts to curb greenhouse gas emissions.

² Caspersen, J., Pacala, S., Jenkins, J., Hurtt, G., Moorcroft, P. & Birdsey, R. 2000. Contributions of land-use history to carbon accumulation in U.S. forests. *Science* **290**, 1148–1151.

³ U.S. Environmental Protection Agency (USEPA). 2002. Inventory of U.S. greenhouse gas emissions and sinks: 1990–2000. Washington, D.C.

⁴ See, for example, Pacala, S., *et al.*, 2001. Consistent land-and atmosphere-based U.S. carbon sink estimates. *Science* **292**, 2316–2320.

Figure 2.



Source: U.S. Environmental Protection Agency (USEPA). 2002. Inventory of U.S. greenhouse gas emissions and sinks: 1990–2000. Washington, D.C.

Carbon sequestration as a bridge

Biological carbon sequestration alone will not provide the reductions needed to stabilize atmospheric greenhouse-gas concentrations at a safe level. As Figure 1 makes clear, the majority of reductions in global warming pollution must come from economic sectors that burn fossil fuels. During the coming decades, however, carbon sequestration can play a crucial role in efforts to slow climate change by helping to jump-start actions to stabilize atmospheric concentrations of greenhouse gases and buy needed time to develop technologies to reduce CO₂ emissions from energy use. As such, carbon sequestration can act as a “bridge” to a sustainable energy future while providing substantial economic benefits to landowners and substantial ancillary benefits to the terrestrial environment.

Environmental Defense believes that this bridge can be built, but only with substantial participation from the Nation’s farmers and foresters. Widespread engagement in carbon-sequestering practices will only be realized through a system that provides sufficient economic incentives to landowners who can make carbon another commodity produced by their lands. We believe that biological carbon sequestration will be most effective if integrated into a cap-and-trade program that uses markets to deliver economic and environmental benefits. Such a program would allow businesses to offset their greenhouse-gas emissions by purchasing credits from landowners who increase carbon sequestration in forests and agricultural lands.

A Proven Tool: Markets work for landowners and the environment

Past experience with cap and trade—a tool that was developed, tested, and proven here in the United States—has shown that markets deliver unprecedented environmental results at unmatched cost efficiency. In 1990, Congress amended the Clean Air Act, establishing a cap-and-trade program to regulate power plant emissions of sulfur dioxide (SO₂), a precursor to acid rain. The acid rain program places an absolute limit, or cap, on industry-wide SO₂ emissions and allows electric utilities flexibility in how they meet their individual emissions caps. Companies either can reduce emissions from their own plants using the technology of their choice or they can strike a deal: a company that is unable to reduce its own emissions enough to comply with its cap can purchase “surplus” reductions—in the form of “allowances,” or credits—from another company that was able to reduce its emissions even lower than its cap. Companies are free to seek out the most cost-effective means to meet their cap. Failure to meet the cap results in significant financial penalties.

The results of this program have been spectacular: the acid rain program has seen 100 percent compliance, and SO₂ emissions have been reduced far beyond required limits at a fraction of previously projected costs. Interestingly, greenhouse gas emissions are even better suited than SO₂ to a cap and trade program. SO₂ emissions cause impacts only downwind from the source. Global warming, by contrast, is the result of the cumulative release of greenhouse gases, particularly CO₂, worldwide. Therefore, a decrease in CO₂ emissions anywhere on the Earth will result in a global-level reduction of greenhouse gases. This characteristic of greenhouse gases

makes them extremely well suited to a cap-and-trade program, as emitters can search an unlimited geographical area to find cost-effective emissions reductions and carbon sequestration opportunities.

Carbon sequestration can be fully integrated into a cap-and-trade program, providing an immediate and low-cost option in a greenhouse-gas-reduction strategy. Regulations that cap greenhouse-gas emissions can grant industries the option of offsetting emissions by purchasing carbon sequestration credits from landowners who increase carbon storage in forests and agricultural lands. A market that allows carbon sequestration offsets will reduce the cost of compliance and the savings will, in turn, allow deeper and more rapid cuts in emissions than would otherwise be possible. This is a positive feedback loop that generates continuing benefits for the atmosphere, rural communities, and the surrounding environment.

Environmental Defense's National Sinks Initiative

Environmental Defense has made an organizational commitment to tapping this latent potential in our farms and forests. In 2003, Environmental Defense launched our National Sinks Initiative, multi-year effort to demonstrate emerging opportunities for land owners and managers to benefit economically from participation in solutions to global warming. Key activities include regional demonstration projects, on-site studies and reports, educational initiatives, transactions of greenhouse gas (GHG) emission reduction and carbon sink credits, and policy applications of these project experiences. Environmental Defense is working with farmers and foresters on several fronts to assure that actionable and economically attractive crediting options for landowners play a pivotal role in American climate protection policies.

