Calendar No. 120

105TH CONGRESS, *1st Session* | SENATE | REPORT 105–54

CONDITIONS REGARDING U.N. FRAMEWORK CONVENTION ON CLIMATE CHANGE

JULY 21, 1997.—Ordered to be printed

Mr. HELMS, from the Committee on Foreign Relations, submitted the following

REPORT

[To accompany S. Res. 98]

The Committee on Foreign Relations having had under consideration a resolution expressing the sense of the Senate regarding the conditions for the United States becoming a signatory to any international agreement on greenhouse gas emissions under the United Nations Framework Convention on Climate Change, reports favorably thereon, and recommends that the resolution do pass.

I. BACKGROUND AND PURPOSE

In May 1992, the United States Senate gave its advise and consent to the ratification of the United Nations Framework Convention on Climate Change. The treaty, which was intended to address the global emission of greenhouse gases, was signed by President Bush at the Rio Earth Summit. Under that treaty the United States, like other developed countries, committed to a non-binding target of containing emission levels at 1990 rates by the year 2000. The treaty entered into force in March, 1994 and is not fully implemented.

Soon after entry into force Parties began preparing for the First Conference of the Parties (COP–1) in Berlin, Germany, and began drafting of a new legal instrument to address emissions reductions beyond the year 2000. At COP–1 in March 1995, the "Berlin Mandate" was adopted by the Parties. That document set the broad framework for negotiations to follow, including a decision that no commitments would be included in a new agreement for countries with developing economies, as defined in the Framework Convention. Countries that would not incur new commitments include China, Brazil, Mexico, and India. The COP–1 also established the

Ad Hoc Group on the Berlin Mandate (AGBM), which was tasked with developing the text of a new agreement.

The Second Conference of the Parties (COP–2) in Geneva, Switzerland, in July 1996, took an additional step in negotiations, calling for "legally binding" commitments that could have significant impact on many world economies. Specifically, Parties agreed to work toward establishing emissions reduction commitments requiring specific, legally binding emissions limits and policies for the period beyond 2000. The "Ministerial Declaration" issued at COP–2 called for accelerated negotiations on the elements of a new legal instrument that would limit emissions of greenhouse gases. That legal instrument continues to be under negotiation on a timetable to be opened for signature at the Third Conference of Parties in Kyoto, Japan, in December 1997.

The next round of negotiations is scheduled for July 1997 in Bonn, Germany. At this round of negotiations members will have for the first time a full negotiating text with submissions from all parties. The Clinton administration submissions include the following key elements: 1) the target for reduction of greenhouse gas emission levels should be binding; 2) the target should focus on the years 2010 to 2020; and 3) countries should have flexibility nationally in implementation of the new commitments.

Other U.S. proposals include: 1) the creation of an "emissions budget" which would allow nations to "trade" emissions in order to meet targets, and "bank" emissions for future years, and "borrow" from future years (with a penalty); 2) establishment of procedures to ensure reporting, measurement, review and compliance of emissions standards; 3) involvement of developing countries (without requiring binding emission reductions), including graduation requirements for developing countries; and 4) provision for "joint implementation," which would permit parties to assume reductions through activities in other countries.

Resolution 98 was introduced by Senators Byrd and Hagel and has more than 50 cosponsors. Supporters believe that the resolution sends a clear and unambiguous signal as to the basic conditions that must be met if the United States is to accept legally binding commitments to reduce greenhouse gas emissions. In addition, the resolution recommends that a bipartisan group of Senators be appointed by the Majority and Minority Leaders of the Senate to monitor the status of negotiations on climate change and report periodically to the Senate. This degree of oversight is unusual and serves to emphasize the high level of member interest in ensuring that the United States ratify a treaty only if U.S. interests are adequately protected.

The attached appendix is an expansive compilation of the testimony of Senators, administration officials, economists, scientists, and U.S. industry and labor. A thorough reading of the testimony indicates that the issues are complex, both in terms of the scientific data that exists on global warming and the potential impact on the U.S. economy if certain proposals are implemented in the United States.

II. Committee Action

The Subcommittee on International Economic Policy, Export and Trade Promotion held two public hearings on June 19 and June 26, 1997. The hearings were chaired by Senator Chuck Hagel. The Committee on Foreign Relations considered Senate Resolution 98 on July 17, 1997, and ordered the resolution favorably reported by a voice vote.

III. Section By Section Analysis

Section One of Senate Resolution 98 has two parts. The first paragraph specifies two key conditions that the Senate expects to see included in any international agreement that the United States signs related to reducing greenhouse gas emissions. This section states that it is the sense of the Senate that any agreement that the United States signs that would impose additional legal commitments on the United States related to the United Nations Framework Convention on Climate Change should include commitments for countries with developing economies (termed non-Annex I countries under the existing U.N. Framework Convention), and should not result in serious harm to the economy of the United States. The section makes clear that these requirements apply to any agreement reached during scheduled negotiations in Kyoto Japan in December 1997 or any agreement reached thereafter.

The second paragraph states the sense of the Senate regarding the materials that must be included in the transmittal documents that would accompany any agreement that is submitted to the Senate for its advice and consent to ratification. Such transmittal documents should include: 1) a detailed explanation of legislation or regulations that would be required to implement the agreement; 2) a detailed analysis of the financial and economic costs to the United States incurred by implementing the agreement submitted to the Senate.

Section Two of the Resolution requires the Secretary of the Senate to transmit a copy of the Resolution to the President.

APPENDIX

STATUS AND IMPLICATIONS OF UNITED NATIONS CLIMATE CHANGE NEGOTIATIONS

C O N T E N T S

HEARING OF JUNE 19, 1997

HEARING OF JUNE 26, 1997

APPENDICES

JUNE 19, 1997 HEARING

Page

JUNE 26, 1997 HEARING

GLOBAL CLIMATE CHANGE NEGOTIATIONS: THE ROAD TO KYOTO

THURSDAY, JUNE 19, 1997

U.S. SENATE,
SUBCOMMITTEE ON INTERNATIONAL ECONOMIC
POLICY, EXPORT AND TRADE PROMOTION,
OF THE COMMITTEE ON FOREIGN RELATIONS,
Washington, DC.

The subcommittee met, pursuant to notice, at 9:33 a.m., in room SD–419, Dirksen Senate Office Building, Hon. Chuck Hagel (chairman of the subcommittee) presiding.

Present: Senators Hagel, Thomas, Sarbanes, and Kerry.

Senator HAGEL. The committee will come to order.

Today the subcommittee meets to receive testimony regarding the status of U.N. Global Climate Change Negotiations. We have before us this morning a group of very distinguished witnesses representing a variety of views from Congress, the administration, and the private sector. We look forward to their testimony.

Welcome.

We are dealing with an issue that has potentially drastic consequences for American foreign, domestic, and economic policy. The course of action we take on this issue will affect for future generations our economy, environment, future energy use, energy costs, economic growth, trade, jobs, global competitiveness, national defense and, perhaps most important, our national sovereignty.

We all agree on the need for a clean environment. We all want to leave our children a better, cleaner, more prosperous world. I have yet to meet one American or one Member of Congress who wants dirty air, dirty water, a dirty environment or declining standards of living for their children and grandchildren.

This debate will not be about who is for or against a clean environment. It never has been. Nor will the debate be about motives, personalities, or politics. This debate is about finding the truth, the facts. It will be about asking the necessary questions and expecting straight-forward answers.

What is the issue? What are the problems? What are the solutions? What are the costs? And what are the consequences?

The debate we are about to enter will be conducted in both Houses of Congress, in numerous committees of jurisdiction, and with the full participation of the administration and the private sector. This initial hearing will focus on educating and informing the public, the media, and the Members of Congress.

We need to insure that any agreement negotiated and signed by the administration will be fair to America, the world, and that it

will not adversely affect America's global competitiveness, our economy, and will not challenge our national sovereignty.

We are all interested in understanding where we are on this issue and how we got here. I have heard reports and read papers in the newspapers of how the American position changed from advocating a position of supporting voluntary emissions reductions to one of calling for legally binding reductions for ourselves and only commitments for others. We look forward to hearing why we changed in mid-stream this course of action, if we did, how that decision was reached, and to what extent the Congress was consulted.

We are also interested in why the administration is advocating legally binding emissions reductions for the United States and not for nearly 130 other countries, like China, Mexico, South Korea, Singapore, Indonesia and other countries.

We look forward to hearing from Under Secretary Wirth on this issue and the apparent inequalities inherent in any such agreement.

Related to this, we are also interested in how the administration intends to curb the future growth of greenhouse gas emissions in countries like China, who would not be subject to the same legally binding emissions, but whose emissions will soon eclipse our own.

We are concerned about the primacy of American sovereignty in any new emissions reduction scheme and look forward to hearing testimony on how the U.S. economy and fuel consumption and use might be monitored by any new international body. How is that going to work? Should it work?

I look forward especially to seeing how exactly any new U.N. treaty dictating our domestic energy use will affect the U.S. economy, not just in terms of lost GDP or lost jobs, lost opportunities and global competitiveness, but, more specifically, how it will affect the standard of living of everyday Americans and future generations of Americans.

We must also take a long, hard look at how our future competitiveness will be affected if American businesses are forced to be subjected to new international regulations while their global competitors are not.

Each of the witnesses before us today will offer a unique and important perspective on the current negotiations as we begin this debate. I thank them in advance for their time, their courtesy, and their testimony.

As this debate moves forward, the U.S. Senate will offer its own unique and important perspective. It is our constitutional responsibility to do so.

We should be very clear to the administration, the American public, and governments around the world that the U.S. Senate intends to be very involved and will have a serious, informed, and strong voice in helping shape the American position on this important issue.

With that, my distinguished colleague from Maryland and ranking Democrat on this subcommittee, Paul Sarbanes, is not yet with us. I would welcome now my colleague from Wyoming, Senator Craig Thomas.

Senator THOMAS. Thank you, Mr. Chairman. I have a statement I would like to have included. I want to thank you for having this

hearing and to welcome our friends, Senator Byrd and Congressman John Dingell.

At the outset, I want to express my concern and opposition regarding the unilateral efforts to push for legally binding targets and timetables on developed countries to reduce greenhouse emissions, while at the same time exempting developing countries from identical requirements.

We have talked about this before with Under Secretary Wirth.

I want to hear from the administration on how they believe putting American industries in a strait-jacket will ensure that it does anything less than worsen the problem they claim to want to fix.

Mr. Chairman, I firmly believe the goals of economic growth and environmental protection do not have to be mutually exclusive. We can do both. We need sound, peer-reviewed science and a cost benefit ratio process.

We can do it. But we cannot achieve our goals by making agreements unilaterally that put a handicap on us and leave the rest of the world producing much of the problem untouched.

I am pleased to be a part of the resolution that Senator Byrd and Senator Hagel have introduced. Sixty-one Members of the Senate have joined in that effort.

There will be a great deal of work taking place between now and December, and I strongly urge the administration to work with the Congress in a bipartisan way so that we can express these concerns and come up with real solutions.

Thank you.

[The prepared statement of Senator Thomas follows:]

PREPARED STATEMENT OF SENATOR CRAIG THOMAS

Thank you, Mr. Chairman, for taking the time to schedule this important hearing to discuss the Clinton Administration's policy on global climate change. Given the significant timing of this issue, and the effects it will have on our nation's economy, I look forward to the information that will be shared and the testimony that will be presented.

At the outset, I want to let my concerns and opposition be known regarding the Clinton Administration's effort to push for legally-binding targets and timetables on developed countries to reduce greenhouse gas emissions, while at the same time exempting developing countries from those identical requirements. I realize that the United States is responsible for significant quantities of carbon dioxide emissions in the atmosphere. On the other side of this equation, however, "developing" countries such as China, Mexico, South Korea, Brazil and India emit over half of all greenhouse gases. For example, in China -- a country with 1.2 billion people -- almost 80 percent of the energy for home cooking and heating comes from high sulfur coal. In India, the second most populous country in the world, the airport in the capital of New Delhi is regularly closed -- for lengthy periods of time -- because the smog is so bad airplanes cannot land because of poor visibility. Our diplomats in New Delhi receive hazard pay because of the air quality and many actually carry oxygen tanks with them. I would like to hear from the Administration on how they believe placing America's industries in a straight jacket will ensure nothing less than the worsening of the problem they claim to want to fix?

This concept is frustrating to me because it is our businesses and industries that are aware of the problems and are attempting to reduce harmful air pollutants. The U.S. and other Annex I countries are the ones with the knowledge and technology necessary to produce a safer environment. No one can argue that our industries are cleaner than in underdeveloped countries.

Nevertheless, if the Administration, led by Undersecretary of State for Global Affairs Tim Wirth, succumbs to binding agreements for industrialized countries in Kyoto, Japan, this December, we will let underdeveloped countries off the hook. They will not have to meet the uncompromising regulations that will be placed on our industries, which will do nothing but jeopardize the United States' sovereignty.

Simply put, imposing legally binding sanctions on the U.S. and other developed countries just doesn't make sense.

Mr. Chairman, I firmly believe the goals of economic growth and environmental protection do not have to be mutually exclusive. We can do both. But it will take a willingness from all countries to evaluate how they will administer new programs in order to obtain better results. The basis for this balance must come from several areas: sound, peer-reviewed science and a cost-benefit approach. Using good science, rather than emotional rhetoric, ensures we're spending our limited resources on actual problems. Cost-benefit goes beyond whether we ought to be doing something, but rather lets us decide how best to spend our money. Once we decide to address a problem, we need to take initiatives that give us the best results for the smallest cost.

However, rushing into agreements that will hurt America's economic competitiveness for questionable benefits will only make solutions less effective and worsen the environment as developing countries increase their production levels. Furthermore, if an international treaty is put in place that legally binds Annex I countries to specific targets and timetables, I am concerned the U.S. will also see a shift of jobs from our soil to overseas.

I will do everything I can to stop the Administration from committing the United States to any binding international agreement regarding global climate change that imposes one set of obligations on us and other developed countries, but excludes those standards on developing countries. Recently, I became an original cosponsor of Senate Resolution 98, sponsored by Senators Byrd of West Virginia and Hagel of Nebraska, Chairman of this subcommittee, calling on the Clinton Administration not to adhere to any protocol or agreement which would do just that. Although we should constantly work to reduce air pollution around the world, this must be done in a manner that does not threaten jobs or our international competitiveness and sovereignty. I thank them for their work and was pleased that so many of my colleagues cosponsored the initiative.

I commend the Chairman for holding this hearing today. Global climate change is a critical measure to our industries and the nation as a whole. A great deal of work and negotiating will take place between now and December and I strongly encourage the Administration to listen to the bipartisan concerns being expressed by the Congress. Additionally, the administration needs to be frank with the American people and explain the economic and social impacts of any proposed changes. Folks need to be aware if a reduction in the Gross Domestic Product will occur, or if gas taxes will increase as a result of their actions. Thank you, and I look forward to hearing from our guests.

Senator HAGEL. Senator, thank you. The first panel this morning will consist of the distinguished senior Senator from West Virginia, Senator Robert Byrd, and our distinguished colleague from the House, Representative John Dingell. Each of you has a long history and tradition of service to this Congress and to our Nation. Each has contributed mightily in many areas. Each of you has particular perspectives and bring great leadership to this issue.

So on behalf of our committee, I welcome you both. We are most, most pleased that you are here and look forward to your thoughts on this very important issue. Senator Byrd, I would ask you to begin. Thank you.

STATEMENT OF HON. ROBERT C. BYRD, U.S. SENATOR FROM WEST VIRGINIA

Senator BYRD. Thank you, Mr. Chairman, members of the committee. Let me say at the beginning that I listened carefully to your statement and that of Mr. Thomas. I think you quite correctly, carefully, methodically, and meticulously set out the problem and where we need to go.

Let me also say at the beginning that I am very privileged to share this opportunity as a witness with my friend John Dingell. I served in the House of Representatives with Congressman Dingell's father. I have watched Congressman Dingell over the years

and I think on most issues, with the exception possibly of the Byrd Rule, we are much in agreement.

Mr. DINGELL. And you beat me fair and square on that one.

Senator BYRD. So, I am just very proud to have this opportunity to work with and to share this time with John Dingell. He is a very articulate, very capable, very highly respected Member of the House and that respect also exists in the Senate.

Mr. Chairman, before I read my prepared statement, let me begin like this. I will soon be 80 years old. I do not need any scientific analysis to tell me that something is wrong out there, that something is happening. I have seen it in my own lifetime. The winters are different. The summers are different from what they were when I was a boy. Something is at work out there. I can't explain it, but I think we must understand that there is something going on that is causing the storms, the floods, causing the elements to be so unpredictable. It seems to me that we are all in this boat together, the developed world and the developing world.

So I begin with that premise, that there is something going on that is very serious. It is already having an impact upon my life, your life, and the lives of all Americans and peoples around the world.

I also begin with the premise that if we recognize that fact and agree that there is something going on, we need to work together in dealing with this problem. It won't get better of itself. We need to work together or else my children, my grandchildren, and their grandchildren will have an intensified problem and one which will be even more costly in its resolution, and more painful.

So with that beginning, I thank you for the opportunity to appear before the subcommittee to discuss the critically important issue of the negotiations aimed at signing a protocol during the Third Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change, which is scheduled to be held in December in Kyoto, Japan. I am concerned that the protocol that results from these negotiations could have a serious impact on American industry and on the American economy while, at the same time, failing to address a looming threat to the global environment.

And so, on June 12, I introduced, together with the chairman of the subcommittee, a Sense of the Senate Resolution. We were joined by a bipartisan group of our colleagues which now numbers 61 *in toto.* It addresses the conditions for U.S. agreement to revisions to the United Nations Framework Convention on Climate Change. The resolution has been co-sponsored, as I say, by 61 Senators, including ourselves, from both sides of the aisle. This resolution states the Sense of the Senate that the developing world must fully participate in the treaty negotiations and commitments and play a meaningful role in effectively addressing the problem of global climate change.

In essence, the resolution accepts the thesis, which is still the subject of some dispute, that the increasing release of carbon dioxide and its accumulation in our atmosphere are causing a very gradual heating of the globe which has many adverse consequences for us all. I believe the administration should be commended for its efforts on this issue and I commend this subcommittee for its at-

tention to the matter. If substantial steps are going to be taken to influence carbon dioxide and other greenhouse gas emissions, we need to accelerate new technologies, anticipate new developments, and encourage public/private sector participation.

President Bush signed the United Nations Framework Convention on Climate Change, the so-called Rio Pact, in 1992, which was subsequently approved by the Senate and calls on the industrialized nations to aim to reduce their greenhouse gas emissions to their 1990 levels by the year 2000, a goal which will not be achieved by the U.S. nor by the vast majority of the industrialized nations.

The parties to the Framework Convention met in Berlin in 1995 to discuss the future direction of the treaty in light of this projected failure to meet the voluntary objectives, agreeing that any new commitments would be binding upon the signatories. Specifically excluded—and this was a mistake—specifically excluded from any new commitments, however, would be the countries that comprise the developing world. The rationale for the so-called Berlin Mandate was that it is the industrialized OECD nations that have been the major emitters of greenhouse gases in the past and will continue to be for the next decade.

There are two intrinsic problems with the Berlin Mandate. First, while the industrialized world is the primary contributor to the current problem, that will not be the case in just a few years.

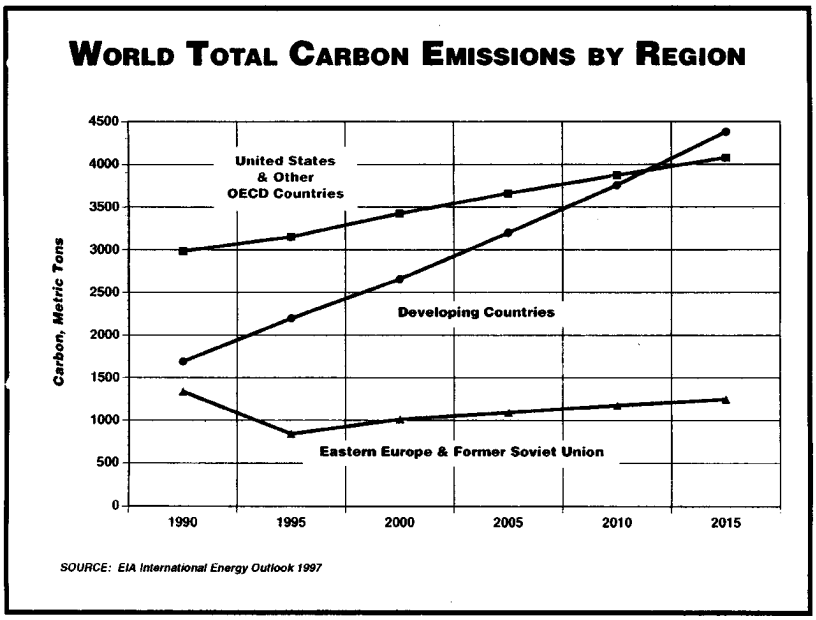


CHART 1

Senator BYRD. As this chart demonstrates, the emissions of the developing world are rapidly increasing on a sharp upward slope. These emissions will actually surpass those of the industrialized OECD nations by the year 2015. In short, the developing world is rapidly becoming a clone of the OECD nations.

Now let us assume that the current negotiations for a new protocol, which are to be concluded in Kyoto this December, result in a binding commitment that the OECD nations must reduce their emissions to 1990 levels by 2010.

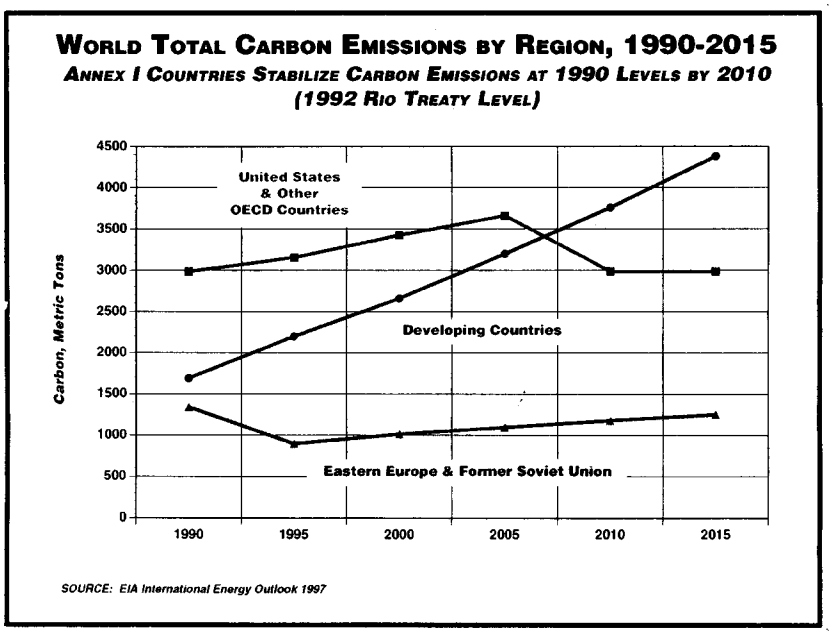


CHART 2

Senator BYRD. This chart demonstrates that under such a scenario, the OECD nations will sharply reduce our emissions of greenhouse gases. The price we will pay in order to achieve these reductions is open to debate as estimates differ. Nonetheless, the key point is that this responsibility will not be shared because of the Berlin Mandate, for the chart clearly shows that the emissions of the developing world continue on their inexorable upward track, even as we, in the OECD group, make the painful and costly adjustments necessary to force down our own emissions.

This demonstrates the second problem with the Berlin Mandate, which is that we gave away the store and we received nothing in return. Many of the biggest emitters of greenhouse gases in the developing world have refused to even discuss, let alone seriously consider, taking any emissions limitations commitments upon themselves. In what can only be viewed as an act of environmental irresponsibility, the developing nations have adamantly refused to recognize that they will, over the next 2 decades, become the primary cause of the problem in terms of annual emissions.

The refusal of the developing world to discuss any future emissions limitations commitments has become a central issue, for any attempt to bring them into the process is labeled by some as a treaty killer. I have a different perspective. I am not interested in killing the treaty. My resolution and yours, Mr. Chairman, is not a treaty killer. It is, in fact, a treaty enhancer. It calls upon the administration not to agree to a protocol unless it includes new commitments to limit or reduce greenhouse gas emissions for developing countries parties within the same compliance period. Our resolution improves the treaty, for any treaty that does not include emissions limitations provisions for the developing world is inherently unsound and ineffectual on its face. Environmentally we are all in the same global boat.

So I ask the rhetorical question: What good does it do for the United States and other developed nations to work feverishly to plug the holes that we have drilled in the bottom of the boat over the past decades while at the same time the developing nations will be drilling holes, larger holes, at the other end just as fast as we plug them on our end? Be assured that the global boat will sink just as rapidly and we are all going to be in for a long, long swim.

Bringing the developing world in under the climate change tent as part of any future treaty will not only increase the prospect of Senate ratification—of Senate approval, I should say; the Senate does not ratify treaties, it approves the ratification of treaties—will not only improve the prospects of Senate approval, it will also be enormously beneficial for the international environment.

Let me further clarify that point.

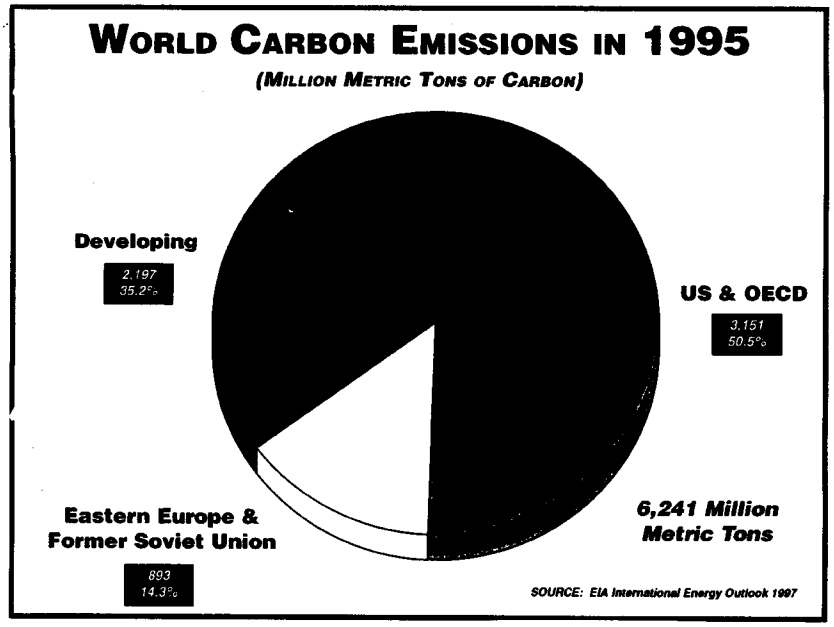


CHART 3

Senator BYRD. The chart before you shows the world of 1995 in terms of world carbon emissions in millions of metric tons of carbon. The United States and OECD nations, shown in red, are responsible for a little over half of that total.

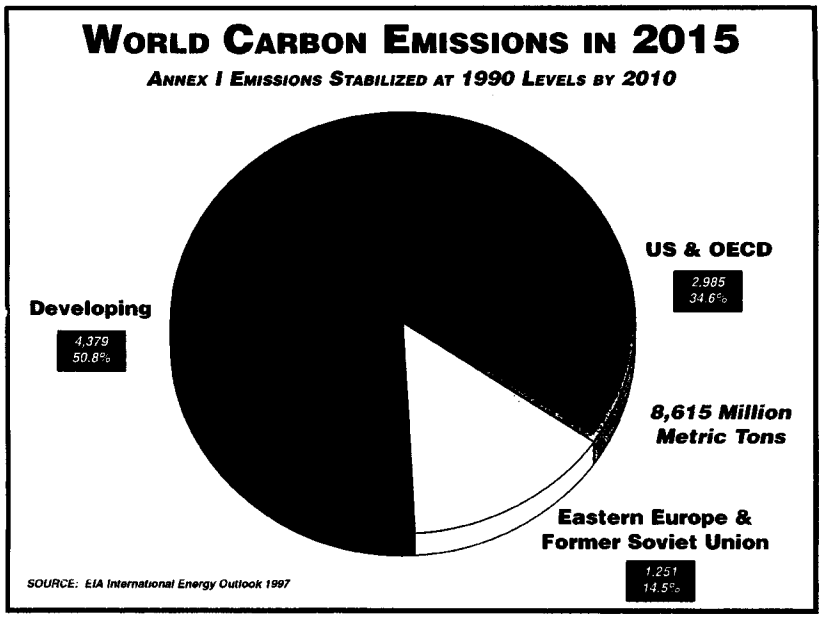


CHART 4

Senator BYRD. The next chart projects the world as it might be after the currently proposed treaty is adopted with only the developed world taking action to reduce greenhouse gas emissions. The difference is startling. The difference, again, is startling. The developing world, shown in purple, has assumed the U.S. and OECD nations' place as the biggest global polluters. The problem remains the same. Only the names have changed. And, again, because of the flawed Berlin Mandate, all of these emissions from the developing world will be completely uncontrolled and free to increase even further. From this perspective, it is the Berlin Mandate and the fact that it lets the developing world off the hook Scot-free that will seriously harm the global environment in future years.

Finally, let us examine the role of China. Despite possessing a strong and growing economic and industrial base, despite possessing a nuclear capability, despite possessing the ability to launch satellites into orbit, China is still counted among the family of developing nations. But its industrial growth is matched by its growing contribution to global pollution.

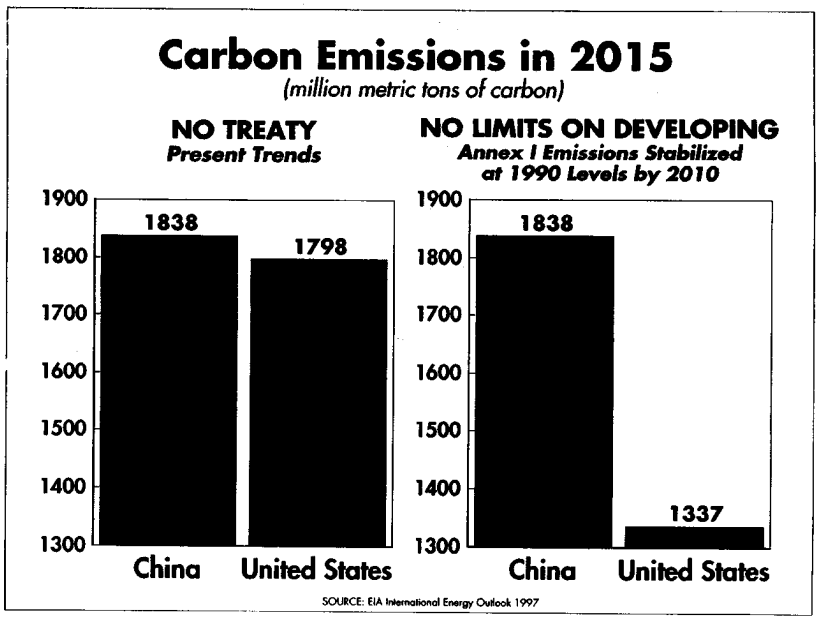


CHART 5

Senator BYRD. This chart compares China's contribution to global carbon emissions with the contribution made by the United States. On the left, we can see that, based upon current trends, China will surpass the United States in carbon emissions by the year 2015. On the right, we can see that if current proposals are adopted, under which we would reduce our carbon emissions to 1990 levels while imposing no requirements upon the developing world and China, China, all by itself, will greatly exceed the United States in metric tons of carbon emitted.

Now if that isn't enough to make environmentalists' hair curl, I don't know what will.

I find it disturbing that, despite its future role as the world's leading contributor to the problem of carbon emissions, China has indicated steadfast refusal to apply any type of binding obligations upon its own economy and its own industry. I believe that if the treaty we are negotiating today does not equally commit developing nations, like China, to binding commitments, there will be no incentive for China and the other nations of the developing world to make responsible and environmentally sound choices as they develop. There will be no incentive for the Senate to approve such a treaty. I can guarantee you that there will be a mountain in the way which a mustard seed of faith will not, in itself, remove.

You can be sure that after China assumes its role as a leading carbon emitter, she will not be very eager to make the tough and costly corrections to retrofit her industries to reduce emissions of greenhouse gases. Indeed, she may expect to benefit from a treaty in which she escapes binding commitments because it may allow her to import industries from OECD nations that would choose to

relocate there rather than change their ways and clean up their acts at home.

Now I am not here to bash China. But I am here to say that we, in the developed world, have to look out after our future as well, our industry, our jobs, the health of our people. We are all in the same boat together. It goes round. What they breathe, we will breathe. There is no way to avoid it.

My message to U.S. negotiators is that all nations, but particularly those that are making and will make a significant contribution to greenhouse gases emissions, need to, (1) make commitments at Kyoto that unequivocally demonstrate an action program to tackle this problem; and (2) start with aggressive efforts to act on those commitments immediately and not settle for vague promises to return to a future negotiation to get serious. In other words, there is no point in our agreeing to meet at some future time at which time we will agree. We must agree now.

Finally, while countries have different levels of development, each must make unique and binding contributions of a pace and kind consistent with their industrialization. It is important. Let's read that again. While countries have different levels of development, each must make unique and binding contributions of a pace and kind consistent with their industrialization. The developing world must agree in Kyoto—if not in December, why not in January? If not in January, why not in February? The developing world must agree in Kyoto to some manner of binding targets and commitments that would begin at the same time as the developed world in as aggressive and effective a schedule as possible given the gravity of the problem and the need for a fair sharing of the burden.

I note that our resolution states that any treaty presented to the Senate be accompanied by a detailed explanation of any legislation or regulatory actions that may be required to implement the protocol or other agreement and should also be accompanied by an analysis of the detailed financial costs and other impacts on the economy of the United States which would be incurred by the implementation of the agreement. We need to know that when this protocol comes before the Senate. We need to know that. There surely will be costs. Nobody is getting off scot-free. There surely will be costs if the United States is to make the changes to our existing industrial base and to our existing lifestyle necessary to meet the goals of this treaty. Our smokestacks must be cleaner and our automobiles more efficient. There are many ways to achieve these goals. But we must be able to tell the American people what will be required to meet any proposed commitment.

Politically, I believe there needs to be a strong consensus between the President and Congress about any plan of action. The administration's policy of follow-on multilateral negotiations to deepen the impact of the Rio Pact requires very substantial consensus building with the Congress. This is one of the reasons why, Mr. Chairman, we felt we ought to start now and let the administration know we are going to be looking over their shoulder and that we want to participate. That is why we have the "whereas" clause, which indicates that the Senate expects to have independent observers appointed not by the administration but by the Majority

and Minority Leaders of the Senate, who will monitor the developments and who will report back to the Senate on those developments.

This is the way to build a consensus. The administration cannot go down the road happily on its own, looking back over its shoulder. We have to be in this boat together, and there must be broad educational activities to bring the American public along.

This is why we want this debate to start now, not in November, not next January. To impose effective, legally binding measures on the United States economy will mean having the strong support of the Senate and the House. We all represent the same people.

We Senators need to be deeply concerned over the alarm that has been expressed to us by a very broad range of American industry and labor over the impacts on our economy of a treaty which commits the United States to deep emission reductions and which does not spread the burden of responsibility equitably across the globe. It has to do that.

These assessments by bedrock American industry must be taken seriously. They will be taken seriously. I hope that this hearing will result in new Senate attention to the progress of these negotiations and that this committee will serve to interact regularly with the State Department and administration policymakers as our negotiating strategy is developed and refined.

The resolution that Senator Hagel and I introduced and which has won the support of a majority of 60 Senators, no, 61, is aimed at that negotiation and beyond. Since carbon and other greenhouse gases can accumulate in the atmosphere and persist for long periods, we will not, as a community of nations, get a handle on these threats to our global climate unless everyone participates and does its share to solve the problem. We all share our Earth in common. We breathe the same air. We are exposed to the same global climate system. We must all accept our share of the responsibility for the global climate. We must keep this fragile boat afloat together, and the sooner we have commitments from all of its passengers to work together in that effort, the better.

Mr. Chairman, I ask unanimous consent that the resolution which we have joined in sponsoring and co-sponsoring appear at this point in the record.

Senator HAGEL. Without objection.

[The information referred to follows:]

III

105TH CONGRESS
1ST SESSION

S. RES. 98

Expressing the sense of the Senate regarding the conditions for the United States becoming a signatory to any international agreement on greenhouse gas emissions under the United Nations Framework Convention on Climate Change.

IN THE SENATE OF THE UNITED STATES

JUNE 12, 1997

Mr. BYRD (for himself, Mr. HAGEL, Mr. HOLLINGS, Mr. CRAIG, Mr. INOUYE, Mr. WARNER, Mr. FORD, Mr. THOMAS, Mr. DORGAN, Mr. HELMS, Mr. LEVIN, Mr. ROBERTS, Mr. ABRAHAM, Mr. MCCONNELL, Mr. ASHCROFT, Mr. BROWNBACK, Mr. KEMPTHORNE, Mr. THURMOND, Mr. BURNS, Mr. CONRAD, Mr. GLENN, Mr. ENZI, Mr. INHOFE, Mr. BOND, Mr. COVERDELL, Mr. DEWINE, Mrs. HUTCHISON, Mr. GORTON, Mr. HATCH, Mr. BREAUX, Mr. CLELAND, Mr. DURBIN, Mr. HUTCHINSON, Mr. JOHNSON, Ms. LANDRIEU, Ms. MIKULSKI, Mr. NICKLES, Mr. SANTORUM, Mr. SHELBY, Mr. SMITH of Oregon, Mr. BENNETT, Mr. FAIRCLOTH, Mr. FRIST, Mr. GRASSLEY, Mr. ALLARD, Mr. MURKOWSKI, Mr. AKAKA, Mr. COATS, Mr. COCHRAN, Mr. DOMENICI, Mr. GRAMM, Mr. GRAMS, Mr. LOTT, Ms. MOSELEY-BRAUN, Mr. ROBB, Mr. ROCKEFELLER, Mr. SESSIONS, Mr. SMITH of New Hampshire, Mr. SPECTER, and Mr. STEVENS) submitted the following resolution; which was referred to the Committee on Foreign Relations

---

RESOLUTION

Expressing the sense of the Senate regarding the conditions for the United States becoming a signatory to any international agreement on greenhouse gas emissions under the United Nations Framework Convention on Climate Change.

★(Star Print)

Whereas the United Nations Framework Convention on Climate Change (in this resolution referred to as the "Convention"), adopted in May 1992, entered into force in 1994 and is not yet fully implemented;

Whereas the Convention, intended to address climate change on a global basis, identifies the former Soviet Union and the countries of Eastern Europe and the Organization For Economic Co-operation and Development (OECD), including the United States, as "Annex I Parties", and the remaining 129 countries, including China, Mexico, India, Brazil, and South Korea, as "Developing Country Parties";

Whereas in April 1995, the Convention's "Conference of the Parties" adopted the so-called "Berlin Mandate";

Whereas the "Berlin Mandate" calls for the adoption, as soon as December 1997, in Kyoto, Japan, of a protocol or another legal instrument that strengthens commitments to limit greenhouse gas emissions by Annex I Parties for the post-2000 period and establishes a negotiation process called the "Ad Hoc Group on the Berlin Mandate";

Whereas the "Berlin Mandate" specifically exempts all Developing Country Parties from any new commitments in such negotiation process for the post-2000 period;

Whereas although the Convention, approved by the United States Senate, called on all signatory parties to adopt policies and programs aimed at limiting their greenhouse gas (GHG) emissions, in July 1996 the Undersecretary of State for Global Affairs called for the first time for "legally binding" emission limitation targets and timetables for Annex I Parties, a position reiterated by the

Secretary of State in testimony before the Committee on Foreign Relations of the Senate on January 8, 1997;

Whereas greenhouse gas emissions of Developing Country Parties are rapidly increasing and are expected to surpass emissions of the United States and other OECD countries as early as 2015;

Whereas the Department of State has declared that it is critical for the Parties to the Convention to include Developing Country Parties in the next steps for global action and, therefore, has proposed that consideration of additional steps to include limitations on Developing Country Parties' greenhouse gas emissions would not begin until after a protocol or other legal instrument is adopted in Kyoto, Japan in December 1997;

Whereas the exemption for Developing Country Parties is inconsistent with the need for global action on climate change and is environmentally flawed;

Whereas the Senate strongly believes that the proposals under negotiation, because of the disparity of treatment between Annex I Parties and Developing Countries and the level of required emission reductions, could result in serious harm to the United States economy, including significant job loss, trade disadvantages, increased energy and consumer costs, or any combination thereof; and

Whereas it is desirable that a bipartisan group of Senators be appointed by the Majority and Minority Leaders of the Senate for the purpose of monitoring the status of negotiations on Global Climate Change and reporting periodically to the Senate on those negotiations: Now, therefore, be it

Resolved, That it is the sense of the Senate that—

(1) the United States should not be a signatory to any protocol to, or other agreement regarding, the United Nations Framework Convention on Climate Change of 1992, at negotiations in Kyoto in December 1997, or thereafter, which would—

(A) mandate new commitments to limit or reduce greenhouse gas emissions for the Annex I Parties, unless the protocol or other agreement also mandates new specific scheduled commitments to limit or reduce greenhouse gas emissions for Developing Country Parties within the same compliance period, or

(B) would result in serious harm to the economy of the United States; and

(2) any such protocol or other agreement which would require the advice and consent of the Senate to ratification should be accompanied by a detailed explanation of any legislation or regulatory actions that may be required to implement the protocol or other agreement and should also be accompanied by an analysis of the detailed financial costs and other impacts on the economy of the United States which would be incurred by the implementation of the protocol or other agreement.

SEC. 2. The Secretary of the Senate shall transmit a copy of this resolution to the President.

○

Senator BYRD. That completes my prepared statement.

Senator HAGEL. Senator Byrd, thank you.

We would now like to hear from your distinguished colleague, Congressman Dingell.

Congressman, thank you for coming over this morning and giving us your thoughts. I have been joined, as you note, here at the desk by my distinguished colleague, Senator Sarbanes, from Maryland, who has asked to make some comments after Congressman Dingell's remarks.

Senator SARBANES. Mr. Chairman, I will defer my comments because I know our colleagues have other business to attend to. I would be happy to hear from Congressman Dingell, Ranking Member Dingell—I'm sorry, John.

STATEMENT OF HON. JOHN D. DINGELL, U.S. REPRESENTATIVE FROM MICHIGAN

Mr. DINGELL. Thank you, Mr. Chairman and thank you members of the committee.

I want to thank you for holding this hearing and commend you for it. There are a lot of questions that need to be answered and I was much comforted by your opening statements, Mr. Chairman, and I am delighted that you are doing this because there are a lot of questions that need answering.

I want to say hello to my good friends, Mr. Thomas and Mr. Sarbanes, who are old and dear friends of mine. They served in the House with me. I am delighted to see them.

I am particularly pleased also to be here with my old friend and colleague from better days, when he served in the House, Senator Byrd, for whom I have enormous affection and respect. As he mentioned, the only significant difference that I can think of that we have between us is the Byrd Amendment, on which he has taught me a lot of valuable lessons.

Mr. Chairman, I do not appear before the committee as a critic of the idea that this country should engage in global climate change negotiations nor do I criticize the idea that we should go forward. In fact, I believe that there is good reason to think that it is time for the world to address the fact that we may be changing the climate and that there is need to address that. But, as Senator Byrd has so wisely pointed out, I think that it is necessary that, if we are going to do it, we insist that all participate fairly, the United States not bear unfair burdens, and that the rules of the game be both founded on good knowledge, good science, careful analytical work, a sound and careful appraisal of our national interests and our policy goals and the well being of our people, as well as the needs of the situation.

With respect to the global climate change negotiations, I have some questions on which I have yet to receive satisfactory answers.

One, have we overreached the science?

The State Department has concluded that the current science proves that global warming is "dangerous" and requires immediate emissions reductions. The official U.N. scientific body has gone only so far as to identify a link between human activity and global warming. But their own document on science states, and I quote: "Our ability to quantify the human influence on global climate is

currently limited." In other words, we do not know with any degree of precision how big the problem is, we don't know how fast it is moving or how it can, or should, be mitigated.

My friend and colleague, Secretary Wirth, who will testify later this morning, agrees on this point. At a public forum this February, he said there is, and I quote, "No doubt about the theory" of climate change. I think that it should be quoted again. "We don't know where, how much or how fast."

Second, is what we are seeing a classic example of mission creep?

It is a very interesting thing. We have observed as this negotiation has gone forward in some curious, imperceptible, and inexplicable fashion that United States policy has changed. Initially, the administration's policy was based on voluntary agreements with industry and reliance on "joint implementation" of mutually beneficial partnerships between U.S. industry and developing countries. Strangely, that approach has changed and has vanished. In regard to that, U.S. companies would get credit for helping developing countries to build clean power plants. But sometime early in 1996, the change became evident and the tone was different. Mandatory emissions reduction became the goal.

Three, who is representing America's interests? The question I think underneath that is the one that you expressed, Mr. Chairman, and that my good friend Senator Byrd expressed. Are we setting the United States up for an economic fiasco? Are we going to assume burdens that no one else in the world is assuming?

In a letter to me in 1995, President Clinton promised not to agree to anything that would adversely affect U.S. competitiveness. That is a good policy. I think it should probably be communicated to the State Department.

The State Department has signed on to agreements that are procedurally and substantively disadvantageous to the United States. The outcome may be an agreement late in 1997 in Kyoto imposing mandatory emissions reductions on the developed countries and at best only voluntary steps for the developing nations. I would note that if you look at how this is going to go, the U.S. and the OECD countries will appear to be absorbing heavy burdens. If you look, you are going to find that the OECD countries are very liable not to be assuming heavy burdens and, in fact, to have wonderful escape clauses which they can flee through while the United States remains trapped. I think that is a question into which this committee should inquire most carefully.

We have already committed ourselves to steps to control emissions and potentially to harm the competitiveness of the United States. Those agreements or at least those pronouncements and those positions have been put on the table already.

The developing countries are scot-free. We do not have a single binding commitment from them. I would note also that Eastern Europe and the Soviets are indicating small desire to be helpful in anything which would be an even sharing of the responsibilities that this global warming treaty, agreement, or whatever it might happen to be, is going to impose on the world and upon the United States.

My friends in the administration argue that they are being hardnosed because they have rejected the more extreme proposals ad-

vanced by such powerful groups as the Association of Small Island States, or the AOSIS. That I am sure took an enormous level of effort by the administration. However, I find scant reason to congratulate our negotiators for refusing the chance to submit our unconditional surrender to so small an adversary.

Fourth, even if you agree that global climate change is a problem, is the administration really doing anything to protect the environment?

The theory of global warming holds that greenhouse gases have an effect no matter where in the world they are emitted. This is not like the debate over acid rain or ozone, where emissions from one part of the country are thought to cause problems in another identifiable region.

As Senator Byrd has told the committee, China will surpass the United States in terms of emissions early in the next century. If you accept the theory of global warming, those emissions will cause as much harm to the climate as emissions from the developed countries today. Of course, that will be true because there are going to be substantial increases from almost everyone in the world, except the United States, if we bind ourselves to the curiously uncompetitive position of the United States being bound and nobody else being bound.

Fifth, how is this whole matter going to work?

I have yet to see the proposed negotiating text that includes specific dates and numbers. These are important matters, but there are some other important and fundamental issues at hand. Who will have to do what? Who will enforce the agreement? And how timely would enforcement be? If we establish a trading system, how will it be enforced? Can we be assured that that trading system is going to be one which will work fairly and which will work for the United States in fair fashion and also in fair fashion as regard to any other country?

The question I think we need to ask is this: Is China or any other developing country going to be allowed to keep the credits for themselves as a country or will there be a trading around the world for these credits? Or will companies be allowed to use them to offset operations elsewhere in the world? Or, for example, would China keep them home?

Does anyone seriously believe that China or any other country, for that matter, will act on altruistic motives and make the credits, if such there will be, available to other countries for economic development? I seriously doubt that.

This leads me to my sixth and final question. Why are we doing all of this before we have the most basic information about how climate change policies will affect our economy? In short, has the administration bothered to do its homework?

I would observe that the administration has been before our committee on at least several occasions. I can think of two, and there may perhaps be three or more. In each instance, the questions that I have raised were raised and the answers were promised. But no answers have been forthcoming.

So I am particularly pleased, Mr. Chairman, that you and this committee are doing this because it is perhaps possible that

through your powers and the exercise of your wisdom, we will get the answers that we, in fact, need.

We were supposed to have the analysis and assessment of the impact of climate change policies on the U.S. economy by the end of last year. It is now something over a year since this was promised and it is something over a year since it was supposed to be done.

The assessment and the analysis have not been made available to the Congress. It is quite certain that they are not yet completed and, despite the fact that the administration has made repeated promises to the Congress and to industry that it would be available before important policy decisions are made, we are rushing headlong toward Kyoto. We have moved forward toward agreement in all fashions in ways which we cannot gauge against any measurable set of standards, any analysis of the U.S. interests, or any assessment of the impact on climate changes.

It is very clear that the State Department has either been rushing forward without information, has been suppressing the information, has not been making it available to the Congress, or has not been cooperating with us in providing the information we need to evaluate what it is they are doing, how they are doing, and how it is going to impact the country.

We also do not have the vaguest idea of what their assessment is about, what the real need is, or what it is we have to do to come forward with an intelligent agreement that is going to serve the best interests of the United States.

The State Department formally proposed a "cap and trade" negotiating position in January. Again, no analysis or assessment was available to them or to us at that time.

In short, the analysis is self-evidently too late to inform the process. It may perhaps be arriving here before the Congress just in time to justify what the administration has already decided on doing or what the administration has already agreed to do.

So perhaps you in the Senate will find yourselves presented with this wonderful assessment after they have completed the negotiation and which was not available either to them or to us as the negotiation went on.

It appears that the intelligent participation of the United States in these negotiations cannot be going forward under those circumstances and, just as clearly, public participation and comment on the analysis and assessment, indeed upon the whole process, appears to be irrelevant in view of the fact that they have not done the work that an intelligent negotiator would do and should do as they go forward into something that is going to affect the entire future of the United States.

It is interesting to note that the Department of Commerce official in charge of the analysis and assessment has moved on to pursue other career opportunities. It may be as you go forward in these matters, Mr. Chairman, that you might want to have the Department of Commerce come up here to assist you because of their responsibilities over climate.

I have asked the administration whether when they go to Kyoto next December they will refuse to sign any agreement that binds the United States to new emissions obligations unless it holds our

economic competitors in the developing world to equivalent obligations. I have not received a reassuring answer to this matter.

My concerns here I think parallel those of yourself and the members of the committee. They also parallel those of American labor. I am delighted that you will be hearing from my good friend and Senator Byrd's good friend, Secretary-Treasurer Trumka of the AFL–CIO. I commend to you the resolution on climate change adopted by the AFL–CIO Executive Council as well as the Senate Resolution offered by my good friend, Senator Byrd, which has, I think, touched the basic good judgment of the Senate and prompted an enormous outpouring of support there.

I am hopeful that this resolution will have a favorable and beneficial effect upon the administration and will perhaps induce them to recognize that they may just have a treaty agreement that they are working on that is not going to get approved because of the slovenly work which they have done to bring themselves to an ultimate agreement toward which they are rushing madly, again without either scientific support for what it is they are doing or without a real appreciation of the economic consequences of that.

I want to close, Mr. Chairman, by thanking you very much for the privilege of being here and for the fact that you are inquiring into this. I would urge you and the committee to proceed most diligently and vigorously to get the answers that we in the House have not been able to get. I suspect you can do rather better than we have done.

I also want to tell you again that I am not opposed to international negotiations on climate change. I would, however, approach these negotiations the way I would approach a high stakes poker game—with an open mind but not with a blank check. As Senator Thomas might tell you, there is an old Western story about a fellow who was seen walking along early Sunday morning. Somebody said to him where are you going. He said I'm going to one-eyed Minnie's. He said I'm going to play poker. They said why are you going to play poker at one-eyed Minnie's? Everybody knows it's a crooked game. He said I know, but it's the only game in town.

Mr. DINGELL. Well, this is not the only game in town and I urge us to be more careful.

Thank you, Mr. Chairman.

[The prepared statement of Mr. Dingell follows:]

PREPARED STATEMENT OF REPRESENTATIVE JOHN D. DINGELL

Mr. Chairman, I appreciate your holding this hearing. I consider it a great honor to testify beside my good friend and highly respected colleague from West Virginia, Senator Byrd.

I do not appear before this Subcommittee as a critic of the idea that we are engaged in climate change negotiations and that we are moving forward. I'm critical of the idea that we are negotiating without the full and proper information that we need.

With respect to the climate change negotiations, I have several questions to which I have yet to receive satisfactory answers.

One: Have we overreached on the science?

The State Department has concluded that current science proves that global warming is "dangerous" and requires immediate emissions reductions. But the official U.N. scientific body has gone only so far as to identify a link between human activity and warming, but their own document on the science states, and I quote, "our ability to quantify the human influence on global climate is currently limited."

In other words, we don't know with any degree of precision how big the problem is, we don't know how fast it's moving, or how it can be mitigated.

My friend and former colleague Tim Wirth, who will testify later this morning, agrees on this point. At a public forum this February he said there is "no doubt about the theory" of climate change and that "we don't know where, how much or how fast."

Two: Is what we're seeing here a classic example of mission creep?

We've seen a shift from voluntary to mandatory policies. Initially, the Administration's policy was based on voluntary agreements with industry and reliance on "joint implementation" of mutually beneficial partnerships between U.S. industry and developing countries. For instance, U.S. companies would get credit for helping developing countries build clean power plants. But sometime early in 1996, the tone changed. Mandatory emissions reduction became the goal.

Three: Who is representing America's interests? Are we setting ourselves up for an economic fiasco?

In a letter to me in 1995, President Clinton promised not to agree to anything which would adversely affect U.S. competitiveness. But the State Department has signed onto agreements that are procedurally and substantively disadvantageous. The outcome may be an agreement late in 1997 in Kyoto imposing mandatory emissions reductions on developed countries, and at best only voluntary steps for developing nations.

We've already committed ourselves to steps to control emissions and potentially harm our competitiveness. The developing countries are scot-free. We've gotten not a single, solid, binding commitment from them.

My friends in the Administration argue that they are being hard-nosed because they have rejected the more extreme proposals advanced by groups such as the Association of Small Island States, or AOSIS. But I find scant reason to congratulate our negotiators for refusing the chance to submit our unconditional surrender.

Four: Even if you agree that climate change is a problem, is the Administration really doing anything to protect the environment?

The theory of global warming holds that greenhouse gases have an effect no matter where in the world they are emitted. This is not like the debate over acid rain or ozone, where emissions from one part of the country were thought to cause problems in another, identifiable region. China will surpass us in terms of emissions early in the next century. If you accept the theory of global warming, those emissions will cause as much harm to the climate as emissions from the developed countries today.

Five: How is all this going to work?

I've yet to see a proposed negotiating text that includes specific dates and numbers. Those are important matters, but there are some other fundamental issues at hand: Who will have to do what? Who will enforce the agreement, and how timely would enforcement be? If we establish a trading system, is China or any other developing country going to be allowed to keep credits for themselves as a country? Or will companies be allowed to use them to offset operations elsewhere in the world? Does anyone seriously believe China, or any other country for that matter, will act on altruistic motives?

This leads me to my sixth and final question. Why are we doing this before we have the most basic information about how climate change policies will affect our economy? In short, has the Administration bothered to do its homework?

We were supposed to have the vaunted analysis and assessment of the impact of climate change policies on the U.S. economy by the end of last year. It has not been completed yet, despite repeated promises to Congress and industry that it would be available before important policy decisions are made. But the State Department formally proposed a cap-and-trade negotiating position in January. In short, the analysis is self-evidently too late to inform the process, and likely will be used to justify what the Administration has already decided to do. Just as clearly, public participation and comment on the analysis and assessment is irrelevant. And the Department of Commerce official in charge of the analysis and assessment has moved on to pursue other career opportunities.

I have asked the Administration whether, when they go to Kyoto next December, they will refuse to sign any agreement that binds the U.S. to new emissions obligations unless it holds our economic competitors in the developing world to equivalent obligations. I cannot in all truth say that I have received a reassuring answer.

My concerns very closely parallel those of American labor, and I am delighted that you will be hearing from Secretary-Treasurer Trumka of the AFL–CIO. I commend to you the resolution on climate change adopted by the AFL–CIO Executive Council, as well as the Senate resolution offered by Senator Byrd.

Let me close by noting again that I am not opposed to our being part of international negotiations on climate change. But I would approach those negotiations the way I would approach a high-stakes poker game: with an open mind, but not with a blank check.

Senator HAGEL. Congressman Dingell, thank you for those wise departing colloquialisms. I will pass those on to Senator Thomas. He will be very proud that you quoted him.

Senator HAGEL. Congressman, thank you.

Senator Sarbanes.

Senator SARBANES. I have no questions. Thank you.

Senator HAGEL. In the interest of time, gentlemen, your time, you have other areas and obligations to address here this morning. On behalf of the Foreign Relations Committee, I add again my thanks for your wise counsel, your experience, and your leadership. You have both brought forward what I think is the essence of the issue here and both in your own ways have contributed mightily to this debate.

I am grateful, and on behalf of all of us. Thank you.

Senator BYRD. Mr. Chairman, my earlier request that a copy of the resolution appear in the record of the hearings goes to the Star print that was just made overnight because it includes all of the then–60 signatories plus the additional "whereas" clause dealing with the monitoring group that would be appointed by the two leaders in the Senate, whereas the original resolution does not have those.

Senator HAGEL. The record will reflect that as well, Senator. Thank you.

Senator BYRD. I thank all Senators and I thank my friend, John Dingell, for being allied with us in this effort.

Senator HAGEL. Thank you, gentlemen.

The next panel will be Secretary Wirth, Under Secretary of State for Global Affairs. Tim Wirth is before us.

Tim, thank you for coming this morning. We had an opportunity to visit a little bit a couple of days ago, to get acquainted, which I thought was valuable. You obviously are no stranger to this body and to this process. So we again thank you for your time, because much of what has been said so far and will continue to be said today obviously cuts in your direction. We are looking for some answers to these questions and I know you will help get us there. But first, Senator Sarbanes.

Senator SARBANES. Mr. Chairman, I'm sorry I was not able to be here right at the outset of the hearing, but I did hear most of the testimony from our Congressional colleagues.

The issues surrounding global climate change and proposals for addressing it are extremely complex. I think it is an understatement to say they are often contentious.

I take it this is the first in a series of hearings, and I think it is important to have such a series. I think it is important to make sure that we are exposed to the great diversity of views which exist on this issue.

The Congress obviously needs to examine this question in a rational and constructive manner and I hope that will be the outcome of these deliberations. So I look forward, I assume, to further hearings. I think there is one scheduled already for next week, or there are tentative plans to have one next week. These will provide an

opportunity for those responsible people who wish to be heard on this issue to present their views to the Congress.

In this regard, my Maryland colleague, Congressman Gilchrist, I understand had hoped or wanted to be here this morning. But in any event, he has written testimony which he has asked me to submit for the record and I certainly do that at this point. This is from Congressman Wayne Gilchrist, who represents the First Congressional District in my State. I ask consent that that be included in the record.

Senator HAGEL. The record will reflect that.

Senator SARBANES. Thank you.

[The prepared statement of Representative Gilchrist follows:

PREPARED STATEMENT OF REPRESENTATIVE WAYNE T. GILCHREST

Mr. Chairman and members of the committee, thank you for the opportunity to submit testimony today on the important subject of global climate change. This is a complex problem and the Congress should be fully engaged in understanding the facts and fiction surrounding it. I would like to touch on three subjects this morning: the science, the economics, and finally, the negotiations and the role of developing nations.

Science

I know that the science of climate change is complex. It involves interpretation of data from a wide range of sources, over long time scales. But this is also an area where we have more scientific consensus than virtually any other environmental issue. Do not be mistaken, this is not an issue where there is an even split in the scientific community. 2,400 IPCC scientists concur that the planet is warming, that human contributions of greenhouse gases are disrupting global climate, and that the impacts of a destabilized climate system are occurring and will continue to escalate if we do nothing. Another 2,400 scientists yesterday signed a statement endorsing the IPCC report, and observing that "the further accumulation of greenhouse gases commits the earth irreversibly to further global climatic change and consequent ecological, economic and social disruption." Skepticism is an inherent part of the scientific process, but it should not be used as an excuse to do nothing.

To the people of my district, the cost of doing nothing is too much to bear. The primary industry in my district is agriculture, followed closely by tourism to places like Ocean City. These are two industries that will be severely impacted by the effects of a sea level rise, more frequent and severe weather events, such as hurricanes and droughts.

Economics

We do need to look at the economic implications of any policy that we take. But we must not fall victim to alarmist gloom and doom scenarios. The US marketplace has demonstrated time and again that we can utilize flexible, innovative, market-based solutions to environmental problems. I am heartened by the numerous studies that have come out showing that significant emissions reductions can be made with little or no disruption to the economy.

It is significant to consider the fact that in a global context, the US uses energy far less efficiently than our economic competitors and trading partners. On a per capita basis, the US uses twice as much energy to produce a unit of GDP than do Germany or Japan. These inefficiencies are more than an environmental waste—they represent lost economic opportunity, as well as increased oil imports and decreased energy security. As a result, numerous studies have found that there is tremendous room for energy efficiency and productivity gains in the US economy through cost-effective investments in energy efficiency and advanced energy technology. A 1991 study by the National Academy of Sciences concluded that "the United States could reduce or offset its greenhouse gas emissions by between 10 and 40 percent of 1990 levels at low cost, or at some net savings . . . the efficiency of practically every end use of energy can be improved relatively inexpensively."

The IPCC 1995 Second Assessment report further confirms that significant energy efficiency gains can be made at no cost or even at a savings to the economy by improving conservation measures and utilizing existing technologies. The report states that "numerous studies have indicated that 10-30% energy efficiency gains above present levels are feasible at negative to zero cost in each of the sectors in many parts of the world through technical conservation measures and improved manage-

ment practices .... Using technologies that presently yield the highest output of energy services for a given input of energy, efficiency gains of 50-60% would be technically feasible in many countries over the same period."

I would also like to note that recently a statement was signed by 2,300 economists—including eight Nobel laureates and many other distinguished economic thinkers—who recognize that "significant environmental, economic, social and geopolitical risks" are posed by climate change, that "preventive steps are justified," and that "economic studies have found that there are many potential policies to reduce greenhouse gas emissions for which total benefits outweigh the total costs. For the U.S. in particular. sound economic analysis shows that there are policy options that would slow climate change without harming American living standards, and these measures may in fact improve U.S. productivity in the long run."

Negotiations

Clearly, mitigating climate change is a global problem, requiring full participation of both developed and developing nations. There is no question that we need commitments and timelines for full participation by developing nations. But in order to address this problem we have to act now, and the US needs to maintain its leadership role.

The US has been the world's leading emitter of greenhouse gases for decades, and with only 5% of the world's population we account for 20% of global emissions. In addition, we have failed to meet our 1992 convention agreement to hold emissions at 1990 levels through the year 2000. Instead, it is projected that we will exceed 1990 levels by 13%. Voluntary programs and targets are a good idea, but they have not been sufficient. Binding targets and emissions trading options are one possible solution. I believe the US should work toward a protocol that provides flexibility and incentives for reducing emissions using market-oriented approaches and that sets a clear time line for bringing developing countries on board. A good climate treaty will need to provide a mechanism whereby all parties are brought into the solution over time.

Recently several leaders from the business community have made strong statements regarding the necessity and importance of addressing the climate change problem. As John Browne, Group Chief Executive with British Petroleum, said in a speech at Stanford University in May of this year, "There's a lot of noise in the data. It is hard to isolate cause and effect. But there is now an effective consensus among the world's leading scientists and serious and well informed people outside the scientific community that there is a discernible human influence on the climate, and a link between the concentration of carbon dioxide and the increase in temperature. The time to consider the policy dimensions of climate change is not when the link between greenhouse gases and climate change is conclusively proven—but when the possibility cannot be discounted and is taken seriously by the society of which we are part."

Some members have called for continued debate of the issue and an open discussion of the policy options that can be used to address it. I agree, but I most strongly urge my colleagues not to give up now and walk away from the negotiations. We have the potential to lead with fair, flexible. sensible strategies that can stabilize climate without disrupting the economy. Climate change is one of the most compelling issues of our time and the moment for action is upon us.

Senator HAGEL. Thank you. Secretary Wirth, welcome.

STATEMENT OF HON. TIMOTHY E. WIRTH, UNDER SECRETARY FOR GLOBAL AFFAIRS, DEPARTMENT OF STATE

Mr. WIRTH. Thank you very much, Mr. Chairman. I am pleased to join you this morning to discuss the importance of climate change and to outline the United States negotiating position as we move toward the Third Conference of the Parties to be held in Kyoto in December.

I am especially pleased to follow this morning two gentlemen I consider important mentors to me. John Dingell was my first tutor legislatively. I was the ranking Democrat on the first Energy Committee on the old Commerce Committee in the mid-1970's. Robert C. Byrd taught me about the importance of institutions and how they demand our continuing, patient attention as we work to con-

tinue the success of our democratic institutions. Thank you, Senator Byrd.

Climate change is probably—excuse me, Mr. Chairman. I am in the throes of a heavy flu. Climate change is probably the most important environmental challenge facing the world. The ecological, human, economic, and political consequences are of enormous importance for the mid-term and for the long-term, and each of us needs to understand them. We look forward to active and frequent consultations with this committee and with other Members of the Congress as we seek to reach an agreement and as we set up the needed long-term process. The "serious, informed, and strong voice" which you noted in your opening remarks, Mr. Chairman, will be most welcome, and we look forward to working closely with you.

I would like to begin this morning with the science, because scientists were the ones who drew our attention to climate change in the first place and because we continue to base our policies on the best evidence and the most rigorous scientific analysis available.

Let me highlight some of the key scientific issues on which there is a global consensus.

Human activities have significantly increased the atmospheric concentration of greenhouse gases over the last century. Global average temperatures have already increased about ½ to 1 degree Fahrenheit. The balance of evidence suggests a discernible human influence on global climate. Projections of the future change based on complex climate models and on our best understanding of the physics of the climate system suggest an increase of another 2 to 6.5 degrees Fahrenheit by 2100, an average greater than any seen in the last 10,000 years.

Sea levels are projected to rise an additional 1.5 feet by 2100 from expansion of the oceans due to global warming and from a melting of glaciers and ice sheets. Climate change is likely to have wide-ranging and mostly adverse effects on human health with direct and adverse effects leading to increased mortality.

Coastal populations and infrastructure are vulnerable. A 20 inch rise in sea levels would put about 100 million people at risk each year from storm surges with significant costs.

Natural and managed ecosystems are at risk as ideal ranges shift with the climate. The location of forest and agricultural zones will change significantly.

Future unexpected changes in the climate are not included in the models. These surprises may have impacts of global magnitude, such as fundamental changes in global ocean circulation or ecosystem behavior.

These are the conclusions of the Intergovernmental Panel on Climate Change, an international body of more than 2,500 scientists, expert in all aspects of climate change, including the physical sciences, the social sciences, and the economics. U.S. Government experts have endorsed their work as have the academic communities in the United States and around the world.

An excellent summary of the science and the impacts that could occur as a result of global climate disruption was presented yesterday on behalf of nearly 2,500 leading American scientists, and I would like to include their statement for the record.

[The information referred to follows:]

SCIENTISTS STATEMENT

GLOBAL CLIMATIC DISRUPTION

JUNE 18, 1997

We are scientists who are familiar with the causes and effects of climatic change as summarized recently by the Intergovernmental Panel on Climate Change (IPCC). We endorse those reports and observe that the further accumulation of greenhouse gases commits the earth irreversibly to further global climatic change and consequent ecological, economic and social disruption. The risks associated with such changes justify preventive action through reductions in emissions of greenhouse gases. In ratifying the Framework Convention on Climate Change, the United States agreed in principle to reduce its emissions. It is time for the United States, as the largest emitter of greenhouse gases, to fulfill this commitment and demonstrate leadership in a global effort.

Human-induced global climatic change is under way. The IPCC concluded that global mean surface air temperature has increased by between about 0.5 and 1.1 degrees Fahrenheit in the last 100 years and anticipates a further continuing rise of 1.8 to 6.3 degrees Fahrenheit during the next century. Sea-level has risen on average 4-10 inches during the past 100 years and is expected to rise another 6 inches to 3 feet by 2,100. Global warming from the increase in heat-trapping gases in the atmosphere causes an amplified hydrological cycle resulting in increased precipitation and flooding in some regions and more severe aridity in other areas. The IPCC concluded that "The balance of evidence suggests a discernible human influence on global climate." The warming is expected to expand the geographical ranges of malaria and dengue fever and to open large new areas to other human diseases and plant and animal pests. Effects of the disruption of climate are sufficiently complicated that it is appropiate to assume there will be effects not now anticipated.

Our familiarity with the scale, severity, and costs to human welfare of the disruptions that the climatic changes threaten leads us to introduce this note of urgency and to call for early domestic action to reduce U.S. emissions via the most cost-effective means. We encourage other nations to join in similar actions with the purpose of producing a substantial and progressive global reduction in greenhouse gas emissions beginning immediately. We call attention to the fact that there are financial as well as environmental advantages to reducing emissions. More than 2000 economists recently observed that there are many potential policies to reduce greenhouse-gas emissions for which total benefits outweigh the total costs.

The Framework Convention on Climate Change, ratified by the United States and more than 165 other nations, calls for stabilization of greenhouse gas concentrations in the atmosphere at levels that will protect human interests and nature. The Parties to the Convention will meet in December, 1997, in Kyoto, Japan to prepare a protocol implementing the convention. We urge that the United States enter that meeting with a clear national plan to limit emissions, and a recommendation as to how the U.S. will assist other nations in significant steps toward achieving the joint purpose of stabilization.

INITIAL SIGNATORIES

Dr. John P. Holdren
Dr. Jane Lubchenco
Dr. Harold A. Mooney
Dr. Peter H. Raven
Dr. F. Sherwood Rowland
Dr. George M. Woodwell

Signed by 2409 scientists as of 6:19 PM on June 17, 1997

Ozone Action 1636 Connecticut Avenue, NW Washington, DC 20009 Voice: (202) 265-6738 FAX: (202) 986-6041

Mr. WIRTH. We do not yet have all the answers with respect to the science. We cannot yet say with certainty what the local effects of climate change will be, but with better scientific data the picture is becoming clearer.

For instance, in the United States, 20 inches of sea level rise would inundate 9,000 square miles of U.S. coastal land, with great

loss of property and infrastructure. Rising temperatures could double the number of heat related deaths. We now know that the 10 warmest years since records began all occurred since 1980. Some of the most recent data shows that four of the five hottest years have occurred since 1990. With CO_2 concentrations doubled in the atmosphere, heat waves like the one that killed 500 people in Chicago 2 summers ago would be 4 to 6 times as likely to occur.

While we acknowledge uncertainties about where, how fast, and when climate change will occur and, while we continue to press for research that will help us to answer these important questions, the basic fact remains that we are having a discernible impact on our climate.

Our policy is based on the current scientific consensus and the need to achieve the most cost effective emissions reductions possible. Our policy has three simple and straight-forward objectives, which are outlined in detail in the framework proposal which we submitted to the climate convention in January, which we discussed with the Congress and submitted to you at the same time. The proposal was shared with this committee, as I noted, and was distributed widely with the public. The three objectives are as follows.

First, we are seeking to establish a legally binding emissions target for developed countries which is verifiable, credible, and realistic.

Second, we are seeking an agreement in Kyoto that maximizes the flexibility for each country to meet this legally binding target, including the use of market mechanisms.

Third, we recognize the importance of involving all countries in the agreement. To this end, we have incorporated extensive language into our proposal that calls for developing countries to act.

Let me go through each of these three elements in greater detail if I might, Mr. Chairman. First is the target.

It is clear that the Framework Convention on Climate Change has not proven adequate to the task of reducing global emissions. We anticipate that only two countries will meet the convention's nonbinding aim of lowering emissions to 1990 levels by the year 2000. We ourselves will miss the aim by about 10 percent.

We believe a binding legal obligation to act will result in the passage of domestic laws in all countries that compel action. In order to build in some flexibility, our proposal calls for the targets to be multi-year in nature. Without this sort of legal obligation, countries will continue to pay only lip service to their efforts to solve this problem. The past shows that this is not enough.

Second is flexibility. Solving the problem of climate change is a long-term proposition that will require enormous effort over a sustained period. It is, therefore, vital that we achieve emissions reductions as cost effectively as possible. Our approach to climate change seeks to do this. We have recommended that each country be given the maximum flexibility to meet its legal obligation and we have rejected common, harmonized policies and measures recommended by some countries. We have also learned from the successes of the past and are, wherever possible, focusing our efforts on the use of market mechanisms to reduce costs.

One of the most innovative of these is the introduction of emissions trading into the lexicon of international agreements. This concept has been successfully used to reduce costs as much as tenfold in meeting the standard set for power plant emissions of sulfur dioxide. A similar program has also been successfully implemented in the Montreal Protocol on substances that deplete the ozone layer.

In the climate context, we envision that parties would be allowed to trade their emissions, seeking to reduce them where it is most cost effective to do so. While we are still engaged in working through some of the details of how to implement this proposal, it is clear that such a program could significantly reduce the costs, some studies suggest, by up to 50 percent.

Another piece of our strategy on flexibility is joint implementation. Through joint implementation, countries are allowed to undertake emissions reductions projects in developing countries and count these reductions against their own emissions. We believe that joint implementation holds enormous potential to reduce global greenhouse gas emissions, again in a cost effective manner. Joint implementation would also produce other benefits, such as encouraging technological innovation, promoting the use of cost cutting U.S. energy technologies and protecting forests and other critical habitat around the world.

The U.S. has extensive experience with successful joint implementation projects. Recently, our approach on joint implementation received a major boost when President Clinton received the endorsements of the Dominican Republic and the seven Central American nations to endorse our concept of joint implementation for credit. This is a good example of our commitment to pushing through flexible mechanisms to implement new commitments under the climate change protocol.

Third concerns developing countries. We recognize the importance of including developing countries in this agreement. Their participation is critical to achieving any kind of lasting success in combating the threat of climate change. For this reason, Mr. Chairman, the participation of developing countries has been a central piece of our negotiating strategy. We must seek a level playing field in which all countries that contribute to the problem contribute to its solution.

Developed countries, including the former Soviet Union and the countries of Eastern Europe, contribute about 60 percent of global emissions today, as Senator Byrd pointed out earlier, and developing countries account for about 40 percent. What do these numbers tell us?

They tell us, first, that the developed countries have historically contributed the greatest amount to the current heightened concentrations. We have fouled the nest. But the developing countries are rapidly growing, as are their emissions. The United States, with 5 percent of the world's population, is the largest greenhouse gas emitter, with more than 20 percent of the world's emissions. But China is not far behind and is expected to pass us sometime in the first quarter of the 21st Century, although on a per capita basis, its emissions are projected to be less than one-fifth of our own even then.

There is a clear concern about the potential impacts on our international competitiveness. Let me assure you that developing countries are part of our negotiating strategy and they must join us in order to insure that no country suffers significant competitive disadvantage.

We are all in this together with different histories but with the same future.

To add to Senator Byrd's appropriate metaphor of the boat, let me add that we pull a heavier oar at the beginning; over time, we must all pull together.

Our policy has to be calibrated to reflect this reality. We cannot expect to solve the global problem unless all countries, developed and developing, participate in the solution. To this end, we have proposed three separate elements for developing countries in our proposal for Kyoto.

First, we call on developing countries to continue to elaborate on their commitments in the convention, including by providing information on emissions on an annual basis, the same as for developed countries and by taking no regrets measures, actions which may be valuable in their own right and which may also mitigate climate change. We also call for a regular review of the actions developing countries are taking, again using a review process similar to that established to assess our own actions.

Second, we call on the newly developed countries, such as Mexico and South Korea, to take on binding legal obligations to reduce emissions, recognizing that, while the targets they adopt may not be the same as our own, such commitments will codify their new status and differentiate them from the lesser developed countries. We are now working with potential members of this group to seek their agreement on such a step. While by no means an easy task, we believe that in Kyoto we can find some language to insure that countries in this category that are graduating to OECD status, for example, will take on commitments that correspond to their more developed status.

Third, we call for the negotiation of a new legal instrument which will include legally binding obligations for all countries, including all developing countries, as a next step in the past for the ultimate stabilization of greenhouse gas concentrations in the atmosphere at a level that is not dangerous. This step, too, faces significant difficulty in the negotiations leading toward Kyoto.

Finally, I want to take this opportunity to note that one of the most important, potential incentives with regard to additional developing country participation in the Global Environmental Facility would be seriously undermined if Congress does not fully fund the U.S. contribution to this program. I hope that you and the committee, Mr. Chairman, will support our request of $100 million for the GEF for this year.

Let me close this morning by briefly reviewing for you the negotiating process between now and December 1, when we meet in Kyoto. We have two more 1-week officials-level negotiating sessions, the first one in late July in Bonn and the second one in late October, also in Germany. During these 2 weeks, we will be examining and negotiating the extensive text which is a compilation of all the materials submitted by all the countries. This is an ex-

tremely divergent and broad document, reflecting many interests around the world, and it must be moved toward some consensus.

At one end of the spectrum, reflecting their strong commitment to making an aggressive statement, the European Union has proposed that developed countries reduce emissions by 15 percent below 1990 levels by the year 2010. The Organization of Small Island States has proposed a 20 percent reduction by the year 2005.

At the other end, reflecting their concerns with the potential impact of various emissions reduction proposals, particularly on reductions on the consumption of fossil fuels, OPEC countries have introduced a proposal that they be compensated for any economic cost they might incur as a result of treaty requirements.

Other countries have introduced recommendations that they be allocated an individualized, different target. This commitment to so-called differentiation is not yet defined but is used by many countries as a first step toward finding their own way of joining the negotiating process.

As we examine these proposals and develop our own negotiating strategy, we will continue to be guided by our own principles of feasibility and economic opportunity. We are, as you know, doing extensive economic modeling and, while some drafts have been leaked, we have not yet completed the process. We expect the modeling will soon be completed and available to all interested parties.

I am aware of stories that interpret some of the model's early findings. Some report that impacts on specific industries and sectors may be negative, while others suggest that the development of new technology will offset the cost. Others still point to the economically beneficial effects of joint implementation and emissions trading, two of our cornerstone approaches to meeting the climate challenge.

I think it is useful, as we think about the economic impacts of reducing greenhouse gas emissions, that we remember over 2,300 economists, including 8 Nobel laureates, have endorsed a statement which in part states, "As economists, we believe that global climate change carries with it significant environmental, economic, social and geopolitical risks and that preventive steps are justified. For the United States in particular, sound economic analysis shows that there are policy options that would slow climate change without harming American living standards, and these measures may, in fact, improve U.S. productivity in the long run."

We agree with the statement of these ecologists and I would ask that their statement be included in the record.

[The information referred to follows:]

STANFORD UNIVERSITY, STANFORD, CALIFORNIA 94305

HAROLD A. MOONEY
PAUL S. ACHILLES PROFESSOR
OF BIOLOGY

May 21, 1997

President Bill Clinton
1600 Pennsylvania Ave.
Washington, D.C. 20500

The accompanying letter comes from a group of ecologists from around the country who have studied the potential impacts of global change on biotic systems, many of whom are the leading international expert on a particular dimension of this problem. As you will read they all have deep concerns about the ecological consequences of rapid climatic change. The letter calls for a "prudent course" that would "limit climate change to the lowest rates feasible given emissions that have already occurred".

Sincerely yours,

Harold Mooney

Harold Mooney

STANFORD UNIVERSITY, STANFORD, CALIFORNIA 94305

HAROLD A. MOONEY
PAUL S. ACHILLES PROFESSOR
OF BIOLOGY

May 21, 1997

President Bill Clinton
1600 Pennsylvania Ave.
Washington, D.C. 20500

Dear President Clinton:

Ecologists' Statement on the Consequences of Rapid Climatic Change

Climate change driven by emissions of greenhouse gases is projected to occur at a very rapid rate, significantly faster, on a sustained global basis, than rates of climatic change during the past 10,000 years (1). Rapid climate change coupled with pollution, habitat fragmentation and habitat loss may lead to the decline and disappearance of many plant and animal communities that might otherwise survive a future climate that is relatively stable but warmer.

We believe that this situation constitutes a dangerous anthropogenic interference with the climate system, one that may not "allow ecosystems to adapt naturally to climate change" as is called for in the Framework Convention on Climate Change (1992). Accordingly, we believe that the prudent course would be to limit climate change to the lowest rates feasible given emissions that have already occurred. These correspond to global rates of warming of no more than 1 degree C per century.

Much of the current debate over limiting global climate change has focused on targets for stabilization of greenhouse gas concentrations many decades in the future. However from an ecological standpoint, it is the *rapid rate* as well as the total magnitude of climate change projected to occur that is pertinent to the future well-being of plant and animal communities and to the continuous availability of goods and services they provide to our society. Global mean temperature could increase by as much as 1-3.5 degrees C (2-6 degrees F), over the next 100 years. At higher latitudes, which include large portions of the United States, temperature increases could be much greater.

Rapid climate change is more dangerous to plant and animal communities than gradual climate change even if the total amount of change that eventually occurs is exactly the same.

During rapid climate change, disturbances like fires, floods, erosion, droughts, storms, pests and pathogen outbreaks may increase with adverse effects on ecosystem functions as important as water supply, soil fertility and carbon sequestration. After disturbance, aggressive, 'weedy' species, including exotics that outcompete native vegetation, may come to dominate these areas. In some US temperate forests, rapid climate change could lead to widespread tree mortality, wildfires and replacement of the forests by grasslands. Species that are long-lived, rare, or endangered will be severely disadvantaged.

In an increasingly developed world, there are fewer and fewer areas available in which native trees and plants can grow. Cities, highways, agricultural fields and other human activities limit available habitat and create barriers to the migration of plants and animals. In fact, many natural areas now can be considered 'islands' in a sea of developed land. Protected areas like national parks and forests were established with current climates in mind. Rapid climate shifts may reduce appropriate native habitats within protected areas while development outside the boundaries of the protected areas would make much of the neighboring new habitat unavailable and limit corridors for species to migrate to suitable new habitats. It would be difficult to imagine, for example, how the imperiled species of Everglades National Park, such as the Cape Sable Sparrow and American Crocodile, could migrate north into the urban and agricultural landscapes of coastal and central Florida and successfully re-establish themselves. Overall, climate change, in combination with existing anthropogenic habitat disruption and loss, could lead to steep declines in worldwide biodiversity.

Furthermore, conditions for plant and animal communities are considerably less hospitable now than prior to the industrial revolution. In many cases, plant and animal populations are less healthy and ecosystems less resilient to further disturbance due to environmental stress from human-made pollutants and habitat degradation. These stresses may reduce significantly an individual's or ecosystem's ability to cope successfully with climate change.

Climate change may also result in rapid sea level rise. Rapid sea level rise causes beach erosion and threatens coastal marshes and mangrove forests. While many of these coastal natural areas have kept pace with historic rates of sea level rise, faster rates may lead to inundation of marshes and mangroves more rapidly than new wetlands can form. Onshore human development will further hamper new establishment of coastal natural areas. Loss of habitat for a substantial number of species of birds, fish, shellfish, microorganisms and animals could result. Marshes and mangroves also protect shorelines from storms and high tides and act as filters for pollutants such as sewage and other

effluents. Their loss would lead to increased erosion and degradation of onshore human development.

It is difficult to quantify precisely the response of a particular species or group of species to climate change. Because there are only sparse records of this type of rapid climate change available, we have little to guide our estimations. Scientists do know the following. Climate determines the distributions of many species. Significant climate change has in the past and will in the future require many species to shift their ranges. Species vary in their ability and opportunities to adapt or migrate. The rate of projected change is enough to threaten seriously the survival of many species. Pollution and human alteration of the landscape have reduced considerably the ability of plant and animal communities to adjust to rapid climate change. Ecosystems will experience a rate of sustained climate change that is unusually rapid and, for many areas, unprecedented during the past 10,000 years. The more rapid that rate, the more vulnerable to damage ecosystems will be.

We are performing a global experiment on our natural ecosystems for which we have little information to guide us. While plant and animal communities may be able to eventually adapt to a stable climate system that is warmer than the existing one, many species may not be able to survive a rapid transition to that new climate. The prudent course would be to limit climate change to the lowest rates feasible given current atmospheric accumulations of greenhouse gases. These correspond to global rates of warming of no more than 1 degree C per century.

(1) *Climate Change 1995 - Impacts, Adaptations and Mitigation of Climate Change: Scientific-Technical Analyses.* Contribution of Working Group II to the Second Assessment Report of the Intergovernmental Panel on Climate Change. Editors R.T. Watson, M.C. Zinyowera, R.H. Moss. Cambridge University Press, p. 21.

cc:
Vice President Al Gore
1600 Pennsylvania Ave.
Washington, DC 20500

Secretary Madeleine Korbel Albright
Department of State
2201 C Street NW
Washington, DC 20521

Under Secretary Timothy E. Wirth
Department of State
2201 C Street NW
Washington, DC 20521

Secretary Dan Glickman
Department of Agriculture
200-A Whitten Bldg.
1400 Independence Ave. SW
Washington, DC 20250

Secretary Federico Peña
U.S. Department of Energy, Headquarters
Forrestal Bldg.
1000 Independence Ave. SW
Washington, DC 20585

Secretary Bruce Babbit
U.S. Department of the Interior
1849 C Street NW
Washington, DC 20240

Ms. Carol M. Browner
Administrator
United States Environmental Protection Agency (EPA)
Washington, DC 20460

Dr. D. James Baker
Administrator
National Oceanic and Atmospheric Administration (NOAA)
14th and Constitution Ave. NW
Washington, DC 20230

Signatories of Ecologists' Statement

Dr. Fakhri Bazzaz
H.H. Timken Professor of Science
Biological Laboratories
16 Divinity Ave.
Harvard University
Cambridge, MA 02138

Dr. Janine Bloomfield
Environmental Defense Fund
257 Park Ave. S
New York, NY 10010

Dr. F. S. Chapin, III
Department of Integrative Biology
University of California
Berkeley, CA 94720

Dr. James Clark
Department of Botany & Division of Earth Sciences
and Quaternary Ecology and Earth Surface Transformations
Duke University
Durham, NC 27708

Dr. Margaret B. Davis*,#
Regents' Professor of Ecology,
Department of Ecology, Evolution and Behavior, University of Minnesota,
Saint Paul, MN 55108

Dr. Paul Ehrlich*
Bing Professor of Population Studies
and Professor of Biological Sciences
Stanford University
Stanford, CA 94305

Dr. Christopher Field
Department of Plant Biology
Carnegie Institution of Washington
290 Panama Street
Stanford, CA 94305

Dr. Jerry F. Franklin#
Professor of Ecosystem Analysis
College of Forest Resources
University of Washington
Seattle, WA 98195

Dr. Diana Wall Freckman, Director and Professor
Natural Resource Ecology Laboratory,
Associate Dean, College of Natural Resources
Colorado State University
Fort Collins, CO 80523

Dr. Gene Likens*,#
Director and President, Institute of Ecosystem Studies
P.O. Box AB
Millbrook, NY 12545

Dr. Jane Lubchenco*,#
Wayne and Gladys Valley Professor of Marine Biology
Department of Zoology, Cordley 3029
Oregon State University
Corvallis, OR 97331-2914

Dr. Pamela A. Matson*
Soil Science Department
Hilgard Hall, Room 108
University of California
Berkeley, CA 94720

Dr. Harold Mooney*,#
Paul S. Achilles Professor of Environmental Biology
Department of Biological Sciences
Stanford University
Stanford, CA 94305

Dr. Louis F. Pitelka, Director and Professor
Appalachian Environmental Laboratory
Center for Environmental & Estuarine Studies
Gunter Hall
Frostburg, MD 21532

Dr. David S. Schimel
University Center for Atmospheric Research
Climate System Modeling Program
P.O. Box 3000
Boulder, CO 80307

William H. Schlesinger
James B. Duke Professor
Department of Botany
Duke University
Durham, NC 27708-0340

Dr. Steve Schneider
Department of Biological Sciences
Stanford University
Stanford, CA 94305

Dr. Herman H. Shugart
W.W. Corcoran Professor and Director, Global Environmental Change Program
Department of Environmental Sciences
University of Virginia
Charlottesville, VA 22901

Dr. Boyd Strain
Professor of Botany
Duke University
Durham, NC 27708-0340

Dr. G. David Tilman
Distinguished McKnight University Professor and
Director, Cedar Creek Natural History Area,
University of Minnesota
St. Paul, MN 55108

Dr. Peter Vitousek*
Clifford G. Morrison Professor in Population and Resource Studies
Department of Biological Sciences
Stanford University
Stanford, CA 94305

*, Member, National Academy of Sciences
#, Past President, Ecological Society of America

Mr. WIRTH. Finally, I should note that we understand that Kyoto is but one more step in the long road toward stabilizing the atmospheric concentrations of carbon and other greenhouse forcing gases. The long-term goal, Mr. Chairman, is stabilization of concentrations of greenhouse gases in the atmosphere at an acceptable level.

Let me state that again, Mr. Chairman, because this is the fundamental issue that has to be understood by all students of this issue. The long-term goal is stabilization of concentrations of greenhouse gases in the atmosphere. This is a task that must begin now but which will require a sustained effort over many decades to come.

Kyoto is a first step, but a very important one. The message that we send by what we do is enormously important. We believe that we can succeed by developing new technologies and, thus, improving the way we fuel our economy, transport ourselves and process materials; using flexible economic instruments and market mechanisms, such as emissions trading and joint implementation; bringing in developing countries as full partners as the thrust of your resolution, Mr. Chairman; fulfilling the obligation of our leadership role.

Through this process we can continue to promote economic development and improve the standard of living for the American people while we protect the environment.

It is important in Kyoto that we set up a system that will work, one that will allow us to reduce our emissions at the lowest possible cost, so that we can achieve the maximum protection of the environment. It is also important that we send a clear signal to governments and industries so that they can make significant investments in the new technologies that will be required if we are to achieve our ultimate goal. Although those of us in the developed world must take the lead, everyone must participate in moving toward the solution.

Let me briefly comment, if I might, also, Mr. Chairman, on the Byrd Resolution or the Byrd-Hagel Resolution which has been discussed this morning.

We agree with the analysis found in Senator Byrd's resolution and we agree with the thrust of the resolution's approach toward the developing world. What has to be worked out are the points of definition of what those commitments ought to be.

What steps do we have to take to show that we are meeting our leadership responsibilities, as defined in the climate treaty. At what level of development do the emerging countries kick in? Is it when they achieve OECD status? Is it when they achieve some level of per capita development? These are important and critical questions which we must come to understand and work with them on. When should such a trigger kick in?

Let me say that I believe that the resolution introduced by you and 59 of your colleagues can be very helpful to us. There is one small part of it, as we have discussed, that causes us to want to have some further discussions with you. But, as a general proposition, we think it is very helpful and a very good sign, Senator, of joining in a very thorough and complete discussion with all of you.

Finally, we should, I believe, join in the spirit, as well, of Senator Byrd's statement. It is the obligation of leaders to recognize dangers to the populace. One of the primary requisites of leadership is to anticipate, rather than just respond, to the problem after it occurs. That is what this issue is all about, Mr. Chairman.

It is about understanding this issue, coming to grips with the fundamental science, and then beginning to move and exercising our leadership in the United States.

We look forward to working closely with you and your colleagues on this most challenging and complex of environmental issues.

Thank you very much. I will be happy to answer any questions which you may have.

Senator HAGEL. Secretary Wirth, thank you very much.

We have another panel behind Secretary Wirth. In the interest of everyone's time, since there are just two of us here, Senator, I propose we do a 7 minute question period and rotate.

Mr. Secretary, let me begin my questions with a couple of overview comments.

As we thread our way along this morning, I want to get to some of the points that Congressman Dingell and Senator Byrd pointed out in their testimony on some of the specifics. We will get to those. But I want to say this to you at the outset so that you can frame this in your own mind, as you heard both Congressman Dingell's and Senator Byrd's testimony.

Mr. WIRTH. I did, Mr. Chairman.

Senator HAGEL. First, can you assure this committee that whatever action is taken by this administration regarding global climate change will come in the form of a treaty?

Mr. WIRTH. Well, it will either be a protocol to a treaty or an amendment to a treaty. But it will have to come back up in front of the U.S. Senate, both for agreement and we will have an implementing stage as well. Whatever we do is going to require, as well, implementing legislation.

So there would be, I anticipate, two areas, one, approval of our actions, and second, the implementing legislation that will be necessary to carry it out.

Senator HAGEL. You mentioned a number of times in your testimony economic decisions and economic well-being. The term "economy" or "economics" was brought out a few times in your remarks.

Based on the last 4 years of analysis, one of Congressman Dingell's points was that we have still not seen the administration's economic model, even though, as Congressman Dingell pointed out, it has been promised for more than a year.

I would be interested to know what the problem is.

Second, perhaps more importantly, Mr. Secretary, how can you make any decisions on the economics and consequences of these actions without any road map, without any analysis, without any assessment, without any model?

You can dive into that, Mr. Secretary, wherever you wish.

Mr. WIRTH. Let me be very careful in what I say because I personally share many of your own frustrations in not having the models out. I think many of us have been very frustrated by the great difficulty that has been reflected in attempting to take the

three different fundamental models that are used and merge them into one.

That process has been going on since our announcements in Geneva in 1996. We had hoped, Mr. Chairman, to have those out early in the year. The task proved significantly more complicated than we thought it was going to be.

For example, there were three different models. None of them was really sensitive to including the very important joint implementation and emissions trading operations, which changes the whole nature of this. That had to be Federal in nature and worked. That also proved to be very difficult.

Second, we have discussed publicly in as many ways as we can the general approach that we are taking to this. I don't think it is any mystery what are the general parameters of what we are discussing. Most people know what they are. In fact, as I noted in my testimony, the first analysis out for peer review on May 15 has been broadly discussed in public. It was in "Inside EPA." One of your future panelists used it as the basis of a broad discussion with dozens of highly respected individuals in Baltimore 10 days ago or 2 weeks ago. So, in fact, that first draft for peer review has been out very publicly.

We are now accepting all of the comments. We are in the process of taking all of the comments. We have been asked if we would peer review it. We said yes, we would. It went out for peer review. It got leaked. That information is out. We have that back and we hope to have that in very soon.

Third, as a non-economic modeler, Mr. Chairman, although I have listened to all of these people to the point of almost becoming thoroughly anesthetized by them, I do believe that one can put a certain amount of faith in these models and they only go so far.

These models are not going to determine a whole lot of things. These are the same models that were very wrong about what happened with the energy bump-up in pricing after the Arab oil boycott of 1972. They were models that, for the most part, were very wrong about the costs of the Clean Air Act. They were models that do not reflect a lot of other aspects, what happens with certain investments that we make in alternative energy programs, for example. There are other groups out.

As a final comment, for example, the Union of Concerned Scientists and NRDC have estimated that we could achieve a 10 percent reduction by the year 2010 with investments that pay back to us, focused predominantly on conservation activities.

Recently, the National Energy Laboratories Group came out saying that we could stabilize by the year 2010 at the equivalent cost of $20 a ton, which would be about $10 billion a year in overall cost to the U.S. economy, which would then be Federal back into the economy. Many think that would be a wash and may be even beneficial.

So there are all kinds of different ways of looking at these models.

We will have it out as soon as possible. Everybody will look at the models. But the models are one high priest of economic activity. Ultimately, we are all going to have to make judgments about what

we do economically and environmentally and what makes the most sense.

Senator HAGEL. I understand that. But you reference cost savings, for example, and you reference the economics of some of the actions and the consequences of those actions.

So I am still confused as to how you get there if you partially dismissed economic models. If you have dismissed economic models, why is it important for us to have an economic model?

Somehow along the way, Mr. Secretary, we have to, in some way, base our actions and understand the consequences as best we can, as you suggest. But we should have some assumptions. As you know so well, we put budgets together in the Senate based on assumptions. If you believe what Senator Byrd's charts indicated this morning and other references to those numbers today, it seems to me that the economics of this are probably at the first grade level.

I don't know what the problem is within the administration, but you should have those numbers, Mr. Secretary, because that is going to be a problem.

Mr. WIRTH. Mr. Chairman, if I might just very briefly, I am not dismissing economic models. I am just saying that economic models are a helpful tool, like other things, to the ultimate judgment that has to be made by the Congress and the administration in broad discussion.

Now they are not going to tell you exactly what to do. But they are helpful indicators which provide us with information and further grist for the discussions that are going to have to occur.

When I mentioned cost savings and economic efficiency, those references, Mr. Chairman, were to joint implementation and to emissions trading. It is very clear and I don't think anybody disagrees with the fact that joint implementation and emissions trading will make the process and the cost of reducing greenhouse gases significantly lower.

I think there is broad consensus on that. There is a great deal of economic data available.

Senator HAGEL. Well, I don't think there is broad consensus on that, Mr. Secretary, not at all.

Senator Sarbanes.

Senator SARBANES. Does the Secretary want to respond to that?

Mr. WIRTH. Oh, I will be happy, Mr. Chairman, to do so. If you have questions about where the consensus may or may not be on emissions trading or joint implementation, I really would be delighted to respond.

Senator HAGEL. I do have a lot of questions on that. But it is Senator Sarbanes time to ask questions. I will defer to him and then I will have my round when we can come back to that.

Senator SARBANES. I would like to try to trace through how we are where we are now.

The Framework Convention that was adopted in October 1992 was where the parties committed to voluntarily bring down the greenhouse gas emissions. Is that correct?

Mr. WIRTH. Yes, Senator Sarbanes. The term of art is a "nonbinding aim."

Senator SARBANES. How many countries were there? I saw that 153 countries, I think, signed that. How many ratified it in the end?

Mr. WIRTH. 161 countries have now ratified.

Senator SARBANES. Was each of the countries that ratified committed to the nonbinding objectives?

Mr. WIRTH. No. There was differentiation between countries, Senator Sarbanes, in what are called Annex I countries and non-Annex I countries.

Senator SARBANES. What was that differentiation?

Mr. WIRTH. The Annex I countries were developed countries, largely the OECD countries, and Russia and the states of the former Soviet Union.

Senator SARBANES. What commitment did they undertake?

Mr. WIRTH. They undertook the agreement to attempt to reach emissions reductions at the 1990 level by the year 2000; to try to stabilize their emissions at 1990 levels by the year 2000.

Senator SARBANES. What commitment did the other countries undertake?

Mr. WIRTH. The other countries had commitments of reporting and commitments of—let me just ask my staff very specifically what specific items were in there. [Pause]

Mr. WIRTH. They had to inventory gases and to take policies and measures that would move them toward greater efficiency. But they did not have the specifics of the nonbinding aim that the developed countries had.

Senator SARBANES. But were they committed to trying to reduce their emissions?

Mr. WIRTH. There was no specific commitment that they had. They understood that this was the direction in which we'd go, but there was written into the treaty no specific that they had for reductions.

Senator SARBANES. Now the commitments on the part of the Annex I countries were voluntary, is that correct?

Mr. WIRTH. They were nonbinding aims, essentially. "Voluntary" means something different because the action plan that we together was fundamentally voluntary.

Senator SARBANES. Let me write that phrase down and then I will make sure that I use it. Nonbinding aims, OK.

Now did the Berlin Mandate put you in the framework of requiring shifting from nonbinding aims to mandatory? What do you call them now? You don't call them nonbinding.

Mr. WIRTH. We believe and we stated in Geneva—Berlin was in 1995, Geneva in 1996—we stated in Geneva that we thought that the nonbinding aims written into the original treaty were not adequate, that countries were stating what they were going to do but were, in fact, not doing so, and that the gap between rhetoric and reality was growing broader and broader.

Consequently, we said that we believed that the way in which we were going to achieve some real results in the area of climate change was to make these aims required, to make them compulsory, and that countries would, therefore, not only adhere to that but would follow and draft their own domestic programs to adhere to what they said they were going to do.

Senator SARBANES. What was the rationale when you shifted from nonbinding aims to compulsory aims of maintaining the differentiation between Annex I countries and all other countries?

I can understand the differentiation and the burden on the Annex I countries is a nonbinding aim, because then they can, in effect, act with an evaluation of what's happening everywhere. But when you then move to compulsory aims, what is the rationale for sustaining the differentiation between the two groups and leaving the—well, are the non-Annex I countries simply called "non-Annex I" countries or is there another name for them?

Mr. WIRTH. They are not called anything. They are known to be non-Annex I countries.

Senator SARBANES. They are not. All right.

What is the rationale for that?

Mr. WIRTH. Well, there were two rationales to that, Senator Sarbanes. The first was the obligation, under the climate treaty, as originally agreed to in Rio in June 1992 and then approved by countries around the world, that the developed countries had an obligation to move first. That was in the treaty.

So we continued that obligation under the treaty.

Second, it is very clear that most of the greenhouse forcing gases in the atmosphere today were put there by the developed countries. We have an obligation to move first.

Senator SARBANES. Let me interrupt you right at that point.

Do you agree with the factual assertions that have been made that by the year 2015, I think it's 2015, that China will be putting more emissions into the atmosphere than the United States?

Mr. WIRTH. Yes. We think that is approximately right and I stated that in my testimony. Yes.

But the question is we have to demonstrate that we are willing, as the people who, as I stated in my testimony, fouled the nest to begin with, that we are prepared to do something about cleaning that up and prepared to take steps in the future.

Senator SARBANES. How will you insure that the countries that are not under compulsory aims will be included within it?

Mr. WIRTH. That is the whole trick to the crossing of the lines that were in Senator Byrd's charts. That is precisely the issue. At what point is there a trigger where the developing countries graduate to status of obligations and what should those obligations be?

Senator SARBANES. Well, I keep reading these articles that say that the only commitment that will be made is to participate in negotiations to seek to determine that. Is that correct?

Mr. WIRTH. In my testimony, Senator Sarbanes, we point out three elements that are essential to our approach to the developing world. First is that they have to elaborate, in other words, draw out in much greater detail what they are going to do with special reference to the no regrets policies that they can be taking. A good example of that is pricing of energy. You don't know how to conserve energy unless you can put a price on energy. There are some very fundamental areas of economics in energy where that is a very, very important step to take.

A second element that we point out is that there are countries which are now graduating to OECD status—Mexico and South Korea—we believe. We have stated that and that is part of our ne-

gotiation, that they should have further obligations than the other non-Annex I countries.

Third is we think that the evolution of all of this we ought to move into a point with a further negotiation where the developing world will then, in that further negotiation, assume over a period of time obligations so that we are all in this together, say by 2030 or something like that.

Senator SARBANES. Mr. Chairman, may I just pursue that one point?

Senator HAGEL. Sure.

Senator SARBANES. How can you assure yourself that the further negotiations will result in an undertaking of compulsory aims on the countries that were not committed to that? How can you guard against a situation in which one group of countries is bound by compulsory aims, by international treaties that have been approved, and another group of countries, their undertaking is that they will negotiate at some point coming under compulsory aims?

Mr. WIRTH. A number of things are happening around the world, Senator, related to this.

First, increasingly countries are coming to understand that their undertaking of actions related to climate change will not only be beneficial to them, such as the pricing issue I referred to earlier, but also enormously beneficial to them in terms of health of their populace and the livability of their cities.

This is found, in particular, as you talk to provincial Governors throughout China, where they understand that there are very significant problems that they have. They are moving slowly, but surely, in beginning to undertake obligations.

A second thing that happens is that, if we are successful with joint implementation and in including that, that becomes a very real incentive for the sharing of technology which, as countries are building, for example, great hundreds of very large power plants, they would like to have that sharing technology with us. In the most efficient kinds of power plants, joint implementation is a real tool to getting there.

Third, many developing countries with excellent science—here I will cite again the Chinese—are coming to understand that the impacts of climate change are going to be extremely deleterious to them, probably moreso than to us. What happens on sea levels and their ability to adapt to sea level rise? What is happening to them in terms of agriculture and the drawing out of hinterlands and agricultural areas which we can probably adapt to in a better way? There is the use of water and our much greater efficiencies—not as much as they ought to be, but our much greater efficiencies. We are seeing all kinds of indications like this that countries are coming to understand the importance of their taking on these obligations.

Senator SARBANES. Well, now, I am not on any of these resolutions. As I indicated at the outset, I think this is a very complex subject and I think it has to be very carefully examined.

I find that answer very soft for the following reason. All of those arguments would apply to the effort to achieve nonbinding aims which you have said the Annex I countries have fallen short on.

Every one of the three arguments you have just listed, which, according to you, would lead these countries that are not committed to some binding aims but in effect would cause them to do so, apply now to the Annex I countries.

Apparently it didn't work there. So now you want to do compulsory aims. But I don't understand why if you are going to move to compulsory aims it would not be all encompassing.

I cannot carry through on it by being given arguments as to why countries not under the compulsory aim regime would take these measures on the basis of arguments which exist now and have not led the Annex I countries to take these measures.

Mr. WIRTH. Well, first, we believe, as I pointed out, that compulsory aims are critical in order to provide exactly the sort of incentives that we need in terms of signals in the economy, in terms of moving toward the kinds of stabilization that we eventually have to go toward. The compulsory nature of this is imperative.

Senator SARBANES. But you are placing a certain group of countries in that regime and leaving another group of countries outside that regime.

Mr. WIRTH. Yes.

Senator SARBANES. Then when I ask you why would the second group of countries in effect undertake these aims, you give me as the answer a series of arguments in terms of a perception of their self interest and so forth and so on that have not worked for the Annex I countries and are now leading you to seek to put the Annex I countries under a compulsory regime.

If that is the case, why shouldn't that analysis lead you to seek to put all countries under a compulsory regime?

Mr. WIRTH. We eventually would like to see all countries under a compulsory regime. We have stated that. That is something that we think is an appropriate thing to do down the line.

But right now, one, we have to demonstrate that we, who were there first fouling the nest, most significantly the people who put most of the carbon up into the atmosphere, are going to be seriously demonstrating that we are willing to take on the problem. Second, as we do so, it is clear, the history of all of this is that what we do is followed very, very closely by other countries. The developing world looks very closely at what we do.

Third, if the developed world together is putting on this kind of pressure, if we can reach this kind of step in the right direction, we think that the developing world would, therefore, be able to come into line a lot more likely than they are now.

If we don't have this kind of evolutionary process, we are not going to get anywhere. That is also the blunt reality of this. We can say we are going to take all of our cards and go home tomorrow if you don't have exactly the same obligations that we do.

Senator SARBANES. They may not be exactly the same. But as I understand the differentiation you have made, it's between obligation and no obligation, not between—I have overrun my time, Mr. Chairman. I apologize.

Senator HAGEL. No, please, go ahead and finish.

Senator SARBANES. It's not between the extent of the obligation. I mean, I'm concerned about a situation in which you have Annex I countries who have committed to a mandatory regime and you

have other countries that are not committed to any sort of mandatory regime. You then say well, these other countries will, in effect, come aboard because they will perceive it to be in their interest to come aboard, and the very arguments that were used with respect to Annex I countries that have not proven out will now lead you to seek a mandatory regime.

I can pursue this in the next round. Thank you, Mr. Chairman.

Senator HAGEL. In fact, I would like to follow on—I know you are pleased about this, Secretary Wirth—I would like to follow on what Senator Sarbanes is getting at. It seems to me Senator Sarbanes has been pursuing the core of this issue.

I am, like Senator Sarbanes, somewhat confused. If these amendments are in the enlightened self interest of all these countries, why do we need binding regulations or legally mandated commitments in the first place? If this is such a good thing for everybody, then why don't we go back to 5 years ago, when we talked about voluntary obligations?

Mr. WIRTH. Bluntly, Mr. Chairman, because we have not done what we said we were going to do.

Senator HAGEL. Who is "we?"

Mr. WIRTH. The United States of America and every other developed, every other Annex I country except for Germany and Great Britain.

Senator HAGEL. What did we say we would do?

Mr. WIRTH. We said we would—it was a nonbinding aim—but we said we would reduce our emissions to 1990 levels by the year 2000. We have missed that, as I pointed out in my testimony, by about 10 percent for a number of reasons. It was not for any malevolence, by any means. There was a good plan to do it. But our economy grew much faster in the 1990's that we anticipated.

Economic models, by the way, suggested that it was going to.

Second, the price of oil, the price of energy, remained significantly lower than we thought it was going to and than the economic model suggested.

Third, we did not have the support in the Congress for the implementation of a lot of the action plan that was necessary, for example, in areas of conservation, building standards, and so on, that were necessary to achieve that plan.

The same is true for reasons of their own of the Canadians, the Japanese, the Australians, and all of the other Annex I countries, again, with the exception of Great Britain, which changed from a coal to a natural gas economy and, therefore, reduced their emissions of carbon very significantly, and of Germany, which inherited the very dirty and inefficient economies of East Germany and shut them down. So they got credit for all of that shutdown in terms of the overall emissions.

Senator HAGEL. So one of the alternatives would be slow down our economic growth? Is that one of the problems that we have?

Mr. WIRTH. No, I'm not saying that that is the alternative.

I am saying that one of the reasons that we did not achieve our goal is that our economy grew much more robustly during the 1990's than it had been anticipated as all the economic modelers were looking at where we were going to be over the decade of the 1990's.

Senator HAGEL. So you think that is good enough reason to shift, as we have, from voluntary to legally binding mandates?

Mr. WIRTH. Well, I don't know what the alternative is, Mr. Chairman. We had nonbinding aims to achieve this and if, in fact, we are able to set a standard which establishes what the aim is going to be, everybody agrees that's what's going to happen, and it's done over a long enough period of time with the kind of flexible economic instruments, then we will see our industries, as happened in 1973, after the Arab Oil Boycott, the anticipated rise in the price of energy caused very, very significant changes in the way in which we viewed energy, the way in which we treated energy, the way in which we priced energy, and the efficiency with which we used energy.

That same sort of thing, that same sort of framework, that same sort of certainty is necessary for us.

We are not going to get out of this without a very significant long-term technological commitment to change if, in fact, we believe that we ought to limit the concentrations of carbon in the atmosphere.

Now I think that there is probably almost no scientist who would agree that if we went long-term, say a quadrupling the concentrations of carbon in the atmosphere, that that would be a good thing. I don't think that anybody would say that this is where we want to be.

Do we want to go to tripling? Well, there may be a few who would say maybe we could go to tripling. Most are saying that when we get around to doubling, it is time for us to stabilize the overall concentrations.

Well, how are we going to get from here to there? That is the conundrum in which we find ourselves. That is what this instrument is designed to do.

For our commitments, for the flexible economics, and to begin to engage the developing world as well—those are the three corners of this negotiation.

Senator HAGEL. Have we not, in fact, done better than what you had stated in Berlin, when I believe you had said something to the effect that we probably would miss by 30 percent?

Mr. WIRTH. It depends on what the percentage is—a percentage against what? What are you talking about?

Senator HAGEL. Well, what were you referring to?

Mr. WIRTH. In Berlin, we were emitting about 14,000 million tons—in 1990 levels, about 13,000 million tons of carbon. We are going to be at over 14,000 million tons of carbon. So we are going to miss by an overall percentage of close to 10 percent, of the overall goal. We are going to miss it and it will probably be at 1,370 or something like that. So we will miss the gap by about 50 percent. We will miss the overall, an overall percentage of our reduction by about 10 percent.

If you look at the base being, say, 1,300, we are going to get at the end of this decade to more than 1,400.

Senator HAGEL. How did you come up with those numbers?

Mr. WIRTH. I think those are very—the scientific community measured the amounts of carbon in the atmosphere and what we are emitting based upon what our economy does, the amount of

gasoline that is used, the kind of fuel that is used in our utilities. I don't think there is any disagreement over those base numbers, Mr. Chairman.

Senator HAGEL. Let's go back to what you said in Berlin and what you are now saying. I believe you told me in my office on Tuesday that the ultimate goal was a 70 percent reduction in emissions. Do you recall that?

Mr. WIRTH. Let me go back. We are talking about two different kinds of reductions, Mr. Chairman.

The first kind of reduction, the first step that we have to take is to stabilize our own emissions at some level at some date. The original aim was to stabilize our emissions at 1990 levels by the year 2000. That was our first aim for our own emissions.

That is a first step toward the much bigger and much more difficult job of stabilizing the concentrations of carbon in the atmosphere. That is the overall loading of carbon in the atmosphere.

We have to reduce now in order for everybody in the world, for all of us, to end up with concentrations in the atmosphere that may be double the historic standard. Again, if you think about this as a swimming pool, we are piping water into that swimming pool. We are piping carbon into the atmosphere.

The pipe that is pouring water into the swimming pool is getting bigger, and bigger, and bigger. Our economy is growing, the European economy is growing, the developing world is growing. The pipe pouring carbon into the atmosphere, pouring water into the swimming pool is getting bigger, and bigger, and bigger.

Now if we continue in this way, the swimming pool is going to overflow very rapidly. If we even stabilize the size of that pipe, our own emissions, you are still pouring a lot of carbon into the pool, a lot of water into the swimming pool. We have to reduce that trickle of water in order to get to the point where the swimming pool does not overflow.

Now that metaphor where, it is overflowing, we will generally assume that overflowing is at about double the concentrations of carbon in the atmosphere. Others would say that maybe it is somewhere between two and three times. It certainly is not four times.

But we have to get to a stabilization of the levels of carbon in the atmosphere. As I said to you in your office, this is the single, most important concept in studying and thinking about climate change one has to understand, concentrations of carbon in the atmosphere.

Senator HAGEL. But are you still saying, as you told me a couple of days ago, and as you said in your testimony, that the ultimate goal, is well beyond Kyoto: a 70 percent reduction in emissions?

Mr. WIRTH. Well, if we set the concentrations, Mr. Chairman, to be double the historic standard, which would be about 520 parts per million of carbon, if that is the ultimate standard, the ultimate concentration that we believe we can tolerate, if you choose that number—there is no number that has been chosen, but for the purposes of illustration let's say if we choose that number, and if we decide that we want to try to get to that number sometime toward the middle of the 21st century, that will require, ultimately, a 70 percent reduction in the amount of carbon that we are pumping into the atmosphere, to get from here to there.

Senator HAGEL. One last point and I will yield. We have been joined by our distinguished colleague from Massachusetts, John Kerry.

I can tell you as a member of the Senate Foreign Relations Committee, Mr. Secretary—and you may want to check the State Department on this, your reference in responding to Senator Sarbanes' questions about developing countries, their self interest and why would they participate—unless China has changed policy as of this morning, it has continuously and resolutely said that it will not be bound by any mandatory restrictions.

Mr. WIRTH. I am very aware of that. I have dealt with and negotiated with them all along for a long time.

Senator HAGEL. But that is not the way you answered the question.

Mr. WIRTH. Excuse me?

Senator HAGEL. That is not the way you answered the question.

Mr. WIRTH. Mr. Chairman, there are all kinds of negotiating statements that are made and I know what people say in negotiations when they are saying things publicly, and I know what goes on and what people say when they are talking to you about OK, where do we go from here. You have had that experience, I know, in a very distinguished political career and a very distinguished economic career. There are certain things that you say for consumption here and then you sit down and try to figure out how you get from here to there. That is what a negotiation is about, to try to figure out how do we get from here to there.

Now if you sat in on an economic negotiation in your business or a political negotiation and said this is where I want to get to, that's all I'm going to do, people will assume that whatever is that bottom line is the beginning of your negotiating position.

Senator HAGEL. Well, if that is your interpretation of where the Chinese are, we may want to get back to the Ambassador on this and determine their position.

But it is now Senator Sarbanes' turn.

Senator SARBANES. Thank you, Mr. Chairman.

I just have a few points I want to make. First of all, in defense of the Organization of Small Island States, since Congressman Dingell dismissed them sort of out of hand in his testimony, I ought to observe that, while they may not be powerful, they obviously have an intense interest in this issue. This is because if this issue is not properly resolved, they may cease to exist. So I think you can understand why they would be quite exercised about it. I just want to make that observation.

I accept the science. I think the science here is pretty overwhelming. In any event, if one has questions about the science, what is wrong with taking steps to address the problem if those steps can be done rationally? In other words, the National Academy of Sciences, apparently in a 1991 study, said about the U.S., at least, that we could reduce or offset our greenhouse gas emissions by between 10 and 40 percent of 1990 levels at low cost or at some net savings. The efficiency of practically every end use of energy can be improved relatively inexpensively.

Of course, they cited the fact that we use about twice as much energy on a per capita basis to produce a unit of GDP than does

Germany or Japan. So it seems to me that if you have, as I think we do, pretty strong scientific evidence that there is a problem, even if one wanted to question that, then you would say well, there are things that can be done to address this problem that do not require a tremendous dislocation and that those things need to be looked at just to be prudent, careful, and cautious.

The thing that is difficult here, though, is this differentiation, it seems to me.

Let me ask you this question. Did the Berlin and Geneva decisions now put you within a framework of negotiating that the differentiation between the Annex I countries and the other countries is an accepted proposition? I'm trying to search here. In other words, I mean when you go to negotiators, you go to Kyoto. Has that been established as a sort of negotiating principle or framework within which you have to operate? Or is that open so that a decision could be reached that would encompass all countries within a mandatory regime?

Mr. WIRTH. In the climate treaty agreed in 1992 and then reaffirmed in the Berlin Mandate, there is a distinction between Annex I and non-Annex I countries. That becomes a basis.

Senator SARBANES. But the regimes were nonbinding.

Mr. WIRTH. Yes. That has become the basis upon which most negotiations go on.

We in the United States are attempting to push this negotiation—and I will tell you at this point without much support from our colleagues in the developed world—for the developing world to assume much greater obligations.

We have been very clear over and over again, and I outlined the three parts of our proposal related to the developing world, to try to move them more rapidly toward the assumption of broader obligations.

Senator SARBANES. But are you operating under understandings reached that the non-Annex countries will remain outside of a compulsory regime, or is there inclusion within a compulsory regime open to negotiation?

Mr. WIRTH. We would like to bring them into a compulsory regime. Our proposal says those three things. One, we would like to elaborate in greater detail those items which they can do now. Second, we want to bring countries like Korea and Mexico, which have graduated to a higher status, into much more specific obligations. Third, we want the developing world to recognize that eventually they have to get into this, they have to evolve into this, and that we should have a next negotiation related directly to their becoming involved in it.

Senator SARBANES. Well now, is that the limit to which you can go in the negotiation?

Mr. WIRTH. We think that is as far as—we are going to have a great deal of difficulty, Mr. Chairman, in getting the other two elements that we want. We want emissions trading and joint implementation. We don't have a lot of support for that.

We want the developing world to have greater obligations. We don't have a lot of support for that. One of the fundamental reasons that we don't have a lot of support for that is the world looks to us, with 5 percent of the world's population and 20 percent of the

world's emissions, missing our target very significantly and not appearing to be very serious about it.

So we are attempting, from a negotiating point of view, to strengthen the position that we're taking in terms of what we do so that that helps us to get the economic instruments that we want and that, in turn, will help to bring in the developing countries.

Senator SARBANES. Yes. But you leave us, then, exposed to a regime in which we are under a mandatory framework and a number of significant countries are not when both the environmental trend lines and the economic trend lines raise serious questions. So we could be down the road somewhere and still find ourselves within the mandatory regime.

You would then say that these countries ought to be in the mandatory regime now, by any standard. But they are not. They refuse to be.

At this point, we—and when I say we I mean the Annex I countries—are in the mandatory regime and the other countries are not.

Mr. WIRTH. And that is where we are today. We are trying to set up a process to bring the developing world into the mandatory regime.

Senator SARBANES. Well, no. Your process does not assure that. Your process, as I perceive it—I'm trying to find this out here—your process assures that the Annex I countries will be within the mandatory regime.

Mr. WIRTH. Which is where we are today.

Senator SARBANES. Well, no, we're not.

Mr. WIRTH. That's where we are today.

Senator SARBANES. No, we are not there today.

Mr. WIRTH. It is with the assurance that the Annex I countries have requirements. You know, the nonbinding aims were world listed.

Senator SARBANES. We're not in a mandatory regime now.

Mr. WIRTH. But we're listed as having requirements today.

Senator SARBANES. I understand that. But they are nonbinding. Now you are going to make them binding.

Mr. WIRTH. Uh-huh.

Senator SARBANES. But there is no assurance that these objectives will become binding on the non-Annex I countries——

Mr. WIRTH. That is true.

Senator SARBANES [continuing]. In the regime you are going to put us into. This is how I understand it.

Mr. WIRTH. That is right. We are going to set up a series of ways in which they elaborate their responsibilities and will be required to do so, and other OECD countries, like Mexico and South Korea, that graduate to status, have newer obligations, and that we undertake a further negotiation to bring in the developing countries.

Now there is no guarantee, that is true.

Senator SARBANES. Yes. But that negotiation may not lead to anything——

Mr. WIRTH. That's true.

Senator SARBANES [continuing]. And they may stay out.

Mr. WIRTH. That's right—at which point, then, I think the whole treaty falls apart.

Senator SARBANES. Well, no. By that time you have a treaty.

Mr. WIRTH. What was that?

Senator SARBANES. By that time you have a treaty.

Mr. WIRTH. But you don't have a treaty that really makes sense to anybody at that point.

Senator SARBANES. Then what are you going to do, denounce the treaty?

Mr. WIRTH. Well, I think you'd get to a point where you'd have to look very carefully at where we are under the obligations of the treaty.

Senator SARBANES. Well, why don't we negotiate a treaty that does not contain in it the prospect of denouncing it?

Mr. WIRTH. Well, if you could figure out, Senator Sarbanes, if you could figure out how to bring the developing countries into this process, how with 151 people who are negotiating on this, in which there are all of these major parties, how we do that immediately—we are setting up a process that we think is the best that we can do in terms of bringing the developing countries into their set of responsibilities over a period of time.

Senator SARBANES. I understand the difficulty. But the problem is you then end up putting us into a mandatory regime without the assurance that the others will be in a mandatory regime. That, it seems to me, is a difficult problem. In fact, people that are supporting your efforts to negotiate have pinpointed that particular aspect of it as raising very significant difficulties.

Mr. WIRTH. Well, as I said to Senator Byrd yesterday, the single most difficult area in all of these negotiations beyond our own domestic political will to make the changes that are necessary is this issue of bringing the developing countries in. That is something that is going to take continuing work, a lot of work over a long period of time.

Senator SARBANES. Thank you, Mr. Chairman.

Senator HAGEL. Senator Kerry.

Senator KERRY. Thank you very much.

Welcome, Mr. Secretary.

Mr. WIRTH. Thank you.

Senator KERRY. I apologize in that I have been in a markup in the Commerce Committee.

Let me try to get at not only what Senator Sarbanes was getting at but sort of the broad confrontation that we face here.

You, in your testimony, which I was just looking through, lay out some of the sort of science findings with respect to where we are heading—the warmth, the increase, the potential increase in the next days of the temperature.

What would you say to Americans is the most compelling set of scientific facts that mandate action? I mean, if you want to really grab people's attention and say listen, this is why we have to incur cost and why there is sacrifice demanded, what are those most compelling scientific rationales?

Mr. WIRTH. Well, 2 years ago, in a heat wave in Chicago, 500 people died. The likelihood of that kind of heat wave occurring again is 4 to 6 times greater. Temperatures in the upper latitudes are going to increase more than they will at the equator. It is much

more likely we are going to get those kind of hot and intense heat events. Four of the five hottest years have occurred since 1990.

Senator KERRY. The implications of that are, obviously, significant crop dislocation, significant agricultural costs, and others.

Mr. WIRTH. I was thinking specifically of the health impacts on people living in big cities.

Second is the point that you make, a very good one, related to the drying out of agricultural areas and the changing of our capacity to grow crops. Probably we, in the United States, would adapt pretty well to that with all of the bioengineering that we currently have and our ability to rotate and change crops in agriculture. The impact that that would have on the developing world would be much more serious. This would be at a time when there are already more than a billion out of 5.7 billion people in the world who are living below any kind of level of nutrition.

That is an open invitation to enormous political instability in some very fragile areas of the world, long-term not in our interest.

Third, I would speak to the question of sea level rise. If we continue in the direction in which we are going, all the models suggest that sea level is going to rise somewhere between a foot and 30 inches. The implications of that in the United States——

Senator KERRY. The minimum it would raise is a foot?

Mr. WIRTH [continuing]. A foot.

Senator KERRY. And the minimal rise that we know will happen means what over what period of time?

Mr. WIRTH. That means that by the middle of the next century, we are going to see some very significant dislocations in the Mississippi River Delta, South Florida, the Cape, the areas of the San Francisco Bay, estuaries in San Francisco Bay, and the impacts, in turn, on wetlands, which are remarkable, as you well know, a remarkable source of life all around the world. They will be flooded with sea water, wetlands that are very, very fragile and are the source of life of practically everything. A very large percentage of living things will be inundated.

Senator KERRY. I recently asked for a briefing from our scientists on this and learned something new which I was not aware of. It is that the half life of these gases is such that, even if we were to stop today, what is currently in the atmosphere will result in some 75 years of sort of status quo.

Is that accurate?

Mr. WIRTH. That is at a minimum, 75 years. The carbon dioxide, when it goes up there, stays there for somewhere between 100 and 150 years. So the average of what is up there would be about 75.

Senator KERRY. I understand also that the oceans are critical in the consumption of the carbon dioxide, that a very significant amount of that carbon dioxide in warming is diminished by virtue of ocean consumption. But no one scientifically can tell us at what point you might have sort of a nuclear reaction within the oceans where the capacity to consume the CO_2 is saturated. So, you'll have an exponential increase. Is that accurate?

Mr. WIRTH. This is one of the single most important research issues. We have come to understand a lot in El Niño about ocean currents, ocean temperatures, and the impact that that has. That has been a major breakthrough in the last 5 years.

We hope that continuing research on this effort will give us a much clearer understanding about concentrations of carbon in the oceans, about the conveyor belt, about the cold water that comes from the Arctic and flows underneath the Atlantic and comes back up again as the Gulf Stream. It moves around and that is what allows Europe to exist. The Gulf Stream keeps Europe warm.

If that conveyor belt, for reasons of climate change, for reasons of melting of the ice caps, if that conveyor belt stops, and circulations in the Atlantic stop, Europe is in very, very significant difficulty, as are we.

Senator KERRY. Now historically, the 8,000 or so years that human kind has existed, as we know ourselves to have existed, those 8,000 years measured against what we are learning from the ice core analyses we are making are, in fact, the most tepid period of human existence, as we measure it historically. Isn't that accurate?

Mr. WIRTH. That's true. We have had, for the most part, very favorable weather.

Senator KERRY. And when you measure it against the ice age periods and the great climate swings that we have had, I would assume that a conservative minded, respectful human being would measure those 8,000 years against those other periods and come to a conclusion, as most scientists have, that we are really playing with some very dangerous possibilities here.

Mr. WIRTH. There is a broad school of analysts, Senator Kerry, who look at this from the perspective of a clear national security problem; that the threats to us from this are so significant that we ought to view it in that way and view the kinds of changes that we invest in as, in fact, a kind of insurance policy.

Senator KERRY. Now I gather yesterday or the day before you cited these 2,500 scientists who came together. I know there is some argument about exactly what kind of local impact might occur and the models are not capable of telling you exactly what the cloud cover may or may not do, *et cetera.* But I also take it there is no argument among these scientists about a sort of *de minimis* level of this negative impact which, in and of itself, is—what—catastrophic, or serious? How do you characterize it?

Mr. WIRTH. I think there are two answers. I think there are remaining a handful of scientists who would doubt the science or are critical of the IPCC. The overwhelming 2,500 scientists around the globe, the best of the world's climate scientists from all over the world, participated in the IPCC and came out with the results that I summarized in my testimony. I think the overwhelming evidence is there. We believe that prudent individuals should look at that. That is what the scientific community overwhelming is saying to us. We ought to act and respond to that particular data.

Senator HAGEL. Senator Kerry, I'm sorry to interrupt but we have another panel behind Secretary Wirth. I know he is not going to be disappointed to escape. But I think in the interest of our other panelists, we need to move on. Obviously we will keep the record open.

Senator KERRY. Mr. Chairman, can I just get a couple of things on the record because I think this is very important?

Senator HAGEL. Well, one question, if you would, Senator. It is not fair to the other panelists. I'm sorry you were late. But ask a question and then we can, if it is appropriate, add the rest for the record. These gentlemen have other obligations.

Senator SARBANES. Why don't you give him a couple of minutes more.

Senator HAGEL. Oh, I will. I am going to give him a couple of minutes.

Senator KERRY. Thank you, Mr. Chairman.

Let me sort of jump ahead because I was trying to come through a logical process. We are 10 percent behind or worse of where we promised we were going to be and we are the world's largest greenhouse gas emitter.

Mr. WIRTH. That's true.

Senator KERRY. So when you look at—there are two questions here that are part of the same question, I guess. When you look at the Byrd Resolution and you just read it as a citizen, you say to yourself well, we are spending money, we are asking our citizens to shell out in order to reduce. Now admittedly, we are not reducing at the rate we committed to, which is sort of question No. 1. What are we going to have to do to live up to our part of the bargain?

But question No. 2 is linked to that. Why is it inappropriate, if we are going to put ourselves under that kind of mandate and we are going to ante up to try to do it, to require that, as China comes on line, as Southeast Asia comes on line, as all of these countries do so—I mean, the President has said repeatedly we cannot afford to have them make our mistakes. Absent some sort of required regime, it is hard for common sense to share a notion of how we get from here to there in a shared sacrificial way.

So how would you address Senator Byrd and the country in saying that it is inappropriate for us to try to come to some kind of requirement that they also are going to develop in a way that won't repeat those mistakes and will, in fact, join us on a proportional level or on some level in those reductions?

Mr. WIRTH. Well, at the end of my statement, Senator Kerry, and this was not in the written statement which I delivered this morning, we said that we agree with the analysis in Senator Byrd's resolution. The question is a definition of what the commitments ought to be. What do we do first? That has to be part of this. At what level of development do emerging countries kick in? Do they do that on a per capita basis? Do they do it on an overall basis? Do they do it on a percentage of carbon going into the atmosphere basis? Do we pick 20 countries and say we are the biggest emitters, let's us 20 get together? That has been proposed by some.

It is a matter of definition as to when this trigger kicks in. As Senator Sarbanes has been pursuing, at what point is it binding when it does kick in? That is the single most difficult part of this negotiation, as Senator Byrd and I have discussed and as we have discussed at length this morning. That is the whole thrust of the Byrd Resolution.

Senator KERRY. I wanted to have some time to explore that, obviously. But I think we can do so at other times.

I certainly appreciate your efforts on this. I think you have been doing an outstanding job in giving meaning to this new portfolio and I want to thank you for wrestling with this on our behalf. I think you are one of the great voices on it.

Mr. WIRTH. Thank you very much, Senator Kerry.

Senator Hagel, thank you very much for having us this morning. We would, of course, be delighted to answer any questions which you might have that might be useful.

If I might suggest, maybe on some of these issues if there are sharpened questions or on the thrust of what Senator Sarbanes was asking, we might look at a progression of questions and get together to see if we can make sure we all understand each other, the answers, and what we know and what we don't know.

This issue, as I have stated, Senator Hagel, is the most difficult and long-term probably the most important, next to our own obligations, and I think this hearing has been extraordinarily useful in helping us to publicly air the issue. Now let's take it the next step and see what we can do in terms of making sure we understand a lot better the specifics.

We would look forward to doing that then. At your request we would be happy to do so.

Senator HAGEL. We will have ample opportunity, Mr. Secretary, to talk about this. I am very appreciative of your time. You have put a lot of effort in this and answered our questions.

One other thing. I think we should leave with this thought.

Senator Kerry, I don't know if you had an opportunity to listen to Senator Byrd this morning or Congressman Dingell and others who have been exchanging ideas and views with Secretary Wirth, but we are all in agreement that, first, this is a tough issue. Second, we are in agreement that we must address it. Obviously, that is why we are holding this series of hearings; to find the best way to do that.

Mr. Secretary, thank you.

Mr. WIRTH. Thank you very much, Mr. Chairman, Senator Sarbanes, Senator Kerry. Thank you.

Senator HAGEL. If the next panel would come forward, we will get started.

Gentlemen, welcome. Let me appropriately introduce you and then we will get started.

First is Mr. Richard L. Trumka, Secretary-Treasurer of the AFL–CIO. Mr. Trumka, welcome. It is a pleasure to have you with us. We appreciate it very much.

Also we have Mr. Bryce Neidig, President of the Nebraska Farm Bureau Federation from a state I have heard a couple of things about, Nebraska.

It is nice to see you, Mr. Neidig.

Also we have Mr. Kevin Fay, Executive Director of the International Climate Change Partnership, Arlington, Virginia.

Mr. Fay, I appreciate very much you taking your time today to come and exchange views with us on this subject.

Again, on behalf of the committee, welcome. Mr. Trumka, would you like to begin.

STATEMENT OF RICHARD L. TRUMKA, SECRETARY-TREASURER, AMERICAN FEDERATION OF LABOR AND CONGRESS OF INDUSTRIAL ORGANIZATIONS, WASHINGTON, DC

Mr. TRUMKA. Thank you, Mr. Chairman, and thank you for the opportunity to testify on the ongoing multilateral negotiations regarding global climate change. This issue is of great importance to the AFL–CIO because the course of these negotiations can have profound effects on the job security and incomes of American workers and the welfare and lifestyle of American families.

AFL–CIO members and their families are concerned about the environment. We share with all Americans a deep desire to leave our children and grandchildren a safe and secure environment, and we are ready to work with you and the administration to insure that these negotiations succeed in meeting these goals.

The administration is now engaged in an effort to negotiate a treaty to mitigate the effects of carbon dioxide emissions on the Earth's climate. At the February 1997 Executive Council meeting of the AFL–CIO, we issued a statement which points out that a treaty will not be effective if it excludes China, India, Mexico, and other developing nations.

Our statement says specifically that the exclusion of new commitments by developing nations under the Berlin Mandate will create a powerful incentive for trans-national corporations to export jobs, capital, and pollution and will do little or nothing to stabilize atmospheric concentrations of carbon. Such an uneven playing field will cause the loss of high paying U.S. jobs in the mining, manufacturing, transport and other sectors.

Although much remains to be decided before December, Mr. Chairman, we are concerned that the United States has already agreed to a very dangerous principle that now governs the rest of the negotiations. At U.N. talks in Berlin in 1995, the U.S. agreed to what has become known as the Berlin Mandate, which says that only Annex I countries would have to meet legally binding targets for their greenhouse gas emissions. Other countries, from impoverished developing nations like those in much of Africa, to the fast growing economies of Southeast Asia, to China and Mexico would have no binding limits on their emissions.

With rapid industrialization, the countries with no requirements will soon be responsible for well over half the planet's greenhouse gas emissions, and with no emissions reductions to meet, these countries will attract foreign businesses like a magnet.

While no firm decisions have been made regarding domestic reduction policies, all of the mechanisms under discussion would have the same impact, that is, a sharp rise in energy prices resulting in significant economic dislocation. For example, a carbon tax or carbon permit price of $100 per ton of carbon is equivalent to a price increase of 26 cents per gallon of gasoline, $1.50 per thousand cubic feet of natural gas, a $52 per ton increase in coal, and 2 cents per kilowatt hour of electricity. These are the minimum levels of energy increases, price increases, for a policy to stabilize U.S. carbon emissions at 1990 levels.

Several studies have been done to estimate the impact of a treaty on the economy. A range of estimates exists, but even the most con-

servative estimate shows a large job loss as a result of policies to reduce emissions.

According to a 1992 study by the U.S. Department of Commerce, a carbon tax to help the U.S. achieve emission reductions of a scale now being discussed in the U.N. would cost some 1.7 million U.S. industrial jobs.

More recently, the administration has conducted two studies estimating the economic impact of meeting emission reduction targets. The first was released in June 1996 and the second is currently in draft form, dated June 1997.

The 1997 study makes new assumptions which reduce the estimated loss of production or GDP and implicit job losses by roughly one-half the expected GDP reductions estimated in the analysis a year before. The new assumptions also accelerate the economy's bounce-back by several years. In general, under the 1997 study, estimated GDP losses are assumed to be one-half of what they assumed in 1996 and the bounce-back occurs in half the time.

Nevertheless, even with those new assumptions, the administration draft study shows that 900,000 jobs could be lost as a result of climate change policies. Jobs will be lost in nearly every region of the country and across a broad range of sectors. The job loss estimate should be regarded as very conservative, Mr. Chairman. A much more realistic estimate of the impacts of stabilization at 1990 levels would be in the order of 1.25 to 1.5 million jobs, with even larger job losses to achieve a reduction level below 1990 levels.

You will recall that the proposal right now from the European Community is to reduce below 1990 levels an additional 15 percent by the year 2010.

The 1997 administration study does not attempt to measure the impact of the job loss to our international competitors who are not subject to emission limitations requirements. This is a crucial matter for jobs and incomes which the administration must address.

The administration and its consultants expect that natural gas will displace coal in increasing quantities. The DRI model used by the administration indicates that 57 percent of all emission reductions by 2010 and in the stabilization case would result from a reduced demand for coal. That would increase to 65 percent by 2020.

Energy intensive industries would be most hurt by rising energy prices. Chemicals, refining, aluminum, paper, cement, and steel are included in the list of industries that would suffer the most serious job loss due to energy price increases. The jobs in production would not disappear. They would simply move overseas.

The rising energy crisis would place U.S. industry at a competitive disadvantage. As energy prices rise to meet more stringent targets, jobs will move to countries that are non-Annex I countries that do not have to meet those targets. Carbon dioxide emissions as well as jobs and incomes will move. Ironically, in those industries where jobs move, emissions of carbon dioxide as well as other air and water pollutants are likely to rise since the industries in the U.S. must already meet more stringent environmental standards than our competitors.

Both the target concentration level and the timetable for meeting these levels are still to be negotiated. These are crucial decisions and must be carefully considered. A rush to judgment in Kyoto

could result in long-term damage to our economy yet produce little or no environmental benefit.

Two basic principles must guide our approach in these negotiations. First, all countries of the world must be included in emission limitations. Emissions in China alone are growing rapidly enough to increase carbon dioxide concentrations in the atmosphere. Even if all other countries were to reduce their emissions, emissions of China and India will ultimately dwarf the emissions of the U.S. as industrialization proceeds because of their much larger populations.

Second, emission reductions must not proceed in a manner or a timetable that causes severe damage to the U.S. economy. Jobs and incomes must be protected and adverse effects on our international competitiveness must be avoided.

The current approach in the U.N. negotiations is fatally flawed, Mr. Chairman. It does not meet the requirements of equity or environmental effectiveness. It requires a very large *de facto* energy tax, the transfer of a large chunk of our industrial base overseas, and at the end of the day does little or nothing to improve the prospects for a better climatic future.

Mr. Chairman, the AFL–CIO is ready to work with you and your colleagues to develop tools to address climate change in ways that are equitable and genuinely deal with the problems. Global warming is a global problem and our response must involve the entire international community.

Thank you, Mr. Chairman.

Senator HAGEL. Mr. Trumka, thank you very much.

We will listen to the remainder of the panel and then come back with a round of questions. Thank you. Mr. Neidig.

STATEMENT OF BRYCE NEIDIG, PRESIDENT, NEBRASKA FARM BUREAU FEDERATION, LINCOLN, NEBRASKA

Mr. NEIDIG. Thank you, Mr. Chairman. My name is Bryce Neidig. I am a farmer and President of the Nebraska Farm Bureau Federation and a member of the board of directors of the American Farm Bureau Federation, which I represent today.

My family owns and I operate, with my son, a 650 acre corn, soybean, and alfalfa farm in northeastern Nebraska, near the town of Madison. To give some credibility about my being a farmer, I live in the house I was born in, the same house my father was born in. My grand kids think I came with the place but I didn't. It has been in the family 105 years.

I am very concerned that the International Agreement on Climate Change will hurt my farm operation and others like it across the Nation.

I appreciate this opportunity to discuss a subject that practically every farmer is an expert on—the weather. Experts or not, they complain about it. It rains too much or to little. It's too cold or too hot, and frost threatens the harvest. We are interested in the weather because our livelihood depends on it.

Farmers who are aware of the climate change treaty are also concerned about controls which may be imposed on the farm to reduce greenhouse gas emissions. They are concerned about higher costs for fuel, energy, vehicles, and equipment. They are concerned

about new, burdensome regulations. They are concerned about threats to their competitiveness in world markets where they now must export about one-third of the crops they grow.

Farmers are aware that in the last decade or so there has been considerable discussion by some scientists that greenhouse gases, carbon dioxide, methane, and nitrous oxide, are contributing to increases in average global temperatures that could cause adverse changes in the world's climate. We know that there is some data to show that there are increases in greenhouse gases, but believe there is still a legitimate debate about the magnitude of those changes, their significance, and the relative contribution of natural versus human causes, including agricultural production.

Many farmers who have followed this important issue believe that the administration is acting hastily and prematurely in leading international efforts for immediate, legally binding and enforceable caps on greenhouse gas emissions. We don't know enough about the problem or even if we have a problem. We don't know about agriculture's contribution to the problem or the solution. We don't know what practices or programs farmers are likely to encounter as a result of an international agreement. To put it simply, most farmers familiar with the climate treaty are less concerned with the illness than they are with the cure that is being prescribed for them.

The administration's proposal will restrict farming practices. Farmers like to think of themselves as good guys. But we are being portrayed as villains when it comes to greenhouse gases. Our own Environmental Protection Agency blames agriculture for about 33 percent of total methane emissions and up to 46 percent of the nitrous oxide generated from human activity in the United States. Led by our own administration, international negotiators are pressing for strict, binding limits on these emissions.

If such limits are adopted, the U.S. would be forced to consider drastic policies to meet those legally enforceable reductions. New taxes on fuel and fertilizer, forced mileage requirements for light trucks and other motor vehicles, controls on planting, cultivation, and harvesting practices, and limits on the number of livestock per acre have all been proposed and may become regulatory policy here in the U.S.

Farms like mine would not only be severely disrupted but could be put out of business.

Restrictions on planting, cultivation and harvesting would interfere with my farm management plans which are designed to reduce my production costs, maximize yields and conserve my farmland. For example, prescriptive crop practices to reduce greenhouse gas emissions may not be compatible with my current personal crop rotation practices. My current production management programs, which reduce pesticide use through intelligence rotation, could also be jeopardized.

Fuel and energy cost increases resulting from the treaty could deal farmers an especially heavy blow. The American Petroleum Institute estimates that the climate agreement proposal could increase prices for gasoline, diesel fuel and electricity by 50 percent or more, depending on the emission targets which are prescribed.

Personally, in the last roughly 5 years in my farm operation, we have reduced the use of our fuel consumption by about two-thirds. We have gone to almost completely no-till. I cannot do that anymore. There is no further way that I can go unless I can find some other way to pull a corn planter through the field. So we have already done that, basically, in agriculture.

Cost estimates by the administration have been lower, but the U.S. Department of Commerce has recently agreed that capping carbon dioxide emissions at 1990 levels requires the equivalent of a 25 cent per gallon gas tax. Fuel cost increases, even at those levels, would be a big hardship on U.S. farmers. That is why the Farm Bureau fought hard several years ago for defeat of the BTU tax. We are concerned that the Climate Change Treaty may provide an opportunity to resurrect the BTU tax under a different name but with the same results.

Fuel and energy are major production costs on my farm. We use 2,600 gallons of gasoline yearly—and these are approximate figures—as well as 3,800 gallons of diesel fuel, and if you have a printed copy of my statement, there was an error in the zero. We use approximately 17,000 gallons of propane in an average year. That covers irrigation, engines, and drying, crop drying. Depending on weather conditions, we will also use up to $4,000 in electricity for crop drying in the fall.

Ours is a medium sized family farm, typical of farms in Nebraska and the Midwest. A 50 percent or even 25 cent per gallon increase in my fuel costs would be a very significant cost of production, which could not be passed on in the commodities I produce.

Critics ignore farmers' positive role in reducing greenhouse gas emissions. I have already mentioned my own case about going no-till and drastically reducing the amount of fossil fuel used. According to some scientists, agricultural cropland here in the U.S. may be a net "sink" for carbon dioxide because of the carbon sequestered by plants through photosynthesis. Little recognition is given to advances in agricultural practices, conservation and energy efficiency by farmers, particularly here in the U.S.

U.S. farmers have significantly improved their efficiency and reduced their use of fuel and fertilizer. They have dramatically increased their use of conservation practices.

Last year, 61 percent of U.S. croplands utilized conservation tillage or reduced management practices which incorporate plant residue and carbon in the soil, reduce trips over the land, and conserve fuel.

Most importantly, agriculture's critics in the climate change debate have focused on agriculture's contribution to greenhouse gases and overlooked agriculture's most important role—feeding and clothing a growing, hungry world. Little, if any, consideration has been given to the climate agreement's impact on our ability to meet future world demand for food and fiber.

The administration's proposal commits the U.S. and other developed countries to specific, legally binding, enforceable emissions reductions forcing higher production costs on U.S. farmers. It sets no binding requirements for developing countries, some of which are our strongest competitors for world markets of agricultural commodities. Some of these developing countries already have lower

labor and production costs and would be given a new, major competitive advantage.

The proposal makes no sense from an environmental or an economic standpoint. By the administration's own projections, carbon dioxide emission increases from developing countries will far outpace those of the United States or other developed nations.

By forcing compliance of developed countries only, we fail to invest our efforts where they will achieve the greatest emissions reductions. In the process, we place U.S. farmers at a competitive disadvantage and make them easy prey in the new world of free trade and market oriented farm programs.

Mr. Chairman, we especially appreciate the leadership provided by Senator Byrd and yourself in introducing last week Senate Resolution 98, which now has more than, as you said this morning, 60 co-sponsors. This resolution will go a long way in helping to assure that agriculture and other economic interests are considered in full.

We hope that it is not overlooked as the administration proceeds with the agreement.

The administration should fully explore methods to reduce greenhouse gas emissions with the least possible disruption to U.S. agriculture. If controls on agriculture are justified, they should be accomplished voluntarily.

Until Farm Bureau and other agricultural groups formally expressed our concerns to the administration, there was no effort to seek our involvement and input before international negotiations. If agriculture is a major contributor to greenhouse gas emissions, as the administration claims, then it is appropriate that the administration seek a full and open debate with agricultural producers, leaders, and organizations. These efforts must include agricultural policymakers within the House and Senate Committees on Agriculture, the Congress, and USDA.

The administration must not accept the final agreement without a full and open public debate which includes agriculture and minimizes the negative impact on agricultural producers.

We thank you for this opportunity to present our concerns.

Thank you, Senator Hagel.

[The prepared statement of Mr. Neidig follows:]

PREPARED STATEMENT OF BRYCE NEIDIG

Thank you. Mr. Chairman, my name is Bruce Neidig. I am a farmer and President of the Nebraska Farm Bureau Federation and a member of the board of directors of the American Farm Bureau Federation which I represent today.

My family owns and I operate, with my son, a 600-acre corn, soybean and alfalfa farm in northeastern Nebraska near the town of Madison. I am very concerned that the international agreement on climate change will hurt my farm operation and others like it across the nation.

Climate change policy is controversial—drastic action proposed by the administration is not justified

I appreciate this opportunity to discuss a subject that practically every farmer is an expert on the weather. Those farmers that aren't experts complain about it. It rains too much or too little, it's too cold or too hot or frost threatens the harvest. We're interested in the weather because our livelihood depends on it.

Farmers are interested in climate change for the same reason. We are willing to consider scientific evidence that human activities, including our own, may lead to increased concentrations of greenhouse gases, higher global temperatures and extreme weather events.

Farmers who are aware of the climate change treaty are also concerned about controls which may be imposed on the farm to reduce greenhouse gas emissions. They're concerned about higher costs for fuel, energy, vehicles and equipment. They're concerned about new, burdensome regulations. They're concerned about threats to their competitiveness in world markets to where they now must export about one third of the crops they grow.

Some farmers are aware that in the last decade or so, there has been considerable discussion by some scientists that greenhouse gases (carbon dioxide, methane and nitrous oxide) are contributing to increases in average global temperatures that could cause adverse changes in the world's climate. We know there is some data to show increases in greenhouse gases but believe there is still a legitimate debate about the magnitude of those changes, their significance and the relative contribution of natural versus human causes, including agricultural production.

Many farmers who have followed this important issue believe that the Administration is acting, hastily and prematurely in leading international efforts for immediate legally binding and enforceable caps on greenhouse gas emissions. We don't know enough about the problem or if we have a problem. We don't know about agriculture's contribution to the problem or even to the solution. We don't know what practices or programs farmers are likely to encounter as a result of an international agreement. To put it simply, most farmers familiar with the climate treaty are less concerned with the illness than they are with the cure that's being prescribed for them.

The administration's proposal will restrict farming practices, disrupt livestock and crop production and increase farm energy costs

Farmers like to think of themselves as good guys, but we're being portrayed as villains when it comes to greenhouse gases. International and U.S. regulators tell us we are contributors to human-caused greenhouse gas emissions. Cattle and sheep produce methane. Crop tillage produces both methane and carbon dioxide. Nitrous oxide comes from fertilizer and the burning of crop residue.

The regulators tell us that we're more than contributors, we're major contributors. According to the United Nations Intergovernmental Panel on Climate Change, one-fourth of the world's greenhouse gases come from agricultural activity. Our own Environmental Protection Agency blames agriculture for more than 40 percent of total methane emissions and 90 percent of the nitrous oxide generated from human activity in the U.S.

Lead by our own Administration, international negotiators are pressing for strict, binding limits on these emissions. If such limits are adopted, the U.S. will be forced to consider drastic policies to meet those legally enforceable reductions. New taxes on fuel and fertilizer, forced mileage requirements for light trucks and other motor vehicles, controls on planting, cultivation and harvesting practices and limits on the number of livestock per acre have all been proposed and may become regulatory policy here in the U.S.

Farms like mine could be severely disrupted. Restrictions on planting, cultivation and harvesting would interfere with my farm management plans which are designed to reduce my production costs, maximize yields and conserve my farmland. For example, prescriptive crop practices to reduce greenhouse gas emissions may not be compatible with my current crop rotation practices. My integrated pest management programs, which reduce pesticide use through the tillage and crop rotation, could also be jeopardized.

Fuel and energy and cost increases resulting from the treaty could deal farmers an especially heavy blow. The American Petroleum Institute estimates that the climate agreement could increase prices for gasoline, diesel fuel and electricity by 50 per cent or more, depending on the emission targets which are prescribed. Cost estimates by the Administration have been lower, but the U.S. Commerce Department recently agreed that capping carbon dioxide emissions at 1990 levels requires the equivalent of a 25 cent gas tax. Fuel cost increases, even at these levels, would be a big hardship to U.S. farmers. That's why Farm Bureau fought hard several years ago for defeat of the B.T.U. tax. We're concerned that the Climate Change Treaty may provide an opportunity to resurrect the B.T.U. tax under a different name, but with the same results. You might say that its a back-door B.T.U. tax.

Fuel and energy are major production costs on my farm. We use 2,600 gallons of gasoline, 3,800 gallons of diesel and 1,700 gallons of propane in an average year. Depending on weather conditions, we also will use up to $4,000 in electricity for crop drying in the fall. Ours is a medium-sized, family farm typical of farms in Nebraska and the Midwest. A 50 percent or even 25 cents per gallon increase in my fuel cost would be a very significant new cost of production which could not be passed on in the commodities I produce.

Agriculture's positive contribution in controlling emissions is not being considered

Our critics ignore farmers' positive role in reducing greenhouse gas emissions. According to some scientists, agricultural cropland here in the U.S. may be a net "sink" for carbon dioxide because of the carbon sequestered by plants through photosynthesis. Little recognition is given to advances in agricultural practices, conservation and energy efficiency by farmers, particularly here in the U.S.

U.S. farmers have significantly improved their efficiency and reduced their use of fuel and fertilizer. They have dramatically increased their use of conservation practices. Last year 61 percent of U.S. croplands utilized conservation tillage or residue management practices which incorporate plant residue and carbon in the soil, reduce trips over the land and conserve fuel.

Most important, agriculture's critics in the climate change debate have focused on agriculture's contribution to greenhouse gases and overlooked agriculture's most important role--feeding, and clothing a growing, hungry world. Little, if any consideration has been given to the climate agreement's impact on our ability to meet future world demand for food and fiber.

The administration's proposal would disadvantage U.S. agricultural producers in world trade.

The Administration proposal commits the U.S. and other developed countries to specific, legally binding, and enforceable emission reductions, forcing higher production costs on U.S. farmers. It sets no binding requirements for developing countries, some of which are our strongest competitors for world markets of agricultural commodities. Countries exempt from controls include China, South Korea, Chile and Argentina. Some of these developing countries already have lower labor and production costs and would be given a new, major competitive advantage.

The proposal makes no sense from an environmental or an economic standpoint. By the Administration's own projections, carbon dioxide emission increases from developing, countries will far out pace those of the United States or other developed nations. By forcing compliance of developed countries only, we fail to invest our efforts where they will achieve the greatest emissions reductions. In the process, we place U.S. farmers at a competitive disadvantage and make them easy prey in the new world of free trade and market-oriented farm programs.

Agricultural's concerns have been strongly expressed to the administration, with negligible results

Last November Farm Bureau and 17 other national farm organizations expressed strong concerns to President Clinton relating to the climate change agreement and its impact on agriculture. Although we have received assurances from the Administration that the agreement will provide maximum flexibility and opportunity for U.S. farmers, the Administration's response does not reduce our concern.

We are greatly appreciative of the efforts of the Senate Agriculture and Natural Resources Committee in reinforcing our concerns. This March, Chairman Lugar and a bipartisan group of 13 members of his committee requested an analysis by the Administration of the following: the potential effect of climate change on agriculture; estimated emissions and sequestration of greenhouse gasses by U.S. agriculture; actions or controls likely to be implemented; and the resulting economic impact on U.S. farmers and ranchers.

Although the Administration has not yet provided this information to us, it is essential that it become available soon, in advance of August treaty negotiations in Bonn and the final agreement scheduled this December for Kyoto.

Mr. Chairman, we especially appreciate the leadership provided by Senator Byrd and yourself in introducing last week Senate Resolution 98, which now has more than 50 co-sponsors. This resolution will go a long way in helping to assure that agriculture and other economic interests are considered in full. We hope that it is not overlooked as the Administration proceeds with the agreement.

In addition to information and analysis requested by the Senate Agriculture Committee and S.R. 98, Farm Bureau supports the following administrative or legislative action relating to the climate agreement. Also supporting these actions are 17 other farm organizations which cosigned this request to President Clinton and the Administration.

The administration should withdraw support for legally binding and enforceable caps on greenhouse gases

The Administration should fully explore methods to reduce greenhouse gas emissions with the least possible disruption to U.S. agriculture. If controls on agriculture are justified, they should be accomplished voluntarily.

There must be a full and informed public debate which involves agriculture and agricultural policy makers

Until Farm Bureau and other agricultural groups formally expressed our concerns to the administration, there was no effort to seek our involvement and input before international negotiations. If agriculture is a major contributor to greenhouse gas emissions, as the Administration claims, then it is appropriate that the Administration seek a full and open debate with agricultural producers, leaders and organizations. These efforts must include agricultural policy makers within House and Senate committees on agriculture, the Congress and USDA.

The final climate change agreement scheduled for completion this December in Kyoto, Japan should be delayed

The Administration must not accept a final agreement without a full and open public debate which includes agriculture and minimizes the negative impact on agricultural producers.

Thank you for this opportunity to present agriculture's concerns with the climate chance agreement.

[See appendix for additional material submitted by Mr. Neidig.]

Senator HAGEL. Mr. Neidig, thank you very much. Mr. Fay.

STATEMENT OF KEVIN J. FAY, EXECUTIVE DIRECTOR, INTERNATIONAL CLIMATE CHANGE PARTNERSHIP, ARLINGTON, VIRGINIA

Mr. FAY. Thank you, Mr. Chairman.

My name is Kevin Fay. I serve as the Executive Director of the International Climate Change Partnership. We are a coalition of U.S. industry representatives and associations as well as international associations interested in the policy development process with respect to global climate change. We appreciate the opportunity to be here this morning.

ICCP continues to recognize the climate change issue as an important matter with which government should be concerned. However, it is a very long-term issue and extraordinarily complex, both in its underlying science and its entanglement with the very foundations of the global economic structure.

We have just recently communicated our views on the issues in the Kyoto negotiations to the administration. I am attaching this correspondence to my testimony and ask that it be included in the record.

We have also communicated to the President on the issue of the administration's as yet unreleased economic analysis, expressing our frustration at their lack of communication on the matters of greatest concern to the private sector, namely, the potential economic impacts of a climate change agreement and the current thinking of future implementation scenarios. This letter is also attached and we ask that it be included for the record.

Our views have been based on the premise that the only agreement that is acceptable is one that is comprehensive and can work with flexibility, maintain national sovereignty, ensure participation by all countries, maintain a competitive, level playing field, and is guided by effective science and includes a long-term objective that will guide future policy-makers as well as future negotiators.

This agreement must continue to balance our need for economic growth and to attain the desired environmental progress.

You will note that in both letters, we urge the President and the State Department to use the opportunities of the upcoming G–8 meeting and the United Nations General Assembly Special Session

on the Environment to reiterate to our negotiating partners that the U.S. policy framework enunciated last July is the only framework that can provide a climate change agreement that is both environmentally beneficial and economically feasible.

Since prior to the first meeting of the parties in Berlin, we have consistently argued that the time is not yet right for a climate change agreement. Unfortunately, the parties established an artificial deadline under the Berlin Mandate to reach an agreement at COP–3, now scheduled to be held in December of this year at Kyoto.

In our view, the administration did make progress in its own deliberations and offered a thoughtful policy framework at COP–2, which we have heard about here today. This policy outline includes a comprehensive approach, identification of a long-term objective, identification of the developing country role under the treaty, implementation flexibility through emissions trading, banking, and joint implementation; and avoidance of a laundry list of so-called "policies and measures."

The U.S. framework also included a call for a binding commitment which the administration has subsequently defined as an emissions budget period of undetermined length to achieve reductions of an undetermined size. While most of the attention has been focused on this part of the discussions, we continue to believe that it is not the only key to a successful treaty agreement in Kyoto or after Kyoto.

We should point out at this time, however, that we have been provided with no analysis to justify any particular target or timetable that might be advocated.

Our primary concern has been that the result of the negotiations would focus on only one or two of these key issues, some of which we have outlined in our letter, and that the rest would be left until later. This would be unacceptable to us. The worst result would be for the administration to agree to some target and not achieve the entire policy framework it has advocated.

We have heard testimony today on the Byrd-Hagel Resolution, and we commend the Senators, including you, Mr. Chairman, for raising the important issue of requiring an agreement that includes developing country commitments. We believe very strongly in this principle. We have concerns, however, that just as some have focused only on identifying a target or timetable as an acceptable Kyoto outcome, others may focus on only one or another of the remainder of these key issues we have identified.

An agreement on a target and timetable in Kyoto and nothing else would be unacceptable to the ICCP. An agreement in Kyoto on a target and timetable, including a developing country schedule but with none of the flexibility or other provisions as articulated last year by the administration, would be just as unacceptable.

To date, we have been disappointed in the progress on most of these fronts. We are pessimistic on the ability to successfully resolve them between now and Kyoto absent strong signals by the White House to reinvigorate the climate change negotiations.

ICCP is not and never has been interested in an agreement at the Kyoto meeting just for the sake of reaching an agreement. This view will not change.

With respect to the economic issues and the impacts of a climate change agreement on the U.S. economy, jobs, and the environment, we remain very concerned. It is difficult to address this issue in any effective way given the lack of dialog on these topics and the lack of information being provided by the administration.

We do know that the economic analysis that has been performed not only by the administration but by several others, tells us several important things—that there are costs involved in reducing greenhouse gas emissions; that the costs are likely to be reduced if the flexibility provisions that have been proposed are incorporated; that you cannot achieve any reasonable goals, either environmentally or economically, without developing country participation; and, last, that the costs are less if you avoid premature capital retirement or turnover and provide industry the opportunity to manage our way into the technological innovation that will be necessary to accomplish whatever long-term goals established by the parties to the convention.

It is difficult to know how the costs compare to the benefits because we also have yet to see any analysis that includes the benefits of mitigating climate change or facilitating adaptation strategies.

In order for there to be an effective treaty, we believe that the parties must first get the treaty structure correct. We have a long way to go before that will happen.

Our companies have determined that the current state of scientific understanding requires a prudent, long-term approach to address this issue. This view is equally applicable to the negotiations themselves.

We cannot support a treaty at any cost, nor can we support a treaty that is incomplete. In your monitoring of the progress of the negotiations and your consideration of its outcome, we urge you to use our list of key issues as a checklist of the administration's effort in this regard.

We appreciate the opportunity to appear before you today and look forward to answering your questions.

Thank you.

[The prepared statement and attachments of Mr. Fay follow:]

PREPARED STATEMENT OF KEVIN J. FAY

Good Morning, Mr. Chairman and members of the Committee. My name is Kevin Fay; and I serve as the Executive Director of the International Climate Change Partnership (ICCP), a coalition of U.S. industry representatives and associations, as well as international associations, interested in the policy development process with respect to global climate change. We appreciate the opportunity to appear before the Subcommittee today on the subject of a global climate change convention.

ICCP was organized in 1991 to provide a forum to address the issue of global climate change and to be a constructive participant in the policy debate. Six months before the Third Conference of Parties meeting in Kyoto, the issue has certainly raised the interest of many of us in the private sector and the Congress.

ICCP continues to recognize the climate change issue as an important matter with which governments should be concerned. However, it is a very long-term issue and extraordinarily complex in both its underlying science and its entanglement with the very foundations of the global economic structure.

We have just recently communicated our views on the key issues in the Kyoto negotiations to the Administration. I am attaching this correspondence to my testimony and ask that it be included in the record. We have also communicated to the President on the issue of the Administration's as yet unreleased economic analysis, expressing our frustration at their lack of communication on the matters of greatest

concern to the private sector--namely the potential economic impacts of a climate change agreement and the current thinking of future implementation scenarios. This letter is also attached.

Our views have been based on the premise that the only agreement that is acceptable is one that is comprehensive and can work with flexibility, maintain national sovereignty, ensure participation by all countries, maintain a competitive level playing field, and is guided by effective science and includes a long-term objective that will guide future policymakers and future negotiators.

You will note that in both letters, we urge the President and the State Department to use the opportunities of the upcoming G–8 meeting and the United Nations General Assembly special session on the environment to reiterate to our negotiating partners that the U.S. policy framework enunciated last July is the only framework that can provide a climate change agreement that is both environmentally beneficial and economically feasible.

Since prior to the first meeting of the parties in Berlin, we have consistently argued that the time is not yet right for a climate change agreement. Unfortunately, the parties established an artificial deadline under the Berlin mandate to reach an agreement at COP-3, now scheduled to be held in December of this year.

In our view the Administration made progress in its own deliberations and offered a thoughtful policy framework at COP-2 which we have heard about here today. This policy outline includes a comprehensive approach; identification of a long-term objective; identification of a developing country role under the treaty; implementation flexibility through emissions trading, banking, and joint implementation; and avoidance of a laundry list of so-called "policies & measures."

The U.S. framework also included a call for a binding continent, which the Administration has subsequently defined as an emissions budget period of undetermined length to achieve reductions of an undetermined size. While most of the attention has been focused on this part of the discussions, we continue to believe that it is not the only key to a successful treaty agreement in Kyoto or beyond Kyoto.I11We should point out at this time, however, that we have been provided with no analysis to justify any particular target or timetable that might be advocated.

Our primary concern has been that the result of the negotiations would focus on only one or two of the key issues, some of which we have outlined in our letter, and that the rest would be left until later. This would be unacceptable to us. This worst result would be for the Administration to agree to some target and not achieve the entire policy framework it has advocated.

We have heard testimony today on the Byrd-Hagel Resolution, and we commend the Senators for raising the important issue of requiring an agreement that includes developing country commitments. We believe very strongly in this principle. We have concerns, however, that just as some have focused only on identifying a target or timetable as an acceptable Kyoto outcome, others may focus on only one or another of the remainder of these key issues we have identified.

An agreement on a target and timetable in Kyoto, and nothing else, would be unacceptable to the ICCP. An agreement in Kyoto on a target and timetable, including a developing country schedule, but with none of the flexibility or other provisions as articulated last year by the Administration, would be just as unacceptable.

To date, we have been disappointed in the progress on most of these fronts and we are pessimistic on the ability to achieve them between now and Kyoto absent strong signals by the White House to reinvigorate the negotiations. ICCP is not and never has been interested in an agreement at the Kyoto meeting just for the sake of reaching an agreement. This view will not change.

With respect to the economic issues and the impacts of a climate change agreement on the U.S. economy, jobs, and the environment we remain very concerned. It is difficult to address this issue in any effective way given the lack of dialogue on these topics and the lack of information being provided by the Administration. We know that the economic analysis that has been performed tells us several important things:

- that there are costs involved in reducing greenhouse gas emissions;
- the costs are likely to be reduced if flexibility provisions are incorporated;
- that you cannot achieve any reasonable goals either environmentally or economically without developing country participation; and
- the costs are less if you avoid premature capital retirement or turnover, and provide industry the opportunity to manage their way into the technological innovation that will be necessary to accomplish whatever long-term goal is established by the parties to the convention.

It is difficult to know how the costs compare to the benefits because we have yet to see any analysis that includes the benefits of mitigating climate change or facilitating adaptation strategies.

In order for there to be an effective treaty, we believe that the parties must first get the treaty structure correct. We have a long way to go before that will happen.

Our companies have determined that the current state of scientific understanding requires a prudent long-term approach to address this issue. This view is equally applicable to the negotiations themselves.

We appreciate the opportunity to appear before you today, and we look forward to answering your questions.

INTERNATIONAL CLIMATE CHANGE PARTNERSHIP,
June 6, 1997.

PRESIDENT WILLIAM CLINTON
The White House,
Washington, D.C. 20500

DEAR MR. PRESIDENT: On behalf of the International Climate Change Partnership, I am writing to express our concern for the status of the economic analysis for purposes of the international negotiations on climate change and the apparent lack of progress in making the economic issues an integral part of these negotiations. The ICCP is a coalition of companies and industries around the world committed to responsible participation in the climate change policy process.

ICCP continues to recognize the climate change issue as an important issue with which governments should be concerned. However, it is a very long-term issue and extraordinarily complex in both its underlying science and in its entanglement with the very foundations of the global economic structure. ICCP commended the U.S. position enunciated in its statement in July of last year as a reasonable framework, and was particularly supportive of its efforts to give the negotiations greater focus on the long-term character of the issue and its economic implications.

It is disturbing to us that, for nearly one year, there has been little public discussion of the economic impacts of the range of proposed climate change mitigation strategies by any of the parties, including the United States.

The Administration had promised the results of its economic analysis to the Congress, its negotiating partners, the private sector and the nongovernmental organizations. While we applaud the recognition of the need to peer review this work, the slow pace at which this activity is occurring raises concerns that it is either not being seriously pursued, or that the results are not being shared. Neither of these reasons, if true, bodes well for constructive private sector support of the Administration's efforts or for any result produced from the Third Conference of Parties meeting to be held later this year in Kyoto.

This matter is further complicated by the recent resignation of Under Secretary of Commerce Ehrlich, who was coordinating the analytical effort. His departure suggests a possible further loss of momentum on this important effort at a critical time.

Those who may be able to provide constructive input into the analysis and assessment being pursued by the Administration wonder what must be done to understand how specific industry sectors are being examined and what steps are being contemplated in order to pursue your climate protection goals. At a minimum, the Administration should be able to immediately publish the policy assumptions being used for individual sectors.

In addition, aside from frequent references to implementation of flexible, market-based approaches, there has been little discussion of what may be suggested as implementation steps for a Kyoto agreement. Failure to discuss some of these issues in advance will likely make it difficult to build support for ratification of the international agreement and for development of implementing legislation.

We respectfully urge you, the Administration, to provide an outline of the economic information and policy considerations, as well as a meaningful time frame for the release of this information. Finally, we understand that you are preparing to attend the meetings of the G–7 and the United Nations General Assembly Special Session on the Environment. We urge you to reiterate the United States' support for these key economic issues as critical elements of any future agreement on cli-

mate change. It is only with these key policy provisions that we will have a climate change agreement that is both environmentally beneficial and economically feasible.

Sincerely,

KEVIN J. FAY,
Executive Director.

INTERNATIONAL CLIMATE CHANGE PARTNERSHIP,
June 6, 1997.

THE HONORABLE TIMOTHY WIRTH
Under Secretary of State for Global Affairs,
Department of State,
Washington, DC 20520.

DEAR MR. WIRTH: You have requested our views on specific issues under consideration as part of the negotiations on implementation of the Berlin Mandate for a possible protocol or other legal instrument to the Framework Convention on Climate Change. We are pleased to provide these comments on specific issues of concern to the members of the International Climate Change Partnership (ICCP) with respect to the treaty negotiations. We are also writing, however, to express our concern with the current lack of focus to the negotiations or linkage of these issues with the important relationship between the international treaty and domestic implementation schemes.

ICCP continues to recognize the climate change issue as an important matter with which governments should be concerned. However, it is a very long-term issue and extraordinarily complex in both its underlying science and its inextricable entanglement with the very foundations of the global economic structure. We are concerned that this complexity is exposing an overly ambitious timeframe for current negotiations and that the cohesive activity necessary to ensure a viable foundation for future action under this important treaty simply has not come to be. It is equally disturbing that there has been little public discussion of the economic impacts of the range of climate change mitigation by any of the parties, including the United States.

ICCP commended the U.S. position enunciated in its statement in July of last year as a reasonable framework, and was particularly supportive of its efforts to force into the negotiations greater focus on the long-term character of the issue and its economic implications. However, we have made clear that our support is for the entire framework, and not for individual components. Some have misconstrued this position as support for early targets and timetables. It would be incorrect to read our position as such. While ICCP members have recognized the possibility that negotiators would agree on a mid-term emissions target, we could not specifically support such a target given the current lack of understanding of the implications of such a target or how it would be implemented.

In our view, the issue of a binding target is not the most critical element of the negotiation. We view it more important to provide definition to the treaty structure through a long-term objective and a mechanism to ensure that all parties, developed and developing, have clearly defined roles before we enter into a binding commitment period. It is also important that the parties are able to achieve these goals with flexibility through emissions trading, banking, and true joint implementation. We appreciate that the U.S. has recognized this need for flexibility.

It is of great concern to us that little progress appears to have been made on many of these issues concerning flexibility and the role of developing countries. While the U.S. has elaborated its views on these positions in subsequent statements and its protocol draft, we have detected little movement by the other parties on these issues. Since we are not privy to your bilateral discussions or the behind the scenes meetings, it is difficult for us to determine the current status of these topics.

It is not acceptable to us for the negotiations to conclude in December with an agreement on a binding commitment towards a mid-term target with all details on other key provisions to be negotiated later.

As you recall, we have consistently expressed our view that 1997 is too soon for a credible technical assessment process which would support an agreement by the parties on these issues. The apparent lack of progress to date, the dearth of information available to us regarding how these issues may be resolved, and the failure to thoroughly discuss the economic implications for an agreement, have only served to confirm this view.

We have pledged to work responsibly with the United States and other parties on the development of an effective framework to address the climate change issue consistent with the need for all nations to sustain economic growth. We remain committed to this principle. It is not clear, however, that these issues can be resolved satisfactorily by the Kyoto meeting. ICCP will, of course, reserve any judgment on the results of Kyoto for the implementation process.

We urge the United States to remain focused on and committed to delivering concrete results on all the points outlined in the statement delivered last July and elaborated on in its subsequent submittals. Further, we believe that the U.S. should indicate its commitment to its proposed climate change policy structure at the upcoming meetings of the G–7 and the United Nations General Assembly Special Session on the Environment.

Concurrently, we believe the economic impacts of a possible agreement should be communicated with industry and other policymakers so we can have an effective dialogue. Failure to discuss some of these issues in advance will make it extremely difficult to build support for ratification and implementation of the international agreement.

We look forward to working with you and appreciate the opportunity to discuss the specific views on the attached position paper in the very near future.

Sincerely,

KEVIN J. FAY,
Executive Director.

Enclosure
cc: The Honorable Madeleine Albright
Secretary, Department of State
The Honorable William Daley
Secretary, Department of Commerce
The Honorable Federico Pena,
Secretary, Department of Energy
Honorable Rodney Slater,
Secretary, Department of Transportation
The Honorable Carol Browner
Administrator, Environmental Protection Agency
The Honorable Frank Murkowski
The Honorable Dale Bumpers
The Honorable John Chafee
The Honorable Max Baucus
The Honorable Thomas Bliley
The Honorable John Dingell
The Honorable Dan Shaefer
The Honorable Ralph Hall

INTERNATIONAL CLIMATE CHANGE PARTNERSHIP

VIEWS ON

KEY ISSUES IN THE CLIMATE CHANGE PROTOCOL NEGOTIATIONS

(IN ALPHABETICAL ORDER)

Developing Country Role

The United States has outlined a specific proposal for dealing with the developing country role as part of the Kyoto agreement, including definition of obligations under Article 4.1 of the Framework Convention, establishment of an Annex B of countries which would voluntarily adopt emissions budgets, and a date certain by which all parties would have emissions budgets.

As stated by Bert Bolin, Chairman of the Intergovernmental Panel on Climate Change (IPCC) at the March 1997 meeting of the Subsidiary Body on Science and Technological Advice (SBSTA) in Bonn, "[I]t is obvious from this graph that no reasonable future reductions by Annex I countries would stabilize global emissions." Therefore, it is imperative that developing countries be part of this agreement. Furthermore, as stated in the Administration's recent economic work, a significant percentage of infrastructure and industry investment by developed countries is occurring in developing countries. Finally, because of the strong linkages between popu-

lation growth and greenhouse gas emissions, it is important that we recognize that seven of the current non-Annex I countries represent two-thirds of the world's population.

The Administration has been forthright in its insistence that the developing country role be defined. ICCP recognizes the potential limits of the current Berlin Mandate with respect to new commitments for non-Annex I Parties. It is clear, however, that the Berlin Mandate contemplates definition and elaboration of Article 4.1 commitments for all Parties, including the developing countries.

Additionally, it is imperative that additional developing country participation, including emission budgets, must be defined prior to the start of the first binding budget period for the current Annex I parties. It is only through such definition that governments and the private sector can ensure that investment flows are not distorted.

Entry into Force

ICCP has noted that six countries, including India and China, currently account for 55% of greenhouse gas emissions. In order for the treaty to enter into force, it is imperative that a significant percentage of greenhouse gas emissions be represented by ratifying countries. In addition, a significant percentage of Annex I countries and developing countries should ratify the treaty before it enters into force.

We also believe that it is inappropriate for a regional economic organization to be allowed to represent both itself and the voting rights of its individual members. The EU has argued that it should be allowed to bubble its emissions and is proposing to allocate emissions internally. It is unfair that the EU be granted this concession to bubble its emissions when it declines to support similar flexibility for other Parties. Therefore, the EU should have to decide to either bubble and count as one vote, or to not bubble and to be counted individually.

Greenhouse Gas Comprehensive Approach

The protocol negotiations should continue to focus on a comprehensive approach at the international level. Recent proposals from the European Union suggested a protocol on only three gases--carbon dioxide, methane, and nitrous oxide--with the notation that fluorocarbon compounds should be covered by policies and measures and added to the basket in the year 2000. ICCP strongly opposes the EU approach. The gases that can be measured should be covered simultaneously in a comprehensive manner. The key to a comprehensive approach is for Parties to focus on achieving the most efficient emission reductions possible; and therefore, it is unproductive to segregate gases from coverage until a later date or to treat gases differently in an international agreement

Long-Term Objective

ICCP has urged the negotiators to provide for a long-term focus or objective. We believe such an objective provides clarity to negotiators, as well as to those charged with implementation of commitments. It is our understanding that the United States has performed some analysis of this issue, and that such analysis could be useful to the negotiators currently. Furthermore, we applaud the article in the U.S. protocol proposals which contemplates a long-term objective.

This objective will be an important guide to future decision making, including private sector investment planning. We note that several participants, including the EU, and certain environmental organizations have suggested certain objectives characterized as atmospheric concentrations of greenhouse gases, and that the IPCC documents present their analysis according to atmospheric loading, of greenhouse gases measured in parts per million (ppm) of CO_2 equivalent.

ICCP has not advocated a greenhouse gas concentration as the appropriate measure for the long term objective. A long-term objective could be defined as a combination of adaptation, impacts, and concentration measures.

Recent analysis of the economics of climate change controls have indicated that the long-term objective is not as relevant as the path charted for the emission reduction. In our view, it is impossible to develop a meaningful path without knowing the point of departure and the intended goal.

We recognize that the current state of science does not provide a precise "correct" answer. Science does provide a basis for making an informed political judgment on the objective, and scientific assessment through the IPCC and elsewhere is critical to future reassessment of any potential long-term objective.

Policies and Measures

It is imperative that each nation maintains maximum national flexibility with respect to implementation of its climate commitments. It is neither appropriate nor productive for the negotiators to determine the manner in which each country should achieve its commitments. ICCP is opposed to any listing of specific annexes of policies and measures in any manner, i.e., mandatory, regional coordination, voluntary, or exemplary.

Target/Budget/Accountability Period

There have been several proposals for specific point targets and/or budget periods as part of the protocol proposals that are currently before the Parties. ICCP has not endorsed the notion of a binding "target." We do, however, recognize that all of the government proposals to be considered in Kyoto do contemplate such a step as a starting point.

The lesson from the non-binding commitment of the 1992 FCCC agreement is that, despite the best of intentions, a specific point target is very difficult to administer due to fluctuations in economic conditions, weather conditions, etc. Therefore, we believe it is imperative that the long-term objectives be utilized to examine a reasonable path that minimizes short-term economic disruption and stimulates the longer-term technological innovation necessary to significantly reduce worldwide greenhouse gas emissions.

The U.S. has indicated a preference for an emissions budget period and a binding commitment to achieve that budget. In our view, the practical timetable for ratification and implementation of a Kyoto climate agreement, including subsequent definition of a developing country role, suggests that meaningful program implementation steps could not be up and running with confidence any time soon after a Kyoto agreement. There has been a great deal of focus on the beginning, of such a so-called budget period.

In our view, the beginning of the budget period is not as important as the end of the budget period, i.e., the point at which the principle of "binding commitment" actually has the potential to impose penalty or sanction. In light of the uncertainties stated above, ratification, implementation, developing country role, and some level of experience with the implementation process, we believe that it would be inappropriate to end the first binding budget period before the year 2020. This time frame will allow industry to develop its programs, and gain confidence in their performance.

ICCP also believes this time frame is consistent with its previous position that policies at the outset of this effort must take into account a reasonable period for capital stock turnover. This will provide a period for industry to "ramp up" its climate change responses.

If the budget period is to be adopted, we believe that it should be long enough to encompass weather and economic cycles, but not so long as to present an impossible horizon to provide both industry and policymakers with some certainty. Therefore, it appears that a 10-year budget period is better than a 3 or 5-year period.

Technology Assessment

Although not specifically included as part of the current protocol proposals, ICCP continues to believe that the FCCC must be grounded in sound scientific and technological assessment processes. This function, as currently served primarily through the Intergovernmental Panel on Climate Change (IPCC), is inadequate.

The IPCC is currently considering restructuring proposals including the adoption of working group outlines that incorporate an effective role for private sector expert participation. We encourage support for these proposals.

Finally, it is also important that we de-politicize the IPCC process to the maximum extent possible. Its credibility can be sustained only if it is truly seen to be the work of scientific and technical experts, and not subject to the whims of the diplomatic and political process or other special interests.

Trading, Banking, and Joint Implementation (JI)

Most available economic analysis continues to indicate that flexibility through emissions trading, banking of emission credits, and joint implementation policies can help to maximize greenhouse gas emission reductions most cost-effectively. ICCP is fully supportive of such mechanisms as part of any agreement in Kyoto and beyond.

We believe it to be imperative that such principles be included in the first agreement and not be left to some future negotiations. We also believe it is important

that these provisions not be relegated to some pilot project with final decisions to be made at some future date.

Finally, it appears that flexibility is a positive inducement to ensure maximum compliance. It also would allow us to avoid the use of trade restrictions or trade sanctions as an enforcement mechanism in the treaty.

ICCP URGES ADMINISTRATION TO INSIST ON FULL CLIMATE POLICY FRAMEWORK AND ENGAGE IN ECONOMIC DIALOGUE

June 19, 1997, Arlington, Virginia.—The International Climate Change Partnership (ICCP) today urged the Clinton Administration to toughen its support for its climate policy framework and to release its long-promised economic and policy analysis. In testimony before the Senate Foreign Relations Subcommittee on International Economic Policy, Export and Trade Promotion, ICCP Executive Director Kevin Fay requested the that Senators urge the President to use the opportunities of the upcoming G–8 meeting and the United Nations General Assembly special session on the environment to reiterate support for the US climate policy framework as "the only framework that can provide a climate change agreement that is both environmentally beneficial and economically feasible."

ICCP urged the Senators to consider a list of key issues in the negotiation and the full outline of the Administration's proposals. These include:

- utilizing a comprehensive approach;
- establishment of a long-term objective;
- identification of a role for all parties, developed and developing;
- utilization of market-oriented measures such as emissions trading, banking, borrowing and joint implementation;
- maintaining national sovereignty and avoiding a laundry list of so-called "policies and measures" such as taxes.

"Our primary concern has been that the result of the negotiations would focus on only one or two of the key issues, such as a target," said Fay, "and that the rest would be left until later. This would be unacceptable to us. This worst result would be for the Administration to agree to some target and not achieve the entire policy framework it has advocated." He urged the Senators to use the list of key issues as a checklist during consideration of any treaty agreement that may be presented to the Senate for ratification.

Fay also expressed doubt about the ability to complete the climate negotiations by the end of this year given the lack of progress to date and the failure of the Clinton Administration to engage in the economic and domestic implementation dialogue it has promised for more than a year. "ICCP is not and never has been interested in an agreement at the Kyoto meeting just for the sake of reaching an agreement. This view will not change."

ICCP is a coalition of US businesses and industry associations, as well as international associations, interested in the policy development process with respect to global climate change.

Senator HAGEL. Mr. Fay, thank you very much. Again, to all three of our panelists, we are grateful for your time. You have each focused on a particular area that is of immense concern and I very much appreciate the courtesy that you have extended to this committee by coming forward and talking a little bit about this important issue.

Mr. Trumka, let me begin with you. I would like to focus a little bit on some of your testimony.

I don't know if you were in the room this morning when Senator Wirth talked a little bit, at my request, about a conversation I had with him a couple of days ago regarding the ultimate goal of this treaty: a 70 percent reduction in greenhouse gases. That is rather significant.

Mr. TRUMKA. Very significant.

Senator HAGEL. Would you give me some analysis of what that would do to jobs?

Mr. TRUMKA. It would devastate jobs, particularly if the timetable were crunched in, as they are currently proposing it.

Right now, to get to 1990 levels and stretching it out to the year 2015 or 2020, you are looking at a job loss of a million and a quarter to a million and a half.

If you magnify that to the level that you are talking about and keep the timetable the same, you are going to magnify the number of job losses. It would actually be devastating to various sectors of the economy.

When you balance that against what it would do under the current structure, it makes absolutely no sense because they would shut a power plant down here and build a power plant in Mexico. They would shut a factory or a steel mill down here and build it somewhere else. We've lost the jobs. They've gained the jobs and the environment gained nothing in the process.

Mr. Chairman, if you limit just stabilizing us, stabilizing to the 1990 levels to the Annex I countries, here is all you do. The CO_2 emissions are scheduled to double, are projected to double by the year 2066. If you put the burden on us and no one else, you will simply move the timetable back to 2059. That is a 7 year difference in timing with job loss that ends up in the millions.

Senator HAGEL. I want to continue along this line. Your testimony also included the comment that for every $100 in a carbon tax or an equivalent trading program, we would be talking about roughly a 26 cent per gallon increase in gasoline.

Actually, I think those numbers, at least the numbers I have seen, are even higher than that. So I think you take a pretty conservative baseline, which is good.

First of all, tell me a little more about the impact, in your analysis and the AFL–CIO's analysis, about that would have on the economy. Second, do you believe your membership, the people of this country, would be willing to do that? It all connects back to something we talked very little about this morning, though we tried to get there. It is something that Mr. Fay talked about: the cost-benefit analysis.

When you have no numbers, even though Secretary Wirth dismissed the models to some extent, I don't know how we get anywhere without having some cost-benefit analysis, some ratio, some rationale, to accomplish whatever it is we need to accomplish.

Finally, as I said right at the beginning of the hearing this morning, there are few people that I know in this body or across this country that do not believe we have some problem here.

Mr. TRUMKA. That's correct.

Senator HAGEL. We have to face this. What we are trying to get at, once again, is the identification of the problem and its magnitude. Once we identify that, with some basis of knowledge and analysis, and cost-benefit analysis is pretty important, we develop a common sense policy.

So with that, would you like to talk a little bit about some of those issues, such as the gasoline tax and your membership.

Mr. TRUMKA. Absolutely, Mr. Chairman.

First of all, it is hard for me, as a negotiator, having negotiated literally hundreds of contracts, to comprehend how you can go into a negotiation, make proposals that ultimately are binding on you

without knowing with some specificity, or at least a fairly good understanding, what those proposals are going to do. That is really what we have been told so far.

Every time we have asked for an analysis on what these proposals will do in terms of impact on the economy, impact on jobs, impact on energy price increases, impact on trade, we are told that the models don't exist and we'll get to that.

I think that is an unhealthy way of negotiating any kind of deal and I would not advocate it to any of our membership.

Our membership looks at those prices. Let's assume for just 1 second that they could pay the 26 cent increase for gas, or they could take a one-third increase in the price of their electricity. Are they willing to do that? I think it is highly unlikely that they are. But the more realistic thing is what does it do long-term to their jobs?

Those types of price increases can destroy industries. Take their jobs away and, whether they were willing to pay them or not, they won't be able to pay them.

There is simply no reason to rush to that right now until we have done a very thorough analysis of the impact, and we can negotiate with all of our partners for a fair, level playing field so that we don't simply displace our jobs by having higher energy prices, higher taxes than our competitors and still have no gain to the environment.

I think my membership, the membership of the AFL–CIO, would be angered, to say the least, at some of these price increases. If you heat your home with gas, for instance, and the tax would go up $1.50 per thousand, it is right now at $1.42 per thousand, so you are looking at doubling the price of gas. That is before you add the increase of what demand will do to a price increase.

If you look at the gasoline tax of 26 cents, the family farmers over there cannot take a hit of that magnitude. They simply cannot do it and still survive in today's economy.