Demonstration projects

Over the next two years, our Sinks Initiative is placing a major emphasis on the creation of cooperative projects demonstrating benefits to both the landowner and the atmosphere from adoption of improved land management practices. Through carbon sequestration and direct GHG emissions reductions, land managers can improve their bottom line through increased productivity and through the sale of carbon and GHG offset credits to energy-intensive industries aiming to limit their GHG emissions. Environmental Defense is working with farmers and ranchers in a number of regions of the U.S. to demonstrate how GHG offset crediting can work in a variety of settings, and how supportive state and Federal policies can be implemented.

Model transactions

An early success in our sinks initiative is a transaction between a group of Pacific Northwest farmers and Entergy, the Louisiana-based energy company. In Washington state, the Pacific Northwest Direct Seed Association, representing 300 farmers owning 500,000 acres, has joined with Entergy to promote direct seeding, a practice which enhances soil carbon sequestration and which provides a host of other benefits such as improved soil productivity, reduced erosion, and better wildlife habitat. In this partnership, which was brokered by Environmental Defense, Entergy will lease 30,000 tons of carbon offsets over a ten year period from participating landowners. In addition to the carbon benefits seen by the atmosphere, the lands affected by the project will contribute less runoff to nearby waterways, helping to improve the habitat for critical steelhead and salmon runs. The attached article from the journal *Top Producer* gives further details on this project. It is the type of success we wish to replicate in through further work with the agricultural community.

Setting high standards

Environmental Defense's work aims not only to demonstrate that certain practices can increase the uptake of carbon by soils and forest, but also that the uptake can be reliably quantified and credibly integrated into GHG emissions control programs and policies. Ultimately, we are confident that carbon sequestration will be included as a means of compliance under a national emissions policy. To ensure the soundness of such an approach as well as its acceptance by the science community, the policy community and the general public requires that a number of technical issues be addressed and resolved. Environmental Defense is working with scientists and practitioners to pinpoint those issues and test various possible solutions, ultimately determining the highest possible standards for carbon sequestration projects.

Partnerships: Critical ground-truthing

In coordination with project work, Environmental Defense will partner with the local-level organizations that are best positioned to offer practical, real-time insights on the experiences of landowners and land managers as they participate in carbon-

sequestering activities. In January 2003 Environmental Defense and the National Association of Conservation Districts formalized an agreement to cooperate on innovative ways for agriculture to produce greenhouse gas reduction credits to enhance income in rural American and help slow global warming. The joint effort of the NACD and Environmental Defense is an unusual and important alliance, and embodies the spirit in which we are pursuing our outreach to the agricultural community.

Policymakers respond: Future opportunities for farmers and foresters

As farmers and foresters become more familiar with their potential to make a positive contribution to global warming solutions, policymakers across the country are responding. Significantly, U.S. Senators John McCain (R-AZ) and Joseph Lieberman (D-CT) have introduced the Climate Stewardship Act (S.139), a bipartisan, comprehensive proposal to establish a national market for greenhouse gas emission reductions. Under the Climate Stewardship Act, farmers and foresters are not regulated, but may elect to undertake carbon-sequestering activities and enter the national carbon market as sellers of low-cost carbon sequestration offsets. Environmental Defense strongly supports this legislation; in our view, it represents the most thorough and complete proposal to create the sort of market that will provide real benefits to farmers, foresters, and the environment.

Policymakers are leading outside of Washington as well. states in all regions of the country have begun to engage in climate policy, and particularly in actions to promote carbon sequestration. Actions ranging from simple study provisions to full-scale cap and trade programs have been proposed and in most cases approved in the state legislatures of California, Connecticut, Hawaii, Idaho, Illinois, Iowa, Louisiana, Massachusetts, Minnesota, Nebraska, New Hampshire, North Dakota Oklahoma, Oregon, South Dakota, Washington, and Wyoming. Other activities, including scientific study and project development, are proceeding independently in states that have not yet enacted formal programs to promote carbon sequestration. In these cases, farmers and foresters are acting first, reflecting their independent interest in this innovative tool. The excellent work of the Consortium for Agricultural Soils Mitigation of Greenhouse Gases, headed by Dr. Charles Rice here at Kansas State, is a good example of this type of activity, as are the activities of the Kansas Coalition for Carbon Management.