I think our people really want a clean environment. They want to leave a clean environment to their children. But they also want to leave a healthy, vibrant economy, and these are not mutually exclusive, Mr. Chairman. If we take our time and do it right the first time, we can get both. That's what I think my membership would demand and I think has a right to.

Senator HAGEL. Thank you.

Senator Sarbanes.

Senator SARBANES. Thank you, Mr. Chairman.

The first question I want to put to each member of the panel is do you think there is a serious problem that we have to deal with with respect to global warming?

Mr. NEIDIG. Do I think there is a serious one? I think there is a problem. Is it a serious problem? To be very candid and frank, no. I don't think it is a serious problem.

The industry I represent does not think it is a serious problem. I don't mean to be flip. I have not been around as long as Senator Byrd has. But in my lifetime, in 1936, in the State of Nebraska, Northeast Nebraska, we had 30 days when the temperature never got below 100 degrees in the summer and 30 days in the winter

when the temperature never got above zero. We did not hear a word about global warming.

The last 4 years I could have used a little of it in the spring when I planted my crop. I don't think there is a serious problem. I don't think we have proven there is.

Senator SARBANES. So you don't think we really need to do anything?

Mr. NEIDIG. I don't think there is a rush to do that. I think we need to be very aware. I think we need to be concerned and certainly would be willing to work at these things. But there is not a compelling reason to rush pell-mell to this at this time.

Senator SARBANES. That is a different question.

Mr. NEIDIG. Sorry?

Senator SARBANES. That is a different point. I wasn't exploring whether we should rush pell-mell. I never believe in rushing pell-mell into anything because you can always make it worse rather than better. The question is whether there is a serious problem that we need to address and I take it your position is no.

Mr. NEIDIG. That's right.

Senator SARBANES. Mr. Fay?

Mr. FAY. I think our companies would agree with the consensus of the Senators here that this is a serious problem. It needs to be addressed, but it needs to be addressed over a long timeframe and not with some emergency short-term action.

Senator SARBANES. But we need to try to come to grips with it?

Mr. FAY. Yes.

Senator SARBANES. Mr. Trumka.

Mr. TRUMKA. Senator Sarbanes, we think that there is a problem and if there is even doubt, the consequences could be so dire that we think we ought to err on the side of caution and assume that that type of problem does exist and attempt to address it as best we can—in a fair, equitable, meaningful way.

Senator SARBANES. Now I was listening to these various figures that you were citing and I'm not quite sure where they come from in terms of the number of jobs that would be lost and the various policies that would be put in place.

I quoted earlier in the hearing a 1991 study by the National Academy of Sciences which concluded with, and let me just read what they said: "The United States could reduce or offset its greenhouse gas emissions by between 10 and 40 percent"—now that is a broad range, I admit. So let's just take the lower figure, 10 percent—by between 10 percent "of 1990 levels at low cost or at some net savings. The efficiency of practically every end use of energy can be improved relatively inexpensively."

Then, people cite the figure that on a per capita basis we use twice as much energy to produce a unit of GDP than does Germany or Japan.

I guess I am interested in to what extent either of you agree with that statement or think that there is something in it. This assertion is that we could, in fact, do a better job without imposing some—and I have taken the low range. I have taken the 10 percent figure because I want just to try to see if we can be on the same path, if that's possible.

This assertion is that we, in fact, could do that without a major—in fact, they say even at some net savings. They cite other countries who seem to have been able to do that.

Do you take sharp difference with that?

Mr. TRUMKA. I think there are ways that we can save CO_2 gases, become more efficient, do conservation. There are a number of ways in which we can do that.

I don't know that you can achieve the levels that they are now talking about through that alone. Clearly, the proposals that are being made by the administration do not envision that. They envision, as Secretary Wirth told you today, affecting through a process energy consumption—not energy conservation but energy consumption. One of the things that they tossed about is a $100 per ton tax on carbon. I gave you the figures. If that proposal is adopted, we are going to have significant and major job loss.

Now there are paths that we could work together on and minimize the job loss and we would encourage that. We would welcome that idea, to work together, to do that so that, one, we do clean up the environment; two, we do not lose our international competitiveness; and, three, we don't cause major economic dislocation throughout the United States while our competitors have none of that.

Senator SARBANES. Mr. Fay?

Mr. FAY. Senator, I think that we have shown that we can do some of these things. We are doing them now. We are doing them voluntarily under some of the climate change action plans.

We have been through hours of briefings on the mind numbing economic analysis. The fact is the analysis is out there and yes, it does show there are costs. It does show there are opportunities as well.

What no one seems to be able to get out on the table is what is it that the administration is thinking of once we sign on to this binding agreement. That is all we are asking: Tell us what you are thinking of. Tell us what your assumptions are about our industries in terms of efficiency improvements that you think we are going to achieve in order to meet whatever goal it is you want.

So the analysis has been done. They are doing the analysis, Senator. They are not talking about it and they are not releasing it. All we are saying is we want to have a dialog.

But yes, there are many things we can do to reduce emissions. Whether we do them to 1990 levels by 2010 or some other time is still open to debate.

Senator SARBANES. Both of you have mentioned this competitive factor. To what extent is your concern about where the administration is going tied to the fact that they have this differentiation between Annex I countries and other countries so that some countries would, in effect, be under the same mandatory regime we would be under but other countries would be outside of that mandatory regime?

I don't think anyone has really thought that through in terms of what the implications of that are, not only environmentally, which is, of course, the whole purpose of this effort, but also what the economic implications would be.

How much of your concern is geared to that aspect of this negotiating arrangement?

Mr. FAY. Unfortunately, I think the 1992 treaty already began to establish some level of differentiation between Annex I countries.

Senator SARBANES. Yes, but that was done voluntarily. That is a big difference.

Mr. FAY. I understand that.

Senator SARBANES. Or to take that differentiation and simply carry it over when you shift from voluntary to mandatory, that's, well.

Mr. FAY. Absolutely.

We feel that the developing countries must be in this treaty. How you get them in is not our area of expertise. But they must be in.

Now are they allowed to grow first? It is not clear to me from the chairman's and Mr. Byrd's resolution whether we are requiring the exact schedule that Annex I countries would have. But yes, they must be in. This is because most of the infrastructure investment that is taking place in the world today is taking place in developing countries. So we don't know what their requirements are. We cannot make effective investment decisions.

So we have to know. What we insisted on in our position paper to the administration is if not at Kyoto, you have to have this resolved before any binding commitment period begins for Annex I countries and you have to insure that, as part of the entry into force requirements, that you have those countries as parties to this agreement.

Senator SARBANES. Within a mandatory regime of some sort.

Mr. FAY. Right.

Senator SARBANES. Mr. Trumka?

Mr. TRUMKA. We would agree that we have a significant concern about their lack of being included in the mandatory regime, as he calls it, because it would create yet another gigantic incentive to move jobs offshore to come up with compliance.

We also have two other major concerns. These are: Even if both people, even if all of the countries are in in some forum, whether it is a lower level, growing to a higher level, as their economy grows, or whatever; the other concern is how we internally will be required to achieve our reduction levels. This is because if it is through a carbon tax, as we just talked about, even if our competitors are going to have to do something that is fair and equitable in the overall scheme of things, we are still disadvantaged.

The other concern we have is the time period for compliance. The more collapsed it is, the more harsh and radical the solutions, the more harsh and radical the effect on the American economy and the American working force.

Senator SARBANES. Thank you.

Senator HAGEL. Mr. Neidig, did you want to respond?

Mr. NEIDIG. Senator Sarbanes, you asked the question about competitiveness and I mentioned that as far as agriculture as well. If I can specify and single out a country, if you will, Argentina would be the one. If we, the United States, and I as a farmer, were faced with mandatory compliance with energy requirements and other things to control greenhouse gas emissions, Argentina has indicated they are not going to be part of that. They have indicated

they would not be. I have been to Argentina twice. It has the most productive capability, I think, of anywhere in the world and would be major competition. Those who think that we can only have it in the United States are wrong. That is a real competitor that concerns agriculture and should concern agriculture.

Senator HAGEL. Mr. Neidig, if I can stay with you for a moment, I have the same general question that I asked Mr. Trumka on gasoline tax concerning increasing energy costs, the effects it would have on his membership, jobs, and the ripple effect. I was talking with Senator Lugar this morning, who is a very distinguished member of this panel and also, as you know, chairman of the Agriculture Committee. He was telling me that he had met recently with some individuals from the United Nations and they were talking about projecting out population numbers. They were projecting what it was going to take to feed the world, with around 9 billion to 10 billion people in 50 years, and what pressure and burden that was going to put on our food producers and our farmers.

Connecting that to what we have been talking about today is a pretty significant challenge.

Would you develop a little bit for this panel, Mr. Neidig, some of the thoughts that you have regarding the numbers that have been thrown around here and what that would do to farm production and the ability to feed the world?

Mr. NEIDIG. Well, as I indicated, it would not only be drastic, it could be devastating. It would be devastating.

As I indicated in some of the figures I had here for my own farm, my own operation, which is not large—it is average to small—if you add that much cost that we are talking about, whatever it be, 25 cents a gallon for gasoline, or a 50 percent increase, or a 30 percent increase, whatever, it gets to the point where it is absolutely uneconomical for me to continue the operation.

Now this is not necessarily dependent upon size of the operation because you just magnify the problem with larger operations under those kinds of situations. So we not only would reduce our ability to make a living or to be profitable, we would reduce our ability to feed the world, if you will, because, as you know, American farmers serve and feed many more people than just those in this country.

So we not only would become uncompetitive, we would go out of business and thereby exacerbate the problem. It is hard to describe, Senator, exactly the fear and the concern that I and my people have if we face this kind of mandatory situation that is not across the board.

Even if it were across the board, we are going to significantly reduce our ability to produce food and fiber for the world.

Senator HAGEL. Thank you.

Mr. Fay, I would like to get to some of your testimony. I have read your letters to the State Department and the White House. I compliment you on each. They are well thought out. As your testimony I think very poignantly brought out, what we are striving for is some kind of policy that is economically sound, allows economic growth, and continues a higher standard of living for all of our people. This is an argument that gets lost in this.

I hear some of my colleagues talk on one side, in the morning, about how we have to give everybody equal opportunity and standard of living. Then, in the afternoon, they suggest cutting our economic growth back 1 or 2 percent to do this.

Well, you can't do that. Something has to give here.

I am interested in your presentation today and the letters that you sent to the White House and State Department from the standpoint of the common sense economic approach you have taken.

First of all, explain why we have not seen any cost-benefit analysis, economic modeling, or anything else to my knowledge that would give us some sense of if we doing the right thing, while tying where we want to go with this environmental policy to sound economic policy.

Mr. FAY. Well, obviously, I cannot speak for the administration on that point. I do know that it has been promised for over a year.

There has been a lot of modeling going on, however, outside of the government. Frankly, it is all pretty consistent and it all points to the kind of conclusions that I outlined.

But what is missing is what are you thinking of in terms of implementation, the types of things you just asked about in terms of imposition of carbon taxes or various policies and measures.

We are not interested in pursuing some laundry list of command and control programs or taxes to implement this initiative. We have heard a lot about a potential of some kind of cap and trade and some kind of emissions trading program. But we would like to know, if you are going to institute a trading program, how are you going to allocate the rights to that and what is the cap going to be.

I cannot respond to that. We all kind of know generally where the economic information is sending us. But we are not getting the kind of specifics, we are not getting the kind of dialog we have been promised.

In 1993, the White House promised the "White House effect" on the greenhouse effect. Well, lately we've felt a little bit more like the "whitewash of the impacts and a blackout on information."

We need to get that dialog done. If it is not going to get done by Kyoto—and I fear that it is too late to have that dialog—then no, there should not be an agreement because we have a right to know.

Now they have ideas inside and they keep telling us that our information is showing the kind of thing cited by the National Academy of Sciences, as Senator Sarbanes referred to, that it is modest, that there are things we can do. That is the wonder of mind numbing macro economic analysis. But there are certainly going to be some people who will suffer, such as Mr. Trumka's members, such as the farm community, such as the manufacturers that I represent. We want to have that debate. We want to have that dialog. We want to have it before they agree to the treaty and not after.

Senator HAGEL. Are you familiar with a study that I understand was done in November known as the Argonne National Laboratory Study?

Mr. FAY. I am familiar with it.

Senator HAGEL. My understanding is that the name of the study was "The Impacts of Potential Climate Change, Commitments on Energy Intensive Industries."

Mr. FAY. Yes, sir.

Senator HAGEL. My understanding is also that it was never released.

Do you know anything more about it?

Mr. FAY. Well, it was never officially released. I guess it managed, like drafts of the current economic analysis managed, to find its way out there. We have been told that well, it is a qualitative study, not a quantitative study, and yes, it does point out these objections.

We sponsored a conference last week where we asked them to present somebody, to present their view and what was good or bad about the study. The administration declined.

So again, I know the study is out there. It suggests very draconian effects. It suggests that a carbon tax won't succeed in achieving the policy objectives they are trying to achieve.

Then it is suggested by the administration that that is not what the study was designed for. But if they are not going to tell us what it was designed for or what they view it to do, we cannot read their minds.

Senator HAGEL. Mr. Fay, thank you.

Senator Sarbanes.

Senator SARBANES. I think that is a very good point. In fact, I think your whole statement was very helpful in terms of its analysis.

I take it your starting point is that we should be striving to reach an agreement but we need to be very careful how we do it and take into account these various concerns that you raise here.

Is that a fair statement of it?

Mr. FAY. Yes, sir.

Senator SARBANES. I have to tell you that I'm not so sure about something. It seems to me there is considerable room here to advance with respect to controlling global warming without getting yet into the situation of paying significant costs. Now at some point you are going to get a tradeoff.

But if we are using double the energy that our competitors are using, the price of gasoline in this country, compared with other industrial countries, is far less. What is it that they are able to do that enables them to absorb this cost and yet remain competitive with us in the marketplace? It is an interesting sort of question, it seems to me.

But there is a lot of conservation that has not yet been done, it seems to me.

What do you understand the framework in which they are going to Kyoto as being?

Mr. FAY. By "framework," do you mean the entire policy framework, the numbers?

Senator SARBANES. First of all, do you understand that they could meet in Kyoto and not reach an agreement? They could continue the process of trying to develop an agreement.

Mr. FAY. That's correct. There is no requirement to reach an agreement. They have set themselves a deadline of Kyoto.

We felt that the technical process to facilitate the negotiations was not properly established and that the year 2000 may have been more appropriate. They set 1997 as their deadline.

Senator SARBANES. Now do you understand them to be bound by the notion that the non-Annex countries are not to be brought under a mandatory regime? Is that, in effect, a defining criterion of the bargaining process or is that open?

Mr. FAY. Well, the administration has proposed, actually proposed, a developing country role and evolution for those countries that some have said violates the premise of the Berlin Mandate, that it brings in commitments that they are not supposed to have.

The Berlin Mandate expires at the end of this year. So for purposes of what they have outlined in these negotiations, technically we have asked for "what does no new commitments mean for developing countries" because, under Article 4.1 of the treaty, it does require that they take policies and measures to reduce emissions. We have said at a minimum you have to define that now.

What does that mean? Nobody knows. Nobody knows what that means. That's Number 1. Number 2, you have to set a schedule for defining what their emissions budget will be before we ever enter into a budget period of our own because we have to know that.

Now whether that's feasible, again, those are legal issues and diplomatic issues that have not been discussed publicly in great detail.

Senator SARBANES. How much interaction has the International Climate Change Partnership had with the administration on this, with respect to these negotiations?

Mr. FAY. We talk to them frequently. We talk to them as often as we can about the policy issues that you see outlined in our letter.

Senator SARBANES. So you don't have a complaint about the extent of consultation? Or do you?

Mr. FAY. Well, we have plenty of access and consultation. But on some of the policy nuances and those issues, the consultation is fine. On the details of what are we talking about in terms of domestic implementation, or what are the impacts, or what is it you think is going to happen to this industry, this industry, or this industry, it is pretty lacking.

Senator SARBANES. Now the Farm Bureau people, have they had consultation?

Mr. NEIDIG. Yes. But I could reiterate what Mr. Fay said: Substantial consultation; details, not much.

Senator SARBANES. Mr. Trumka?

Mr. TRUMKA. Significant consultation. Answers to specific questions have been lacking. This goes over a period of probably 3 or 4 years. My own personal experience goes back even further.

When I was President of the United Mine Workers, we were promised information on analysis over a 2 year period. We never received it. When we talked about specifics, there are no specifics.

I think the danger of all of this is probably what was perhaps a strategy, the strategy to adopt the treaty and worry about how you comply with it later, and we are very, very concerned with that type of strategy.

Mr. FAY. Senator, if I might add, the chairman raised a question at the beginning of this about Mr. Wirth and his 70 percent reduction goal. That is one of the reasons we have encouraged them to tell us where we are going. What is your long-term objective?

The original treaty has this vague language about stabilizing at a level to prevent dangerous anthropogenic modification of the climate. The science does not provide us with a precise answer to that. But if it means that what they are really thinking is 70 percent reductions, then we are talking about a marathon, not a sprint. If they mean that but are not telling us, then we are going to burn ourselves out in the first mile.

So we have to know if they think they have enough scientific data to tell us what we should be doing 20 years from now. We think they have, then, enough information to tell us where they think they want to be 100 years from now because the technological innovation that is going to be required to achieve whatever that is not out there today.

All we have said is just tell us where we are going.

Senator SARBANES. Did you think that the goal that was set in 1992 was a realistic one?

Mr. FAY. The 1990 levels by the year 2000?

Senator SARBANES. Uh-huh.

Mr. FAY. I don't know that I have a basis for addressing that. I think if that were the goal adopted in Kyoto, 1990 levels by 2010 or something like that, which often has been mentioned, I think it is going to be very difficult. It will be difficult both procedurally, just getting ratification and implementation in this country. Whether we can achieve it or how easy it is, I don't know. I don't think any of us knows.

Senator SARBANES. That's why you want to see the specifics of the game plan to do it, is that correct?

Mr. FAY. Right.

Now we do recognize, I should add, we do recognize, Secretary Wirth did talk about the fact that it is a negotiation. You don't expect a negotiator to give out a bottom line during the negotiations.

I will say that I have been to the negotiations. We participate as observers in the negotiating sessions. We are carving out from the active negotiators the conservative position, the United States is. We are the only country that is talking about a developing country role. We are the only country that is talking about flexibility through emissions trading.

We are the only country that tabled a proposal to establish a long-term objective, though some have now talked about long-term objective.

So the outline was a good start. But the progress or the willingness of our negotiating partners, whether it is the developing countries or the European Union, or Australia or Japan, has been slow in coming.

Part of this is perhaps they have not listened to our framework enough. Perhaps they are not sure we are serious about it.

We think the United States has the strongest economy in the world and should stand up and negotiate from a position of strength and a right policy; but negotiate from a position of strength and don't be afraid to walk away from a bad agreement.

Senator SARBANES. Well, now, what is the European Union position, as you perceive it?

Mr. FAY. They want a number. They want a number and they have a laundry list of so-called policies and measures that reads

like a tired old list of regulatory programs that we would just as soon not repeat, whether it is CAFE standards, energy efficiency standards, chemical bans, carbon taxes. To our credit, the U.S. is also one of the few governments that is insisting now that that is unacceptable. But that is what the European Union wants.

Senator SARBANES. This is an interesting perspective which probably has not been brought out this morning. That is, it is your perception that, compared with other parties that are at this negotiating table, there is more, I don't know whether the word is "rationality" or "prudence," perhaps, in the American position that in a lot of the other significant countries' positions.

Mr. FAY. A year ago this time there was no discussion of long-term objectives. There was very little support or no discussion of developing country role. There was only discussion of short-term, very short-term, targets and timetables.

The U.S. is the one who said they are all very impractical, not doable. So, yes. I mean, the U.S. has done the most scientific work on the issue and has done more economic analysis, I think, than anyone else in the negotiations. But that still does not mean you just agree to something, even if it is a bad deal.

Senator HAGEL. Mr. Trumka, did you have a comment?

Mr. TRUMKA. The proposal by the European Union, Senator, is an additional 15 percent below 1990 levels by the year 2010. You asked the question whether the framework was such that the developing countries are now locked out of it.

Well, whether we think they are I think is probably less important than what they think. They think that they are. They think that they have done everything they have to, according to the Berlin Mandate, and the Berlin Mandate sets the framework for these negotiations. That is why it is so important for us to change that notion.

This is because he is right. We are the only ones out there saying that.

Now the administration can talk very loudly about how they want to include Third World countries. They are not going to succeed in Kyoto in doing that. They are the only ones out there saying that. If we agree to that type of treaty, I agree with you, Mr. Chairman, that signing a treaty and then renouncing it when it goes sour for us does not really increase our level of esteem around the world.

This is a subject that has such wide ranging impacts both on the environmental side and on the economic side and for the development of this country that we need not set an artificial deadline of Kyoto and say it must be done by then without any clue of how we will achieve what we have agreed to.

That is a prescription for a disaster. We will then be stampeded into bad decisions rather than some of the decisions that Senator Sarbanes talked about, where we can really sit and counsel together and really work toward a real lowering of carbon dioxide gases in the atmosphere by everyone while we do not pay all of the economic prices with jobs and the economy here at home.

Senator SARBANES. Thank you.

Senator HAGEL. Gentlemen, thank you. You have offered great insight into this issue. We will be talking with you again, I'm sure.

We will keep the official record open till close of business on Friday for our colleagues or others who want to submit questions for the record.

Mr. TRUMKA. Thank you, Mr. Chairman.

Mr. FAY. Thank you.

Senator HAGEL. We are adjourned.

[Whereupon, at 12:52 p.m., the subcommittee adjourned, to reconvene at 9:32 a.m., June 26, 1997.]

ALL MEMBERS GLOBAL CLIMATE NEGOTIATIONS: ECONOMIC AND SCIENTIFIC CONSIDERATIONS

THURSDAY, JUNE 26, 1997

U.S. SENATE,
SUBCOMMITTEE ON INTERNATIONAL ECONOMIC
POLICY, EXPORT AND TRADE PROMOTION,
OF THE COMMITTEE ON FOREIGN RELATIONS,
Washington, DC.

The subcommittee met, pursuant to notice, at 9:32 a.m. in Room SD–419, Dirksen Senate Office Building, Hon. Chuck Hagel [chairman of the subcommittee], presiding.

Present: Senators Hagel, Thomas, and Sarbanes.

Also present: Senator Enzi.

Senator HAGEL. The subcommittee will come to order. This morning, the subcommittee meets to consider for the second time the current international negotiations underway intended to curb global greenhouse gas emissions. As world leaders began to focus on this issue last week at the G–8 Summit and this week at the United Nations, I want again to stress the importance of our efforts in the U.S. Senate to be very actively involved in this issue.

As I mentioned last week, these hearings are not about motives or blame, personalities, or politics. These hearings are about finding the truth and the facts.

This hearing will focus on the economics and science that form the basis of these negotiations and discussions. I look forward to a fair and informative exchange on the merits of the issue.

I want to thank our distinguished panelists for their time, their testimony, and their courtesies. Welcome.

Before I ask each of you to respond, let me lay out some of the facts of life that we are dealing with this morning. The Senate just went into session at 9:30. We are dealing with the Tax Reconciliation bill today. That means we will have a number of votes this morning.

To the best of my knowledge, as of 9:30, what we will try to do is get in at least a half hour of testimony. Then, when the first vote is recorded, we will recess very briefly to allow the other Members who are here and myself to vote. We will then come back. That should take about 10 minutes. We will pick up from there and finish that testimony. There will probably be one more vote, for which we will do the same thing. Then I think we will have some daylight for the rest of the hearing. That will be the schedule as of now.

Sometimes, as you know, when you have a number of Members present, we just hand off the gavel and let someone else preside. But I don't want to do that because I would miss someone's testimony. It is one of the prerogatives of the chair to do it your way. It may be wrong, but it is your way.

So I will run the subcommittee hearing this morning in that way. Before I ask for your testimony this morning, let me introduce my friend and colleague from the State of Wyoming, Senator Mike Enzi, who is not a member of this committee but is very involved, engaged, and interested in this subject matter.

Senator Enzi, welcome.

Senator ENZI. Thank you, Mr. Chairman.

Senator HAGEL. Do you have a statement? Would you like to make any comments?

Senator ENZI. I would like to do so. I really do appropriate your inviting me to be a part of this. This is a very crucial issue to the United States and particularly to Wyoming. Wyoming is the Nation's largest producer of coal. This is a bipartisan issue, of course, because Wyoming and West Virginia are large producers of coal. So I share Senator Byrd's interest in the attempts to see that we do not incrementally kill our Nation's energy producing capability.

I believe the theme of these hearings, which are going to concentrate on economic and scientific considerations in the global warming debate, go straight to the heart of the issue. Even though there is a disturbing lack of scientific consensus on this issue, the hype threatens to carry the day and stands to have a devastating effect on our economy. Some of the studies I have seen indicate it will be about $350 billion per year.

Many, when they hear these numbers, perceive them with certain hysteria. They might say well, come on now, there's no way the Government should risk that kind of economic carnage unless the science is pretty persuasive. Well, I am still waiting to see that persuasive science.

In fact, the newest sciences indicate exactly the opposite. We can also look at past examples of what we have done to ourselves. One of them is with our national forests. We had environmental predictions that were backed on the body of dubious science that showed that the spotted owl was headed for certain extinction. They said the logging industry in the Pacific Northwest had to be halted. We did do that. An entire industry of workers was thrown out of work.

Our national forests were left unmanaged. They are a big tinderbox. They are going up from lightning strikes. There is no economic advantage out of the forests. At the same time, this timid little owl is being found building nests in billboards.

While we do that, what we are doing is sending our economy to other countries where we are devastating their forests. We have sent them to the Siberian forests, where they are tearing down 10 million acres of forest a year with no environmental protection.

So in supposing to save the spotted owl, we have wiped out the Siberian tiger—or we will. That is the kind of action that we often take in the United States.

I have this rule of legislative action, which is that if it is worth reacting to, it is worth over-reacting to. I see where we do that time after time and send our economy to other countries.

That is what the proposed treaties want to do now. They want to send the economy to those areas of the world that are underdeveloped without putting them under the same kind of rules as the developed countries. We cannot take that kind of economic hit. We just transfer dollars and jobs.

I am anxious to hear the testimony today to see if it changes any of my views on the economy and the science. I really do appropriate the opportunity to be a part of this hearing.

Thank you, Mr. Chairman.

[The prepared statement of Senator Enzi follows:]

PREPARED STATEMENT OF SENATOR MIKE ENZI

Thank you, Mr. Chairman. I am very grateful to have been invited to participate in these hearings this morning. This is a very bipartisan issue. Wyoming and West Virginia are the first and second largest coal producing states in the nation. Consequently, I share Senator Byrd's interest in the attempts to—as I see it—incrementally kill our nation's energy producing and utilizing—industries.

I believe that the theme of these hearings, which concentrate on the economic and scientific considerations of the global warming debate, goes straight to the heart of this issue. Even though there is a disturbing lack of scientific consensus on this issue, the hype threatens to carry the day, and in so doing, stands to have a devastating effect on our economy to the tune—some studies claim—of 350 billion dollars per year. Now, many citizens might hear those numbers and perceive in them a certain hysteria.

They might say, "well come on now, there is no way our government would risk that kind of economic carnage unless the science was pretty persuasive." To those people I would just say two words: National Forests. I cannot think of a more illustrative example of dire environmental predictions, backed by a body of dubious science, made real in the most unexpected ways by the sheer demagogic momentum of their proponents. In an effort to save the spotted owl from certain extinction, they said, the logging industry in the Pacific Northwest must be halted. And halted it was. An entire industry's worth of Americans—over twenty thousand of them in five states—were thrown out of work. Meanwhile, our national forests were left unmanaged and are now overgrown fire bombs awaiting the lightening strike that will detonate them, while the timid and ecologically fragile spotted owl, never in imminent danger in the first place, is occasionally seen building nests in bill board signs. And if that was not bad enough, consider what is happening in Siberia. So productive was the carefully managed forests of the Pacific Northwest, that for every one hundred thousand acres of those forests taken out of production, one and a half million acres of Siberian wilderness must be cut down to fill the gap. And indeed, many of the surviving saw mills in those states are importing Siberian timber just to keep their heads above water. In fact the Russians are cutting down ten million acres per year of Siberian Wilderness. Does anyone really think they observe the same stringent environmental standards that we observed? In an effort to save the spotted Owl, the government and the environmental activist community have probably signed the death warrant for the Siberian Tiger. I relate this sad tale only to illustrate that—no indeed—the power of sound science is never a guaranteed trump to skillful spin and demagoguery. I am very concerned that we will wind up exporting jobs, damaging our economy and encouraging the environmental degradation of other nations if we fail to demand that a high scientific standard rule this debate. We have done it before. It looks like we are determined to do it again.

This is also an issue of common fairness. Some of the terms of the International Treaty on Global Climate Change would hobble our economy while allowing the economies of other nations to steam happily along for years, barely burdened at all by their own, often lax, environmental standards. How is that fair?

I am a big believer in the axiom that the worst thing in the world for the environment is poverty. I think that a visit to any third world country will confirm this. And it is precisely this conviction that strikes so much fear into my heart whenever I hear someone predict that unless we subject our economy to those of the developing world in this misguided attempt to satisfy a scientific consensus that does not exist, we will soon find ourselves face to face with an environmental apocalypse. I

do not believe it and until I see the scientific community agree on a body of quality science, I will not. So I look forward to your testimony gentlemen, and to asking you questions. My comments notwithstanding, I assure you I am here to learn.
Thank you Mr. Chairman

Senator HAGEL. Senator Enzi, thank you. We are grateful that you are here and participating.

Let me now introduce our first panel of witnesses. We have Mr. William J. Cunningham, Jr., Legislative Representative of the AFL–CIO. Welcome, sir. Also we have Dr. W. David Montgomery, Vice President, Charles River Associates. Dr. Montgomery, welcome. We have Dr. Robert Repetto, Vice President and Senior Economist, World Resources Institute.

We, again, are grateful that you would take the time to come here this morning and share with us your views on this issue.

Let me ask Mr. Cunningham to begin the testimony. Mr. Cunningham.

STATEMENT OF WILLIAM J. CUNNINGHAM, JR., LEGISLATIVE REPRESENTATIVE, AFL–CIO, WASHINGTON, D.C.

Mr. CUNNINGHAM. Thank you, Mr. Chairman for this opportunity to testify on behalf of the AFL–CIO on the potential economic impact of a United Nations' global climate treaty.

The AFL–CIO has repeatedly stressed that environmental protection and job creation can go hand in hand and we recognize that sound environmental policy can create jobs as well as improve the environment. The AFL–CIO supports the administration in its efforts to enforce the Nation's environmental laws and to insure adequate funding for research, enforcement and cleanup as sound economic as well as good environmental policy.

We are, however, deeply concerned with the ongoing efforts to negotiate a treaty to mitigate the effects of carbon dioxide emissions on the Earth's climate. In particular, we are concerned that the so-called Berlin Mandate requirements will have an adverse impact on American economy but little or no effect on the problem of greenhouse gas emissions. We are further concerned that the permit trading of energy tax regimes now under consideration by the administration will worsen the adjustment problems.

At the February 1997 Executive Council meeting, the AFL–CIO issued a statement elaborating on those concerns.

The Executive Council statement says: "Carbon taxes or equivalent carbon emission trading programs will raise significantly electricity and other energy prices to consumers. These taxes are highly regressive and will be most harmful to citizens who live on fixed incomes or work at poverty level wages.

"As corporations shut down domestic factories, mines, and mills as a result of higher energy costs, they will have additional incentives beyond the search for cheap labor and anti-labor regulatory regimes to locate new capacity off-shore, in countries with no carbon reduction commitments. Carbon emissions, therefore, will be transferred to the developing world along with the jobs, thus providing no real benefit to the environment."

As the administration considers its objectives for the upcoming Kyoto negotiations, we urge that the Berlin decision to confine mandatory emissions limitations to Annex I countries be reconsidered.

Carbon dioxide emissions are growing three to four times faster in the developing countries and these countries, with no requirements, will soon be responsible for well over half the planet's greenhouse gas emissions. Exclusion of developing countries means that greenhouse gas emissions will continue to grow at a rapid pace and the harm that increased concentrations do will only be delayed rather than avoided. In fact, all else being equal, stabilization of carbon dioxide at 1990 levels in Annex I countries will delay the doubling of carbon dioxide in the atmosphere by only 7 years.

Several studies have been done to estimate the impact of an emission reduction regime on our economy. A range of estimates exists, but even the most conservative estimate shows large job losses.

According to the 1992 study by the U.S. Department of Commerce, the carbon tax that would help the U.S. achieve emission reductions of a scale now being discussed at the U.N. would cost some 1.7 million U.S. industrial jobs.

The Urban Institute estimated that a carbon tax of $15 per ton would reduce total nonagricultural employment by up to 410,000 jobs. Economists estimate that a carbon tax well over $100 per ton would be needed to meet the requirements of the Berlin Mandate.

CONSAD Research calculated that a total of 1.4 million American jobs could be considered severely at risk under a carbon tax of $24 a ton. Primary metals, oil and gas production, electric and gas utilities, and railroads would have the most jobs at risk. Again, this is a much smaller tax than would be necessary to meet the requirements now being considered by the United Nations.

CONSAD Research also showed substantial production cost increases for energy intensive industries. For example, a carbon tax of $100 per ton raises the cost of producing aluminum by about 20 percent and the cost of cement by 41 percent.

Recently, the administration conducted two studies estimating the economic impact of meeting emission reduction targets. The first was released in June, 1996, and the second is currently in draft form, dated June 1997.

The 1997 study makes new assumptions which reduce the estimate of lost production and implicit job losses by roughly one-half the GDP reductions estimated in the 1996 analysis. The new assumptions also accelerate the economy's recovery by several years. In general, estimated GDP losses are now smaller and recovery occurs sooner. Nonetheless, the administration draft study shows that 900,000 jobs could be lost as a result of climate change policies. The job loss estimate should be considered as very conservative. A more realistic estimate of the impacts of stabilization at 1990 levels may be on the order of 1.25 to 1.5 million jobs, but even larger job losses to achieve a reduction below 1990 levels.

The 1997 administration study does not attempt to measure the impact of the job loss to international competitors who are not subject to emission limitation requirements. This is a critical matter for jobs and incomes which the administration must address.

The administration and its consultants expect that natural gas will displace coal in increasing quantities. The DRI model used by the administration indicates that 57 percent of all emission reduc-

tions by 2010 in the stabilization case would result from reduced demand for coal, increasing to 65 percent by 2020.

A serious consequence of the loss in jobs in the coal industry will be reduction of the fuel diversity in the U.S. Less diversity in fuel use means the economy will be more vulnerable to price and supply fluctuations of imported oil and natural gas.

Both the target concentration level and the timetable for the treaty are still to be negotiated. These are crucial decisions that must be carefully considered because they will have an impact on jobs and incomes. An examination of a range of targets shows that there is time to put together a sound treaty with carefully considered goals and timetables. Negotiations should continue beyond the December Kyoto meeting if that is necessary to arrive at an effective treaty with a minimum of dislocation and cost to the economy.

A target of 550 parts per million is twice the preindustrial level and is often cited by scientists as a desirable goal. To stabilize concentration of carbon dioxide in the atmosphere at 550 parts per million, total world emissions of carbon could increase from current levels of some 6 billion tons per year to a peak of 9 to 11 billion tons by the years 2033 to 2063. Major, near-term reductions of U.S. emissions would not be required to meet such a target.

A target of 650 parts per million, which is well within the range of concentration levels considered appropriate as a long-term target, would allow global carbon emissions to grow to 11 to 13 billion tons by the years 2040 to 2075, reducing rapidly thereafter.

These timetables are considerably longer than the short-term carbon reduction proposals for industrial nations now being debated before the United Nations. Obviously, setting aggressive emission reduction goals for industrial nations could prove to be premature and wasteful if other nations do not make similar commitments.

In its discussion of reducing emissions, the administration does not set a goal in terms of stabilizing carbon dioxide concentrations at a given level. Signatories to the Rio Treaty have not even begun to debate the appropriate target concentration level. Yet such a goal is a key to a lasting solution to the problem that we face and establishing such a goal must logically precede a decision as to what kind of emission requirements to place on any country.

If the administration is serious about stabilizing carbon dioxide concentrations in the atmosphere, obligations must be placed on all nations of the world to reduce or limit their rates of growth of emissions. These reductions and limitations should take into account the economic growth needs of developing nations. Although this is a difficult task, it is the only effective means of accomplishing climate change goals.

Thank you.

Senator HAGEL. Mr. Cunningham, thank you.

We have been joined by my friend and colleague, the Ranking Minority Member of the subcommittee, Senator Sarbanes from Maryland.

Senator Sarbanes, would you like to make a statement?

Senator SARBANES. No, I have no statement, Mr. Chairman. I know that we have a vote problem on the floor and I think it is important to try to get the testimony of these witnesses.

Senator HAGEL. Thank you. Dr. Montgomery.

STATEMENT OF DR. W. DAVID MONTGOMERY, VICE PRESIDENT, CHARLES RIVER ASSOCIATES, WASHINGTON, DC

Dr. MONTGOMERY. Thank you, Mr. Chairman and Senator Sarbanes. It is an honor to appear before you today and I appreciate your invitation.

For the record, my name is David Montgomery. I am Vice President of Charles River Associates and head of the CRA environment practice.

I have a prepared statement which I have submitted for the record and I will try to summarize and hit on the high points of that to try to keep us moving along before the debate.

Just to mention a bit of background, the conclusions that I will be presenting today come from work that we have been doing at Charles River Associates for the past several years where we have developed a set of integrated economic models that deal both with international trade and with national economic impacts of carbon limits. I will draw on the results of several of our studies to try to cover the range of economic impacts that I think are of interest to the committee.

I would also be happy to provide copies of our more detailed studies dealing with these issues for the record. I have some of those here with me.

As you are aware and as Mr. Cunningham mentioned, the current negotiating process is working under a series of guidelines or ground rules set by the Berlin Mandate, which essentially say that the agreement to be brought to the meeting in Kyoto in December should deal with near-term targets and timetables for emission reductions that would only involve the industrial countries and that would exempt the developing countries from any additional commitments.

There have been a number of proposals along those lines. The most ambitious was one from the Alliance of Small Island States to have the industrial countries reduce their emissions to 20 percent below 1990 levels by the year 2005 and then keep them there from there on.

The European Union has made a somewhat more modest proposal of a limit of 85 percent of 1990 levels in the year 2010. They ask that a bubble be provided, essentially for the European Community, that the European Community be allowed to work out its own set of arrangements for meeting that goal while the rest of the world, each country, was subject to a uniform target.

The United States position is not yet explicit, but one possibility that seems potentially consistent with things the administration has been working on would be to cap emissions from industrial countries at 1990 levels from 2010 onwards. That is probably the least binding of the targets that seem to be underway in the negotiations.

I will actually concentrate on that one because that proposal by itself would have serious economic consequences for the United States and any of the others would have potentially similar but larger consequences of the same kind.

So we can add to most of the things that I say, and if one of the more severe proposals is adopted, it will be worse in the same direction.

Any of these proposals would have serious consequences for the U.S. economy as a whole. They would affect the trade position of the United States and they would reduce the international competitiveness of energy intensive industries.

I have not mentioned this much in my prepared statement because I have taken it as a given, but let me mention that, of course, their most severe impacts would be on the energy producing industries themselves. That is something that we need to keep in mind when thinking about all of these consequences.

The effects on U.S. international trade are due in large part to the provision in the Berlin Mandate that developing countries need not agree to any limits on their carbon emissions. Just to cite some of the kinds of economic impacts that are at issue, if any of these proposals is adopted in Kyoto, they would lead to increases in energy prices and costs for U.S. industry and households; they would lead to reductions in U.S. GDP from levels it would otherwise reach; they would increase the costs of U.S. industries relative to their international competitors; they would cause losses in U.S. exports and losses in output and jobs in specific energy producing and energy intensive industries.

I thought what I would do in the remaining time that you have allotted to me is just go through these kinds of impacts. There are, basically, 10 points that I will try to hit and I will try to hit each of them briefly. Then I will make myself available for your questions.

The first point is that even the goal of holding emissions at 1990 levels through 2010 will require a substantial reduction of carbon dioxide emissions from levels they would otherwise reach. The U.S. Energy Information Administration forecasts that carbon dioxide emissions will be 20 to 25 percent above 1990 levels by the year 2010. That means it will take a 25 percent reduction in emissions from what they would otherwise reach in order to meet these targets.

This is going to require quite substantial policies. The administration has indicated a preference for a cap in trade system like that which was set up for sulfur emissions under the Clean Air Act. Another alternative is a carbon tax. We can discuss differences between them at some point. But they will have similar implications for the cost of energy and the prices that consumers and businesses face.

Our studies indicate that the price of an emission permit that is sufficient to meet this cap of holding emissions to 1990 levels would have to reach $150 to $200 per ton of carbon to introduce sufficient fuel switching and energy conservation to reduce emissions by the 25 percent that is required. This is equivalent to about a 50 cent per gallon tax on gasoline, fuel oil, and other petroleum products using industry. It would be an increase of 50 percent or more in the price of natural gas and electricity to households and businesses. And—I am always surprised when I do this calculation but I checked it again—it would increase the price of coal by a factor of about 4 at the mine mouth.

The result of these higher costs of energy would first be a loss of aggregate output in the economy. Since this topic may come up later, like all other economic modelers, we assumed that the revenues from taxes and permits are recycled in the economy. It is not the collection of revenues that causes damage to the economy. It is the change in patterns of energy use and patterns of production and trade patterns that add up to that loss in GDP.

We estimate that, again, for the limit of just holding emissions at 1990 levels, the cost would be on the order of 1 percent of GDP in the year 2010, rising to about 3 percent in later years. I think those are substantial and significant economic impacts.

Countries that do not adopt emission limits, the developing countries that are left out of the process right now, would not incur these costs. These disparities in energy costs will give some developing countries a competitive advantage over the United States.

I have given in my prepared testimony examples of some of the countries that might gain such advantages. Jamaica, because it is an oil importing country, will benefit from lower world oil prices. It produces bauxite, which is a highly energy intensive product which competes with the U.S. aluminum industry.

India, another oil importing country, also has the industrial infrastructure to take advantage of lower costs and compete in a variety of manufactured products.

China, the world's most energy intensive economy, would probably gain significantly in its export markets because it would no longer face such a disadvantage in energy costs if the industrial countries imposed these costs on their manufactured goods and exports.

Industries that are most likely to be affected by carbon limits are, first of all, the energy producing industries. The kinds of reductions in coal production Mr. Cunningham was talking about sound reasonable to me. They not only mean cutting off growth in coal. They mean substantially lower levels of output for the coal industry in 2010 and beyond than it has today.

But there are other energy intensive industries that are likely to be substantially affected. I have put in my prepared testimony a chart which shows the cost increases that we would expect for the top 25 non-energy industries, that is, 25 out of about 100 industries the way we put them together, due to a $100 a ton carbon tax. It shows, for example, that the aluminum industry would face cost increases of about 12 percent.

Now we have looked at the implications of these kinds of cost increases in a couple of our economic models. One is a broad model that looks at patterns of international trade and it suggests that, in general, for the non-ferrous metals industry, we would expect to see losses in output—this is not just exports, but losses in total output—of 2 percent to maybe 10 percent, depending on the region and the strength of the emission limit that we are looking at, and corresponding increases in output for the non-ferrous metals industries in China, in India, and in the rest of the world.

So we definitely reach the conclusion that there will be shifts in output and that carbon limits in the industrial countries not applied to the developing countries will produce a significant shift in the production of some energy intensive goods away from countries

like the United States and toward developing countries that would not be subject to these emission limits.

Now this shift of energy intensive industries to developing countries not subject to emission limits also frustrates the environmental objectives of the United Nations treaty because, as those countries increase the output of their energy intensive industries and increase their use of energy, they will increase their carbon emissions. This is known as the phenomenon of leakage.

Different studies with different models have seen leakage anywhere from 10 percent to 70 percent of the emission reductions that would be recurring in the industrial countries. At the high end of the range, that says for every 3 tons of emission reduction in the U.S., we would only reduce global carbon emissions by 1 ton. That reduces immensely the cost effectiveness of any policy. It increases in direct proportion what it costs to meet any goal for protecting the global climate, which, of course, depends on what every country's emission reductions are.

Let me conclude by pointing out—and this, again, follows on a point Mr. Cunningham made—that the economic costs to the U.S. economy from these near-term emission limits are neither necessary nor sufficient for achieving the goals that are expressed in the Framework Convention on Climate Change.

Climate change depends on the concentrations of greenhouse gases in the atmosphere. There are many different time paths for emissions by which we could achieve any target for concentrations of greenhouse gases. Choosing one of those time paths which delays emission reductions until technologies can be developed to make those emission reductions cheaper and to allow normal turnover of the capital stock and avoid stranding assets throughout the economy can reduce costs by about 30 percent.

Bringing the developing countries into the process so that emission reductions occur where they are cheapest, like in China, with its immensely inefficient coal fired power plants they will be building over the next century, can reduce costs further.

We conclude that appropriate timing of emission reductions, which really means delay of the emission reductions well beyond any of the targets and timetables that are being looked at in the Berlin process and including developing countries can reduce the costs by 90 percent and leave us at the same point or even better in terms of the objectives of the Framework Convention.

Thank you.

[The prepared statement of Dr. Montgomery follows:]

PREPARED STATEMENT OF W. DAVID MONTGOMERY

Mr. Chairman and members of the Subcommittee, I am honored to appear before you to discuss the potential economic impact of a United Nations' global climate treaty. For the record, my name is David Montgomery and I am Vice President of Charles River Associates (CRA) and head of the CRA environment practice. I have been involved in the analysis of economic impacts of climate policies since the late 1980s, when as Assistant Director for Natural Resources and Commerce, I directed the Congressional Budget Office study of carbon taxes. I was a principal lead author of the Second Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), with responsibility for sections on the economic impacts of limiting carbon emissions. Under my direction, we have conducted a series of studies on economic impacts of climate chance policies at CRA, with support from the Electric Power Research Institute, the American Petroleum Institute, the American Automobile Manufacturers Association, and other clients.

In particular, my colleagues and I have developed a set of integrated economic models that deal with international trade and national economic impacts of such limits. I will draw on the results from several of our studies to cover the range of economic impacts that I believe should be of interest to the subcommittee. We are continuing to investigate these issues, and expect to be completing new estimates of economic and trade impacts shortly. I would be happy to provide copies of our more detailed studies dealing with these issues for the record.

As you are aware, international negotiations are now in progress leading up to a meeting in Kyoto, Japan in December. These negotiations are taking place under a set of ground rules known as the "Berlin Mandate," referring to the location of the First Conference of the Parties to the Framework Convention on Climate Change (COP-1). Negotiations under the Berlin Mandate are intended to produce a "protocol, or other legally binding agreement" incorporating quantitative objectives for limiting and reducing Greenhouse gas emissions, for the years 2005 to 2015, and excluding any additional commitments on the part of developing countries.

A number of proposals for such emission limits have been introduced. Three of the most important are from the Alliance of Small Island States, the European Union, and the United States.

AOSIS: limit greenhouse gas emissions from industrial countries to 80% of 1990 levels from 2005 onwards.

European Union: limit emissions from industrial countries to 85% of 1990 levels in 2010, with a "bubble" for the European countries.

United States: support for "hard targets in the medium term," without committing to specific targets or timetables. One possibility is capping emissions from industrial countries at 100% of 1990 levels from 2010 onwards.

Any of these proposals, if adopted, would have serious consequences for the United States economy as a whole, affect the trade position of the United States, and reduce the international competitiveness of energy-intensive industries. The consequences for U.S. international trade are due in large part to the provision in the "Berlin Mandate" that developing countries need not agree to any limits on their carbon emissions.

The important economic impacts of proposals that could be adopted in Kyoto include increases in energy prices and costs for U.S. industry and households, reductions in GDP, increases in costs of U.S. industries relative to their international competitors, losses in U.S. exports, and losses in output and jobs in specific energy producing and energy-intensive industries. I will use results from Charles River Associates' study of a proposal to cap emissions at 1990 levels from 2010 onward to illustrate the potential impacts of an agreement in Kyoto. Any of the other proposals would have similar, but larger, impacts.

The remainder of my testimony is organized to answer the following questions:

- How large a reduction in carbon dioxide emissions could be required?
- How high will the required carbon tax or price of emission permits be?
- How much will energy prices increase?
- What losses in GDP are likely?
- How great a disparity in energy costs between the United States and its international competitors will be created?
- How will the U.S. terms of trade with other countries be affected?
- How will U.S. exports be affected?
- How will output of specific energy intensive industries be affected?
- How does increasing production of energy-intensive goods in developing countries affect progress toward global climate policy objectives?

Holding emissions at 1990 levels from 2010 onwards will require significant efforts, because in the absence of limits on emissions, economic growth will cause rising demand for energy services. Even assuming that there will be substantial future improvements in energy efficiency, the U.S. Energy Information Administration projects that carbon emissions are likely to grow to more than 20% above 1990 levels by 2010. Thus it would be necessary to reduce emissions by 25% or more below the levels they would otherwise reach to meet the 1990 target, and further to comply with more ambitious proposals.

The Administration has indicated that its preferred method of implementing an emission limit is through a "cap and trade" system, similar to that pioneered in the sulfur emission trading program created by the Clean Air Act Amendments. The price of a carbon emission permit would be set in the emission trading market, and would equal the marginal cost of reducing emissions to the required level. Taken from another perspective, the price of an emission permit would equal the carbon tax required to reduce emissions to the level of the cap. Our studies estimate that the price of emission permits would have to reach $150 - $200 per ton to induce

sufficient fuel switching and energy conservation to reduce emissions by 25% in 2010. This is the cost of the most expensive measures required to meet the target - such as building new natural gas combined cycle units to replace coal in existing electric utility power plants, or increasing the cost of new cars to achieve large increases in fuel economy.

This cost would be reflected in the market prices of different forms of energy. A cost of $200 per ton of carbon is equivalent to approximately a 50 cent per gallon tax on gasoline, fuel oil, and other petroleum products used in industry, and an increase of 50% or more in the price of natural gas and electricity to industry and households.

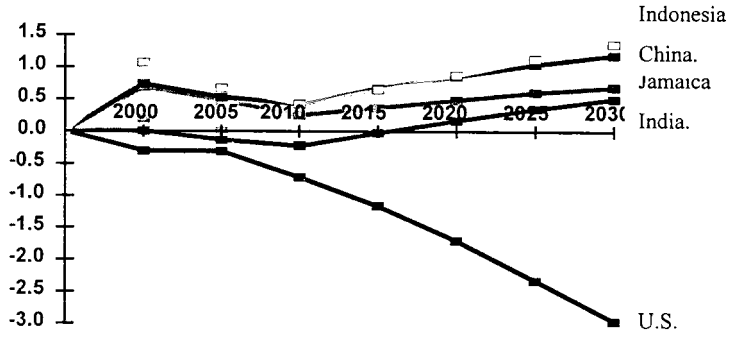
The result of these higher costs of energy would first be a loss in aggregate output in the economy. It is important to emphasize that this loss comes about not because of revenue that would be collected by the Treasury. Like all other economic models, we assume the revenues from taxes or permits are recycled in the economy. The economic cost of emission limits comes from the costs that must be incurred to reduce energy use and switch fuels in order to meet the limits. This is true whether carbon taxes or tradable permits are used. We estimate that holding carbon emissions to 1990 levels from 2010 onward would cause GDP losses on the order of 1% of GDP in 2010, rising in later years as greater efforts are necessary to hold to the cap with rising energy demand.

Countries that do not adopt emission limits will not incur these costs. Indeed, energy importing developing countries will benefit from lower energy costs than they would face in the absence of emission limits, because the drop in fossil fuel demand in industrial countries will put downward pressure on the prices of oil and coal imported by developing countries. These disparities in energy costs will give some developing countries a competitive advantage over the United States. The countries in the best position to exploit this benefit are the more advanced developing countries like Korea, that import most of their oil supplies - thus benefiting from lower world oil prices - and have the industrial infrastructure in place to take advantage of their lower costs and increase their share of world markets.

Differences in energy costs will affect the terms of trade between the U.S. and regions of the world not included in the negotiations for emission limits. Terms of trade measure the price received for exports divided by the price paid for imports. When the terms of trade rise, it means that export prices have risen relative to the cost of imports. The result is that U.S. exports are less competitive on international markets, and imports are more competitive in U.S. markets. We estimate that limiting U.S. emissions to 1990 levels would cause the cost of U.S. exports to rise, relative to the cost of imports, by about 1%.

Overall, U.S. exports are likely to fall, and exports from non-participating countries are likely to rise as a result of the costs imposed on the U.S. by carbon limits. Figure 1 displays our estimates of changes in exports from the United States and selected developing countries, due to adoption of carbon limits in the U.S. and other industrial countries.

Figure 1: Change in Non-Energy Exports Due to Limiting Industrial Country Emissions to 1990 Levels in 2010

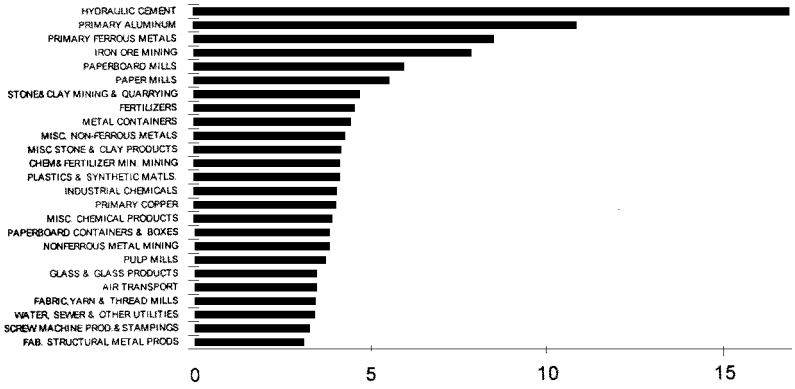


Source: Charles River Associates, International Impact Assessment Model

Jamaica's exports are likely to increase because Jamaica imports oil, whose cost will fall, and exports bauxite, a very energy intensive material. Indonesia is in a position to use its domestic oil and gas production to support increases in its exports of non-energy goods, and China is a very energy-intensive economy whose products will become more competitive when energy costs increase in the industrial countries. India is an oil importing country with the industrial base to take advantage of lower energy costs.

The industries whose competitiveness is most likely to be affected by carbon limits are energy intensive industries. Figure 2 gives an indication of which industries are most likely to be affected. It shows the increase in cost likely to be caused by a $100 permit price or tax on carbon. Both direct costs due to higher energy costs in the industry itself, and indirect cost increases due to changes in the costs of materials purchased by the industry, are included. The industries particularly at risk include cement, pulp and paper, copper, iron and steel, and aluminum.

Figure 2: Direct and Indirect Cost Increases in Top 25 Non-Energy Industries Due to a $100 Carbon Tax (Percentage Change from Baseline, 2000)



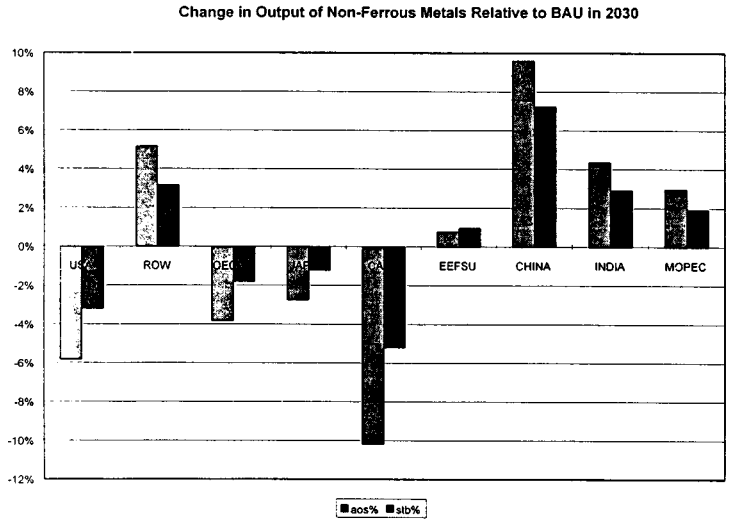
Source: Charles River Associates, *Economic Impacts of Carbon Taxes*, EPRI TR-104430-V1

How large a loss in output will be caused by such cost increases depends on several factors: how sensitive demand for the products of the industry is to their price, what kinds of substitutes are available, and in particular whether competitors producing the same goods in other countries are subject to the same emission limits.

Figure 3 contains results from our most comprehensive dynamic model of international trade that incorporates 9 world regions, 6 non-energy industries, and a detailed representation of energy production and use. These results give an example of how emission limits applying to just the industrial countries could affect output of the nonferrous metals industries, which include several of the industries with the largest likely cost increases in Figure 2. Output of these industries in the United States and all other OECD countries would fall, while output in developing countries such as China not subject to emission limits would rise.

Employment in affected industries will be also be reduced by the reduction in their output, compared to levels projected in the absence of emission limits. Energy industries, of course, will shrink most, with coal likely to suffer the largest losses.

Figure 3: Change in Output of Non-Ferrous Metals Under AOSIS Proposal and Under Proposal to Limit Industrial Country Emissions to 1990 Levels



Source: Charles River Associates, Carbon Emissions Trade Model

In another recent study, we examined three energy-intensive industries in more detail: aluminum, copper, and pulp and paper. In all three cases we concluded that increased energy costs due to emission limits could have significant effects on output of these industries in the United States between 2010 and 2030, ranging from about 5% for the copper industry to over a 50% loss in output for the aluminum industry. We made these estimates by comparing the cost of expanding capacity in countries not subject to emission limits to the costs of continuing operations in the United States. We concluded that because of their advantages in energy cost, many of the countries that are exempt from carbon limits under current proposals could expand output and capacity at a cost less than the cost of continued operations in the United States, and at significantly less than the cost of adding new capacity in the United States.

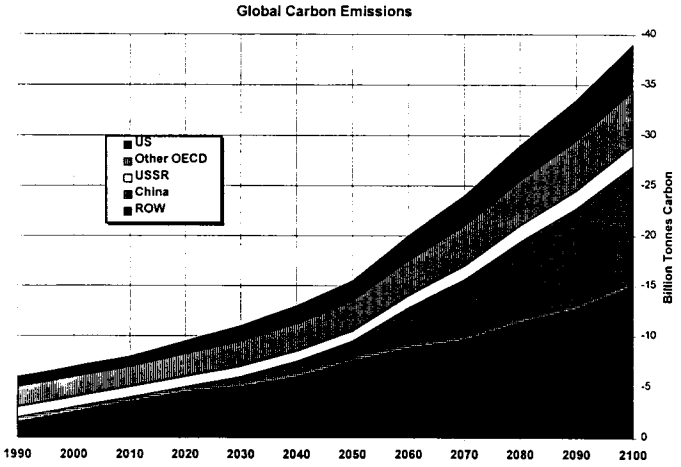
The shift of energy-intensive industries to developing countries not subject to emission limits also frustrates the environmental objectives of the United Nations treaty. Since the developing countries will be producing more energy-intensive goods, and using more energy, than they would in the absence of emission limits on the industrial countries, carbon emissions from developing countries will rise. This increase in emissions from exempt countries is known as "carbon leakage." In another recent study my colleagues estimate that carbon leakage could be about 12% -- for every 8 tons of emissions reduced by the United States, global emissions would fall by only 7 tons because there would be I ton of increased emissions from developing countries. Other studies have found even higher leakage, some implying that two-thirds of the emission reductions from the industrial countries would be offset by increases in the developing world. (see T. F. Rutherford in An Economic Perspective on Climate Change Policies, American Council for Capital Formation, 1995). The phenomenon of leakage follows solely from the failure to include developing countries in the process of limiting emissions, and significantly increases the cost of reaching any goal for global emissions.

Finally, I would like to put these economic impacts in a broader perspective. Near term limits on emissions from the industrial countries are neither necessary nor sufficient to address global climate change. These are the issues of "where and when" flexibility. As the Framework Convention on Climate Change itself recognizes, it is the concentration of greenhouse gases in the atmosphere that matters for climate change. There are many different time profiles of emissions that can produce the

same effect on ultimate concentrations of greenhouse gases (the definitive study on this subject is by Wigley, Richels and Edmonds in Nature, March 1996.) Delaying emission reductions to allow time to develop new technologies that will provide substitutes for fossil fuels at lower cost than any available today, and to deploy those technologies as the capital stock turns over naturally, can reduce economic impacts dramatically.

Costs can also be reduced by bringing developing countries into the process. As Figure 4 illustrates, the developing countries will be responsible for the vast majority of the world's carbon emissions over the next century. Even eliminating carbon emissions from the industrial countries would not be sufficient to keep carbon concentrations in the atmosphere from rising. Moreover, countries like China could reduce emissions from planned coal-fired power plants far more cheaply than the United States can squeeze further improvements out of its already efficient systems.

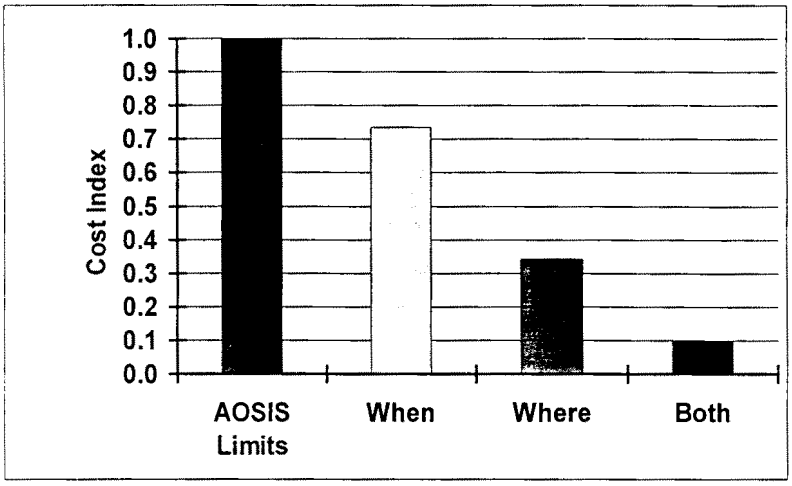
Figure 4: Relative Carbon Contributions of Different Regions



(Adapted from Alan Manne and Richard Richels, *Buying Greenhouse Insurance*, MIT 1992, p. 91)

Figure 5 illustrates the cost savings that are possible. These results were developed as part of an IPCC exercise examining where and when flexibility. The first bar represents the costs of meeting the AOSIS targets as a reference. Each other bar shows global costs of achieving the same total reduction in emissions that would be achieved under AOSIS in the 2000-2050 time period. The second bar assumes that the industrial countries are still solely responsible for emission reductions, but are allowed to choose the timing of emission reduction flexibly. The third bar assumes no flexibility in timing, but that the burden of achieving the emission reductions required by AOSIS is spread across all countries, including developing countries. The fourth bar includes both flexible timing and inclusion of developing countries in emission reduction. These results show that it is possible to reduce costs by 90% by allowing time to develop lower cost technologies and to bring developing countries fully into the process of reducing emissions. All this is possible while achieving the same results for protection of the global climate.

Figure 5: Cost Savings from Where and When Flexibility



Source: Charles River Associates, International Impact Assessment Model

To recap my testimony, let me make a series of points.

- The proposals now under consideration in negotiations on the United Nations climate treaty could have significant economic impacts on the United States.
- They would increase energy costs in the United States relative to competing countries that are not being asked to make commitments to reduce carbon emissions.
- These cost increases are likely to reduce U.S. exports and confer trade advantages on industries in the same developing countries.
- Energy-producing and energy-intensive industries are likely to suffer losses in output and employment if any of these proposals are adopted.
- Failure to include developing countries in any agreement to limit emissions results in carbon leakage that significantly increases the cost of achieving the goals of climate policy.
- Substituting investment in science and technology for near term emission limits, and including developing countries in commitments to limit emissions, can reduce costs by as much as 90% while achieving the same or better effects on concentrations of greenhouse gases in the atmosphere.

Senator HAGEL. Dr. Montgomery, we thank you very much.

Senator, we have a vote right now. I think this will be a good time to recess until we return.

The subcommittee will stand in recess and we will be coming straight back.

[Recess]

Senator HAGEL. The subcommittee will come to order.

We have been joined by my colleague from Wyoming, Senator Craig Thomas, who is a member of the full Foreign Relations Committee as well as this subcommittee and who also serves as chairman of the Asian Subcommittee. I would ask Senator Thomas for any comments or remarks.

Senator THOMAS. Thank you, Mr. Chairman. I have a couple some remarks to make.

As I stated last week, I am opposed to any efforts that would set legally binding targets and timetables on developed countries to reduce greenhouse emissions, while at the same time exempting de-

veloping countries. I do not believe this process is based on good policy judgments, or sound science.

Restricting economic growth in this country while allowing developing nations, such as China, Mexico, South Korea, Brazil, and India the unlimited use of fossil fuels will insure nothing less than worsening the problem we claim we want to fix.

I am pleased that 64 Members of the Senate have co-sponsored the resolution introduced by Senators Byrd and Hagel, which represents this same point of view.

Hopefully, we will get the attention of the administration and they will refrain from signing any binding agreement for industrialized countries in Kyoto this December. Rushing into this agreement will, I believe, hurt America's economic competitiveness for questionable benefits.

I am also concerned that the U.S. will see a shift of jobs from our soil to overseas. We should constantly work to reduce air pollution. But we should continue to do that around the world, and everyone must participate.

However, this must be done in a manner that does not threaten our jobs or international competitiveness.

I appreciate the efforts of the chairman and this subcommittee to continue to work on this. I shall continue to work on it as well. I hope we can slow the administration, stop the administration, from committing to any binding agreements.

Mr. Chairman, I am pleased to be here and glad you are having this hearing.

Senator HAGEL. Senator Thomas, thank you.

Now I would like to introduce our fourth panelist, Jerry Jasinowski, who is President of the National Association of Manufacturers.

Jerry, we are pleased to have you. I understand you have a date with Carol Browner at 11:30. We would be very pleased to receive your remarks and then in whatever time you have remaining, Senator Sarbanes and the rest of us might ask a question or two.

Senator SARBANES. Has Dr. Repetto given his testimony?

Senator HAGEL. He will be next, after Mr. Jasinowski.

STATEMENT OF HON. JERRY J. JASINOWSKI, PRESIDENT, NATIONAL ASSOCIATION OF MANUFACTURERS, WASHINGTON, D.C.

Mr. JASINOWSKI. Thank you very much, Mr. Chairman. I would want to say good morning to Senator Thomas and Senator Sarbanes and to thank the committee for its leadership on this very important issue.

I have a longer statement I would like submitted for the record and would like to make several points briefly in summary about the economic impact and why this is an unworkable treaty.

As you know, I am President of the National Association of Manufacturers. We have 14,000 companies, 10,000 of which are small, all across the country, covering all the industries that would be impacted by this treaty and representing 18 million workers.

As a result, we have a very big stake in this, Mr. Chairman, and I would say that, first, we feel that the global climate issue is a very important one and that we ought to continue to make progress

in understanding it and make progress in even reducing emissions through means of greater energy efficiency, exporting technology that reduce pollution abroad, and studying this problem so that we understand the real science.

Manufacturers have been responsible for about two-thirds of the investment in pollution control over the last 2 decades, and we have a terrific record in the United States of having made progress on air quality. We want to continue to do that.

Our record certainly is as good or better than that of the Europeans, notwithstanding some of the comments in the press recently by the Europeans.

Our problem with this proposal, Mr. Chairman, is that it calls for a legally binding international agreement on only industrialized countries, not the developing countries, which will make it unworkable since we won't be able to reduce emissions properly, and it also will put us at a considerable trade and competitive disadvantage, which will cause the loss of jobs in this country and severely damage several industries. This, in turn, will affect workers and have an enormous effect on the economy as a whole.

Let me say before I go into the details of the economic impact that I would want to subscribe to pretty much everything that David Montgomery said. As I carefully listened to what he said, the range of economic estimates that he made for every aspect of a proposal to cap the 1990 emissions by 2010 reflects pretty much what we know from the studies that we have looked at as well as a great deal of information from these real live manufacturers who are out there analyzing and trying to understand what this treaty means.

I think that the estimates are pretty much congruent with Mr. Cunningham's proposals and analyses as well. But let me go through and repeat these in terms of six major reasons why we are opposed to a legally binding treaty—not opposed to moving forward with dealing with this important global issue.

I might say before doing that that we support Senate Resolution 98, which you have shown great leadership in sponsoring as well.

Turning to the enormous negative impact associated with this on the economy as a whole and repeating some of what David Montgomery said, if you look at this overall, what you see from DRI studies, his analyses, comments and analyses from Professor Nordhaus, the Australian studies, basically you see a 1 to 2 percent reduction in GDP growth, which would give you roughly a $100 billion plus increase in costs associated with moving or capping the 1990 emissions.

It could be as high as $200 billion, but let's take the most conservative estimates.

From this, you see from our members and the Argonne Lab analyses that we are looking at a 5 to 10 percent increase in the cost of most of the industries affected. Mr. Montgomery's chart does an excellent job of telling you precisely what industries these are. But we are talking about steel, petroleum, paper, coal, chemicals, transportation, aluminum, utilities, and all the related industries. So we are talking about an extraordinary expanse of American industry that would have a 5 to 10 percent increase in their costs.

Now, Mr. Chairman, as you know, in today's global economy you cannot raise prices. The average price increase for manufacturing

over the last 5 years has been 1 to 2 percent. It is impossible—it is impossible—to pass on a 10 percent increase in this global economy. So what happens? The next thing is that you lose out on your global competitiveness. You are not able, of course, to export. Once that happens, you look at it and say look, I cannot produce in the United States the way I could before. Unfortunately, Mr. Chairman—this is not suggested as any kind of threat; it is the reality—firms will move abroad. This absurd design of the treaty that leaves out developing countries means that we are going to move to developing countries in order to produce cement, or chemicals, or these other matters. This is going to mean an extraordinary loss of jobs, which is a very large part of the reason that the NAM and the AFL–CIO both oppose this binding, legal agreement at this time.

So if you look at the macro effects, they are enormous in terms of GNP, trade competitiveness, the cost of industries, the specific industry affected, and in jobs.

As you go down that ladder, it also gets very damaging with respect to consumers and workers.

Now the job estimates are hard to come by altogether. In my own testimony, in the written part, I would like to correct a statement at the beginning, where it says millions of jobs lost. My estimate is that we are talking about something between 1 million and several hundred thousand. Some suggest, and I know the AFL–CIO think, that it could be even higher. I don't know that it ever got into the millions.

What was the highest estimate that you had?

Mr. CUNNINGHAM. We estimated at 1.25 to 1.5 million. That is based upon the administration's study for stabilization at 1990 levels.

Mr. JASINOWSKI. I could go to 1.2 million. I just did not want to suggest that it is millions and millions. We are talking that it could be that, but we are talking, conservatively, about something in the range of a million to several hundred thousand associated with these GNP losses.

The numbers are hard to believe, as Mr. Montgomery said—a 50 percent increase in gasoline, a four-fold increase in coal, fuel oil increases of 60 to 70 percent. These are at, again, the minimum proposal that is being discussed in this treaty negotiation.

So what you have here as a result of these extraordinary economic impacts is this. I really should have mentioned agriculture, where you see, and I am sure you are aware in your own State, everything from fuel oil to fertilizer, to pesticides, are going to increase in costs. Our ability to compete in terms of the farm industry is going to be damaged.

As a result, what we see are small business, energy intensive industry, manufacturing, utilities, agriculture, labor unions, and I think increasingly mayors and Governors saying why are we in a situation where we are pursuing an extreme set of proposals in terms of its economic impact and at the same time, to go to my next point, leaving out the developing countries.

In my statement I say not only do you harm the United States economically because what you do is put them at a trade disadvantage and you shift production abroad, but what you have because

of leakage and what you have because you are leaving out these developing countries is that you don't achieve your goal.

I mean, it is a little bit absurd, when we are looking forward over the next decade or so, where the developing countries will contribute three-quarters of the greenhouse gas emissions, and where China's emissions are going to double, that we would, in fact, consider a proposal where we would shoot ourselves in the foot economically, give a competitive advantage to the developing countries that we are struggling to compete with, and we support open trade, and we support fair competition, and we fought along many of you for China MFN. Why would we, in fact, give ourselves a competitive disadvantage and then not achieve our environmental goal because of leakage and the fact that these people do not have to comply with the treaty?

It is, I think, even for serious analysts, absurd to really think that this kind of proposal makes sense for the American people.

If you go on and look at other aspects of the economic impact, besides the ones that I mentioned, you begin to ask yourself this question: If the economic impact is so large and if by leaving out the developing countries the treaty becomes so unworkable, what about the rest of the proposals with respect to the treaty in terms of a mechanism that will achieve the results?

There I think what is striking is the extent to which we do not really know what the administration proposal is.

Now I know that there is some inconsistency in what I am saying. On the one hand, I am outraged by what are, I think, some extraordinarily ambitious environmental goals and their negative impact. On the other hand, we don't know what the administration is proposing.

I must say in my 15 years of public policy experience that I have never seen a case where we had something this important. Some people suggest that it has the largest potential economic impact on the United States of anything—the tax bill, the regulatory bill that we heard announced yesterday—and yet we have very few facts from the administration as to what our proposal is. We are supposed to go to Kyoto in 6 months and decide this legally binding treaty.

We don't know what the economic impact is. We don't know what the goals are. We don't know what mechanism it will be. Is it a carbon tax? Is it a trading system? How do we do it? Then, beyond that, what is the enforcement mechanism that would achieve this?

People talk, and I certainly am sympathetic to trading mechanisms because they use price signals. But can you imagine a trading regime on a worldwide basis even being able to track emissions well enough to know who can trade what? I think it is very close to impossible.

So what you have, I think, is a lack of specifics as to what we are asking the Senate and this committee to go forward with. It seems to me this cries out for a much larger national debate before we go forward with this treaty.

So in conclusion, Mr. Chairman, we think that we ought not to go forward with the legally binding treaty at this time because we don't have enough information on the science, which I have not gone into but you have taken great testimony on it and it is not

convincing. The adverse economic impacts are huge. We ought not to go forward as long as the developing countries are not full participants.

Now I have debated the environmentalists on this issue many times and all of them who are thoughtful analysts agree that this will not work unless the developing countries are included.

Bill Nordhaus, who is a leading economist who supports moving forward, says it won't work unless you've got the developing countries.

So let's not kid ourselves. Let's take time to do the analyses and have the national debate that this important issue requires.

Thank you, Mr. Chairman.

[See appendix for longer statement submitted by Mr. Jasinowski.]

[The prepared statement of Mr. Jasinowski follows:]

PREPARED STATEMENT OF JERRY JASINOWSKI

Senator Hagel, and others: Good morning. My name is Jerry Jasinowski. I am President of the National Association of Manufacturers, the nation's oldest and largest broad-based industrial trade association. Its 14,000 member companies and subsidiaries, including approximately 10,000 small manufacturers, are in every state and produce about 85 percent of U.S. manufactured goods. The NAM's member companies and affiliated associations represent every industrial sector and employ more than 18 million people. The NAM's mission is to enhance the competitiveness of manufacturers and improve living standards for working Americans by shaping a legislative and regulatory environment conducive to U.S. economic growth, and to increase understanding among policymakers, the media and the general public about the importance of manufacturing to America's economic strength.

The National Association of Manufacturers opposes a legally binding international agreement on climate change that requires industrialized nations to reduce level of greenhouse gas emissions, to the exclusion of developing nations. Such an agreement would hurt America's manufacturers, workers and families, with little or no environmental benefit, since new restrictive energy policies in the U.S. simply would force the flight of U.S. investment to developing countries. Millions of Americans would lose their jobs, and American manufacturers could take a severe hit in the world marketplace. With no consensus in the scientific community to support the theory of enhanced global warming, it makes no sense for the U.S. to participate in an international political compromise that would employ drastic measures without reaching its goal.

I commend the Chairman for his leadership in holding this hearing today to help get more input on this important issue. We support Senate Resolution 98, sponsored by 64 senators, which Senator Byrd and Hagel introduced recently. We appreciate your leadership on this critical issue that will affect all Americans.

On behalf of the NAM, let me suggest six areas that animate our opposition to adoption of a binding treaty this year:

1. First, Adoption of Legally Binding Emission Reduction Commitments Will Profoundly Impact the U.S. Economy.

If legally binding caps are placed on greenhouse gas emissions in developed countries and not on developing countries as well, the United States will experience a slowdown in economic growth, a reduction in manufacturing productivity and competitiveness, a flight of domestic industry to locate abroad, and a loss of jobs. These are indisputable facts supported by a number of studies.

According to William Nordhaus of Yale University, "the magnitude of the global investments necessary to make a significant dent in the problem (would be) probably hundreds of billions of dollars a year."

A report prepared by DRI/McGraw Hill estimated a decline in the GDP of 2-3 percent ($140-200 billion) if carbon emissions are stabilized at 1990 levels by the year 2010. A recent study by the Pacific Northwest Laboratory found that stabilizing greenhouse gas emissions will result in a 1-2% reduction in GDP.

We have learned from our members that some industries are at particular risk: primary aluminum, primary ferrous metals, iron ore mining, pulp and paper mills, chemical and fertilizer mineral mining, industrial chemicals, and transportation industries. Production costs could increase substantially; for example, 15% for blast

furnaces and steel mills, 9% for primary aluminum, chemical and fertilizer mineral industries, and 6-8% for paper and pulp mills.

A draft report not yet published by the Department of Energy's Argonne Lab evaluated the impacts of reducing greenhouse emissions to 1990 levels by the year 2010. One scenario estimates the price of electricity would increase by 50 percent, the price of coal would more than double, the price of natural gas and fuel oil would increase by 70-80 percent. As a result, the U.S. trade competitiveness in six energy-intensive industries would significantly decline, and those industries would relocate production capacity abroad to developing countries with no emission caps. These industries include: iron and steel, petroleum, paper and allied products, aluminum, chemical and cement industries.

2. Proposed Commitments Would Also Result in Substantial Costs to Americans, Including Higher Energy Costs and Job Loss.

A carbon tax set high enough to achieve the proposed reduction goals would cause gasoline, fuel oil, and electricity, prices to rise by 50 percent. A recent Data Research International study concluded that to merely stabilize emission to 1990 levels by 2010 would require a tax of as much as $200 per ton of carbon. That is the equivalent of $23 tax per barrel of oil. The impact on a family is estimated as high as $5,000 per year for a family of four.

Impacts would be severe on agriculture. Crop production products, diesel fuel, feed and seed, electricity, and fuels, would affect food pricing and availability.

The AFL-CIO's Executive Council adopted a resolution in February 1997 condemning the exclusion of developing countries from efforts to negotiate legally binding carbon restrictions because it will "create a powerful incentive for transnational corporations to export jobs, capital and pollution, and create an uneven playing field that will cause the loss of high-paying U.S. jobs in the mining, manufacturing, transport and other sectors."

Job losses will result from economic slowdown and rising unemployment. Estimates range from the DRI study's one million jobs lost to Charles River Associates study showing at least 250,000 American jobs. DOE's Argonne lab estimated job losses of 23,000 for aluminum smelters, the chemical industry could experience job losses by as much as 75,000, in the cement industry by as many as 5,800.

3. By Exempting Developing Countries from the Treaty, the Proposed Commitments Will Negatively Impact U.S. Trade Competitiveness Without any Net Environmental Benefit.

Greenhouse gas emissions in developing countries are rapidly increasing and are expected to surpass emissions of the United States and other OECD countries as early as 2015. Developing nations are expected to contribute 76 percent of total greenhouse gas emissions within the next fifty years. Developing countries are expected to be responsible for as much as 85 percent of the projected increase in carbon dioxide emissions.

The majority of greenhouse gas emissions in the next century will come from China, India, Brazil, Indonesia, Singapore and others as a result of their projected population surges and economic growth. By 2015, developing countries' emissions will have increased by more than 141% over 1990 levels while the OECD countries' emissions will increase only 30%.

A recently-released study from the Australian Bureau of Agriculture and Resource Economics stated that by the early part of the 21st century, China's emissions alone will be nearly double the amount emitted by the U.S. and triple that of the European Union.

Developing countries will experience a surge in economic growth as industry shifts their production capacity abroad to areas with no greenhouse gas emission caps (and probably little to no environmental pollution control requirements). Industries leading the exodus from the U.S. are those that are most energy-intensive, as discussed earlier.

4. The U.S. Should Not Agree to New Commitments Without a Full Debate of the Economic Realities and Public Debate on Whether the Costs to the American Economy are Justified.

The Administration's proposal has been inadequately developed and disclosed and this raises serious questions about its workability. The Administration's analysis of economic impacts of global climate change proposals has not been complete .

What are the goals? What measures will have to be taken to reach those goals? How will it be enforced? These are all crucial questions that need to be answered as part of the Treaty negotiations.

The Administration has given indications that it favors an international permit trading scheme as the implementing mechanism to meet a binding emissions target.

EPA has been evaluating a wide number of implementation options. While details are still lacking, the primary focus has been on an emissions trading system or some form of carbon tax.

A carbon dioxide trading program would be unworkable since it could potentially involve millions of emitters with wide variations in categories of sources. A carbon dioxide trading program would have to be administered world-wide. The initial allocation of emission permits would be extremely controversial and hard fought politically. Once assigned, how would such a system be monitored and enforced? Who would implement this program and how would it work?

A carbon tax would be a blind stab in the dark, set at a politically acceptable (rather than scientifically defined) level with only the vaguest idea of whether or not it would achieve a politically determined level of emissions reductions.

5. Progress is Being Made to Reduce Carbon Dioxide Emissions.

Progress is being made toward the goal established in May 1992 to limit greenhouse gas emissions to 1990 levels by the year 2000. Between 1950 and 1985, carbon dioxide emissions per unit of GDP fell 1.3 percent a year as a result of more energy-efficient technologies and lifestyles in our country.

Refinements in manufacturing processes are reducing the units of energy needed to produce a given product; the discovery of new, lighter materials, insulating products, adhesives, and coatings is contributing to the process.

America's manufacturers are improving energy efficiency, reducing emissions, accelerating commercialization of new technologies, and assisting governments and industries in less advanced countries.

Individual companies, such as British Petroleum, have begun to develop their own carbon dioxide emission reduction plans. They include developing a better understanding of how emissions of carbon dioxide can be monitored and controlled.

Pollution prevention and reduction efforts have resulted in more complete use of current inputs to the manufacturing process. The drive for profits and greater productivity is inseparable from the trend toward cleaner and more energy-efficient manufacturing techniques.

Many NAM members are helping develop and commercialize new technologies to reduce greenhouse gas emissions. For example, electrification of machines and processes that were once powered by free-standing internal combustion engines; development of fuel cell technologies and photovoltaic cells; and innovations in lightweight materials. They are helping to transfer this promising new technology to developing countries as well.

The Federal Government should expand its programs to promote the export of energy-efficient technologies as well as environmental pollution control and monitoring technologies.

6. Given the State of the Science, the U.S. Should Not Compromise its Economy and American Jobs.

We don't have strong evidence on how much, how fast, or in which direction global climate change is going. So how can we set mandates on greenhouse gas reductions?

The science of predicting man's influence on global temperatures is inexact. The argument for man-induced climate change rests on estimates generated by mathematical, computer-driven simulations. These models must be revised and updated based on new data.

The Intergovernmental Panel on Climate Change (IPCC), a joint effort of the United Nations and the World Meteorological Organization, bases its global climate change assumptions on a General Circulation Model, which attempts to replicate complex climate processes. As a result to changes in the model and its underlying assumptions, the IPCC has revised its estimates of global temperature change downward by about 30% in its Second Assessment published in 1995, as revised from its original estimates presented in 1990.

However, global temperature changes have also been measured by satellite, weather balloons, and land-based systems. Each method predicts different forecasts for global climate, some even showing cooling trends.

There are other variables involved in creating global climate conditions. A study was published last year by the Lawrence Livermore Laboratory that showed global climate was affected by both warming from greenhouse gases and cooling from sulfates. In 1995, the IPCC agreed that increases in sulfate aerosols are partially counteracting warming due to increases in greenhouse gases.

Conclusion.

In conclusion, we urge the Senate not to ratify any treaty that imposes limits or reductions in greenhouse gas emissions unless the science supporting global climate change is more convincing, the adverse economic impacts better understood, the de-

veloping countries are full participants, and an enforcement regime is understood. In short, there must be much more complete debate before the Senate is asked to ratify a binding treaty.

Senator HAGEL. Thank you very much, Mr. Jasinowski. Dr. Repetto.

STATEMENT OF DR. ROBERT REPETTO, VICE PRESIDENT AND SENIOR ECONOMIST, WORLD RESOURCES INSTITUTE, WASHINGTON, DC

Dr. REPETTO. Thank you, sir.

My testimony today will address the two issues that we have been discussing, that is, the economic impacts in the United States of limiting CO_2 emissions——

Senator SARBANES. Dr. Repetto, if you would pull the microphone closer to you, it would be helpful.

Dr. REPETTO. Yes, sir. Thanks very much.

Senator SARBANES. You really need to speak right into it in order for it to work.

Dr. REPETTO. Thank you, sir.

Second is the relationship between the U.S. and the developing countries in limiting global emissions.

I am going to provide the highlights of two reports that WRI, World Resources Institute, has just released, which I would like to submit for the record, sir.

Senator HAGEL. Yes.

[The material was received and has been retained in committee files.]

Dr. REPETTO. It undoubtedly, as my predecessors said, is extremely important to analyze and understand the economic impacts of limiting CO_2 emissions. The administration has analyzed the issue. They are apparently about to release a report on it. There is a large number of predictions and forecasts circulating outside Government. We just heard some of them.

All of these forecasts and predictions are necessarily based on macroeconomic models that simulate the economic impacts of limiting fossil energy use.

Many of these models are highly complicated. They are hard to understand. But, nonetheless, they are gross simplifications of how the economy actually works.

They are essentially a set of assumptions, and the predictions that come out of them are 100 percent determined by the assumptions that are built into them.

What we have done to try to understand this issue is we have collected essentially all of the credible economic models that are available, that are being used, have been used to analyze this issue—16 models. It includes the three that the administration has used. It includes those developed by the OECD, by some of the national laboratories, by academic economists at Harvard, Stanford, and elsewhere, models developed by consulting firms, like Charles River Associates, DRI.

We have built a data base of 162 different model simulations of what would be the impact of enacting policies to limit CO_2 emissions. Those predictions are presented graphically in Exhibit 1, in the back of my written testimony, Mr. Chairman.

As you can see, being the work of economists, the predictions are all over the map. But this is not simply noise. What we have found is that 83 percent of the difference among these predictions is attributable to six basic assumptions built into the models.

So, in other words, if you understand these 6 basic assumptions, you've got 83 percent of the difference among all of these economic predictions of the impact of limiting CO_2 emissions, achieving any limitation targets. This is pretty remarkable, in fact, because it implies that the hundreds of other coefficients, parameters, and other assumptions built into the models collectively result in the remaining 17 percent of the differences.

Now what are these basic assumptions?

First, about the nature of economic behavior, will firms and consumers in the long run respond efficiently to changes in energy prices to take advantage of opportunities to limit cost increases and so on? Models that assume that firms and consumers reallocate their resources efficiently in the long run predict much smaller impacts from limiting CO_2 emissions.

Second, will some backstop, nonfossil energy sources, such as hydroelectricity, nuclear power, solar and wind energy be available at stable prices as fossil fuel costs rise? If that is true, it will limit the increase in energy prices. Models that ignore the existence of nonfossil alternative energy sources predict much higher cost of stabilizing CO_2 emissions in the long run.

Third, will nations cooperate to take advantage of low cost opportunities to reduce emissions by undertaking joint implementation or by trading CO_2 emissions permits internationally?

Models that assume that the United States must meet its reduction target in isolation predict much higher costs because there are potential gains from trade for taking advantage of low cost emissions reductions opportunities elsewhere.

Fourth, will the policy instrument used to reduce CO_2 emissions generate revenues that will be used, can be used, to cut other business taxes? For example, would business income or payroll taxes be cut and the revenues be made up by auctioning off carbon permits or through some tax or fee mechanism? Models that ignore the possibility of reducing other burdensome taxes through these revenues predict much more adverse economic impacts.

Fifth, will reducing fossil fuel consumption avoid damages from a change in climate? Most of the models used to analyze this climate policy have no climate in them so that there are no potential costs to the economy, no droughts, no floods from climate change.

Models that try to build in the costs of a change in climate predict, on balance, a less unfavorable economic impact.

Finally, will reducing fossil fuel and particularly coal use reduce damages from conventional air pollution? Will the switch to cleaner fuels reduce health damages, health expenditures, and so on? Models that try to build in the reduced damages from lower pollution, again on balance, predict less unfavorable economic impacts.

Now what we have done is shown the result of moving from a set of unfavorable assumptions on these six points to a more optimistic set. Exhibit 2 indicates—and I want to emphasize that these results are not based on our model or some "green" model; it is based on the models that are out there, other people's models. It

simply derives from them a consensus set of predictions based on the underlying assumptions.

Under the worst case assumptions, achieving the target that Mr. Montgomery spoke about, that is, stabilizing emissions at 1990 levels and holding them there, would result in a loss in GDP of about 2.4 percent, compared to business as usual projections by the year 2020.

This is not by any means an insubstantial loss. It implies that by 2020, the economy would be approximately 70 percent larger than today's rather than 74 percent larger than today's.

The remainder of that exhibit shows the effects of altering those assumptions within these 16 models. Assuming that firms and households react efficiently cuts the loss to about 1 percent of GDP. Assuming that joint implementation opportunities would be available cuts it again to about 0.5 percent of GDP.

Assuming that there will be noncarbon alternative energy sources available at competitive prices cuts the losses to a very small figure.

Assuming that the policy instrument used will generate revenues that are then used to cut burdensome business taxes means that, in fact, the economy would be somewhat larger in 2020 than it would be today. Building in the reduced environmental damages implies that the net economic benefits would be larger still.

So these are the results of this body of analysis of 16 models, 162. It shows a range of going from worst case to best case assumptions. Of course, one need not assume either the worst case or the best set. One can form a judgment as to what other realistic assumptions about how the economy will work, what energy sources will be available, what policy approaches are feasible and so on, and then derive a corresponding judgment about what the economic impacts will be.

Of course, three of these key assumptions are policy variables. One, will we be able to practice joint implementations? Mr. Jasinowski says that to do that will take an awful lot of institutional work to create a framework. But all analyses show that the potential gains are very, very large.

For example, it could limit the increase, the necessary increase, in the price of carbon fuels, reduce that increase by more than 50 percent if we can do joint implementation.

Second, if revenues are raised out of this policy that are then used to cut other burdensome taxes, say by auctioning off rather than grandfathering or giving away carbon permits, that would have substantial economic benefits.

Third, the Federal Government can, in cooperation with industry, pursue research and development programs to make nonfossil energy sources more widely available at lower prices. These are policy measures that can be used to mitigate the cost increase.

Now let me just turn briefly to the question of international competitiveness.

It is absolutely true that, unless the developing countries and the transitional countries participate, it is going to be impossible to stabilize CO_2 concentrations. This is a global issue.

There are two underlying concerns. One, which has been discussed extensively, is about the competitiveness if the U.S. and other advanced countries go first.

I think this competitive issue is exaggerated. There is scant empirical evidence that having low energy prices confers an international trading advantage.

There are many countries in the world that have maintained low energy prices, such as the former Soviet Union, Russia, China, Mexico, Venezuela and others. These countries have not been highly competitive in industry, industrial trade. As a matter of fact, having low energy prices has contributed to economic crises and collapse in many of those countries because they have contributed to highly inefficient deficit running enterprises and overall fiscal deficits.

Consequently, since 1990, what has been happening around the world is that many of these countries unilaterally, for their own self interest and economic motives, have been raising energy prices.

In the former Soviet Union, in India, in China and in other countries, between 1990 and 1995, fossil fuel subsidies have been reduced by from 45 percent. Many of these countries have already begun restructuring energy markets, privatizing energy industries, inviting participation from private, independent power producers, other private energy companies, with the result that there has been increased investment in high efficiency cogeneration facilities and combined cycle gas fired power plants because they are more efficient and cheaper.

Countries have been doing that unilaterally throughout the developing world for their own economic reasons. U.S. companies have been participating in that business.

They have been promoting energy efficiency and renewable energy. Mexico, for example, has developed energy efficiency standards for appliances, buildings, electric motors and industrial boilers. India provides depreciation, immediate depreciation, write-off, and customs exemption for wind turbines and so on.

There is no reason why these countries will not continue to do that because it is in their own interest whether they accept binding commitments to limit CO_2 emissions or not.

I think that those past and continuing policy changes to raise energy prices, to raise energy efficiency, and to reduce CO_2 emissions in our major and other large developing, emerging market countries should not be overlooked in this discussion.

Thank you very much, sir.

[The prepared statement of Dr. Repetto follows:]

PREPARED STATEMENT OF ROBERT REPETTO

This testimony addresses two issues: the impacts on the U.S. economy of limiting carbon dioxide emissions, and the respective roles of the U.S. and less developed countries in limiting global emissions. What follows provides -- very briefly -- the findings of two new WRI research reports, The Costs of Climate Protection: A Guide for the Perplexed, by Duncan Austin and myself, and Developing Countries Already Taking Action to Slow Climate Change?, by Walter Reid and Jose Goldemberg. Copies of those reports have been made available to the Subcommittee.