Activities are also proceeding beyond our borders. At the international level, a market in greenhouse-gas-emissions-reduction credits is already emerging. Significant market activity is occurring in Europe, where many nations have adopted national emissions caps pursuant to the Kyoto Protocol and European officials have officially endorsed creation of a European market in greenhouse gas emissions reductions. And the volume of transactions is growing. Countries and companies traded an estimated 12 million metric tons of emissions credits in 2001, and transactions totaling 24 million metric tons have closed over the first six months of 2002. Some observers have estimated that number could rise to 68 million metric tons by the end of 2002.⁵

Conclusions

Environmental Defense commends the leadership of Subcommittee Chair Senator Brownback and his colleagues in pursuing the unique opportunities that carbon sequestration presents to the agricultural and forestry communities. You are truly leaders in this field, and we look forward to working with you to make this emerging market a robust reality for rural communities nationwide. I am happy to answer any questions you may have on any aspect of my testimony. Thank you.

Senator BROWNBACK. Thank you, Ms. Carey. Thanks for being here.

Dr. Walsh, let me just start with the basics on this for the Chicago Climate Exchange, do you have any carbon trades with agriculture that are going through the Chicago Climate Exchange today? And if so, could you describe those?

Dr. WALSH. Senator, we are just now finalizing the terms of trade. We have taken our high-level rule book and drafted it into a multi-hundred-page document that details all this. And we are

⁵ World Bank. 2002. "State and Trends of the Carbon Market(s)". Presentation prepared by Frank Lecocq and Karan Kapoor, on the basis of material provided by Natsource LLC, CO2e.com LLC, and Point Carbon. October 18, 2002.

going to have trades this year. But let me take you, step by step, through the process here.

Each individual producer will execute a very simple contract, a 4-year commitment. Let us take, as an example, continuous no-till on a specified piece of property. That piece of property will then be assigned a standardized quantity of emission credits, of offsets, and they will be managed by their aggregator. For example, if we had a cooperative or a farm bureau that becomes a registered aggregator that has certain professional qualifications and financial qualifications that we are required to have by our Commodity Futures Trading Commission exemption, then the producer registers his contract with the aggregator. The aggregator provides the exchange a summary document. And as we establish that the contracted activities are undertaken in the field, then the aggregator gets the credits and can sell them in the open market on our Internet-based trading platform. And then the aggregator will feed back the proceeds to the farmer. And we will have somebody from Ted's shop, perhaps, or a subcontract, perhaps somebody from an RC&D, in fact, do a field inspection to determine that the agreed-on practice took place. And it is at that point where we have an opportunity to gain far more information as to, you know, what is going on in the field and the other technical information we would like to start to accumulate.

The buyers in the market are these industrial companies—the Fords, the American Electric Powers, and so on, perhaps the DuPont or—who may either be unable to make their reduction commitment for 2003, or they anticipate that the reduction commitment for 2004, 2005, or 2006 is not going to be something they can get to in-house, and they want to buildup a bank of allowances, or of offsets.

Senator BROWNBAC. So if I am a farmer in Kansas, and I want to work through the Chicago Climate Exchange, I will sign a simple contract, and for 4 years I am going to do this particular agricultural practice, a no-till type of operation, that is then verified on this number of acres.

Dr. WALSH. Correct.

Senator BROWNBAC. And that will go, then, through an aggregator that will get a number of acres together. And then what you will sell or trade to one of these companies a set of carbon credits, over a 4-year time period?

Dr. WALSH. That is one option, but we—that would be a forward deal, Senator. It is going to be a year-by-year, a spot market.

Senator BROWNBAC. So they buy yearly?

Dr. WALSH. Yes.

Senator BROWNBAC. American Electric Power buys yearly carbon credits?

Dr. WALSH. That is correct.

Senator BROWNBAC. This year, somewhere in the United States, there are 80 credits of carbon that are in the soil that would not otherwise be there.

Dr. WALSH. That is right. Well, I should note that to keep this high level of confidence and to keep it simple and to focus on the big place, the delivery territory spreads from Central Kansas over to Central Ohio up into Southern Michigan and across to Southern

Minnesota, so we are really focused on the corn-and-bean belt as a starting point, because we have good knowledge and good information on the carbon sequestration rates for that area. As we get into the Northwest and get into the Southeast, it is highly dependent on local conditions. So we focused first on the big source of supply.

Senator BROWNBACK. So your group, in describing the geographic area that you did there, the Midwest/Upper Plains corn-belt region, you feel quite confident that if you contracted a farmer to do this practice on this land in this area, we are going to be setting aside this amount carbon. You feel like that the science is well-developed to be able to say that with certainty to the purchasers.

Dr. WALSH. With very high confidence. Let me explain how we arrived at the standard value we have achieved here. We, first, have convened Dr. Rice and a couple of other top soil carbon experts at land-grant universities and asked them, if we picked, really, the prototype heart of the Midwest location—and I think we talked about Iowa as heart of the Midwest for soil carbon opportunities—and we said, what would be—

Senator BROWNBACK. We would consider Kansas—

[Laughter.]

Dr. WALSH. Oh, absolutely.

[Laughter.]

Senator BROWNBACK. I will just register my opinion.

[Laughter.]

Dr. WALSH. I would like to be true to the record.

We said that if we just picked a field that is a very good potential field in the Midwest, what could we be confident in achieving under a continuous no-till regime? And then we employed a traditional capital-markets tool where we give it a haircut. We took 15 percent off of that, because we really would like to be confident in these numbers.

Now, if you end up proving to me, Senator, that your land has more soil carbon accumulating than our standard value, that belongs to you and may ultimately be tradeable. But we wanted to be conservative and credible.

First, we picked the standard value and discounted it. Then we asked, “Where is that standard value applicable?” And I will tell you that Western Kansas is not as conducive to carbon accumulation under no-till as Eastern Kansas is. However, we also recognized that some of these other practices—grass plantings, tree plantings—offer opportunities, and the delivery territory for grass plantings includes all of Kansas. So you can do grass plantings in much of the Midwest, and you can do it in all of Kansas and much of Nebraska, as well, and get the specified tonnage per acre per year. Anything above that belongs to the farmer. And we would like to start measuring that excess so that we get additional credit for the grower over time.

Senator BROWNBACK. Ms. Carey, what do you think of the trading system described here by Dr. Walsh because you noted, as well, and even in your motto, “Finding the Ways That Work”—I certainly think the way we will work through this is through a market—what do you think of what he describes on being able to

produce carbon credits for a market system the way he has described this?

Ms. CAREY. I think, just to start at sort of a high level, what Dr. Walsh is describing is a difficult balance between accuracy and scale at this point, given the technologies and the methodologies we have to accurately measure, monitor, and verify carbon. Ideally, in undertaking a carbon sequestration project, you would like to be as specific as possible about what you are measuring. And certainly, the precision is available. It is a matter of at what cost you want to attach to it.

One thing that we have described over and over again to some of the doubters who have raised this question is that scientists have known how to accurately measure soil carbon, for example, for decades. It is something—it is a standard scientific practice. The question is, How do you modify measurement techniques, for example, that are well-adapted to scientific study, and modify them up to be accurate at larger scale?

We are working on something we are referring to internally as the “gold standard.” We are working with scientists to develop the highest possible quality methodologies for measuring, monitoring, and verification. And we are testing them out in the context of some of the demonstration projects we are undertaking that I described in my testimony to, sort of, showcase the most advanced methodologies and technologies and show that you really can become extremely accurate on a project-by-project basis.

Senator BROWNBACK. You have mentioned your project that you have in the Northwest. Now, do you have projects in other places around the country, Ms. Carey?

Ms. CAREY. We are working on it. Our National Sinks Initiative was actually just started in this calendar year. So the process of going out into the field and identifying partners and potential projects has just begun. We are currently working in a couple of places—Texas is one place, Mississippi, Louisiana, New York possibly—and we would like to come to Kansas, as well.

Senator BROWNBACK. Good. Good.

I want to ask you, Ms. Blackman—

Ms. BLACKMAN. Yes.

Senator BROWNBACK.—in Kansas, could you describe some of the features of a good sequestration project, what it ought to have to make it attractive to producers and buyers? What is the model type program in our state for a farmer to engage this program?

Ms. BLACKMAN. The conservation tillage, of course, is part of the initial program that we feel would add it, really, to their overall carbon-credit product or availability of carbon credits within his production.

You know, one of our greatest concerns in Kansas is that we want to be certain that the producer, the ones that are sequestering this carbon out here, taking this carbon out of the atmosphere, is going to be the one that is going to be receiving the benefit of the sale of that carbon credit, receiving the biggest percentage within his pocket for the work that he is doing on the land, that it is not going to be tied up in legalese, if you will, and getting it down to the very basic cost, not putting a lot of additional cost into it with unnecessary verifications and so forth.

Our conservation districts, our RC&D councils out here, have done a very good job in putting the farm bill programs on the ground in Kansas, and that we have got our products is proof of that, in our grain and our livestock. And the opportunity that we have in our farm bill to increase our ability to put good conservation practices on the ground and increase the opportunity for carbon credit is certainly going to be an advantage.