I. Macroeconomic Impacts of Limiting C02 Emissions

As the United States approaches the Kyoto negotiations in December under the Framework Convention on Climate Change, the economic impacts of limiting greenhouse gas emissions are coming under increasing scrutiny. The Clinton Administra-

tion has analyzed this issue in an InterAgency Taskforce report. Widely divergent predictions about the costs of stabilizing or reducing greenhouse gas emissions are circulating outside government.

All such predictions are based on macroeconomic models that simulate the economic impacts of policies that raise energy costs. These models are complicated and hard to understand, but nonetheless are gross simplifications of the real world; what modellers leave out influences their predictions as strongly as what they put in. The predicted economic impact of policies adopted to reduce carbon dioxide emissions depends totally on the assumptions built into the forecasting models.

Fortunately, one doesn't have to be an econometrician to understand the key assumptions and how they affect the predicted costs. WRI examined 162 different simulations using sixteen widely used economic models, including all three that the InterAgency Taskforce used to analyze its climate policy options. (Exhibit I) Though the predictions varied substantially, we found that, across all sixteen models, only six basic assumptions account for eighty percent of the differences in the models' predictions. These six basic assumptions determine whether the predicted economic impacts of controlling carbon emissions are large or small, positive or negative. This is remarkable. It implies that the hundreds of other assumptions on which the models are based collectively account for only the remaining twenty percent of the difference in their predictions.

Reasonable people can readily form their own judgments about these key assumptions. The most important ones are these:

1. Will firms and consumers reallocate their expenditures efficiently in the long-run as energy prices increase to take advantage of cost-savings opportunities? Models that assume that firms and consumers reallocate their resources efficiently in the long-run predict much smaller economic impacts from limiting CO_2 emissions.

2. Will some "backstop" non-fossil energy source, such hydroelectricity, nuclear power, solar and wind energy, be available at a stable competitive price as fossil fuel costs rise? Models that ignore the existence of non-fossil alternative energy sources predict much higher costs of stabilizing carbon dioxide emissions.

3. Will nations cooperate to take advantage of low-cost opportunities to reduce emissions by undertaking "joint implementation" of abatement commitments or by "trading" CO_2 emissions, permits internationally? Models that assume that the United States must meet its reduction target in isolation predict a much higher cost.

4. Will revenues from energy taxes or from auctioning off permits to emit carbon dioxide be used to cut income, profits or payroll taxes? Models that ignore the possibility of using energy tax revenues to cut other burdensome taxes predict more adverse economic impacts.

5. Will reducing fossil fuel consumption avoid damages from a changing climate? Models that incorporate the predicted impacts of a changing climate on the economy tend to predict, on balance, a lower net cost of controlling emissions.

6. Will reducing fossil fuel -- and especially coal -- consumption affect damages from the conventional air pollutants? Models that ignore health and environmental damages from rising fuel combustion predict higher net costs from controlling them.

As Exhibit II indicates, people who assume that the unfavorable assumptions on all these points are most realistic should expect -- based on simulations from all sixteen models -- that stabilizing carbon dioxide emissions at 1990 levels by 2010 and holding them steady thereafter would result in economic losses of about 2.4 percent in GDP in the year 2020. That would be about one-year's growth in gross domestic product. Were these impacts to occur, the economy in 2020 would be about 70 percent larger than today's, rather than 74 percent larger under a "business-as-usual" scenario.

Exhibit II also shows the implications of changing those unfavorable assumptions one-by-one. For example, people who think that the firms and households will reallocate their expenditures efficiently over the long-run to minimize the effects of higher energy prices should expect much smaller impacts -- about 1 percent of GDP in 2020 rather than 2.4 percent. If, in addition, the availability of non-carbon energy sources and the possibility that nations will agree on joint implementation are accepted as reasonable long-run assumptions, then people should expect that meeting this stabilization target would have negligible impacts on the economy twenty-three years down the road. Those who also accept the assumption that revenues from energy taxes or similar policies will be recycled to the economy through other tax cuts should expect a small positive impact on the economy. And, finally, if they believe that,avoiding climate change and air pollution will avert health and other economic damages, people should conclude from these models that the overall economic impacts of stabilizing carbon emissions will be even more favorable. The underlying assumptions strongly affect the predicted impacts.

Of course, people need not accept all the best-case or all the worst-case assumptions. The chart indicates the effect of each key assumption singly on the predicted economic impacts of stabilizing emissions.

Three of these assumptions are policy decisions:

- The United States can, and should, negotiate vigorously with other nations to achieve international cooperation in stabilizing carbon emissions through a system of joint implementation. All nations can potentially gain.
- The federal government can choose the policy instruments with which to limit carbon dioxide emissions. It can, and should, restructure the tax system to lower income, profits, or payroll taxes, making up the revenues through energy taxes or revenues from auctioning off carbon emissions permits.
- The federal government, in cooperation with industry can, and should, vigorously pursue research and development programs to make renewable, non-fossil energy sources more widely available at lower prices.

Through such measures the government can make sure that climate protection will not adversely affect the economy.

II. International Competitiveness

The Framework Convention and the Berlin Mandate negotiated in 1995 agreed that developing and developed countries should have differentiated responsibilities, in view of the preponderance of developed country emissions and the lower incomes per capita emissions of developing countries. Nonetheless, a resolution recently circulated in the Senate states that the United States should not accept binding commitments to reduce emissions unless developing countries do likewise.

There are two underlying concerns. First, that any reductions achieved by the United States and other developed countries would be soon swallowed up by increased emissions from large, rapidly developing countries such as China. Second, that measures adopted only by the United States and other developed countries would put industries in these countries at a competitive disadvantage.

The second concern is exaggerated. There is scant evidence that lower energy prices or weaker environmental standards give countries a competitive advantage in trade or investment. Countries that have had low energy prices -- including the FSU, Mexico, Venezuela, India, and China -- have not been particularly competitive in energy-intensive industrial sectors. Low energy prices lead mainly to energy inefficiency; weak environmental standards result in high environmental damages.

The first concern is more realistic. Annual emissions from developing countries will exceed those of OECD countries by 2020, given current trends. Stabilizing greenhouse gas concentrations requires global cooperation.

However, it's important to realize that without any international commitments developing countries have already taken significant steps to curtail carbon dioxide emissions, purely on "no regrets" economic grounds. They have:

- reduced energy subsidies: Between 1990 and 1995 fourteen developing countries whose combined emissions match those of the United States reduced fossil fuel subsidies by 45 percent. China reduced coal subsidies from 37 to 29 percent and oil subsidies from 55 to 2 percent. The World Bank estimates substantial savings in CO_2 emissions as a result.
- restructured energy markets: Many developing countries have privatized energy industries or invited participation from private independent power producers and other private energy companies. The result has been increased investment in high efficiency cogeneration facilities and combined cycle gasfired power plants, meeting energy needs with lower emissions.
- promoted energy efficiency and renewable energy: Mexico, for example, has developed energy efficiency standards for appliances, buildings, electric motors and industrial boilers. India provides immediate write-off and customs exemptions for wind turbines. Brazil has a large-scale ethanol program for automotive fuels.

Such programs as these have reduced developing countries emissions substantially relative to their business-as-usual trend. The importance of these "no regrets" policy changes should not be overlooked.

Predicted Impacts of Carbon Abatement on the U.S. Economy

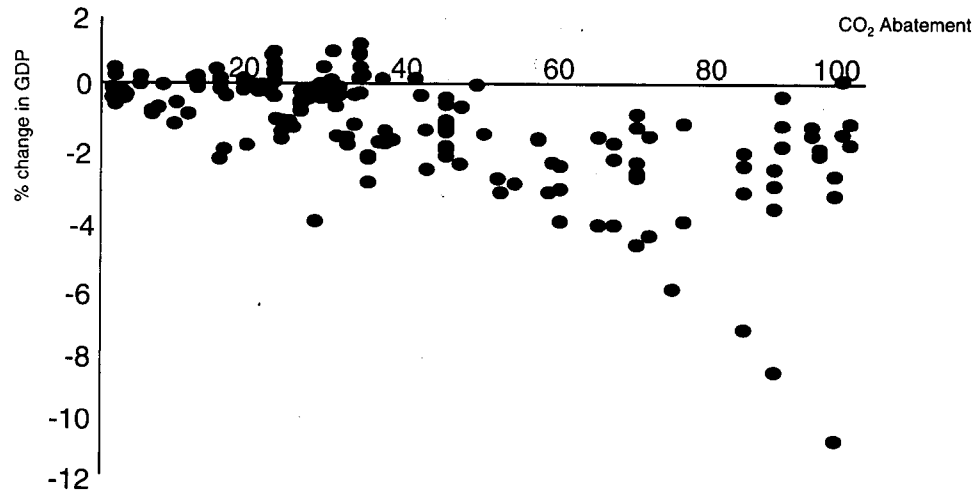
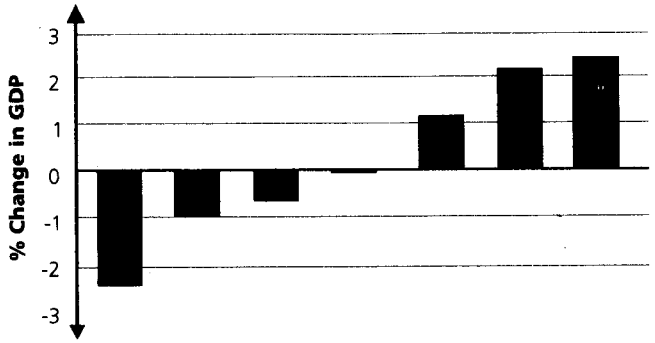


Exhibit 1

World Resources Institute

Predicted Impacts on GDP of Stabilizing CO_2 Emissions at 1990 Levels by 2020: The Effect of Changing Underlying Assumptions



Worst Case Assumptions								Best Case Assumptions
1. Inefficient economic responses*	1	1	1	1	1	1	1	1. Efficient economic responses*
2. No non-carbon backstop fuel	2	2	2	2	2	2	2	2. Non-carbon backstop fuel available
3. No Joint Implementation	3	3	3	3	3	3	3	3. Joint Implementation
4. Revenues recycled lump-sum	4	4	4	4	4	4	4	4. Revenues recycled effectively
5. No air pollution damages averted	5	5	5	5	5	5	5	5. Air pollution damages averted
6. No climate change damages averted	6	6	6	6	6	6	6	6. Climate change damages averted

* Macro Model

* CGE Model

Exhibit 2

Senator HAGEL. Dr. Repetto, thank you very much.

I think it is fair to say that we have had a fairly significant range of ideas presented this morning. What I would like to do, since I do not have the expertise of the four panelists, is ask the panelists to respond to each other, at least during my round of questioning.

I was particularly intrigued, Dr. Repetto, with your point that you believe the competitiveness issue is exaggerated. I would like to start there, as it really does cut to some of the previous testimony. I would like to ask all three panelists to respond to that, starting with you, Mr. Jasinowski.

Mr. JASINOWSKI. Thank you very much, Mr. Chairman.

First of all, I would congratulate Mr. Repetto on a fine piece of work because it sets out a framework which allows experts and nonexperts to debate this issue. I would want first to emphasize the extent to which I agree with his framework and agree with many of his conclusions, some of which show very, very serious, adverse economic effects, and certainly which make the point that you cannot do this without having the developing countries involved. It would be impossible, in his words.

I was intrigued with the energy point and competitiveness. I would not only disagree, I would say that his problem is that he is looking at this through macroeconomic lenses and does not really understand the way American competitiveness now works. I think a lot of people don't.

As I said, manufacturers can only increase prices now about 1 percent. I talk to them every day. They think reducing costs in every way is absolutely essential. Since they cannot raise prices, they have to raise productivity in order to maintain market share.

So the notion that this would not affect their competitiveness from an American point of view is just not the way any single businessman I know, would think of it. His citation of Mexico and the Soviet Union as being examples of energy competitiveness not making any difference is really overlooking the extraordinary reasons why those countries are not competitive that have nothing to do with energy pricing.

So there are countries in which I think his generality would hold. But it does not hold for the American economy, which has become competitive again. We are now back, able to compete around the world. But we can only raise prices 1 percent, Mr. Chairman. Therefore, every single cost that you can cut you must cut and every company I know, from the 14,000 companies, are trying to reduce energy costs. To have this kind of energy cost increase piled on top is going to have all the effects that Mr. Montgomery and I have suggested.

Senator HAGEL. Dr. Montgomery.

Senator SARBANES. Mr. Chairman, Mr. Jasinowski, I take it, has an appointment at 11. Is that correct?

Senator HAGEL. At 11:30.

Would you like to ask him a question before he leaves?

Senator SARBANES. I wonder, since there is a vote on, whether we could do that. Obviously, when we leave for the vote, we will have to excuse him because we could not really hold him. He would miss his other appointment.

Senator HAGEL. Why don't you go ahead and ask a question.

Senator SARBANES. I wonder if we could sort of inquire of him.

Senator HAGEL. Absolutely.

Senator SARBANES. I had just a couple of questions.

First of all, is it your view that there is an issue with respect to global warming that needs to be dealt with? Or could we simply say look, there is no problem, so let's just put this thing off to one side and there is really nothing to deal with? Or is there something to deal with?

Mr. JASINOWSKI. No, no. I think there is a problem and I think most of my members do, too, Senator Sarbanes, in the sense that we have increasing population, increasing emissions occurring in the world, and there are reasonable speculations that that can have significant environmental harm.

Therefore, for those reasons, we need to pursue it. Beyond that, there is the question of energy efficiency which both relates to and contributes to that and is important for competitiveness reasons. We need to improve our energy efficiency.

So we think there is a serious set of issues here. We want to be a part of it. We just need to get the facts more clearly in mind on everything from the science to the economic impacts.

Senator SARBANES. OK. I think it is important. I think this framework of analysis, as you pointed out, is very important. I was struck that Mr. Montgomery said coal prices would go up 4 times where you said 2 times. So there is a wide kind of disparity here.

Mr. JASINOWSKI. Yes, there is a wide variation.

Senator SARBANES. The other question I wanted to put is this. European countries have made the argument that the United States uses 2 to 3 times as much energy per capita even than they do. Many of them, of course, are the most highly industrialized and modern economies in the world. In fact, Chirac took the U.S. to task, I think, at the summit in Denver on this very issue.

I am just curious. Why is this the case and what is our response when they say we are highly competitive and we use a half or a third per capita energy in terms of the emission problem?

Mr. JASINOWSKI. I think you have asked the most important question in a global political sense on this whole issue, Senator Sarbanes. Let me just make the case on the other side from the Europeans. They have obviously made the case for themselves.

I think you've got two or three things here that they don't talk about that are really involved. In fact, the American economy now has a competitive advantage in industry relative to a number of Europeans. If we want to trade that away by raising energy prices enormously in order to deal with these vague scientific notions under global warming now, we can do that. That is what they want, in fact.

They know we've got a competitive advantage and they are not slow. This is a very good way for them to knock that out of the box. That is point number one.

Second, if you look at France, they've got 50 percent of their energy in nuclear. That is great for them. We don't and you know the reasons why as well as I do.

So it is easy for the French to say hey, no problem for us. The Europeans have a way of saying one thing and making it fairly easy on themselves. This takes me to my third point.

This notion of a European bubble is a very fascinating notion, so that they can kind of get by without more severe country limitations. I think it is another reason why they are for it.

Finally, and the most important reason is, as you know, Isabel, my wife, is French. We spend a lot of time in France. The French have a different way of implementing these things than do the Americans. They will be all for it and they will implement it in the French way, as do the Europeans.

In the United States, you are in court the next day with somebody suing you because you did not do what the treaty or the U.S. Senate told us to do. So if we implement a treaty in this country, we implement it. They won't implement it the same way in Europe.

Senator SARBANES. Thank you.

Senator HAGEL. We will leave in a minute or two and they are holding the vote, so it is all right. Let me just stay with you for a moment, Mr. Jasinowski.

In your testimony, you talked about the framework needed to achieve this. Let's say that all the facts are there, the science is there, and the economics are there. Would you further develop the question that you brought out in your testimony? How in the world would this work?

Mr. JASINOWSKI. I wish that I could develop it. But I have to say that I don't know how. I have read widely what proposals are made.

I think that if you just look at the enforcement question, it is very hard to know who would enforce this. Is it enforced, as some people have said, by the World Bank? Some people have said it's by various European organizations. I don't know how even to enforce it.

I don't honestly know what would be an appropriate goal. I have looked at the science and you get everything from the increases by the computer models to decreases by satellite and other information. The computer models themselves have been revised down by 30 percent over the last several years.

Now all that this tells me is that we have a situation where we don't have enough facts to make a decision. I do think that we really should debate this and get more facts.

I don't see why this cannot be postponed for several years. That is what I think we should do. I know there is a rush toward judgment. But let me tell you that the people who are rushing toward judgment in the rest of the world want to do it to put America at a competitive disadvantage.

Senator HAGEL. Would any of the other panelists like to pick up on the question I asked Mr. Jasinowski?

Dr. Repetto?

Dr. REPETTO. Yes, sir. Just on the enforcement issue, the experience in this country with the trading, the pollution trading, has been moving toward reduction first, credit second. It's make the reduction and then you have a credit which you can sell.

There are enforcement problems. But certainly that would be the way to move toward solving it. All right, you've put in the new

plant, or the energy efficiency, or whatever, and then you have some credit which you can then transact.

Senator HAGEL. Thank you.

Senator Sarbanes, I understand we have about 7 minutes. I think we will stand in recess. We will vote twice and then return.

Mr. Jasinowski, I understand you have a prior engagement. Our best to the EPA Administrator.

Mr. JASINOWSKI. Thank you.

Senator HAGEL. Thank you very much, Jerry.

[Recess]

Senator HAGEL. The subcommittee will come to order.

Once again, we appreciate your tolerance of our schedule. I think we are in some clear water now for the next 3 or 4 hours. I'm not sure we'll ask you to stay that long, unless Senator Sarbanes has volumes of questions. What we will do, if it is OK with the panel, is have Senator Sarbanes and I take another round of questions. Then we will ask the second panel to come forward. Thank you.

I would like to pick up a little bit on where we left off when Senator Sarbanes and I went to vote. I would like to go to your testimony, Dr. Montgomery.

I was intrigued with your graphs on pages 4 and 5 of your testimony. I would like you to develop those points a little more, especially in light of Dr. Repetto's testimony. It seems to me, as we work our way through this, that the connection of international competition does matter, the cost of energy does matter, and productivity is directly related to the cost of energy. There is the leakage issue that you talked about and to which Mr. Jasinowski referred. This is where I would like to begin.

Could you more fully develop your point, Dr. Montgomery? I would ask the other panelists to respond as well. Thank you.

Dr. MONTGOMERY. Yes, sir. Thank you.

Beginning with the broader issue of how important are these trade and cost advantages that developing countries will achieve, I think that I would endorse in large part what Mr. Jasinowski said, that it is not at the macro level that we need to look at the issue, it is at the level of the individual industries that will be affected.

The issue is not that somehow the developing countries are going to gain tremendous overall benefits for their economies from the OECD limiting emissions. In fact, I think that it is probably, on balance, for many of the developing countries going to be harmful to their economies as well. This is because the markets for their imports are here in the OECD. We produce a lot of the goods that they, in turn, import. If we have lower rates of economic growth, we are going to buy less of their imports and we are going to charge more for the goods we ship to them.

So, in general, the developing countries' economies I think may suffer as well.

The issue on competitiveness comes up when we look at specific industries because there are specific industries in the United States that are likely to suffer in competition with those industries in other developing countries that gain cost advantages.

In many ways what it is expanding those energy intensive industries in competition with the U.S. is kind of the best effort that the

developing countries can make in order to avoid some of the harm that they are likely to see in general because of shrinking markets here in the OECD. So that is the first point, I think, that I do not want to disagree, that it is not overall the status of the developing countries that is important, it is their ability to compete in specific industries, that the U.S. is largely facing harm from the climate, from the emission limitations because directly of how much it will cost us to produce goods for our own use, and that, since we will have to spend more on energy, more on energy conservation, we will be using more of our resources for those purposes and have less resources available to produce goods and services for our own citizens.

In addition, there are important trade effects for specific industries and specific countries. This is what I tried to show in these two figures, that we will see U.S. exports decline in the aggregate because U.S. goods will cost more than those of other countries and that there are other specific countries—here I took India, Jamaica, China, and Indonesia—that are able to take advantage of lower costs in order to expand their own exports.

In the case of India, I think it is because that is a country that is an oil importer. It is also a country with many manufacturing industries and the infrastructure to compete with the U.S.

I think I would take a somewhat different perspective than Dr. Repetto on countries like China. What China would get from being a nonparticipant in the Climate Change Treaty is a real cost advantage over the OECD.

Now I agree that there are many cases in which the developing countries have harmed their economies by subsidizing energy use and using resources in efficiently. But they would gain real cost advantages over the U.S., not artificial ones supported by their own internal subsidies, and those real cost advantages I think are what we see translating into significant impacts on trade and particular industries.

The second chart I think shows which of the specific industries we would see being affected by these cost advantages. This is because the impact is very concentrated in the U.S. economy. There are a number of industries that are really at serious risk, and these are the ones that we characterized here—cement, aluminum, metals, mining, the paper industry, quarrying. These are industries that are likely to be seriously affected because they, in particular, will face very large cost disadvantages to their competitors.

Senator HAGEL. Dr. Repetto, would you like to quickly respond to that?

Dr. REPETTO. Yes, please, sir.

I think we have to remember that trade is based on comparative advantage. General price increases will be offset over the long run by exchange rate adjustments. So I do agree that, if we want to think about competitiveness effects, we have to think about them in the context of particular industries.

Some industries will have a competitive disadvantage, some will have a competitive advantage.

Now China is a good example. If you examine the trade and investment flows going into and out of China, it is absolutely clear that their comparative advantage is in relatively labor intensive in-

dustries, not in relatively energy intensive or capital intensive industries. This is reflected in their actual trade and investment flows.

Their labor cost advantage dominates, absolutely dominates, any potential difference in energy cost. In fact, the heavy industries, like cement and paper, are hopelessly inefficient in China.

I think it is just totally unrealistic to expect that that pattern of comparative advantage in a country like China or India would be overturned or drastically modified by any relative adjustments in energy costs in the long run.

Senator HAGEL. Dr. Repetto, thank you.

Senator Sarbanes.

Senator SARBANES. Thank you, Mr. Chairman.

Mr. Cunningham, I would first like to put the question to you that I put to Mr. Jasinowski. Do you think there is a problem that we have to try to deal with with respect to global warming?

Mr. CUNNINGHAM. Yes, Senator. We have not criticized the need for a treaty. We have said that in the area of environmental improvement worldwide, many of these issues require global solutions—forestry, ocean dumping—and that includes climate change. The only way to deal with a problem like that is to deal with it worldwide through a treaty process.

Our criticisms have been at the kind of treaty, at the nature of the treaty that the administration appears to be locked into; that they have not set concentration levels; they have not done it logically to set concentration levels as a target; and then, to work backward, to see how each country should fit into those, what the obligations of each country should be.

Senator SARBANES. I understand that. I just wanted to make sure I understood the basic starting point.

So you don't take the position that there is really no problem here and we should not be spending any time looking at it, is that correct?

Mr. CUNNINGHAM. No, Senator. That is not our position.

Senator SARBANES. Mr. Montgomery, would you respond to that same question?

Dr. MONTGOMERY. No. I think that the climate change issue is a serious one which is important to address. In fact, one of the reasons I ended my testimony the way I did is to try to focus on the fact that I think it is possible to separate, looking at the economic issues of what is the best way to get to a particular concentration of greenhouse gases from the issue of how should we balance the costs and benefits to the world of climate change in order to choose a concentration target. I think that is a very serious issue that actually has not yet really been addressed in the negotiating process and that we need to look at both sides of that, both the costs and benefits of doing something in the long run.

Senator SARBANES. Have you all had a chance to read this study of Dr. Repetto's?

Mr. CUNNINGHAM. Yes.

Dr. MONTGOMERY. No.

Senator SARBANES. You have not had a chance?

Dr. MONTGOMERY. No, I haven't, but I am catching up rapidly this morning.

Senator SARBANES. And you have, Mr. Cunningham?

Mr. CUNNINGHAM. Yes.

Senator SARBANES. Well, it strikes me as a very useful analytical tool and I wondered whether you agree with that. When you start making judgments about the assumptions and so forth, obviously people can differ. But one of the things I am concerned about is getting an analytical framework here where everyone is operating on the same playing field, as it were, and where we can try to identify the facts to the extent we can.

I was struck in that you testified, for instance, that the price of coal would go up fourfold and Mr. Jasinowski said it would double. Well, that is a fairly significant difference as one tries to evaluate these things, although doubling is in and of itself very substantial, obviously. But it seems to me that is an important difference.

What is your view of this analytical framework? Do you think it is useful to work with?

Mr. CUNNINGHAM. The models that we relied on, the ones that we interpret as being most useful, are models like the DRI model that the administration uses, the WEFA model, and others, which look at adjustment problems in the economy when some kind of shock hits the economy or some policy measure is introduced like the ones that the administration is considering, the ones that raise energy prices.

The models we find not useful are models that presuppose some sort of instantaneous change in people's behavior and the remolding of capital into different kinds of capital, instantaneous adjustment of people from the suburbs and remodeling their houses into apartment buildings in the city. These kinds of instantaneous adjustments do not take place in the real world. So we look at those models that are based upon the past kinds of adjustments that people have had to make in similar kinds of situations and think that those are the ones that are most realistic to use.

Senator SARBANES. Mr. Repetto, I take it that you looked at all models, is that right, and constructed this analytical framework to try to, in effect, put all of the models to use, or I guess 16 of them.

Dr. REPETTO. Certainly a large number, almost all of them or virtually all of them.

Senator SARBANES. So the models that Mr. Cunningham says he thinks are the most realistic are encompassed within your analysis? Is that correct?

Dr. REPETTO. Yes, sir.

Senator SARBANES. Did you want to add to that, Dr. Montgomery?

Dr. MONTGOMERY. Yes, Senator, if you would not mind.

I have, I think, had an opportunity to look through it and having heard Dr. Repetto's testimony, I would like to respond to some of that.

I also wanted to congratulate him on his work. I think this is a very helpful sorting out of the issues and I do appreciate being included in the comparison. I think that these are key points that need to be looked at in comparing the models.

Given that, though, I do disagree on some of the details, in particular on, I think, points 1, 4, 5, and 6. Rather than launch into a long exposition on each of those, let me just summarize.

Senator SARBANES. I wasn't suggesting that because the analytical framework may be useful that this meant that anyone who acceded to that view was signing off on all of the details of it. Obviously, you can differ. I would assume that Dr. Repetto might make some evaluations with which you would differ and so forth.

But we have to get into some kind of mode of thinking here that enables people to have rational and reasoned exchanges about this issue, so that we can come in from way out at the edges and can kind of focus, to the extent we can, on having a common ground on facts and analysis. Then we may differ on evaluations.

I mean, some people will be more willing to impose costs, others less. Some will value one aspect of this problem differently than another.

But it seems to me we need to try to focus in on a way of thinking that is helpful to us.

Dr. MONTGOMERY. Yes, I agree. The only thing I would add to that is I do find it helpful in many cases. I was concerned about looking at the three green bars at the end of Dr. Repetto's testimony indicating potential economic benefits from limiting emissions.

That is where I am convinced that applying basic economic principles will tell us that some of these results just cannot be right. So, in one sense I appreciate Dr. Repetto setting out the issues this way. But it is because I think that if we were to focus on the issue of double dividend and tax recycling, I could convince you that applying basic economic principles says that the models at the green end just are not treating that right. Therefore, it is a good thing to do to characterize what are the assumptions behind these models because then it will help us after we have had a chance to talk about the specific issues to have a better appreciation of which of those general results we agree with.

For the most part, all we hear is that a study said that the climate treaty is going to decrease GDP by 2 percent and we don't hear the assumptions that are behind it. I think it is very important that we look at those.

Senator SARBANES. Thank you, Mr. Chairman. My time is up.

Senator HAGEL. Speaking of models and studies, we talked last week during our hearing about the lack of any economic model from the administration, even though it has said it would come forward with one. Maybe one of you would like to enlighten this panel as to why that has not happened. I understand it is more than a year old.

But there is one model, one study, and some evidence, I understand, that was developed over the last half year. It was brought up this morning. I asked some questions about it last week. It is the Argonne National Lab study.

I will start with you, Mr. Cunningham. I did not have a chance to ask Mr. Jasinowski about it, but he referred to it in his testimony in a knowing way. I am anxious to know what is out there and why the administration has not released it.

Have you seen it? What do you know about it? Any of the other panelists can also respond.

Mr. CUNNINGHAM. The Argonne studies were conducted in early and mid-1996. I participated in two peer review workshops for that study and I sat in on the third one.

Each of the six studies had a peer review workshop and those studies were presented.

The studies included six industries. They were chemicals, refining, cement, paper, steel, and aluminum. We were told at that time that the studies would be released in July or August of last year.

I called many times after that time period to find out when the studies would be released and finally gave up when I realized that they, apparently, just were not going to be released.

Senator HAGEL. Why was that. Was it obviously not favorable to the administration's position?

Mr. CUNNINGHAM. I never got an explanation for why the studies were not released. Now and then I hear a rumor that they will be released and I call around to see if that rumor is true. Apparently they are still being held up for some reason. But I think you might have to ask the administration as to what the particular reasons are.

Senator HAGEL. So you cannot shed any enlightened commentary on either what was inside or outside or on what we found or did not find?

Mr. CUNNINGHAM. Well, I know that each of the studies showed a consistent pattern which probably the administration does not view favorably. That pattern is that if you raise energy prices significantly in the United States relative to those prices in other countries as the treaty, in its current mode, might do, the industries would begin moving out of the country and the plants and jobs as well as the pollution and emissions would also move out of the country. So you would have a job loss and damage to these industries without doing very much or anything at all about the emissions problem.

In fact, pollution from these industries could increase because the requirements in the countries they are moving to, the environmental requirements, are less stringent than those in the United States.

But I think they were a very valuable set of studies. They were very descriptive and I think that they would make a valuable contribution to the dialog that is going on.

Senator HAGEL. Well, we would all like to see them. Thank you.

Dr. Repetto, do you know about this study? Have you seen it?

Dr. REPETTO. I think I can perhaps comment on the first part of your question, about what has happened to the administration's analysis. My understanding is that they used three models, all three of which were also included in this overview. I understand that their results are undergoing some peer review from people inside and outside the administration. How they are going to incorporate those review comments and then release the results, I am not sure what that timetable is. But I think that is what is happening now.

Senator HAGEL. Dr. Montgomery?

Dr. MONTGOMERY. I have nothing enlightened to say about what is happening within the administration. But from what I have seen of the reports and from what Mr. Cunningham mentioned, I would

say they certainly seem to be reaching conclusions that are very much along the lines of the studies that we have done.

As I mentioned, we have done some detailed work in fairly complex analysis of the aluminum and pulp and paper industries worldwide. Certainly we would confirm those conclusions, that with the kind of cost differences that would exist between the U.S. and other countries, you could build new aluminum plants in developing countries for less than the cost of operating aluminum plants in the United States. It's similar things for the other industries that we looked at.

They did choose the energy intensive industries, and I would say that our results certainly seem to confirm what I have heard is in the Argonne reports.

Senator HAGEL. Thank you.

Senator Sarbanes.

Senator SARBANES. Mr. Cunningham, you said you were on the peer review for these Argonne studies?

Mr. CUNNINGHAM. Yes, Senator, for two of the studies.

Senator SARBANES. Mr. Jasinowski in his statement says one scenario, and then he writes out an estimate of energy price increases. You should recall that.

I take it there were other scenarios with different estimates, is that right?

Mr. CUNNINGHAM. In the study, which included the six industries, they made an estimation of fuel price increases that probably were based about on a $100 a ton increase, what a $100 a ton increase in the carbon tax or a permit trading system that did that same thing might do to the jobs and production in that industry.

Senator SARBANES. How much would that raise the price of coal?

Mr. CUNNINGHAM. I think the threefold or fourfold increase that Dr. Montgomery put forth was the right number for that. Coal does vary a little bit in carbon content. But it is a number that I also have to sit down and recalculate several times to convince myself that it is really true. It has an enormous impact on the coal price compared to natural gas prices, for example.

Dr. MONTGOMERY. Could I throw in a specific number here? A $100 a ton carbon tax is $55 a ton of coal. Translating that into proportions depends on what you assign to the price of coal, which has varied a lot and varies across different kinds of coal. But the $55 a ton of coal is a direct translation from the tax to the carbon content of coal.

Senator SARBANES. Now on this chart here that you have in your statement, direct and indirect cost increases for the top 25 nonenergy industries, this is both the direct and the indirect cost increases, is that correct?

Dr. MONTGOMERY. That's correct. For a typical industry, maybe half of that cost increase would come from the fuels that they use within that industry and the other half would come from higher costs in producing the materials that they had purchased for that industry. It varies between industries.

Senator SARBANES. So for the five industries—the six industries—of the ones you've listed, the direct and indirect cost increases would be over 5 percent. For the balance, it would be below 5 percent, is that correct?

Dr. MONTGOMERY. That's correct. The average is about 3.5 percent, if I remember correctly.

Senator SARBANES. Thank you.

While I do have more questions, I think we had better go on the second panel, Mr. Chairman.

Senator HAGEL. Senator, thank you.

Again, on behalf of the panel, we wish to thank our witnesses for your time this morning and particularly your courtesies in allowing Senator Sarbanes and me to escape and do the people's business.

We will keep the record open and I am sure we will be back in touch with you to ask more questions. Thank you.

We will now have our second panel.

Gentlemen, welcome.

Dr. Michaels, are you all set up there?

Dr. MICHAELS. Yes, indeed.

Senator HAGEL. First let me welcome each of you. We are grateful that you would take time to come before this panel and help us get through this issue.

Let me formally introduce each of our panelists. Dr. Patrick Michaels is Professor of Environmental Sciences at the University of Virginia. Dr. Michaels, thank you. Dr. Alan Robock is Maryland State Climatologist, Department of Meteorology, University of Maryland. Dr. Robock, thank you. Dr. Michaels, would you like to begin?

STATEMENT OF DR. PATRICK MICHAELS, PROFESSOR OF ENVIRONMENTAL SCIENCES, UNIVERSITY OF VIRGINIA, CHARLOTTESVILLE, VIRGINIA

Dr. MICHAELS. Yes, I would.

I would like to thank you very much for inviting my testimony. You may want to refer to illustrations in my printed version as I proceed over the next few minutes.

Nearly 10 years ago, I testified before the Senate Foreign Relations Committee. At that time, I argued that forecasts of dramatic and deleterious global warming were likely to be in error because of the very modest climate changes that had been observed to date. Further, it would eventually be recognized that this more moderate climate change would inordinately be directed into the winter and night, rather than the summer, and that this could be benign or even beneficial.

I testified that the likely warming, based upon the observed data, was between 1.0 and 1.5 degrees Celsius for doubling the natural carbon dioxide greenhouse effect.

As you can see in Figure 1, since then the global mean temperature of the Earth has not warmed a bit. We have three independent measuring systems—surface thermometers, satellites that sense the temperature of the lower atmosphere, and weather balloons in the same region—and they all show no warming since that testimony.

In science, regardless of how much external political and social pressure is applied, it is inevitable that the observed data and theoretical hypotheses or models, if you will, will eventually reach an internally consistent equilibrium. This is happening today.

However, it was apparent that when the first so-called consensus was imposed upon the issue of global warming by the First Scientific Assessment of the United Nations Intergovernmental Panel on Climate Change, or IPCC, such an equilibrium had not been reached.

That report in 1990 stated, "When the latest atmospheric models are run with the present concentrations of greenhouse gases, their simulation of climate is generally realistic on large scales."

The suite of climate models extant at that time predicted that the globe's mean temperature should have risen by then between 1.3 and 2.3 degrees Celsius. Slightly revised versions of these models provided the technical background for the Framework Convention on Climate Change, signed in 1992.

The observed warming since the late 19th Century has only been 0.5 degrees Celsius, or less than one-third of the predicted value. Critics argued, as I did before this committee, that there would have to be a dramatic reduction in the forecast of future warming in order to reconcile the facts and the hypotheses.

By 1995, in its second full assessment of climate change, the IPCC admitted the validity of the critics' position: "When increases in greenhouse gases only are taken into account, most climate models produce a greater mean warming than has been observed to date, unless a lower climate sensitivity to the greenhouse effect is used. There is growing evidences that increases in sulfate aerosols are partially counteracting the warming due to increases in greenhouse gases."

Let me translate this statement. It means either it is not going to warm up as much as we said it would or something is hiding the warming. I predict that every attempt will be made to demonstrate the latter before admitting that the former is true.

Such attempts were made, and initial results, particularly those published in "Nature" on July 4, 1996, appeared initially to bolster the argument that the sulfates were masking the expected warming. That particular study used weather balloon data from 1963 through 1987. Most striking was a warming of the middle of the Southern Hemisphere, which you can see in the top of the figure on page 3. There is a box around this dramatic warming region. It contributed most to the apparent reality of the sulfate-greenhouse effect interaction.

However, when the entire set of weather balloon data from 1958 through 1995, rather than what was used in the paper was used, this most pronounced region of warming shows no change whatsoever.

In the figure that I am referring to here on page 3, the closed circles, the filled circles, are the data that were used in the 1963 through 1987 study and all the circles are all the data.

In response to this, the senior author of that paper told the December meeting of the American Geophysical Union that the correspondence failed because greenhouse warming had overwhelmed the cooling effect of sulfates since 1987.

As you can see from Figure 1, there was no net change in temperature in the last decade. So this statement was clearly wrong.

In the on-line discussion published recently on this, the explanation was now given that sulfate cooling leaked into the Southern

Hemisphere, or exactly the opposite of the explanation that was given a mere 4 months earlier.

The fact that the sign of the explanations has changed so quickly is prima facie evidence of a paradigm of rapid greenhouse warming that is in serious, serious trouble. Let's consider the default option, that it is not going to warm up as much as the earlier projections had indicated. This is becoming increasingly attractive.

A new suite of climate models which now seems to fit the observed history bears witness to this conclusion.

Figure 3, which is on page 4, shows the new result from the UKMO, United Kingdom Meteorological Office, model. The top line, the dashed line in the figure is the warming projected in the paper as it is published. But if you read the manuscript carefully, you will see that the changes in the greenhouse effect that were assumed to occur over the 21st Century were simply unrealistically high. When you put in the accepted mid-range scenario from the United Nations IPCC, the warming dropped to the lower figure, which is a solid line, or about 1.7 degrees Celsius by the year 2100.

Figure 4 on the lower right of the page is the analogous new model from the U.S. National Center for Atmospheric Research, as published in the May 16 issue of "Science." It, too, uses a change in the greenhouse effect that is 30 percent greater than the known and projected changes. It changes the greenhouse carbon dioxide effectively at 1 percent per year. It is know that the change is 0.7 percent per year, and that is the figure that is often used.

By the way, I have never gotten an adequate explanation as to why this is the case. Dr. Trenberth told me at a meeting in Ashville about a month ago that well, it is a standard modeling experiment. My reply was all you have to do in the computer code is write "*.7 on one line of code," and it will give you the right answer.

Why the wrong greenhouse effect was used, nonetheless, is anyone's guess.

Anyway, this NCAR model, when you put in the correct greenhouse effect, yields only about 1.3 degrees of warming out to the year 2100. It does not have any cooling from sulfate aerosols in it.

The cooling from sulfate aerosols is being revised downward as we speak. Various and sundry empirical and laboratory measurements now suggest that it would probably drop the warming in that right hand curve by an additional 0.3 degree, which puts it in the 1 degree range.

All of this may be irrelevant, Senator. We don't really care whether it warms. What we do is we care how and how much it warms. The nature of the observed changes in the atmosphere are rather surprising given the level of concern about this issue.

Greenhouse physics predicts that the driest air masses should respond first and most strongly to changes in human activities. These are, generally, the coldest air masses, such as the great high pressure system that dominates Siberia in the winter and its only slightly more benign cousin in North America. When the jet stream catches a corner of that North American cold anti cyclone, it kills orange trees in Florida.

A look at the trends in the satellite data, which is the only true record of global temperature, is remarkably revealing. It is on figure 5 on page 5.

I do not put trend lines in data unless they are statistically significant. There is a statistically significant net cooling in this record which is now 18.5 years old.

Now on page 6, what I have done at the top is plot out the relative change in temperature on a latitude longitude basis in the satellite record. What you see is a pronounced warming trend of the regions of the Northern Hemisphere's coldest winters, a band stretching from Siberia through Northern Europe, Iceland, and Western North America. This is not global warming. It is a regional warming superimposed upon a slight cooling trend in this data.

Another way to appreciate this in a frame of reference that is longer than the satellite—and we are often criticized for using the satellite data because it only starts in 1979 and most people know there was a jump in the temperature that took place between 1977 and 1978, 20 years ago the last jump—another way to appreciate this, though, would be to look at a longer frame of reference, say the surface temperature record for the last 50 years.

In figure 7, at the bottom on page 6, I subtracted from the winter climate change the summer change. The redder it is, the more change there is in the winter compared to the warm half-year.

It is very obvious that what you are seeing is a warming of the coldest air masses in North America and Europe and very little else.

Much has been made in recent years of an apparent increase in what has been called extreme rainfall. Federal climatologists recently produced a press release during last winter's floods in California claiming that these intense rains had increased by 20 percent. This was a gross distortion of reality and deserves investigation.

The original study by Tom Karl and others showed that the percent of rain in the United States that falls from storms of 2 inches or more in 24 hours has increased from 9 percent of all rain to 11 percent of all rain. Senators, this is a change of 2 percent.

However, in order to create a sensational effect, this 2 percent change was divided by the average amount of 10 percent, resulting in a figure of 20 percent.

In reality, what Karl found was that, on the average, there is only one more day in every 730 in which the 2 inch rainfall threshold is exceeded. No one could notice that.

Karl also informed me that there is no significant change in rain of 3 inches per 24 hours or more.

Is a 2 to 3 inch rainfall "extreme?" Is it "intense?" Or, given the fact that much of our agricultural regions are in moisture deficit every summer—look outside—is it "beneficial?" Simple logic can make that value judgment.

Imagine if the truth had really been told. The percentage of rainfall originating from storms of less than 2 inches per 24 hours has declined from 91 percent to 89 percent. That is a real headline grabber. Unfortunately, there is no news and no scare value in the truth.

Another view of the future will conclude my remarks.

I believe it is fair to say that the people once labeled as a "small band of skeptics," those who championed the position that warming would be modest and primarily in the coldest air masses, have won the day.

Many of these same scientists are now forming a new environmental paradigm. It is that the concept of fragile Earth may have to be abandoned.

I will depart from my remarks here to tell you of an experience on Earth Day that I just had. Our Department of Environmental Sciences at the University of Virginia is a very highly rated department. Some say it is the best in the Nation, and the President and the administration are very, very proud of us.

We had an Earth Day fest on the environment, and I was astounded to see how many of my colleagues were of the opinion that the new paradigm was going to be the paradigm of resiliency. This is the cutting edge department in the United States.

It asks the impertinent question—and it is an impertinent question—since when is everything that man does to the planet necessarily bad?

During the 20th Century, we have gone half-way toward effectively doubling the national carbon dioxide greenhouse effect and here is what happened. Life expectancy doubled in the free and developed world. The developing world is catching up as their emissions rise. Corn production per acre increased five-fold. The growing season in the coldest latitudes increased slightly, but enough to increase greenness in those latitudes by 10 percent.

Rainfall in the world's breadbaskets increased slightly, even as summer temperatures did not warm. Australia now reports a massive increase in agricultural production that may be related to climate.

There are thousands of laboratory and field experiments as well as the practical activities of professional horticulturists that demonstrate that rising carbon dioxide makes most plants grow better. Don't listen to me. Consider the writings of Sylvan Wittwer, the man who conducted some of the very first experiments on this phenomenon. He ultimately became chairman of the Board on Agriculture of the national Research Council.

Quoting Wittwer, "There is currently a blind spot in the political and informational systems of the world. This is accompanied by a corruption of the underlying biological and physical sciences. It should be considered good fortune that we are living in a world of gradually increasing levels of atmospheric CO_2. The rising level of atmospheric CO_2 does not make the United States the world's worst polluter. It is the world's greatest benefactor. Unlike other natural resources—land, water, energy—essential for food production, which are costly and progressively in shorter supply, the rising level of atmospheric CO_2 is a universally free premium on which we can all reckon for the future."

I recommend Wittwer's book, the compilation of his 750 articles and refereed scientific literature for a remarkable view of this issue.

Now I will close by asking the questions that I think need to be asked.

How much money are we willing to spend to stop this?

How much money are we willing to spend on the slight amelioration of the coldest temperatures in the air masses that are most inhospitable to unprotected life where there is human settlement?

How much money are we willing to spend to stop making the Earth greener, more productive, and human life increasingly long over the mass of the planet, and the mass of the planet still does find us the envy of history?

Thank you.

[The prepared statement of Dr. Michaels follows:]

PREPARED STATEMENT OF PATRICK J. MICHAELS

Nearly ten years ago, I testified before the Senate Foreign Relations Committee. At that time, I argued that forecasts of dramatic and deleterious global warming were likely to be in error because of the very modest climate changes that had been observed to that date. Further, it would eventually be recognized that this more moderate climate change would be inordinately directed into the winter and night, rather than the summer, and that this could be benign or even beneficial. I testified that the likely warming, based on the observed data, was between 1.0 and 1.5°C for doubling the natural carbon dioxide greenhouse effect.

Since then, the global mean temperature of the earth has not warmed a bit. Three independent measuring systems (and the only three that exist)-surface measured temperature, temperatures of the lower atmosphere measured by weather balloons, and temperature of the lower atmosphere measured by orbiting satellites-all show no warming since that testimony (see Figure 1).

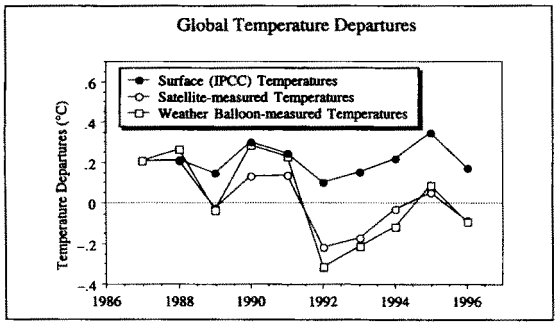


Figure 1. During the last 10 years (1987–1996) neither the surface thermometers, weather balloons, nor satellites observe any net warming in global annual temperature departures.

In science, regardless of how much external political and social pressure is applied, it is inevitable that observed data and theoretical hypotheses will eventually reach an internally consistent equilibrium. However, it was apparent that when the first "consensus" was imposed on the issue of global warming, by the First Scientific Assessment of the United Nations Intergovernmental Panel on Climate Change (1990), that such an equilibrium had not been reached.

That report stated that "when the latest atmospheric models are run with the present concentrations of greenhouse gases, their simulation of climate is generally realistic on large scales." (1) The suite of climate models extant at the time predicted that the globe's mean temperature should have risen by 1.3° to 2.3°C, with the larger figure for the Northern Hemisphere, where most of us live. These models provided the technical background for the Framework Convention on Climate Change, signed in 1992.

The observed warming since the late 19th century was 0.5°C, or less than one-third of the predicted value. Critics argued, as I did before this Committee, that there would have to be a dramatic reduction in the forecast of future warming in order to reconcile fact and hypothesis.

By 1995, in its second full Assessment of Climate Change, the IPCC admitted the validity of the critics' position: "When increases in greenhouse gases only are taken into account ... most [climate models] produce a greater mean warming than has been observed to date, unless a lower climate sensitivity [to the greenhouse effect]

is used ... There is growing evidence that increases in sulfate aerosols are partially counteracting the [warming] due to increases in greenhouse gases." (2)

I believe the secular translation of this statement is that either it is not going to warm up as much as was previously forecast, or something is hiding the warming. I predict every attempt will be made to demonstrate the later before admitting that former is true. [1]

Such attempts were made, and initial results, particularly those published in Nature on July 4, 1996 (3), appeared to bolster the argument that the sulfates were masking the expected warming. That particular study used annual weather balloon data from 1963 through 1987. Most striking was a rapid warming of the middle of the Southern Hemisphere, where there in fact are virtually no sulfates available to counter greenhouse warming.

However, when the entire record of weather balloon data, from 1958 through 1995, was used, this most pronounced region of warming turned out to show no change whatsoever (4) (Figure 2). In response to this, the senior author of the original study told the December meeting of the American Geophysical Union that the correspondence between the sulfate-greenhouse model and reality vanished because greenhouse warming had overwhelmed sulfate cooling since 1987. As there was no net change in any of the temperature records in the last decade (Figure 1), this statement was clearly wrong. In an on-line discussion recently published, the explanation is now given that sulfate cooling "leaked" into the Southern Hemisphere, or exactly the opposite of the explanation given a mere four months earlier.

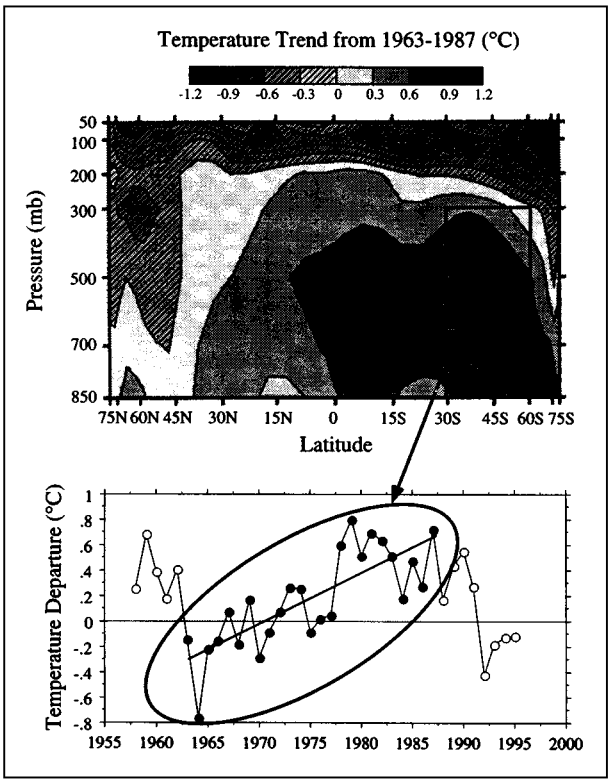


Figure 2. Observed warming in Santer et al. (1996) from 1963 to 1987 (top). The highlighted region in the Southern Hemisphere shows the strong observed warming. The entire temperature history over the same region from 1957 to 1995 shows no significant warming trend (bottom). However, the period that was chosen for study by Santer et al. (filled circles) warms dramatically.

[1] However, one of the United Kingdom's most prominent modelers, who surely does not want his name revealed, informed me in Asheville, North Carolina on June 5, 1997 that "it appears we have overestimated the sensitivity of the climate to greenhouse changes."

Clearly the default option-that it's simply not going to warm as much as the earlier projections had indicated-is increasingly attractive. And a new suite of climate models, which now seem to fit the observed history more accurately, bear witness to this conclusion.

Figure 3 shows the new result from the United Kingdom Meteorological Office model (5). The published forecast is the higher value, which still shows considerable warming. But a careful read of the related manuscript reveals that the changes in the greenhouse effect that were used are much greater than the observed and projected changes. When the more accepted values (as given by the IPCC) are used, the warming drops to the lower figure, or about 1.7°C by the year 2100.

Figure 4 is an analogous new model from the U.S. National Center for Atmospheric Research, as published in the May 16 issue of Science (6). It, too, uses a change in the greenhouse effect at least 30% greater than the known and projected changes. The lower figure adjusts this model for that error and it produces only 1.3°C of warming by 2100.

Notably this model does not include any cooling from sulfates. While this effect was apparently overestimated, new, direct measurements by Hobbs et al., indicate that it should reduce warming by about 0.3°C over this period (7).

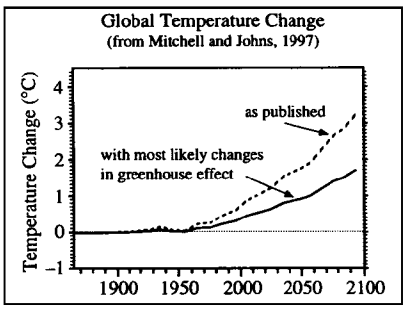


Figure 3. Temperatures predicted by the UKMO model (Mitchell and Johns, 1997). The dashed line uses an unrealistic CO2 concentration of 859 ppm by 2050. The solid line estimates the warming if the most likely concentration, as given by IPCC 1995, is used.

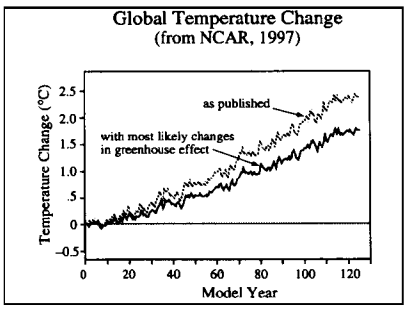


Figure 4. Temperatures predicted by the new NCAR model. The dashed line increases effective CO2 by 1 percent per year, but the more realistic increase, as given by the IPCC 1995, is 0.7 percent per year. The solid line estimates warming using the IPCC value. The nominal staring time is around 1965.

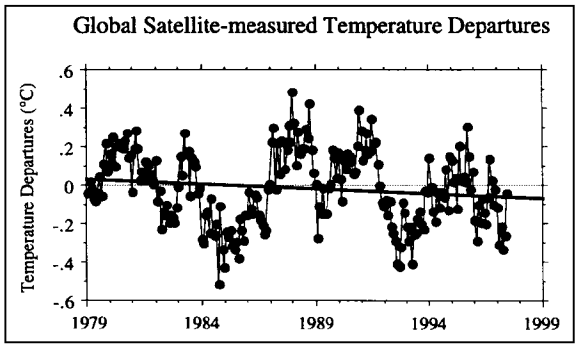


Figure 5. Monthly average global temperature departures as measured by satellites show a statistically significant decline since the measurements began in 1979. This has occurred during a period when GCMs indicate that the earth should have warmed 0.6°C according to greenhouse models, and 0.35°C according to sulfate-greenhouse models.

The Nature of Observed Change

Greenhouse physics predicts that the driest airmasses should respond first and most strongly to changes induced by human activities. These, in fact, are generally the coldest airmasses such as the great high pressure system that dominates Siberia in the winter, and its only slightly more benign cousin in northwestern North America. When the jet stream attains a proper orientation, it is this airmass that migrates south and kills orange trees in Florida.

A look at the trends in the satellite data-our only truly global record of lower atmosphere temperature-is remarkably revealing (Figure 5). In spite of a statistically significant global cooling trend over the 18.5 year period of record, there is a pronounced warming trend in the coldest winter regions (Figure 6).

Another way to appreciate observed change in a frame of reference longer than the satellite record is to look at the ground-based thermometers for the last fifty years. In Figure 7, I have subtracted the summer temperature changes from the winter ones. The redder the map, the more pronounced is the warming in the winter versus the summer.

Much has been made in recent years of an apparent increase in what has been called "extreme" rainfall. Federal climatologists recently produced a press release, during last winter's floods in California, claiming that these rains had increased by 20%. This was a gross distortion of reality.

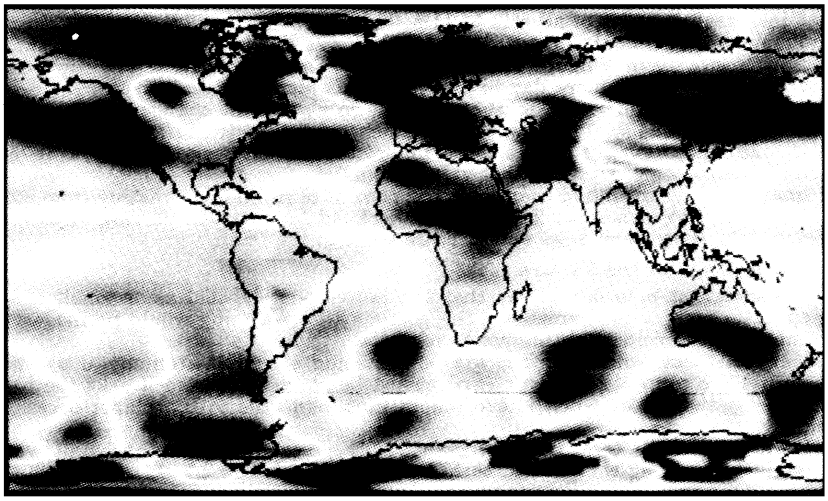


Figure 6. Satellite-measured temperature trends (1979–1996). Red areas have become warmer. while the blue areas have become cooler.

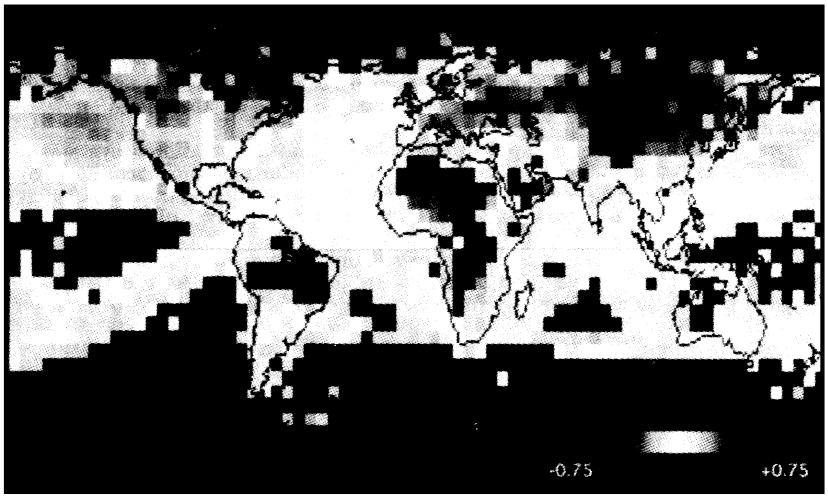


Figure 7. Winter minus summer surface temperature trends since 1946 indicate that most of the observed warming has been occurring in some of the coldest airmasses on earth—over Siberia during the winter.

The original study, by Thomas Karl and others (8), showed that the percent of rain in the United States that falls from storms of two inches or more in 24 hours has increased from 9% of all rain to 11%. This is a change of 2%. However, in order to create a sensational effect, this 2% change was divided by the average amount of 10%, resulting in a figure of 20%! In reality, what Karl found was that, on the average, there is one more day in every 730 in which the two-inch threshold is exceeded. Karl also informed me that there is no significant change in rain of three inches per day or more. Is a two-to-three inch rainfall "extreme"? Or, given the fact that much of our agricultural region is in moisture deficit every summer, is it "beneficial"? Simple logic can make that value judgment.

Imagine if the truth had been told: The percent of rainfall originating from storms of less than two inches per 24 hours has declined from 91% of all rain to 89%. Unfortunately, there is no news and no scare value in the truth.

Another View of the Future

I believe that it is fair to say that the people once labeled as "a small band of skeptics" - those who championed the position that warming would be modest and primarily in the coldest air masses-have won the day.

Many of these same scientists are now forming a new environmental paradigm. It is that the concept of "fragile earth" must be abandoned. And it asks the impertinent question: since when is everything that man does to the planet necessarily bad?

During the 20th century, we have already proceeded more than half way to radiatively doubling the natural carbon dioxide greenhouse effect. Here is what resulted:

Life expectancy doubled in the free and developed world. The developing world is catching up as their emissions rise. Corn production per acre increased fivefold. The growing season in the coldest latitudes increased slightly, but enough to increase greenness by 10% (8). Rainfall in the world's breadbaskets increased slightly, even as summer temperatures did not warm. Australia reports a massive increase in agricultural production that may be related to climate (9).

There are thousands of laboratory and field experiments, as well as the practical activities of professional horticulturalists, that demonstrate that rising carbon dioxide makes most plants grow better. Consider the writing of Sylvan Wittwer, the man who conducted some of the very first experiments on this phenomenon. He ultimately became chairman of the Board on Agriculture of the National Research Council.

There is currently a blind spot in the political and informational systems of the world. This is accompanied by a corruption of the underlying biological and physical sciences. It should be considered good fortune that we are living in a world of gradually increasing levels of atmospheric CO_2 .... The rising level of atmospheric CO_2 does not make the United States the world's worst polluter. It is the world's greatest benefactor. Unlike other natural resources (land, water, energy) essential for food production, which are costly and progressively in shorter supply, the rising level of atmospheric CO_2 is a universally free premium on which we can all reckon for the future. [2]

I must ask this Committee the real questions of the day: How much of the money of the citizens of this nation are you willing to spend to stop this? How much to stop a slight amelioration of the coldest temperatures, in the airmasses most inhospitable to unprotected life where there is human settlement? How much to stop making the earth greener, more productive, and human life increasingly long over the mass of the planet that still finds us the envy of history?

References

(1) Houghton, J.T., G.J. Jenkins, and J.J. Ephraums (Eds.) (1990). Climate Change: The IPCC Scientific Assessment. Cambridge: Cambridge University Press.

(2) Houghton, J.T., L.G. Meira Filho, B.A. Callander, N. Harris, A. Kattenberg, and K. Maskell (Eds.) (1996). Climate Change 1995: The Science of Climate Change. Cambridge: Cambridge University Press.

(3) Santer, B.D., et al. (1996). A Search for Human Influences on the Thermal Structure of the Atmosphere. Nature, 382, 39-45.

(4) Michaels, P.J. and P.C. Knappenberger, 1996. Human Effect on Global Climate? Nature, 384, 522-523.

[2] Members of the Senate would do well to read Wittwer's book, Food, Climate and Carbon Dioxide (10) a distillation of his 750 articles in the refereed scientific literature.

(5) Mitchell, J.F.B. and T.C. Johns (1997). On modification of Global Warming by Sulfate Aerosols. Journal of Climate, 10, 245-266.
(6) Kerr, R.A. (1997). Model Gets It Right-Without Fudge Factors, Science, 276, 1041.
(7) Hobbs, P.V., et al. (1997). Direct Radiative Forcing by Smoke from Biomass Burning, Science, 275, 1777.
(8) Karl, T.R. et al. (1995). Trends in high-frequency climate variability in the 20th century. Nature, 337, 217-220.
(9) Myneni, et al. (1997). Increased plant growth in the northern high latitudes from 1981 to 1991. Nature, 386, 698-702.
(10) Nicholls, N. (1997) Increased Australian wheat yield due to recent climate trends. Nature, 387, 484--485.
(11) Wittwer, S.H. (I 995). Food, Climate and Carbon Dioxide. CRC Press, Boca Raton, Fla. 236pp.

Senator HAGEL. Dr. Michaels, thank you. Dr. Robock.

STATEMENT OF DR. ALAN ROBOCK, MARYLAND STATE CLIMATOLOGIST, DEPARTMENT OF METEOROLOGY, UNIVERSITY OF MARYLAND, COLLEGE PARK, MARYLAND

Dr. ROBOCK. Thank you very much. I only had a day to prepare my statement, so I don't have any graphs like Pat has. But I will just read from it and expand on it.

First, I would like to introduce myself and tell you who I am and what my expertise is. I have a Ph.D. in Meteorology from MIT, which I received in 1977, and I have been a Professor at the University of Maryland ever since. I am also the State Climatologist of Maryland. Pat is the State Climatologist of Virginia.

I have been involved in climate research for the last 25 years. I published more than 125 articles on my research, including some which address the detection issue. I have published a paper recently showing that the cooling of the stratosphere which was observed for the last 30 years is very unlikely to have happened by chance and is probably a signal of human impacts on the climate system.

I am the contributing author to 4 of the 11 chapters of the most recent IPCC report, including chapter 8, the Detection of Climate Change and Attribution of Causes.

The work I did in contributing information to these chapters and in reviewing these and other chapters was done as a volunteer at night, in my spare time, with no compensation.

I have grants from several U.S. agencies to support my research at the university, from the National Science Foundation, NASA, NOAA and Department of Energy. But I do not receive any private financing of my research.

I am a member of the American Meteorological Society, the American Geophysical Union, the American Association for the Advancement of Science, and I serve on the Scientific Advisory Board of the National Institute for Global Environmental Change, Great Plains Regional Center, which is at the University of Nebraska, in Lincoln. I have served on that since its inception in 1992. This is funded by Department of Energy.

I worked as a Congressional Science Fellow 10 years ago for Congressman Bill Green for a year, and I also worked on the Energy and Environment Study Conference, which was chaired by him and Senator Gore at the time, and wrote a report for Congress on the greenhouse effect. I think it was the first one that was put out by them.

I was a visiting scientist for a year at Princeton 2 years ago, where I worked on climate research.

I agree with the conclusions of the 1995 Working Group I report. "The balance of evidence suggests that there is a discernible human influence on global climate."

Note that this says the "balance of evidence." It does not say that there is unambiguous proof.

The report points out, "Our ability to quantify the human influence on global climate is currently limited because the expected signal is still emerging from the noise of natural variability, and because there are uncertainties in key factors. These include the magnitude and patterns of long-term variability." I agree with that, too.

So what we are saying is that if we look at all of the evidence, it supports that we are having a human impact on climate, but it does not prove it unambiguously because there is so much natural variability and we are trying to see a very small signal so far.

What is the evidence we use? The evidence which supports a human influence includes observations that the concentrations of greenhouse gases produced by humans, especially carbon dioxide, are increasing. These gases warm the surface by enhancing the natural greenhouse effect. This is undisputed. We can measure the increase of CO_2.

But these gases are not the only cause of climate change. When we take the most recent climate models and include these effects plus the effects of aerosols, that is, particles in the atmosphere, plus the effects of volcanic eruptions, plus ozone depletion, solar variations, and El Ninos, then these models produce simulations of climate for the past 100 years that agree quite well with the past surface temperature record.

This is how science progresses. We do the simple experiment first, putting in only CO_2. Then we put in other factors which we begin to understand are also important. If this changes the result, this is scientific progress. It does not mean that what was done originally was wrong or that the people had a particular bias. It is just advancement and better understanding.

In addition, stratospheric temperatures are decreasing, the sea level is rising, and glaciers are melting. All of these are in agreement with these theoretical calculations.

So sea level rise, which has not been mentioned much here, is another consequence of global warming. It is usually pointed out that small island states would be one of the principal people that would be affected. But I am from the State of Maryland. Maryland is a small island State, too. We have small islands in the Chesapeake Bay. As sea level rises, they will be affected. In fact, there is already evidence of this in Chesapeake Bay.

There will be increasing effects all along the coast as the sea level rises.

So these same models that we tested to explain the past climate we use for projections of future climate. They say that the average global temperature will rise by 2 to 6 degrees Fahrenheit by the end of the next century. There is a typo in my written report. It should be 6 degrees, not 9 degrees.

Even for the smallest increase projected, "The average rate of warming would probably be greater than any seen in the last 10,000 years."

So the IPCC goes on to say, "The actual annual decadal changes would include considerable natural variability. Regional temperature changes could differ substantially from the global mean value."

This means that at any one location on the globe, the probability of high temperatures will increase. But it will not be warmer on each and every day.

There also could be some surprises. There could be some rapid changes that we do not even understand or cannot predict now. Ten years ago, when I worked here, I sat in on a lot of hearings about ozone depletion and should we restrict freons, and many industry people sat up here and said no, it will destroy our industry if we can't have freons. Some scientists said but the science shows that ozone is going to be depleted.

Two years ago, Sherry Rowland, Mario Molina, and Paul Cruson received the Nobel Prize in Chemistry for their work warning us about it more than 20 years ago.

The ozone hole appeared over the South Pole. Nobody predicted it. Nobody thought that that would happen. We were only worried about gradual ozone depletion. All of a sudden we have this rapid depletion of ozone that nobody predicted.

We understand it now. It is a very complex interaction between stratospheric clouds and atmospheric circulation. But this was a surprise. It actually was much worse than we had thought.

So I am giving you what we know now, this range. But the rest is unknown. It could be that the warming could be less or it could be more. We don't know. We need more research to find that out.

Now what would be the consequences of this climate change? Well, obviously, the most threatening one is our food supply. If there would be an increase in the latitude of drought and crop failures in the bread baskets of the world, that would have a significant impact. The latest analysis from IPCC shows very large or very small changes in agricultural production in many different places around the world. But it is something that is very poorly known at this point and needs a lot more work.

According to our current understanding, the average is that it probably would not be so much of a problem, but we don't know.

Other potential impacts include stronger, more violent storms, coastal flooding and erosion, forest declines, spreading of deserts, more intense droughts and floods, the spread of tropical diseases, poorer winter skiing and snow boarding, increased human mortality and illness from heat, and increased economic and geographical dislocations.

Ironically, the distribution of these impacts is not uniform. It looks now that the developed nations would be less impacted than the developing countries, even though the developed nations are the ones that are producing, that are major producers of greenhouse gases right now.

In the rest of my written statement, I have sort of taken off my scientist hat and given you my opinion based on my knowledge of the political process and what should be done about it. So I don't

want really to dwell too much on that except to say that improved knowledge is one of the things that we still need. We still need to know a lot about what is going to happen.

There is going to be warming no matter what we do, no matter what treaties we sign, because all the greenhouse gases that we have put in in the past up until today are going to influence climates for decades to come. So if we try to restrict emissions of gases, we will change the rate of climate change. We will make it slower and allow us more time to adapt and to deal with the problems.

In order to adapt and to know what the patterns are, we need more research to understand what these patterns are.

I will just close by giving you an analogy of this very different problem of detecting an anthropogenic climate change. Suppose you have a car and you are driving down the road, but the front wheels are really loose and are wobbling back and forth. So you just hold straight to the steering wheel. But the car is going to be going back and forth, and back and forth. You cannot predict at any one time exactly where it is going to be.

That is how the climate changes now because of all the noise generated by storms, by the changing storms. For the same reason that we cannot predict the weather more than a week in advance, those same storms, which are unpredictable, produce changes of climate.

Now if we turn the wheel of the car a little bit, which is the analogy to putting in greenhouse gases, the car is going to curve a little bit. But at any individual time it is going to be left or right of the place that you are pointing to.

Right now, we are trying to measure this wiggly signal coming out of the noise of climate change and we are just about at the edge. It is very hard to say, and we are looking for particular patterns that would not have occurred naturally. The change of vertical temperature is one of them. The changes from different hemispheres is another one. But the balance of evidence, all of our theoretical understanding, points to that there really is a greenhouse warming effect and we are seeing it now.

Thank you.

[The prepared statement of Dr. Robock follows:]

PREPARED STATEMENT OF ALAN ROBOCK

Introduction

First I would like to introduce myself. I earned a Ph.D. in Meteorology at the Massachusetts Institute of Technology in 1977. Since then I have been on the faculty of the Department of Meteorology of the University of Maryland, where I am now a Professor and the State Climatologist of Maryland. My research involves many aspects of climate change, including the greenhouse effect, impacts of climate change and satellite observations. I have published more than 125 articles on my research, more than half of these in the peer-reviewed literature. I conduct both observational analyses and climate model simulations.

I have published papers on the creation of regional climate change scenarios for impact analysis and on the effects of climate change on corn production in Venezuela. I recently published a paper (Vinnikov, Konstantin Ya., Alan Robock, Ronald J. Stouffer, and Syukuro Manabe, 1996: Vertical patterns of free and forced climate variations. Geophys. Res. Lett., 23, 1801-1804) which showed that the cooling of the stratosphere which has been observed during the past 30 years has a very small chance of having happened due to natural climate fluctuations, and is most likely a signal of human impacts on the climate.

I am a contributing author to 4 of the 11 chapters of the most recent EPCC 1995 Working Group I report, including Chapter 8, "Detection of Climate Change and Attribution of Causes." The work I did in contributing information to these chapters, and in reviewing these and other chapters, was done as a volunteer, at night and in my spare time, with no compensation. I currently have grants from the National Science Foundation, the National Aeronautics and Space Administration (NASA), the National Oceanic and Atmospheric Administration (NOAA), and the US Department of Energy (DOE) that support my scientific research. I have no private financing of my research or publications.

I am a member of the American Meteorological Society, the American Geophysical Union, and the American Association for the Advancement of Science (AAAS). I serve on the Scientific Advisory Board of the National Institute for Global Environmental Change, Great Plains Regional Center, at the University of Nebraska in Lincoln, and have since its inception in 1992. This center is funded by DOE. I am the Associate Editor for Meteorology of Reviews of Geophysics. I serve on the International Climate Commission of the International Association for Meteorology and Atmospheric Science (IAMAS) and the American Meteorological Society Committee on Climate Variations. I was awarded a AAAS Congressional Science Fellowship in 1986, and served as Legislative Assistant to Congressman Bill Green (R-NY) and as a Research Fellow with the Environmental and Energy Study Conference from September, 1986, through August, 1987, where I authored the report The Greenhouse Effect: Global Warming Raises Fundamental Issues. During the 1994-95 academic year I was a Visiting Research Scientist at Princeton University in the Atmospheric and Oceanic Sciences Program, conducting climate research at NOAA's Geophysical Fluid Dynamics Laboratory.

Scientific Consensus on Global Warming

I agree with the conclusions of the 1995 IPCC Working Group I report that "the balance of evidence suggests that there is a discernible human influence on global climate." Note that this is the balance of evidence, NOT unambiguous proof. The report points out that "our ability to quantify the human influence on global climate is currently limited because the expected signal is still emerging from the noise of natural variability, and because there are uncertainties in key factors. These include the magnitude and patterns of long term variability...." [Both these quotes are from p. 5 of the Summary for Policymakers.] I agree with this part of the assessment, too.

What is the evidence we use? The evidence which supports a human influence on climate includes observations that the concentrations of "greenhouse gases" which are produced by human activity, especially carbon dioxide, are increasing and that these gases warm the surface by enhancing the natural greenhouse effect. These facts are undisputed. But these gases are not the only cause of climate change. When the most recent climate models include the effects of greenhouse gases, aerosols (particles in the atmosphere), volcanic eruptions, solar variations, and El Niñio in their calculations, they produce simulations of climate change of the past 100 years that agree quite well with the past surface temperature record. In addition, stratospheric temperatures are decreasing, sea level is rising, and glaciers are melting, all in agreement with these theoretical calculations.

It is these same models that we use for projections of future climate, and they say that the global average temperature will rise by 2 to 9°F by the end of the next century. Even for the smallest increase projected, "the average rate of warming would probably be greater than any seen in the last 10,000 years." [p. 6 of the EPCC Summary for Policymakers.] The EPCC goes on to say, "actual annual to decadal changes would include considerable natural variability. Regional temperature changes could differ substantially from the global mean value." This means that at any one location on the globe, the probability of high temperatures will increase, but it will not be warmer on each and every day.

Of the projected consequences of global warming to society, I see the threat of midlatitude drought, and resulting crop failures in the breadbaskets of the world, as a significant potential danger. The food supply of a planet that will have many more mouths to feed is threatened. It is difficult to quantify this threat. While IPCC studies show possible large increases and decreases in crop productivity in different regions of the world, with no net large changes in current production, much more work is need in this area.

Other potential impacts on humans include stronger and more violent storms, coastal flooding and erosion, forest declines, spreading of deserts, more intense droughts and floods, spread of tropical diseases, poorer winter skiing and snowboarding, increased human mortality and illness from heat, and increased economic and geographical dislocations. The distribution of impacts is not uniform

around the world. Ironically, while the developed nations of the world produce the majority of greenhouse gases, it appears that developing countries will be more severely affected. However, quantified estimates of total damage to society are currently quite uncertain.

What Should We Do?

Here I give you my professional opinion based on my scientific and political knowledge. We need to take measures as insurance against possible serious consequences. Policy responses will have to made in an environment of uncertainty, but not in an environment of ignorance.

Our response to the threat of global warming at this time should be one of adaptation, improved knowledge, and mitigation. "No regrets" responses should be strongly pursued. I will briefly comment on each of these.

Adaptation. No matter what our response, the planet will warm. The most we can hope to achieve is to slow the rate of warming in the next century. Therefore, in the case of each threat to society listed above, all the threats not mentioned, and the threats that will appear that we are not smart enough to imagine now, we will have to adapt to minimize the negative impacts. This adaptation will require much better information and technological innovations. This represents a significant business opportunity in the United States to develop the necessary devices and products and to market them to the world.

Improved knowledge. We need better data, better models, better computers, and more trained scientists and engineers to address the problems presented by global warming. Investing in the nation's scientific research establishment is a very inexpensive and very rewarding allocation of the nation's resources. We have to know where and when temperature, precipitation, storm, and sea level changes will take place. We need to know the biological response of agricultural and natural ecosystems to the changed climate. Only then can we gauge the impacts of our actions, and help to adapt precisely to the changes.

Mitigation. If climate change is slowed down and more gradual, society will have more time to learn to live in this new world. This means stopping the global growth in the emission of carbon dioxide, and slowly reducing it. The only way to do this is to include burning less coal and oil in the response. Any combination of conservation, energy efficiency, energy tax, and public transportation enhancements will result in less gasoline being burned and less coal being burned.

"No regrets" policies. Reduced usage of energy will have many positive benefits to society, while exacting small costs, even if projected global warming turns out to have been exaggerated (which is just as likely as that the warming turns out to have been underestimated). We would have cleaner air, less acid rain, greater visibility in the atmosphere, cooler central regions of cities, more trees, and less dependence on foreign oil supplies (currently about half of our usage). There are many proposals along this line that will not reduce American living standards, and our productivity will increase in the long run as we use energy more efficiently.

Legislative response. In light of the above discussion, I cannot support the Byrd/Hagel Senate Resolution 98 which seeks to limit current US participation in a climate treaty unless developing countries are also included now. The United States agreed in Berlin in 1995 that the current round of negotiations will only commit industrialized nations to emissions targets, and that the developing countries will produce commitments in the subsequent round of talks. There is no reason to change this now. The latest scientific research supports this position.

The fact is that each US citizen currently produces more than 5 times the greenhouse gas emission as the average person on earth. Once industrialized countries set an example, as we have in so many other social, moral, and environmental issues, the developing world will accept its responsibility to restrict greenhouse gas emissions as already agreed in the next few years.

Senator HAGEL. Dr. Robock, thank you very much.

To both of you, thank you again.

Dr. Robock, you heard your colleague, Dr. Michaels, say, I believe, that over the last 18.5 years there has been a net cooling. Obviously you disagree with that.

Dr. ROBOCK. No. He has a graph here showing the data from the satellites. He has another graph showing the data from the surface temperature observations.

These are measuring different things. So the question is what are you talking about, surface temperatures or temperatures in the middle part of the atmosphere.

In both cases, it looks like the average temperature of the last 20 years has been about constant. It has not gone up very much and if there is a negative trend, it is tiny. So the trend is much smaller than the individual year to year variations.

The largest volcanic eruption of the past century, the Pinatubo eruption, took place in 1991 and produced substantial cooling for several years. 1992 was quite cold compared to the years before that and we are only just now recovering from that cooling. So he has picked a very short period of time, only 20 years, and at the end of that period there are the effects of a volcanic eruption. So you have to interpret this in light of all the causes of climate change, not just greenhouse warming.

This does not conflict with our understanding of how the climate system should behave. This is a response to greenhouse warming, to El Ninos which take place. There was the largest El Nino of the whole last 100 years at the beginning of this period, in 1982–1983. So it was a warm period caused by an El Nino at the beginning and a cold period at the end caused by a volcanic eruption. That, superimposed on the greenhouse gases that come up, can explain the entire record. So it is not inconsistent with a global warming theory.

Senator HAGEL. Let me ask Dr. Michaels to respond to that. Thank you.

Dr. MICHAELS. The satellite record can be broken into hemispheres. One of the things that scientists like to do is to look at the Southern Hemisphere because it is thought to be relatively pristine compared to the Northern. It does not have a lot of the particulate emissions. It does have the changes in the greenhouse effect, though, because the greenhouse gases are long-lived.

There is a statistically significant negative trend in the Southern Hemisphere satellite data as well. But, moreover, if we take out the period 1992 through 1994, which is when the Pinatubo cooling is in that record, the cooling remains statistically significant. Pinatubo did not do that.

Dr. ROBOCK. Well, you don't know that the Pinatubo effect ended in 1994.

Dr. MICHAELS. Except that the temperature went back to where it was by mid-1994.

Dr. ROBOCK. Yes. But it might have been much warmer if there had not been an eruption.

Dr. MICHAELS. Well, if you take a look at the modeling simulation from Hansen, which he was talking about in "Science" magazine a few years ago, a couple of years ago, he said that they had correctly diagnosed both the magnitude and the period of the Pinatubo cooling, and he hit the bottom about 10 months or 11 months after the eruption and then got it back to the background temperature about 2 years after the eruption, didn't he?

Senator HAGEL. Obviously we have a little difference of opinion here. I think this really makes the case on why, along with, I suspect a lot of U.S. Senators, am rather confused about what do we

have here. What is the problem, what is the issue. Do we have an issue? Do we have a problem?

But moving along from there Dr. Robock, there are your comments about food supply and agricultural production. Your colleague Dr. Michaels as well as the President of the Nebraska Farm Bureau, talked about the incredible increases in agricultural production which have occurred in this country, Australia and other places. Your testimony does not give that same indication of an increase in productivity.

Dr. ROBOCK. Well, just like climate change, there are many things that cause changes in agricultural productivity.

If you look at agricultural productivity over the most recent time, climate has not been the most significant factor. It has been changes of fertilizers, technology, energy, new seeds. So, because of technological inputs to farming, there indeed has been an increase in agricultural productivity.

If you look at figures of that, little wiggles on those impacts of climate. The drought in 1988 I am sure had an impact on climate productivity. There was an extreme. But to predict technological responses and human responses and how they will deal with a gradually changing climate and to know what the total agricultural productivity will be in the future is very difficult to do. I don't know how to do that.

Indeed, it is true that right now, in our country and in the world, except for extreme cases, the climate change is not the most dominant thing for food supplies.

But what we are talking about is the most rapid climate change ever before experienced in the history of our species happening much more rapidly than has happened in the past. Current model projections show that there will be significant drought in the summertime, much more than we have ever before experienced.

So the threat is that there will be much larger climate extremes that we will have to deal with and it may not be possible to deal with that the way we are dealing with it now.

Senator HAGEL. I am going to ask Dr. Michaels to respond. I am sure he wishes to. But I can tell you that if Mr. Neidig, the Nebraska Farm Bureau President, was sitting here and listening to some of that, he might bring up the Dust Bowl of the 1930's.

Dr. ROBOCK. I didn't bring that up.

Senator HAGEL. No, I did, because your point was that the productivity increases have come as a result of fertilizer, technology and so on and that climate did not have much to do with it. Those in Nebraska and the Midwest would tend to differ.

Dr. Michaels, you might have a response.

Dr. MICHAELS. Well, the fact of the matter is that as a percentage of the yield of crops from year to year, the weather component drops more and more and more as the technological component goes up. That is a peculiarity of our society that many people do not realize; that we actually engineer out these big drops in agricultural productivity.

Let me tell you a little story about this. It's fascinating.

I actually got my Ph.D. in crops and how they change around the world as the climate fluctuates. I did a bunch of work after that in the area.

Now Al is right. There is a tremendous increase in the technological component of yield and it is about to jump up again, I think, by the way, as selective genetic engineering makes plants more efficient with respect to water use and fertilizer use.

We were looking at a study of Eastern agriculture. What we do in these models is try to put some estimator of the technological change in. Every time we did, we could not quite explain the increase.

Well, now we are seeing research by Neville Nichols in Australia saying well, maybe the reason for some of this increase is climate change itself or, as Sylvan Wittwer would say, the fact that you have put more carbon dioxide in the air.

This is not a one-way street. Everything you do is not bad and technology has its way of ameliorating some of the problems.

Senator HAGEL. Did you want to respond, Dr. Robock?

Dr. ROBOCK. I just wanted to say that I think maybe I was misunderstood.

I agree with you that the Dust Bowl had a significant impact on agriculture. So if you look to include that in the record, certainly the increase in productivity was because the climate is more beneficial now than during the Dust Bowl.

Dr. MICHAELS. Thirty seconds. After the Dust Bowl——

Dr. ROBOCK. Just let me say one other thing.

Dr. MICHAELS. Sure.

Dr. ROBOCK. About the CO_2 fertilization issue which Dr. Michaels brought up, increased CO_2 can also make weeds grow faster. It can also make insects eat more plants than they have before in order to get enough nutrition.

So it is not clear and we don't understand well enough yet what the total mix of the influence of increased CO_2 fertilization will be on productivity because it can affect lots of other things and not just the growth of crops.

Senator HAGEL. Dr. Michaels, we will finish with this and then pass the ball on to Senator Sarbanes.

Dr. MICHAELS. I would just argue that if there are more insects eating more plants, there have to be more plants for the insects to eat.

Senator HAGEL. Well, would you like to pick up on that, Senator Sarbanes.

Senator SARBANES. Well, in a way.

I take it, Dr. Michaels, that as you just said, it is not a one-way street. In fact, as I read your statement, you think it is so much a two-way street that I take it you would be in favor of more emission of carbon dioxide. Would that be correct?

Dr. MICHAELS. No, I didn't say that.

Senator SARBANES. Let me read your statement.

Dr. MICHAELS. Let me tell you what I am in favor of.

Senator SARBANES. No, let me read your statement. "During the 20th Century, we have already proceeded more than half-way to radiatively doubling the natural carbon dioxide greenhouse effect. Here is what resulted. Life expectancy doubled in the free and developed world."

So you link the increase in life expectancy to the increase in carbon dioxide greenhouse effect?

Dr. MICHAELS. No. No, sir. No.

The society that developed, the technological society that developed that was based upon fossil fuel developed technology and lifestyles that clearly doubled the life expectancy. It was not caused by carbon dioxide nor was the fivefold increase in corn yield. It was the society that developed as a result of this. Other societies want to do the same.

Senator SARBANES. So it really says nothing as to whether the increase in carbon dioxide greenhouse effects is related to these measures.

In other words, if you had developed a society which had exercised better control over its greenhouse effects, you might have still had these results, is that correct?

Dr. MICHAELS. We cannot run that experiment.

Senator SARBANES. Well, would you run it now?

Dr. MICHAELS. I don't have the ability to run it.

Senator SARBANES. No, I mean that we can just let this thing go. Do you think there is any problem here? On the basis of this analysis, I take it one would simply say well, just let it rip.

Dr. MICHAELS. Why do something drastic right now? Yes, I agree. I certainly don't think there is any need to do anything drastic.

Senator SARBANES. Would you do anything?

Dr. MICHAELS. I would believe our greener friends.

Senator SARBANES. Pardon?

Dr. MICHAELS. I would believe our greener friends who have told us that technology of the future will become more energy effective and cost effective with respect to the current mix of technology. When it does that, that technology becomes cheaper.

Senator SARBANES. But why should we bother to do that if there are no harmful consequences of a greenhouse effect?

Dr. MICHAELS. Well, we will run that experiment, won't we?

Senator SARBANES. But why should we do it if there are no harmful consequences?

Dr. MICHAELS. Because if the technology is cost competitive, people are going to buy it no matter what, and that is what we are being told. We can buy a lot more of it in the year 2020 than we can in the year 1996.

Senator SARBANES. Why do we want a technology that reduces the greenhouse effect if the greenhouse effect is not harmful?

Dr. MICHAELS. I don't think that's the point, Senator. I think we want a technology that produces energy efficiently, whether it emits carbon dioxide or not. That is where we are told we are heading.

Senator SARBANES. Now let me ask you this. I am interested in this assertion. You don't think there is any problem, I take it, in a rising level in the oceans.

Dr. MICHAELS. I will tell you that many recent studies, notably by John Mather at the University of Delaware, who is a very esteemed climatologist, and several others that I could cite if I could get into my little white book here, now indicate sea level rise not to be thought to be as much as people said.

Now hold on for a second.

Senator SARBANES. No, I don't want to get into that argument——

Dr. MICHAELS. I do.

Senator SARBANES. [continuing]. as to whether it is more or less. Do you think there is sea level rise?

Dr. MICHAELS. The sea level has risen a few inches in the 20th Century. Much of the rise was before much of the greenhouse emissions.

Senator SARBANES. Now I take it you say if the heat is at the ice caps, it doesn't matter because they are well below freezing in any event, is that correct?

Dr. MICHAELS. In the winter, yes.

What you do is you actually increase the amount of snow in the highest latitudes. The simulations that I am referring to by Mather—and there are several of them; Al can probably help me out with this—now indicate that the two largest areas of ice on the planet in toto, which is Greenland and Antarctica, actually grow a bit if you warm the atmosphere some because of the propensity for winter warming.

Dr. ROBOCK. No. As I understand it, Greenland would melt slightly but Antarctica might grow.

Dr. MICHAELS. And the net is positive between those two.

Dr. ROBOCK. But the total amount of contribution to sea level rise from melting ice is much smaller than the contribution just from thermal expansion; that is, you heat the water and it becomes thicker.

So it is not a significant part of the projected sea level rise, anyway. It may be a third of it. There are a lot of glaciers on land that are melting.

I was just in Glacier Bay, Alaska. The glacier has retreated 50 miles in the last 200 years. When the first explorers came there, there was a huge sheet of ice and how it has contributed to sea level rise. Glaciers around the world on land are melting. That is the main contribution from glaciers.

But it is much less than the contribution just from heating the ocean and it is getting thicker.

Dr. MICHAELS. If you melt all the land glaciers on the surface of the planet, I believe you raise the sea level by 7 inches. Isn't that right?

Dr. ROBOCK. Yes. So that's not very important. The thermal expansion is much more important.

Dr. MICHAELS. Thermal expansion has given us half, it has generally given us 50 percent of the contribution, an equal contribution that you get from melting ice.

I don't think that you are going to disagree with me that warming in models is coming down. Nature is trying to tell us something. The NCAR model is sitting there at about 1.3 degrees with the right greenhouse effect in it. PKMO is down there. Nature has not really warmed us up very much in the last 20 years, as you have said. So what about all this thermal expansion?

Dr. ROBOCK. There are about five things there that I would like to disagree with.

Senator SARBANES. Well, go ahead and do it.

Senator HAGEL. Yes, we have time.

Dr. ROBOCK. The argument that models are giving different answers now than they did before and that that trend signifies anything about the future is really misleading.

If you put in aerosols into a model, which tend to cool, then the warming will be less than if you are only put in greenhouse gases. We knew that. I published a paper in 1978 showing that and showing that the Northern Hemisphere would warm less than the Southern Hemisphere because of the aerosols.

So we have known that for a long time. It is just that these very sophisticated models have not had the technology to put in the effects of aerosols in a correct way. So now that we do it, we get the result that we expect.

This gives us further confidence in the models, not less.

If you increase carbon dioxide by 0.7 percent a year rather than 1.0 percent a year, of course you will get less warming. There is nothing controversial about that.

Any projection of future climate depends on how much CO_2 will be in the atmosphere. That means we have to predict human behavior. We have to predict what the human emissions will be.

So you can take any scenario you want and then get the answer based on those assumptions. If Pat is saying that we put in a better estimate of past CO_2 changes and we get a better estimate from the models, that strengthens our confidence in the models, not weakens it.

Dr. MICHAELS. The person who, I guess, ignited, the scientific witness who ignited the "Bonfire of the Greenhouse Vanities" was James Hansen from NASA in his 1988 testimony. He is often thought of as quite an authority.

Let me read to you from the May 16 "Science" magazine his opinion of sulfate aerosols. I am quoting from an article by Richard Caere. "But the assumptions about how hazes"—that's the aerosols—"affect the climate may have taken a hit recently from climatologist James Hansen, the man who told Congress in 1988 he believed 'with a high degree of confidence' that greenhouse warming had arrived. In a recent paper, Hansen and his colleagues pointed out that recent measurements suggest that aerosols don't just cool, they warm the atmosphere by absorbing sunlight. The net effect of this reflection and absorption Hansen estimates would be small—too small to have an effect on temperature."

Dr. ROBOCK. What Pat is talking about is the direct effect of aerosols; that is, aerosols just scatter some of the sunlight back to space and that heat doesn't get to the ground.

Indeed, recent studies off the coast of Virginia last year, the TARFOX experiment, showed that a lot of the haze is carbon based not sulfate aerosols——

Dr. MICHAELS. That would cause warming.

Dr. ROBOCK. [continuing]. which would cause warming.

Dr. MICHAELS. And it didn't warm.

Dr. ROBOCK. So what Hansen is saying, which is the part Pat didn't read, is that, therefore, the effect of aerosols must be the indirect effect that is causing the cooling. This indirect effect of aerosols is when they go into clouds. When aerosols go into clouds, they produce smaller cloud droplets and make the clouds brighter.

It increases their reflectivity. This indirect effect cools by reflecting more sunlight.

You can see this if you look at a satellite picture of ship tracks. You can see a line in the clouds as a ship steams underneath it because the pollution from the smokestack of the ship goes up into the cloud and makes this bright white line.

This area of indirect effects of aerosols on clouds is an area of active research and is very difficult to quantify by observations because you cannot do in the real world an experiment with and without the aerosols. But, based on the observations that were taken of how it changes over time and based on our climate models, the climate models will give you any answer you want depending on what assumptions you make about the theory.

But Hansen's conclusion is that there has to be something missing that caused the cooling that prevented the warming that the models say, and it was this indirect effect of aerosols.

So, indeed, I can agree with Pat that there are things that we don't understand yet. But that does not change the conclusion that the balance of evidence supports it. Nobody has found any evidence to prove that greenhouse warming is wrong, that the theory is wrong.

Senator HAGEL. Dr. Michaels, you have 15 seconds and then we will move on with our series of questions.

Dr. MICHAELS. The question, again, is one of sensitivity.