I guess I would say that our greatest concern is our producers out there, the viability of rural America, rural Kansas, through the opportunity that we see in the carbon sequestration activities. But I do not know that I have answered your question fully—but, you know, I certainly have tried. I hope I have, so—

Senator BROWNBACk. Well, I do not know that it was very artfully asked, either.

Senator BROWNBACk. So I think you—no, I think you hit the right issue. I mean, from my perspective, in family farms, the program would have to be something that is relatively, I think, straightforward in its design, that, OK, here is what you would be required to do over this period of time, and here is what the payment would be, so that—

Ms. BLACKMAN. Right.

Senator BROWNBACk.—you could measure and say, “Well, OK, I’m willing to do these things for that price.” And ideally, what I would like, as a legislator, is to see that money get back to rural America, get back to a farmer’s pocket, because it is a tough financial business. And—

Ms. BLACKMAN. Right.

Senator BROWNBACk.—I have said to many people, over a long period of time, the farmer really wants to take care of that soil. He really wants to care of that land.

Ms. BLACKMAN. Exactly.

Senator BROWNBACk. But it has to be economically viable, because he is not going to starve his family to death. And it is a thin-margin business in too many respects. So, to the degree that we can get something here where he is paid for the way he produces, that can be economically significant, environmentally beneficial, then I think you find a lot of people willing to do it. If you tie it up in too much difficulty, cost, regulation of it, I think it loses—

Ms. BLACKMAN. We have a good—

Senator BROWNBACk.—its attractiveness.

Ms. BLACKMAN.—system on the ground. And as I stated earlier this morning, Kansas has been noted for the conservation issues and practices that we accomplish here in our state. I think we can be a model for some other states within our Nation. And our system is working, and we get excellent technical support through NRCS and so forth for our producers to be able to continue to put this best-management practice on the ground—to bring better water quality, better soil quality, better production—into our efforts out there.

And we would like to see that these efforts would be rewarded for those good-steward practices. So I would feel that that would be something that should be being made as a key issue in looking at the overall picture of carbon sequestration and the opportunity for marketing carbon credits.

Senator BROWNBACK. Mr. Hartsig, what protocols will you be using to monitor and verify the carbon storage of enrolled acres? I heard Dr. Rice talk about global position systems, computer modeling. What sort of protocols are you looking at, as a verifier in this field?

Mr. HARTSIG. I think those basic protocols, such as you indicated, in using the tools that are available, currently most of the tools available are probably a little bit more labor-intensive than those that will develop, I think, very shortly, as Dr. Rice had indicated. Definitely GPS positioning. We are looking at using remote-sensing technology, perhaps satellite technology, to be able to identify and look at fields on the ground from satellite technology. When you use a multi-spectral aspect, there are potential techniques for—and, actually, there are existing techniques—for looking at the ground cover to see what is there under what conditions and if, indeed, the farmer has the acreage that he claims, as well as if he has put the crop in the ground, and if it is under no-till conditions. The no-till conditions from satellite data is a little bit more difficult, but we are looking at strategies for that.

Senator BROWNBACK. Are we going to be able to do this from satellites so that you will be able to have an accurate degree of verification that the farming practice that was set is being done and the carbon being accumulated, that we have a fair degree of certainty this is being accomplished?

Mr. HARTSIG. Using satellite data, you are looking at the practices; you are not looking at soil carbon content. Unless something can peer down from outer space—and I do not know what they have in the Government at this point—

Senator BROWNBACK. That is black-box programs—

Mr. HARTSIG. Right.

Senator BROWNBACK. But the actual verification of carbon content is still an on-the-ground type thing. Ideally, with this ???* system that Dr. Rice has mentioned and that they are researching and developing, that sounds like it has tremendous opportunity and potential for doing a rapid, real-time analysis of soil carbon content. Again, that is an on-the-ground procedure. As Ms. Carey has indicated, a lot of these procedures for looking at and verifying the amount of carbon in the soil can be onerous.

A strategy is going to have to be developed as to what percentage or to what degree are we going to look and what frequency are we going to be looking at carbon in the ground. Dr. Rice has indicated he would like to see the development of check standards or reference points in landscapes, for various landscapes, to use as an indicator within regions, within locations. So that data can be interpolated as long as people are following specific practices. Using remote-sensing data, that is where we look for the practices.

So it is a combination of strategies and protocols that will have to be developed. And again, as I had indicated, these are things that are going to have to be agreed upon, in the scientific community, with Government, with the actual people on the ground and with the industry, to say, “Yes, we agree that this is going to work.”

Senator BROWNBACK. But you do not see any real problem in being able to get this done. It is just—this is going to take—and

probably going to be a lot more labor intensive at the outset than it is when we get the ultimate practices that establishes—we build the database up of information and—

Mr. HARTSIG. That is absolutely right.

Senator BROWBACK.—based upon farming practice, geographic location, soil type—

Mr. HARTSIG. Right. Any project of this magnitude is always more difficult at the outset, because you have that data collection, you have the trying it out, the testing of the procedures to make sure they work. If they do not work or if there is a small flaw or if something comes better, you go back and you try that. So there is a continual refinement process. The refinement process will make that a more eloquent, more efficient system as you go through the time.

Senator BROWBACK. Do you think—some others were saying earlier that the carbon variability varies more year to year than it does over a five- to 10-year time period, and that makes some sense to me, because you get variabilities in what a crop produces based upon did we get any rain this year or not. And you can predict that a little better over a five- to 10-year window than you will on a year to year. Like, we are going to have more carbon here this year than last year—I can guarantee that—in Kansas, given that we are getting rain this year and we did not last year.

Senator BROWBACK. And do you think, in the future, we are probably going to go to a way where you buy or sell agricultural farm carbon credits over a period of years rather than a spot market year to year—where you go to year to year—that, instead, you will probably sell 5-year credits or 10-year credits because it is a little more predictable?

Mr. HARTSIG. Actually, I think—

Senator BROWBACK. To you or Dr. Walsh, either one.

Dr. WALSH. Well, Senator, you have really hit on the core challenge here. We were advised, from the very beginning, a couple of years ago, I remember the discussion that the annual change in carbon relative to the carbon stock is quite small, and it is extremely expensive to detect that change. And what we need to do is to be right on average; that, on average, we need to have our standard value being realized, not only on an individual farm, but in our entire delivery territory, so if a farmer in Southern Minnesota, 1 year, has a slightly below-our-standard number, we can be pretty confident that, the next year, he might be higher, or another farmer in Illinois or Indiana or Kansas might be higher, so that, on average, the carbon credits we are selling to industry represent real, tangible increases in stored carbon. So that concept of over-time averaging and over-space averaging, I think, is correct. That is what the atmosphere sees, is that long-term and that real actual buildup. It does not exactly matter where the reduction occurs, as long as we get to happen.

And I should note that our philosophy for this simple 4-year pilot is to try to find credible, simple ways to take some of the transaction cost out of the system so that Ms. Blackman's members can get the most possible revenue from these trades. We do not know what the revenue stream will be. And I should also emphasize that it is very easy to underestimate the challenges of building the

human institutions—the contracts, the verification procedures, the aggregation process, the trading rules to be employed by the aggregators. Once we have focused on a very simple definition, conservative definition, of the carbon credit, then we are freed up to start to focus on these other institutional challenges, which are significant. They are fun to work through, though. And the folks here in Kansas are helping to push that frontier, as well.

But averaged over time, averaged over space, that is what is really going to matter to the environment at the end of the day.

Senator BROWNBACK. Well, this is a huge challenge. And we held a hearing, I think, here a couple of years ago and have been working on this topic for some time. Dr. Rice has been working on it for 20 years. It is a big challenge. I can see the progress that is being made in the thinking and the knowledge and where we are really going. So I have thought, for some time, that God gives us problems so we have to talk to each other, because otherwise we would sit at home and just eat bonbons—

[Laughter.]

Senator BROWNBACK.—you know, sort of, “I don’t need to talk to anybody.” So we have problems. So we have to talk with each other. And the United States is leading the world on figure this out. I have been in other places where they have said, “Yes, this is a possibility.” And indeed, when they did the ultimate protocol on global warming internationally, carbon sequestration is a huge part of cutting the final deal. It was a big part of it. And it was a big part of getting countries like Russia, a number of South American countries, into it to say that sequestration—but they did not know how they were going to measure it. They had a much better idea on forestry than they did on agricultural lands. I think we are coming along very nicely on agricultural lands.

I do think probably, over time, this is going to end up being a 5-year credit or a 10-year credit, probably more likely than a spot market year to year. I think we will have a lot more predictability with that type of system to go with.

I very much appreciate your testimony. I appreciate how much thought has gone into this. We will be taking this issue up, even possibly this next week, in the U.S. Senate, the bill you talked about. There are several other possibilities of bills coming forward that would push carbon sequestration but not the cap and trade that McCain-Lieberman, which is a controversial step yet. But there is a lot of other carbon sequestration issues that will be coming forward, possibly even this next week, as we debate the energy bill in the U.S. Senate.