I believe you were at the American Geophysical Union meeting in December in San Francisco——

Dr. ROBOCK. Yes.

Dr. MICHAELS. [continuing]. where Hansen gave the paper and said the effect of aerosols on the temperature of the last 20 years is negligible. So you are right, it depends upon the model that you use.

Senator HAGEL. Thank you.

Dr. Robock, I would like to read the last page from your statement. Senator Byrd will be concerned to hear that you cannot support the Byrd-Hagel Resolution, but I am going to pass it on anyway. Moving on to what I think is the more important point, you say the United States agreed in Berlin in 1995 that the current round of negotiations will only commit industrialized nations to emissions targets and that the developing countries will enter commitments in a subsequent round of talks. There is no reason to change this now. The latest scientific research supports this position.

Considering what we have just witnessed here, and given the latest scientific research presented by our two distinguished panelists, I am not sure that is exactly right. But I would like to ask a couple of questions about that.

First of all, why must we rush into this in 6 months, allowing the developing countries not to commit in any binding way?

Second, I keep coming back to a figure that was shown last week with which Secretary Wirth agreed, and with which I assume you agree as well. It indicated that China will be the largest contributor of greenhouse gas emissions in the world by the year 2015.

If, as I said, and as Secretary Wirth agreed that is true, why would we let China and the developing countries out of this, while

we must stick with the way it is in the protocol and implement it immediately?

Dr. ROBOCK. Well, I will give you my opinion as an amateur politician. I am not an expert on this.

The way I see it is that the U.S. has to exert a leadership role in the world and take actions so that other people will follow.

Indeed, you are correct that China and India will be much larger emitters of greenhouse gases in the near future than the developed countries are as they develop. What if everybody in China wants a refrigerator or a car? They will make the same mistakes we did.

So the challenge really is to produce technology so that people can live at a better style of life using energy much more efficiently.

If the U.S. begins this process now, we can develop that technology and it can even be an economic boon to us to produce that technology that the world will demand to use energy more efficiently.

As far as timing, whether it is 6 months or a year, as I understand it, the developing countries will agree to some targets for themselves subsequently. But if the U.S. does nothing, you cannot expect them to do anything, either.

So it is just that we should set an example and do what we have to, even though for 50 or 100 years we will still be using much more energy per person than people in China. We have to make some commitment to demonstrate that it is a problem.

If we don't think it is a problem, how can we expect them to take any action at all?

Senator HAGEL. I would suggest that this goes well beyond setting an example.

Dr. Michaels, you might want to respond to this.

Dr. MICHAELS. Well, the fact of the matter is that energy per capita is somewhat of a misleading unit in this debate. What you really want to look at is the amount of energy per unit of GDP.

In the United States, we now use only 60 percent as much energy as we did in the early 1970's to produce a unit of deflated Gross Domestic Product. That didn't happen because of somebody who was scared of the greenhouse effect. It happened because somebody was scared of high prices, and industry invested its capital in increased efficiency. That is going to continue to happen in the future whether or not we try to force it along.

So I would suspect that we are going to see increasing energy efficiency and economies of scale to be the rule in the 21st Century whether or not we mandate it.

Senator HAGEL. Senator Sarbanes.

Senator SARBANES. You don't see any dangers posed by the developing world in its use of energy as far as greenhouse gases?

Dr. ROBOCK. Are you asking me?

Senator SARBANES. No, I'm asking him.

Dr. MICHAELS. You need to make more question more specific.

Senator SARBANES. Well, people say China should be brought into this thing because they will be emitting more than the U.S. by the year 2015. But you don't see that as a problem?

Dr. MICHAELS. What I would suggest, again, is that the Chinese are going to want to become more energy efficient. I believe many of the things that the first panel said.

You will see—and this is certainly an economic opinion. I am out of my field and probably should say nothing. You will doubtless see more energy efficient technologies being exported from the United States whether or not we mandate emissions reductions because everybody has to compete in an economy that rewards the efficient.

When I lived in Chicago, there was a company called Northern Illinois Gas which had a great slogan. It was, "The future belongs to the efficient." Nothing could be truer.

Senator SARBANES. So your view is that that will take care of the problem, that there won't be a problem because that will take care of it?

Dr. MICHAELS. Well, we see all kinds of interesting little things along this line, you know. People have a difficult time explaining what made the United States become so much more efficient with respect to GDP production over the last 30 years.

Senator SARBANES. What do you think there?

Dr. MICHAELS. If somebody could explain that that was caused by regulation, I'd like to hear the explanation. It was clearly caused by economies of scale.

Senator SARBANES. By what?

Dr. MICHAELS. By economies of scale and people wanting to be more efficient.

Senator SARBANES. Because of increase in costs, energy costs?

Dr. MICHAELS. Increasing price.

Senator SARBANES. Yes.

Dr. MICHAELS. That is supply and demand.

Dr. ROBOCK. If I could just make one comment about the latest scientific research, the reason I said that is there is a time lag built into this whole problem. The greenhouse gases we put in today and that we put in during the time we delay any restriction will have an impact for decades into the future. All the greenhouse gases we put in the past, there is nothing we can do about those. The climate is going to change in the next few decades even if we stop emitting all greenhouse gases now. It would still continue to change based on that.

There is a long time lag. So we cannot wait until we see terrible problems. Then there is nothing we can do. There will still continue to be effects for decades and it will be too late to do anything about it.

So we have to take a cautious attitude, looking at it from the viewpoint of insurance, to what if it is right, what can we do that would be a good thing to do anyway. What if it is going to be much worse? What if there is going to be a huge change in ocean circulation, as some people have suggested, possibly as a surprise and there will be a rapid climate change that nobody predicted?

So it is not like aerosols where if you stop burning today, in a week or two they will all be out of the atmosphere. The greenhouse gases last for decades. So there is a big time lag. We cannot reverse it if we come to a point where we say oh, yes, it really is a problem now.

Dr. MICHAELS. But Al, this leads to what you and I know is the great conundrum about this issue, which is if you really believe in the gloom and doom models, you have to reduce emissions by about 60 to 80 percent. No one knows how to do that.

If you don't believe in them, if you believe in the modest climate change scenario, you have to ask yourself the question why bother. When we look at the emissions proposals that are coming out, you and I know that if you believe the 4 degree warming—and I don't and I'm not so sure you do, for a doubling—but if you believe that, how much would it change the temperature by the year 2050? The answer is probably somewhere around a tenth of a degree or so.

These policies are not credible as far as stopping deleterious and dramatic climate change. The magnitude is just simply too small. I believe that that is the crux of the issue, isn't it?

Senator SARBANES. No. Part of the crux of the issue is whether you think there is any problem at all, and I take it you don't think there is a problem.

Dr. MICHAELS. Again, I think the problem that we have is the lack of warming given how much was predicted.

I think Al will agree that the climate models that were used as the basis for the Framework Convention predicted that it should have warmed between 1.3 degrees and 2.3 degrees by now.

Dr. ROBOCK. No, I don't agree with that.

Dr. MICHAELS. This is Mitchell, 1995.

Dr. ROBOCK. No. They said only if you put in greenhouse gases.

Dr. MICHAELS. Correct.

Dr. ROBOCK. They don't take into account everything else. They never said that that's how the real climate would behave because they know there are lots of other things that cause climate change.

Dr. MICHAELS. In the 1990 IPCC report, there was precious little reference to sulfate cooling except a slight speculation.

Senator HAGEL. Senator, do you have any more questions?

Senator SARBANES. Well, I didn't really get an answer to my question, but I don't think I am going to.

Senator HAGEL. All right. Let's close it up in 60 seconds.

Senator SARBANES. Well, I don't really think I am going to. So it's all right.

Senator HAGEL. Would one of you like to take another run at his question?

Dr. MICHAELS. Sure.

Senator, if you don't think you are going to get an answer, I am trying my best to give you what I think is the answer. The answer is that, one, more efficient technologies we are told will come on the line. Two, they will result in reductions in greenhouse emissions.

Senator SARBANES. Do you want to reduce greenhouse emissions?

Dr. MICHAELS. I want efficient technology.

Senator SARBANES. Do you want to reduce greenhouse emissions?

Dr. MICHAELS. If that reduces greenhouse emissions, so be it.

Senator SARBANES. If it doesn't?

Dr. MICHAELS. No comment.

Senator SARBANES. So be it. All right. That's my answer. Thank you.

Senator HAGEL. Gentlemen, thank you both. This is the great conundrum closing.

I think, again, it reflects that we, at least in this humble Senator's opinion, have a long way to go before we have a strong, significant scientific base to give us some solid, clear direction on this.

Thank you.

We are adjourned.

[Whereupon, at 12:58 p.m., the subcommittee adjourned, to reconvene subject to the call of the Chair.]

APPENDIX

JUNE 19, 1997 HEARING

November 8, 1996.

THE PRESIDENT
The White House,
Washington, DC 20500

DEAR MR. PRESIDENT: Last summer, participants in the second Conference of Parties of the United Nations' Framework Convention on Climate Change (UNFCCC) agreed to negotiations for legally binding numeric limits on greenhouse gas emissions. This dramatic shift from voluntary to enforceable caps on greenhouse gases was led by the U.S. According to your spokespeople, there is now a consensus in the world scientific community which demands urgent action to reduce greenhouse gas emissions.

There is less than agreement outside the United Nations' scientific body. Furthermore, there is still a lively debate among respected scientists about the human versus natural sources of greenhouse gases and their effect on climate. Controversy notwithstanding, the climate change treaty is moving full-speed ahead with the Administration's enthusiastic support. A final agreement is scheduled to be completed in December of 1997, with ratification by individual countries beginning in 1998. If ratified by the U.S. Senate, the treaty will be binding on the U.S. and other developed countries and may be incorporated into U.S. law. However, developing countries will not have to comply.

Of great concern to agriculture are reports under consideration by the U.N. scientific panel which blame agriculture for more than 20 percent of human-caused greenhouse gas emissions. Specifically, we are concerned about proposals for the following:

- fuel economy requirements
- reduction or phaseout of the use of diesel fuel
- limitations on production per acre for some crops
- requirements for "plowless" soil preparation
- mandatory fallowing of crop land
- limits and restrictions on livestock production to reduce methane emissions
- restrictions on use of fertilizer
- restrictions on timber harvesting
- restrictions on processing, manufacturing and transportation of food products

Unfortunately, these proposals ignore agriculture's positive role in reducing greenhouse gases by removing carbon dioxide from the atmosphere through photosynthesis. Most importantly, they cavalierly disregard the most valuable function of modern agriculture—feeding a hungry world. Ironically, rice production has been singled out as the number one culprit in human-caused methane emissions.

We are very concerned that these recommendations or similar ones will be incorporated in the final climate change agreement, ratified and imposed on U.S. farmers and ranchers through U.S. laws. Binding and enforceable controls would apply only to developed countries and would severely disadvantage U.S. farmers and ranchers in today's global markets.

Moreover, we are deeply concerned and surprised that the Administration has not actively consulted with agriculture as the agreement has been developed. We respectfully request that the Administration take the following actions:

(1) The Administration must fully and actively consult with agriculture. Agricultural interests have not been considered by the Department of State and other U.S. agencies which are closely involved with the development of the climate change agreement. The agreement must include an open and extensive public debate which

involves agricultural producers and members of Congress, USDA and other agencies.

(2) The Administration should withdraw its support for legally binding and enforceable caps on emissions until there is a stronger consensus from the scientific community that they are justified. If it is determined that controls are justified, they should be accomplished voluntarily or in ways which minimize disruption of U.S. agricultural producers.

(3) The final climate change agreement, scheduled for completion in December of 1997, must be delayed to provide sufficient time for consultation with agriculture and for adequate risk, cost and benefit assessment.

Without proper scientific and economic analyses and assessment, U.S. farmers and ranchers may be placed at a serious disadvantage with agricultural producers in countries which do not plan to reduce greenhouse gases.

If the Administration does not adequately address the above concerns, we may raise them with Congress during the ratification process.

Sincerely,

AMERICAN FARM BUREAU FEDERATION
AMERICAN CROP PROTECTION ASSOCIATION
AMERICAN SHEEP INDUSTRIES ASSOCIATION
AMERICAN SOYBEAN ASSOCIATION
CENEX
NATIONAL ASSOCIATION OF WHEAT GROWERS
NATIONAL CATTLEMEN'S BEEF ASSOCIATION
NATIONAL CORN GROWERS ASSOCIATION
NATIONAL COTTON COUNCIL
NATIONAL FOOD PROCESSORS ASSOCIATION
NATIONAL GRANGE
NATIONAL MILK PRODUCERS FEDERATION
NATIONAL PORK PRODUCERS COUNCIL
THE FERTILIZER INSTITUTE
UNITED AGRIBUSINESS LEAGUE
UNITED FRESH FRUIT AND VEGETABLE ASSOCIATION
USA RICE
WESTERN GROWERS ASSOCIATION

"There's a lot of noise in the data. It is hard to isolate cause and effect. But there is now an effective consensus among the world's leading scientists and serious and well informed people outside the scientific community that there is a discernible human influence on the climate, and a link between the concentration of carbon dioxide and the increase in temperature....

"The time to consider the policy dimensions of climate change is not when the link between greenhouse gases and climate change is conclusively proven—but when the possibility cannot be discounted and is taken seriously by the society of which we are part.

"We in BP have reached that point."

—John Browne, Group Chief Executive,
British Petroleum (BP America),
Sanford University, 19 May 1997

CLIMATE CHANGE SPEECH

By John Browne, Group Chief Executive, British Petroleum (BP America) Stanford University, 19 May 1997

Dean Spence, Ladies and Gentlemen, good morning.

It is always marvelous to come pack to Stanford and it is a pleasure and a privilege to be here to speak to you today on a subject which I believe is of the utmost importance.

I can't think of anywhere better than Stanford to discuss in a calm and rational way a subject which raises great emotion and which requires both analysis and action.

I think it's right to start by setting my comments in context.

Following the collapse of Communism in Europe and the fall of the Soviet Empire at the end of the 1980s, two alternative views of the consequences for the rest of the world were put forward.

Francis Fukuyama wrote a book with the ironic title "The End of History". Jacques Delors, then President of the European Commission, talked about the "Acceleration of History".

In the event, history has neither accelerated nor stopped. But it has changed.

The world in which we now live is one no longer defined by ideology. Of course, the old spectrums are still with us—of left to right—of radical to conservative, but ideology is no longer the ultimate arbiter of analysis and action.

Governments, corporations and individual citizens have all had to redefine their roles in a society no longer divided by an Iron Curtain separating Capitalism from Communism.

A new age demands a fresh perspective of the nature of society and responsibility.

The passing of some of the old divisions reminds us we are all citizens of one world, and we must take shared responsibility for its future, and for its sustainable development.

We must do that in all our various roles as students and teachers, as business people with capital to invest, as legislators with the power to make law, as individual citizens with the right to vote, and as consumers with the power of choice.

These roles overlap, of course. The people who work in BP are certainly business people, but they're also people with beliefs and convictions, individuals concerned with the quality of life for themselves and for their children.

When they come through the door into work every morning they don't leave behind their convictions and their sense of responsibility.

And the same applies to our consumers. Their choices determine our success as a company. And they too have beliefs and convictions.

Now that brings us to my subject today—the global environment.

That is a subject which concerns us all—in all our various roles and capacities.

I believe we've now come to an important moment in our consideration of the environment.

It is a moment when because of the shared interest I talked about, we need to go beyond analysis to seek solutions and to take action. It is a moment for change and for a rethinking of corporate responsibility.

A year ago, the Second Report of the Inter-Governmental Panel on Climate Change was published. That report and the discussion which has continued since its publication, shows that there is mounting concern about two stark facts.

The concentration of carbon dioxide in the atmosphere is rising, and the temperature of the earth's surface is increasing.

Karl Popper once described all science as being provisional. What he meant by that was that all science is open to refutation, to amendment and to development.

That view is certainly confirmed by the debate around climate change.

There's a lot of noise in the data. It is hard to isolate cause and effect. But there is now an effective consensus among the world's leading scientists and serious and well informed people outside the scientific community that there is a discernible human influence on the climate, and a link between the concentration of carbon dioxide and the increase in temperature.

The prediction of the IPCC is that over the next century temperatures might rise by a further 1 to 3.5 degrees centigrade, and that sea levels might rise by between 15 and 95 centimeters. Some of that impact is probably unavoidable, because it results from current emissions.

Those are wide margins of error, and there remain large elements of uncertainty—about cause and effect and even more importantly about the consequences.

But it would be unwise and potentially dangerous to ignore the mounting concern.

The time to consider the policy dimensions of climate change is not when the link between greenhouse gases and climate change is conclusively proven, but when the possibility cannot be discounted and is taken seriously by the society of which we are part.

We in BP have reached that point.

It is an important moment for us. A moment when analysis demonstrates the need for action and solutions.

To be absolutely clear—we must now focus on what can and what should be done, not because we can be certain climate change is happening, but because the possibility can't be ignored.

If we are all to take responsibility for the future of our planet, then it falls to us to begin to take precautionary action now.

But what sort of action? How should we respond to this mixture of concern and uncertainty?

I think the right metaphor for the process is a journey.

Governments have started on that journey. The Rio Conference marked an important point on that journey. So was the Berlin review meeting. The Kyoto Conference scheduled for the end of this year marks another staging post.

It will be a long journey because the responsibilities faced by governments are complex, and the interests of their economies and peoples are diverse, and sometimes contradictory. But the journey has begun, and has to continue.

The private sector has also embarked upon the journey, but now that involvement needs to be accelerated.

This too will be long and complex, with different people taking different approaches. But it is a journey that must proceed.

As I see it, there are two kinds of actions that can be taken in response to the challenge of climate change.

The first kind of action would be dramatic, sudden and surely wrong. Actions which sought, at a stroke, drastically to restrict carbon emissions or even to ban the use of fossil fuels would be unsustainable because they would crash into the realities of economic growth. They would also be seen as discriminatory—above all in the developing world.

The second kind of action is that of a journey taken in partnership by all those involved. A step by step process involving both action to develop solutions and continuing research that will build knowledge through experience.

BP is committed to this second approach, which matches the agreement reached at Rio based on a balance between the needs of development and environmental protection. The Rio agreements recognize the need for economic development in the developing world. We believe we can contribute to achievement of the right balance by ensuring that we apply the technical innovations we're making on a common basis—everywhere in the world.

What we propose to do is substantial, real and measurable. I believe it will make a difference.

Before defining that action I think it is worth establishing a factual basis from which we can work.

Of the world's total carbon dioxide emissions only a small fraction comes from the activities of human beings, but it is that small fraction which might threaten the equilibrium between the much greater flows.

You could think of it as the impact of placing even a small weight on a weight scale which is precisely balanced.

But in preserving the balance we have to be clear where the problem actually lies.

Of the total carbon dioxide emissions caused by burning fossil fuels only 20% comes from transportation.

80% comes from static uses of energy—the energy used in our homes, in industry and in power generation. Of the total 43 per cent comes from petroleum.

We've looked carefully using the best available data at the precise impact of our own activities.

Our operations—in exploration and in refining—produce around 8 megatonnes of carbon.

On top of that a further 1 megatonne is produced by our Chemical operations. If you add to that the carbon produced by the consumption of the products we produce—the total goes up to around 95 megatonnes.

That is just one per cent of the total carbon dioxide emissions which come from all human activity.

Let me put that another way—to be clear.

Human activity accounts for a small part of the total volume of emissions of carbon—but it is that part which could cause disequilibrium.

Only a fraction of the total emissions come from the transportation sector—so the problem is not just caused by vehicles. Any response which is going to have a real impact has to look at all the sources.

As a company, our contribution is small, and our actions alone could not resolve the problem.

But that does not mean we should do nothing.

We have to took at both the way we use energy—to ensure we are working with maximum efficiency—and at how our products are used.

That means ensuring our own house is in order. It also means contributing to the wider analysis of the problem—through research, technology and through engagement in the search for the best public policy mechanisms—the actions which can produce the right solutions for the long term common interest.

We have a responsibility to act, and I hope that through our actions we can contribute to the much wider process which is desirable and necessary.

BP accepts that responsibility and we're therefore taking some specific steps.

To control our own emissions,
To fund continuing scientific research,
To take initiatives for joint implementation,
To develop alternative fuels for the long term,
And to contribute to the public policy debate in search of the wider global answers to the problem.

First we will monitor and control our own carbon dioxide emissions.

This follows the commitment we've made in relation to other environmental issues. Our overall goal is to do no harm or damage to the natural environment. That's an ambitious goal which we approach systematically.

Nobody can do everything at once. Companies work by prioritising what they do. They take the easiest steps first—picking the low hanging fruit—and then they move on to tackle the more difficult and complex problems. That is the natural business process.

Our method has been to focus on one item at a time, to identify what can be delivered, and to establish monitoring processes and targets as part of our internal management system and to put in place an external confirmation of delivery.

In most cases the approach has meant that we've been able to go well beyond the regulatory requirements.

That's what we've done with emissions to water and to air.

In the North Sea, for instance, we've gone well beyond the legal requirements in reducing oil discharges to the sea.

And now at our crude oil export terminal in Scotland—at Hound Point—which handles 10% of Europe's oil supplies—we're investing $100m to eliminate emissions of volatile organic compounds.

These VOCs would themselves produce carbon dioxide by oxidation in the atmosphere.

No legislation has compelled us to take that step—we're doing it because we believe it is the right thing to do.

Now, as well as continuing our efforts in relation to the other greenhouse gases, it is time to establish a similar process for carbon dioxide.

Our carbon dioxide emissions result from burning hydrocarbon fuels to produce heat and power, from flaring feed and product gases, and directly from the process of separation or transformation.

So far our approach to carbon dioxide has been indirect and has mainly come through improvements in the energy efficiency of our production processes. Over the last decade, efficiency in our major manufacturing activities has improved by 20%.

Now we want to go further.

We have to continue to improve the efficiency with which we use energy.

And in addition we need a better understanding of how our own emissions of carbon can be monitored and controlled, using a variety of measures including sequestration. It is a very simple business lesson that what gets measured gets managed.

It is a learning process—just as it has been with the other emissions we've targeted but the learning is cumulative and I think it will have a substantial impact.

We have already taken some steps in the right direction.

In Norway, for example, we've reduced flaring to less than 20% of 1991 levels, primarily as a result of very simple, low cost measures

The operation there is now close to the technical minimum flare rate which is dictated by safety considerations.

Our experience in Norway is being transferred elsewhere—starting with fields in the UK sector of the North Sea and that should produce further progressive reductions in emissions.

Our goal is to eliminate flaring except in emergencies.

That is one specific goal within the set of targets which we will establish.

Some are straightforward matters of efficient operation—such as the reduction of flaring and venting.

Others require the use of advanced technology in the form of improved manufacturing and separation processes that produce less waste and demand less energy.

Other steps will require investment to make existing facilities more energy efficient. For instance we're researching ways in which we can remove the carbon dioxide from large compressors and reinject it to improve oil recovery. That would bring a double benefit—a cut in emissions and an improvement in production efficiency.

The task is particularly challenging in the refining sector where the production of cleaner products require more extensive processing and a higher energy demand for each unit of output.

That means that to make gasoline cleaner, with lower sulphur levels, takes more energy at the manufacturing stage. That's the trade off.

In each case our aim will be to establish a data base, including benchmark data; to create a monitoring process, and then to develop targets for improvement through operational line management.

Monitoring and controlling emissions is one step.

The second is to increase the level of support we give to the continuing scientific work which is necessary.

As I said a few moments ago, there are still areas of significant uncertainty around the subject of climate change. Those who tell you they know all the answers are fools or knaves.

More research is needed—on the detail of cause and effect; on the consequences of what appears to be happening, and on the effectiveness of the various actions which can be taken.

We will increase our support for that work.

That support will be focused on finding solutions and will be directed to work of high quality which we believe can address the key outstanding questions.

Specifically, we've joined a partnership to design the right technology strategy to deal with climate change. That partnership which will work through the Batelle Institute includes the Electric Power Research Institute and the US Department of Energy. We're also supporting work being done at MIT in Cambridge and through the Royal Society in London.

We're also joining the Greenhouse gas programme of the International Energy Agency which is analysing technologies for reducing and offsetting greenhouse gas emissions from fossil fuels.

The third area is the transfer of technology and the process of joint implementation which is the technical term for projects which bring different parties together to limit and reduce net emission levels of greenhouse gases.

Joint implementation is only in its infancy, but we believe it has great potential to contribute to the resolution of the climate change problem. It can increase the impact of reduction technology by lowering the overall cost of abatement actions.

We need to experiment and to learn and we'd welcome further partners in the process. The aim of the learning process must be to make joint implementation a viable and legally creditable concept that can be included in international commitments.

We've begun by entering into some specific programmes of reforestation and forest conservation programmes in Turkey and now in Bolivia, and we're in discussion on a number of other technology based joint implementation projects.

The Bolivian example I think shows what can be done.

Its a programme to conserve 1.5 million hectares of forests in the province of Santa Cruz. It is sponsored by the Nature Conservancy and American Electric Power and sanctioned by the US Government.

We're delighted to be involved, and to have the chance to transfer the learning from this project to others in which we are involved. Forest conservation projects are not easy or simple, and that learning process is very important.

Technology transfer is part of the joint implementation process but it should go wider and we're prepared to engage in an open dialogue with all the parties who are seeking answers to the climate change problem.

So those are three steps we can take—monitoring and controlling our own emissions, supporting the existing scientific work and encouraging new work, and developing experiments in joint implementation and technology transfer.

Why are we doing all those things? Simply because the oil industry is going to remain the worlds predominant supplier of energy for the foreseeable future.

Given that role we have to play a positive and responsible part in identifying solutions to a problem which is potentially very serious.

The fourth step—the development of alternative energy—is related but distinct.

Looking ahead it seems clear that the combination of markets and technology will shift the energy mix.

The world's population is growing by 100 million every year. By 10,000 just since I started speaking.

Prosperity is spreading. By the end of the century 60 per cent of the world's economic activity will be taking place in the South—in areas which ten years ago we thought of as Third World countries.

Both these factors will shade a crowing level of demand for energy.

At the same time technology moves on.

The sort of changes we've seen in computing—with continuing expansion of semiconductor capacity is exceptional but not unique.

I think it is a reasonable assumption that the technology of alternative energy supplies will also continue to move forward.

One or more of those alternatives will take a greater share of the energy market as we go into the next century.

But let me be clear. That is not instead of oil and gas. It is additional.

We've been looking at alternative energies for a long time, and our conclusion is that one source which is likely to make a significant contribution is solar power.

At the moment solar is not commercially viable for either peak or base load power generation. The best technology produces electricity at something like double the cost of conventional sources for peak demand.

But technology is advancing, and with appropriate public support and investment I'm convinced that we can make solar competitive in supplying peak electricity demand within the next 10 years. That means, taking the whole period from the time we began research work, that 25 to 30 years will have elapsed.

For this industry that is the appropriate time scale on which to work.

We explore for oil and gas in a number of areas where production today wouldn't be commercially viable at the moment.

Thirty years ago we did that in Alaska.

We take that approach because we believe that markets and technology do move, and that the frontier of commercial viability is always changing.

We've been in solar power for a number of years and we have a 10 per cent share of the world market.

The business operates across the world—with operations in 16 countries.

Our aim now is to extend that reach—not least in the developing world, where energy demand is growing rapidly.

We also want to transfer our distinctive technologies into production, to increase manufacturing capacity and to position the business to reach $1bn in sales over the next decade.

I am happy to report that there will be significant investment in the USA and we'll be commissioning a new solar manufacturing facility here in California before the end of this year.

The result of all is that gradually but progressively solar will make a contribution to the resolution of the problem of carbon dioxide emissions and climate change.

So a series of steps on the journey. These are the initial steps. We're examining what else we should do, and I hope to be able to announce some further steps later in the year.

Of course, as I said at the beginning, nothing we can do alone will resolve the concern about climate change. We can contribute, and over time we can move towards the elimination of emissions from our own operations and a substantial reduction in the emissions which come from the use of our products.

The subject of climate change, however, is a matter of wider public policy.

We believe that policy debate is important. We support that debate, and we're engaged in it, through the World Business Council on Sustainable Development, through the President's own Council here in the United States, and in the UK where the Government is committed to making significant progress on the subject.

Knowledge in this area is not proprietary, and we will share our expertise openly and freely.

Our instinct is that once clear objectives have been agreed, market based solutions are more likely to produce innovative and creative responses than an approach based on regulation alone.

Those market based solutions need to be as wide ranging in scope as possible because this is a global problem which has to be resolved without discrimination and without denying the peoples of the developing world the right to improve their living standards.

To try to do that would be arrogant and untenable—what we need are solutions which are inclusive, and which work through cooperation across national and industry boundaries.

There have been a number of experiments—all of them partial, but many of them interesting because they show the way in which effective markets can change behaviour.

We're working, for instance. with the Environmental Defence Fund to develop a voluntary emissions trading system for greenhouse cases, modelled on the system already in place in respect of sulphur.

Of course, a system which just operates here in the United States is only a part of the solution. Ideally such structures should be much wider.

But change begins with the first step and the development of successful systems here will set a standard which will spread.

Ladies and Gentlemen, I began with the issue of corporate responsibility. The need for rethinking in a new context.

No company can be really successful unless it is sustainable—unless it has capacity to keep using its skills and to keep growing its business.

Of course, that requires a competitive financial performance .

But it does require something more, perhaps particularly in the oil industry.

The whole industry is growing because world demand is growing. The world now uses almost 73 million barrels of oil a day—16% more than it did 10 years ago.

In another ten years because of the growth of population and prosperity that figure is likely to be over 85 mbd, and that is a cautious estimate. Some people say it will be more.

For efficient, competitive companies that growth will be very profitable.

But sustainability is about more than profits. High profitability is necessary but not sufficient.

Real sustainability is about simultaneously being profitable and responding to the reality and the concerns of the world in which you operate. We're not separate from the world. It's our world as well.

I disagree with some members of the environmental movement who say we have to abandon the use of oil and gas. They think it is the oil and gas industry which has reached the end of history

I disagree because I think that view underestimates the potential for creative and positive action.

But that disagreement doesn't mean that we can ignore the mounting evidence about climate change and the growing concern.

As businessmen, when our customers are concerned, we'd better take notice.

To be sustainable, companies need a sustainable world. That means a world where the environmental equilibrium is maintained but also a world whose population can all enjoy the heat, light and mobility which we take for granted and which the oil industry helps to provide.

I don't believe those are incompatible goals.

Everything I've said today—all the actions we're taking and will take are directed to ensuring that they are not incompatible.

There are no easy answers. No silver bullets. Just steps on a journey which we should take together because we all have a vital interest in finding the answers.

The cultures of politics, and of science, and of enterprise, must work together if we are to match and master the challenges we all face.

I started by talking about the end of history. Of course it hasn't ended. It's moved on.

Francis Fukuyama who coined that phrase describes the future in terms of the need for a social order—a network of interdependence which goes beyond the contractual. An order driven by the sense of common human interest. Where that exists, societies thrive.

Nowhere is the need for that sort of social order—at the global level—more important than in this area. The achievement of that has to be our common goal.

Thank you very much.

June 18, 1997.

GREENPEACE DUMPS COAL AND OIL BARRELS ON CAPITOL STEPS TO PROTEST "BYRD-BRAINED" ATTEMPT TO DE-RAIL CLIMATE TREATY

WASHINGTON, D.C. (GP)—Today, Greenpeace dumped four tons of coal and seven barrels of oil in front of the US Capitol to protest a resolution introduced by Senator Robert Byrd (D-WV) and 45 other senators. The Resolution (S. 98) threatens to derail international negotiations of the Framework Convention on Climate Change, first signed by President Bush at the Rio Summit in June 1992.

Under the terms of the Climate Convention, to which the US government is a signatory, countries such as the United States must take the first steps to cut greenhouse gas emissions caused by the burning of coal and oil. The US has been and continues to be the number one emitter of greenhouse gases that cause global warming and climate change. Now, Senator Byrd and 45 other co-signers are threatening to renege on this international agreement by mandating that some of the world's poorest nations and lowest greenhouse gas emitters assume the same international commitments as industrialized countries.

"Greenpeace will remove the coal and oil from the Capitol when all of the 45 Senators remove their names from the resolution," said Kalee Kreider, Director of the

Greenpeace Climate Campaign. "The Senator's Byrd-brained scheme will only perpetuate our dependence on coal and oil rather than allow us to save the climate and make the twenty-first century the solar century," she continued.

The coal and oil industry together have spent millions of dollars in paid advertising and propaganda to downplay the threat of global warming and climate change. Currently, the Business Roundtable (an industry group) is engaged in a $1 million dollar campaign to draw attention to the "economic consequences" of the climate treaty. "Interestingly, the industry's language concerning the Climate Treaty is markedly similar to the language of senator Byrd's resolution," stated Kreider. "By threatening to derail the climate negotiations these Senators show a criminal disregard for human health and the environment."

In 1995, 2,500 of the world's global warming and climate change experts concluded that human activities, such as burning coal and oil, are causing the temperature and seas to rise. In response to the overwhelming consensus of opinion in this scientific body (the Intergovernmental Panel on Climate Change) Greenpeace advocates that industrialized countries reduce greenhouse gas emissions 20 percent by 2005 and stop new oil exploration in frontier areas such as Alaska and North Atlantic.

FOR MORE INFORMATION CONTACT:
Kalee Kreider 202-253-1295 (cell phone) 202-319-2523 (office)
Deborah Rephan 202-319-2492 (office)
ATTENTION BROADCASTERS—SATELLITE FEED OF TODAYS ACTION AVAILABLE AT: 3:00 -@ 3:30P (EST) ON GALAXY C4, TRANSPONDER 9.
1436 U Street. NW—Washington, DC 20009 Tel (202) 462-1177—Fax (202) 462-4507—Tlx 89-2359

REDEFINING PROGRESS,
June 18, 1997.

AUTHORS OF ECONOMISTS' STATEMENT ON CLIMATE CHANGE URGE ACTION AT THE SUMMIT OF THE EIGHT IN COLORADO

2,600 ECONOMISTS DECLARE THAT POLICIES TO SLOW GLOBAL WARMING ARE WARRANTED

"The greatest risk lies with inaction."

The authors of the widely circulated "Economists' Statement on Climate Change" urged the United States government, the other Group of Seven nations, and Russia to address the topic of global climate change at their upcoming meeting in Denver, Colorado.

"A meaningful climate change treaty must contain significant commitment to a reduction in greenhouse emission. The G-7 countries and Russia must take the first steps in emission control since they can best afford them and are the source of most of the emissions," stated Stanford University economist and Nobel-laureate Kenneth J. Arrow.

Added Dale W. Jorgenson, Chairman of the Economics Department at Harvard University: "The Kyoto summit on climate change is just six months away. Without leadership among the developed world, it is unlikely we will see any progress in Kyoto. The Summit of the Eight provides an excellent chance to lay the groundwork toward a meaningful international agreement."

Arrow and Jorgenson, along with Nobel-winner Robert M. Solow of the Massachusetts Institute of Technology, Paul R. Krugman of the Massachusetts Institute of Technology, and William D. Nordhaus of Yale University, crafted the statement in January 1997. To date, more than 2,600 economists have joined in signing the statement, including eight Nobel Laureates of Economics. The effort was sponsored by Redefining Progress, a nonpartisan, non-profit public policy organization.

The statement makes three major points:

- A review of the evidence has found a discernible human influence on global climate. Climate change "carries with it significant environmental, economic, social, and geopolitical risks" and "preventative steps are justified."
- Economic studies have determined that there are many potential policies for which the benefits outweigh the costs. Policy options are available that would

slow climate change without harming employment or U.S. living standards and these may be economically beneficial in the long run.

- The economists emphasize the importance of market mechanisms, such as carbon taxes or trading of marketable emissions permits among countries. It is essential that nations coordinate their policies so that the costs of attaining the climate objectives can be minimized. Revenues raised from such taxes or permits can be used to reduce the budget deficit or to lower existing taxes.

One of the concerns of policymakers is whether the U.S. can reduce greenhouse gas emissions (predominantly carbon dioxide emissions from energy use) without damaging the economy. The economists' statement emphasizes that well-designed policies relying on market mechanism can be economically beneficial and "may in fact improve U.S. productivity in the longer run." The statement specifically endorses market-based policies such as carbon taxes and the auction of internationally tradable emissions permits as a way of reducing the costs of slowing climate change.

"A panel of the world's foremost scientists, under the auspices of the Intergovernmental Panel on Climate Change, have concluded that the balance of evidence suggests a discernible human influence on global climate," said Stephen DeCanio, senior economic fellow for Redefining Progress and a former senior staff economist with President Reagan's Council of Economic Advisors.

"This statement will be extremely valuable to the G-7 and Russian leaders when they address climate change policy options in Denver," DeCanio went on to say. "Many people remain unaware that ongoing changes in the Earth's climate pose large economic and environmental risks. Some groups have asserted that we cannot address the global climate problem without incurring serious economic harm. These 2,600 economists have said essentially the opposite—that the greatest risk lies with inaction."

T6 Lay #1 re smaller Statement

AMERICAN FARM BUREAU FEDERATION®
225 TOUHY AVENUE • PARK RIDGE • ILLINOIS • 60068 • (847) 685-8600 • FAX (847) 685-8896
600 MARYLAND AVENUE S W • SUITE 800 • WASHINGTON, D C • 20024 • (202) 484-3600 • FAX (202) 484-3604
Internet: http://www.fb.com/

STATEMENT OF
THE AMERICAN FARM BUREAU FEDERATION
TO THE
INTERNATIONAL ECONOMIC POLICY, EXPORT
AND TRADE PROMOTION SUBCOMMITTEE
SENATE FOREIGN RELATIONS COMMITTEE
REGARDING
UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

Presented by

Bryce Neidig, President
Nebraska Farm Bureau Federation
American Farm Bureau Federation

June 19, 1997

STATEMENT OF
THE AMERICAN FARM BUREAU FEDERATION
TO THE
INTERNATIONAL ECONOMIC POLICY, EXPORT
AND TRADE PROMOTION SUBCOMMITTEE
SENATE FOREIGN RELATIONS COMMITTEE
REGARDING
UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

Presented by

Bryce Neidig, President
Nebraska Farm Bureau Federation
American Farm Bureau Federation

June 19, 1997

Thank you, Mr. Chairman, my name is Bryce Neidig. I am a farmer and President of the Nebraska Farm Bureau Federation and a member the board of directors of the American Farm Bureau Federation which I represent today.

My family owns and I operate, with my son, a 600-acre corn, soybean and alfalfa farm in northeastern Nebraska near the town of Madison. I am very concerned that the international agreement on climate change will hurt my farm operation and others like it across the nation.

Climate change policy is controversial. Drastic action proposed by the Administration is not justified.

I appreciate this opportunity to discuss a subject that practically every farmer is an expert on-- the weather. Those farmers that aren't experts complain about it. It rains too much or too little, it's too cold or too hot or frost threatens the harvest. We're interested in the weather because our livelihood depends on it.

Farmers are interested in climate change for the same reason. We are willing to consider scientific evidence that human activities, including our own, may lead to increased concentrations of greenhouse gases, higher global temperatures and extreme weather events.

Farmers who are aware of the climate change treaty are also concerned about controls which may be imposed on the farm to reduce greenhouse gas emissions. They're concerned about higher costs for fuel, energy, vehicles and equipment. They're concerned about new, burdensome regulations. They're concerned about threats to their competitiveness in world markets to where they now must export about one third of the crops they grow.

Some farmers are aware that in the last decade or so, there has been considerable discussion by

some scientists that greenhouse gases (carbon dioxide, methane and nitrous oxide) are contributing to increases in average global temperatures that could cause adverse changes in the world's climate. We know there is some data to show increases in greenhouse gases but believe there is still a legitimate debate about the magnitude of those changes, their significance and the relative contribution of natural versus human causes, including agricultural production.

Many farmers who have followed this important issue believe that the Administration is acting hastily and prematurely in leading international efforts for immediate, legally binding and enforceable caps on greenhouse gas emissions. We don't know enough about the problem or even if we have a problem. We don't know about agriculture's contribution to the problem or the solution. We don't know what practices or programs farmers are likely to encounter as a result of an international agreement. To put it simply, most farmers familiar with the climate treaty are less concerned with the illness than they are with the cure that's being prescribed for them.

The Administration's proposal will restrict farming practices, disrupt livestock and crop production and increase farm energy costs.

Farmers like to think of themselves as good guys, but we're being portrayed as villains when it comes to greenhouse gases. International and U.S. regulators tell us we are contributors to human-caused greenhouse gas emissions. Cattle and sheep produce methane. Crop tillage produces both methane and carbon dioxide. Nitrous oxide comes from fertilizer and the burning of crop residue.

The regulators tell us that we're more than contributors, we're major contributors. According to the United Nations Intergovernmental Panel on Climate Change, one-fourth of the world's greenhouse gases come from agricultural activity. Our own Environmental Protection Agency blames agriculture for more than 40 percent of total methane emissions and 90 percent of the nitrous oxide generated from human activity in the U.S.

Lead by our own Administration, international negotiators are pressing for strict, binding limits on these emissions. If such limits are adopted, the U.S. will be forced to consider drastic policies to meet those legally enforceable reductions. New taxes on fuel and fertilizer, forced mileage requirements for light trucks and other motor vehicles, controls on planting, cultivation and harvesting practices and limits on the number of livestock per acre have all been proposed and may become regulatory policy here in the U.S.

Farms like mine could be severely disrupted. Restrictions on planting, cultivation and harvesting would interfere with my farm management plans which are designed to reduce my production costs, maximize yields and conserve my farmland. For example, prescriptive crop practices to reduce greenhouse gas emissions may not be compatible with my current crop rotation practices. My integrated pest management programs, which reduce pesticide use through the tillage and

crop rotation, could also be jeopardized.

Fuel and energy and cost increases resulting from the treaty could deal farmers an especially heavy blow. The American Petroleum Institute estimates that the climate agreement could increase prices for gasoline, diesel fuel and electricity by 50 per cent or more, depending on the emission targets which are prescribed.

Cost estimates by the Administration have been lower, but the U.S. Commerce Department recently agreed that capping carbon dioxide emissions at 1990 levels requires the equivalent of a 25 cent gas tax. Fuel cost increases, even at these levels, would be a big hardship to U.S. farmers. That's why Farm Bureau fought hard several years ago for defeat of the B.T.U. tax. We're concerned that the Climate Change Treaty may provide an opportunity to resurrect the B.T.U. tax under a different name, but with the same results. You might say that its a back-door B.T.U. tax.

Fuel and energy are major production costs on my farm. We use 2,600 gallons of gasoline, 3,800 gallons of diesel and 1,700 gallons of propane in an average year. Depending on weather conditions, we also will use up to $4000 in electricity for crop drying in the fall. Ours is a medium-sized, family farm typical of farms in Nebraska and the Midwest. A 50 percent or even 25 cents per gallon increase in my fuel cost would be a very significant new cost of production which could not be passed on in the commodities I produce.

Agriculture's positive contribution in controlling emissions is not being considered.
Our critics ignore farmers' positive role in reducing greenhouse gas emissions. According to some scientists, agricultural cropland here in the U.S. may be a net "sink" for carbon dioxide because of the carbon sequestered by plants through photosynthesis. Little recognition is given to advances in agricultural practices, conservation and energy efficiency by farmers, particularly here in the U.S.

U.S. farmers have significantly improved their efficiency and reduced their use of fuel and fertilizer. They have dramatically increased their use of conservation practices. Last year, 61 percent of U.S. croplands utilized conservation tillage or residue management practices which incorporate plant residue and carbon in the soil, reduce trips over the land and conserve fuel.

Most important, agriculture's critics in the climate change debate have focused on agriculture's contribution to greenhouse gases and overlooked agriculture's most important role-- feeding and clothing a growing, hungry world. Little, if any consideration has been given to the climate agreement's impact on our ability to meet future world demand for food and fiber.

The Administration's proposal would disadvantage U.S. agricultural producers in world trade.

The Administration proposal commits the U.S. and other developed countries to specific, legally binding and enforceable emission reductions, forcing higher production costs on U.S. farmers . It sets no binding requirements for developing countries, some of which are our strongest competitors for world markets of agricultural commodities. Countries exempt from controls include China, South Korea, Chile and Argentina. Some of these developing countries already have lower labor and production costs and would be given a new, major competitive advantage.

The proposal makes no sense from an environmental or an economic standpoint. By the Administration's own projections, carbon dioxide emission increases from developing countries will far out pace those of the United States or other developed nations. By forcing compliance of developed countries only, we fail to invest our efforts where they will achieve the greatest emissions reductions. In the process, we place U.S. farmers at a competitive disadvantage and make them easy prey in the new world of free trade and market-oriented farm programs.

Agricultural's concerns have been strongly expressed to the Administration, with negligible results.

Last November Farm Bureau and 17 other national farm organizations expressed strong concerns to President Clinton relating to the climate change agreement and its impact on agriculture. Although we have received assurances from the Administration that the agreement will provide maximum flexibility and opportunity for U.S. farmers, the Administration's response does not reduce our concern.

We are greatly appreciative of the efforts of the Senate Agriculture and Natural Resources Committee in reinforcing our concerns. This March, Chairman Lugar and a bipartisan group of 13 members of his committee requested an analysis by the Administration of the following: the potential effect of climate change on agriculture; estimated emissions and sequestration of greenhouse gasses by U.S. agriculture; actions or controls likely to be implemented; and the resulting economic impact on U.S. farmers and ranchers.

Although the Administration has not yet provided this information to us, it is essential that it become available soon, in advance of August treaty negotiations in Bonn and the final agreement scheduled this December for Kyoto.

Mr. Chairman, we especially appreciate the leadership provided by Senator Byrd and yourself in introducing last week Senate Resolution 98, which now has more than 50 co-sponsors. This resolution will go a long way in helping to assure that agriculture and other economic interests are considered in full. We hope that it is not overlooked as the Administration proceeds with the agreement.

In addition to information and analysis requested by the Senate Agriculture Committee and S.R. 98, Farm Bureau supports the following administrative or legislative action relating to the

climate agreement. Also supporting these actions are 17 other farm organizations which co-signed this request to President Clinton and the Administration.

The Administration should withdraw support for legally binding and enforceable caps on greenhouse gases.
The Administration should fully explore methods to reduce greenhouse gas emissions with the least possible disruption to U.S. agriculture. If controls on agriculture are justified, they should be accomplished voluntarily.

There must be a full and informed public debate which involves agriculture and agricultural policy makers.
Until Farm Bureau and other agricultural groups formally expressed our concerns to the administration, there was no effort to seek our involvement and input before international negotiations. If agriculture is a major contributor to greenhouse gas emissions, as the Administration claims, then it is appropriate that the Administration seek a full and open debate with agricultural producers, leaders and organizations. These efforts must include agricultural policy makers within House and Senate committees on agriculture, the Congress and USDA.

The final climate change agreement scheduled for completion this December in Kyoto, Japan should be delayed.
The Administration must not accept a final agreement without a full and open public debate which includes agriculture and minimizes the negative impact on agricultural producers.

Thank you for this opportunity to present agriculture's concerns with the climate change agreement.

f:\stm\climate.619

U.S. Greenhouse Gas Emissions in 1994 (in Million Metric Tonnes of Carbon Equivalents and Full Molecular Weight).†

	MMTCE	*MMT*
Net Carbon Dioxide (CO2)	1408	5161
Fossil fuel combustion	1390	5098
Other	17	63
Forests (sink)	(119)‡	(436)
Methane (CH4)	188	28.0
Agriculture	61.4	9.2
Enteric Fermentation	40.2	6.1
Manure	17.0	2.5
Rice Cultivation	3.4	0.5
Field Burning	0.8	0.1
Nitrous Oxide (N2O)	41	0.2
Agriculture	19	0.2
Fertilizer Use	18.4	0.2
Field Burning	0.4	---
Other (HFCs, PFCs, SF6)	30	---
TOTAL	1666	
Net Emissions	1547	
Forestry	(119)‡	
Agriculture	80.4	

43% from ag. sources

92% from ag. sources

† Source: U.S. Environmental Protection Agency. 1995. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-1994. Office of Policy, Planning and Evaluation, U.S. EPA. Washington, D.C. Report No. EPA-230-R-96-006. November 1995.

‡ Richard Birdsey, USDA/Forest Service, personal communication.

Carol Whitman, USDA
5/9/97

The Washington Post
June 15, 1997

Everett M. Ehrlich

A Common-Sense Approach to Global Change

A leading business group a week ago advertised its desire for a national debate on climate change policy. All power to them: Such a debate is sorely needed.

But a debate needs to start somewhere, which means asking ourselves what we understand about climate change policy. Economists have thought about this issue—the administration's among them—and their thinking provides a set of "common sense" precepts about climate change that form a worthwhile basis for the discussion our nation needs to have. Before we debate, let's remind ourselves of what we already know.

(1) The science is compelling. Carbon dioxide warms the planet and by pumping more of it into the atmosphere, humankind is changing its climate. It's hard to say by how much, and it will affect different places in different ways, but the net effect is unlikely to be good. And as is too often the case for "system changes," the shift in temperature is likely to be more abrupt than we'd like it to be.

(2) The economic costs are small. Limiting carbon dioxide and other greenhouse gases will entail economic costs, but these are small and transitional. The economic literature suggests that we could roll back our CO_2 emissions to their 1990 levels by 2010 for the equivalent of a 25 cent gas tax. It's not free, but it's not the end of the world. Catastrophic climate change, if it occurs, could be.

(3) Price signals matter. Would that we could mandate that all refrigerators run on hamster power and that banana peels fuel automobiles. We can't. Broad price signals—perhaps the product of emissions permits that polluters could trade—send everybody the right message. They're not a whole policy, but a requisite basis for one.

(4) Waiting won't work. As serious as it is, climate change is not some sci-fi terror that requires immediate mobilization and massive sacrifice. But deferring action will raise the cost of stabilizing the world's atmospheric concentrations of greenhouse gases, our ultimate goal. That's because our emissions (both the United States' and the world's) are growing faster than any imminent technology can abate them. The longer we wait, the further we have to catch up. On the other hand, the sooner we give ourselves some lead time, the easier all of this will be.

> *"The longer we wait, the further we have to catch up."*

(5) Capital incentives are important. The faster we invest, the faster we turn over our capital stock, and the faster we achieve emissions reductions. That's because new investment embodies the latest technologies for reducing emissions. Experience across a wide range of industries shows that well-designed processes reduce both emissions and total business costs. Investment incentives must be considered as part of climate change strategy, because pro-investment policy is pro-environment policy.

(6) Allow cross-border trading. It's all one atmosphere, whether it's polluted by U.S. utilities, German steel plants or Korean traffic jams. If we let polluters in one country search for cheaper pollution offsets in others, then we lower the cost of the entire process. The former Soviet bloc, China, India and others will offer such opportunities, at least for the next few decades. The question is: How do you make such a system work? That's something worth debating.

(7) Technology is the key. The economic effects of climate change policies occur over periods so long that even Alan Greenspan can't manage them—decades, even generations. We must have a far-sighted technology program that aims our most formidable economic weapon—new ideas—at this pressing problem. Let's sidestep the yammering about "corporate welfare," sit down with the business leaders who have expressed their concern and work out a shared program to innovate our way through this problem.

(8) The whole world must be involved. The current negotiating framework would require the leading industrial economies and the former Soviet bloc to sign up to firm commitments now while the newly industrializing nations of Asia and Latin America catch up, somehow, later. Will this lead to a massive out-migration of capital from the United States and the other developed nations as firms flee the burden climate change policies impose? Probably not, given that there are already sizable differences in energy costs and environmental stringency between these two groups. But that's no reason to let them persist. Any climate treaty has to show how all of the world's nations are brought into the process.

(9) Compensate the losers. The fact that the economic costs are small in general does not mean that everyone escapes unharmed. It would be high-handed in the extreme to speak of climate change policy as an abstract "transition" without addressing the losses it imposes on men and women who work hard and support their families through jobs such as coal-mining. Fairness demands nothing less.

(10) The United States must lead. The business leaders are right when they call for a debate that allows our entire nation to understand the climate issue. But there are also international negotiations underway. The United States can't walk away from the table. To date, it has done a good job of pushing for greater flexibility for our private sectors as a general principle, even while not agreeing to any specific targets. If the United States falls back from a leadership role in these negotiations, then the vacuum will only be filled by thinking and directions that will disserve us later. We must stay involved, even as we build consensus at home.

It's time to have a climate change debate. But the debate should concern itself with how best to take these "common sense" precepts and turn them into a policy that preserves both our prosperity and our quality of life for generations to come.

The writer was undersecretary of commerce for economic affairs until this month.

November 8, 1996

The President
The White House
Washington, DC 20500

Dear Mr. President:

Last summer, participants in the second Conference of Parties of the United Nations' Framework Convention on Climate Change (UNFCCC) agreed to negotiations for legally binding numeric limits on greenhouse gas emissions. This dramatic shift from voluntary to enforceable caps on greenhouse gases was led by the U.S. According to your spokespeople, there is now a consensus in the world scientific community which demands urgent action to reduce greenhouse gas emissions.

There is less than agreement outside the United Nation's scientific body. Furthermore, there is still a lively debate among respected scientists about the human versus natural sources of greenhouse gases and their effect on climate. Controversy notwithstanding, the climate change treaty is moving full-speed ahead with the Administration's enthusiastic support. A final agreement is scheduled to be completed in December of 1997, with ratification by individual countries beginning in 1998. If ratified by the U.S. Senate, the treaty will be binding on the U.S. and other developed countries and may be incorporated into U.S. law. However, developing countries will not have to comply.

Of great concern to agriculture are reports under consideration by the U.N. scientific panel which blame agriculture for more than 20 percent of human-caused greenhouse gas emissions. Specifically, we are concerned about proposals for the following:

- fuel economy requirements
- reduction or phaseout of the use of diesel fuel
- limitations on production per acre for some crops
- requirements for "plowless" soil preparation
- mandatory fallowing of crop land
- limits and restrictions on livestock production to reduce methane emissions
- restrictions on use of fertilizer
- restrictions on timber harvesting
- restrictions on processing, manufacturing and transportation of food products

Unfortunately, these proposals ignore agriculture's positive role in reducing greenhouse gases by removing carbon dioxide from the atmosphere through photosynthesis. Most importantly, they cavalierly disregard the most valuable function of modern agriculture -- feeding a hungry world. Ironically, rice production has been singled out as the number one culprit in human-caused methane emissions.

We are very concerned that these recommendations or similar ones will be incorporated in the final climate change agreement, ratified and imposed on U.S. farmers and ranchers through U.S. laws. Binding and enforceable controls would apply only to developed countries and would severely disadvantage U.S. farmers and ranchers in today's global markets.

Moreover, we are deeply concerned and surprised that the Administration has not actively consulted with agriculture as the agreement has been developed. We respectfully request that the Administration take the following actions:

1) The Administration must fully and actively consult with agriculture. Agricultural interests have not been considered by the Department of State and other U.S. agencies which are closely involved with the development of the climate change agreement. The agreement must include an open and extensive public debate which involves agricultural producers and members of Congress, USDA and other agencies.

2) The Administration should withdraw its support for legally binding and enforceable caps on emissions until there is a stronger consensus from the scientific community that they are justified. If it is determined that controls are justified, they should be accomplished voluntarily or in ways which minimize disruption of U.S. agricultural producers.

3) The final climate change agreement, scheduled for completion in December of 1997, must be delayed to provide sufficient time for consultation with agriculture and for adequate risk, cost and benefit assessment.

Without proper scientific and economic analyses and assessment, U.S. farmers and ranchers may be placed at a serious disadvantage with agricultural producers in countries which do not plan to reduce greenhouse gases.

If the Administration does not adequately address the above concerns, we may raise them with Congress during the ratification process.

Sincerely,

AMERICAN FARM BUREAU FEDERATION
AMERICAN CROP PROTECTION ASSOCIATION
AMERICAN SHEEP INDUSTRIES ASSOCIATION
AMERICAN SOYBEAN ASSOCIATION
CENEX
NATIONAL ASSOCIATION OF WHEAT GROWERS
NATIONAL CATTLEMEN'S BEEF ASSOCIATION
NATIONAL CORN GROWERS ASSOCIATION
NATIONAL COTTON COUNCIL
NATIONAL FOOD PROCESSORS ASSOCIATION
NATIONAL GRANGE
NATIONAL MILK PRODUCERS FEDERATION
NATIONAL PORK PRODUCERS COUNCIL
THE FERTILIZER INSTITUTE
UNITED AGRIBUSINESS LEAGUE
UNITED FRESH FRUIT AND VEGETABLE ASSOCIATION
USA RICE
WESTERN GROWERS ASSOCIATION

DEPARTMENT OF AGRICULTURE
OFFICE OF THE UNDER SECRETARY
WASHINGTON, D.C. 20250

JAN 17 1997

Mr. Richard W. Newpher
Executive Director
American Farm Bureau Federation
600 Maryland Avenue, S.W., Suite 800
Washington, D.C., 20024

Dear Mr. Newpher:

Thank you for your letter to the President regarding the climate change negotiation and its potential impact on agriculture in the United States.

The issue of global climate change is a serious one with wide-ranging implications for the earth's environment and the U.S. economy. The most recent conclusions of the Intergovernmental Panel on Climate Change (IPCC) emphasize this point. Based on current trends, the IPCC projects that the rate of temperature warming would probably be greater than any seen in the last 10,000 years, and that such changes could result in significant impacts on ecological systems and socioeconomic sectors, including food supply, water resources and human health.

To reduce the threat of climate change, the Administration has called for next steps under the Climate Convention. These steps should include verifiable, binding medium-term greenhouse gas emission targets that are realistic and achievable. The U.S. position for the ongoing climate change negotiation is based on three premises: that the target be binding, that it focus on the medium term, and that there be national flexibility in implementation. Flexibility includes allowing Parties nationally to determine the most appropriate policies and measures to meet the agreed target, and allowing emissions trading and joint implementation between Parties to minimize the cost of reductions. In addition, the U.S. position underscores the need to include developing countries in next steps since global cooperation is necessary for any effective response. The U.S. continues to oppose proposals by other Parties for "harmonized" policies and measures on the basis that they would limit national flexibility.

The Administration welcomes input from the agricultural sector as we address this global environmental problem. To date, the best scientific scenarios available indicate that some aspects of American agriculture will benefit from climate change, and others will experience losses. Certainly farmers will need to adapt to changing climatic conditions. There is also widespread recognition of opportunities within agriculture to reduce emissions and sequester greenhouse gases. The agricultural community must be involved in the development of solutions to ensure that they are economically viable and reflect the needs of the community.

Although the international timetable is moving rapidly, the Administration is committed to seeing that the agricultural community is fully engaged. To begin this process, I would like to host a meeting to bring together leaders from the agricultural community with members of the Administration's climate change team to discuss your concerns in greater detail. I have asked a member of my staff to contact you to arrange such a meeting.

Thank you again for your interest on this important matter. I hope to meet with you soon.

Sincerely,

DAN GLICKMAN
Secretary

United States Senate

COMMITTEE ON
AGRICULTURE, NUTRITION, AND FORESTRY
WASHINGTON, DC 20510-6000
202-224-2035

March 14, 1997

The Honorable Al Gore
Vice President
The White House
Washington, D.C.

Dear Mr. Vice President:

Farm state members of Congress have become increasingly concerned with the lack of adequate attention given to agricultural concerns as the Administration works on the United Nations Framework Convention on Climate Change (UNFCC). As you know, this treaty, if ratified, could affect U.S. agricultural production and competitiveness.

American agricultural interests must be adequately represented during the upcoming negotiations. This representation will ensure the continued success of farmers and ranchers and allow them to maintain their productivity, which ultimately benefits consumers. We believe we can address the global greenhouse gas issue and protect the environment while carefully considering the interests of America's farmers, ranchers and consumers. However, before the United States is committed to a final international agreement to limit greenhouse gases, it is essential that we know more about the treaty's impact on our nation's largest employer and the world's most efficient producers of food and fiber.

We will be closely monitoring the negotiations as work continues on the final agreement before its submission to the Senate for ratification. We request an analysis and briefing by the Administration on the following issues as soon as possible:

1) The potential effects of climate change on U.S. agriculture and livestock production.

2) The estimated greenhouse gas emissions resulting from the production of crops and livestock in the U.S.

3) The net contribution of U.S. forests and crops in the sequestration of greenhouse gases.

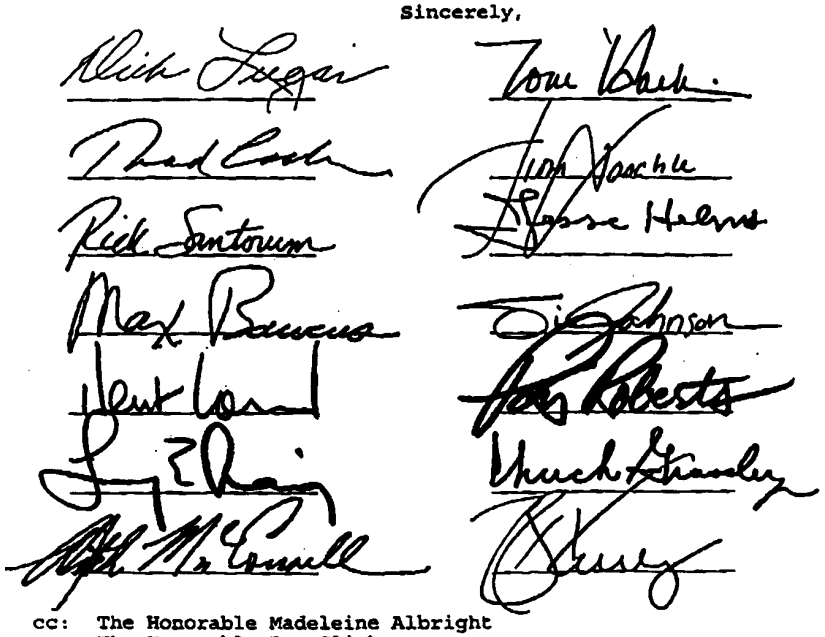
4) Actions or controls necessary to reduce agricultural greenhouse gas emissions to comply with obligations that may arise under the treaty and an economic analysis of their impact on U.S. farmers and ranchers.

5) Whether and to what extent greenhouse gas emission controls would disadvantage agricultural producers in this country compared to producers in other countries with less stringent emission controls or no controls at all.

We understand that serious discussions in preparation for the Kyoto meeting may commence during July and August of this year. We firmly believe this information, as well as the Administration's formal economic analysis, should be submitted to Congress well before then so that the various options for U.S. policy may be understood and their impact on American agriculture and the American economy may be carefully assessed.

We look forward to working with you on this important issue.

Sincerely,



cc: The Honorable Madeleine Albright
The Honorable Dan Glickman

Policies and Measures for the Common Action Study:

Sustainable Agriculture and Forestry

Tranche 1: Development of options for best practices for GHG reduction

A study for the OECD Environment Directorate by:
Merylyn McKenzie Hedger

OECD Contact: Mark Storey
Tel: (33 1) 4524 1766; Fax: (33 1) 4524 7876
email: mark.storey@oecd.org

Table of Contents

EXECUTIVE SUMMARY

1. Particularly varied policies and institutional frameworks exist in the agriculture and forestry sectors. To accommodate this situation, the ' best practice' approach is proposed as a common action mechanism for these sectors. It is considered to be a pragmatic way to expedite progress in ghg reduction through sustainable agriculture and forestry and to disseminate knowledge more effectively. Furthermore it provides a well-recognised and possible formal/ informal intervention mode to articulate with non-climate policy fora. In forestry policy frameworks at national and international levels the best practice approach is being currently developed to address sustainable forest management; in agriculture this approach has been adopted at national level to avoid water, air and soil pollution.

2. According to the IPCC's Second Assessment Report, it is possible to use management of agricultural lands, rangelands and forests to reduce current emissions and/ or enhance the sinks of carbon dioxide, methane and nitrous oxide. A number of forestry measures could conserve and sequester substantial amounts of carbon (approximately 60-90 GtC in the forestry sector alone) over the next 50 years. Significant additional carbon could be sequestered by altering management of agricultural soils. Biomass continuously harvested and regrown in a sustainable manner, would avoid the release of fossil carbon. Other practices, such as improving efficiency of fertiliser use or the diet of domesticated ruminants, could reduce emissions of other greenhouse gases such as methane and nitrous oxide. Altering the treatment and management of animal wastes and reducing agricultural biomass burning also will decrease methane releases. Combining these practices could reduce methane emissions from agriculture by 100Mt CH_4/yr. Using presently available techniques to improve the efficiency of fertiliser and manure could reduce agricultural emissions by 0.3 to 0.9 Mt of nitrogen per year.

3. Agriculture and forestry policy are long established policy frameworks at national government level -forestry is often one of the oldest sectors. Their management depends on the special and varied circumstances of local situations. Both these sectors have increasingly been influenced by broader environmental considerations, principally the impacts of pollution and the loss of biodiversity and also the need for Governments to save funds involved in suppport mechanisms. In addition, through increasing concern about soil degradation, caused by intensive production methods, new techniques are being adopted to ensure the viability of sustaining production long term. There are thus significant new policy developments in both these sectors as they try and address these concerns.

4. Following completion of this assessment it is clear that the guidelines concept is an appropriate, flexible tool. It constitutes a policy approach which is non-compulsory and characterised by 'social regulation' including encouragement, persuasion and facilitation. However there are close interactions with formal legal frameworks regulating environmental pollution and many of the existing efforts to formalise 'best practice' are helping farmers and growers to avoid legal action. For the FCCC process, 'best practice' guidelines would work where targets and timetables have been established, unless there was agreement for harmonisation of policies and measures.

5. Uncertainty does exist about estimating and monitoring ghg emissions from these sectors, and the effects of mitigation measures. The estimates of potential carbon sinks are low compare to the fossil fuel emissions of the past decade so these measures can only partly contribute to the mitigation of the climate change problem and within a limit in time. Furthermore, complexity is enhanced because these sectors will be impacted by climate change as would mitigation methods within them. There is therefore a need for a flexible tool capable of adapting to changes in scientific and technical knowledge.

6 There is an enormous, if not bewildering, number of possible measures which can be used in the agriculture sector for ghg mitigation and there is invariably already considerable operating experience somewhere in the world with them. However climate protection policy is not the driving force. Reductions in agricultural greenhouse gas emissions are generally an incidental and additional benefit

to on-going national and regional or international agricultural policy reforms concerned with controlling agricultural surpluses and pollution - i.e. policy reforms with non- climate objectives. The fact that farmers are not widely using these measures systematically at present suggests that they are not profitable on their own and involve additional investments in time and/or money. It also reflects the fact that they are often operating under financial support systems pulling in different directions. Those policies that have been implemented are often under-resourced, restricted to only limited and defined areas and applied as 'add-ons' to exisiting support structures. Much more could be achieved through a systematic and more rigorous application of many of the options. They could be adopted individually or as part of a package designed to promote sustainable agriculture.

7. It is clear that from a forest policy perspective, carbon management is not yet a primary policy determinant either and many consider it will play only a minor role of multi-purpose forestry. It may well transpire that this assessment is likely to be changed when climate change impacts become clearly identifiable on forest ecosystems and if value can be claimed for carbon storage in forest biomass.

8. However, there have been several substantial policy initiatives in international forest policy to develop 'sustainable' forest management practices principally in response to what have been perceived to be an over-domination of timber production interests in relation to the needs to protect environmental quality, biodiversity and the needs of indigenous communities. These policy dynamics initially started in relation to tropical forests but more recently have extended to temperate and boreal forests. New processes have been established and national governments are required to produce forest plans. The Helsinki and Montreal processes are developing criteria for sustainable forest management in Europe and non-European temperate and boreal forests countries respectively. The CSD has established an Intergovernmental Panel on Forests. There are associated workshops on criteria for sustainable forest management and certification etc. Moves on certification of forest products are proceeding principally through the Forest Stewardship Council (FSC) but there are also moves to use the International Standards Organisation. The principles and criteria of the FSC are intended to apply to all forests worldwide which are managed for timber and non-timber production. There is set of well- elaborated principals but none of these cover C management.

9. So far therefore C management has not been an objective of sustainable forest management in these processes. In relation to carbon management through forestry measures, the essential policy prerequisite is for an institutional framework which will enable the development of complex management strategies over long timescales, particularly for the boreal forests. Moreover in view of anticipated climate change impacts on the boreal forests, there will be a need to include protective measures, such as species diversity, which will involve making tradeoffs on carbon storage. The unmanageability of the long time frame is an additional reason for some commentators to advocate the use of short rotation forestry for biofuel displacement, particularly as it there is general agreement that the dominant opportunity for net reduction in C emissions is seen to be fossil fuel displacement. There are also tricky isues to tackle about when to optimise carbon sequestration which impact on harvesting and choice of species (hardwoods versus conifers).

10. This study has confirmed that the development of best practice guidelines is a viable way to expedite progress in ghg reduction in agriculture and forestry. However, it has also identified that there is a need to achieve greater clarity on the concept, particularly in relation as to how it might be achieved. It could be undertaken on a broad front, for sustainable agriculture or forestry as a whole, or measure by measure. Clearly the former suggests some form of international cooperation such as exists in the Montreal and Helsinki processes on forestry. The latter could be undertaken by coordination across countries on specific technologies and institutional

f rameworks. It should also be recognised that there will be potential differences which will need resolution when attempts are made to align policies operating to varying objectives. These issues need to be addressed as the study is considered.

11. For the next stage, it is possible to proceed at broad sectoral level and/or a specific measure basis. It is proposed that a combined approach is adopted Possible options for future development have been identified in relation to the following criteria:

a. Substantial existing work being undertaken on the specific measure at national level which would benefit from improved networking at international level. (Many measures are not a priority for individual attention and can be adequately left at national level.)

b. Significant potential for ghg reduction.

c. Ease of overcoming barriers and implementation.

d. Opportunity / necessity to link with significant policy developments underway in other fora. Scope to accommodate differing policy objectives.

e. Timescale for results from action by 2005, 2010, 2020.

The following measures could therefore be considered for Tranche II:

- Reduction of methane emissions from manure
- Reduction of mineral nitrogen fertilisers
- Reduction of agricultural subsidies
- Develop sustainable agriculture as best practice
- Enhance carbon storage in soils
- Promotion of energy forests/ crops to produce biomass for energy
- Integrate forest and climate protection policies
- Enhance carbon sequestration in natural forest through silviculture
- Make carbon management one criterion of sustainable forest practice

In each of these specific actions are suggested covering appropriate institutional fora to progress the measures and additional information requirements.

1. Introduction.

1.1. Policy Objective

1.1.1. The goal of the common action study is to broadly assess the relative potential of a range of cost- effective policies and measures for possible common action by countries and Parties listed in Annex I to the FCCC. There is a range of types of common actions:

- common actions could be specific policies and measures implemented by a group of countries together under some form of agreement, to increase the effect of the measure;
- common actions could involve coordination of action to implement the same or similar measures together;
- common action could be an agreement to take actions in a sector towards a given aim or target; or
- common action could simply be successful policies and measures that could be replicated by other parties.

1.2. Approach and Methodology

1.2.1 The study reviews the scope for climate change mitigation options across two large and long established sectors of public policy. It uses two main sources of information:

(i) The IPCC Second Assessment Report, particularly of Working Group III which included specific chapters in which mitigation options for ghg emissions in agriculture and forestry sectors.
(ii) National Communications submitted by parties to the Framework Convention on Climate Change to indicate policies and measures that it has adopted to meet its commitments under the treaty, with a national inventory of anthropogenic emissions by sources and sinks of ghgs.

1.2.2 In addition other documents relating to relevant policies and measures in countries were reviewed where available. The work undertaken by this study can only be regarded as a start in this respect. Other literature, such as reports by the OECD was also examined. Particular use was made of the Enquete Commission Protecting Our Green Earth: How to Manage Global Warming through Environmentally Sound Farming and Preservation of the World's Forests (Report by 12th German Bundestag, 1995). In addition, forest policy assessments have been reviewed such as those provided by Governments for the Helsinki process. Academic literature on the relative effectiveness of alternative forest and bioenergy strategies and their impact on net C emissions has been identified. The workshop on Economics of Carbon Sequestration in Forestry (May 1995, Bergendal, Sweden) was used as an authoritative source for assessment. On the agriculture side, two unpublished reports were used: Greenhouse Gas Emissions from the Agricultural sector. (Report to WWF International, March 1995 by R Howes); and Initial Analysis of Options for Future GHG Mitigation Strategies ,Promising Areas for Common Action, (Report to OECD, Sept 1995 by PEM Lammers and A.F.Savornin Lohman, IES, Amsterdam).

1.2.3 Within time and resource constraints, efforts have been made to engage in dialogue with key experts. A workshop was held at Kings College, University of London, on 9th February 1995. The

aim of the workshop was to assist in the identification of the most promising options for best practice guidelines for sustainable agriculture and forestry. The workshop was a collective brainstorming session, with a small group of people with from the UK, US, the Netherlands, Norway and New Zealand attended; no formal papers presented. The discussions were divided into four parts: the overall context for the study; possible measures for greenhouse gas emission reductions in the agricultural sector; issues relating to carbon sequestration for forestry measures; and finally overall conclusions. The workshop helped to assist in the identification of options for further development (section 4) and to identify key contentious issues, such as time trade-offs in carbon sequestration management, agricultural support and the potential need for OECD land to produce food for developing countries. Special attention was given in the wind-up to: criteria for selection of measures, the need and opportunity to take advantage of on other policy areas and institutions; and the need for more information on best practice on low-input agriculture systems.

1.2.4 The study has revealed that there are many policy and academic communities which relate to these sectors. It has begun the process of identifying those most relevant but has not been able to access all these directly for the benefit of the study. That remains to be undertaken at the next stage (s). The study notes however that many networks are not inter-relating at present and policy on both sustainable agriculture and forestry is developing in other institutional fora without integration of greenhouse gas (ghg) reduction reduction objectives.

1.2.5 In relation to data on ghg reduction potential, it should be noted that the study suffered form the the fact that many of the relevant data sets have not been processed on an Annex I or OECD basis but rather by biome, forest type, country, region, or ghg type. There are, as indicated, considerable methodological uncertainties. The topics covered by this report have already been identified as the subjects for special workshops by the IPCC/OECD/ IEA programme on national greenhouse gas inventories, (Estimating sources and removal by sinks of ghgs from land use change and forestry; and land use and biomass) so the Tranche I and II reports can access the results of these.

1.2.6 To facilitate presentation of the material, the report comprises two main separate sections on agriculture (Section 2) and forestry (Section 3) . Within these the following aspects are examined:
(i) ghg emissions in the sector;
(ii) ghg reduction potential;
(iii) description of each of the possible measures, existing practise, their particular scope for ghg reduction and economic effects (where known) and other relevant comment about existing practise;
(iv) climate change effects on mitigation options;
(v) economic assessment issues;
(v) other environmental and policy developments relating to the sector;
(vi) for forestry additional material is presented on existing practice by country.

Finally, possible options are presented for development in Tranche II (Section 4).

1.3. The role of 'best practice' guidelines

1.3. 1 Whilst the Berlin Mandate structures negotiations within the FCCC process on the discussion of policies and measures, none of the issues surrounding them have yet been resolved. Indeed it can be perceived that their respective role in relation to a targets and timetables approach is now less clear. It may be that within the treaty process there is only coordinated action on a very small number of policies which need international action, such as bunker fuels, and that countries and parties choose their own ways to meet agreed targets and timetables. At the other extreme there may be agreement to implement some central policies.

1.3.2 The particular characteristics of the policies and their institutional frameworks in the agriculture and forestry sectors resulted in the ' best practice' proposals as a means to identify common action for these sectors. There is a considerable range of potential measures encompassed in these two sectors due to the variety of conditions at national level. The national level itself is a composite of a myriad of varying local situations: agriculture and forestry activities are dependent on the particularities of local conditions in respect to soil and climate and relate to deeply rooted social and cultural practises in land tenure and land management systems. The provision of detailed deterministic and prescriptive action from international level would never be appropriate or feasible.

1.3.3 The 'best practice' approach is further considered to be a pragmatic way to expedite progress in ghg reduction in sustainable agriculture and forestry for the following reasons:

- Much action is innovative and there is a need to facilitate the dissemination of good ideas

- The opportunity exists to access policy developments which are designed to meet non-climate policy objectives.

- Much knowledge already exists and is documented but has not been succinctly analysed and synthesised.

1.3.4 Different policy instruments are available to government and a wide range have already been applied in the environmental field which rest within a compulsory- non compulsory continuum. Clearly it would be inappropriate for policies to be formalised as requiring compliance at international level where they are not resting with national frameworks which demand their enforcement, backed by legislation and sanctions for non-compliance.

1.3.5 In the environmental field, as others, where restriction on actions are seen to be necessary for public safety or tax revenue raising purposes direct intervention by government is necessary to achieve compulsory action. In these cases, there is a need for universal application, extensive monitoring and enforcement of compliance. At the other end of the continuum is action which is non-compulsory and characterised by 'social regulation' including encouragement, persuasion and facilitation (see Table below: Government policy instruments and implementation structures).

Table : **Government policy instruments and implementation structures**

Participation	**Compulsory**	**Semi-Voluntary**	**Non-Compulsory**	
Means	Coercion	Pressure	Social Regulation (encouragement,persuasion facilitation)	
Implementation by				
Individuals or corporations	Public law regulations	(rare because of transaction costs	Inducements Information	Codes of best practise
Groups of individuals or corporations	Formal Tradable quotas	Negotiated agreements with no legal standing	Inducements Information	Strategic support
			(voluntary cooperative action)	

Source OECD 1995

1.3.6 The 'best practice' approach comfortably rests within the 'social regulation' framework although there are close interactions with formal legal frameworks. Two particular recent developments will be highlighted: the Codes of Best Practice Approach in the UK and the recent developments in the Voluntary Action approach, particularly the Australian Land Care programme.

1.3.7 'Best Practice' instruments

1.3.7.1 The issue is well explained in relation to the Codes of Good Agricultural Practice developed by the UK for the: protection of water; protection of soil; and protection of air. Each of these codes relates to agricultural practice in different media for which there are different legal frameworks. Water pollution is more stringently regulated through law than air pollution and soil pollution is not a specific offence. The Codes rest between regulation and voluntary practice and help to achieve compliance with desired environmental policy objectives. The Air Code explains the links between agricultural practice and ghg emissions but there are no ways in which the good practice can be enforced.

BOX: CODES OF GOOD AGRICULTURAL PRACTICE FOR THE PROTECTION OF AIR, WATER AND SOIL, Ministry of Agriculture,Fisheries and Food, UK

a) Water Code: The Code is a practical guide to help farmers and growers avoid water pollution. It is a statutory Code, which means that if the code is adhered to it is not regarded as an offence but it will be taken into account in any legal action. However, following the Code is not a defence against legal action. There is legislation to prevent pollution from silage effluent and slurry.

b) Air Code: This Code is a practical guide to help farmers and growers avoid causing air pollution from odours, ammonia and smoke or from ghgs. It is to help dispose of wastes in ways which reduce the risk of causing nuisance or annoyance from air pollution. It is not a statutory Code and following it will not provide a defence in legal action although it should lessen the chance of legal action. There are regulations which cover odour nuisance or smoke (but not ghgs as yet)

c) Soil Code: This is a practical code to help farmers and growers to avoid long term damage to the soils they farm. it also provides general guidance on practices which will maintain the ability of soil to support plant growth. The Code was describes the main risks of causing irreversible- or only slowly reversible- physical, chemical or biological changes to soil which would reduce their ability to grow plants for commercial, conservation or recreational purposes and to support living organisms. The Code provides guidance on protecting the current condition of the soil. Soil pollution is not a specific offence although there are regulations covering toxic waste and sewage sludge.

Each Code describes the main risks of causing water, air soil pollution from different agricultural sources. In each section of each code good agricultural practice is set down in a way which minimises the risk of pollution while allowing economic agricultural practice to continue. The Codes were written using the latest information available.

Source: MAFF. 1991. 1992.1993)

1.3.8 Voluntary approaches

1.3.8.1 Cooperation within farming communities has been deep-rooted, initially as a way to maximise production amongst separate landowners in a small geographical locality by overcoming local resource and physical constraints and also later, to joint marketing initiatives. With increased awareness of environmental problems in the past decade and the need for sustainable agriculture there have been new developments in several OECD countries with Government encouragement of voluntary organisations. These associations have often originated in single issue campaigns but have widened out to tackle a number of environmental quality issues in an integrated or targeted way.

1.3.8.2 Governments have encouraged these moves as they are finding that for many categories of environmental problems, actions gained at or policies implemented through organised groups can be more effective or less costly than those aimed at individuals (OECD, 1995) . They are effective at dealing with local problems and where outcomes can be readily observed and they have become established in a period in which agricultural support has often been substantially reduced. The most well-developed of these approaches is the National Landcare Programme (NLP) in Australia which involves programmes at all levels of governance. The Community Component of the NLP is the one which provides the bulk of direct assistance to community landcare groups which are supported by direct assistance to undertake activities for the sustainable management of land, water, vegetation resource biological diversity and cultural heritage in their local area. A major theme of the Landcare movement is to shift the focus from individual land users to groups and the involvement of the people whose daily decisions shape the land in developing the strategies for more sustaining practice. It is a 'bottom-up' approach aimed at encouraging land-user groups to devlop their own land management strategies in response to their particular, environmental and economic conditions.

Schemes have been developed in Canada, New Zealand and the Netherlands.

1.4. Context and Scope for Action

1.4.1. Scope

Obvious opportunities exist in both agriculture and forestry sectors for policies and measures.

- Agriculture: Natural ecosystems in temperate zones are significant carbon sinks because they continually create organic soils. Modern industrial agriculture however is a significant source of CO2 and other greenhouse gases as soils depleted of organic matter require increasing amounts of fossil-based fertilisers to be productive and soils fertilised with inorganic fertilisers are significant N2 O sources. Common problems have also been identified in livestock intensive farming systems in industrialised countries with manure management and CH4 emissions.

- Forestry: The world's natural forests have a vital role in the global carbon cycle and mid and high latitude forests are currently estimated to be a net C sink. There are three broad categories of promising forestry practices that conserve and sequester carbon:(i) management for conservation of the existing C pool by slowing deforestation, changing harvesting regimes and protecting the forests; (ii) management for expanding the C storage by increasing the area and/or C density in existing forests, plantations, and agroforestry or in wood products; and (iii) management for substitution by increasing the transfer of forest biomass into biofuels and long-live wood products . Projections of climate change impacts, however, suggest that these strategies are dependent on additional land being secured because sequestration in existing forests in may be offset by C releases.

1.4.2. Context

Whilst the primary causal activity of the increased atmospheric concentrations of greenhouse gases is the burning of fossil fuel for energy, land use and land use change are also considerable sources of increased concentrations . The major greenhouse gases associated with land use change are:
a) CO2 for which the major sources are fossil fuel use, deforestation and shifting cultivation and the major sinks atmospheric accumulation, oceans and the biosphere;
b) CH 4 for which the major sources are rice paddies, wetlands, landfill sites, oceans/lakes, biomass burning, fossil fuel burning, coal mining and gas exploitation and the major sinks atmospheric accumulation, soil oxidation, atmospheric chemistry;
c) N2O for which the major sources are cultivated soils, natural soils and fossil fuel and the major sinks atmospheric accumulation, atmospheric chemistry and soils.
(See Table 1.4)

1.4.3 The are thus several causes of land use change which relate to global warming. In relation to the key global carbon cycle, large reservoirs of carbon exist undisturbed in soil and biomass. But major emissions of ghgs in the land use sector are associated with changes in land use. The fluxes associated with normal growth and regeneration are small compared to those when land use is intensified or when land use has been changed (Adger and Brown, 1994). The observed trend of accelerating land use change in recent centuries has been primarily driven by frontier expansion and population total and there has been a reduction in the world's forests and woodlands which are 80% of their 1700 total (Richards 1990). Although tropical deforestation receives the greatest attention at present evidence suggests that over the timeframe of a few centuries , temperate and boreal forestation is by far the most significant in real terms (Adger and Brown, 1994). One global land use assessment suggests that from the pre-industrial era to the present, tropical forests have declined in area by approximately 4% where temperate and tropical forests have lost close to 20% of their area (Mathews, 1983).

1.4.4 A major force behind these changes in the last 300 years is undoubtedly the increased productivity of labour in exploiting land through the application of capital and new technologies (Adger and Brown 1994). There are complex interrelationships between greenhouse gas fluxes and changes in land use. Extensified production systems have felled forest to increase land area as a means to raise production. Intensified agricultural production has resulted from increasing nitrogen fertiliser use and thus increased N2O emissions. Intensive indoor stock keeping and liquid removal systems can result in high methane emissions. Wetland drainage for agriculture, forestry and horticulture reduces CH 4 but also carbon accumulation. There are important policy options to consider and trade-offs which could be made.

1.4.5 In its broad review of mitigation options completed for the Second Assessment Report (SAR) in 1995 the IPCC Working Group II identified in its Technical Summary (TS) several technology options for land management at global level:

Management of agricultural lands, rangelands and forests can play an important role in reducing current emissions and/ or enhance the sinks of carbon dioxide, methane and nitrous oxide. A number of measures could conserve and sequester substantial amounts of carbon (approximately 60-90 GtC in the forestry sector alone) over the next 50 years, including slowing deforestation, enhancing natural forest regeneration, establishing tree plantations, and promoting agroforestry. Significant additional amounts could be sequestered by altering management of agricultural soils and rangelands and restoring degraded agricultural lands and rangelands. Biomass for the production of electricity or liquid fuels, continuously harvested and regrown in a sustainable manner, would avoid the release of fossil carbon. In the long run this would offer a more efficient strategy than one based on carbon storage in vegetation and soils which would saturate with time but could be an effective mitigation option during the transition period to atmospheric stabilisation of carbon.

Table 1.4 Atmospheric concentrations, increase, residence time, sources and sinks for the major greenhouse gases, and their contribution to global warming.

	CO_2	CH_4	N_2O
Residence time (year)	100	8 - 12	100-200
Annual increase (%)	0.5	1.0	0.2-0.3
1990/1991 concentration	355 ppmv	1.72 ppmv	310 ppbv
Radiative absorption per ppm of increase	1	32	150
Contribution % to global warming	50	19	4
Total source	6.5-7.5 bt C	400-640 mt CH_4	11-17 mt N
% biotic	20-30	70-90	90-100
Major sources	Fossil fuel use (5.4 bt) deforestation and shifting cultivation. (1-2 bt).	Rice paddies (60-140 mt) wetlands (40-160 mt) ruminants(65-100 mt) termites (10-100 mt) landfills (30-70 mt) oceans/lakes (15-35 mt) biomass burning (50-100 mt) coal mining + gas exploitation (50-95 mt)	Cultivated soils (3 mt), natural soils, fossil fuel
Sinks	Atmospheric accumulation (3.5 bt) oceans (<bt), biosphere, charcoal formation	Atmospheric accumulation (30 mt), soil oxidation (32 mt), atmospheric chemistry (420-520 mt).	Atmospheric accumulation (2.8), atmospheric chemistry (10.5), soils

Sources:Adger and Brown, 1994)
Notes: ppmv = parts per million by volume ppbv = parts :per billion by volume, na not available.

Other practices, such as improving efficiency of fertiliser use or the diet of domesticated ruminants, could reduce emissions of other greenhouse gases such as methane and nitrous oxide. Altering the treatment and management of animal wastes and reducing agricultural biomass burning also will decrease methane releases. Combining these practices could reduce methane emissions from agriculture by 25 to 100Mt/yr. Using presently available techniques to improve the efficiency of fertiliser and manure could reduce agricultural emissions by 0.3 to 0.9 Mt/yr. (IPCC WG1TS 4.4)

1.5. Uncertainty Issues

1.5.1 Although there are demonstrated effective measures which can be applied in agriculture and forestry sectors, a number of important uncertainties exist regarding their global potential to reduce emissions.

(i) In relation to the estimates of possible reduction in ghgs there are considerable uncertainties which exist in respect of the partitioning of terrestrial carbon sinks (between tropical, boreal and temperate forests areas and between above ground and below ground biomass and soil carbon) and the quantification of CH 4 and N2O sources.
(ii) There are also other uncertainties associated with: estimating the amount of land suitable and available for forestation/ afforestation programmes; the rate at which tropical deforestation can be reduced; long term security for forestry programmes.

1.5.2 Furthermore there a number of other unresolved issues in respect of the impact of changing climate on agriculture and forests. A changing climate could lead to a significant increase in the characteristic growing season of agricultural crops through increasing temperature and shifting rainfall regimes. And whilst increasing CO 2 concentrations could enhance plant growth the effect of enhancement is not well understood under realistic agricultural conditions. Experiments show an increase in production in C3 plants (most crop plants are C3 except maize, millet sorghum and sugar cane) at doubled CO 2 concentrations but the measured response in C4 plants[1] is much smaller (IPCC 13.2.2). Nor have studies included changes in insects, weeds and diseases, changes in soil management practices and hydrological regimes (Tech Summary WG11). The failure to integrate many key factors into agronomic and economic models limits their ability to consider transient climate scenarios (Tech Summary WG11).

1.5.3 These issues also point to the need for flexible instruments such as guidelines which can proceed with the benefit of existing knowledge to gain experience with implementation and can be rapidly changed.

[1] C4 plants have a CO_2 concentrating mechanism which suppresses photorespiration.

2. Mitigation Options in the Agriculture Sector for the Reduction of Greenhouse Gas Emissions

2.1. Introduction: The Relative Contribution of the Agricultural Sector to Total Anthropogenic GHG Emissions

2.1.1. Overview

2.1.1.1 Agriculture is a significant source of greenhouse gas emissions, particularly of methane and nitrous oxide. On a global scale it has been estimated that agriculture presently contributes about 21-25%, 57% and 65-80% of the total anthropogenic emissions of $C0_2$, CH_4 and N_20 respectively. Overall it accounts for one-fifth of the annual increase in anthropogenic greenhouse warming. For individual OECD countries, the agricultural sector, excluding food processing, packaging and distribution, is likely to contribute between 6-15% of total national anthropogenic GHG emissions.

2.1.1.2 The main agricultural sources of GHG emissions include methane emissions from livestock (methane is produced as part of the normal digestive process of ruminant animals and from the anaerobic decay of livestock waste) and from paddy rice cultivation; nitrous oxide emissions from the application of synthetic and organic nitrogenous fertilisers to agricultural soils; and carbon dioxide emissions resulting from both direct and indirect energy use in agriculture. The burning of agricultural wastes is also a significant source of both methane and nitrous oxide. In addition modern industrial agriculture is a significant source of $C0_2$, as intensive annual crp production depletes soils of organic matter and inorganic nutrients. Sources of agricultural GHG emissions of relevance to the OECD are discussed in more detail in 1.2 below.

2.1.1.3 Comparatively fossil fuel use by agriculture is low, about 3-4.5% of the total energy consumption for the developed countries of the world (Enquete Commission, 1995) But fuel requirements by the food sector as a whole (including processing, preservation, storage and distribution) account for 10-20% of total fossil energy consumption (Pimental et al, 1990). High-intensity animal production has become the biggest consumer of fossil energy in modern agriculture (Enquete Commission 1995).

2.1.1.4 The significance of the agricultural sector as a major source of ghg emissions is closely related to the level and intensity of agricultural production in most OECD countries. Over the past fifty years agriculture within the OECD has become increasingly dependent upon external inputs of fertilisers, pesticides, and mechanisation. Dramatic increases in productivity have masked a progressive decline in energy efficiency and an increased reliance and dependence upon fossil fuels. It is this specialisation and intensification of agricultural production - often involving the spatial separation of livestock and arable enterprises - that has resulted in the sector becoming an important source of greenhouse gas (ghg) emissions. Where extensive agricultural systems exist, such as Australia, other factors such as land clearing assume more importance as sources of ghgs from the agriculture sector.

2.1.1.5 Options exist to reduce the level of $C0_2$, CH_4 and N_20 emissions from the agricultural sector by modifying agricultural policies and practices. Since measures are often concerned with efficiency, and will not be adopted by farmers unless they improve profitability, many have the potential to deliver both reduced ghg emissions and improved economic returns - the so called win-win outcomes or double dividend more generally associated with industry. For this to be achieved however there has to be a level plying field, with no financial incentives or subsidies for practises which are un-climate friendly.

- Enteric fermentation: Enteric fermentation accounts for the largest source of agricultural methane emissions. The process involves the break down of carbohydrates, which release methane, and occurs in both ruminant (cattle and sheep) and non ruminant (pigs and horses) animals, although ruminants produce the majority of the methane because of their ability to digest cellulose. The amount of methane produced by an individual animal depends upon, among other things, the type, weight, and age of the animal, as well as the quality and quantity of feed and energy expenditure of the animal in question. In general, increasing global livestock numbers will translate to higher methane emissions from this source. Methane is also a relatively short lived GHG with an estimated Global Warming Potential of 24.5 (including both direct and indirect effects) over a 100 year time horizon.

- Paddy Rice Cultivation: Most of the world's rice is grown on flooded fields. Consequently soils are flooded and through anaerobic decomposition of soil organic matter, methane is released into the atmosphere. The methane is principally released through the rice plants, which act as conduits from the soil to the atmosphere (US GPO, 1994). Emissions can vary tremendously due to irrigation and fertiliser practices, soil/paddy characteristics, cultivation history, temperature and season.