With that, I thank you all for your attendance, your testimony. I thank the audience for being here. I think this was a very informative hearing. And the project and the work continues to move on forward.

The hearing is adjourned.

[Whereupon, at 5:02 p.m., the hearing was adjourned.]

A P P E N D I X

PREPARED STATEMENT OF JAMES R. MAHONEY, PH.D., ASSISTANT SECRETARY OF COMMERCE FOR OCEANS AND ATMOSPHERE, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)

Good afternoon Senator Brownback (and members of the Subcommittee).

I am James R. Mahoney, Assistant Secretary of Commerce and Deputy Administrator of the National Oceanic and Atmospheric Administration (NOAA). I am appearing today in my capacity as Director of the United States Climate Change Science Program (CCSP). The CCSP integrates the Federal research on climate and global change, as sponsored by thirteen Federal agencies (the Departments of Agriculture, Commerce, Defense, Energy, Health & Human Services, the Interior, State, and Transportation; together with the Environmental Protection Agency, the National Aeronautics and Space Administration, the National Science Foundation, the Agency for International Development, and the Smithsonian Institution) and overseen by the Office of Science and Technology Policy, the Council on Environmental Quality, the National Economic Council and the Office of Management and Budget.

I am very pleased to have this opportunity to describe the Administration's scientific research program on climate and global change, with specific reference to the important role that soil carbon sequestration can play in reducing net greenhouse gas (GHG) concentrations. Climate variability often plays an important role in shaping the environment, natural resources, infrastructure, and economy. Potential human-induced changes in climate and related environmental systems, and the options proposed to adapt to or mitigate these changes, may also have substantial environmental, economic, and societal consequences. Because of the pervasiveness of the effects of climate variability and the potential consequences of human-induced climate change and response options, citizens and decision makers in public and private sector organizations need reliable and readily understood information to make informed decisions about climate issues.

President Bush's approach to addressing global climate change emphasizes science-based decision making, and recognizes that economic growth is part of the solution. A nation that grows its economy is a nation that can afford investment in research and development of new technologies. For agriculture, this investment will likely have the added benefits of increased agricultural production, improved soil quality, and increased soil carbon sequestration.

CCSP Carbon Cycle Research and Soil Carbon Sequestration

Decision makers searching for options to stabilize or mitigate concentrations of greenhouse gases in the atmosphere are faced with two broad approaches for affecting atmospheric carbon concentrations: (1) reduction of carbon emissions at their source; and/or (2) enhanced sequestration of carbon—either through enhancement of biospheric carbon storage or through engineering solutions to capture carbon and store it in repositories. Enhancing carbon sequestration is of current interest as a near-term policy option to slow the rise in atmospheric carbon dioxide (CO₂) and provide more time to develop a new generation of low-GHG emitting technologies.

Successful carbon management strategies will require solid scientific information about the basic processes of the carbon cycle and an understanding of its long-term interactions with other components of the Earth system. Such strategies also will require an ability to account for all carbon stocks, fluxes, and changes and to distinguish the effects of human actions from those of natural system variability. Breakthrough advances in techniques to observe and model the atmospheric, terrestrial, and oceanic components of the carbon cycle have readied the scientific community for a concerted research effort to identify, characterize, quantify, and project the major regional carbon sources and sinks.

The overall goal for the CCSP carbon cycle research is to provide critical scientific information on the fate of carbon in the environment and how cycling of carbon

might change in the future. Current research on the global carbon cycle is focusing on two overarching questions:

- How large and variable are the dynamic reservoirs and fluxes of carbon within the Earth system, and how might carbon cycling be managed in the future?
- What are our options for managing carbon sources and sinks to achieve an appropriate balance of risk, cost, and benefit to society?

Substantial current interest in carbon sequestration centers on land management practices that enhance the storage of carbon in soils and biomass. An example of research at the forefront of this field can be found within the Consortium for Agricultural Soils Mitigation of Greenhouse Gases (CASMGs), led by Dr. Charles Rice at Kansas State University. CASMGs is a multi-year, collaborative effort funded by the Department of Agriculture to improve the scientific basis of using land management practices to increase soil carbon sequestration, reduce GHG emissions, and provide the tools needed for policy assessment, quantification, and verification. More than 50 research and outreach projects among 10 institutions are underway focused on:

- Improving the understanding of basic processes and mechanisms controlling soil carbon sequestration and GHG emissions;
- Developing best management practices for carbon sequestration;
- Using models and databases to improve prediction and assessment of carbon sequestration and GHG emissions;
- Using measurements to evaluate the impact of management practices on soil C storage, total GHG radiative forcing, and soil NO₃ leaching.
- Developing websites, publications, and newsletters to communicate research findings and news with policymakers, regulators, the public, and others.