  The original estimate from the IPCC suggested that methane emissions from this source were around 100 Tg year (equal to 100 million tonnes, or roughly 20% of anthropogenic emissions). However, this estimate was based on limited data and has now been revised downwards to 60 Tg (see Houghton et al., 1992). The magnitude of this revision illustrates the great uncertainty surrounding many of the GHG emission inventory estimates. (In an Annex 1 context, only Japan is significantly involved in rice cultivation)

- Animal Wastes: Methane emissions from animal wastes result from the decomposition of the waste in anaerobic conditions. Consequently, manure management policies can have a large impact on the overall level of emissions. For example, liquid based systems, using ponds, lagoons or pits promote an oxygen free environment and consequently tend to produce significant emissions.

2.1.2.2 Nitrous oxide:

- Nitrous oxide is emitted by microbial activity in the soil, de nitrification (the process that reduces nitrate) and also by nitrification - the microbial oxidation of ammonium to nitrate. Its rate of release is accelerated following the application of nitrogenous fertilisers and the application of animal wastes to farmland, i.e. anything that increases the level of nitrogen including organic green manures. It is long lived greenhouse gas, with a global warming potential of 320 over 100 years, [2]

- Nitrous oxide can also be emitted during the burning of agricultural crop residues. Emissions from this source, however, are small relative to overall emissions. Emissions also result from the production of nitric acid, manufactured by the oxidation of ammonia, a raw material used primarily to make synthetic commercial fertilisers (and also for the production of adipic acid and explosives).

2 To illustrate the scale of emissions at a local level it has been estimated that a typical 76 hectare dairy farm in the south-west of England is likely to be responsible for the emission of 18 tonnes of methane and over one tonne of nitrous oxide annually (Jarvis, 1994).

2.1.1.6 For CO_2, reductions, it is possible to implement appropriate management practises worldwide in agricultural soils - including increased input of crop residues, reduced tillage and restoration of agricultural land, which could sequester between 400- 800 TgC/yr, over period of 50-100 years, as new equilibrium levels of soil organic matter are achieved. In addition agriculturally related CO_2 emissions can be reduced and biofuel produced to replace fossil fuels. Significant decreases in methane emissions from agriculture can be achieved through improved nutrition of ruminant animals and better management of paddy rice fields. Additional methane decreases are possible by altered treatment and management of animal wastes and by reduction of biomass burning. Combining these practices could reduce methane emissions from agriculture by 100 Mt/yr (TS 4.3). Nitrous oxide emissions from agriculture could be reduced by 9 to 26% by improving agricultural management with available techniques (IPCC WG11 ch 23 E.S)

2.1.1.7 There is an enormous, if not bewildering, number of possible measures which can be used in the agriculture sector for ghg mitigation and there is invariably already considerable operating experience somewhere in the world with them. However climate protection policy is not the driving force. Reductions in agricultural greenhouse gas emissions are generally an incidental and additional benefit to on-going national and regional or international agricultural policy reforms concerned with controlling agricultural surpluses and pollution, and in some countries,the drive for sustainable agriculture - i.e. policy reforms with non-climate objectives. The fact that farmers are not widely using these measures systematically at present suggests that they are not profitable and involve additional investments in time and/or money. It also reflects the fact that they are often operating under subsidy systems pulling in different directions. Those policies that have been implemented - are often under-resourced and restricted to only limited and defined areas and have been appplied as 'add-ons'. Much more could be achieved through a systematic and more rigorous application of many of the options detailed in the following pages. They could be adopted individually or part of a package designed to promote sustainable agriculture.

Before reviewing policy options to reduce ghg emissions in section 2.2, section 2.12 provides some more detail on sources of agricultural emissions.

2.1.2. Sources of agricultural GHG emissions of methane and nitrous oxide

(Carbon dioxide is covered in sections 1,2.2.10 and 3.)

2.1.2.1 Methane

Methane is produced from a wide variety of anaerobic processes. The main agricultural sources of methane emissions are from enteric fermentation (22% of total emissions), paddy rice cultivation (17% of total emissions) and from the anaerobic digestion of livestock wastes (7% of total emissions). Including biomass burning agriculture is responsible for approximately 57% of anthropogenic methane emissions. For individual OECD countries such as Australia, New Zealand and Denmark, the agricultural sector is responsible for over 65% of anthropogenic emissions. More typically, the agricultural sector for individual OECD countries is responsible for about 30- 50% of total anthropogenic emissions. Livestock are the single most important anthrpogenic source contributing 30% globally and in the OECD 47% (Cruten,1995). It has been calculated that the contribution of methane from domestic animals in the OECD is 6% of the anthropogenic emissions of ghgs (OECD, 1995). There are wide variations in methane emissions on a per capita basis within the OECD: it is higher in those countries where production and consumption from cattle is high such as Australia and New Zealand and low in countries such as Japan where a significant share of livestock product consumption is imported.

- There is still a great deal of uncertainty surrounding the various sources and sinks of nitrous oxide as it is also emitted by a large number of small sources. The main anthropogenic sources are cultivated soil (1.8 -5. Tg(N)/yr) and the main natural source is tropical wet forest soils (2.2-3.7Tg (N)/yr). The IPCC's 1994 report stated that new research showed that emissions from cropped, nitrogen- fertilised agricultural systems was signficant on a world scale (Houghton et al, 1995).

- As disclosed in their National Communications, the agricultural sectors of Switzerland, Denmark and Australia contributed 93%, 83% and 87% of total anthropogenic emissions of nitrous oxide respectively. More typically, the agricultural sector within individual OECD countries contribute about 50% of total anthropogenic nitrous oxide emissions.

Table: Estimated sources of selected ghgs by region :1995
Source: den Born, RIVM,1996

GHG SOURCE Gg	CANADA	USA	OECD EUR	EAST EUR	CIS	OCEANIA	JAPAN	WORLD
CH4 animals	502	4124	6889	1579	4461	3667	210	76460
CH4animal waste	145	2079	3255	995	1161	271	442	14653
N2O natural soils	114	325	117	58	362	279	17	7551
N2O fertiliser	28	249	178	63	161	48	8	1330
N2O animal waste	9	57	97	42	66	19	7	1013

2.2. *Policy Options to Reduce GHG Emissions from the Agricultural Sector*

Policy measures already implemented have been started for non-climate objectives particularly for water, air pollution and soil degradation concerns. They are generally compatible with the promotion of lower external input, more sustainable and less energy intensive systems of agricultural production. There is no single set of technologies or practices. The whole essence of lower-input, more sustainable agricultural systems is that management practices and systems of production are adapted to suit local conditions. For climate protection purposes they can thus be selected individually or as a package. There are over-laps and cross-linkages between them and important issues of principle are involved which need detailed consideration.

For reference purposes, the table summarising the assessment of options made by the IPCC team considering mitigation in agriculture is in Annex . This list has been expanded through a review of National Communications, and other relevant literature and the following sections outline policy options and measures that could be considered for further development in the 'common action' framework, using also chapter 25 of the IPCC WG11's report. The measures are:

- Reduction/reform of agricultural support measures
- Cross compliance of agricultural support - i.e. tie agricultural support payments to the requirement to adhere to defined agricultural management practices
- Reduce methane emissions per unit of product
- Reduce methane emissions by improving manure management systems
- Reduce methane emissions from manure by means of surplus nutrient/manure levies
- Reduce nitrous oxide emissions from agricultural soils
- Raising the price through taxes or levies on mineral nitrogen fertilisers

- Reduce agricultural emissions of C02 and enhance carbon storage in agricultural soils
- Promotion of organic systems of agricultural production
- Improve the energy efficiency of agricultural production
- Reduce ghg emissions through the promotion of energy crops & biofuels

Various options are also examined within them.

2.2.1. Measure: Reduction/Removal of Agricultural Support Measures

2.2.1.1 This measure has the objective: to limit surplus production of animal products/reduce livestock numbers. There is a clear relationship between the production intensity, degree of specialisation and level of emissions of radiatively active trace gases from agriculture (Enquete Commission, 1995). Reduction or removal of subsidies reduces the incentive for over production. In recent years agriculture policy reforms in many OECD countires (Europe in particular) have been principally aimed at limiting the surplus production of agricultural produce). Recent reforms to both the CAP and US Farm Bill's have sought to shift the emphasis of support away from production. These reforms have resulted in a decline in overall livestock numbers. Several Parties to the Convention refer to CAP reform, and continued reform to the CAP, as the mechanism enabling them to reduce agricultural methane emissions by reducing livestock numbers. The UK for example, have estimated that CAP reform could lead to a 15% reduction in the number of diary cattle.

2.2.1.2 Despite the reforms, producers income is still largely dependent upon production linked suppport throughout much of the OECD (particularly in Europe). The incentive to maximise yields, although weakened, has not been removed. Reduced levels of agricultural support and more stringent and targeted support for remaining agricultural spending could accelerate this trend and assist in the move to more integrated and lower external input systems of agricultural production.

2.2.1.3 Substantial reductions in agricultural subsidies can be achieved, as is illustrated by experience in New Zealand. As part of a major restructuring of the New Zealand economy, the level of government assistance to agriculture fell from 30% of output in 1984 to 3% in 1990. Together with a reduction in world-wide livestock commodity prices, stocking rates are substantially lower in New Zealand than a decade ago.

2.2.1.4 There is also enormous resistance to the reform of agricultural susbsides. Even where there have been concerted efforts to tackle them, there is often considerable resistance to changes. the US farm Bill has been deferred. Whilst the Conservation Reserve Programme is under pressures it is likely to remain in some form.

2.2.2. Measure: Define Maximum Stocking Rates

2.2.2.1 This measure also has the objective: to limit surplus production of animal products/reduce livestock numbers. It can be considered as a 'second-best approach' to the problem whereas a first best' approach might be to reduce livestock support prices. It has particular relevance for the EU where intensive livestock production systems are causing serious polution problems. Although recent reforms to the CAP reduced the number of cattle eligible for support payments (on the basis of Livestock Units (LSU) per hectare), there are no maximum restrictions on the number of cattle or stocking densities permitted. Producers can actually increase stocking densities even though subsidies would be restricted to eligible cattle only.

2.2.2.2 Eligibility for compensation payments conditional upon allowable stocking densities not being exceeded could, together with other policy measures, assist in maintaining the downward trend in livestock numbers. At a stocking density of 1.5 LSU/ha animals can feed on the farms own land, with no need to purchase or import additional feeds (this also ensures that organic manure is effectively utilised)[3].

2.2.3. Measure: Cross Compliance of Agricultural Support - i.e. tie agricultural support payments to the requirement to adhere to defined agricultural management practices

2.2.3.1 This is the third measure with the objective: to limit surplus production of animal products/reduce livestock numbers. Cross compliance could provide an effective and efficient mechanism to achieve both GHG emission reductions in the agricultural sector whilst at the same time achieving many of the wider social and environmental objectives of recent agricultural policy reforms. However it is difficult to target and enforce and in many ways runs counter to achieving fundamental reform of agricultural support systems.

2.2.3.2 Possible examples of cross compliance could include tying eligibility for Area Support Payments (introduced under the 1992 MacSharry reforms to the CAP) to adhering to defined agricultural management practices across the whole farming enterprise. At present, income support in the form of area payments is only coupled to the controversial obligation to set aside certain areas from production each year, typically 10-15% of the farming enterprises eligible area.

2.2.3.3 Management practices could include, as detailed above, not exceeding recommended stocking densities (Per the 1992 CAP reforms these are 3 livestock units(LSU)/ha in 1995, 2.5 LSU/ha in 1996 and 2 LSU/ha in 1997); the requirement to follow Codes of Good Agricultural Practice with regard to such things as timing and dosage rates for fertilisers (see below); storage and management of manure (see below); maintenance of catch crops and cover crops, provision of environmental 'goods and services' such as hedgerows and woodlands with provision for public access and so on.

2.2.4 Measure: Reduce methane emissions per unit of product

2.2.4.1 Part of the energy from feed absorbed by animals is used to maintain their vital functions, the remainder is then converted into weight gain or directly into saleable products such as milk, eggs etc. Depending upon how easily the feed is utilised, a large part of this energy many be unused and lost in the form of methane. For ruminants as much as 12% of the energy present in feed may be lost in this way (Enquete Commission, 1995).

2.2.4.2 The following table details the main technological options for reducing methane emissions from enteric fermentation. Each is then discussed in more detail. As shown, according to the EPA, they have the potential to achieve a 25%-75% reduction in methane emissions from this source. Overall current emisions are estimated to be 80TgCH4/yr.

[3] One LSU/ha corresponds to an animal population of 500kg live weight

Technological Options for Reducing Methane Emissions from Enteric Fermentation

Enteric Fermentation	Availability of technique	Capital needs
Feed processing	Now	low/medium
Strategic supplementation	Now	low
Production enhancing agents	Now	medium
Genetic improvement	Now	medium
Reproduction improvement	Now	medium
Changing rumen microflora	5-10 years	low

Source:Modified from ' Methane, The Other Greenhouse Gas: Research and Policy in the Netherlands' A.R. Van Amstel et. al. 1993. Research for Man and the Environment (RIVM) (report No. 4815070010)

(a) Improved nutrition through mechanical and chemical feed processing. This option is applicable to accessible ruminant animals with limited resources. Assuming that feed digestibility is increased by 5%, methane emissions per unit produced may decrease by 10 to 25%, depending on management practices. Different options include alkali/ammonia treatment of low digestibility straw, and chopping of low digestibility straw and wrapped rice straw (Leng 1991 in Amstel et. al.).

(b) Improved nutrition through strategic supplementation. Improved rumen function may reduce methane emissions by about 5 to 10%. Emissions per unit product may be reduced by 25 to 75% due to increases in productivity. Options include: molasses/urea blocks with or without bypass protein (short-term) and rumen bio-engineering (long-term) (Leng, 1991). The objective is to optimally balance the feed composition by adding limiting nutrients and active ingredients. Some aditives suchas copper can build up in soils.

Although the reduction potential for intensively managed cattle in North America and Europe may be more limited than other regions, since most livestock animals already receive high quality feeds and concentrates/feed supplements, it is still estimated to be somewhere in the region of 25%. This would equate to a reduction in these two regions of some 7 Tg of methane by 2025 (IPCC 1992). If each global region was to achieve its estimated reduction potential, global methane emissions would be reduced by some 84 Tg by 2025, giving total emissions from livestock of 54Tg in 2025 compared to 138 Tg without reduction measures.

Under Action 39 of the US Climate Programme, improved ruminant productivity, largely through modifications to diet, is forecast to reduce GHG emissions by 1.8 MMTCE by 2000.

(c) Changing rumen microflora by: modifying the rumen micro-organisms by means of genetic engineering; biotechnological manipulation, adding specific inhibitors or antibiotics;

(d) Productivity enhancing agents Agents that have been used include bovine somatotropin (BST) and anabolic steroids. BST is a naturally occurring hormone that with recombinant DNA techniques can now be synthesised in large quantities. BST can improve lactation by 10% to 20%. This option is not acceptable in Europe. Anabolic steroids can improve feed efficiency but were recently banned in the EC.

(e) Breeding programmes. These can achieve: increasing output and growth rates; increasing reproduction; improved resistance to disease. This option includes crossbreeding in developing countries and genetic improvement in dairy cattle. Dairy countries 'have significant breeding programmes in place Detailed recording systems are used to assess the genetic potential of cows and bulls. Embryo techniques can accelerate improvements.

(f) Improving the reproductive performance by: generating twin births; transplanting embryos artificial insemination and rutting synchronisation; and improved reproduction.

Large numbers of ruminants are maintained for the purpose of producing offspring. Methane emission per unit product can be significantly reduced if the reproductive efficiency is increased. Options include reduction of time to maturity by improved feeding, twinning, artificial insemination and embryo transplantation, so that each cow becomes pregnant once a year.

Box 3: The U.S. Ruminant Livestock Methane Program

This partnership programme between the US EPA, the USDA and livestock producers aims to increase livestock productivity, reduce costs, and produce healthier products whilst protecting the environment. It forms one (No. 39) of 44 Actions detailed in the US Climate Action Plan and is anticipated to result in a reduction in methane emissions equivalent to 1.8 MMTCE. The Program fact sheet states that a ruminant can lose 2-12% of the energy from its feed to the production of methane. By avoiding this loss, dietary energy is made available for growth and lactation. As a result, producers will benefit economically and GHG emissions will be reduced.

The program will address the six main options for reducing emissions from cattle through improved management at the farm level. The options are as follows: (1) improved nutrition through mechanical and chemical feed processing and improved grazing management, (2) improved nutrition through strategic supplementation as part of pasture and range management, (3) production-enhancing agents to improve feed efficiency, (4) improved production through improved genetic characteristics, (5) improved production efficiency through improved reproduction, and (6) controlling disease. The programme will also build on existing efforts to remove market barriers to, and create incentives for, increased production of milk and meat with lower fat content. Such products create less methane per unit of product than do higher-fat products.

source: The Climate Action Plan: Technical Supplement (DOE, 1994)

2.2.4.3 Constraints Some the above measures have clear implications for animal welfare together with implications for human health. They are included here as options but not necessarily as recommendations. An important caveat should also be added to all of these measures. Although they are all capable of improving the productivity and performance of individual animals, a reduction in overall methane emissions from livestock farming will only be achieved if the number of animals is reduced. If, as in the past, productivity gains are simply used to increase production - rather than reduce animal stocks or encourage extensive production - agricultural surpluses will be maintained and it is unlikely that there would be any reduction in ghg emissions.

2.2.4. Measure: Reducing methane emissions by improving manure management systems

2.2.4.1 Methane emissions from animal wastes result from the decomposition of the waste in anaerobic conditions. Consequently, manure management policies can have a large impact on the overall level of emissions. For example, liquid based systems, using ponds, lagoons or pits promote an oxygen free environment and consequently tend to produce significant emissions. For some countries, for example Germany, liquid based systems account for over 90% of methane emissions from animal manure. Increasing attention is being given to this issue but there are often significant political constraints on the implementation of technical solutions: the Flemish Regional Government (which covers 45% of Belgium) fell in March 1995 over limits on pig production and pig manure Southery 1995).

2.2.4.2 There are significant regional variations in manure management depending on whether livestock is managed on pastures on ranges (such as in Australia) or in intensive indoor complexes such as Wesern Europe

2.2.4.3 Methane emissions from anaerobic digestion of animal manures constitute a wasted energy resource which can be recovered by adapting manure management and treatment practices to facilitate methane (biogas) collection. The technology is well used and tried at a larger scale in OECD countries, such as Denmark for CHP and District Heating. It is also widely used in India and China. On farm the biogas can be used directly for energy, or to generate electricity for use or sale. The other products of anaerobic digestion, contained in the slurry effluent, can be used as animal feed and aquaculture supplements, in fish farming and as a crop fertiliser. Additionally, managed anaerobic digestion is an effective way of reducing the environmental and health problems associated with manure management (IPCC WG111 ch7 4.7)

2.2.4.4 With current technologies it has been estimated that methane emissions from this source can be reduced by between 25%-80% (IPCC 1990 and US EPA1993). Other options include aerators to increase the oxygen content of the slurry and hence reduce the activity of the anaerobic bacteria

2.2.4.5 In the USA and other countries farmers are being encouraged, as part voluntary initiatives primarily concerned with pollution prevention, to utilise methane produced from animal wastes to generate on farm energy needs. Under the US AgStar Programme (see Box) the EPA suggest that possibly 2000 diary and 2000 pork producing facilities in the USA could profitably utilise methane recovery technology and reduce methane emissions by 0.5Tg to 0.8Tg by the year 2000, and 0.6tg to 1.0Tg by the year 2010. Emissions of methane in the US from poultry and livestock wastes was in the order of 2.3Tg in 1990 (Roos, 1994)

The U.S. AgSTAR Program: A Smart Investment in Manure Management

AgSTAR is a voluntary pollution prevention program with the livestock industry. The programme encourages diary and swine facilities to adopt animal manure best management practices that profitably manage animal manure, protect surface and ground water, and reduce fertiliser costs. The AgSTAR programme overcomes a number of barriers that currently hinder the more widespread use of on farm energy recovery technologies. These barriers include farmers' lack of information about the profit potential of methane recovery options and their memory of projects launched during the 1970's that failed. Under the programme, producers commit to survey their facilities to identify profitable options for capture and use of methane for on-farm power usage. A Memorandum of Understanding is signed with the EPA who provide technical and other support to AgSTAR participants. The programme emphasises that producers can realise substantial returns through reduced electrical, gas and oil bills, revenues from high quality manure by-products, and savings on manure management operational costs. At the same time producers also reduce water and odour pollution and global warming.

source: The Climate Action Plan: Technical Supplement (DOE, 1994) & AgSTAR Program flier

2.2.4.6 In the AgStar Program producers in the US are being encouraged to adopt such technologies as part of a government-producer voluntary initiative. According to the US National Climate Action Plan, the AgStar Program is forecast to save over 1.8 MMTCE of methane emissions by the year 2000. However in 19995 methane recovery for on-farm energy had been practised at fewer than 1% of US farms that could do so profitably and only covers several farms (US EPA 1995). Although these systems started in the 1970's many of the early systems were over designed and led to operating problems which farmers have not forgotten. It is intended to establish 'Charter Farms' -on farm demonstration sites - that will display improved demonstration recovery systems across the nation. The Natural Resources Conservation Service (NRCS) of USDA is working with EPA to draft Conservation Practice Standards and technical Notes to ensure that recovery systems are correctly installed, maintained and operated (US EPA 1995). These standards will help manufactures and producers to meet optimum performance levels for variety of field tested, on-farm biogas systems. NRSC will develop and issue updated standards as new systems and technologies emerge.

2.2.4.6 The UK WATT Committee (Report No.28) concluded that the costs of covering slurry stores, using aerators or installing anaerobic digesters are all very expensive compared to farm incomes (for small European family farms) indicating that without adequate financial support (possible in the form of capital grants/low interest loans etc) or more stringent fines for pollution incidents, farmers/producers are unlikely to adopt such technologies on a wide scale..

In most OECD countries however some direct budgetary assistance is already available for waste storage and processing and research is also underway aimed to reduce emissions from livestock wastes through improved management and initiatives aimed at reducing the production of liquid manure production in the first place.

2.2.5. Measure: Reduce methane emissions from manure by means of surplus nutrient/manure levies

2.2.5.1 Under the Dutch Memorandum on the Third Phase of the Manure and Ammonia policy (Nota Derde Fase Mest en Ammoniakbeleid) the proposed introduction of an ammonia levy is forecast to cut manure production and also to reduce methane emissions by a further 37 Gg/year (In 1990 methane emissions from animal wastes in the Netherlands were 91Gg, emissions in 2000 are forecast to be 77Gg). This further reduction is not reflected in the Netherlands 10% CH_4 reduction target). See Box for more details.

The Dutch Minerals Accounting System

The Dutch minerals accounting system, introduced into the livestock sector in 1995, provides a powerful and useful management tool which will enable producers to monitor mineral flows and surpluses on their holdings. From 1996 all livestock producers will be required to report any unacceptable manure surpluses on their holdings. Acceptable loss standards will be set and producers will ultimately be liable for regulatory levies on 'unacceptable losses'. To this extent the minerals return is also a kind of tax return. In 1997 the minerals accounting is to be introduced into the crop sector. A year later, compulsory returns and regulatory levies will be applied. Ultimately the Dutch plan to introduce minerals accounting to all agricultural and horticultural holdings. A principal advantage of the system is that the producer is free to decide whether to dispose of any mineral surplus by switching to another type of feed, by selling manure to a holding with a deficit, by reducing chemical fertiliser inputs or by reducing stocking densities.

2.2.5.2 The widespread adoption of mineral accounting within the OECD, with 'acceptable loss standards' based on local circumstance, does offer a mechanism to more accurately match agricultural inputs to crop and livestock requirements in theory. However it is unlikely that the conditions required for implementation of this system exist elsewhere unless environmental pollution levels deteriorate and/or further leverage can be exerted on farmers. The measure demands considerable inputs of time and effort by farmers and they have resisted it in the Netherlands.

2.2.6. Measure : Reduce Nitrous Oxide emissions from agricultural soils

2.2.6.1 Increasing the efficiency of the use of N supplied as mineral and animal waste fertiliser could globally decrease nitrous oxide emissions by 0.7 (0.34 to 1.0) Tg N2)-N/yr (IPCC 23.3.1.2.2) . Further, since fertiliser production is extremely energy intensive, reduced fertiliser use will also lead to a reduction in C02 emissions as 1.2kg of fossil C equivalents are required for each kg of fixed N (IPCC, 23 2.3). This is important as current levels of global consumption of 80 Tg N are expected to increase by 50% in 2025 (ibid).

2.2.6.2 Nitrous oxide is emitted by microbial activity in the soil, de nitrification (the process that reduces nitrate) and also by nitrification - the microbial oxidation of ammonium to nitrate. Its rate of release is accelerated following the application of nitrogenous fertilisers and the application of animal wastes to farmland, ie anything that increases the level of nitrogen including organic green manures. The intensification of agriculture within much of the OECD over the post war years has seen a tremendous increase in the use of synthetic and energy intensive nitrogenous fertilisers. Combined with atmospheric deposition, this increased use of fertilisers has been associated with nitrate contamination of ground and surface water suppliers, the eutrophication of streams, rivers and lakes along with other negative environmental impacts.

2.2.6.3 According to the OECD default methodology, 1% of applied nitrogenous fertilisers are directly released as nitrous oxide. There is a great deal of uncertainty over the estimation of these losses. It is also estimated that an additional 0.75% of N applications will also be evolved to the atmosphere as N_2O resulting from N leaching, run off and NOX and NH3 volatilisation (IPCC, 23..3.1.2.1) According the German National Communication loses are likely to lie in the range of 1-3% of applied fertilisers depending upon fertiliser type, soil type and climatic factors.

2.2.6.4 If mineral fertiliser is matched better to crop requirements, less will be required, therefore less N_2Owill be produced and less N will leak from the system. Options include :

a) The use of nitrogen testing kits to more closely match crop requirements to nutrient inputs;
b) Regular calibration of machinery to ensure accurate delivery of fertilisers;
c) The use of slow release products and the incorporation of compounds that inhibit the conversion of one nitrogen compound to another, eg nitrification inhibitors;
d) Careful attention to the frequency, timing and appropriate placement of fertiliser applications.

Codes of Good Agricultural Practice in several OECD countries are beginning to cover these issues and these clean technologies have also been adopted by interested farmers groups (OECD, 1994). Actions 17 & 18 of the US Climate Action Plan, which are aimed at reducing the use of fertilisers and pesticides and improving the efficiency of fertiliser nitrogen use, are forecast to achieve 2.7 MMTCE and 4.5 MMTCE reductions in methane emissions by the year 2000 respectively.

2.2.6.5 Other policy measures within the OECD include: Provision of information and advice to farmers on the efficient use of fertilisers; the use of economic incentives to promote ecological/lower external input systems of agricultural production; bans on the application of fertilisers at certain times (Sweden). In addition, several OECD countries are conducting research programmes to develop more efficient fertiliser application methods together with new/modified products. In the Netherlands, for example, a feed levy of 6 million guilders per year is currently imposed, for funding research into environmentally sound production processes (UBA, 1994 in Enquete Commission, 1995)

2.2.6.6 However, to date, these measures have been far from effective. As discussed elsewhere, the incentive to maximise yields still remains within much of the OECD, adherence to Codes of Good Agricultural Practice is not compulsory and those specific measures aimed at promoting less intensive systems of agricultural production are frequently limited to defined areas (eg UK pilot Nitrates Sensitive Areas Scheme - to enable UK to comply with EC Nitrate Directive (91/676/EEC)) or are under resourced, offering insufficient incentives to producers within the existing and distorted policy environment.

2.2.7. Measure: Raising the price through taxes or levies on mineral nitrogen fertilisers

2.2.7.1 As long as the price of N fertilisers remains low (the real price of fertilisers has fallen substantially since the 1960s) and the incentive still remains to achieve maximum yields over all other considerations, there is unlikely to be a drastic reduction in the use of N fertilisers. For this reason alternative ways have been sought to internalise external costs of pollution. Reductions in the use of N fertilisers could be achieved through the use of a levy or N- tax. Clearly more work would need to be undertaken if a coordinated approach were to be adopted - particularly sensitivity analyses to assess the necessary tax levels to induce change. Also alternatives such as the role of leguminous crops could be investigated.

2.2.7.2 Fertiliser levies and taxes have already been introduced in Austria, Finland, Norway and Sweden. In Austria the levy amounted to 40% increase in the price of N. In 1988, following the introduction of the levy, fertiliser use fell by 11%. However, in Sweden, despite an effective 30% price levy on N being introduced, N demand remained constant - partly because of falling energy prices and rising product prices. Both the UK and Switzerland are considering the introduction of N tax. In the UK the revenue would be used to pay for water treatment. It has been calculated that it costs in the region of DM 40 to remove each kg of N from the water supply.

2.2.7.3 The Enquete Commission have recommended the introduction of a N levy combined with a phased increase in the price of mineral N fertilisers. Some members of the Commission had argued for a phased in crease in the levy to between DM4 and DM 5 per kg of N by 2000 (the current price of N fertiliser is about DM 1.15/kg N). A sufficiency high levy, with appropriate mechanisms to deal with the resulting welfare impacts and to ensure livestock farms are not given preferential treatment, would not only reduce the environmental burden of agricultural production in the EU/OECD, it would also have the ability to return the European market for agricultural products back into a state of equilibrium and hence remove the need for costly set aside.

2.2.8. Measure: Nitrogen Quotas

2.2.8.1 An alternative is a quota system. Under a N quota system , licences would be issued permitting the use of a certain total quantity of N per farm or region. The quantity could be a percentage of the quantity previously applied or a fixed amount per hectare. Differential quotas could be set in different regions to reflect local conditions, ecological priorities and so on.. However, the need for administration and monitoring would put a limit on how far quotas could differ according to local and operational circumstances (Gottlieb, 1992 in Enquete Commission, 1995).

2.2.8.2 The imposition of quotas on production materials that increase yield has been regarded as the 'height of interventionism'. As such, a quota policy would be unlikely to work due to political unpopularity and the high administrative costs involved with such a system (Enquete Commission, 1995).

2.2.9. Measure: Reduce Agricultural Emissions of C02 and Enhance Carbon Storage in Agricultural Soils

2.2.9.1 Large amounts of C could be sequestered in soils (23-44Pg over a 50 year period) through improved management of agricultural land, permanent set-asides, and restoration of degraded lands. Increasing soil C levels has additional benefits in terms of improving the productivity and sustainability of agricultural production systems. There are potential costs associated with C storage including fossil fuel requirement (e g fertilisers), lost production (e g. set-aside programmes) and additional labour and financial requirements (e g. land restoration) which may constrain the potential for increasing C storage. Direct fossil fuel use by agriculture is a relatively minor proportion of society's total

consumption therefore high reductions in use within agriculture have a relatively modest mitigation potential (IPCC WG11 23..5).

2.2.9. 2 There is high degree of uncertainty in estimates concerning both flux rates and C storage capacity as well as the level at which the various mitigations option could be implemented. In its assessment of quantifying the scope for ghg reductions, mitigation potential were expressed in terms of arbitrary range (10 -50% in implementation of technical potential) representing possible lower and upper limits for developing policy scenarios (IPCC WG11 23.2.5) See Table .
2.2.9.3 Options in OECD include:

a) Reversion of agricultural land

In temperate regions the conversion of native ecosystems to agricultural land use is generally not an issue as there is little development of new agricultural lands, with the exception of Australia[4]. In regions with food surpluses (US, Canada, Western Europe) the agricultural land base is being reduced. A similar situation may occur in the longer term for countries in Eastern Europe and the FSU as per area productivity increases. Thus the reversion of marginal agricultural land to forest, grasslands and wetlands represents potential for C sequestration. Rates of C accumulation in agricultural soils varies widely depending on climate and soil conditions, the vegetation type established, and the degree of management.

Currently about 25 Mha in the US, Canada and the EU has been taken out of production in Government setaside programmes. The US Conservation Reserve Programme is scheduled to expire in 1996 and 75% of the land will return to agriculture unless the programme is extended. So far it has been extended for one year with no new enrolments permitted. It is likely to remain in some form focusing on the most environmentally sensitive areas and allowing for biomass rather than food crops. In the EU set-aside programmes are temporary, for 1-5 years and have been basically targeted to reduce agricultural production not soil conservation. if soils are left uncultivated and left to return to native vegetation, C contents in upper horizons could eventually reach levels comparable to their precultivation condition. An estimate of 1.5 -3 PgC could result if 15% of the surplus 640 Mha of cropland in US, Canada, FSU, Europe and Australia and Argentina assuming recovery of C soil lost to cultivation (25- 30%) (IPCC 23.2.1.2). Experience in New Zealand has shown that the removal of agricultural subidies has been the incentive stop the farming of marginal land which has reverted to natural ecosystems and is being planted to forestry.

A large-scale reversion or afforestation of agricultural land is only possible if adequate supplies of food, fibre, and energy can be obtained from the remaining area. If farming intensity changes because of environmental concerns or other changes in policy this mitigation option may no longer be available (IPCC 23.2.1.2).

b) Soil carbon management in permanently cropped fields

Most temperate agricultural soils have been cultivated for decades to centuries and have probably attained a C content close to equilibrium level. Temperate agricultural soils are not a large source or sink of C under current practises but in some places such as the US, improved residue management and reduced tillage is probably increasing soil carbon (IPCC 23.2.2.2). In general, management directed to achieve high residue production, the use of perennial forage crops, elimination of bare fallow periods and reduced tillage will promote C sequestration in soils (IPCC, 1995). Poor management of agricultural soils through overuse, salination, excessive fertilisation, overgrazing, inappropriate

[4] Australia is however a major exception and it is estimated that according to current IPCC inventory methodology land clearing contributes 27% of its ghg emissions.

management techniques such as tillage practices employed etc lead to the loss of soil carbon through erosion and the oxidation of soil humus/organic matter.

Options to Increase CO_2 Sequestration

A long term strategy for countering climate change might involve not only reductions in greenhouse gas emissions but also active measures to retain carbon in terrestrial "sinks". Vast amounts of carbon are stored in crops and soils. Consequently by providing a sink for certain greenhouse gases specific cropping and land use management practices can help to mitigate against increased anthropogenic emissions of these gases.

Carbon sequestration can occur when conservation cropping systems are adopted in place of conventional cropping systems, when land use is shifted from annual cropping to perennial crops and pasture and when lands are converted to forests. For example, minimum and reduced tillage systems not only help to conserve soil carbon but can also begin to sequester carbon in the soil more effectively than more intensive cultivation. Minimum tillage systems of production also tend to be associated with higher energy ratios and hence lower energy related carbon emissions.

Source: Advances in Soil Science: Soil Management and Greenhouse Effect, (p5). R.Lal et. al. Eds. 1995. Lewis Publishers, London.)

Canadian studies show that improved management practices such as appropriate levels of fertilisation and erosion control through zero tillage could sequester C equivalent to 3.4% of Canada's annual C02 emissions. No and reduced tillage agriculture promotes carbon storage in soils and has the added benefit of reducing C02 emissions associated with fossil fuel use in the agricultural sector. No till practices are increasingly being used in the US where 10-14% of the total acreage of corn, soybeans and wheat were managed in this way in 1992. This represents a two fold increase in the use of no till systems of production for these crops over 5 years . Current levels of reduced tillage are 27% of cultivated land (IPCC 23.2.2).

Australia's programme to enhance CO_2 sinks

- expansion of plantation and farm forestry development by coordination of plantation development activities and funds to community groups to protect and manage remnant native vegetation
- appropriate tillage and stuble management practice
- perennial rather than annual pasture species
- reducing soil loss by excluding stock, conservative stocking rates, careful land use.
- 2,500 Landcare Groups which demonstrate that policies and measures developd through grassroots action are most likely to achieve ecological and economic sustainability

Source: Barson, 1996

c) Various other measures to promote sustainable soil management
(identified by the Enquete Commission) include:

- Imposing soil management requirements to improve soil structure and water/nutrient capacity through the input of organic matter (green manuring/farmyard manuring, forage culture, luning and avoidance of soil compaction

- Banning arable use of slopes with over 12% gradient

- Making it compulsory to maintain year round plant cover, undersowing, mulch sowing, direct sowing, minimal soil preparation, ploughless soil preparation, catch crops, reduction or prohibition of maize, sugarbeet and hop cultivation and limitation of weed control in areas at risk of erosion, obligation to vegetate steep slopes under vine cultivation.

- Practising contour-parallel strip cultivation, sowing of grain in individual rows or strips in fields at risk of erosion; making it compulsory to work perpendicular to the slope (up to a 12% gradient)

- Reducing field sizes, creating or preserving steps and terraces during land consolidation projects

- Working perpendicular to the prevailing wind direction

- Sowing and planting of grass strips and hedges as wind breaks every 200-300 metres perpendicular to the prevailing wind direction

Global option: Restoration of Degraded Lands

Reliable estimates of the extent of global soil degradation do not exist. The UNEP (1986) estimated that about 2 billion hectares of once biologically productive land has been rendered unproductive through irreversible degradation (to put this figure in perspective, the arable land area of the former Soviet union 210 million ha). From a global perspective, restoration of degraded lands offers a tremendous potential to sequester atmospheric carbon. Restoration of biological productivity of these lands would enhance their soil organic carbon content and render them as an effective terrestrial carbon sink.

Significance/scale: If the soil organic carbon content of 2x10 to the nine ha of land for the top 0-10cm layer could be increased by 0.01% per year it would amount to C influx of 250Tg per year. This influx is 2 to 2.5 the annual C fixation of 100 - 120Tg per year by world biota through photosynthesis.

How: Restoration of degraded lands requires the adoption of a world soil policy at the global level. To be effective, it may be implemented through the United Nations as a World Soil Charter on Restoration of Degraded Lands for Carbon Sequestration. Restorative practices would involve large scale afforestation, application of fertilisers and soil amendments, construction of runoff management and erosion control devices, ban against deforestation and biomass burning, and incentives for the adoption of conservation tillage based on the return of crop residues to the soil and frequent use of cover crops and planted fallows in food crop rotations. Improvements of grasslands and pastures is equally crucial to carbon sequestration. Controlled grazing at low stocking rates, seed improved pasture species, and using chemicals and soil amendments are important considerations in restoration of degraded pastures.

Source: Advances in Soil Science: Soil Management and Greenhouse Effect, (p5). R.Lal et. al. Eds. 1995. Lewis Publishers, London.)

2.2.10. Measure: Promotion of Organic Systems of Agricultural Production

2.2.10.1 The promotion of lower external input, more extensive and or organic/ecological systems of agricultural production could contribute to lowering agricultural emissions of all three principal ghgs. In relation to carbon emissions, organic systems, for example, tend to have & maintain a higher organic/humus content in their soils. Consequently, these systems can enhance/maintain the carbon storage potential of their soils. Policy initiatives that promote organic and lower-external input systems of production also offer the opportunity to reduce GHG emissions associated with the production and use of synthetic fertilisers and pesticides, particularly energy related $C0_2$ and N_20 emissions resulting from the production of synthetic nitrogenous fertilisers and enhanced nitrous oxide emissions from agricultural soils resulting from the application of synthetic nitrogen fertilisers. However the spreading of animal waste does also lead to N_2O emissions.

2.2.10.2 Support measures are being introduced under the European Agri-Environment Regulations (EEC 2078/92) to promote organic farming. However, the level of payments and uptake of the schemes are very low. The UK Organic Aid Scheme, introduced in 1994, provides 5 years of payments for land entering into conversion at a rate of £70/ha in year one declining to £25 in year five. For land in less favoured areas (LFA) rates start at £14/ha and are reduced to £5/ha by year five. Within the OECD organic farming probably accounts for well below 5% of total agricultural production.More targeted and generous/reasonable subsidies directed at encouraging extensive/organic/lower external input systems of agricultural production could deliver greater reductions.

2.2.11. Measure: Improve the energy efficiency of agricultural production

2.2.11.1 Significant savings in $C0_2$ emissions are available from targeted improvements in energy efficiency within the agricultural sector. The Netherlands, for example, have set specific energy efficiency improvement targets for agriculture. The principal policy instruments under the Dutch plan are voluntary long term agreements with producers and a government intermediary backed up by technical support and financial incentives. A major attraction to reducing agriculture's demand for heat and power is that any savings realised translate directly into reduced variable costs and should therefore be of interest to producers. Under the Dutch scheme an overall 26% improvement in energy efficiency within the agricultural sector has been set between 1989-2000.

2.2.11.2 The adoption of similar voluntary agreements between Governments and producers, with targets and timetables, could assist in reducing the overall energy intensity of agricultural production within the OECD and contribute to lowering C02 emissions.

2.2.12. Measure: Reduce GHG Emissions Through the Promotion of Energy Crops & Biofuels

2.2.12.1 One of the most viable options to reduce GHG emissions from the agricultural sector and contribute to lowering the overall energy intensity of agricultural production systems is offered by the production and consumption of energy crops and biofuels, assuming there are no land availability constraints. If grown sustainably some forms of plant material, or biomass, can provide a virtually $C0_2$ neutral energy source. When used to displace fossil fuels, the large scale use of energy crops, notably woodfuel, could contribute to reducing $C0_2$ emissions.

Forestry sector analyses are presented in section three, from an agricultural sector perspective too, it has been hailed as "the greatest agricultural opportunity for mitigating CO2" (IPCC 23.2.4).

2.2.12.2 It is envisaged that biofuel crops could be substituted for other agricultural crops, (particularly those in surplus supply), or growing them on lands held in agricultural set-aside, or by intermixing biofuel plants with food or forage in an agroforestry system. It is also thought that other opportunities exist for converting marginal crop or surplus land for forest, increasing the use of forest biomass, non-commercial thinning or industrial timber and paper production wastes, and using recycled wood and paper products for biofuels. Many of the agricultural biofuels considered could be advantageously combined with forest biofuels to stagger harvest dates, reduce storage facility needs, create a more uniform year-round feedstock supply, and reduce the collection radius needed for feasible utilisation facility such as utility scale electrical power system (IPCC 23.2.4).

2.2.12.3 The CO_2 mitigation potential of a large scale global agricultural biofuel programme could be significant (Johansson et al 1993). Assuming that 10-15% of the world's cropland could be used fossil fuel substitutions in the range of 0.3 to 1.3 PgC/yr have been estimated. This estimate does not include the indirect CO_2 effects of biofuel production through increasing C storage, in standing woody biomass or increased soil C sequestration. Biofuels include rape-methyl-ester or biodiesel, produced from oil seeds, ethanol and methanol, produced from the fermentation of arable crops and short rotation forestry (SRF) (coppice and single stem forestry).

2.2.12.4 It has been calculated that dedicated energy plants, including short rotation woody coppice, perennial herbaceous energy crops and annuals such as whole plant cereal crops could be sustainably grown on 8-11% of the good cropland in the temperate zone (Sampson et al, 1993). In the EU it has been estimated that 15-20 Mha of good cropland will be surplus to food production needs by the year 2010 (Scurlock et al 1993) equivalent to 20-30% of the current cropland area (IPCC 23.2.4.1. In the temperate regions C emission reduction could potentially range from 85 to 493 TgC/yr (Sampson et al 1993). In addition in agroforestry systems potential reductions of 10- 55 TgC/yr could be achieved in temperate regions (IPCC 23.2.4.1).

2.2.12.5 Biodiesel currently costs more to produce than petroleum diesel so it is not likely to see expanded usage unless government subsidies alter the economic situation. Generally crops from which only the oil, starch or sugar are used are of limited value in reducing CO_2 emissions due to the low net energy produced and the relatively high fossil fuel inputs required (IPCC 23.2.4.2). Energy ratios vary, and woody biomass, particularly SRF, rather than liquid biofuels offers the greatest potential. The estimated net CO_2 is negative because the soil carbon gain is much greater than fossil-fuel inputs via fuel and fertiliser (Gebhart et al, 1995).
For liquid biofuels from arable crops the energy ratio can be above 1 or below depending on what fraction of crop residues or by products are used.

2.2.12.6 Sweden obtains about 16% and Austria about 10% of their national energy requirements from wood. The US have over 9000 MW of electrical generating capacity installed and are planning on a rapid programme of expansion. Several countries are implementing programmes to expand the demand for and the production of biofuels including Austria, the Czech Republic, Germany, Japan, Sweden and Liechtenstein.

•Austria has estimated that national policies aimed at the promotion of biofuels has resulted in a saving of approximately 7% of their annual C02 emissions (based on 1990 emissions):the cultivation of oil seed crops to substitute fossil fuels with biogenic fuels is estimated to save approximately 0.5% of annual C02 emissions: the utilisation of the energy of surplus straw is estimated to save approximately 1% of annual C02 emissions and the use of wood in furnaces is estimated to save approximately 5.2% of annual C02 emissions

2.2.12.7 Other initiatives that promote on-farm energy generation, for example, straw and agricultural waste burning to provide heat for farm buildings, hot water for diaries and so on, or heat and power generation from methane recovery schemes, such as the USA's AgSTAR Programme, can also contribute to lower energy demand in the agricultural sector and hence fossil fuel related emissions of ghgs.

Economic instruments to promote the use and production of biofuels include:

- Agricultural subsidies to produce biofuels - adopted by Austria and the Czech Republic
- Tax exemptions to promote the production of biofuels - adopted by Germany
- Research and development on renewable energy sources - on-going in many OECD countries
- Subsidies for electricity generation form renewable energy sources - eg UK Non Fossil Fuel Obligation which gives premium prices for electricity generated from renewable energy sources including agricultural wastes; and in the USA where 1.5c/kWh incentives are available for renewable energy production.
- Opening of electricity grids to independent producers, encouraged sugar mills to export bagasse-generated electricity in Australia

There is considerable amount of documentation on the biofuels from wood measure and substantive policy experience in several countries. Because of this there have already been moves in the US and EU to evolve 'best practice guidelines'. In the US a National Biofuels Roundtable was held in 1994 to develop Principles and Guidelines for the Development of Biomass Energy systems. In the EU the UK is leading on the development of Best Practice Guidelines for the Biomass Energy Industry through the ALTENER programme of DGXVII. The IEA Bioenergy Agreement is also working on the development of guidelines for biomass energy and it is intended, apparently, that the IEA pull together relevant work in an attempt to define an international document.

2.3. Assessment of Options

2.3.1. Climate change impacts on mitigation options

2.3.1.1 Climate change will affect agriculture through effects on crops, soil, insects, weeds and diseases, and livestock. Climatic conditions interact with agriculture through numerous and diverse mechanisms. Mechanisms and responses, include, for example, eutrophication and acidification of soil, the survival and distribution of pest populations, the effect of CO2 concentration, crop breeding aims, animal shelter requirements and the location of production (IPCC WG11 13.1). Variation of agricultural and climatic conditions leads to different local and regional impacts.

2.3.1.2 Climate change is expected to result in shifts in cropping systems, for example in Western Europe there will be a northward shift of crops growing zones with potential for maize to be grown as far north as the UK and central Finland. Increased demands for irrigation/ and /or increased areas likely to suffer from water deficits particularly in Southern Europe are also expected (IPCC WG11 13.6.7). In the US and Canada warmer temperatures may shift wheat-maize-soybean producing capacity northward, reducing US production and increasing production in Canada (IPCC WG11 13.6.8). These changes are likely to put pressure on the need to adopt soil conservation practices. This is also necessary as many soils are potentially vulnerable to soil degradation (loss of soil organic matter,

leaching of soil nutrients and erosion) as a likely consequence of climate change (IPCC WG11 13.3)This would be exacerbated if climate change resulted in intensification of production on existing cropland (IPCC WG 11 ch 13.8.1.2). It should also be noted that nitrogen and other fertilisers would be likely to be necessary to take advantage of the enhanced CO2 effect (IPCC WG11 13.9.1). It has been found that cropping practices designed to maintain a more closed ground cover over longer periods (and thus also maintain soil carbon levels) would be similarly effective where climate change had the potential to exacerbate land degradation (Rasmussen and Collins, 1991). Under a transient scenario of climate change it has been found that soil physical, chemical and biological processes will be given time to adapt thereby counteracting human-induced land degradation (Brinkman and Sombroek,1995)

2.3.1.3 For animal agriculture intensive livestock production systems are likely to be directly affected in minor ways as they control exposure to climate and provide opportunity for further controls (e.g shading) (IPCC WG11 13.5). There may be a need for new breeds which are more heat and insect resistant. The impacts of changes in feed grain production are likely to be moderated by markets.

2.3.1.4 The biggest uncertainty affecting land use mitigation options is the extent that key world food producing areas would be more susceptible to drought (mid-continental areas of the US and Canada, and large areas of Australia) and whether there would then be surplus land available for conversion to forestry activities, particularly, biomass production for energy in these countries and in Europe, as it being predicted at present. In view of the expected severe regional impacts of climate change in some existing semi-arid and arid regions (Sub- Saharan Africa, South and South-East Asia, as well as some Pacific Island Countries and tropical Latin America, some areas may be needed to maintain world food supplies.

2.3.1.5 Three critical high priority research areas were identified in IPCC WG11:

- Development and broad application of regional integrated agricultural modelling at the regional scale.
- Development of the capability to readily simulate agricultural impacts of multiple transient climate scenarios.
- Evaluation of the effects of variability rather than changes in the mean climate and the implication of changes in variability on crop yields and markets.

2.3.2. Inventory and Reporting Issues

There are three ghg inventory issues which relate to the agricultural sector:
(i) Methane emissions from rice paddies: default guidelines have been questioned, there is to be a special workshop on this later in the year. This issue has not been covered in this report as it only involves one Annex I country: Japan.

(ii) The uncertainties about the sources of nitrous oxide: there have been recent changes to the IPCC/OECD/IEA reporting guidelines proposed which may improve this situation. It is proposed to allocate sources from their point of origin, the consumer and not the producer.

(iii) Soil carbon uptake in agricultural soils will be covered by new reporting guidelines which will cover changes to agricultural practice. However in order to accurately prepare data, details are required about land use changes within countries which cn vary frequently. Agreement to remote sensing monitoring will be needed.

Progress in all these cases relects change in experience in operating the guidelines and scientific research -these will be an ongoing with improvements being made to default values. All these issues

would assume a high political significance if removals by sinks were to be counted as measures in any protocols to the treaty. For some stakeholders in the process this issue is extremely controversial . At present the specific commitment in the FCCC to aim to return anthropogenic emissions of ghgs to their 1990 levels by 2000 is not adjusted for sinks.

2.3.3. Economic Assessment

2.3.3.1 There has been very little work undertaken to undertake economic assessments of many of the agriculture measures that is useful for comparative purposes at inter-national level, due to the particularities of the situations in which they are used, the fact that they rest within financial structures which are heavily influenced by subsidies (see below) and the fact that they are currently being promoted for their environmental objectives. For example, no costs are given of any of these measures in the Technology Summaries produced by IPCC WG II which was a recent major comprehensive overview of these mitigation options and where cost information had been sought (see Annex for specimen). Many of the measures considered are already being promoted by Governments in their interface with the farming community as cost effective ways of achieving desired performance standards which are underpinned by legislation. Thus for example the US AGSTAR programme sells biogas from methane as a way of reducing on-farm energy costs which can often account for 20% of monthly operational costs- 'Profitable Energy from Manure Management' (US EPA 1995).

2.3.3.2 The major problem is, according to a lobby which includes environmentalists and economists, is that current agricultural subsidies in high income OECD countries, especially the EU and the US have effectively exacerbated environmental pollution, especially soil erosion, surface and groundwater pollution and concentrated streams of animal wastes (Runge, 1995). This is because markets neither penalise farmers for these environmental impacts, nor offer rewards for avoiding or reducing them. In the EU because payments have been made on units of production extremely high levels of fertiliser and chemical inputs have been applied the demand for which is derived in part from the levels of subsidy paid to output. The bulk of subsidies received in agriculture have been explicitly focused on enhancing producer incomes by supporting prices above those that would be received in their absence. It is increasingly perceived that these subsidies are (a) economically inefficient and (b) environmentally harmful (Runge, 1995). Some of the relationships between agricultural impacts and their environmental costs are sketched out below.

Agricultural impacts with environmental costs implications:

- agricultural activities can generate both harmful and beneficial effects on the environent, yet many of those efects are not confined to the agricultural sector, and are not accounted for in farmers' costs and revenues;
- environmental effects depend on the amount and compostion of agricultural production and site specific natural conditions, many of which are influenced by the type of policy intervention and the level of subsidies , which as noted in section 2.3, are high in many OECD countries;
- agricultural policies often pull in opposite directions - some contribute to environmentally damaging activities, some offer subsidies to farmers to install facilites to reduce environmentally harmful practices, while others are intended to benefit the environment including giving budgetary support that is conditional upon farmers undertaking actions to enhance the environment;
- countries are increasingly attempting to incorporate environmental concerns into their agricultural policies, but there is often difficulties in linking them to particular farms, yet there is little application of the Polluter Pays Principle in agriculture;

- agriculture is affected by industrial pollution and climate change, as well as environmental policy measures- especially relating to water quality and use of farm chemicals which incur costs on farmers.

Source: Legg, 1995

2.3.3.3 Thus a review of the cost effectiveness of many of the measures discussed above would be extremely complex because subsidies are so closely woven into the fabric of many countries ' farming systems. One study examined linkages between Produce Subsidy Equivalents (PSEs) and fertiliser use and found a clear derived linkage from high level of subsidy to heavy applications of fertiliser across countries (Harold and Runge 1993).

2.3.3.4 Serious analysis reveals that essentially fundamental reforms are needed to redress the situation. However the reality of the political situation is that this will be difficult to achieve. The Ist GATT round only achieved a small step and only effective at getting subsidies capped on 1986 levels. PSEs have remained at an averagelevel of 42% in OECD countries since 1986- 88. The set of environmental policies so far enacted in the EU are piecemeal and unsystematic. However if the EU is to extend eastward that could provide a major boost to CAP reform.

2.3.3.5 The provision of new incentives to introduce environmentally benign practices can be construed as paying the polluter to pollute. But the proportion of funds available for agri-environmental measures in the EU is still only a very small proportion of the total funds available for agricultural production. The Conservation Reserve Programme (CRP) in the US has come in for heavy criticism too, as being untargeted. The incentives are to retire low productivity land rather than land especially vulnerable to environmental damages, the consequence is that neither supply nor environmental goals are accurately targeted. Whilst modest land improvements are required under the programme, in essence it pays the polluter not to pollute, rather than rewarding farmers for environmental affirmative action (Runge, 1995).

2.3.3.6 Nevertheless, the move to direct payments to farmers rather than price guarantees or other measures directly linked to production or factors of production is seen as potentially providing more leverage to introduce new environmentally friendly forms of land management such as farm forestry (Bonnis, 1994). There is however a long way to go on this: in 1993 the OECD average for direct payments to farmers was only 17% of total assistance to agricultural producers.

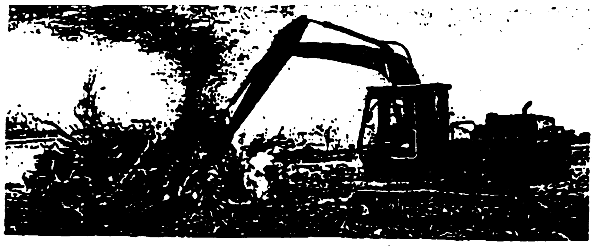
2.3.4. Other Agriculture Policy Developments

2.3.4.1 Public concern about the effects of intensive agricultural practices on the environment have long been evident and can be traced back to the movement generated by Rachel Carson in "Silent Spring". In recent years, environmentalists have been able to form new allegiances with Treasuries and Finance Ministries trying to save money, and farmers trying to keep subsidies. Many early initiatives to link agriculture and environmental policy were not born out of a single-minded concern for the environment e.g. the CRP was born out of the urgent need to reduce farm subsidies and to reduce crop surpluses and the EU setaside was to control production. Once installed environmentalists concerned with biodiversity preservation have ben able to suggest ways in which these mechanisms could restore biodiversity. (The attached advertisment which appeared in major UK newspapers in September 1992 links CAP to the destruction of wildlife).

2.3.4.2 Gradually concern about the degree to which agriculture is contributing to environmental problems, and most particularly water and air pollution, land degradation; and a decline in landscape amenities and biodiversity has become mainstream policy agenda. (See e.g OECD 1994 Workshop on Sustainable Agriculture Technologies and Practices). In the OECD the work (principally jointly by the

Agriculture and Environment Policy Committees since 1993) is in the context of the commitment to agricultural policy reform made by OECD Ministers in 1987, the agreements reached in the Uruguay Round of multilateral trade negotiations in 1994, and the directions set for sustainable development at UNCED in 1992 (Legg, 1995).

2.3.4.2 Attention has already been given to the range of measures currently being deployed as many of these also have benefits from a ghg reduction perspective. Although there are a set of problems surrounding production support which creates barriers, there is generally considered to be considerable technical potential . It is recognised that the knowledge and experience embodied in existing practices can be combined with that in older, traditional and a newer more "environmentally friendly" agriculture can be achieved to create new pathways to amore environmentally sustainable agriculture (OECD, 1994)



Will you carry on paying £228* a year to watch the countryside you love disappear forever?

Each year, every man and woman in the UK gives £228* to the Common Agricultural Policy. This means that you are paying for what is happening to our countryside.

But are you ever asked about the issues that are discussed by the policy-makers? Are you informed of their plans? You should be, because you and your children will have to live with the decisions they make.

In fact, if you look around you today, the effect is already all too plain to see.

Our disappearing countryside

Where once there was a patchwork patchwork of pasture, heaths and hedgerows, there are now prairie farms. Where once there were flowering meadows, there are now cash crops.

Mechanisation and pesticides have destroyed a landscape that was as familiar to our parents as it was to our ancestors.

This alone is bad enough. But, as land has been cleared for more "profitable" use, the wildlife that depends upon it has been devastated.

Creatures that were once commonplace may never be seen again. Others, such as the barn owl, the natterjack toad, the skylark, the red squirrel, the turtle dove, the otter and the nightingale, are now under threat.

Would you choose to live in a country where creatures like these existed only in the pages of a nature book and where the sound of summer birdsong was silenced forever? Indeed would you like your children to inherit a land that would be unrecognisable to your grandparents?

If your answer is no, then now is the time to act.

The decline of our countryside

Hedgerows ...... [illegible] miles lost since 1984
Meadows ...... 97% lost since 1945
Ancient woodland ...... 45% lost since 1940
Chalk downland ...... 80% lost since 1940
Moorland ...... 30% lost since the 1940s
Grazing marshes ...... 50% lost since the 1930s
...and the wildlife that depends on it:
Barn Owls ...... 50% decline since 1930s
Lapwing ...... 50% decline since 1963
Linnet ...... 50% decline since 1968
Turtle Dove ...... 50% decline since 1974
Kingfisher ...... 40% decline since 1974
Large Blue Butterfly ...... extinct since 1979
Dragonfly ...... 4 species extinct since 1953

Our chance to stop the onslaught

On September 28th the European Agriculture Ministers meet in Cambridge to debate the place of wildlife in the Common Agricultural Policy.

We will be there to argue the case for conservation. Our demands for the countryside are:

– at least 30% of farmland to be recognised as "Environmentally Sensitive Areas."

– the best wildlife sites to be given permanent protection from road and building development.

– not just the protection but the extension of wildlife habitats.

In short, we want a countryside where wildlife, rural communities and farming thrive side-by-side. If that is the way you would prefer to see your countryside, then please help us.

Your countryside - your choice

Our message to Europe's Agriculture Ministers will have so much more impact if they know we have your support.

We are not appealing to you for a donation. All we ask is that you spare a few minutes to complete the coupon and return it to us FREEPOST today.

Then, when we meet with the policy-makers, we will be able to prove that you, and thousands of other people, care about the countryside and the birds and wildlife that depend upon it.

Remember, your £228* a year pays for the policies that will be decided by Europe's Ministers. And you and your children will have to live with their decisions.

You will have a chance to say how your money should be spent and what kind of countryside you want. But you must act now. Make your voice heard by returning the coupon before the Ministers meet on September 28th.

*Source: [illegible]

After today you may have no choice, so please return this coupon now.

YES, I am concerned about the future of the countryside. Please add my voice to your arguments for the protection of the land and the wildlife that depends on it.

Signature ______

Name (Title) ______

Address ______

______ Post Code ______

☐ Please send me the RSPB Action Pack on the RSPB's efforts to save our countryside.

[illegible]

RSPB campaign for the Countryside

The Royal Society for the Protection of Birds, The Lodge, Sandy, Beds [illegible]

IND. 10.9.92

2.3.4.3 Countries work within different social, economic and environmental contexts and so it is miseading to impose a rigid definition of sustainable agriculture. There is an emerging consensus that sustainable forms of agriculture are characterised by the adoption of practices and technologies that:

(i) use integrated management techniques that maintain ecological integrity both on and off the farm;
(ii) are necessarily site specific and flexible
(iii) preserve biodiversity, landscape amenity and other publicgoods not valued by existing markets;
(iv) are profitable to producers in the long term; and
(v) are economically efficient from a societal perspective (OECD, 1994

2.3.4.4 Apart from the political barriers involved in restructuring agricultural support so that assistance could facilitate the move to more sustainable agricultural practices, significant other constraints to the adoption of more sustainable forms of agricultural practice can also be identified:

(i) farm-level constraints create real limits on the ability of indvidual producers to test adopt, or modify alternative production technology, includling cash-flow and skilled labour;
(ii) institutional arrangements and research and devlopment agendas which are not farmer input in policy and technology development;
(iii) market failure to send production signals that are coupled with the environment's capacity to sustain production;
(iv) current farm input policies particularly on information about 'safe'levels constrain the more appropriate use of farm inputs.

2.3.4.5 A Code of Best Management Practices to guide farmers in the transition to, and practice of, sustainable farming techniques has been recommended (OECD 1994). This is a useful mechanism at farm level where ultimately the transformation required in agriculture must be addressed. However , few would underestimate the extent of the difficulties involved in constructing international frameworks in which this can happen. In the EU there is window of opportunity to start to tackle this isse with the InterGovernmental Conference There is scope to change the agricultural articles of theTreaty (38-43) to achieve a more efective integration of agricultural and environmental concerns and some stakeholders are striving to achieve this.

3. Management of Forests for Mitigation of Greenhouse Gas Emissions

3.1. Overview

3.1.1 The world's natural forests have a vital role in the global carbon cycle both as carbon sinks and through emission of CO_2. Forests contain up to 60-80% of the above-ground and approximately 40-50% of the below gound carbon of the terrestrial ecosystems. Most of the C pool in vegetation is located in the low latitude forests (64%) whereas most of the soil C pool lies in high latitude forests (52%) and mid and high latitudes. Whilst forests are currently estimated to be a net C source there are regional differences and potentials for most forests to be transformed into a temporary carbon sink for a period of 50 -100 years. There has been some controversy about an unattributed terrestral sink - the'missing sink'. This has now been identified as being the result of northern forest re-growth, and higher carbon assimulation in undisturbed tropical rainforest together with soil carbon sequestration.

3.1.2 Studies have shown that 700 Mha of land might be available globally for C conservation and sequestration programmes but that the tropics have the potential to sequester by far the highest quantity of C (80%) followed by the temperate zone (17% and the boreal zone (3%). The former Soviet Union (FSU) accounts for more than 70% of the potential in the boreal zone. In mid.latitudes the greatest potential for sequestering C would be in the US (about 3.4Pg) followed (in Annex 1) by New Zealand (1.7Pg). These strategies are dependent on additional land being secured because sequestration in existing forests in may be offset by C releases, particularly in in mid- and high latitude forests.

3.1.3 Environmental changes are expected to be higher in the boreal forest than other zones with increased mortality and slowed forest succession from rapidly warming climate and consequent large-scale disturbance, enhanced growth from a warmer growing season temperatures and increased CO_2 . Under conditions of climate and land use change as projected in the IMAGE 2.0 model, sequestration by new forests in temperate and boreal regions may be offset by transient decline and the loss of carbon from existing forests in response to climate change.

3.1.4 There are three broad categories of promising forestry practices that conserve and sequester carbon:(i) management for conservation of the existing C pool by slowing deforestation, changing harvesting regimes and protecting the forests; (ii) management for expanding the C storage by increasing the area and/or C density in existing forests, plantations, and agroforestry or in wood products; and (iii) management for substitution by increasing the transfer of forest biomass into biofuels and long-lived wood products .

3.1.5 These three broad categories cover a wide range of possible actions: afforestation, agroforestry, breeding genetics, biomass for energy; disease control; drainage; fertilisation; fire control; herbivore control; improved regeneration; increased forest products; insect control; irrigation; control water table, longer rotation; preservation; recycling; reduced impact logging; reforestation; salvage of dead biomass; shade trees; shelterbelts; soil management; stocking control-thinning, enrichment, plantings, reduce regeneration delays, selection of appropriate harvesting method . These elements can be combined. Whilst they can be technically described, there is however comparatively little information about operational experience available. Few Annex I parties have mentioned policies and measures in their national communications in these sectors. Within individual national situations, there have been long established forest management practices which impact on C management though as yet they have been rarely viewed in this light.

3.1.6 It is clear that from a forest policy perspective, carbon management is not yet a primary policy determinant and some consider it may continue to play only a minor component of multi-purpose forestry. It may well transpire that this assessment is likely to be changed when climate change impacts become clearly identifiable on forest ecosystems.

3.1.7 However, there have been several substantial policy initiatives in international forest policy to develop 'sustainable' forest management practices principally in response to what have been perceived to be an over-domination of timber extraction interests in relation to the needs to protect environmental quality, biodiversity and the needs of indigenous communities. These policy dynamics initially started in relation to tropical forests but more recently have extended to temperate and boreal forests. New processes have been established. National governments are required to produce forest plans. The Helsinki and Montreal processes are developing criteria for sustainable forest management in Europe and non-European temperate and boreal forests countries respectively. The ITTO has established that 2000 should be a target year by which timber trade between members should effectively be restricted to sustainably produced timber. The CSD has established an Intergovernmental Panel on Forests. There are associated workshops proceeding on criteria for sustainable forest management and certification. But, as indicated,
C management has not been an objective of sustainable forest management in these processes.

3.1.8 In relation to carbon management through forestry measures, the essential policy prerequisite is for an institutional framework which will enable the development of complex , management strategies over long timescales, particularly for the boreal forests. Moreover in view of anticipated climate change impacts on the boreal forests, there will be a need to include protective measures, such as species diversity (deciduous versus conifers), which will involve making tradeoffs on carbon storage. Different forest management practices will affect both the total amount of carbon stored in the ecosystem and when sinks will reach their maximum levels. The unmanageability of the long time frame is an additional reason for some commentators to advocate the use of short rotation forestry for biofuel displacement, particularly as it there is general agreement that the dominant opportunity for net reduction in C emissions is seen to be fossil fuel displacement.

3.1.9 Reviews of existing economic analyses of forestry mitigation options have shown that they are considered relatively cost-effective compared to other mitigation strategies. Precise numerical costs in $/tC are site dependent and subject to methodological issues. Full accounting must include those factors that tend to increase social costs relative to financial costs, such as the effect of removing non-marginal quantities of land from agricultural production, transaction costs associated with establishing new land use patterns, administrative costs of implementing a large scale carbon sequestration programme and decreases in carbon benefit associated with timber harvest. One new imporant study shows that if the value of a even a small carbon tax is related to forest stored carbon, the value is 2-30 times higher than its timber.

3.1.10 Particular attention is given in this section to the ongoing development of certification which is developing criteria to verify that forest products are produced sustainably. Public impatience - especially in North America, Europe, and Australia - with the lack of progress about existing sustainable forest initiatives have resulted in moves to market-based, voluntary approaches. To manage these initiatives, the Forest Stewardship Council was created as an international body to accredit certifying organisations in order to guarantee the authenticity of their claims. The goal of the FSC is to promote environmentally appropriate, socially beneficial and economically viable management of the world's forests by setting a worldwide standard of widely recognised and respected principles of forest management. The principles and criteria of the FSC are intended to apply to all forests worldwide which are managed for timber and non-timber production. There is a set of well-elaborated principals but none of these cover C management. Moves are also underway to use the ISO for the same purposes. It may be necessary to work through WTO to enable certification to move on from its voluntary basis.

3.2. *Forests and the world's carbon cycle*

3.2.1 The world's natural forests have a vital role in the global carbon cycle both as carbon sinks and through emission of CO_2. They contain vast quantities of organic carbon with an estimated 330 PgC in vegetation (live and dead above and below ground) 660 PgC in soil (mineral soil plus organic horizon) and another 10 PgC in plantations[5]. Most of the C pool in vegetation is located in the low latitude forests (64%) whereas most of the soil C pool lies in high latitude forests (52%).(IPCC 24.2.2) (See Table).

3.2.2 Mid and high latitude forests are currently estimated to be a net C sink of about 0.7+- 0.2 PgC/yr because forests at these latitudes are generally composed of relatively young classes with higher rates of net production as they recover from past disturbances such as abandonment of agricultural land, harvesting, and wildfires. A part of these forests are actively managed and it is estimated that some areas may be responding to increased levels of atmospheric CO_2 and N fertilisation effects. But because secondary forests in mid and high latitudes are rebuilding C pools, there is a finite potential over which this sequestration can occur. For example, the current C sink in European forests may disappear within 50-100 years although some say it may take as long as several centuries or longer to reach a C steady state (IPCC 24.2.2). Uncertainty is increased when the effects of climate change itself are introduced (IPCC 24.6 and 15.5)

3.2.3 Studies have shown that 700 Mha of land might be available globally for C conservation and sequestration programmes but that the tropics have the potential to sequester by far the highest quantity of C (80%) followed by the temperate zone (17% and the boreal zone (3%). The former Soviet Union (FSU) accounts for more than 70% of the potential in the boreal zone. In mid latitudes the greatest potential for sequestering C would be in the US (about 3.4Pg) followed (in Annex 1) by New Zealand (1.7Pg) (IPCC 24.2.2).

3.2.4 Environmental factors such as future climate change, increases in atmospheric CO_2, increased mobilisation of other elements such as NOx and tropospheric ozone are likely to have the greatest impacts in mid- and high latitude forest (Apps et al 1993). Environmental changes are expected to be higher in the boreal forest than other zones with increased mortality and slowed forest succession from rapidly warming climate and consequent large-scale disturbance, enhanced growth from a warmer growing season temperatures and increased CO_2 (IPCC 15.5). Under conditions of climate and land use change as projected in the IMAGE 2.0 model, sequestration by new forests in temperate and boreal regions may be offset by transient decline and the loss of carbon from existing forests in response to climate change (Medium confidence statement IPCC Executive Summary).

5 However these figures use factors covering some components which are poorly known such as the C pool in woody detritus in slash and dead roots.

Table *Estimated C pools and flux in forest vegetation (above and below ground living and dead mass, including woody debris) and soils (O horizon and mineral soil to 1 - m depth) in forests of the world. Dates of estimate vary by country and region but cover the decade of the 1980s. Estimates are based on complete C budgets in all latitudes, using date from original source or from adjustments for completeness.*

Latitudinal belt	C Pools (Pg) Vegetation	Soils	C Flux (Pg/yr)
High			
FSU[1]	46	123	+0.3 to +0.5
Canada[2]	12	211	+0.08
Alaska[3]	2	11	
Subtotal	60	345	+0.48 ± 0.2
Mid			
USA[3]	15	21	+0.1 to +0.25
Europe[4]	9	25	+0.09-+ 0.12
China[5]	17	16	-0.02
Australia[6]	18	33	trace
Subtotal	59	95	0.26 ± 0.1
Low			-0.50 to -0.90
Asia[7]	41 - 54	43	-0.25 to -0.45
Africa[4]	52	63	-0.5 to -0.70
America[8]	119	110	-1.65 ± 0.40
Subtotal	212	216	
			-0.9 ± 0.5
Total	331	656	

* Included with USA
1 Former Soviet Union: Kolchugina and Vinson 1993, 1995
2 Apps and Kurz 1991;Kurz and Apps. 1993; K urz *et al* 1992.
3 Birdsey, 1992; Birdsey *et al.*, 1993; Dixon *et al.*, 1994a; Turner *et al* 1995a.
4 Dixon *et al.* 1994a; Kauppi *et al.* 1992
5 Xu 1992
6 Gifford *et al* 1992
7 1993; Houghton, 1995
8 Dixon *et al.*, 1994a FAO, 1993; Houghton 1995

Source: IPCC WGII ch24

3.2.5 Country level analyses demonstrate that forests can offset fossil fuel emissions and some countries have made detailed calculations of the amounts of C currently being sequestered by their forests taking into account the historic rates of planting and harvesting and the dynamic of forest growth, and the flow to litter and forest product pools (see Table). In Britain and New Zealand, carbon is being sequestered as a result of recent forest programmes whereas in Finland, C is being sequestered by natural generation and regrowth forests because the annual regrowth is greater than the annual harvest. In 17 west European countries, forestry offsets from 1-2% (the Netherlands, Britain, Germany) to about 90% (Sweden) of fossil fuel emissions (IPCC 24.2.2). In Australia however, land clearing has been identified as contributing up to 27% of total greenhouse gas emissions according to current IPCC inventory methodology.

Table: Carbon storage and C sequestration rate in forest and national C emissions

Country	Year	Carbon stored in trees & litter (Tg)	Fossil Fuel C Emissions (Tg/yr)	Rate of C Removed by Forests (Tg/yr)	
Britain	1990	60[2]	164	2.5 (1.5)	Cannell and Dewar 1995
New Zealand	1990	113	8	3.5 (44)	Maclaren and Wakelin 1991
Finland	1992	978	18	5.0 (28)	Karjalainen and Kellokäki 1993
Germany	1990	1500-2000	268	5.4 (2)	Federal Ministry for Env.1994
Canada	1986	12000	136	51.0 (37.5)	Kurz *et al.*, 1992
Polnd	1990	1113	131	8.0 (6)	Galinski and Kuppers 1994
USA	1990	18585	1300	80 (6)	Turner *et al.*, 1995a

[1] Value in parentheses is the percentage of fossil fuel emissions removed by forests.
[2] Plantation forests only: all forests and woodlands contain - 87 TgC in the trees alone

Source: IPCC WG II ch 24

3.2.6 It is thought that a large part of the imbalance in the global C budget must be due to a sink in tropical latitudes. The primary data for C budgets for temperate and boreal countries originate from national forest inventories, so any increased growth of forests due to forest CO_2 and N fertilisation and climatic effects are already included in the net flux inventories. In contrast the tropical forest C flux is based on a model and not on repeated forest inventories, and does not include the effects of CO2 and N fertilisation and climate(IPCC 24.2.2). As a result these estimates are much mor uncertain. New work suggests however that undisturbed tropical rain forest may be a significant sink (Grace et al 1995).

3.2.7 Many boreal forests grow on peat or organic soils which contain very large amounts of C. Undisturbed anaerobic peatlands are sinks for CO_2 and sources of CH_4. Drainage of these soils virtually stops CH_4 emissions but initiates rapid CO_2 loss by aerobic decomposition. Draining peat soils for forest establishment can produce a C loss from these soils that exceeds C stored in the forest if 20-30 cm of peat decomposes as a result of the drainage (Cannell et al 1993).

3.2.8 There is also an opportunity to manage forest soils to sequester carbon. Regional and national programmes to protect soils have been implemented worldwide, though not primarily for soil carbon storage to date. Management practises to maintain, restore and enlarge forest soil C pools include enhancement of soil fertility; concentration of agriculture and reduction of slash and burn purposes; preservation of wetlands; minimisation of site disturbance during harvest operations to retain organic matter; forestation of degraded and non-degraded sites; and any practices that reduces soil aeration, heating and drying. Carbon can accrete in the soil at rates of 0.5 to 2.0 Mg/ha/yr according to some long-term experiments (Dixon et al 1994a).

3.2.9 However there are limits on achieving potential. The extent of management of the worlds' forests varies by region, only about 17% of the high latitude forests, and 20% of the mid latitude forests are managed, though this is considerably higher than the low latitude forests (4%) (Winjum et al 1992a).

3.2.10 Moreover recent work undertaken by Kurz and Apps on Canadian forests has shown that periods of high natural disturbances at timescales of decades to centuries will affect C dynamics for several decades thereafter (Kurz and Apps, 1995). The recent 20 year period of high disturbances (particularly fires, also insect damage) have greatly increased the pools of organic matter, and the area of young regenerating forests whose C uptake rates are initially low. Scenario analyses of the Canadian forest sector suggest that for many scenarios the forest could remain a C source in the near future (Kurz and Apps, 1995). The scale of events in the vast boreal forests leads to identifiable impacts on global carbon budgets.

3.3. Feasible Measures for Conservation of Existing C Pools in Forests

3.3.1 Controlling deforestation and protection and conservation of forests.

3.3.1.1 Slowing the rate of loss and degradation of existing forests could reduce CO_2 emissions substantially. The term 'deforestation' has been most applied to tropical areas where most deforestation and degradation is caused by the expansion and degradation of arable and grazing lands and subsistence and commodity demand for wood products. These in turn are a response to the underlying pressures of population growth, socio-economic development and political forces. So the most significant C conservation benefit would occur in the tropics, where each Mha of deforestation produces about a 0.1 PgC net flux (IPCC 24.3.1.1). Because the burning of biomass usually accompanies deforestation, slowing deforestation also would reduce emissions of other GHGs.

3.3.1.2 However, apart from the Amazon basin of Brazil, the forests of the former Soviet Union (FSU) have received attention as a C reservoir in recent years because the largest contiguous area of C dense forests in the world are found there. These forests are subject to environmental degradation and harvesting accelerating the loss of carbon. Protection of these forests from harvest without regeneration, uncontrolled fires, and pollutants is a priority of the FSU but infrastructure is undeveloped and considerable resources are required. These forests comprise 60% of the boreal zone with 30% in Canada. As a whole the boreal zone is estimated to contain around 700 billion tonnes of carbon and appears to represent the largest atmospheric carbon store concentrate in any one biome (Apps et al 1993). In general temperate forests currently show a net expansion, although there are countries that are currently losing forests (IPCC 24.3..2). So protection of exisiting forest is a relevant option for Annex I

3.3.2 Methods to Sequester C in Natural forests: Overview

3.3.2.1 Sequestration strategies focus on increasing the storage per hectare and on increasing the forested area over what it would otherwise be . Storage management means increasing the amount of carbon stored in vegetation (living, above and below ground biomass), soil (litter, dead wood, mineral soil and peat where important), and durable wood products. Increasing the C pool in vegetation and soil can be accomplished by protecting secondary forests and other degraded forests whose biomass and soil C densities are less than their maximum value and allowing them to sequester C by natural or artificial regeneration and soil enrichment. Other approaches are to establish plantations on non-forested lands; promote natural or assisted regeneration in secondary forests, followed by protection (IPCC 24.3.2).

3.3.2.2.Many concerns however have been expressed with the expansion of C pools through the establishment of plantations when these do not account for biodiversity and cultural and land tenure

factors. In addition some consider the range of options available for expanding forest areas in the temperate and northern latitudes to be limited, if extensive farming systems are introduced (Enquete Commission p 478).

3.3.2.3 Sequestering C by storage management produces only finite sequestration potential in vegetation and soils, beyond which little additional C can be accumulated. These approaches also need to be related within a political and legislative framework which can ensure such strategies have time to work . Furthermore management of C pools may or may not be compatible with other desirable objectives for forest reserves such as preservation of biological diversity (IPCC 24.3.2).

There are various ways of considering the options. The following categorisation and review of the options in paras 3.2.3 to 3.2.13 derives from 'Sequestering carbon in natural forests C.S Binkley, M.J.Apps, R.K.Dixon, and L-O Nelson, In, Proceedings of Economics of Carbon Sequestration in Forestry, Bergendal Sweden, May 1995. The options are:

- substitution management (creating additional biomass C to substitute for products that lessen he use of fossil fuels)
- change rotations
- control stand density
- manage logging residues
- enhance available nutrients
- lower the water table
- select useful species and genotypes
- reduce regeneration delays
- select an appropriate harvesting method
- protection against fire
- protection against pests
- salvage dead and dying trees

Those with most potential are considered first.

3.3.3 Substitution management

3.3.3.1 Substitution management which is generally considered as a strategy which has the greatest mitigation potential in the long term (up to 50 years), views forests as renewable resources (Marland and Marland 1992, Swisher 1994). It focuses on the rate of C sequestration or the transfer of biomass C into products that substitute for, or lessen the use of, fossil fuels rather than on increasing the pool itself. This approach involves extending the use of forests for wood product and fuels either by establishing new forests or plantations by increasing the growth of existing forests through silvicultural treatments (as discussed above) to increase the rate of C sequestration.

3.3.3.2 However, as the change rotations option indicates, it is better not to convert forests with a large initial standing biomass C and slow growth rate (e.g.old growth forests) to managed stands because it may take a very long time (up to centuries) until the net C sequestered returns to its initial value (Harmon et al 1990, Marland and Marland 1992) or never if they are harvested on a rotational basis (Dewar, 1991, Vitousek, 1991, Dewar and Cannell, 1992, Cannell 1995). In contrast forests with high growth rates and low to medium initial biomass C standing stocks are amenable for conversion to managed forests with considerable quantities of C sequestered if the harvested wood is directly used (Marland and Marland, 1 992). One analysis which compared the two strategies of carbon storage or fossil fuel substitution found that, depending on the assumptions made, growing trees for carbon storage may be more appropriate on low productivity land or indeed where the biomass cannot be harvested. However it found that where high productivity can be expected, the cost effective strategy is to manage

the forest for a harvestable crop and to use the harvest for maximum efficiency for long-lived products or to substitute for fossil fuels (Marland and Marland, 1992).

3.3.3.3 In the case of forest grown on previously non-forested lands for energy products such as fuelwood, not only is there an increase in the amount of C stored on the land but if the wood displaces fossil fuel usage, it creates an effective rate of C sequestration in unburned fossil fuels, as much as 10tC/ha (Hall et al 1991, Sampson et al 1993). However these high rates are based on the establishment of plantations made up of fast growing trees such as willow, poplar and eucalyptus which can be harvested at short intervals between 3 and 10 years. Depending on the site this intensive form of forest management calls for a large energy input in the form of fertilisers and energy expended in the transportation and processing (Enquete Commission p485). The extent to which fuelwood plantations are able to displace fossil fuel use in developed countries will depend on the continued development of highly efficient technologies for converting wood into clean energy forms like electricity and with plant located to minimise transportation costs.

3.3.3.3 Where forests are used to produce sawtimber, plywood or other industrial wood product, C can be sequestered for long periods depending on how the timber is treated and used. The production of wood products often requires much less energy than does production of alternative products like steel, aluminium and concrete and there can be a large energy return on investment in wood products. However an analysis of the full life cycles of wood products is required to appreciate the impact on net C storage and net C emissions. Over long time periods the displacement of fossil fuels either directly or through production of low-energy-intensive wood products is likely to be more effective in reducing C emissions than physical storage of C in forests or forest products (IPCC 24.3.3).

3.3.4 Change rotations

3.3.4.1 The option to change rotations fits with a broader measure which has been considered, substitution management (see 3.3.3). This change rotations approach also involves extending the use of forests for wood products and fuels either by establishing new forests or plantations or by increasing the growth of existing forests through silvicultural treatments. It follows early work which demonstrated that converting a forest region of fully stocked mature stands into a maximum sustained yield forest decreases the standing stock by about two-thirds and this releases CO_2 into the atmosphere (Cooper 1983). Various authors have since demonstrated that a consideration of growth rates and initial standing stocks of biomass is critical in determining which existing forests should be used for this purpose.

3.3.4.2 Natural forests in disturbance-dominated systems include immature as well as mature stands. In some cases logging can merely substitute the natural disturbances as the mechanism by which CO_2 is released into the atmosphere. In the Nordic countries, the pool of C in forest vegetation has increased this century despite continuous and steadily increasing logging (Kauppi et al 1993). It does not always result in a dramatic decrease of C pool. When presented with cleared or disturbed forest lands many forest management practices that increase the C pools and cycle the C by harvesting wood for substitution of energy-intensive products or fossil fuels will remove CO_2 from the atmosphere on a continuing basis. Other authors have shown that either lengthening or shortening the rotation age will increase the C stock, depending on initial conditions (e.g. age structure) of the forest, harvesting methods, silviculture and in particular the fate of harvested C (Schlamadinger and Marland 1995). In some cases making long lived products from wood grown in short rotation forestry can sequester C effectively. Short rotation management of woody crops for production of bioenergy feedstocks can replace or offset the need for fossil fuels (Sampson et al 1993).

3.3.4.3 A careful analysis is needed for each particular case, particularly when soil carbon management is considered. In the temperate zones in particular it has been found that after clearing over a number

of decades, the carbon content of the soil is reduced. The carbon losses from the soil exceed the carbon bound up in the fathoms, so that the ecosystem steadily declines over the forest 50 years after felling (Kawaguchi and Yoda 1986).

3.3.5 Control stand density

Thinning is widely used to alter the size of individual stems in a stand, the timing of their availability, and the overall amount of merchantable timber available. In some regions stands are thinned three to five times in a rotation in order to collect material which otherwise would decay. The remaining trees grow to larger dimensions more quickly but this practice has been declining in Europe since the 1970's because logging costs are higher in thinnings than in clear cutting.
Thinnings affect carbon sequestration in three ways: low thinnings utilise small stems which would otherwise decay and release C back into the atmosphere. High thinnings which reduce forest growth rates may help sequester C by providing more of the total value in longer-lived solid wood products such as timber. Thinning- to- waste will generally be neutral or negative in terms of carbon sequestration.

3.3.6 Manage logging residues

Logging residues are already being used as a bioenergy in many Annex I countries, particularly in countries such as Finland (17%) and Sweden(16%), Austria 10% and the USA 4% (Hall, 1993) Whole tree harvesting (where branches, needles, roots and stumps are removed) can increase the amount of the forest available for bioenergy. But the pool of nutrients in the ecosystem is reduced particularly in coniferous forests.

3.3.7 Enhance available nutrients

Water and nutrient availability control forest growth in most parts of the world. As a result, fertilisation and irrigation will generally enhance forest growth and numerous experiments have proved this in many parts of the world. The viability of this as a forest management option is limited by its costs.

3.3.8 Control the water table

About 11.5 Mha of boreal peatlands have been drained worldwide in order to lower the water table and thereby promote forest growth (Gorham 1991). Drainage of forested peatlands promotes forest biomass growth, but the net C benefit is partly offset by increased respiration in the exposed peat. It has been estimated that lowering the water table by 20-3cm increases CO_2 emissions by 150-200% (Zoltai and Martikainen, 1995). Also a more important but difficult to predict consequence of altering the water table is a change in methane production. This is one silvicultural practise which needs careful attention from carbon management viewpoint.

3.3.9 Select useful species and genotypes

There can be substantial variations in productivity between provenances originating from the same tree species and the improvement with some genera including *Pinus,populus, Picea, Eucalyptus, Leucaena and Tectona* has dramatically improved the yield and other favourable commercial attributes over the last 50 years. Furthermore, the choice of tree species itself plays a critical role. Forest growth has declined in several locations responding to a poor choice of species. A large number of multi purpose trees have been identified which can be used to increase C sequestration or storage, or to improve site productivity on a sustained basis.

Enrichment planting below the canopy can increase overall system productivity in cases where one or more aspects of the growing sites are underutilised. This might occur in natural stands which are not fully stocked as a result of various non-stand-replacing disturbances. This technique can also be effective if shade tolerant species were planted below less tolerant ones.

3.3 10 Reduce regeneration delays

Recovery of disturbed natural forests –whether by harvest, insect, fire or disease, drought or other factors depends on both the availability of viable seed sources and site conditions. There is often a period of time- the regeneration delay- when these conditions are not met, particularly in high latitude forests. On some sites, particularly low quality ones, losses of organic material and nutrient capital by leaching can degrade the site potential and delay its realisation. In some high quality sites, more successful opportunistic species, such as grasses can invade the site and temporarily prevent the establishment of trees.

Appropriate choice of harvest timing and method can prevent regeneration delays. If regeneration is not prompt, such mitigation techniques as in-planting, site preparation, and nutrient supplements can be effective in speeding full stand occupancy (Winjum et al 1993)

3.3.11 Select an appropriate harvesting method

Harvesting techniques are generally highly mechanised, capital intensive methods with a low fossil fuel consumption per unit of C harvested. Logging can either have the objective of stand replacing or stand conserving. Stand replacing may be undertaken with clear or selective felling. Selective logging maintains forest cover which gradually replaces the stand. Normally trees are planted only with stand replacing harvesting methods.

The choice of harvesting method can have impacts on C sequestration although differences are poorly documented in the literature and most research has been undertaken on low latitude forests. More work is needed which would measure and monitor the C pool in vegetation and soils over a fairly long period of time.

3.3.12 Protection against fire

Fires of both natural and anthropogenic origin play an important role in the life cycle of many natural forests. From the point of view of C storage, fires may be broadly categorised into two types: non-stand replacing and stand replacing. Non-stand replacing fires often occur in uneven age forests and produce relatively low immediate C releases and may reduce pathogens and remobilise nutrient for over story utilisation and as such are a regular practice by some forest managers.

Stand - replacing fires are dramatic events having locally catastrophic impacts leading to complete mortality of the over story. Large intense conflagrations are the dominant type of fire in any boreal systems (Apps and Kurz,1993). For example, 7.7 million ha of boreal forest burned (an area 50% larger than Switzerland) in Northern Saskatchewan in a single season, 1989.

The effects of these fires is threefold: (i) C is redistributed amongst the various ecosystem pools and subsequent post-fire releases may be as much as three times the immediate release (ii) C is released the atmosphere as CO_2 and other C compounds including CO and CH_4 and (iii) the forest structure is reset and succession is started. While such fires entail major and immediate C released to the atmosphere, the forests where such fires occur naturally are adapted to them and indeed are dependent on them for

regeneration, removal of pests and disease vectors and a host of ecological relationships (Levine 1991,Cofer et al 1991).

Eliminating these large C releases is potentially attractive option and has been advocated in one ghg mitigation strategy in Russia (Vinson et al 1995). From a forest management viewpoint, suppression of fires may merely open the way for other pathological agents which would normally have been kept at bay by the periodic cleansing action of wildfire. However it would seem to be clearly necessary to remove debris and harvest mature trees in some types of forest to maximise carbon sequestration. It has been suggested that the large fires in the American west during the past decade may be have been due to a buildup of fine fuels and an eventually higher intensity fire. Recent Australian experience confirms the difficulties in avoiding fire. But if it is difficult to protect forests aginst fires, it has to be questioned whether considering increased reliance on forests for C mitigation even on temporary basis may be wise.

3.3.13 Protection against Disease, Pests and other Herbivores

Stand replacing or endemic disturbance can result from disease and pests. In the former case direct releases of carbon to the atmosphere is smaller and the transfer of carbon to the forest floor correspondingly greater. It is difficult to protect against these events which depend on the types of local conditions applying. Aerial applications of chemical or biological pesticides are generally effective in sustaining forests in a living condition long enough to harvest wood but are generally not effective in eliminating insect populations. Such management approaches also have substantial impacts on biodiversity.

Endemic impacts of insect disease and herbivores may reduce the net increment of forest phytomass. The effect on C sequestration is not clear and depends on many factors including forest age and disturbance type (Kurz et al 1995).

There may well be synergistic effects with climate change. Laboratory studies have shown that insect damage on plants grown in high CO_2 concentrations is dramatically increased because as the proportion of N declines relative to C, insects consume more to compensate for the loss of protein, so net CO_2 sequestration in future global forests may be less than it is in current conditions (Drake 1992, Dixon et al 1995).

3.3.14 Salvage Dead and Dying Trees

From a C storage perspective, the removal of decomposing C from the natural system to the economic system may enable an increase in the net C storage associate with a given piece of land. But this will depend on three factors; whether more C is then transferred to forest products (of longer lifetimes) than would be if the C is left on site (Hendrikson,1990); the extent to which site regrowth is increased relative to the untreated condition and; how much fossil fuel is used in the salvage and product manufacture and distribution operations.

This type of measure has become extremely controversial in the Pacific Northwest forests in the US where it has been used to justify increasing logging rates.

3.4. Increasing the C pool

3.4.1 Many of the options already discussed relate to increasing the C pool so as to optimise available forest carbon. In addition the establishment of new forests, plantations and agroforestry is also

undertaken. These options have been mentioned previously and discussed in relation to soil degradation and, soil carbon sequestration in section two. However some further brief points can be made.

3.4.2 Most analyses of the potential for additional afforestation have been undertaken on a global basis. In particular many studies have emphasised the tropics because of the higher growth rate, and the fact these areas have been recently deforested. But degraded or sub-standard soils and marginal lands currently ocupy a significant proportion of boreal and temperate as well as tropical biomes (Grainger, 1988). The Enquete Commission also pointed out that large areas of land technically suitable for forests are degraded or are otherwise under-producing because of human misuse (Enquete Commission, 1995).

Table *Regional estimates of land availability; average mean annual increment (MAI), rotation length and planning rate for a global forestation program, including establishment of plantations and agroforestry to sequester C (data from Nilsson and Schopfhauser,cited in IPCC ch24)*

Region/ Country	Land Available (Mha)	MAI (m^3/ha/yr	Rotation Length (yr)	Planting Rate[2] (Mha/yr)
High Latitudes				
Canada[3]	28.3	2.5-8.0	60	1.14
Nordic	0.35	5	60	0.014
FSU	66.5	3	80	1.66
Mid Latitudes				
USA	21.0	6-15	15-40	0.70
Europe	7.74	6-10	20-60	0.31
China	62.5	12.3	80	2.5
Asia	12.5	12.5	12	0.50
South Africa	1.9	16	30	0.075
South America	4.6	15	25	0.18
Australia	4.3	6-23	30	0.123
New Zealand	5	25	25	0.1
Low Latitudes				
Tr. America	40.5	8-25	20	0.74
Tr. Africa	31.6	8-16	30	0.58
Tr. Asia	57.7	8-16	20	1.05

1 Full details of sources are provided in Nilsson and Schofhauser (1995); any of the sources originate from individual countries.
2 Includes rate of establishment of both plantations and agroforestry systems.
3 Canada includes not satisfactorily restocked (NSR) forest areas in addition to marginal agricultureal lands (Van Kooten 1991); the low end of the MAI was used for NSR forests.