I view the CASMGs program to be a highly important building block in developing the information and management tools needed to optimize the deployment of soil carbon sequestration as a key component in reducing the growth of GHG emissions in the United States. Moreover, the CASMGs research projects can provide guidance for worldwide increased soil sequestration of carbon through the adoption of improved agricultural management practices. More details on CASMGs projects are available at www.casmgs.colostate.edu and www.oznet.ksu.edu/ctec.

Other CCSP ongoing research evaluates the important role that sequestering carbon in cropland and grazing lands can play in mitigating the potential adverse impacts of climate change. For example, current research focuses on how carbon sequestration can be optimized through management of tillage, fertilization, irrigation, drainage, and other practices. In addition, methods are being developed for rapid, accurate, and cost-effective ways to measure carbon in soil directly, and to estimate it on large geographic scales.

CCSP Management and Planning Activities

Since President Bush created the new cabinet-level management structure for climate science and technology programs in February 2002, the CCSP has made substantial progress on the program's objectives, including those related to carbon cycle research, through a variety of review and planning activities, including:

New, Integrated Management Structure: The CCSP, under the new interagency management structure that assures joint planning of approximately \$1.7 billion (annual budget) climate and global change research, has (a) completed a comprehensive review of the ongoing research programs in all CCSP collaborating agencies, (b) prepared an interagency integrated climate science budget request for FY 2004, included in the President's budget request to Congress, and (c) prepared the basis for operational interagency management of the FY 2003 budgets.

Strategic Plan: The CCSP published an extensive *Discussion Draft Strategic Plan* of its new 10-year strategic plan in November 2002. A public workshop focusing on the plan was held in December 2002 and was the most highly attended and structured discussion of climate change issues held to date. CCSP will publish its updated strategic plan for the climate science program on June 25, 2003, after consideration of all of the workshop discussions and the full range of the written comments received after the workshop. The plan, which will be subject to future modification as warranted by the emergence of key science findings and key public questions to be addressed, will guide the conduct of the Federal research activities, including those focused on soil carbon sequestration. All of the documentation of the CCSP strategic plan, the work-

shop proceedings, and the public comments appears on the website www.climate-science.gov.

Comprehensive Review by the National Academy of Sciences: CCSP requested that the National Academy of Sciences—National Research Council (NRC) conduct a comprehensive review of the draft and final versions of the CCSP Strategic Plan. The Academy appointed a special 17-member committee of experts in the physical, biological, social and economic sciences that has provided preliminary public recommendations which are being considered in the update of the strategic plan. The NRC recommendations complement the input provided by experts nationwide as part of CCSP's commitment to a highly open process of public and expert participation in the understanding of climate change issues and response strategies. The NRC report on the final Strategic Plan will be available in the fall.

Integration of Scientific and Technological Developments: One of the principal themes of the workshop was the likely need for breakthrough technology options to address the long-term challenge of global climate change. CCSP is working closely with the Climate Change Technology Program to assure that: (a) science drives the definition of technology needs, and (b) science is used to evaluate both the *intended* and the *unintended* consequences of proposed technology innovations.

Major U.S.-Led Earth Observation Summit Announced: Building on the need for a truly integrated global climate and ecosystem observing and data management system as documented in the CCSP *Discussion Draft Strategic Plan*, the United States will host an Earth Observation Summit to be held in Washington, DC, on July 31, 2003. The meeting will involve the Science Advisors and the Science or Technology Ministers of the G-8 nations and other nations, and will serve as a foundation for comprehensive observation of the Earth's climate system, which will be a focus of the December 2003 *Conference of the Parties* of the United Nations Framework Convention on Climate Change.

Closing Statement

Comprehensive, objective, transparent and well-reviewed scientific inquiry must be the core methodology used to evaluate the highly complex relationships between natural and anthropogenic influences on Earth systems, and to project potential outcomes of the many different investment and action strategies that have been proposed to mitigate or adapt to potential changes in global conditions.

While many important scientific and technological aspects of the climate change issue await improved resolution, some issues are already sufficiently resolved to compel action. In particular, soil carbon sequestration is clearly identified as a win-win strategy that deserves rapid implementation. Soil carbon sequestration provides for improved agricultural productivity and enhanced economic outcomes and assured contributions to meeting U.S. and global carbon management goals. We look to the highly important CASMGS research and outreach programs as major resources for the development and implementation of enhanced soil carbon sequestration practices in the United States and throughout the world.

Thank you very much for the opportunity to participate in this hearing.