As the table above illustrates there is significant land available in high latitudes as well. In these high latitudes, afforestation also means the reduction of regeneration delays in existing forests (as discussed above).

3.4.3 Restoration and management of degraded lands with integrated agricultural and forest production systems (e.g. agroforestry) if introduced on broad scale may present a significant global opportunity to reduce the accumulation of greenhouse gases in the atmosphere. Many problems have been experienced with the establishment of large areas of new commercial forestry plantations due to social constraints and ecological impacts. Some advantages can accrue from the plantation approach through increased

production levels and the fact that such sources can take pressure off timber extraction in natural forests.

3.4.4 Integrated forest and agronomic cropping systems have been practised for centuries and there is increased interest in how they could provide a biologically and ecologically sustainable alternative to land uses which cause deforestation and desertification. Agroforestry is a land use that involves deliberate retention, introduction or mixture of tree or other woody perennials in crop/ annual production fields to benefit from these ecological and economic interactions. It is viewed as having potential in the humid temperate lowlands and dry lowlands of the USA, the humid temperate lowlands of the FSU and the humid tropical lowlands of Australia (Dixon et al,1994). Integrated land use practices for C pools can involve the establishment of fuelwood and fibre plantations, intercropping systems (trees, agronomic and horticultural crops) and shelterbelts and windbreaks.

Conclusions

3.4.15 These carbon management strategies have evolved from silvicultural practices designed to maximise yields. They have obvious potential for adaptation to carbon management. Two important points however need to be made: many of these practices are being questioned from some of the new sustainable forest management initiatives, and this is discussed below in section 3.6. Secondly they need to be carefully assessed from a carbon management perspective. Some very clear messages have emerged so far, principally from the substitution management option:

- it is better not to convert forests with a large initial growth standing biomas C and slow growth rate (e.g. old growth forests) to managed stands because it may take a very long time (up to centuiries) until the net C sequestered returns to its initial value

- growing trees for carbon storage may be more appropriate on low productivity land or indeed where the biomass cannot be strategically harvested. However where high productivity can be expected, the cost effective strategy is to manage the forest for a harvestable crop and to use the harvest for maximum efficiency for long-lived products and to substitute for fossil fuels

- over long time periods the displacement of fossil fuels either directly or through production of low-energy -intensive wood products is likely to be more effective in reducing C emissions than physical storage of C in forests or forest products.

Some comments can be made about silvicultural options from a carbon management perspective: there is potential to change rotation lengths; use logging residues; previous practice associated with afforestation in drained boreal peatlands needs to be carefully assessed, and there seem to be limits to the effectiveness of fire management as a strategy.

3.5. Assessment of Options

3.5.1 Climate change impacts on mitigation options

3.5.1.1 Each of the promising forest management options for mitigation of C emissions is likely to be affected differently under a changed climate and human population density. In the mid and high latitudes where changes in land use are relatively stable at present the direct and indirect effects of climate change are likely to be more important (IPCC 24.6).

It has been proposed that during the transient phase - in the first 100 years or so following global warming- the processes of forest dieback and other disturbances could have a major impact on the

effrts to change C balances (Smith and Shugart 1993). Gains in sequestration from forest programmes in mid and high latitudes could be offset in the transient phase by the release of C from unmanaged forest, resulting from the processes of migration and regeneration being slower than dieback and other disturbances (IPCC 24.6.1).

3.5.1.2 Forest-sector programmes aimed at C conservation and sequestration should be targeted toward those areas, tree species and practice that are most likely to succeed even if climate change occurred (IPCC 24.6.1). Based on change in land availability alone, the amount of C that can potentially be sequestered in mid and high latitudes would likely change little with possible slight gains.

3.5.1.3 Some national Communications such as Sweden and Norway's have examine the impacts of forest growth. In the case of Sweden it is thought that higher temperatures due to increased precipitation should result in general improvements in forest growth, but that an increased temperature could also bring negative consequence. Milder and windier winters could lead to a greater risk of windthrow. Some key species such as Scot's pine and Norway spruce are expected to grow less well in a milder climate. Increases in pest and fungal damage is expected. Model experiments show a shift in tree species towards a greater hardwood composition in large parts of the country. Planted forests with one or a two few tree species are poorly suited to cope with different types of disturbances such as rapid climate change and spruce forests of continental orgin with low genetic variation are expected to be the most vulnerable (Persson, 1985). It is suggested that forestry will have more difficulty adapting to climate change.

3.5.1.4 At ecosystem level, there are great uncertainties on the future distribution of global forest biomes. The development of the IMAGE 2.0 model attempted to overcome some of the problems in projecting future changes in vegetation (since upgraded to 2.1). Model output (2.0) analyses for IPCC SAR suggests that there could be large gains in areas of land suitable for forest activities in mid and high latitudes because of warmer temperatures and a longer growing season. However the potential increase is based on climatic factors alone and does not consider whether soils will be suitable for forest establishment. This is potentially problematic in the high latitudes, where the boreal forests are projected to increase into the tundra as tundra soils have characteristics that can retard forest establishment (IPCC 24.6.1). Furthermore, one static model BIOME, which was conceived specifically for assessing geographically distributed responses of vegetation types to expected climate changes, projects a loss of between 20-50% in boreal forest area (IPCC 15.2.3). Large assumptions are made in such modelling exercises about agricultural demand, migration of tree populations into abandoned farmland, and migration of tree populations from temperate into former boreal forest areas.

Research and data needs identified by the IPCC (24.7) are:
a) Realistic land-use modelling at national scales to determine trends in and constraints on forest cover, agricultural land needs, land availability potentials.
b) Improvements in the economic methodology for valuing all costs, including land and especially benefits associated with forest management options for C conservation, storage and substitution.
c) Improved information about how different silvicultural and other management practices for major forest types and plantation species, and how growth under different climate and soil regimes affect the dynamics, distribution and retention of C in forests
d) Better understanding of the efficiency with which wood is converted into wood products and life expectancy of wood products.

This suggests that policy will need to evolve gradually to allow a better understanding of forest ecosystem dynamics and comparative costs/ outcomes of different options to become available.

3.5.2 Carbon Inventory and Reporting Issues

There are two current ghg inventory issues which relate to the forestry sector:

(i) There are some inconsistencies with forest fire reporting in that non-CO2 emissions from are recorded but CO2 is not. Also some consideration is being given to the need to account for prescribed burning.
(ii) The assessment has shown that a 'best' option it to use sequestered carbon for long-life wood products. The reporting guidelines may be changed to allow for changes on harvested wood products. These issues relate to the development of criteria for sustainable forest managment discussed below and the need for more information on the life expectancy om wood products raised above..

Progress in all these cases relects change in experience in operating the guidelines and scientific research -these will be an ongoing with improvements being made to default values. All these issues would assume a high political significance if removals by sinks were to be counted as measures in any protocols to the treaty. For some stakeholders in the process this issue is extremely controversial . At present the specific commitment in the FCCC to aim to return anthropogenic emissions of ghgs to their 1990 levels by 2000 is not adjusted for sinks.

3.5.3 Economic Assessment

3.5.3.1 Mitigation options costing in the forestry sector raises difficult questions and while conceptual frameworks for approaching this critical matter are becoming refined, the data required to undertake comprehensive assessments does not yet exist. The literature combining the costs and benefits with their carbon consequences is quite limited (IPCC ch 24 Exec Summary). Moreover as has been indicated in the previous section, measuring the carbon consequences of particular options is in itself difficult and not without controversy. Apart from the difficulty of assembling complete baseline data, no studies to date have addressed the mitigation potential of forests under a changed climate condition, with no effects of climate change or increased atmospheric CO_2 (IPCC 24.1) The cost estimates which were reviewed by the IPCC in the SAR generally only represent the cost of direct forest practices. Costs can be several times higher if land and opportunity costs and/ or costs of establishing infrastructure, protective fencing, training programmes, and tree nurseries are included; on the other hand costs can be offset by revenues from timber, non-timber products and ancillary benefits from projects such as damage costs avoided (IPCC 24.1).

Key issues in forest sector mitigation costing have been identified as:

- Developing a consistent evaluation of monetary and carbon implications
- Including all costs over lifetime in addition to initial capital investment (e.g. maintenance costs)
- Accounting for all direct and ancillary benefits
- Accurately valuing the incremental cost of projects (Sathaye and Makundi, 1993)

3.5.3.2 New methods are being proposed to establish frameworks for analysis. One such is Integrated Forestry Planning (IFP) (presented as a cross-Sectoral Method for mitigation options Assessment in IPCC WGII chap 27). Details are presented in the box overleaf.

3.5.3.3 Reviews of existing economic analyses of forestry mitigation options have shown that they are considered relatively cost-effective compared to other ghg mitigation options (IPCC WG III ch7). An early US high cost estimate of Nordhaus of $100/tC now seems to have ignored changes in soil carbon through tree planting and to have underestimated the carrying capacity and length of productivity of forest plantations. It has since been found that the costs of stabilising US carbon emissions could be reduced by as much as 80% by forestry options (Richards et al 1993,1993a).

Box : INTEGRATED FOREST PLANNING (IFP)

IFP is a framework for assessing forest sector greenhouse gas mitigation options based on their cost-effectiveness in reducing emissions or sequestering carbon. Many technical and policy options applied in the forest sector promote carbon emission reductions and carbon fixation, including activities that increase carbon stored or sequestered on forest land and in forest products and those that displace fossil fuels with biomass resources. IFP can be used to help policy makers: (1) balance competing land use needs, (2) assess potential demand-side mitigation options, and (3) provide a means for conveniently identifying and comparing ancillary impacts associated with forestry mitigation options(e.g. reduced soil erosion or employment benefits). IFP identifies a mix of options that maximise carbon reduction at lowest possible costs subject to social, economic and ecological constraints).

Generally IFP must confront three broad analytic issues associated with a mitigation option: (1) the physical (land and carbon) impacts, (2) the social and environment ancillary benefits and (3) the incremental costs. Several steps are involved;

Define baseline land use and carbon stocks

Estimate annual changes in on-site carbon stocks on these lands

Identify options to mitigate ghg emissions from forest related activities, including taxes or subsidies to encourage the use of wood and technical options such as conversion of agricultural land to forest land

Estimate carbon stocks under alternative policy scenarios with annual change in on-site carbon and post harvest indirect and unintentional emission impacts

Assess the economic and other ancillary impacts on other sectors (both quantifiable and non-quantifiable) of different option packages

Assess the cost effectiveness of different combinations of options.

Integrated forest planning can be very data intensive and successful use will require information on: land use statistics, forest carbon stocks and sequestration rates; soil erosion rates; economic and social data; and data for incremental costing on wage rates, future product prices; technological needs and institutional requirements.

(Source: IPCC WG II Ch 27 App 1 111-E)

3.5.3.4 The focus of the studies reviewed by WG III has been global and they have principally looked at the costs of afforestation or slowing down deforestation , although there is a separate set of work which relates to economic evaluation of wood as a biomass energy. The studies have taken a "engineering-efficiency approach rather than the welfare economic approach" and as such fundamental questions arise about methodology (see below) (IPCC WG III ch 7, 4.6.1). With respect to afforestation the assumption has been generally made that the forests are not harvested but are left to mature (cemetery forests). The emphasis is on the costs of afforestation including maintenance and land protection. Although other aspects are recognised they have not been formally evaluate such as the exploitation of timber and non-timber benefits. The process of undertaking these studies has led many authors to comment that social, political and infra structural problems will keep afforestation rates low (Trexler, 1991).

3.5.3.5 Recognition of these problems has led to a questioning of the point estimate \Oat one moment in time) approach as the costs in terms of C sequestration are perceived as being likely to rise because:

a) There will be diminishing uptakes as less suitable land is forested resulting in a lower carbon uptake per ha.

b) Increasing public resistance and legal problems of local populations against interference with current land use.
c) Rising opportunity costs as fallow land is used up.
d) Negligible economies of scale in operating costs (IPCC WG III ch 7 4.6.1)

Thus it is considered that the marginal costs will rise as the areas being afforested increases unless the amount of land needed for agriculture shows a declining trend. Recent work using a more sophisticated methodology is finding that there could be steeper increase in costs with the marginal cost pert roughly doubling from about $30-$60/tC for large annual uptakes (IPCC WG III ch 7 4.6).

Table Initial cost of expanding carbon sinks by different regions and practice.

Region/Country			
Boreal	Natural Regeneration[2]	5 (4-11)	Dixon *et al* 1994b
	Reforestation	8 (3-27)	
Temperate	Natural Regeneration[2]	1	Dixon *et al* 1994b
	Afforestation	2 (1-5)	
	Reforestation	6 (3-29)	
Australia	Reforestation	5	Winjum *et al* 1993
Canada	Reforestation	11	Winjum *et al* 1993
	Regeneration	6	
Germany	Agroforestry	6 - 21	
	Reforestation	29	Winjum *et al* 1993
USA	Reforestation	5	Winjum *et al* 1993
	Afforestation	2	
	Various Options	5 - 43[4]	Moulton and Richards, 1990
	Various Options	19 - 95[5]	Adams *et al* 1993
FSU .	Reforestation	6	Winjum *et al* 1993
	Regeneration	5	
Russia	Plantations	1 - 8	Krankina and Dixon 199-

1 Forest components for sequestering C vary by source: Dixon *et al* (1994b),Krankina and Dixon (1994), and Winjum *et al* (1993) include only C in vegetation: Xu (1995),, Ravindranath and Somashekhar (1995), Wongwacharakul and Bowornwiwat (1995) and Masera *et al* (1995) include vegetation and soil C: Swisher (1991). <pi;tpm amd Riocjards (1990). amd Adams *et al* (1993) account for C in vegetation, soil and litter.
2 Values in parentheses are interquartile ranges.
3 Figures vary depending on land rental costs per ha. from $400 to 1,000; FLORAM = Florestales AMAZONIA.
4 Marginal costs include planting and land rental costs.
5 Includes land rental costs.

Source :IPCC WGII ch 7

3.5.3.6 A review of the methodological questions surrounding cost estimation of carbon sequestration studies has found that analysis of intangible factor costs or of double dividends has been hampered by the fact that many studies have imposed constraints on the forestry or types of land that they consider, such as that they decrease soil erosion, meet local needs or provide other environmental benefits such as habitat preservation (IPCC WGIII ch8 3.4.1). These factors should instead be accounted for as beneficial secondary benefits. Concern has also been expressed about damage costs and discount rates (Sampson et al 1995, Kooten et al 1995).

3.3.4.7 Detailed reviews of carbon sink cost studies have also found that harvesting whilst increasing economic benefits raises difficult methodological questions regarding the rate of release of the carbon in the harvested product. Studies which ignore this issue will overstate the costs and the benefits. Indeed the closer the examination, the more detailed is the analysis which is required.

However full accounting must include those factors that tend to increase social costs relative to financial costs, such as the effect of removing non-marginal quantities of land from agricultural production, transaction costs associated with establishing new land use patterns, administrative costs of implementing a large scale carbon sequestration programme and decreases in carbon benefit associated with timber harvest. (IPCC WGIII ch8 3.4.1)

It is also necessary to consider the potential leakage of carbon sequestration gains by landowners. If they feel the value of their land is threatened by the carbon sequestration programme itself they will tke steps to obtain benefit 'prematurely'.

3.5.4.8 This prompts the question about the how the economic value of carbon sequestration will be handled and managed. One new study (Solberg 1995) relates the value of the existing carbon fee in Norway to the value of carbon sequestration in forest biomass. Although the existing fee level is quite modest, about 0.12$ per litre of gasoline, this translates into a net economic value of carbon sequested in forest biomass 2-30 times higher than its net value as raw material for the forest industry in Norway, which has one of the highest timber prices in the world. Furthermore the analysis shows that if a fee high enough to stabilise the CO_2 emission in Norway were to be introduced, the value of carbon sequestration would be at least as twice as high as the above estimates. The paper recognises that this would imply substantial changes in forest management in developed and developing countries.

3.6. Non-Climate Forest Policy Problems

Up to now, all reviews of mitigation options to foster C conservation and sequestration in forests have recognised that this is but one of a variety of objectives in forest management (IPCC 24.3). Other policy goals will drive the selection of policies (Bergendal Workshop summary). In order to develop options for climate mitigation through forest management, it is vital to understand the dynamics of mainstream forest policy particularly as it has been rapidly evolving in the past ten years. During this period concepts of sustainable forest management have been introduced and are now being operationalised. This process is involving the development of sets of criteria and principles. These can be construed as 'high level guidelines' and as such of relevance to the current review. Carbon management rarely features in the new policy developments.

3.6.1 Sustained yield forestry: a solution becomes a problem

3.6.1 The range of possible practices to foster C conservation and sequestration in forests closely relate to well-developed silvicultural practices which form part of the normal tools available for forest managers.

A particular set of the tools have been applied and refined in a new and more intensive system of forestry particularly in the Nordic countries over the past 40 years (Dudley et al 1995). The sustained yield model characterised primarily with timber production and therefore with the maintenance and increase of on-site woody biomass. It is based on careful assessments of the potential for continuous productivity from a given area of forest over time. Harvest must be less than or equal to timber growth, and therefore a critical factor in operation of the sustained yield models is the knowledge of the rate at which trees of a particular species grow on a given site. In theory sustained yield management can be used in natural forest where small amounts of timber are extracted, and the forest allowed to replenish itself through natural regeneration. Sustained yield models are also in principle easily adaptable to multiple-purpose management, where timber production takes place alongside other use such as hunting, food gathering, recreation and nature conservation. However in practice the emphasis has been placed on the production of timber in preference to other goods and services.

3.6.2 Sustained yield forestry has put the main focus for improvement towards increasing annual growth and success measured in terms of the sustained yield of timber or biomass. Until recently it had become accepted as environmentally sound management particularly in temperate and boreal regions. The gradual shift from natural to managed stands has been achieved most on the temperate, broad-leaved hardwood and mixed hardwood forest of the temperate latitudes. Currently the overall forest in the temperate zone is showing a tendency to expand through plantation; each year 2.5% is felled for the most part within the framework of controlled forest management without actual loss of forest. Natural stands now only occur sporadically over small areas and single age-class forest and monocultures have spread over large areas (Enquete Commission).

3.6.3 Although these plantations are comparatively easy to manage, many of the practices have been found to produce susceptibility to damage by air pollution, increase soil erosion, and reduce biodiversity. Plantations have been established to replace existing biodiversity rich, natural forest often using monoculture or exotic tree species. There have been damaging effects on soil structures with deep ploughing and disturbance to water table and water quality. Changes to fire regimes have been associated with plantation management. The use of monoculture and exotic species has been associated with increased pest and disease attack. To counter pest attacks and maintain fertility agrochemical use has increased with greater damage to wildlife (Dudley et al 1995).

3.6.4 Overviews of forestry policy such as the Enquete Commission's, have produced sets of problems in which climate change scarcely features:

- In temperate forests, the most important task in forest conservation has been judged to be the drastic reduction of pollutant inputs. In many regions the forest ecosystems are burdened with pollutants, notably sulphur dioxide, nitrogen oxides ammonia and ozone. In western Europe high nitrogen inputs and high summertime levels of ground-level ozone, give particular cause for concern. In eastern Europe forest damage is primarily the result of sulphur dioxide emissions.

- Forest policy concerns about the boreal forests relate to a different set of issues. The Commission considered that they are suffering from increasing levels of inefficient felling resulting in severe overuse and degradation in certain regions. It noted that forest fires are reportedly increasing. And recognised that one of the problems about this area is the inability to assess the current development of forest stands with any certainty on the basis of the available data. The unplanted forest area has increased considerably in recent decades and now measures approximately 15 Mha -only a quarter of which is temporary- as result of felling and fires. In Canada the largest forest fire took place in 1989, followed by the second largest some 6 years later - in 1995 fires consumed nearly seven million hectares from Yukon to Quebec. Overall Canadian forests are now acting a net source of carbon, not a sink. The majority of boreal forests especially in the FSU will remain unstocked due to the lack of reforestation and soil damage. Massive degradation has also occurred as result of pollutant input. Despite devastation over large areas, it is estimated that the forests and bogs of the northern zone are still a carbon sink. But in view of the poor condition of the forest particularly in the FSU, the net uptake is probably no more than 0.3 to 0.5 billion tC per year.

3.6.5 In summary the most broadly perceived (Upton and Bass, 1995) forest problems are:

a) A reduction of forest area and quality with the quantity and quality of forests declining due to over extraction of forest products in relation to natural regeneration, poor management and forest clearance (particularly in tropical areas.)

b) environmental degradation of forest areas causing soil erosion, watershed destabilisation and industrial air pollution in temperate forests is reducing forest health

c) these problems are contributing to a rapid reduction in ecosystems, species and genetic diversity in both natural and planted forest

d) loss of culture and knowledgein local populaitions

e) loss of livelihood for forest dependent people

f) broad concern about the impacts of the loss of forest on climate change.

3.7. New Solutions to Forest Policy Problems

The perception of these environmental problems is important because they have triggered three types of response, all of which bear upon possible measures and intervention mode for carbon forestry policy. These have been categorised (by Dudley at al 1995) as falling into 3 broad types: policy responses; forest based solutions and market based solutions. In summary these comprise:

3.7.1.Policy-based solutions. Policy-based solutions comprise several, new institutional mechanisms. Those of most relevance to the current study being:

The CSD In May 1995 it established the Inter Governmental Panel on Forestry with a complex programme of work covering national forest plans; deforestation and forest degradation; protection of indigenous forest knowledge; monitoring of action to support reforestation and forest pollution; technology transfer and bilateral assistance forest data bases; criteria and indicators for sustainable forest management; forest product trade issues; international institutions and procedural arrangements. No reference is made to climate change issues.

The Montreal process and the Helsinki declaration. Both these are drawing up criteria and indicators for sustainable forest management, the former for non-European temperate and boreal forests and the latter for European countries.

- The Montreal Process now functions through the Working group on Criteria and Indicators for Conservation and Sustainable Management of Temperate and Boreal Forests. Since its first meeting in Montreal in 1993, a number of technical meetings have now taken place between ten developed and developing countries. Seven criteria have now been established (covering biodiversity conservation, ecosystem productivity, ecosystem health and vitality, soil and water conservation, global carbon cycles, multiple socio-economic benefits, and legal/policy/ institutional frameworks); and work on indicators for each criterion began in 1994.

- The Helsinki Conference in 1993 adopted four resolutions covering: the adoption of general guidance for sustainable management, conservation of biodiversity; cooperation with Eastern Europe and a set of strategies for a process of long term adaptation of forests to climate change. (Annex). These climate change strategies recognised a set of issues relating to impacts on forests and resolved to support appropriate measures for the mitigation of climate change and identified areas for forest research.

Sustainable forest management was defined at the Helsinki Conference in the following way:

'Sustainable management means the stewardship and use of forests and forest lands in such a way, and at a rate that maintains their biodiversity, productivity, regeneration capacity, vitality, and their

potential to fulfil now and in the future, relevant ecological, economic and social functions, at local, national and global level, and that does not cause damage to other ecosystems.'

Countries are committed to implementing a set of general guidelines. The first guideline refers to greenhouse gases:

'Human actions must be avoided which lead, directly or indirectly to irreversible degradation of forest soils and sites, the fora and fauna they support and the services they provide. Efforts should be increased to keep the emissions of air pollutants and greenhouse gases below the expected tolerance of forest ecosystems, taking into account the long-term cumulative and/or synergistic effects of pollutants Forest fires and the pollution of soils must be strictly controlled and could dictate overall policy and management objectives and practices in particularly sensitive parts of Europe.'

Countries are now involved in reporting process and joint research on the work programme is underway.

3.7.2 Forest based solutions

These are forest technology- based solutions some aspects of which have been reflected in the policy responses. In order to confront the environmental and social damage which was perceived to be caused by some forest management practices forestry management methods have themselves been changed by governments establishing policy environments at national level and also by changed practices by timber companies (Dudley et al 1995).

Governments have sometimes sought to distinguish between productive forests and reserves: a policy of setting aside natural or near natural forest as a complete reserve while allowing highly industrialised forestry on the remaining area.

Multipurpose sustainable forestry has been developed as an approach which aspires to establish management systems which allow timber extraction, other economic activities; environmental protection; biodiversity conservation and other functions to operate side by side in a given area. This often combines a return to some traditional forest management practices and also 'new forest principles'. Some basic principles have been identified: including the use of local species; management practices which mimic natural dynamics including disturbance patterns; maintaining old growth fragments; relying on natural regeneration; planning for mixed forests; protection of particularly sensitive ecosystems within forests; protection of key wildlife habitats; use of small clear felling or selective logging; and keeping a proportion of dead timber and down logs in the forest along with other dead wood components such as coarse woody debris (Dudley et al 1995). These in many ways seem to completely reverse intensive management approaches including those outlined for advancing carbon sequestration outlined in 3.3 above. It is clear from the review of national forest policies in Annex, that many Governments have incorporated such ideas recently into their forest policy.

3.7.3 Market-based solutions: Certification.

Due to dissatisfaction with the process of reform within the policy process and in an effort to drive the momentum for sustainable forest management at a technical level, a third approach has been initiated by Non Governmental organisations and with the assistance of some parts of the timber industry since 1990 (Dudley at al 1995). This approach allows consumers to interact directly with producers in setting priorities for the production and management of forest products. It was born from concern on tropical forests and the activities of the timber industry and the perceived failure of the two major international initiatives which were intended to lessen industry's impacts on tropical forests: the Tropical Forestry Action Plan and the International Tropical Timber Association. Post UNCED the focus widened to

include temperate as well as tropical forests. Initially responses involved the use of bans and boycotts of tropical timber as a mechanism to reduce demand. The Austrian government went further: in 1990 the parliament passed a law forbidding all tropical timber imports from countries which did not practise sustainable forestry. Following a reaction against such measures with increased questions being raised about their effectiveness and fairness, and under pressure from tropical countries the Austrian government repealed the law in 1992 (Dudley et al 1995).

On response to such boycotts producers and vendors of timber products began to claim that their products came from sustainable managed forests. But two major research projects found that virtually none of the claims that timber comes from sustainable managed forests could be verified and many products, on the contrary, clearly came from forests that were being unsustainably logged or badly managed (WWF UK). Out of an initial survey of 625 companies, only three were found which were prepared to make a serious attempt to justify their claims. There was confusion amongst the timber trade about what constituted good forest management and 'sustained yield' was confused with 'sustainability'. Complaints were successfully submitted in the UK to the Advertising Standards Authority. Pressures began to build world-wide for system of independent timber certification. The World Bank's new Forest Policy of 1991 supported the value and need for green labelling systems to permit preferential market treatment for wood grown under sustainable circumstances. In addition to lowering the overall demand for wood produced by unsustainable practices, it considered such a scheme would remove the disincentive for adopting improved management practices that might otherwise diminish competitiveness.

Since the early 1990's there has been a marked interest in certification in the industrial sector of major producing countries such as Indonesia, Sweden, Finland and Canada. The African Timber Organisation is also working on a scheme. Four certification bodies are already in existence: Forest Certification Programme of Scientific Certification Systems (for profit, USA); Smartwood Certification Programme of Rainforest Alliance (NGO, USA); SGS Forestry (for profit, UK); and Pacific Certified Ecological Forest Products (NGO, USA). The four certification bodies have already verified 7 different forest areas around the world, covering a total of over 4 million hectares. Ten of the certified forests are in the tropics and seven are in temperate regions. Governments of various countries have also expressed an interest in independent timber certification (Austria, Sweden, Switzerland, Finland, Indonesia, the Netherlands and Canada and there are current active initiatives underway.) There are also national labelling schemes such 'Swiss Wood' and the 'Plus Forest' project in Finland which essentially consist of a label verifying the country of origin. They are based on the premise that in the country concerned, forests are generally well managed; thus any purchaser should be confident that the labelled timber has been produced in accordance with good forestry practice.

In the early 90's the growing interest in timber certification and the proliferation of labelling schemes was seen as potentially confusing for both producers and consumers. In an effort to validate the claims of the certifiers and to avoid confusion, a diverse group of representatives from environmental organisations, community forest associations and forest product certification institutions have come together to establish an organisation known as the Forest Stewardship Council (FSC) . The FSC began to take shape at a meeting of environmental groups and forest managers in Washington DC in 1992. It was formally founded in October 1993 when 10 participants from 25 countries covering industry, indigenous groups, retailers and environmental NGOs voted to establish the FSC as a membership organisation. The FSC is now established in Oaxaca, Mexico. Its principles and criteria are intended to apply to all tropical, temperate and boreal forest worldwide which are managed for timber and non-timber production. These include a set of detailed management prescriptions which cover: compliance with laws and FSC's principles; tenure and use right; indigenous people's rights; community rights; optimising benefits from the forest (these are detailed but do not cover carbon management); environmental impact (itemised but not covering carbon management); management plans; monitoring and assessment and the relationship between natural forests and plantations.

Forest Stewardship Council

FSC Principles of Forest Management

The FSC Principles of Forest Management are the cornerstone of the certification process, and are shown below in abbreviated form.

1. Compliance with laws and FSC principles

Forest management shall respect all applicable laws of the country in which they occur, and international treaties and agreements to which the country is a signatory, and comply with all FSC Principles and Criteria.

2. Tenure and use rights and responsibilities

Long term tenure and use rights to the land and forest resources shall be clearly defined, documented and legally established.

3. Indigenous peoples' rights

The legal and customary rights of indigenous peoples to own, use and manage their lands, territories and resources shall be recognized and respected.

4. Community relations and workers' rights

Forest management operations shall maintain or enhance the long-term social and economic well-being of forest workers and local communities.

5. Benefits from the forest

Forest management operations shall encourage the efficient use of the forest's multiple products and services to ensure economic viability and a wide range of environmental and social benefits.

6. Environmental impact

Forest management shall conserve biological diversity and its associated values, water resources, soils and unique and fragile eco-systems and landscapes, and by so doing, maintain the ecological functions and integrity of the forest.

7. Management plan

A management plan - appropriate to the scale and intensity of the operations - shall be written, implemented and kept up to date. The long term objectives of management, and the means of achieving them shall be clearly stated.

8. Monitoring and assessment

Monitoring shall be conducted - appropriate to the scale and intensity of forest management - to assess the condition of the forest, yields of forest products, chain of custody, management activities and their social and environmental impacts.

9. Maintenance of natural forests

Primary forests, well developed secondary forests and sites of major environmental, social or cultural significance shall be conserved. Such areas shall not be replaced by tree plantations or other land uses.

10. Plantations

Plantations shall be planned and managed in accordance with Principles and Criteria 1-9, and Principle 10 and its criteria. While plantations can provide an array of social and economic benefits, and can contribute to satisfying the world's needs for forest products, they should complement the management of, reduce pressures on, and promote the restoration and conservation of natural forests.

The full text of the FSC Principles and Criteria is available on request from the FSC UK Working Group.

Chain of Custody

The 'chain of custody' procedure provides both the method and the guarantee that timber and timber-based products bearing the FSC Trademark originated in forest or woodland managed to standards which meet the FSC Principles and Criteria. It is determined on a case-by-case basis, tailored to meet the particular requirements of the circumstances, and may require all or some of the elements noted below. In addition to the Trademark, the product label will also identify the Certification Body responsible for verification of the chain of custody.

Principal Criteria

An organisation wishing to identify products from certified forests must:

1. provide physical evidence that the goods originate from a particular forest
2. identify and segregate the goods concerned
3. document the record system which runs in parallel to the goods
4. monitor compliance with chain of custody requirements

Product Identification

The organisation ensures that:

1. all products from certified forests, or manufactured from products derived from such forests, are clearly marked as such
2. documented procedures exist to control the marking of certified products

From the forest to the mill

1. logs are marked in order to identify the forest of origin
2. the volume of logs transported from the forest is recorded by species

From primary conversion to subsequent stages of manufacture, wholesale distribution and retail

1. products are marked to identify the production run or stage of processing
2. the volume and species or type of product is recorded at each step

Product Segregation

The organisation ensures that:

1. all products from certified forests, or manufactured from products derived from such forests, are segregated from other products
2. documented procedures exist to control the segregation of certified products

From the forest to the mill

1. certified logs are segregated from non-certified logs at the log yard
2. a batch production process is implemented to segregate certified products during processing unless continuous coding mechanisms are used
3. certified products are segregated in the production area, green timber store, kilns and final storage areas

From primary conversion to subsequent stages of manufacture, wholesale distribution and retail

1. all certified products are segregated upon arrival at the premises
2. a batch production process is implemented
3. separate documents are prepared for certified products during storage and shipment

Records

The organisation ensures that:

1. orderly records are kept relating to purchases, shipments, receipts, forwarding and invoicing for certified forests
2. records include customs, phytosanitary, transportation and invoice documentation
3. maintains its record keeping system
4. shows that transport and invoice documentation can be reconciled with actual loads
5. demonstrates a [illegible] stock of certified products

The FSC has been funded by Governments in the UK, Germany, Australia, the EU, Austria, Mexico, private foundations and NGOs. The future of the FSC is not assured and it has encountered opposition in some parts of the industry. In June 1995 a proposal was made to the International Standards Organisation by Canada and Australia that an Environmental Management System be developed. This proposal originated with the Canadian Standards Association (CSA) and was proposing less stringent criteria than the FSC's. It was withdrawn at that meeting but is being pursued actively now. Governments in Indonesia and Malaysia are establishing eco-labelling schemes.

3.7.4. Summary

The sustained yield management practices established to maximise timber production have a great deal in common with those types of silvicultural practices which have been identified as enhancing sequestration potential in natural forests. But new sustainable forest management principles are gradually being operationalised throughout the international system involving fundamental changes to forest policy. Carbon management issues scarcely feature in these. In order to speed up the adoption of sustainable forest management, new ecolabelling mechanisms are being deployed on a voluntary basis. In order to merit these labels, various production methods and principles have to be deployed.

It would seem that sustainable forestry management principles should take account of carbon management aspects, not only for ghg mitigation strategies but also for the impacts of climate change. From a climate protection policy viewpoint, it would be useful to take advantage of the developments to evolve criteria and principles for carbon management. As a matter of some urgency therefore the two political frameworks should start to mesh together.

4. IDENTIFICATION OF POSSIBLE OPTIONS FOR FUTURE DEVELOPMENT

4.1. *Criteria for identification*

Options below are being advanced for further consideration. They are widely varying and would relate to different scales of action. They meet one or more of the following criteria:

1. Substantial existing work being undertaken on the specific measure at national level which would benefit from improved networking at international level. (Many measures are not a priority for individual attention and can be adequately left at national level.)

2. Significant potential for ghg reduction

3. Ease of implementability.

4. Opportunity / necessity to link with significant policy developments underway in other fora.

5. Timescale for results from action by 2005, 2010, 2020.

The following matrix summarises how these apply to the selected measures.

Measure	Work underway	Reduces GHGs	Easy to implement	Linkages	Reduce by
Reduce methane emissions from manure	•	•	•	•	2005
Reduce mineral nitrogen fertilisers	•	•	•	•	2005
Reduce agricultural subsidies	•	•		•	
Develop sustainable agriculture as best practice	•	•		•	
Enhance carbon storage in soils	•	•		•	2005
Promote short rotation coppice to produce biomass for energy	•	•	•	•	2005
Integrate forest and climate protection policies		•		•	
Enhance carbon sequestration in natural forest through silviculture		•		•	2005
Make carbon management one criterion of sustainable forest practice		•		•	2005

4.2. *Agriculture*

4.2.1 Measure: Reduction of methane emissions from manure by manure management

Rationale ...nsiderable action underway at national level with identification of 'best practice' in e.g. USA and C... Refined systems have been developed in the Netherlands. When biogas production is

used win-win-win situations are created. (renewable energy supplied, reduction in ghg emissions achieved; reduced pollution of air and water.)

Action required:

(i) Creation of experts forum for interchange of information and establish common reporting methodology. (Use existing OECD/IEA networks as basis?)

(ii) Preparation of information about technologies and costs for different types and sizes of production units and dissemination methods.

4.2.2 Measure: Encouragement of reduction in use of mineral nitrogen fertilisers

Rationale: The price of nitrogen fertilisers remains extremely cheap and incentives are still to achieve maximum yields; high applications result in over-production, systemic pollution of water courses and supplies and N2O emissions.

Action required:

(i) Creation of experts forum to evaluate various options which have been tried in different countries such as direct regulation, nitrogen levies, nitrogen quotas, use of slow release products, and nitrogen testing kits;

(ii) Preparation of information using common reporting methodology on 'best practice'.

(iii) Identification of scope for harmonised and coordinated responses in view of trade implications.

4.2.3 Measure: Reduction of agricultural subsidies/ targeting of support to achieve environmental objectives

Rationale: Reduces incentives for over-production and payments to polluters, redirection of agricultural subsidies already underway.

Action required:

(i) Need for clearer links between ghg emissions and agricultural practices to be made in agricultural policy debates at Government and Inter-Government level to provide additional arguments for review.

(ii) Closer integration of agricultural policy and climate promotion policy framework at national level.

4.2.4 Measure: Development of 'best practice' concept as an all-encompassing measure within integrated approaches to sustainable agriculture.

Rationale: The intensive industrialised agricultural system model is being reviewed in many countries in terms of: its financial support mechanisms; its external environmental impacts; its food health impacts; and its capacity to result in "over-production" in some regions. Many of its associated practice have ghg emission impacts and are therefore relevant to climate protection policy debate. In developing best practice guidleine emphsis shoul be placed onth ned fornintegrate approach to sustainable agriculture. Whilst such initiatives are difficult, they could ,have high pay-offs for ghg reductions.

Action required:

(i) Within the OECD there is already an experts forum on these issues (Agriculture and Environment Policy Committee): considerable work has been undertaken on environment and agriculture issues. There is scope to build on this , integrate it with climate protection policy and develop a higher external profile for it.

(ii) In national governments there is scope for closer links between agricultural and climate protection policy frameworks.

(iii) Governments could consider launching international processes to mirror the Helsinki and Montreal fora in forestry, or use the CSD.

(iv) European Union Governments can use the opportunity provided by the Inter Governmental Conference (1996) to alter Article 39 of the Treaty of Rome, introduce new environmental objectives for the CAP and lessen the emphasis on increasing agricultural yields.

(v) Further work could be undertaken, through modelling, in analysing the net emission benefit from two alternative systems of agriculture on with high external inputs in agriculture and low agricultural land demands, and the other with low internal inputs and larger land demands.

4.3. Cross-sectoral

4.3.1 Measure: Enhance carbon storage in soils

Rationale: Soils are a major sink of carbon. Management practises in agriculture for soil conservation have developed in recent years and these also increase soil carbon pools. Management of forestry for soil carbon sequestration has yet to emerge as a significant practice but potentially offers great opportunities.

Action required:

(i) Clarification of scope and potential effects through modelling exercises. It is suggested that the IMAGE 2.1 model be used for an investigation of the effects and potential of sequestration of carbon in soils biota. It is understood this could be achieved within a few weeks.

(ii) The agreement to establish an Inventory Reporting methodology for these measures through the IPCC/IEA Guidelines.

(iii) The provision of incentives to achieve these measures as allowable 'offsets' within the FCCC process.

4.3.2 Measure: Promotion of energy crops and biofuels to produce biomass for energy

Rationale: There is broad agreement that one of the most promising and cost-effective mitigation options is the sequestration of carbon in trees and its use as a substitute for fossil fuels through continuous harvesting for the production of electricity or liquid fuels.

Action required:

(i) Many countries have undertaken research and development of this option and full-scale commercialisation has been reached in some places. Coordinated international action could however help to promote this strategy into take-off stage. In the absence of resolution of the issue of valuation

of wood as offset carbon (see below). some financial support may be necessary for investments in wood-fuel generation capacity.

(ii) There have already been moves to prepare guidance in the UK and USA. These efforts are principally directed at overcoming the problems surrounding the adoption of this strategy in relation to some of its environmental impacts as a continuously -grown crop. In addition the EU Altener programme of DG XVII and the IEA BioEnergy group are also in the process of developing guidelines. This measure seems an ideal candidate for further investigation, starting with an examination of what is already happening to see how it might benefit from additional resources, wider dissemination etc.

(iii) There are uncertainties about land availability for biomass crops for energy in relation to future demands for food, fibre and timber products) which could be further investigated through the IMAGE 2.1 model (which has already been used for some analyses).

4.4. Forestry

4.4.1 Measure: Enhance integration of forests and climate protection policy frameworks at national and international level.

Rationale: Forest policy has been rapidly changing since UNCED, developing policies, criteria and principles for sustainable forest management, which in general do not cover carbon management. There is a need for forest and climate protection policy frameworks to be more closely coordinated in terms of ghg mitigation opportunities offered by forests and to develop adaptation strategies for climate change impacts on forests .

Action required:

(i) Open dialogue between existing institutions at international and national level: the InterGovernmental panel on Forestry and FCCC; the Annex I Experts group and the Helsinki and Montreal processes and further interconnect research networks associated with these institutions

(ii) Create new temporary fora to bridge gaps at international and national levels between policy makers in these fields (i.e. not just academic researchers).

4.4.2 Measure: Enhance sequestration of carbon in natural forests through silvicultural methods

Rationale: There is a package of management practices which closely interconnect and which can be used to maximise carbon sequestration in natural forests. As forests ecosystems transcend national boundaries there is scope for international coordination on knowledge sharing.

Action required:

(i) Closely identify what is already happening in forest policy institutional frameworks.

(ii) Take account of need to address other environmental policy aims for forest management as well as carbon sequestration. Then select most promising options for development of best practices for dissemination.

(iii) Further develop tools such as Integrated Forest Management and computing packages which help selection of optimum carbon sequestration strategy for specified land areas, in relation to: existing forest

cover; local physical conditions; resilience to climate change; and optimum time path for maximising carbon pool.

(iv) Establish viable economic system for carbon sequestration with financial incentives or other market mechanisms.

4.4.3 Measure: Investigate how carbon management can be established as an integral part of criteria and standards verifying forest products are produced sustainably

Rationale: There are several separate processes underway to establish criteria, principles or standards for sustainable forest management so that forest products can be certified. There are two separate reasons why this measure is of significance for climate protection policy. First it seems prudent that these practices are consistent with carbon management objectives and at present there is no attempt to make them so. Secondly, the use of longer life wood products would enlarge the pool of sequestered carbon, on a once and for all basis .

Action required:

(i) As a matter of some urgency, a stock take should be made of progress to define criteria and principles for forest management in the Montreal and Helsinki processes, the IEA BioEnergy group, the FSC, and the ISO and regional trade fora.

(ii) Following from work on the previous measure, criteria should be defined for carbon management. Ways to overcome direct conflicts can be agreed (sustainably produced but short life timber products which cause CO2 emissions e.g. paper use)

(iii) A strategy can be developed to integrate these criteria into other parallel processes.

5. ANNEX I: FORESTRY POLICY IN SELECTED ANNEX 1 COUNTRIES

Australia

National Greenhouse Response Strategy

a) The One Billion trees program which aims to have a billion more trees planted and growing by the year 2000 to assist in improving sink strategy
b There is a national trade association programme to promote the use of timber and other wood products including more appropriate building standards.
c) The National Landcare programme will contribute to the productivity of native and planted vegetation and improve soil carbon levels (described in agriculture section).
d) There is a National Forest Inventory.
e) Tighter controls have been introduced on clearance of native vegetation.

Australia: National Forest Policy Statement 1992

f) Goal to maintain an extensive and permanent native forest estate in Australia
g) Goal to develop internationally competitive and ecologically sustainable wood production and wood products industries
h) Goal to ensure that private native forests are maintained and managed in an ecologically sustainable manner
I) Goal to expand commercial plantations
j) Goal to promote sustainable use of forests outside Australia to ensure Australia fulfills its objectives under relevant international agreements.

Greenhouse 21C

New estimates (March 1995) are that agriculture, forestry and land use change accounted for about 40% of total ghg emission in 1990 with clearing of native vegetation considered to be the most significant contributor to ghgs in this sector. There will be therefore be: greater recognition of greenhouse issues in Landcare and forest policies; Expansion of the One Billion Trees programme; Labour market programme for expanded tree planting; and better monitoring of land clearance.

Wood and Paper Industry Strategy

a benchmark of 15% of the pre-European distribution of each forest type to be protected within the reserve system
a process of comprehensive forest assessments
recognition of the value of native forests as an influence on climate and as carbon sinks
to add value to wood exports
to encourage plantation and farm forestry

Austria

InterMinisterial Committee to Coordinate Measures to Protect the Global Climate

a) Opportunities for increased CO_2 sequestration were identified with increased forest expansion but it is also recognised that forest health is severely threatened due to air pollution and measures are proposed for NOx and VOC's.

b) Opportunities to continue the substitution of fossil fuels by biomass (wood and straw_ have been proposed.

Austria Forest Policy

c)Forest areas have been increasing. Forest policy now advocates the use of natura species t encourage the share of broad-leaved species.
b) there has been soil erosion, increasing pest damage and snow damage to forests due to over use of conifers.
c) Air pollution problems have damaged 45% of monitored trees.
d) Natural regeneration is threatened by game and cattle and is only possible in 25% of forest areas.

Canada

a) Tree Plan Canada is intended to generate 325 million trees in rural and city areas.
b) Research is underway to assess forest sinks and their possible role in offsetting ghg emissions.
c) The National Action programme mentions several approaches to sink enhancement and emission mitigation but none are being implemented in the forestry sector apart from fire and pest control management measures.
d) The in depth review team noted that there seemed to be potential to develop sink enhancement measures. It was reported to them that forest land is now thought to be a net source of CO_2 primarily due to increased forest fires and pests. Possible causes for the increased incidence of fires are now being investigated. (including climate and weather variations, changes in types and age of trees, more reporting of fires and increased visitor pressure on wilderness areas.

Czech republic

National Communication

a) There is a policy to promote forests as sinks. A Cohesion and Guarantee Forestry Fund has been established by the Ministry of Agriculture. Subsidies are given for afforestation on agricultural land and reforestation activities particularly to increase species mix .
b) The intensive monoculture forestry systems have been found to be extremely vulnerable to air pollution and thence unable to resist additional stresses of wind, snow, and pests so that damage of more than 60% has been found in the total forest area
c) There is an active policy to promote the use of biomass for energy from agriculture and forestry sectors.

A new Forest Act has been prepared and will introduce new forest management planning both on state forest (60%) and private owners. More attention will be paid to ecological aspects such as species mix, felling practices; natural regeneration and reduction of damage by game.

Denmark

National Communication

a) It is aimed to double the forest area in Denmark within the next 8-100 years. Afforestation has been assisted by subsidies.
b) It has been calculated that this will result in a small additional sink in the next 30 years, reaching its peak in 70-120 years and comprising about 5% of present man made emissions in Denmark.
c) It is recognised that extending rotation periods does not give permanent additional sink capacity but that it would provide an opportunity to seek alternative solutions.
d) Approximately 15% of wood production was used for fuelwood in 1990. It is calculated that

this proportion will increase particularly as the quality of timber produced is low.

Forest Policy

A new Forest Act was enacted in 1989 and is based on the principle of integrating production and conservation in all forest areas. The Act defines good and multiple -use forest management as management with due regard to increasing and improving wood production as well as nature conservation, landscape, historical values, environmental protection and recreational interests.. Subsidies are given in private forests for nature conservation. Funds are allocated for afforestation particularly for urban, recreation forests with broadleaved trees.. Funds are also allocated for forest unprovement and afforestation on private land.

The Danish Strategy for Sustainable Forest Management (1994) serves partly as a follow-up to UNCED and Helsinki and also as the Danish policy on how to substantiate and bring into operation international efforts on the implementation of sustainable forest management. A 'Green Forest' management project is being implemented on state forests (one-third of total).

Hungary

a) No specific climate change forest measures are proposed bu the national communication reports forest policy.
b) The national afforestation programme has increased the forested area by 600.000 ha (from 12 to 18% of the country) and a further 500,000 ha to 1 mn ha of land currently agricultural land is surplus and the bulk of this could be afforested. This is expected to assist in employment generation as well as improve other benefits.
c) The bulk of the forest estate is deciduous forest and 27% of the forests are covered with fast growing species.
d) There is public concern over air pollution affects on the forest as well as possible climate change impacts on them.
e) The current Forest Law was enacted in 1961 basically has maintained the forest heritage and increased its extent and quality. The new law will give a higher priority to non-productive forest functions (such as leisure) and will stimulate new private forestry. The new Act is intended to cover the Helsinki resolutions.

Finland

Forest Policy

In 1994 it was agreed to implement the principles of sustainable forest management and there is a programme for the revision of forest laws. This is involving the development of new silvicultural guidelines where the aim is to have mixed forests on different sites and the share of broad leaves is being increased. The development and gradual implementation of the new practices aimed at mimicking the natural dynamics of the northern boreal forests. Government funding for the forestry sector has declined due to the recession. The focus is being shifted from wood production towards management of the whole forest ecosystem.

In order to achieve the new objectives forestry organisations have embarked on continuous in-service training of their personnel. During 1993 alone some 10.000 persons, i.e. all who work in the forest at different levels were given further training with a special focus on maintenance of biological diversity in forestry operations.

Germany

National Communication

a.) Conservation of existing forest is regarded as the most important forestry related measure for protecting the climate. Currently the amount of area covered by forests is increasing Air pollution is however playing a central role in damage to existing forests. The Plan points out that nearly all measures taken to reduce air pollution directly or indirectly reduce emissions of climate relevant trace gases.

b) Afforestation has been promoted for years by means of investment subsidies and in 1991 incentives for afforestation on new agricultural land were considerably enhanced through the introduction of an additional 20 year new afforestation bonus for farmers and forest owners. It is envisaged that a further 150.000 ha could be planted by 2005 but that this would only represent 0.2% contribution to overall CO_2 emissions in 1990. It is considered that this option is limited as it depends on the decision of private landowners and land availability with nature conservation and aesthetic constraints.

c) Increasing levels of biomass of existing forests: The use of longer rotation periods and optimum use of increments are thought only to make a modest contribution to improving the CO2 balance.

d) Increased use of wood: The increased use of wood products either as energy sources as a substitute for fossil fuels or as long-life wood products is thought to be beneficial.

e) Use of silvicultural and forest management measures: Overall it is thought that some scope for improvement is possible although there are considerable uncertainties about when forests reach maturity.

Altogether the forestry measures could correspond to 2-4% of national CO_2 emissions.

Forest Policy

Forest owners and foresters have been working on the implementation of sustainable management of forests and conservation of biological diversity in forests for some decades. The 1975 Forest Act forces all forest owners to manage their forests in sustainable and proper way. Key recent developments have included the National Forest Report (1994) which comprises a comprehensive analysis of the condition of forest ecosystems; economic ecological, socio-economic and cultural role of forests; multiple stresses and based on this, it describes policy objectives legal regulations; measures to protect forest ecosystems and measures to promote sustainable management. In addition, due to multiple stresses on forest ecosystems. A plan has been completed for the conservation of forest genetic resources. Further measures are perceived to be necessary to mitigate forest decline and to protect the global climate.

Italy

National Communication

Forests have been increasing in Italy both due to reforestation and the natural spread of forests due to the abandonment of grazing land and arable land. Coupled with te application of Eu U setaside policy there are incentives to be applied in Italy over the next ten years for the conversion of coppices into forests, planting of poplars and commercially valuable wood and urban parks. These are estimated to lead to an increase of 10% in the wood mass with an estimated annual sink potential of 10MT.

Specific reference is made to the National Forestry Plan.

National Forestry Plan

The Plan was prepared amidst the concern for the decrease in forest area and quality throughout the world. In Italy the forest are mainly coppices which are abandoned and in poor condition. They are highly fragmented with low productivity and subject to forest fires and disease. Reforestation is rare and the increasing abandonment of arable land has resulted in soil erosion and the loss of both protective and the conservation functions.

The plan aimed to achieve a balance between the management of forestry resources and a respect for the forest ecosystem with environmental improvement. The basic measures of the Forestry Plan were;

a) Maintenance and improvement of existing forests, with regard to ecology, hydrology and productivity.

b) Providing incentives to reforestation on abandoned and fertile land encouraging valuable native species such as cherry walnut, chestnut and cork

c) Consolidation and development of efficient forestry for wood harvesting with poplars and other growth species.

d) Improvement of forestry management and use of Italian wood and wood products.

e) Development of urban parkland.

Japan

National Communication(Action Report) and Forest Plan System

Despite its industrial activity, Japan has maintained one of the higher forested land ratios in the world (67%) which it is has maintained with 41% of its forests being plantations which are currently maturing. Projected CO_2 removals from forestry in 2000 are approximately 25MT of carbon. The Action Report on Climate Change recognises that it is necessary to strive for better forest management for sink enhancement. *"With respect to sinks of CO_2, efforts should be made to work for the conservation and development of forests, greenery in urban areas and so forth in Japan and to also to take steps to conserve and expand forests on a global scale".*

The national forestry and wood products industries have been unable to provide proper management due to depressed prices (presumably due to high timber imports from tropical areas). Japan's measures on forestry outlined in detail in its national communication, emanate from its Forest plan System. The Forest Plan system was radically revised in 1991 to try and tackle the poor management legacy and now constitutes a complex, prescriptive process comprising many separate forest planning documents covering forest resources, operations, regional forest plans and specific management plans. The process is underpinned by surveys and data collection. Priority for forest management is still timber and wood products production. Separate measures for some areas have been established through the National Parks Law and Nature Conservation Law of which the vast majority are forested areas (80%) comprising some 14%of total area. All these measures are presented as measures to enhance carbon-dioxide sinks.

The basic Nationwide Forest Plan is formulated in accordance with Government policy for forest resources and products. There are four forest types national conservation forests; forests for natural sustenance; forests for recreational use; and forests for timber protection. The Plant is revised every five years and clarifies goals and other matters associated with forest improvement in all forests over 15 year periods and provides guidance for 44 different wide-area river basins. This plan is operationalised in a separate document.

- Regional forest plans are prepared within the prefectural system for private forests on a regional basis and private owners are obliged to seek permission for forestry activities. Forest owners are prepared by private owners and submitted for approval.

- Approximately 35% of Japan's forests were designated as Protection forests in 1991, comprising about 35% of Japan's forested area or about 24% of its total land area. Conditions are set on harvesting.

- There is an afforestation plan which promotes forests for flood prevention, water basin management and soil protection as well as afforestation activities in private forests.

- Under the Forest Improvement Plan, an emergency programme of thinning has been underway together with the construction of access roads and processing capacity.

Sustainable forest management is viewed essentially as sustained yield forestry with distinct policies and programmes designed to prevent insect damage and improvements in wood processing productivity and efficiency.

The Netherlands

National Communication

The national communication refers to its domestic forestry plan. The target of this Plan is to afforest an area of 75,000 ha in 25 years representing an increase of over 20% of existing forested area. Of the total additional area, 30,00 is to be afforest by farmer following EU proposals. In addition there is government finance to afforest a further 25,000 ha. the remainder will be achieved through voluntary activities. A system of carbon credits is under consideration which will give economic sectors an incentive to invest in afforestation: the quantity of carbon fixed through afforestation will determine the number of credits awarded.

Forest Policy

The national forest Policy Plan was produced shortly after the Rio Conference and provides an important stimulant to a further enhancement of sustainable forest management in the Netherlands. It considers the elaboration and subsequent implementation of criteria and indicators an important step towards the goal of sustainable forest management. To promote sustainable management the Netherlands are in favour of the introduction and application of ITTO guidelines for sustainable management and the introduction of a labelling system both for imported and homegrown timber. Some user groups have restricted themselves on a voluntary basis to sustainable produced timber. Recreation is by far the most important socio-economic function of the forests

The Netherlands has a very limited forest area which provides only 10% of the demand for forest products. Efforts have been underway since the nineteenth century to increase afforestation initially in poor land, and now measures are in hand to improve the ecological values of these areas. Approximately 20% of the forest area is exclusively reserved for ecological functions. Only about 20% of the forest is formed by mixed stands and the biodiversity of these young forests is increasing as a result of reducing clear-cut areas or adopting shelterbelt systems, increasing rotation periods, promoting indigenous tree species (including local provenances) and mixed stands, increased natural regeneration and conservation of dead wood. Forest condition and biodiversity are affected by high levels of N deposition.

Norway

National Communication

The net anthropogenic sink of CO_2 in the forest (12MT) and estuaries, freshwater and soils (2.8 MT) of Norway is estimated to be about 40% of the total emissions of CO_2 in 1992. The greatest uncertainty is in the estimate of the net sink in forest soil. The annual accumulation in forests occurs mainly because the annual increment in the standing volume in Norwegian forest is larger than the sum of CO_2 from wood harvesting and wastes. Forest residues are extensively use of energy particularly for pulp and paper production.

Harvesting from the forest has a long tradition in Norway and up to the beginning of this century the annual harvest was large than the gross increment. Since then there has been an increase in the standing volume of Norwegian forest.The standing volume estimates are based on annual surveys. The standing volume of Norwegian forests has been steadily increasing in recent years and is now estimate to total 800 MT CO_2 .The National Communication states that one of the main objectives of Norwegian forestry policy is to maintain and enhance forestry resources both because this permits continued exploitation of the natural resource base for forestry purposes and because it has a favourable effect on climate. It states that current forestry policy emphasises the conservation, development and utilisation of natural resources. It recognises that it is possible to increase the yearly net fixation of CO_2in Norwegian forests through specific measures and a number of such measures have been evaluated and may be of interest in an integrated system of forest management. It notes that continuous evaluation will be required to find the right balance between forestry and climate policy on the one hand and local environmental effects related to biodiversity, recreational value on the other.

The National Communication also assesses the impacts of climate change on terrestrial ecosystems.

Norway Forestry Policy

Although from a climate policy perspective, forest issues assume great importance, it is of interest to note that climate policy issues do not assume great significance in forest policy which has been dominated in recent year by moves to integrate other environmental policy aims. New national plans for forestry were passed in 1985 and 1993. The main objectives of forest policy are to stimulate to:

- active and sustainable use of forest resources in short and long term
- conservation and further enhancement of the environmental values in forests

The main goals of the Forestry Act are to promote forest production, afforestation, and protection of forest whilst at the same time allowing the forest as sources of recreation, major landscape features, living environments for plants and animals and as hunting and fishing grounds. Many regulations on aspects of forest management such as the construction of roads, and the use of chemical agents were revised in 1994 in order to achieve better integration of the preservation and enhancement of biological diversity. Additional provisions have ben introduce in the Forestry act for land with special protective functions and 2% f the forest area as now been so designated. There is a also a separate pn for the protection of coniferous forests. An action plan for preservation an sustainable use of biodiversity in forets was submitted to nation-wide hearing in 1994. new comprehensive monitoring systems were established .

Forestry activities are supported by providing owners with tax advantages. But all financial support schemes were revised in 1994 to improve the preservation of biological diversity. The financial support schemes now favour environmentally sound investments and all support schemes require that forest owners must take environmental value considerations. Guidelines for strategic planning of forestry at municipality level were introduced in 1993 in which a wide variety of forestry and environmental aspects are reflected at the planning stage to reflect an increasing environmental consciousness.

New Zealand

National Communication

New Zealand has been an advocate of a forestry sinks policy. Its natural forests (6.2 mn ha) are substantial carbon reservoir. In addition in 1994 there were 1.4 mnha of forest managed on sustained yield management principles with the predominant species being Pinus radiata. There is also a substantial programme of new forest planting with on average 100,000 ha being planted each year as a result of a concerted programme with a number of policies which have promoted forest expansion, including

- tax deductibility for establishment costs.
- limitations on tax liability
- abolition of duties on forestry rights
- easing of granting of forestry rights on Maori-owned land
- reduction of planning controls on forestry

These policies are expected to result in rates of 135,000 h / year in the mid nineties and land availability constraints are unlikely to apply until around 2020. There have been specific large schemes which have been launched as carbon sinks. In addition to formal afforestation, the drastic value in the reduction of agricultural subsidies from 25% in 1979-86 to 3% in 1992 is expected to entail reversion to shrub land. New Zealand regards its plantation forest as a crop rather than the product of a natural ecosystem.

The indigenous forest occupy 6.2 mn ha of which 4.9 mn are owned by the state. Only 1% of New Zealand's commercial wood production is from its indigenous forests. The Government has been introducing new measures for sustainable managment in indigenous forest in order to stop unsustainable forest harvesting in these forests. This includes measures to control pests. There are existing policies to ensure a 'risk averse' approach to fires and it is stated that genetic tree improvement to offset growth rates resulting in losses from disease.

New Zealand calculated in its national communication that forestry absorption of carbon dioxide was estimated to be 16,716 Gg in 1990. This figure apparently allowed for 1255 Gg that was emitted through forest clearing and fire. By 2000 it was estimated that planted forests are projected to remove 25.519 Gg of carbon dioxide from the atmosphere. New Zealand developed its own method to quantify carbon sequestration by managed forests based on calculating a carbon inventory at two points in time and identifying the difference. It has been controversial because it excludes transportation and energy requirements of timber and processing operations, nor the degradation of sinks and the impact of pests.

Wood is extensively used in residential heating and some industrial use, particularly in forest processing industries. Possible changes to the wholesale electricity market are planned and they would assist non-traditional renewable energy sources in gaining access to energy markets.

Sweden

National Communication

The forest is one of Sweden's most important natural resources and a large carbon reservoir: as a much as 62% of Sweden is covered in forest. However, even though at present the sink capacity is considerable in comparison to the emissions, the net sequestration is expected to level off in a few decades. Keeping the level of carbon stored in the forest will demand continue sustainable forestry policy.

The timber and forest products of the forests has been intensified during the twentieth century with conversion of natural forests into conifer plantations. In 1993 a new forest policy was adopted. Environmental goals are now equated with production goals. The environmental goal is that the natural

carrying capacity of forest and is to be sustained and the biological and genetic diversity of the forest is to be safeguarded.

There has only recently been small increases in total area during the past decades. Whilst there has been some fertilisation benefits from airborne nitrogen deposition in some parts of the country, acidification of forest soil in others involves able damage in the form of timber losses and carbon sequestration in others.

The Swedish forest today constitutes a sink for carbon dioxide due to incremental annual growth. the net carbon dioxide accumulation has been estimated to be nearly 35MT/per year which is more than half the annual emissions of carbon dioxide. Most of the increment is anthropogenic due to forest management practises which raise the timber stock above the level of non-managed forest. It is estimated that the increase in the forest biomass could continue for another few decades. There is uncertainty as to whether soil-bound carbon is accumulating or is approaching a balance point.

Various silvicultural practices have been modified to reduce CO2 emissions in the forestry sector:

- there is less intensive site preparation prior to planting
- new land drainage prohibitions have been enforced in some areas and is now regulated by permit in others
- direct nitrogen fertilisation has been reduced as it is not judged to cause significant reductions in emissions of ghgs. Liming and fertilisation are is being undertaken to combat acidification but this can reduce soil carbon levels
- there has been a reduction in clear-fell harvesting, and a reduced clearing of clear fell areas and the use of shelterwood for better soil husbandry to sustain soil carbon levels
- a greater use of natural regeneration methods
- afforestation of relatively small areas of arable land under agricultural policy
- transition to wood products with a longer life and increased recycling of paper products and use of old paper for fuel
- substitution of fossil fuel by forest fuel with investment support to CHP and support to expansion of district heating plants.

Sweden Forest Policy

A new forest policy was approved in 1993 when the commitment to UNCED was integrated into national policy. There is one goal for forest environment and another for production. The two goals must be given equal weight in the management of the forest resource. A multiple use approach to forest management means that the needs for both wood production and other functions of the forest should be satisfied in principal on all forest land. The environment goal covers biodiversity, the maintenance of natural forest ecosystems and the protection of endangered species. The production goal aims to utilise forest and forest land in an efficient way for a sustainable and valuable yield and to ensure that forest production can satisfy different human needs in the future.

There have been consequent changes in forest policy instruments with less emphasis on forest legislation and subsidies and more emphasis on education and extension. Forest owners are to take a greater responsibility themselves from both an economic and ecological mange viewpoint. The owners are required to specify the method for regeneration and the environmental measures to be taken in final felling. If the costs are too high, the owner is eligible for subsidies.

Only 3% of the forest land is protected, principally in northern Sweden. In addition a further 14% of forest can only be used extensively. The national board of forestry and local boards work with a broad representation of stakeholders and the necessity for people's participation is stressed. Forestry certification run by WWF is supported by the forestry sector but there has so far been no direct

involvement by the state. There have been specific moves to enhance the biodiversity value of forest have been undertaken establishing ecological corridors, changed harvesting and silvicultural methods. These include the increased use of natural regeneration and shelterbelts (indicate above). The extension service has changed its emphasis for increased forest yield and now covers guidance on nature conservation. Since the late 1980's 100.000 forest owner and forest employees have been involved in a special "Richer Forest"campaign.

Switzerland

National Communication: Global Warming and Switzerland: Foundations for a National Strategy

Swiss forests cover a total area of 1.2 mn ha which is reservoir of 90 Mt C. The recent annual rate of increase has been 6.600 ha. It has been calculated that if all the fallow land theoretically technically available for planting new forests was available this could only offset about 2% of emissions.

It is therefore recognised that increased removal of CO2 by sinks has only a limited potential in Switzerland. But that opportunities exist to make better use of wood. Some measures are identified which could contribute if given adequate support, for example, through a policy of subsidised investments or with the help of economic instruments.

1. Use of wood and biomass as substitutes for fossil fuels- it is aimed to double wood consumption annually if technology for energy generation is improved with potential to reduce CO2 emissions by 3Mt/yr. .

2. It is also intended to increase the use of long life product which could have the effect of reducing emissions by 1Mt CO2/yr during 25 years.

Various adaptation measures are proposed to make forests more resilient to climate change.

UK

National Communication :Climate Change the UK Programme

Forest cover in the UK has been increased by 5% to 10% this century. There are no genuinely natural forests left but remnants of ancient woodland which are semi-natural in character. The UK is encouraging afforestation through incentive schemes (such as the Woodland Grant Scheme and Farm Woodland Premium scheme). These schemes are designed to encourage the creation of multipurpose woodlands. UK forest policy is not determined by its climate protection policy and ha been working to different imperatives since it started in 1919.

In the last decade afforestation has been at a rate of 20,000 to 30,000 ha/yr and these rates (1% year) are being maintained. The rate of carbon fixation is estimated to be broadly static at 2.5MtC/yr equivalent to 1.5% of the UK's CO2 emissions.

It is however recognised that the creation of new woodlands and forests could make a contribution towards the UK's efforts to help limit increases in CO2. Every 50.000 ha planted would absorb about 3% of the current annual carbon emissions.

The Sustainable Forestry Plan refers briefly to the role of UK forests as sinks and that this will possibly become more important. The main thrust of the Plan however is to focus on improving sustainable management of the UK forest resource in terms of its biodiversity interest and forest health problems. Great stress is laid on multi-purpose forestry due to land availability constraints.

US

National Communication: Climate Action Plan

Forests cover roughly one-third of the US land area. Forested areas in the US have expanded in the past 20 years but the amount of old-growth continues to decline. The forest are immensely variable ranging from complex juniper forests of the arid interior, to the humid and highly productive forests of the coastal Pacific Northwest and Southeast. It is recognised that climate change will present great challenges involving shifts in the optimum growing conditions for some North American forest species by more than 300 miles to the north exceeding the rates at which the less actively managed forest could migrate.

The US has an active policy to promote carbon sequestration in forests and to protect carbon sequestered in forests. The Action Plan include several programmes to maintain carbon sequestered in forest ecosystems which provide about 9% of the emission reductions needed to reach the greenhouse gas target in 2000. The emphasis is not on afforestation or reforestation, unlike some countries, but by better management of existing forests.

- Lower harvests in old-growth forests will help prevent CO2 emissions because of their high carbon densities and a shift towards ecosystem management will favour less-damaging timber harvesting methods.

- Increased recycling will extend the useful life of forest products.

- The Cool Communities programme will encourage the planting of shade trees to improve home energy efficiency and will act as a sink.

- Technical and economic assistance will be given to the non-industrial private sector landowners to aid them making silviculturally and financially sound timber-harvesting decisions. It is hoped to improve forest management practices in these forests and to increase carbon sequestration by reducing harvesting practices (to sequester 4 MMTCE in 2000)

- Tree planting will be assisted on poorly stocked and nonstocked, nonindustrial private forest land by 233,000 acres in 5 years through the Stewardship Incentive Programme

6. ANNEX II: TECHNOLOGY SUMMARIES: BEST AVAILABLE PRACTICE

TECHNOLOGY LIMITATIONS: REDUCTION IN USE OF NITROGEN FERTILIZER AND ANIMAL MANURE

Source Country for Data: Various ***Date:*** 1994

Technology Data Type: Best Available Practice

GENERAL DATA CHARACTERISTICS

Sector: Agriculture.

Applications: Agricultural practices.

Typical Size: Can be any size but to have any meaningful effect on mitigation of N_2O, must be at least several hundred hectares.

Design Fuels: Not applicable.

Performance Measure: Extent of reduction in nitrogen fertilizers without appreciable effect on health, productivity, and growth rates of agricultural components.

Design Lifetime: Indefinite, with harvesting cycles dependent on species grown on particular site.

Construction and Delivery Timeframe: Minimal; would require initial testing of soils to determine nitrogen fertilizer needs of site. In addition, some changes in planting and maintenance activities may be needed to compensate for reduction in use of nitrogen fertilizers.

Development Status: Currently available.

COST INFORMATION

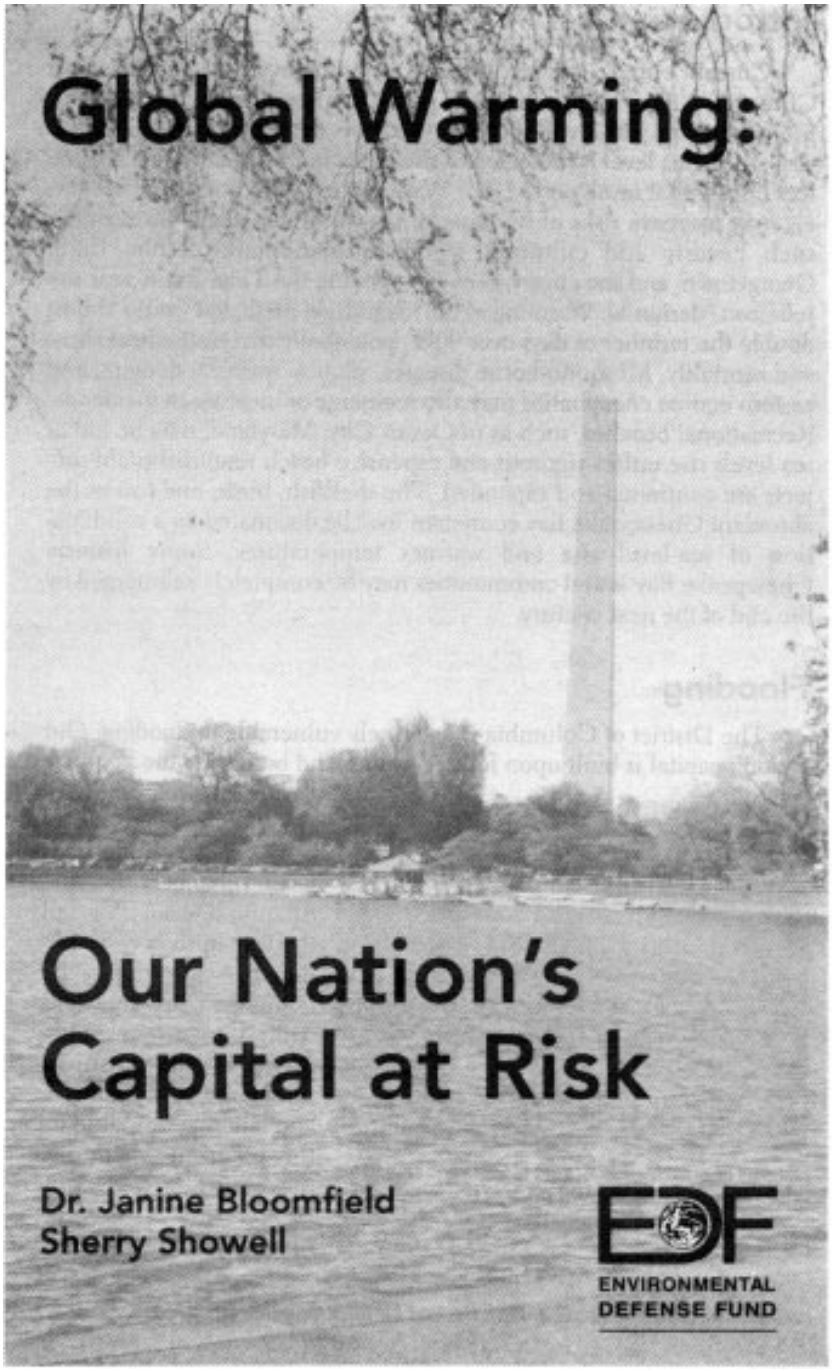
Location and Year: Various parts of the world.

Capital and Installation: Initial soil tests required to determine nitrogen requirements of site.

Non-fuel Operation and Maintenance:
Various practices would need to be adopted to improve efficiency of the use of nitrogen fertilizers and manure.

Some of these would include:

- timing of nitrogen fertilizer application to needs of crops
- application of nitrogen to deeper soil layers
- application of nitrification inhibitors to the soil
- use nitrogen fertilizers with improved formulations - are likely to be more expensive than conventional fertilizers
- use controlled release nitrogen fertilizers- are likely to be more expensive than conventional fertilizers

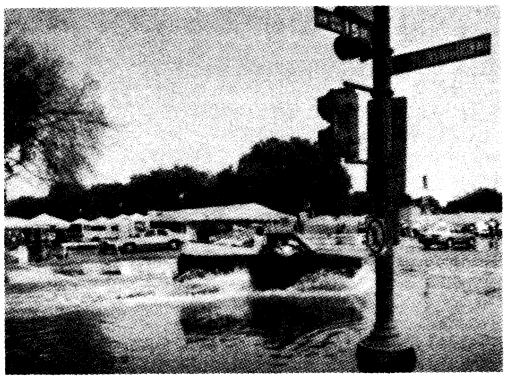

Global Warming:
Our Nation's Capital at Risk
Dr. Janine Bloomfield
Sherry Showell
EDF
ENVIRONMENTAL DEFENSE FUND

Introduction

Current climate models used by the Intergovernmental Panel on Climate Change, an international group of more than 2,000 scientists, project that the Earth will warm by two to six degrees Fahrenheit by the year 2100. Sea level is projected to rise by six inches to as much as three feet during that same period. For Washington, D.C., increased sea levels may increase risks of flooding of the Potomac River, threatening such historic and culturally significant landmarks as the Mall, Georgetown, and the cherry trees surrounding the Tidal Basin near the Jefferson Memorial. Warming of the magnitude predicted would almost double the number of days over 90°F, potentially increasing heat stress and mortality. Mosquito-borne diseases, such as malaria, dengue, and eastern equine encephalitis may also reemerge or increase in incidence. Recreational beaches, such as in Ocean City, Maryland, may be lost as sea levels rise unless vigorous and expensive beach renourishment projects are continued and expanded. The shellfish, birds, and fish of the abundant Chesapeake Bay ecosystem may be decimated by a combination of sea-level rise and warmer temperatures. Some historic Chesapeake Bay island communities may be completely submerged by the end of the next century.

Flooding

The District of Columbia is extremely vulnerable to flooding. Our nation's capital is built upon former swampland bordering the Potomac River. This region of the Potomac, up to the base of Little Falls, is tidal: sea level changes in the Atlantic Ocean flow all the way upriver to Washington, so that the Potomac rises and falls with the ocean tides. Many of the District's most familiar monuments and landmarks, including the Jefferson Memorial, the Mall, the Reflecting Pool, and National Airport, are very low-lying,



Flooding near the Mall as a result of Hurricane Fran. This type of flooding could worsen if sea-level rise increases due to global warming. (©1996, *The Washington Post.* Photo by Bill O'Leary. Reprinted with Permission.)

EDF would like to thank Dr. Stephen P. Leatherman of the University of Maryland and Robert DeFeo of the U.S. Park Service for reviewing this work.

and are therefore susceptible to flooding. Although flooding during storms would not cause permanent inundation, large areas could be covered temporarily. Last winter, Hurricane Fran caused extensive flooding along the Potomac, including National Airport and parts of Georgetown and the Mall. In 1985, severe flooding due to heavy rains led to the deaths of at least 47 people and the region suffered more than $900 million in damage. Flooding due to heavy rains and storm surges will be exacerbated if global warming further increases sea level. Property damage and loss of life may become more common and more severe. Mitigation efforts, including increased bulkheads and retreat from vulnerable zones, may be expensive.

Scientists estimate that by the year 2040 sea level might rise from two inches to one foot higher than today. If it rises one foot, a major storm surge would push the Potomac River over its banks, flooding the park along the river and the Reflecting Pool. The Jefferson Memorial would become an island. By the year 2075, sea level might rise from four inches to two feet higher than today. If it rises two feet, a major storm surge would nearly encircle the Washington Monument and completely surround the Internal Revenue Service, the National Museum of Natural History, the National Gallery of Art and neighboring structures. Muddy waters would even reach the grounds of the U.S. Capitol.

*- from the exhibition **Global Warming: Understanding the Forecast,** developed by the American Museum of Natural History and EDF.*

Disease

The increased temperatures predicted for Washington by climate models may lead to greater risk of mosquito-borne diseases, those we usually associate with much more tropical areas. Studies show that the ranges of malaria, dengue or "breakbone" fever, and eastern equine encephalitis are all expected to expand with increased warming. Higher temperatures would increase the number of mosquitoes, make each mosquito bite more infectious, and cause mosquitoes to bite more frequently. No vaccines currently exist for dengue or malaria.

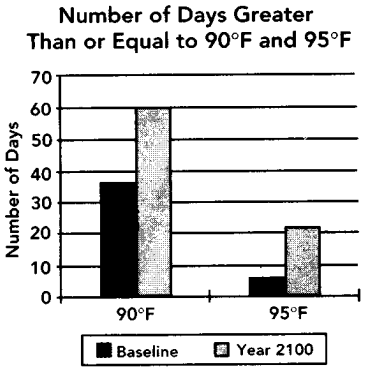
While most strains of malaria can be controlled, drug-resistant strains are proliferating. Dengue, a serious illness when contracted initially, can lead to hemorrhagic (bleeding) fever in those who contract it a second time. Of this group, 1 to 5 percent would be expected to die even with adequate medical care. The incidence of eastern equine encephalitis, which attacks both horses and humans, has been increasing in parts of the United States in recent years, although transmission is still considered rare. Prince Georges County, adjacent to Washington, reported 5 cases in 1996, however, the origins of contraction are not known. Early symptoms include fever, headache, drowsi-

ness, and muscle pain, followed by disorientation, weakness, seizures, and coma. Sixty percent of symptomatic cases are fatal, and most survivors will suffer permanent neurological damage. Mild winters and wet springs, predicted to increase with global warming, are associated with increased risk of eastern equine encephalitis.

Global warming would require mosquito-control programs in the Washington area to be initiated or expanded to address the additional risks. But even spraying to control mosquitoes may not be fully effective, as more and more mosquito species are becoming resistant to pesticides.

Heat Stress

Global warming could dramatically increase the number of days above 90°F and 95°F. Currently, Washington experiences an annual average of 36 days above 90°F. By the end of the next century, best estimates project about 60 days above 90°F though one scenario produces as many as 87 days that hot. The city would also experience more heat waves, some of which would be of much longer duration. Heat-related illness and mortality may greatly increase as a result, affecting first the most vulnerable parts of the population: the elderly, the young, and those already weakened by illness.



Global warming could dramatically increase the number of hot days in Washington, DC. The best estimate scenario—a global warming of 3.6°F by the end of the next century—could more than triple the average number of days per year over 95°F. The baseline represents observed temperatures between 1950 and 1980.

Warmer temperatures could also exacerbate already poor urban air quality. In the summer, high temperatures in combination with sunlight produce ground level ozone and smog, which can cause serious respiratory distress and eye irritation.

Cherry Blossoms

The blooming of the cherry trees in Washington is a national event, symbolizing the capital's natural beauty, the coming of spring, and the links between the people of our nation's capital and peoples around the world. The cherry trees, given to the people of America by Japan in 1912, are probably not in danger from projected warming. However, due to their proximity to the Potomac River, they are threatened by increased flooding from sea-level rise. Cherry tree roots are extremely

sensitive to extended periods of high water. Last year's floods damaged many of the trees. New trees are being planted on mounds in an attempt to reduce their exposure to excessive moisture.

Dr. Janine Bloomfield

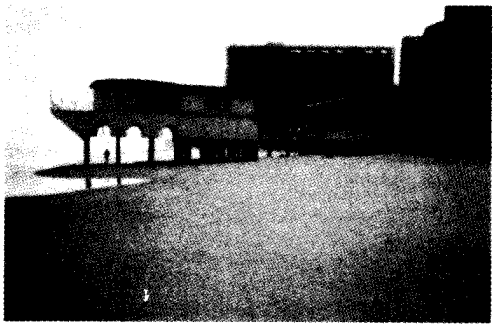
New Cherry Trees near the Tidal Basin must be planted on mounds to protect roots from current levels of flooding. If sea level rises due to global warming it may become harder to maintain existing trees and establish new ones.

Interestingly, the date of peak blooming for cherry trees is being pushed earlier, in part due to warmer temperatures. Between 1921 (when peak bloom dates were first recorded) and 1970, the average date of blooming for Yoshino cherry (*Prunus xyedoensis*) was April 5. But between 1970 and 1997, the average date of peak bloom was April 3. This period included the earliest peak blooming date ever recorded, March 15, 1990. The peak blooming date (defined as the date when 70% of the single, white blossoms of the Yoshino cherry surrounding the Tidal Basin are open) is dependent to a large extent on spring temperatures. Warmer springtime and nighttime temperatures tend to lead to an earlier bloom date. Both warmer average springtime temperatures and warmer nighttime temperatures are predicted to occur with global warming. The earlier blooming of the cherry trees is indicative of the trend that could occur with global warming.

Beach Erosion - Ocean City, Maryland

Sea-level rise threatens beaches and resort areas on the Atlantic coast in the Washington-Baltimore region. Ocean City, Maryland, located about 150 miles from Washington and 135 miles from Baltimore, is an excellent example. Built on a barrier beach island, Ocean City is one of the primary resorts on the East Coast, boasting a temperate climate, lovely bathing beaches, and a variety of hotels, restaurants and amusements that attract more than eight million visitors each year. Visitor spending in Ocean City contributed an estimated $1.5 billion to the local and state economy in 1996. Nearby Assateague Island National Seashore (MD, VA), Assateague State Park

(MD), and Chincoteague National Wildlife Refuge (VA) provide excellent opportunities to enjoy and explore nature. The broad beaches, secluded coves, and marshes of these barrier islands teem with nature and are home to crabs, plovers, and wild horses.



Dr. Stephen Leatherman, University of Maryland

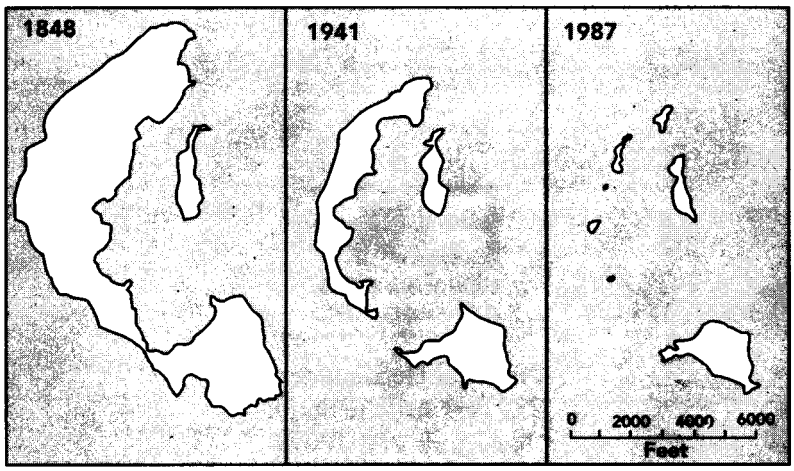
Ocean City, Maryland. If sea level rises due to global warming, shore erosion could accelerate. Beaches could be lost without costly replenishment of sand.

Sea-level rise caused by global warming would threaten the barrier islands, their natural resources, and their economies. An Environmental Protection Agency study in 1985 estimated that a one-foot rise in sea level at Ocean City could double the rate of beach erosion, causing the loss of more than 200 feet of shore. To maintain current shorelines would require expensive, ongoing projects, dredging sand from offshore, transporting the sand to the islands, and spreading the sand to fill in the beaches. The 1985 EPA study estimated that, for a one-foot rise in sea level, maintaining the beach at Ocean City alone would cost a total of $60-$85 million. High-rise condominiums and hotels built only a few hundred feet from the water's edge will prevent migration of the barrier island inland, so without continuous sand replenishment, inundation and erosion could lead to beach loss.

During storms, increased sea levels would lead to greater flooding due to storm surges and thus greater levels of storm damage. Drinking water supplies could be threatened as higher sea levels increase the salinity of surface and ground water. Higher sea levels also push up water tables and could lead to the inundation of low-lying areas, including beachfront development. In the nearby national parks and seashores, where beach nourishment and other human interventions would probably be too expensive, marshes would have to migrate landward or, if sea-level rise were too rapid, they would be inundated.

Chesapeake Bay

Chesapeake Bay is an immense body of water bordered by Baltimore, Maryland and Norfolk, Virginia, and fed by the Potomac, James, and Susquehanna Rivers. The Bay's watershed is home to thirteen million people. Chesapeake Bay is the nation's largest estuary, formed by the confluence of fresh water from rivers and streams and salt water from the ocean that creates a nutrient-rich zone which sup-



Historical shoreline changes on Poplar Island, Maryland in Chesapeake Bay. As a result of relative sea-level rise and its associated erosion, the island is losing more than 13 feet of land per year. This process may accelerate and threaten more land if sea-level rise increases due to global warming.

ports a huge diversity of fish, shellfish, mammals, shorebirds, and migratory birds. Sea-level rise threatens this rich ecosystem as well as numerous Bay Island settlements, some dating from the 19th century.

Sea level has been rising at a rate of about 3 feet per 1,000 years for the last 5,000 years. In the last 100 years, that rate accelerated to 1 foot per 100 years. In the next 100 years, it is predicted that a combination of subsidence and global warming will cause this area to experience a relative sea-level rise of from 2 to 3 feet. Impacts from this accelerated sea-level rise are expected to include greater damage from wave action on the eastern shore of the Bay, intrusion of saline waters into freshwater marshes, and an inundation of wetlands. Some islands in the Bay,including historic Poplar Island, could become completely submerged.

Higher sea levels would cause the Bay to become saltier, causing damage to shellfish, such as oysters and soft shell clams. The soft shell clam, already at the southernmost point of its range, could be eliminated due to a combination of salinity changes and warming waters. Saltwater intrusion could cause large-scale plant die-off, which is already occurring at Chesapeake's Blackwater National Wildlife Refuge as a result of current rates of sea-level rise. Although sea-level rise will convert some low-lying areas to marshes, that process is much slower than the rate at which existing marshes are lost. Onshore human development will constrain the amount of land that can be converted to wetland.

National Headquarters
257 Park Avenue South
New York, NY 10010
(212) 505-2100

1875 Connecticut Ave., NW
Washington, DC 20009
202-387-3500

5655 College Avenue
Oakland, CA 94618
510-658-8008

1405 Arapahoe Avenue
Boulder, CO 80302
303-440-4901

128 East Hargett Street
Raleigh, NC 27601
919-821-7793

44 East Avenue
Austin, TX 78701
512-478-5161

Project Office
6 Faneuil Hall Marketplace
Boston, MA 02109
617-723-2996

100% recycled (75% post-consumer) paper

I. DECISIONS ADOPTED BY THE CONFERENCE OF THE PARTIES

Decision 1/CP.1

THE BERLIN MANDATE: REVIEW OF THE ADEQUACY OF ARTICLE 4, PARAGRAPH 2 (A) AND (B), OF THE CONVENTION, INCLUDING PROPOSALS RELATED TO A PROTOCOL AND DECISIONS ON FOLLOW-UP

The Conference of the Parties, at its first session,

Having reviewed Article 4, paragraph 2(a) and (b), of the United Nations Framework Convention on Climate Change, and

Having concluded that these subparagraphs are not adequate,

Agrees to begin a process to enable it to take appropriate action for the period beyond 2000, including the strengthening of the commitments of the Parties included in Annex I to the Convention (Annex I Parties) in Article 4, paragraph 2(a) and (b), through the adoption of a protocol or another legal instrument:

I

1. The process shall be guided, *inter alia,* by the following:

(a) The provisions of the Convention, including Article 3, in particular the principles in Article 3.1, which reads as follows: "The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Accordingly, the developed country Parties should take the lead in combating climate change and the adverse effects thereof;"

(b) The specific needs and concerns of developing country Parties referred to in Article 4.8; the specific needs and special situations of least developed countries referred to in Article 4.9; and the situation of Parties, particularly developing country Parties, referred to in Article 4.10 of the Convention;

(c) The legitimate needs of the developing countries for the achievement of sustained economic growth and the eradication of poverty, recognizing also that all Parties have a right to, and should, promote sustainable developments;

(d) The fact that the largest share of historical and current global emissions of greenhouse gases has originated in developed countries, that the per capita emissions in developing countries are still relatively low and that the share of global emissions originating in developing countries will grow to meet their social and development needs;

(e) The fact that the global nature of climate change calls for the widest possible cooperation by all countries and their participation in an effective and appropriate international response, in accordance with their common but differentiated responsibilities and respective capabilities and their social and economic conditions;

(f) Coverage of all greenhouse gases, their emissions by sources and removals by sinks and all relevant sectors;

(g) The need for all Parties to cooperate in good faith and to participate in this process.

II

2. The process will, *inter alia:*

(a) Aim, as the priority in the process of strengthening the commitments in Article 4.2(a) and (b) of the Convention, for developed country/other Parties included in Annex 1, both

- to elaborate policies and measures, as well as
- to set quantified limitation and reduction objectives within specified timeframes, such as 2005, 2010 and 2020, for their anthropogenic emissions by sources and removals by sinks of greenhouse gases not controlled by the Montreal Protocol,

taking into account the differences in starting points and approaches, economic structures and resource bases, the need to maintain strong and sustainable economic growth, available technologies and other individual circumstances, as well as the need for equitable and appropriate contributions by each of these Parties to the global effort, and also the process of analysis and assessment referred to in section III, paragraph 4, below:

(b) Not introduce any new commitments for Parties not included in Annex I, but reaffirm existing commitments in Article 4.1 and continue to advance the implementation of these commitments in order to achieve sustainable development, taking into account Article 4.3, 4.5 and 4.7.

(c) Take into account any results from the review referred to in Article 4.2(f), if available and any notification referred to in Article 4.2(g).

(d) Consider, as provided in Article 4.2(e), the coordination among Annex I Parties, as appropriate, of relevant economic and administrative instruments, taking into account Article 3.5;

(e) Provide for the exchange of experience on national activities in areas of interest, particularly those identified in the review and synthesis of available national communications; and

(f) Provide for a review mechanism.

III

3. The process will be carried out in the light of the best available scientific information and assessment on climate change and its impacts, as well as relevant technical, social and economic information, including, *inter alia,* reports of the Intergovernmental Panel on Climate Change. It will also make use of other available expertise.

4. The process will include in its early stages an analysis and assessment, to identify possible policies and measures for Annex I Parties which could contribute to limiting and reducing emissions by sources and protecting and enhancing sinks and reservoirs of greenhouse gases. This process could identify environmental and economic impacts and the results that could be achieved with regard to time horizons such as 2005, 2010, and 2020.

5. The protocol proposal of the Alliance of Small Island States (AOSIS), which contains specific reduction targets and was formally submitted in accordance with Article 17 of the Convention, along with other proposals and pertinent documents, should be included for consideration in the process.

6. The process should begin without delay and be conducted as a matter of urgency, in an open-ended ad hoc group of Parties hereby established, which will report to the second session of the Conference of the Parties on the status of this process. The sessions of this group should be scheduled to ensure completion of the work as early as possible in 1997, with a view to adopting the results at the third session of the Conference of the Parties.

9th plenary meeting
7 April 1995

FRAMEWORK CONVENTION ON CLIMATE CHANGE
18 July 1996

CONFERENCE OF THE PARTIES
Second session
Geneva, 8–19 July 1996
Agenda item 5

REVIEW OF THE IMPLEMENTATION OF THE CONVENTION AND OF DECISIONS OF THE FIRST SESSION OF THE CONFERENCE OF THE PARTIES

MINISTERIAL DECLARATION*

The Ministers and other heads of delegations present at the second session of the Conference of the Parties to the United Nations Framework Convention on Climate Change,

Noting that this, our meeting at Ministerial level under the Convention, is a demonstration of our intention to continue to take an active and constructive role in addressing the threat of climate change,

*This text was introduced by the President at the 6th plenary meeting, on 18 July.

1. Recall Article 2 of the Convention; the principles of equity and of common but differentiated responsibilities and respective capabilities in Article 3.1 of the Convention; and the provisions of Article 3.3 concerning precautionary measures; as well as the specific national and regional development priorities, objectives and circumstances of the Parties to the Convention;

2. Recognize and endorse the Second Assessment Report of the IPCC as currently the most comprehensive and authoritative assessment of the science of climate change, its impacts and response options now available. Ministers believe that the Second Assessment Report should provide a scientific basis for urgently strengthening action at the global, regional and national levels, particularly action by Annex I Parties to limit and reduce emissions of greenhouse gases, and for all Parties to support the development of a Protocol or another legal instrument; and note the findings of the IPCC, in particular the following:

- The balance of evidence suggests a discernible human influence on global climate. Without specific policies to mitigate climate change, the global average surface temperature relative to 1990 is projected to increase by about 2C (between 1C and 3.5C) by 2100; average sea level is projected to rise by about 50 centimetres (between 15 and 95 centimetres) above present levels by 2100. Stabilization of atmospheric concentrations at twice preindustrial levels will eventually require global emissions to be less than 50 per cent of current levels;
- The projected changes in climate will result in significant, often adverse, impacts on many ecological systems and socio-economic sectors, including food supply and water resources, and on human health. In some cases, the impacts are potentially irreversible; developing countries and small island countries are typically more vulnerable to climate change;
- Significant reductions in net greenhouse gas emissions are technically possible and economically feasible by utilizing an array of technology policy measures that accelerate technology development, diffusion and transfer; and significant no regrets opportunities are available in most countries to reduce net greenhouse gas emissions;

3. Believe that the findings of the Second Assessment Report indicate that the continued rise of greenhouse gas concentrations in the atmosphere will lead to dangerous interference with the climate system, given the serious risk of an increase in temperature and particularly the very high rate of temperature change;

4. Recognize also the need for continuing work by the IPCC to further reduce scientific uncertainties, in particular regarding socio-economic and environmental impacts on developing countries, including those vulnerable to drought, desertification or sea-level rise;

5. Reaffirm the existing commitments under the Convention, including those intended to demonstrate that Annex I Parties are taking the lead in modifying longer-term trends in emissions by sources and removals by sinks of greenhouse gases not controlled by the Montreal Protocol, and agree to strengthen the process under the Convention for the regular review of the implementation of present and future commitments;

6. Take note that Annex I Parties are fulfilling their commitments to implement national policies and measures on the mitigation of climate change. Also take note that this is not the only commitment that Annex I Parties have made and that many of these Parties need to make additional efforts to overcome difficulties that they face in achieving the aim of returning their emissions of greenhouse gases to 1990 levels by 2000;

7. Acknowledge the considerable work done by the Ad Hoc Group on the Berlin Mandate (AGBM) since the first session of the Conference of the Parties, including the substantive proposals presented by a number of Parties, and call on all Parties to come forward with proposals to facilitate substantive negotiations beginning at the fifth session of AGBM in December 1996;

8. Instruct their representatives to accelerate negotiations on the text of a legally-binding protocol or another legal instrument to be completed in due time for adoption at the third session of the Conference of the Parties. The outcome should fully encompass the remit of the Berlin Mandate, in particular:

—commitments for Annex I Parties regarding:

- policies and measures including, as appropriate, regarding energy, transport, industry, agriculture, forestry, waste management, economic instruments, institutions and mechanisms;
- quantified legally-binding objectives for emission limitations and significant overall reductions within specified timeframes, such as 2005, 2010, 2020, to their anthropogenic emissions by sources and removals by sinks of greenhouse gases not controlled by the Montreal Protocol;

—commitments for all Parties on continuing to advance the implementation of existing commitments in Article 4. 1;
—a mechanism to allow the regular review and strengthening of the commitments embodied in a Protocol or other legal instrument;
—commitments to a global effort to speed up the development, application, diffusion and transfer of climate-friendly technologies, practices and processes; in this regard, further concrete action should be taken;

9. Welcome the efforts of developing country Parties to implement the Convention and thus to address climate change and its adverse impacts and, to this end, to make their initial national communications in accordance with guidelines adopted by the Conference of the Parties at its second session; and call on the GEF to provide expeditious and timely support to these Parties and initiate work towards a full replenishment in 1997;

10. Recognize that the continuing advancement of existing commitments by developing country Parties, in the context of their national priorities for sustainable development, requires determined and timely action, in particular by Annex II Parties. Access to financial resources and to environmentally-sound technologies consistent with Articles 4.3, 4.4, 4.5 and 4.7 will be most critical;

11. Thank the Government of the Swiss Confederation for its contribution to the work of the second session of the Conference of the Parties in Geneva and look forward to meeting again at the third session in Kyoto, in 1997, thanks to the generous offer of the Government of Japan.

THE BUSINESS ROUNDTABLE,
July 8, 1997.

THE HON. CHUCK HAGEL
Chairman, Senate Foreign Relations
Subcommittee on International Economic Policy,
Export and Trade Promotion
450 Dirksen Senate Office Building
Washington, D.C. 20510

DEAR MR. CHAIRMAN: The Business Roundtable is pleased to provide comments for inclusion in the record of the June 19 and 26 Senate Foreign Relations Subcommittee on International Economic Policy, Export and Trade Promotion's hearings on issues related to global climate change.

The Roundtable is a public policy organization comprising the chief executive officers of over 200 of the nation's largest corporations. We view global climate change as an important and complex issue with significant potential environmental and economic implications. We congratulate you on the dialogue begun in your committee, and your engagement of the Administration as it prepares for the upcoming negotiations on this subject. The Roundtable is committed to full and open public dialogue on this issue.

While the science of global warming is far from clear, the Second Assessment Report of the Intergovernmental Panel on Climate Change has concluded that the concentration of greenhouse gases in the earth's atmosphere are increasing and this may contribute to climate change. This fact has the attention and concern of the Roundtable and its member companies. At the same time, the analytical methods used to predict the extent and timing of future climate changes related to these increases in greenhouse gases are imprecise, indicating the need to be cautious in our approach to global climate policy.

Climate change predictions currently are based on three-dimensional General Circulation Models (GCMs) which must take into account a range of complex and naturally variable factors. While scientists are improving the state of three-dimensional GCMs, they remain an inexact tool for measuring the complex and naturally variable factors linked to global transfer of heat from myriad sources. As a recent summary article in the May 16, Science Magazine stated: "... most modelers now agree that the climate models will not be able to link greenhouse gas warming unambiguously to human actions for a decade or more."

However, The Roundtable believes our inability to accurately predict the effects of greenhouse gases need not delay discussion of this important issue. Rather, the current state of the science should only give pause to taking precipitous action on a unilateral basis without judging the economic consequences. We would note that the documented .5 degree centigrade increase in global temperature in the last 120

years may be within the normal range of variability. Moreover, most of this increase occurred prior to 1940, while most of the increase in man-made greenhouse gas emissions occurred after that date.

Because the science is less than compelling, the current debate over global climate change creates difficult policy choices. At one extreme we may indeed face the prospect of dramatic climate changes with severe economic impacts for ours or future generations. At the other extreme, if we rush to judgment and take drastic measures, we could do irreparable harm to our economy. This is why The Roundtable is adamant about the need for a full and open public debate of the scientific and economic issues in order to steer a more reasonable course. And we have welcomed the Administration's most recent responses to engage in this debate prior to committing to any specific course of action later this year in Kyoto.

The Roundtable believes that a dialogue should begin between the many stakeholders affected by this issue with the objective of developing policies that stimulate reductions in greenhouse gas emissions, while also stimulating continued economic growth. This, we believe, can be achieved through innovative tax and capital formation policies that reward development of low greenhouse gas emissions technology and the actions of those companies that have proven records of greenhouse gas emissions reductions. A pro-investment strategy is a pro-environment policy. As noted environmental scholar Jesse Ausubel of The Rockefeller University notes: "... over the last two centuries we have been freeing ourselves from carbon and dramatically increasing our energy efficiency at the same time." New policies should encourage this natural tendency of the free market system toward greater efficiencies, not burden it with additional regulations. The Roundtable believes it would be unfortunate if we imposed the same punitive, command and control approach to what is a more complicated problem involving virtually every aspect of our society.

The Roundtable is opposed to tax and regulatory structures which would impose unnecessary burdens on our economy in advance of more compelling scientific insight into the problem. A DRI/McGraw Hill study shows stabilizing emissions at 1990 levels by the year 2000 would require a tax equal to $16/barrel of oil or a $0.40/gallon of gasoline in the U.S. This study also shows such a tax would reduce GDP by 2.3%/year and cost the average American family $900/year. A larger 20% reduction from 1990 levels by year 2020 would require a tax of $80–$85/barrel of oil or a gasoline tax of nearly $2/gallon. Dr. Lawrence Horowitz of Primark Decision Economics argues that taxes necessary to reduce emissions to 1990 levels by 2010 would reduce US GDP by more than 4% annually or over $350 billion/year; household disposable income would fall 1.2%; wages would drop; and electricity prices could double from $0.07 per kwh to $0.15–$0.16 per kwh.

Among the more recently discussed policy options for reducing greenhouse emissions are those which focus on a system of tradable emissions between countries. Notwithstanding how such a system would be enforced on a multilateral basis, such a system does recognize that a ton of carbon dioxide emitted in a developing country has the same effect as one in a developed economy. If economic projections are correct, sometime in the early part of the next century, the developing world will emit the majority of greenhouse gases. Soon afterwards, China will become the leading source of greenhouse gas emissions. According to the United Nations, developing nations are producing 52 percent of all new emissions of greenhouse gases and are expected to contribute 75 percent of all carbon dioxide emissions by the year 2050.

A critical role for our government is to lead the way toward a sound, achievable multilateral policy on global climate change; one which does not put our economy at a competitive disadvantage. For this reason, The Roundtable supports the climate change resolution offered by Senator Byrd now pending before the Senate.

Proposals to limit future emissions of greenhouse gases involve possible consequences and tradeoffs that could affect not only the environment, but also economic development, employment, trade, investment, energy security and national sovereignty. The decisions made on how best to address global climate change may well be the among the most important we will make in the next decade. For this reason The Roundtable believes specific plans to reduce greenhouse gas emissions need to be carefully reviewed for their overall impacts.

The Roundtable plans to be an active participant in analyzing such plans and for developing its own recommendations. We clearly need a public debate that engages us in reconciling the uncertainties in the science in a way which balances prudent action and sound economics.

In sum, The Business Roundtable believes that:

- Climate change is an issue which will evolve over many decades, and strategies must incorporate such a long term focus.
- Policy and long term goals should recognize the scientific uncertainty and consider the associated range of environmental and economic consequences.

- A climate change policy that fails to meaningfully include all nations should be opposed.
- There is a need for policy flexibility so that government and the private sector can craft individual responses to their own situations, with maximum emphasis on performance based approaches rather than prescriptive measures.
- Any policy options also should have the objective of stimulating economic growth through innovative tax, capital formation and technology policies.

Until the scientific and economic issues are better understood, there should be no rush to impose dramatic climate change policy measures, either by individual nations or, collectively. Further agreements reached must include a requirement or negotiating process to bring all countries, developed and developing, into the commitment making process.

The member companies of The Roundtable look forward to continuing to participate in these discussions and congratulate the subcommittee for their leadership in further engaging this discussion.

Sincerely yours,

ROBERT N. BURT,
Chairman and CEO, FMC Corporation,
Chairman, Environment Task Force, The Business Roundtable

ASSOCIATION OF AMERICAN RAILROADS,
June 24, 1997.

THE HONORABLE CHUCK HAGEL
Chairman, Subcommittee on
International Economic Policy,
Export, and Trade Promotion
Committee on Foreign Relations
United States Senate
Washington, DC 20510

DEAR MR. CHAIRMAN: The Association of American Railroads (AAR)[1] submits these comments in connection with the Subcommittee's July 26, 1997 hearing on the issue of global climate change. AAR asks that its comments be made a part of the hearing record.

AAR favors continued efforts by the scientific community to narrow the range of uncertainty about climate change. At present, however, the state of scientific knowledge does not justify the extreme measures being contemplated on the international level.

Background

In 1992, the United States and other nations ratified the Framework Convention on Climate Change whose objective is to reduce concentrations of greenhouse gases in the atmosphere to a level that will prevent dangerous interference with the Earth's climate.

While scientists generally agree that the Earth's climate has warmed about 0.5 degree C since the late 19th century, uncertainty remains about whether this is the result of human-induced climate change, or simply fluctuation within the range of normal climate variability.

As recently as last month, the respected journal Science reported, "Many climate experts caution that it is not at all clear yet that human activities have begun to warm the planet." Likewise, the Intergovernmental Panel on Climate Change, the world's leading body of climate experts, said in its latest report on climate change that slight variations in temperature "...cannot be considered compelling evidence of a clear cut cause-and-effect link between anthropogenic forcing [human activity] and changes in the Earth's surface temperature."

Despite these cautionary notes, the signatories to the Framework Convention on Climate Change in 1995 approved the so-called "Berlin Mandate" which calls for the adoption of a protocol or other legal instrument in Kyoto, Japan in December 1997 strengthening emissions reduction commitments for developed nations after the year 2000. The Berlin Mandate, however, specifically exempts developing countries from

[1] AAR is a trade association whose members account for 77 percent of total linehaul mileage, produce 93 percent of total freight revenue, and employ 91 percent of the freight railway workforce.

any new commitments—despite the fact that their greenhouse gas emissions are rapidly increasing and are expected to surpass emissions of the U.S. and other OECD countries as early as 2015.

Economic Impacts

Near-term requirements to stabilize or reduce carbon emissions would be likely to produce significant economic dislocation in the United States, including profound job losses and major economic restructuring.

A DRI/McGraw-Hill study of carbon taxes as a means of reducing carbon emissions to 1990 levels by the year 2010 suggests that such an approach would lead to job losses averaging more than 500,000 per year. Economist Alan Manne of Stanford University, who studied abatement proposals intended to reduce carbon emissions to 80 percent of their 1990 level by the year 2010, found that such steps would result in annual losses ranging from 1.0–2.5 percent of the nation's gross domestic product.

Emissions reduction requirements would also have a sharply negative impact on international trade, with resulting higher fuel prices adversely affecting both industries whose production processes are energy-intensive as well as industries which are dependent upon transportation between distant suppliers and manufacturing locations, and between manufacturing locations and ocean ports.

Nowhere in the world is the importance of transportation greater than it is in the U.S. In Western Europe, most manufacturing centers are located no more than a few hundred miles from ports. Distances to ports are even less in Japan, Taiwan, and Korea.

In the U.S., however, major manufacturing centers are often located far from ports. One critical industrial concentration is in the upper Midwest. An efficient transportation system is essential for these industries to play a vital role in the global marketplace.

Rail Impacts

Policies aimed at stabilizing or reducing greenhouse gas emissions levels would have a strongly negative effect on railroad customers and revenues. Based upon available sectoral analyses—and depending upon the reduction targets and implementation alternatives selected—AAR estimates that rail carloads would drop 8–16 percent by 2010, rail tonnage would drop 11–24 percent, and freight revenue would drop 7–15 percent.

In particular, emissions reduction requirements would have a pernicious effect on domestic coal production, which accounts for 59 percent of the fuel burned in electric utilities and comprises the largest source of revenue for the railroad industry. AAR estimates that such requirements would lead to a reduction in coal traffic and coal-related revenue of 25–54 percent. Chemical, auto, mining, pulp, and paper production would also suffer, causing further industrial and rail industry losses.

S. Res, 98

AAR commends you and Senator Robert Byrd for introducing S. Res. 98, a resolution calling upon the U.S. to refrain from signing any agreement regarding the Framework Convention on Climate Change which would cause serious harm to the economy or which would mandate new commitments to reduce greenhouse gases in developed nations unless the agreement also mandates "new specific scheduled commitments to limit or reduce greenhouse gas emissions for developing countries within the same period." The fact that the resolution has more than 60 Senate sponsors indicates that there is a high level of concern regarding precipitate governmental action.

AAR agrees with the Transportation Trades Division of the AFL–CIO, which earlier this year adopted a resolution calling on the Clinton administration to renegotiate the terms of the Berlin Mandate so that "all nations bear an equal level of responsibility for addressing concerns arising out of greenhouse emissions."

Until the world community reaches such agreement—given the potential for crippling costs that would be inflicted with aggressive emissions abatement policies—reasoned concern and study appear to be the most responsible ways to proceed. In that respect, AAR supports a coordinated international research effort, in addition to the continuation of the multi-billion dollar U.S. climate research program.

Sincerely,

M.B. OGLESBY, JR.

PREPARED STATEMENT OF RICHARD K. DAVIDSON

Chairman Hagel, Members of the Committee, thank you for the opportunity to share our perspective on the pending global climate treaty and its potential economic impact on us and our customers. Union Pacific is a diversified transportation company with primary operations in rail, trucking and logistics. Through our various operating companies, we serve all 50 states and employ more than 65,000 people. Our core business is the Union Pacific Railroad, headquartered in Omaha, Nebraska. Since the merger of Union Pacific Railroad with the Southern Pacific, we now operate a 36,000 mile rail network linking 23 states from the Midwest to the West and Gulf Coasts.

As the international community takes steps to reduce the levels of greenhouse gases in the environment, it is important that the United States not be saddled with a disproportionate share of the burden in the effort to improve our environment. Union Pacific Railroad ships hundreds of commodities for use in every component of the economy from coal to agricultural products to automobiles. We can safely say that every one of our customers will be adversely affected by this Treaty if it is implemented—because of their and our need for readily available, reasonably priced energy. Accordingly, we join our customers in the agriculture, automotive, coal, petroleum, steel, chemical and intermodal sectors, as well as our unionized workforce in urging the United States not to enter an international treaty that would jeopardize our economy, our transportation network and the thousands of jobs they support.

As the Committee is aware, in 1992, the United States signed the Rio Framework Convention on Climate Change. This agreement required a reduction in greenhouse gases, such as carbon dioxide, to the 1990 levels by the year 2000. Following that, in 1995, the United States agreed, in the so called Berlin Mandate, for a process of negotiations to establish emission goals for the next century. Under this Mandate, developed countries, including the United States, must take the lead in fighting climate change. However, developing countries are excluded from any obligation to further reduce greenhouse gases. Under this scenario, the United States is being asked to significantly reduce greenhouse emissions from all sources, while countries that are now developing their production capacity will bear a minimal burden from this Treaty. Current treaty proposals could do significant damage to the U.S. economy without achieving any appreciable benefit to the environment. Developing countries like China and India, which by early in the next century will be the worlds largest emitters of greenhouse gases, do not have to participate. This situation will force U.S. companies to shift production to developing countries, thus jeopardizing our current economic base and the jobs it supports. More importantly, by shifting production to developing countries and giving them the upper hand with respect to this Treaty, the goal of reducing greenhouse gases will have been missed entirely. There will simply be fewer emissions from the United States, but significantly more emissions from developing countries. There will also be fewer jobs in the United States, fewer automobiles to ship, less coal to meet our energy needs and fewer chemicals for manufacturing and household needs. This Treaty makes it very difficult for us to run the race if we are forced to shoot ourselves in the foot with the starting gun.

The United Nations is currently in the midst of negotiations over the magnitude of reductions and the time frame that will be imposed for meeting those reductions under the Berlin Mandate. In order to meet the goals being considered, the American Mining Congress estimates that coal production would be curtailed by a minimum of 25 percent. Coal is currently the largest single commodity shipped by domestic railroads, representing more than 40 percent of the tons originated and nearly 22 percent of the rail revenue. New energy taxes would need to be imposed, a new permit trading program would be required for consumers of fossil fuels and gasoline and diesel prices would soar. DRI/McGraw Hill estimates the cost of holding emissions at 1990 levels by the year 2000 would require a minimum new fuel tax equal to $16 per barrel of oil or $0.40–0.50 per gallon. The rail industry currently consumes more than 3.5 billion gallons of diesel fuel annually. Of that amount, Union Pacific uses nearly 1.4 billion gallons of diesel fuel per year, making us the largest private consumer of diesel fuel in the United States. In spite of these figures, railroads are highly fuel efficient and recognized as the most environmentally friendly method of surface transportation. A significant increase in the cost of fuel, coupled with diminished car loadings, as would be the case under the Treaty, would have a devastating impact on Union Pacific and all the other freight railroads. In fact, the Association of American Railroads estimates a $1.8–4.0 billion decline in annual rail revenues under this Treaty.

Quite frequently big business and labor are at odds over various government policies. With respect to this Treaty, however, business and labor are together. In fact, the AFL-CIO passed a resolution expressing concern that the Administration has

not completed a thorough analysis of the effects of the proposed treaty on the U.S. economy, and that the proposals under discussion will cause the loss of U.S. jobs to such countries as China, Mexico and Korea. With unionized labor representing more than 85 percent of freight rail employment, we are pleased to say that we have reached agreement on this issue before we had to go to the bargaining table.

Before the U.S. takes the next step, the Administration needs to provide important details about global climate change and the potential ramifications of this Treaty. These details should include targets, timetables and other components of the U.S. proposal contingent upon commitments for binding emission reductions from developing countries. Given the scientific uncertainty surrounding the benefits of any greenhouse gas reduction treaty, an accurate assessment of the cost becomes critical. Key assumptions as well as an assessment of the impact on the economy and employment need to be thoroughly addressed before we move forward with this Treaty. Corporate America has a responsibility to ensure a healthy economy and an ever-increasing standard of living for current and future generations, and an equal responsibility to protect our environment. We know that it is possible to do both with a balanced approach. A balanced approach is not possible however without careful study, input from a wide variety of sources, and extensive public debate prior to the Administration negotiating a U.S. position in Kyoto this December.

Chairman Hagel, again I want to thank you and the Members of the Committee for the opportunity to share our views on this critical issue. On behalf of Union Pacific, I especially wish to convey my appreciation to you and Senator Byrd for your work on Senate Resolution 98. This Sense-of-the-Senate Resolution calls upon the United States to refrain from signing any protocol or agreement that would seriously harm the U.S. economy. Additionally, the Resolution calls for greater parity between developed and developing nations as we try to meet mutual environmental goals. Your willingness to carefully review the ramifications of this Treaty is of vital importance to us and our hundreds of customers and employees throughout the country.

GREENPEACE

GLOBAL WARMING AND AVOIDING DANGEROUS HUMAN INTERFERENCE WITH THE CLIMATE

The United Nations Environment Programme Advisory Group on Greenhouse Gases has calculated indicators of "ecological limits" to total amounts of temperature change and sea level rise and to the rates of change that human health and the environment can tolerate.

Staying within ecological limits is a central objective of the Framework Convention on Climate Change, signed at Rio in 1992. The Convention clearly states that "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic (human made) interference with the climate system." It adds that "Such a level should be achieved within a timeframe sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and enable economic development to proceed in a sustainable manner."

Greenpeace has adopted these United Nations Environment Programme indicators of ecological limits as a means to protect both ecosystems as well as human systems.

Sea Level Rise

- maximum rate of rise 2 millimeters per decade
- maximum 0.2 meters above the 1990 global mean sea level

Global Mean Temperature

- maximum rate of 0.1 C degrees per decade
- maximum increase of 1.0 degree C

The United Nations report continues to say that above 1.0 C there may be "rapid, unpredictable and non-linear responses that could lead to extensive ecosystem damage." A total of 2 degrees C increase is viewed as an upper limit beyond which the risks of grave damage to ecosystems, and of non-linear response, are expected to increase rapidly. (The report identified the carbon dioxide—CO_2—equivalent con-

centrations corresponding to these potential temperature changes as 330–400ppm for 1 degree C and 400–560ppm for 2 degrees C. Carbon dioxide is the primary greenhouse gas which causes global warming and is emitted when oil, coal and gas are burned).

The global mean temperature already has risen 0.3–0.6 C degrees above pre-industrial levels and current rates of increase are around 0.2 C degrees per decade.

GLOBAL WARMING AND THE CARBON BUDGET

In order to avoid dangerous human interference with the earth's climate svstem, using the IPCC science, Greenpeace has calculated a global carbon budget. This budget demonstrates how much carbon dioxide (CO_2) may be emitted while remaining within the limits human identified by the United Nations Environment Programme health and the environment can endure. Carbon dioxide is the primary Greenhouse gas and the main sources are fossil fuels—oil, coal and gas. The logic which follows is that in order to limit emissions of carbon dioxide, we must limit the exploration for and use of fossil fuels.

Background

Each year, the world releases over 6 billion metric tonnes of carbon for a total of approximately 240 billion tonnes since industrialization (1860). The United States historically has been and continues to be the largest emitter of greenhouse gases.

Currently, the world has over 1,000 billion tonnes of carbon in current economically recoverable reserves of oil, coal and gas. If all of these reserves were burnt, it would lead to over 4 degree C increase in global temperature in the long far above what would be safe for human health and the environment.

The fossil fuel resource base is well over 4,000 billion tonnes of carbon. Over time, and with the development of technology to extract oil. coal and gas, these resources will become available as economic reserves.

The Carbon Budget

To limit ecological damage, the carbon budget calculated by Greenpeace demonstrates that only approximately 150–270 billion tonnes of carbon may be emitted.

If no action is taken to stop deforestation then only around 150 billion tonnes can be emitted.

With action to halt deforestation and with a significant afforestation program around 230 billion tonnes may be emitted. At current rates of fossil fuel use this amount would be used up in less than 40 years.

With a major afforestation program then around 270 billion tonnes may be emitted.

The inescapable conclusion: not only must new exploration for oil, coal and gas be stopped but also fossil fuel use be phased out. Reserves and future resources of oil, coal and gas cannot all be burnt if we are to protect human health and the environment from global warming.

GLOBAL WARMING AND THE GREENPEACE SOLUTION

The Greenpeace Position

In order to protect human health and the environment by ensuring we do not exceed ecological limits. Greenpeace believes that US policy should be set to achieve the carbon budget (150–270 billion tonnes of carbon). In order to meet these ecological and policy goals, immediate action must be taken to stop new exploration for oil, coal and gas and to stop deforestation.

The carbon logic demonstrates that unless fossil emissions are reduced soon a complete Global phase out will be necessary within 30–40 years on current trends in fossil fuel use.

What the Governments Can Do

Achieving a fossil fuel phase out on such a timescale is the only way to achieve the necessary dramatic reductions in emissions of greenhouse gases such as carbon dioxide. As a first step, Greenpeace is calling on governments of industrialized nations to agree to reduce carbon dioxide emissions to 20 percent below 1990 levels by 2005 for the December 1997 Climate Convention in Kyoto, Japan.

In addition to adopting strong stance at the treaty negotiations, Greenpeace also is advocating that as a first step toward a fossil fuel phase out that governments in industrialized nations stop new oil exploration. Given that society cannot afford to burn even a quarter of oil, coal and gas reserves, continued exploration for more

fossil fuels is irresponsible. As well, governments should stop offering subsidies to fossil fuel companies and encouraging aggressive new oil, gas and coal development.

For example, the US government currently subsidizes the coal, oil, gas and nuclear industry at a rate of $33 billion per year. In contrast, aid to welfare mothers (Aid to Families with Dependent Children) totals only $18 billion and subsidies to clean, renewable energy is a mere $1 billion (Federal Energy Subsidies, April 1993, Department of Health and Human Services). In the European Union, close to $15 billion US dollars of taxpayers' money has been used every year since 1990 to prop up the fossil fuel and nuclear industry.

GREENPEACE DEMANDS

The United States has a special responsibility to act on global warming and climate change. The US is: responsible for about one quarter of historical and current global emissions of C02 from coal, oil and gas; the world's largest economy; and, a technological and market leader in delivering clean energy solutions such as solar power. In order to protect the climate, which is the aim of the international agreements under the climate treaty, substantial cuts in emissions of C02 must be achieved.

Therefore, Greenpeace is calling upon all industrialized governments attending the Kyoto meeting in December 1997 to agree mandatory cuts in emissions of C02 to 20 per cent belowl990 levels to be achieved by 2005.

Additionally, Greenpeace calls on the US government to:

- Shift subsidies away from dirty energy sources such as coal, oil, gas and nuclear power to renewable energy such as solar and wind power,
- Stop new oil exploration in Alaska, and
- Recognize that the world cannot afford to burn more than a fraction of the coal, oil and gas reserves known to exist, much less to search for additional reserves. Therefore, the US must take a lead in beginning a phase out of fossil fuels over the next 30 to 40 years.
- Work closely with labor unions to create an economic justice package to help American workers transition from a fossil fuel economy to a renewable energy economy.
- Raise car fuel efficiency standards (so that automobiles run more efficiently and on less gas);
- Increase and improve energy efficiency programs;
- Begin to invest in renewable energy sources for federal Government buildings and facilities; and,
- Use funds to rebuild homes destroyed by natural disasters with solar and renewable energy.

Global Climate Coalition
1275 K St. N.W.
Suite 890
Washington, D.C. 20005
Tel: 202.682.9161
Fax: 202.638.1043

July 3, 1997

Corrected Version

Honorable Chuck Hagel
Chairman
Subcommittee on International Economic
Policy, Export and Trade Promotion
Committee on Foreign Relations
U.S. Senate
Room 450
Dirksen Senate Office Building
Washington, DC 20515

Dear Mr. Chairman:

The Global Climate Coalition would like to submit the enclosed statement for inclusion in the record of the Subcommittee's June 19 and June 26, 1997 hearings on the United Nations Global Climate Treaty Negotiations.

Thank you for considering our request.

Sincerely,

Gail McDonald

Gail McDonald
President

GM/rm

Enclosure

STATEMENT

OF THE

GLOBAL CLIMATE COALITION

TO THE
SUBCOMMITTEE ON INTERNATIONAL ECONOMIC
POLICY, EXPORT AND TRADE PROMOTION
U.S. SENATE

HEARINGS ON
GLOBAL CLIMATE NEGOTIATIONS

JUNE 26, 1997

GLOBAL CLIMATE COALITION STATEMENT
TO THE SENATE FOREIGN RELATIONS COMMITTEE

Mr. Chairman and Members of the Subcommittee, the Global Climate Coalition (GCC) appreciates the opportunity to present this statement on the subject of the status of the U.N. global climate change negotiations. The GCC is the leading representative of business and industry on this issue. Our memberships spans manufacturing; agriculture; small and large businesses; air, rail, barge transportation companies; domestic and international vehicle manufacturers; oil, coal, natural gas and other natural resource developers; municipal, coop and investor-owned electric utilities; cement; iron and steel; forest and paper; and various producers of chemicals, plastics and other industrial and consumer products. These companies--the backbone of the American economy--joined the Coalition because they support cost-effective long-term climate policies that are based on sound climate science, a balance approach to economic and environmental objectives, meaningful participation of developing nations and consideration of the unique social, economic and natural resource characteristics of each country.

We commend you, Chairman Hagel and Ranking Minority Member Sarbanes, for holding these important oversight hearings. We are particularly supportive of your efforts, Chairman Hagel, and those of Senator Robert Byrd, in introducing S. Res. 98 with the 62 Republican and Democratic Cosponsors. We, like the AFL-CIO, have long felt that the 1995 Berlin Mandate decision built a wall between developed and developing Nation Parties to the Framework Convention on Climate Change (FCCC) and created a serious economic and environmental impediment to the negotiations. We fully agree that to the limited extent that the science may support the need for further action on climate change, such action must be global and must be consistent with protecting our nation's economic interests.

Turning now to the negotiation, we note that in only a few weeks the U.S. delegation will head to Bonn for the penultimate meeting of the AGBM and in less than six months the U.S. delegation will go to Kyoto, Japan to consider the results of a negotiating process which is scheduled to conclude in October. We, like others in industry, labor and agriculture, are dismayed about this frantic and, we believe, unnecessary schedule that in a rush to judgment will produce policies that would be inequitable and harmful to the U.S. economy with no lasting environmental benefit to the United States or globally. A recent example of this growing concern about the Administration's climate policies can be found in a three page national ad signed by more than 100 member company Chief Executive Officers of the Business Roundtable. The core of their message is that "there has been little public debate on the [climate] treaty even though it could have a dramatic effect on the way we live and work here in the United States."

As Representative John Dingell has made clear, it borders on recklessness to conduct international negotiations before there has been a full analysis of the economic consequences of the policies that might be adopted and without the meaningful involvement of the Senate which has a Constitutional role in the treaty process. Members of the GCC urge Congress to closely oversee U.S. climate policy development, analyses, assessment and negotiations. This is particularly important since the environmental benefits and economic consequences depend on

the involvement of China, India, Korea, Mexico and other developing nations in any effort to limit future emissions. The current negotiations have significant domestic implications. For example, policymakers should examine closely a statement by the Department of Commerce's interagency analytic team that suggests coal should bear the "brunt of greenhouse gas stabilization" in 2010 or soon thereafter. Before singling out one fuel or sector, it is imperative that policymakers understand the consequences of such a strategy, including the fact that there is no near-term prospect that alternative fuels will be available at competitive prices. The American public and economy would be seriously disadvantaged by a premature climate agreement. The bottom line is that the United States should not accept the greenhouse emission limitation and reduction proposals that are now the focus of international negotiations.

Lack of Information on U.S. Impact and Implementation

We continue to be disappointed that the Administration has not yet released for public review, comment and debate the long-promised analysis and assessment of the impacts of post-2000 climate change commitments that the U.S. delegation plans to negotiate. In March 1995, as the Berlin Mandate began to take shape, President Clinton expressed in a letter to Representative John Dingell the Administration's intent as it entered these negotiations:

> "We have said this process must include thoughtful analysis and reflect the fact that global problems require global solutions. Furthermore, I assure you the U.S. delegation will not accept any outcome or agree to any process that adversely affects the United States and its industrial competitiveness."

A year later the Department of Energy (DOE) and the Environmental Protection Agency (EPA) jointly held a workshop in Springfield, Virginia to unveil the Administration's initial analysis. At a June 19, 1996 hearing before the House Commerce Committee, DOE's Acting Assistant Secretary for Policy, Marc Chupka, testified that the "U.S. strongly believes that analysis and assessment is central to the development of further commitments by Annex I Parties and to the furtherance of existing commitments of other parties to the Framework Convention on Climate Change." When it was announced last summer that Dr. Everett Ehrlich would assume the role of directing and coordinating this analytic effort, he assured everyone that the results would be available this past January. Undersecretary of State Tim Wirth has also repeatedly stated that the Administration's analysis would be released soon. That has not occurred and yet negotiations proceed. This clearly is a case of putting the cart before the horse.

Industry, labor, agriculture and the general public are not only in the dark about the Administration's analysis and assessment process and results. We and others also lack the most basic policy information, such as the range of targets and timetables the Administration is now considering, and, of equal importance, what regulations, taxes or other instruments might be used to implement a Kyoto agreement. The official communiqué of the Denver Summit of Eight called for "reductions" by 2010. There is no basis for judging if this is a realistic and achievable

date without knowing what the objective is. Some targets being discussed could require that the United States reduce our fossil fuel use by 25% or more.

Indeed, we question whether the Senate can fulfill its Constitutional duty to provide advice and consent on any new climate agreement if the Administration fails to provide a clear account of specific policies now under consideration, an explanation of how those policies would be implemented domestically and internationally, and quantitative analyses outlining the impact of such policies on the U.S. economy, labor, industry and trade.

Lack of Scientific Evidence to Impose Mandatory Targets and Timetables

The GCC is not a scientific body. However, our members have followed closely the debate about potential human impacts on climate, efforts by various modelers to duplicate past temperature trends and to predict possible future changes, and the persistent questions within the scientific community that solar activity or simply natural variability may better explain part or all of the 1° Fahrenheit increase in average surface temperature during the past 130 years. Climate scientists and modelers simply do not know enough about possible human impacts on the global climate system to take near-term actions to suppress emissions and energy use to meet the type of goals being considered by international negotiators.

That is not our opinion alone, but one shared by scientists who participated in the Intergovernmental Panel on Climate Change (IPCC) who wrote the 1995 *Second Assessment Report* and others within the scientific community. That report does state that "the balance of evidence suggests a discernible human influence on global climate" and the Administration repeatedly quotes that sentiment--out of context--in its statements on climate science, including official speeches or communiqués during the Denver Summit and the U.N. General Assembly special session on "Rio Plus Five." Dr. Benjamin Santer, a lead IPCC author, warned against such over-simplifications in the May 16 issue of *Science* when he stated that "It's unfortunate that many people read the media hype before they read the [IPCC] chapter" [on greenhouse warming]....We say quite clearly that few scientists would say that the attribution issue was a done deal." [p. 1040, attached] That same *Science* article also reports that the latest National Center for Atmospheric Research model shows that "two-thirds to three-quarters of the [temperature variation of the] last 130 years can be explained as natural variation" and that the British Meteorological Office/Hadley Center model has reduced its estimated impact of a doubling of carbon dioxide concentrations from 5.2°C to 1.9° C.

Moreover, Dr. Bolin, Chairman of the IPCC, has repeatedly said it would be a mistake to link human activity to particular severe weather events. He has also cautioned against expecting global temperature impacts from efforts by a few countries to limit their greenhouse emissions. For example, during his February 25, 1997 presentation in Bonn to international negotiators, Dr. Bolin noted that the proposals under consideration for emission reductions by developed countries alone "would not be detectable on projected temperature increases." His point--and ours--is that costly measures undertaken by a few countries would yield few, if any, environmental benefits. Nor would it be fair.

Lack of Equity Among All Countries

We note that last February, the AFL-CIO Executive Council said:

> "We believe the parties to the Rio Treaty made a fundamental error when they agreed to negotiate legally-binding carbon restrictions on the United States and other industrialized countries, while simultaneously agreeing to exempt high-growth developing countries like China, Mexico, Brazil and Korea from any new carbon reduction commitments.
>
> * * *
>
> "The AFL-CIO Executive Council further urges that in the ongoing negotiations to amend the Rio Treaty on climate change, the United States insist upon the incorporation of appropriate commitments from all nations to reduce carbon emissions; and seek a reduction schedule compatible with the urgent need to avoid unfair and unnecessary job loss in developed economies. The President should not accept and the Congress should not ratify any amendment or protocol that does not meet these standards."

The State Department is not listening to labor. The amended U.S. draft protocol not only continues to accept the exemption for China, India, and other developing countries, but also imposes added commitments on Parties, like the U.S., that might sign the protocol.

Apparently, the State Department thinks labor and other critics of the exemption, including you, Mr. Chairman, Senator Byrd, and the other sponsors of S. Res. 98, should be placated by a provision of the Department's draft protocol which calls for a two protocol strategy, one in Kyoto in 1997 and a second by 2005. A provision to consider an undefined commitment eight years hence is meaningless. It simply cannot be relied on to prevent or mitigate the inevitable migration of American jobs, capital and prosperity to the developing countries who insist on being exempted from a Kyoto agreement. In short, an "agreement to agree" is entirely illusory. The two protocol strategy fails utterly to assure that developing countries would agree to commitments in the future that would impose appropriate limits on the growth in their greenhouse emissions. If there is an agreement in Kyoto, it must apply to <u>all</u> countries and all countries should enter into it at the same time.

It should be remembered that the U.S. and other Annex I countries took the lead in 1992 in agreeing to commitments under the Rio Treaty. It is time for all Parties to participate. The idea of a two-protocol strategy over less than 10 years with reductions in both periods for the Annex I countries is mind-boggling. The possibility of such a double reduction scheme will only exacerbate the unnecessary uncertainty for industry, labor, agriculture, and consumers. This "double-hit" for Annex I countries like the U.S. compounds the "fundamental error" made in Berlin in 1995 by the Parties and the U.S.

Differentiation, the EU "Bubble" and International Trading

The State Department's "Non-Paper" of last December was quite adamant in its opposition to the concept of "differentiation of commitments" among Annex I Parties. The Paper said that: "To date, we have seen no formula for a differentiated approach which equitably addresses all Parties' concerns." It endorsed instead:

> "the adoption of a common approach with respect to targets that retains each Party's flexibility with respect to the choice of domestic policies and measures to implement the target. We also support international trading instruments to minimize and equalize Parties' marginal costs of making reductions. Such an approach would enable the completion of the agreement by December 1997."

However, the U.S. Non-Paper fails to address clearly the trade and competitive advantages that European Union (EU) nations would realize if they were permitted--as they have proposed--to meet any new commitment collectively, with differentiated targets for individual nations. This concept, which is built on unique circumstances such as the shut down of East Germany, is designed to insulate many EU countries from taking meaningful actions while disadvantaging the United States.

The EU bubble serves other purposes as well. It has enabled the European Community to raise the stakes in current negotiations. Last March, the EU proposed a 15% reduction from 1990 emission levels by 2010 as a "negotiating position," not a commitment. This target is neither realistic nor achievable, but it has put the United States on the defensive and increased pressure on our negotiators to sign onto a flawed agreement in Kyoto. The EU bubble--if formally recognized in a Kyoto agreement--would allow the European Union a competitive windfall as it expands eastward, adding former members of the Union of Soviet Socialistic Republics whose emissions declined dramatically once Communism fell. If the lower emission levels of these potential EU members were to be included in the EU's collective baseline, individual European nations would possess a significant competitive advantage over U.S. companies and workers for years to come.

The United States does not have a "bubble" with other nations. Unlike France, for example, we would not have a zero reduction target because Germany claims an offsetting reduction. A far better approach would be to provide credit for Joint Implementation (JI) activities that lower emissions in developing countries while lowering emission mitigation costs in the U.S. and other developed nations. JI, or AIJ as some call it, is simply the application of common sense to a complicated, costly policy process. If additional steps beyond the Framework Convention are to be taken, it makes far better sense to take those steps gradually and to distribute the burden--and credit--equitably around the globe. By sharing its technology with nations such as China and India where emissions are rising rapidly, in exchange for credits against its own emissions, the global environment as well as U.S. economic interests would be protected. It may also be noted that while the EU is a party to other international environmental

agreements, including the Montreal Protocol and the Biodiversity Convention, the bubble concept is unique to the climate convention.

What is Meant by "Legally Binding"?

Other aspects of Berlin Mandate negotiations also deserve close scrutiny. The Geneva Ministerial Declaration of July, 1996, which the U.S. delegation "wholeheartedly" supported, calls on developed countries to adopt a protocol or other legal instrument to limit or reduce post-2000 greenhouse gas emissions that would be "binding," not voluntary, on the Parties that ratify.

According to the 1980 Vienna Convention on Treaties, all treaties, including the Framework Convention on Climate Change, are considered binding on the Parties that ratify them. But what does "legally binding" mean for different countries? For the United States it means approval by the Senate by a two-thirds vote. However, similar parliamentary action is not required by most other nations, even many democratic ones. This allows their negotiators to agree to international treaties with a different level of concern for enforcement. In short, for most nations "binding" means simply one's "best effort."

For the United States, "binding" emissions targets means Congress must enact new laws and authorize new regulations that are enforceable in courts and subject to private litigation. However, legal systems in other nations vary substantially. The result can be uneven legal "playing field." Some have argued that the only way to obtain compliance is by creating an international regulatory authority under the UN. Once a "binding" targets and timetables regulatory regime is established, some kind of international compliance mechanism becomes the likely next step. For most Americans, that would represent an unacceptable step towards a loss of national sovereignty and freedom.

Another "Rush" Amendment To The Convention

Finally, we call your attention to the fact that the COP agenda for Kyoto at the last minute has been revised to include a EU proposal (setting a 3/4 majority vote for approval of protocols) that seeks to circumvent the "entry-into-force" provision of the Convention. Specifically, the EU wants their amendment to take "provisional" or "retroactive" effect before ratification of a new agreement by three-fourths of the Convention Parties. The net result would be to allow a change in the rules of procedure to enter into force before the proposed amendment to the FCCC is ratified by the U.S. and other Parties to the FCCC.

This tactic strikes us as unprecedented. Agreeing to such a proposal would be a significant departure from normal State Department practice. Indeed, it seems another example of someone trying to bend the rules in order to facilitate the rush to judgment on an issue far too complex to proceed with haste. We urge you to closely oversee the negotiating process and ensure that proper negotiating and treaty procedures are followed.

Convincing the American People and Congress

The GCC notes the statement of President Clinton on June 26, 1997 to the UN General Assembly Special Session reviewing the results of the 1992 Rio Earth Summit five years later. The President wisely resisted very strong pressure to turn that occasion into a negotiation session on the very complex and controversial issue of the future commitments under the Berlin Mandate. He also said, "we must convince the American people that the climate change problem is real and imminent." We doubt if he can do this—given the economic and scientific data now available on this issue. In fact, precisely because the Administration is wary of an open and public debate, officials have stonewalled Congress and tried to frighten the American public into supporting a premature climate agreement.

No one can reasonably question that both the American people and members of Congress lack vital information on this issue. An opinion poll (attached) conducted by Charleton Research Company last month, for example, could only find 4 percent who said they were familiar with US global climate policy.

While the climate change issue has been the subject of international negotiations for more than 7 years, the public debate, outside diplomatic and academic circles, is only just beginning. The statements made at the G-8 Denver Summit and the UN General Assembly Special Session by several leaders of European nations, moreover, only demonstrated their desire, once again, to try to score political "points" at the expense of those who would take the issue seriously. Without the prospect of a protective EU bubble, we are certain that the "tune" of many of these same leaders would be different.

On June 23, 1997, the new British Prime Minister, Tony Blair, for example, told the UN in New York that "We in Europe have put our cards on the table. It is time for special pleading to stop and for others to follow suit." In fact, those European cards were not face up. They failed to show, for instance, that seven of the EU's fifteen members would not be required to reduce their emissions below 1990 levels in 2010 (see attached list). Nevertheless, Mr. Blair has warned that he plans to "kick the U.S. hard" into a new agreement.

Let's Do It Right

The U.S. should not rush to Bonn or Kyoto with the view that a signing ceremony is the goal. The science does not compel such haste. Neither does the economic analyses or the sense of fair play. On reflection, it is clear that that time exists to do a better job, one that would lead to the development of global, not Annex I, solutions while moving all countries forward economically and environmentally. With the end of the AGBM process and the Berlin Mandate in October, the Conference of the Parties have a golden opportunity to develop a new process that is global and does not divide developed and developing countries into exempted and non-exempted countries. We have the time to do it right and to exercise real leadership, leadership built on principle rather political expediency.

Regrettably, we already are well down the latter path. Given their interest in limiting future fossil fuel use--whatever the cost--, one can understand why some U.S. officials have hidden economic analyses from Congress, industry, labor and the American public and resorted to scare tactics about extreme weather events and unproved health risks in an effort to build public support for their position. But no amount of hand wringing or finger pointing can obscure the fact that there is no credible evidence that human activities pose an imminent threat to our climate or the fact that costly actions by a few nations, such as the U.S., would produce great social and economic damage for little or no environmental benefit. We urge Congress to take every step possible to ensure that the Administration approaches negotiations in Bonn and Kyoto with due respect for science, equity, economics and the future of our nation.

July 3, 1997

REFERENCED MATERIAL

- Text of "Berlin Mandate" and Article 4 of the UN Framework Convention on Climate Change, to which it refers.
- List of major proposals made under the Berlin Mandate negotiation process with regard to post-2000 emission limitation targets and timetables.
- List of developing nations exempt from new commitments to limit greenhouse gas emissions under the Berlin Mandate.
- List of developed nations (Annex I) not exempt from new commitments under the Berlin Mandate.
- List of developed nations required to reduce greenhouse gas emissions below 1990 levels under the European Union proposal.
- Reductions in U.S. greenhouse gas emissions needed to return to 1990 levels in 2010; and to reach the EU proposal of 15 percent below 1990 levels.
- Projected global carbon emissions by area 1990-2100 and 1990-2015.
- Recent reports indicating continuing uncertainties in climate science, (Science, February 7, 199; May 16, 1997).
- Statement of Bert Bolin, Chairman, Intergovernmental Panel on Climate Change, on projected impact of Berlin Mandate proposals, February 25, 1997.
- "Public Opinion on Global Climate Issues", Charlton Research Company, May, 1997.
- Letter to Assistant Secretary of State, Eileen Claussen from the Global Climate Coalition, February 14, 1997.

FCCC/CP/1995/7/Add.1
English
Page 4

I. DECISIONS ADOPTED BY THE CONFERENCE OF THE PARTIES

Decision 1/CP.1

The Berlin Mandate: Review of the adequacy of Article 4, paragraph 2 (a) and (b), of the Convention, including proposals related to a protocol and decisions on follow-up

The Conference of the Parties, at its first session,

Having reviewed Article 4, paragraph 2(a) and (b), of the United Nations Framework Convention on Climate Change, and

Having concluded that these subparagraphs are not adequate,

Agrees to begin a process to enable it to take appropriate action for the period beyond 2000, including the strengthening of the commitments of the Parties included in Annex I t the Convention (Annex I Parties) in Article 4, paragraph 2(a) and (b), through the adoption of a protocol or another legal instrument:

I

1. The process shall be guided, inter alia, by the following:

(a) The provisions of the Convention, including Article 3, in particular the principles in Article 3.1, which reads as follows: "The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Accordingly, the developed country Parties should take the lead in combating climate change and the adverse effects thereof;"

(b) The specific needs and concerns of developing country Parties referred to in Article 4.8; the specific needs and special situations of least developed countries referred to in Article 4.9; and the situation of Parties, particularly developing country Parties, referred to in Article 4.10 of the Convention;

(c) The legitimate needs of the developing countries for the achievement of sustained economic growth and the eradication of poverty, recognizing also that all Parties have a right to, and should, promote sustainable development;

(d) The fact that the largest share of historical and current global emissions of greenhouse gases has originated in developed countries, that the per capita emissions in developing countries are still relatively low and that the share of global emissions originating in developing countries will grow to meet their social and development needs;

(e) The fact that the global nature of climate change calls for the widest possible cooperation by all countries and their participation in an effective and appropriate international response, in accordance with their common but differentiated responsibilities and respective capabilities and their social and economic conditions;

(f) Coverage of all greenhouse gases, their emissions by sources and removals by sinks and all relevant sectors;

(g) The need for all Parties to cooperate in good faith and to participate in this process.

II

2. The process will, inter alia:

(a) Aim, as the priority in the process of strengthening the commitments in Article 4.2(a) and (b) of the Convention, for developed country/other Parties included in Annex I, both

- to elaborate policies and measures, as well as
- to set quantified limitation and reduction objectives within specified time-frames, such as 2005, 2010 and 2020, for their anthropogenic emissions by sources and removals by sinks of greenhouse gases not controlled by the Montreal Protocol,

taking into account the differences in starting points and approaches, economic structures and resource bases, the need to maintain strong and sustainable economic growth, available technologies and other individual circumstances, as well as the need for equitable and appropriate contributions by each of these Parties to the global effort, and also the process of analysis and assessment referred to in section III, paragraph 4, below;

(b) Not introduce any new commitments for Parties not included in Annex I, but reaffirm existing commitments in Article 4.1 and continue to advance the implementation of these commitments in order to achieve sustainable development, taking into account Article 4.3, 4.5 and 4.7;

(c) Take into account any result from the review referred to in Article 4.2(f), if available, and any notification referred to in Article 4.2(g);

(d) Consider, as provided in Article 4.2(e), the coordination among Annex I Parties, as appropriate, of relevant economic and administrative instruments, taking into account Article 3.5;

(e) Provide for the exchange of experience on national activities in areas of interest, particularly those identified in the review and synthesis of available national communications; and

(f) Provide for a review mechanism.

III

3. The process will be carried out in the light of the best available scientific information and assessment on climate change and its impacts, as well as relevant technical, social and economic information, including, inter alia, reports of the Intergovernmental Panel on Climate Change. It will also make use of other available expertise.

4. The process will include in its early stages an analysis and assessment, to identify possible policies and measures for Annex I Parties which could contribute to limiting and reducing emissions by sources and protecting and enhancing sinks and reservoirs of greenhouse gases. This process could identify environmental and economic impacts and the results that could be achieved with regard to time horizons such as 2005, 2010, and 2020.

5. The protocol proposal of the Alliance of Small Island States (AOSIS), which contains specific reduction targets and was formally submitted in accordance with Article 17 of the Convention, along with other proposals and pertinent documents, should be included for consideration in the process.

6. The process should begin without delay and be conducted as a matter of urgency, in an open-ended ad hoc group of Parties hereby established, which will report to the second session of the Conference of the Parties on the status of this process. The sessions of this group should be scheduled to ensure completion of the work as early as possible in 1997, with a view to adopting the results at the third session of the Conference of the Parties.

9th plenary meeting
7 April 1995

UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

ARTICLE 4 COMMITMENTS

1....All Parties, taking into account their common but differentiated responsibilities and their specific national and regional development priorities, objectives and circumstances, shall:

(a)....Develop, periodically update, publish and make available to the Conference of the Parties, in accordance with Article 12, national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, using comparable methodologies to be agreed upon by the Conference of the Parties;

(b)....Formulate, implement, publish and regularly update national and, where appropriate, regional programmes containing measures to mitigate climate change by addressing anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, and measures to facilitate adequate adaptation to climate change;

(c)....Promote and cooperate in the development, application and diffusion, including transfer, of technologies, practices and processes that control, reduce or prevent anthropogenic emissions of greenhouse gases not controlled by the Montreal Protocol in all relevant sectors, including the energy, transport, industry, agriculture, forestry and waste management sectors;

(d)....Promote sustainable management, and promote and cooperate in the conservation and enhancement, as appropriate, of sinks and reservoirs of all greenhouse gases not controlled by the Montreal Protocol, including biomass, forests and oceans as well as other terrestrial, coastal and marine ecosystems;

(e)....Cooperate in preparing for adaptation to the impacts of climate change; develop and elaborate appropriate and integrated plans for coastal zone management, water resources and agriculture, and for the protection and rehabilitation of areas, particularly in Africa, affected by drought and desertification, as well as floods;

(f)....Take climate change considerations into account, to the extent feasible, in their relevant social, economic and environmental policies and actions, and employ appropriate methods, for example impact assessments, formulated and determined nationally, with a view to minimizing adverse effects on the economy, on public health and on the quality of the environment, of projects or measures undertaken by them to mitigate or adapt to climate change;

(g)....Promote and cooperate in scientific, technological, technical, socio-economic and other research, systematic observation and development of data archives related to the climate system and intended to further the understanding and to reduce or eliminate the remaining uncertainties regarding the causes, effects, magnitude and timing of climate change and the economic and social consequences of various response strategies;

(h)....Promote and cooperate in the full, open and prompt exchange of relevant scientific, technological, technical, socio-economic and legal information related to the climate system and climate change, and to the economic and social consequences of various response strategies;

(i)....Promote and cooperate in education, training and public awareness related to climate change and encourage the widest participation in this process, including that of non-governmental organizations; and

(j)....Communicate to the Conference of the Parties information related to implementation, in accordance with Article 12.

2....The developed country Parties and other Parties included in Annex I commit themselves specifically as provided for in the following:

(a)....Each of these Parties shall adopt national1 policies and take corresponding measures on the mitigation of climate change, by limiting its anthropogenic emissions of greenhouse gases and protecting and enhancing its greenhouse gas sinks and reservoirs. These policies and measures will demonstrate that developed countries are taking the lead in modifying longer-term trends in anthropogenic emissions consistent with the objective of the Convention, recognizing that the return by the end of the present decade to earlier levels of anthropogenic emissions of carbon dioxide and other greenhouse gases not controlled by the Montreal Protocol would contribute to such modification, and taking into account the differences in these Parties' starting points and approaches, economic structures and resource bases, the need to maintain strong and sustainable economic growth, available technologies and other individual circumstances, as well as the need for equitable and appropriate contributions by each of these Parties to the global effort regarding that objective. These Parties may implement such policies and measures jointly with other Parties and may assist other Parties in contributing to the achievement of the objective of the Convention and, in particular, that of this subparagraph;

(b)....In order to promote progress to this end, each of these Parties shall communicate, within six months of the entry into force of the Convention for it and periodically thereafter, and in accordance with Article 12, detailed information on its policies and measures referred to in subparagraph (a) above, as well as on its resulting projected anthropogenic emissions by sources and removals by sinks of greenhouse gases not controlled by the Montreal Protocol for the period referred to in subparagraph (a), with the aim of returning individually or jointly to their 1990 levels these anthropogenic emissions of carbon dioxide and other greenhouse gases not controlled by the Montreal Protocol. This information will be reviewed by the Conference of the Parties, at its first session and periodically thereafter, in accordance with Article 7;

(c)....Calculations of emissions by sources and removals by sinks of greenhouse gases for the purposes of subparagraph (b) above should take into account the best available scientific knowledge, including of the effective capacity of sinks and the respective contributions of such gases to climate change. The Conference of the Parties shall consider and agree on methodologies for these calculations at its first session and review them regularly thereafter;

(d)....The Conference of the Parties shall, at its first session, review the adequacy of subparagraphs (a) and (b) above. Such review shall be carried out in the light of the best available scientific information and assessment on climate change and its impacts, as well as relevant technical, social and economic information. Based on this review, the Conference of the Parties shall take appropriate action, which may include the adoption of amendments to the commitments in subparagraphs (a) and (b) above. The Conference of

the Parties, at its first session, shall also take decisions regarding criteria for joint implementation as indicated in subparagraph (a) above. A second review of subparagraphs (a) and (b) shall take place not later than 31 December 1998, and thereafter at regular intervals determined by the Conference of the Parties, until the objective of the Convention is met;

(e)....Each of these Parties shall :

i)....Coordinate as appropriate with other such Parties, relevant economic and administrative instruments developed to achieve the objective of the Convention; and

(ii)....Identify and periodically review its own policies and practices which encourage activities that lead to greater levels of anthropogenic emissions of greenhouse gases not controlled by the Montreal Protocol than would otherwise occur;

(f)....The Conference of the Parties shall review, not later than 31 December 1998, available information with a view to taking decisions regarding such amendments to the lists in Annexes I and II as may be appropriate, with the approval of the Party concerned;

(g)....Any Party not included in Annex I may, in its instrument of ratification, acceptance, approval or accession, or at any time thereafter, notify the Depositary that it intends to be bound by subparagraphs (a) and (b) above. The Depositary shall inform the other signatories and Parties of any such notification.

3....The developed country Parties and other developed Parties included in Annex II shall provide new and additional financial resources to meet the agreed full costs incurred by developing country Parties in complying with their obligations under Article 12, paragraph 1. They shall also provide such financial resources, including for the transfer of technology, needed by the developing country Parties to meet the agreed full incremental costs of implementing measures that are covered by paragraph 1 of this Article and that are agreed between a developing country Party and the international entity or entities referred to in Article 11, in accordance with that Article. The implementation of these commitments shall take into account the need for adequacy and predictability in the flow of funds and the importance of appropriate burden sharing among the developed country Parties.

4....The developed country Parties and other developed Parties included in Annex II shall also assist the developing country Parties that are particularly vulnerable to the adverse effects of climate change in meeting costs of adaptation to those adverse effects.

5....The developed country Parties and other developed Parties included in Annex II shall take all practicable steps to promote, facilitate and finance, as appropriate, the transfer of, or access to, environmentally sound technologies and know-how to other Parties, particularly developing country Parties, to enable them to implement the provisions of the Convention. In this process, the developed country Parties shall support the development and enhancement of endogenous capacities and technologies of developing country Parties. Other Parties and organizations in a position to do so may also assist in facilitating the transfer of such technologies.

6....In the implementation of their commitments under paragraph 2 above, a certain degree of flexibility shall be allowed by the Conference of the Parties to the Parties included in Annex I undergoing the process of transition to a market economy, in order to enhance the ability of these Parties to address climate change, including with regard to the

historical level of anthropogenic emissions of greenhouse gases not controlled by the Montreal Protocol chosen as a reference.

7....The extent to which developing country Parties will effectively implement their commitments under the Convention will depend on the effective implementation by developed country Parties of their commitments under the Convention related to financial resources and transfer of technology and will take fully into account that economic and social development and poverty eradication are the first and overriding priorities of the developing country Parties.

8....In the implementation of the commitments in this Article, the Parties shall give full consideration to what actions are necessary under the Convention, including actions related to funding, insurance and the transfer of technology, to meet the specific needs and concerns of developing country Parties arising from the adverse effects of climate change and/or the impact of the implementation of response measures, especially on:

(a)....Small island countries;

(b)....Countries with low-lying coastal areas;

(c)....Countries with arid and semi-arid areas, forested areas and areas liable to forest decay;

(d)....Countries with areas prone to natural disasters;

(e)....Countries with areas liable to drought and desertification;

(f)....Countries with areas of high urban atmospheric pollution;

(g)....Countries with areas with fragile ecosystems, including mountainous ecosystems;

(h)....Countries whose economies are highly dependent on income generated from the production, processing and export, and/or on consumption of fossil fuels and associated energy-intensive products; and

(i)....Land-locked and transit countries.

Further, the Conference of the Parties may take actions, as appropriate, with respect to this paragraph.

9.....The Parties shall take full account of the specific needs and special situations of the least developed countries in their actions with regard to funding and transfer of technology.

10....The Parties shall, in accordance with Article 10, take into consideration in the implementation of the commitments of the Convention the situation of Parties, particularly developing country Parties, with economies that are vulnerable to the adverse effects of the implementation of measures to respond to climate change. This applies notably to Parties with economies that are highly dependent on income generated from the production, processing and export, and/or consumption of fossil fuels and associated energy-intensive products and/or the use of fossil fuels for which such Parties have serious difficulties in switching to alternatives.

MAJOR
BERLIN MANDATE PROPOSALS
EMISSION REDUCTIONS FROM 1990 BASELINE

	GAS	EACH ANNEX 1 PARTY BINDING TARGETS	2005	2010	2020	2030	POLICIES & MEASURES
Alliance of Small Island States	CO_2	**Flat Rate**	**20%**				**Binding "Common" Measures**
Germany Austria	CO_2	**a**	10%	15-20%			" " " "
United Kingdom	CO_2	**a**		20%			" " " "
European Union	CO_2 CH_4 N_20	**Differentiated for EU Members Only**	**?**	**15%**	**?**	**?**	" " " " **Joint Implementation**
Denmark	CO_2	**a**	20%			50%	Binding "Common" Measures
Netherlands	GH	**a**	Average 1-2% Per Year				" " " "
Netherlands/EU	GH/ CO_2	**a**	10/8%	15/13%			" " " "
France Spain	GH	Differentiated	Per Capita or Unit of GDP				?
Japan	CO_2	**Differentiated**	**Average Tons/CO_2 Per Capita Over x Years, or Reduce CO_2 Average of x % Over x Years**				**Menu of Measures List in Annex I**
Australia	GH	**Differentiated (-30% to +40% of 1990)**		**GDP, Population, Emissions Intensity**			**Joint Implementation**
Norway	GH	**Differentiated**	**Emissions Intensity; GHG, GDP Per Capita**				**Joint Implementation**
Russia	GH	**Flat Rate for Annex II Parties**		**b**	**c**		**Joint Implementation**
		Differentiated for Countries in Transition			**d**		
US	GH	**Flat Rate** **?**	**Multi-Year "Budgets"** **?**				**No "Common" Measures** **Emissions Trading** **Joint Implementation**

a) Assumes EU members comply collectively as a Party = EU "Bubble"
b) Stabilization at base year level (1990 or other)
c) Post 2010 target to be set for Annex II Parties by 2007
d) Stabilization at 1990 or other base year until Party exceeds average GDP per capita for CITs

BOLD FACE: Proposals of Particular Interest

PARTIES EXEMPT UNDER THE BERLIN MANDATE FROM NEW COMMITMENTS (132)

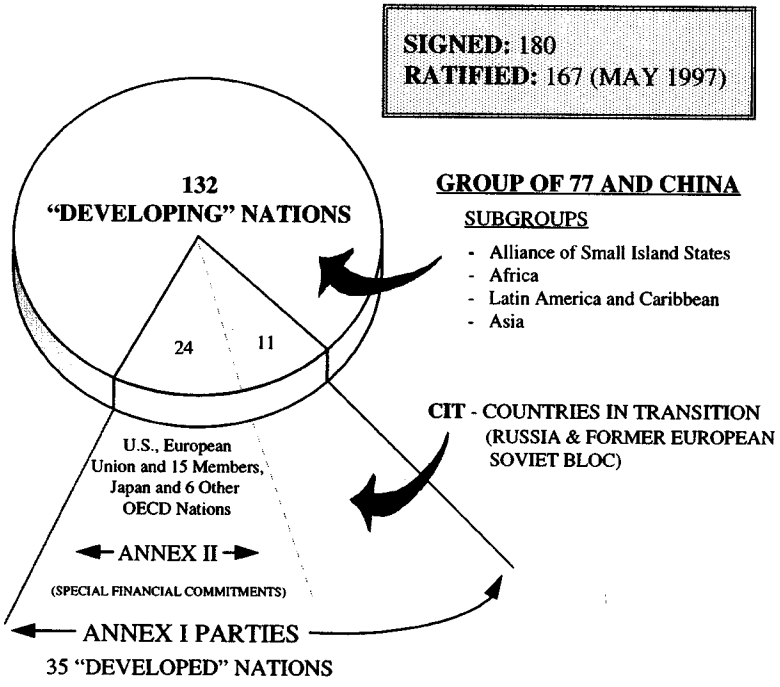
Albania
Algeria
Antigua & Barbuda
Argentina
Armenia
Azerbaijan
Bahamas
Bahrain
Bangladesh
Barbados
Belize
Benin
Bhutan
Bolivia
Botswana
Brazil
Burkina Faso
Burundi
Cambodia
Cameroon
Cape Verde
Central African Rep.
Chad
Chile
China
Colombia
Comoros
Congo
Cook Islands
Costa Rica
Cote d'Ivoire
Croatia
Cuba
Democratic Republic of the Congo
Democratic People's Republic of Korea
Djibouti
Dominica
Ecuador
Egypt
El Salvador
Eritrea
Ethiopia
Fiji
Gambia
Georgia
Ghana
Grenada
Guatemala
Guinea
Guinea Bissau
Guyana
Haiti
Honduras
India
Indonesia
Iran (Islamic Republic of)
Israel
Jamaica
Jordan
Kazakhstan
Kenya
Kiribati
Kuwait
Lao People's Democratic Rep.
Lebanon
Lesotho
Liechtenstein
Malawi
Malaysia
Maldives
Mali
Malta
Marshall Islands
Mauritania
Mauritius
Mexico
Micronesia (Federated States of)
Moldova (Republic of)
Monaco
Mongolia
Morocco
Mozambique
Myanmar
Namibia
Nauru
Nepal
Nicaragua
Nigeria
Niger
Niue
Oman
Pakistan
Panama
Papua New Guinea
Paraguay
Peru
Philippines
Qatar
Republic of Korea
Saint Kitts & Nevis
Saint Lucia
Saint Vincent and the Grenadines
Samoa
San Marino
Saudi Arabia
Senegal
Seychelles
Sierra Leone
Singapore
Solomon Islands
Solvenia
Sri Lanka
Sudan
Swaziland
Syrian Arab Rep.
Thailand
Togo
Trinidad & Tabago
Tunisia
Turkmenistan
Tuvalu
Uganda
United Arab Emirates
United Republic of Tanzania
Uruguay
Uzbekistan
Vanuatu
Venezuela
Viet Nam
Yemen
Zambia
Zimbabwe

NOTE:

Among Those Currently Not A Party To Climate Change Convention:

South Africa
Turkey
Taiwan

PARTIES TO THE FRAMEWORK CONVENTION ON CLIMATE CHANGE



PARTIES RATIFYING THE FRAMEWORK CONVENTION ON CLIMATE CHANGE WITH "DEVELOPED" NATION COMMITMENTS UNDER ARTICLE 4.2

	European Union[1]	Countries in Transition (CIT)
Australia	Austria	Belarus[3]
Canada	Belgium	Bulgaria
Iceland	Denmark	Czech Republic
Japan	Finland	Estonia
New Zealand	France	Hungary
Norway	Germany	Latvia
Switzerland	Greece	Lithuania
United States	Ireland	Russian Federation
Monaco[2]	Italy	Poland
	Luxembourg	Romania
	Netherlands	Slovak Republic
	Portugal	Ukraine
	Spain	
	Sweden	
	United Kingdom	

[1] A separate Party to the Convention as a "regional economic integration organization."
[2] Not listed as Annex I Party, but has agreed to be bound by Article 4.2 (a) and (b) commitments.
[3] Signed, but has not yet ratified Convention as of May 1997.

DEVELOPED NATION PARTIES GREENHOUSE GAS EMISSION INCREASES/REDUCTIONS TARGETS RESULTING FROM EUROPEAN UNION 15% REDUCTION PROPOSAL FOR 2010

NON-EUROPEAN UNION	
-15%	Australia
-15%	Canada
-15%	Iceland
-15%	Japan
-15%	New Zealand
-15%	Norway
-15%	Switzerland
-15%	United States

COUNTRIES IN TRANSITION[2]	
-15%	Belarus
-15%	Bulgaria
-15%	Czech Republic
-15%	Estonia
-15%	Hungary
-15%	Latvia
-15%	Lithuania
-15%	Russian Federation
-15%	Poland
-15%	Romania
-15%	Slovak Republic
-15%	Ukraine

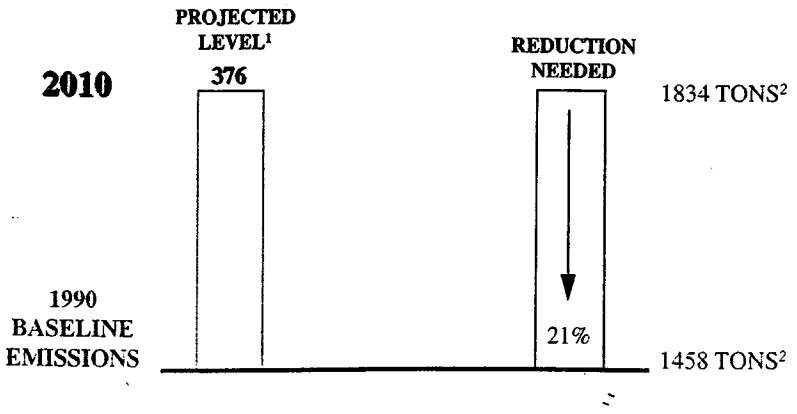
EUROPEAN UNION[1]	
+40%	Portugal
+30%	Greece
+17%	Spain
+15%	Ireland
+5%	Sweden
0	Finland
0	France
-7%	Italy
-10%	Netherlands
-10%	United Kingdom
-10%	Belgium
-25%	Austria
-25%	Denmark
-25%	Germany
-30%	Luxembourg
-10%	European Union

[1]National targets shown for EU members are for a 10% reduction by 2010 and therefore are only suggestive. EU could not agree on national targets under a 15% reduction.

[2]Former Soviet Bloc/emission as group are projected to be 12% below 1990 levels in 2010 on a business as-usual-basis. (DOE/EIA, "International Energy Outlook 1997".) Thus, under a 10% reduction target, these nations may avoid taking additional greenhouse gas mitigation efforts before 2010.

GREENHOUSE GAS EMISSIONS REDUCTION PROPOSALS

IT WOULD REQUIRE A 21% REDUCTION IN PROJECTED GROWTH TO JUST STAY AT 1990 LEVELS IN 2010

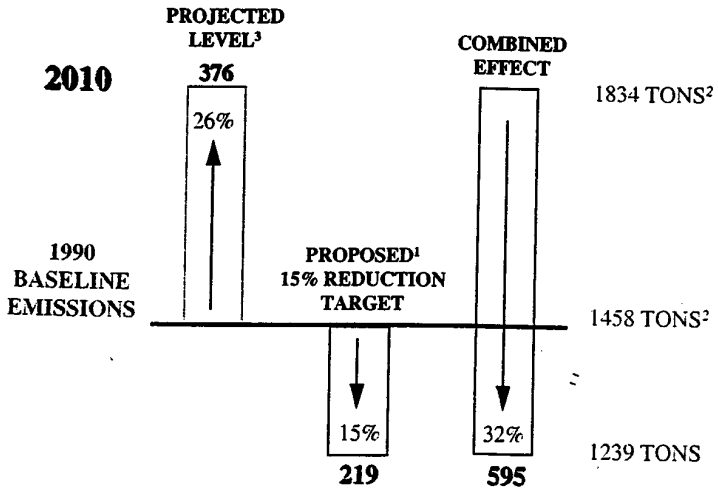


[1] Projected U.S. Greenhouse Gas Emissions in 2010 with Current Climate Action Programs.
[2] Million Metric Tons Carbon Equivalent

Data Source: U.S. Climate Action Report, 1997

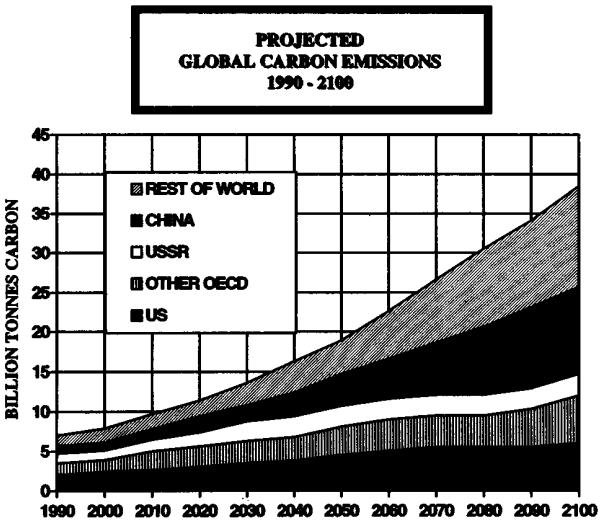
GREENHOUSE GAS EMISSIONS REDUCTION PROPOSALS

A 15% REDUCTION TARGET MEANS THE U.S. ECONOMY WOULD HAVE TO USE 30% LESS ENERGY IN 2010



[1] European Union Proposal
[2] Million Metric Tons Carbon Equivalent
[3] Projected U.S. Greenhouse Gas Emissions in 2010 with Current Climate Action Programs.

Data Source: U.S. Climate Action Report, 1997



Source: Manne and Richels, Buying Greenhouse Insurance.

CARBON EMISSIONS
(Million Metric Tons)

		PERCENT OF WORLD	PROJECTIONS		PERCENT OF WORLD	PERCENT CHANGE
	1990	*1990*	*2000*	*2015*	*2015*	*1990 - 2015*
World	**6,012.0**	100%	**7,093.0**	**9,784.0**	100%	+61%
Developing Nations	**1,687.0**	**28.0**	**2,660.0**	**4,379.0**	**45.1%**	**+160%**
- China	625.0	10.4	1,031.0	1,838.0	18.9%	+194%
Russia/E. Europe	**1,339.0**	**22.3**	**1,012.0**	**1,251.0**	**12.9%**	**-6.6%**
Developed (OECD)	**2,985.0**	**49.7**	**3,421.0**	**4,074.0**	**42.0%**	**+36%**
- U.S.	1,337.0	22.3	1,543.0	1,798.0	18.5%	+34%
- Japan	308.0	5.1	401.0	492.0	5.1%	+60%

Source: U.S. DOE/EIA, "International Energy Outlook 1997". Reference Case Scenario Data

Greenhouse Forecasting Still Cloudy

An international panel has suggested that global warming has arrived, but many scientists say it will be a decade before computer models can confidently link the warming to human activities

The headlines a year and a half ago positively brimmed with assurance: "Global Warming: No Longer in Doubt," "Man Adversely Affecting Climate, Experts Conclude," "Experts Agree Humans Have 'Discernible' Effect on Climate," "Climate Panel Is Confident of Man's Link to Warming." The official summary statement of the UN-sponsored Intergovernmental Panel on Climate Change (IPCC) report that had prompted the headlines seemed reasonably confident, too: "... the balance of evidence suggests that there is a discernible human influence on global climate." But as negotiators prepare to gather in Bonn in July to discuss a climate treaty that could require nations to adopt expensive policies for limiting their emissions of carbon dioxide and other greenhouse gases, many climate experts caution that it is not at all clear yet that human activities have begun to warm the planet—or how bad greenhouse warming will be when it arrives.

What had inspired the media excitement was the IPCC's conclusion that the half-degree rise in global temperature since the late 19th century may bear a "fingerprint" of human activity. The patchy distribution of the warming around the globe looks much like the distinctive pattern expected if the heat-trapping gases being poured into the atmosphere were beginning to warm the planet, the report said. But IPCC scientists now say that neither the public nor many scientists appreciate how many if's, and's, and but's peppered the report. "It's unfortunate that many people read the media hype before they read the [IPCC] chapter" on the detection of greenhouse warming, says climate modeler Benjamin Santer of Lawrence Livermore National Laboratory in Livermore, California, the lead author of the chapter. "I think the caveats are there. We say quite clearly that few scientists would say the attribution issue was a done deal."

Santer and his IPCC colleagues' overriding reason for stressing the caveats is their understanding of the uncertainty inherent in computer climate modeling. The models are key to detecting the arrival of global warming, because they enable researchers to predict how the planet's climate should respond to increasing levels of greenhouse gases. And while predicting climate has always been an uncertain business, some scientists assert that developments since the IPCC completed its report have, if anything, magnified the uncertainties. "Global warming is definitely a threat as greenhouse-gas levels increase," says climate modeler David Rind of NASA's Goddard Institute for Space Studies (GISS) in New York City, "but I myself am not convinced that we have [gained] greater confidence" in recent years in our predictions of greenhouse warming. Says one senior climate modeler who prefers not to enter the fray publicly: "The more you learn, the more you understand that you don't understand very much." Indeed, most modelers now agree that the climate models will not be able to link greenhouse warming unambiguously to human actions for a decade or more.

NCAR

Rough approximation. Models can't reproduce clouds, but they incorporate some cloud effects, including those of water (white) in the atmosphere, seen in the above model output.

The effort to simulate climate in a computer faces two kinds of obstacles: lack of computer power and a still very incomplete picture of how real-world climate works. The climate forecasters' basic strategy is to build a mathematical model that recreates global climate processes as closely as possible, let the model run, and then test it by comparing the results to the historical climate record. But even with today's powerful supercomputers, that is a daunting challenge, says modeler Michael Schlesinger of the University of Illinois, Urbana-Champaign: "In the climate system, there are 14 orders of magnitude of scale, from the planetary scale—which is 40 million meters—down to the scale of one of the little aerosol particles on which water vapor can change phase to a liquid [cloud particle]—which is a fraction of a millionth of a millimeter."

Of these 14 orders of magnitude, notes Schlesinger, researchers are able to include in their models only the two largest, the planetary scale and the scale of weather disturbances: "To go to the third scale—which is [that of thunderstorms] down around 50-kilometers resolution—we need a computer a thousand times faster, a teraflops machine that maybe we'll have in 5 years." And including the smallest scales, he says, would require 10^{36} to 10^{37} more computer power. "So we're kind of stuck."

To get unstuck, modelers "parameterize" smaller scale processes known to affect climate, from the formation of clouds to the movement of ocean eddies. Because they can't model, say, every last cloud over North America, modelers specify the temperatures and humidities that will spawn different types of clouds. If those conditions hold within a single grid box—the horizontal square that represents the model's finest level of detail—the computer counts the entire area as cloudy. But as modelers point out, the grid used in today's models—typically a 300-kilometer square—is still very coarse. One over the state of Oregon, for instance, would take in the coastal ocean, the low coast ranges, the Willamette Valley, the high Cascades, and the desert of the Great Basin.

Having the computer power to incorporate into the models a more detailed picture of clouds wouldn't eliminate uncertainties, however, because researchers are still hotly debating the overall impact of clouds on future climate. In today's climate, the net effect of clouds is to cool the planet—although they trap some heat, they block even more by reflecting sunlight back into space. How that balance would change under greenhouse warming, no one knows. A few years ago, a

Model Gets It Right—Without Fudge Factors

Climate modelers have been "cheating" for so long it's almost become respectable. The problem has been that no computer model could reliably simulate the present climate. Even the best simulations of the behavior of the atmosphere, ocean, sea ice, and land surface drift off into a climate quite unlike today's as they run for centuries. So climate modelers have gotten in the habit of fiddling with fudge factors, so-called "flux adjustments," until the model gets it right.

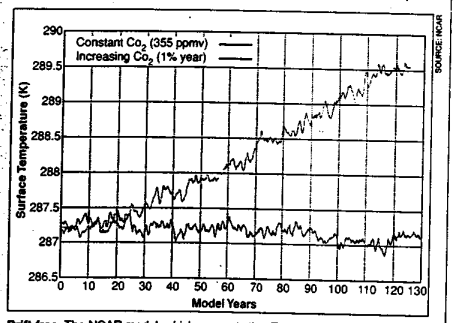
No one liked this practice (*Science*, 9 September 1994, p. 1528). "If you can't simulate the present without arbitrary adjustments, you have to worry," says meteorologist and modeler David Randall of Colorado State University (CSU) in Fort Collins. But now there's a promising alternative. Thirty researchers at the National Center for Atmospheric Research (NCAR) in Boulder, Colorado, have developed the first complete model that can simulate the present climate as well as other models do, but without flux adjustments. The new NCAR model, says Randall, "is an important step toward removing some of the uneasiness people have about trusting these models to make predictions of future climate" (see main text).

The NCAR modelers built a host of refinements into their new Climate System Model (CSM). But the key development, says CSM co-chair Byron Boville, was finding a better way to incorporate the effects of ocean eddies, swirling pools of water up to a couple of hundred kilometers across that spin off strong currents. Climate researchers have long known that the eddies, like atmospheric storms, help shape climate by moving heat around the planet. But modelers have had a tough time incorporating them into their simulations because they are too small to show up on the current models' coarse geographic grid. The CSM doesn't have a finer mesh, but it does include a new "parameterization" that passes the effects of these unseen eddies onto larger model scales, using a more realistic means of mixing heat through the ocean than any earlier model did, says Boville.

Even when run for 300 model "years," the CSM doesn't drift away from a reasonably realistic climate, says NCAR's Climate and Global Dynamics director Maurice Blackmon. "Being able to do this without flux corrections gives you more credibility," he says. "For better or worse, we're not biasing the results as was necessary before."

The first results from this still vastly simplified model imply that future greenhouse warming may be milder than some other models have suggested—and could take decades to reveal itself. Doubling atmospheric carbon dioxide concentrations in the model raised the global temperature 2 degrees Celsius, which puts the model's sensitivity to greenhouse gases near the low end of current estimates. Based on an array of different models and other considerations, the UN-sponsored Intergovernmental Panel on Climate Change estimated in 1995 that a carbon dioxide doubling could raise global temperatures by as much as 4.5°C; their best guess was 2.5°C.

A 300-year run without any increase in greenhouse gases produced slow, natural variations in global temperature of about 0.5°C. If the real climate behaves the same way, "two-thirds to three-quarters of the [temperature variations of the] last 130 years can be explained as natural variation," says Blackmon. That would make the detection of a modest-size greenhouse warming all the more difficult.



Drift-free. The NCAR model, which suggests that Earth will warm moderately (red), can reliably simulate present climate (blue).

The CSM is available on the Internet, but Blackmon warns that if you want to check out future climate scenarios, you'll "need the biggest supercomputer you can get." Indeed, even NCAR researchers haven't been able to experiment with the model on as large a computer as they would like. While their purchase of an NEC SX4 computer is tied up in a trade dispute with Japan (*Science*, 30 August 1996, p. 1177), they are making do with a leased Cray C-90 with perhaps 20% of the speed of the SX4. That worries some modelers. Americans have "been among the leaders of the field from the beginning," says CSU's Randall, but "if we can't get access to the most powerful machines, we are going to be left behind."

–R.A.K.

leading climate model—developed at the British Meteorological Office's Hadley Center for Climate Prediction and Research, in Bracknell—predicted that an Earth with twice the preindustrial level of carbon dioxide would warm by a devastating 5.2 degrees Celsius. Then Hadley Center modelers, led by John Mitchell, made two improvements to the model's clouds—how fast precipitation fell out of different cloud types and how sunlight and radiant heat interacted with clouds. The model's response to a carbon dioxide doubling dropped from 5.2°C to a more modest 1.9°C.

Other models of the time also had a wide range of sensitivities to carbon dioxide, largely due to differences in the way their clouds behaved. That range of sensitivity has since narrowed, says modeler and cloud specialist Robert Cess of the State University of New York, Stony Brook, but "the [models] may be agreeing now simply because they're all tending to do the same thing wrong. It's not clear to me that we have clouds right by any stretch of the imagination."

Nor are clouds the only question mark in researchers' picture of how climate works. Modelers saw for the first time the fingerprint of global warming when they folded an additional process into the models: the effect of pollutant hazes on climate. Wind-blown soil and dust, particles from the combustion of fossil fuels, and ash and soot from

agricultural burning all reflect sunlight—shading and cooling the surface beneath them. Including this aerosol effect in four independent climate models at three centers—Livermore, the Hadley Center, and the Max Planck Institute for Meteorology (MPI) in Hamburg, Germany—produced geographic patterns of temperature changes that resembled those observed in the real world over the past few decades, such as the greater warming of land than ocean.

Fingerprinting work since then has only strengthened the confidence of IPCC's more confident scientists that greenhouse warming has arrived. "I've worked with the models enough to know they're not perfect, but we keep getting the same answer," says Tim P. Barnett, a climatologist at the Scripps Institution of Oceanography in La Jolla, California, and a co-author of the IPCC chapter. Another climatologist and IPCC contributor, Gerald North of Texas A&M University in College Station, is similarly heartened. "I'm pretty optimistic about climate modeling. ... I don't know anybody doing [fingerprinting] who is not finding the same result."

NOAA

Crucial component. Thunderstorms like the one above help to shape climate by lofting heat and moisture.

But the assumptions about how hazes affect climate may have taken a hit recently from climatologist and modeler James Hansen of NASA's GISS—the man who told Congress in 1988 that he believed "with a high degree of confidence" that greenhouse warming had arrived. In a recent paper, Hansen and his GISS colleagues pointed out that recent measurements suggest that aerosols don't just cool; they also warm the atmosphere by absorbing sunlight. The net effect of this reflection and absorption, Hansen estimates, would be small—too small to have much effect on temperature.

Hansen and his colleagues conclude that aerosols probably do have a large effect on climate, but indirectly, through clouds. By increasing the number of droplets in a cloud, aerosols can amplify the reflectivity of clouds, and thus may have an overall cooling effect on the atmosphere. If true, this would greatly complicate the modelers' work, because meteorologists are only just starting to understand how efficiently particles of different sizes and compositions modify clouds. "I used to think of clouds as the Gordian knot of the problem," says cloud specialist V. Ramanathan of Scripps. "Now I think it's the aerosols. We are arguing about everything."

And the complications don't stop with the multiplication of aerosol effects, according to Christopher Folland of the Hadley Center. Folland and his colleagues have been trying to sort out what was behind the intermittent warming of recent decades, which in the third quarter of the century was more rapid in the Southern than Northern Hemisphere. Earlier work by Santer and a dozen other colleagues showed an increasing resemblance between the observed pattern of warming through 1987, the end of their temperature record, and the results of a model run that incorporated aerosol effects. The researchers suggested that the North's more abundant pollutant aerosols could have been moderating the warming there from greenhouse gases. But when Folland compared the results of his model run with a longer, more recent temperature record, the resemblance that had been building into the 1980s faded by the early 1990s. Contrarian Patrick Michaels of the University of Virginia, Charlottesville, also has pointed out this trend.

The Hadley model suggests that "there appears to be more than one reason" for the variations, says Folland. The waning of aerosols as pollution controls took effect probably helped the North catch up, he says, but so did natural shifts in atmospheric circulation that tended to warm the continents (*Science*, 7 February, p. 754). Most provocatively, Folland and his colleagues are suggesting that a shift in North Atlantic Ocean circulation that has tended to warm the region also has contributed. "There's no doubt," says Santer, "that multiple natural and anthropogenic factors can contribute, and probably have, to the interhemispheric temperature contrast. ... We've learned something about detection."

All of which only adds to the skepticism of scientists who might be called the "silent doubters": meteorologists and climate modelers who rarely give voice to their concerns and may not have participated even peripherally in the IPCC. "There really isn't a persuasive case being made" for detection of greenhouse warming, argues Brian Farrell of Harvard University, who runs models to understand climate change in the geologic past. Farrell has no quarrel with the IPCC chapter on detecting greenhouse warming, but he says the executive summary did not "convey the real uncertainties the science has." He further contends that if IPCC scientists had had real confidence in their assertion that global warming had arrived, they would have stated with more precision how sensitive the climate system is to greenhouse gases. But the IPCC left the estimate of the warming from a doubling of carbon dioxide at 1.5°C to 4.5°C, where it has been for 20 years. "That's an admission that the error bars are as big as the signal," says Farrell.

Climate modeler Max Suarez of NASA's Goddard Space Flight Center in Greenbelt, Maryland, agrees that it's "iffy" whether the match between models and temperature records is close enough to justify saying that greenhouse warming is already under way. "Especially if you're trying to explain the very small [temperature] change we've seen already," he says, "I certainly wouldn't trust the models to that level of detail yet."

Rather than dwelling on model imperfections, IPCC co-author Barnett emphasizes some of the things that current models are doing fairly well—simulating present and past climates and the changing seasons, predicting El Niño a year ahead, and producing good simulations of decades-long climate variations. But he agrees that too much confidence has been read into the IPCC summary statement. "The next 10 years will tell; we're going to have to wait that long to really see," he says. Klaus Hasselmann of the MPI also sees a need to wait. He and his colleagues "think we can see the [greenhouse warming] signal now with 97% confidence." But, as North notes, "all that assumes you knew what you were doing to start with" in building the models. Hasselmann has faith in his model but recognizes that his faith is not universally shared. "The signal is not so much above the noise that you can convince skeptics," he observes. "It will take another decade or so to work up out of the noise."

That's no excuse for complacency, many climate scientists say. Basic theory, this century's warming, and geologic climate records all suggest that increasing carbon dioxide will warm the planet. "I'd be surprised if that went away," says Suarez, as would most climate researchers. North suggests that while researchers are firming up the science, policy-makers could inaugurate "some cautious things" to moderate any warming. The last thing he and his colleagues want is a rash of headlines saying the threat is over.

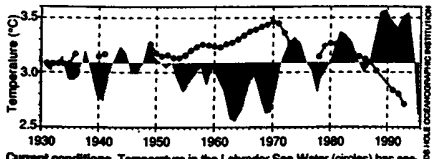
–Richard A. Kerr

CLIMATE

A New Driver for the Atlantic's Moods and Europe's Weather?

Last November, oceanographer Michael McCartney was enjoying a strangely peaceful voyage across placid waters off southern Greenland. Placid is not the usual word for these latitudes in winter; most of McCartney's previous winter voyages here had met with stormy seas for weeks on end. McCartney already knew part of the reason for this trip's fine weather: Only 1 year before, the atmosphere over the North Atlantic had jumped from the circulation pattern it had favored for 20 years to another mode of operation, which steers storms away from the seas off Greenland. This unheralded atmospheric seesawing—one swing of the so-called North Atlantic Oscillation, or NAO—wasn't entirely benign: While McCartney was savoring calm seas, Europeans were entering their second brutal winter in a row, and skaters in the Netherlands raced long-distance along canals frozen for the first time in a decade.

What drives these decade-long mood swings in North Atlantic wind and weather? McCartney, of the Woods Hole Oceanographic Institution (WHOI) in Massachusetts, and some other oceanographers suspected it wasn't a random whim of the atmosphere but a complex interaction between the ocean and the atmosphere, something like the shorter oscillations in the tropical Pacific Ocean, dubbed El Niño. In higher latitudes, the existence of such an ocean-atmosphere link has never been clear. Now, new data from ocean voyages and new modeling efforts suggest just such a connection.



Current conditions. Temperature in the Labrador Sea Water (circles) has seesawed in time with the North Atlantic Oscillation index, now running low (blue) and bringing cold winter to Europe; the high index (red) means warmer winters.

Deep within the North Atlantic, McCartney and others are finding parts of a fluid clockwork that may pace the decades-long swings of the NAO of the past century.

If researchers can understand what triggers the NAO switch, they may one day be able to predict it. And they may gain insights into how it may be modulating the warming of the Northern Hemisphere and perhaps even confusing the current search for signals of increasing greenhouse warming (see sidebar). Still, there's a long way to go before oceanographers' studies of the Atlantic catch up with their understanding of the tropical Pacific. McCartney's "suggestions are provocative," says Hugo Bezdek of the Atlantic Oceanographic and Meteorological Laboratory in Miami, one of the oceanographers picking up signs of a link. "There's some evidence to support his ideas, but it will be some time before we can make an ocean-atmosphere connection in the midlatitudes that is robust."

Although the North Atlantic's part of the story is only just coming into view, the atmospheric part of the NAO has long been on display. Typically, low pressure and a counterclockwise wind circulation are centered over Iceland, in contrast to higher pressure and clockwise circulation near the Azores off Portugal. As air swirls around each

A Case of Mistaken Identity?

Two years ago, researchers investigating the suspicious worldwide warming of recent decades concluded that they had glimpsed the culprit's fingerprint. A distinctive geographical pattern of warming pointed to increasing amounts of atmospheric greenhouse gases as the guilty party. As a result, in late 1995, the international scientific community declared that "the balance of evidence suggests that there is a discernible human influence on global climate" (*Science*, 8 December 1995, p. 1565). But is the fingerprint really unique to the greenhouse? Natural agents of climate change, such as the atmosphere's decades-long oscillations in circulation (see main text and *Science*, 28 October 1994, p. 544), may be masquerading as a strengthening greenhouse, according to James Hurrell of the National Center for Atmospheric Research in Boulder, Colorado, and others.

If so, says Hurrell, the recent indictment may have been premature. "It's really important work," says Benjamin Santer of Lawrence Livermore National Laboratory, whose work was pivotal in last year's indictment. "I think it's an issue the [greenhouse] detection community is going to have to get more involved with."

In the 1970s, a pattern of temperature changes began to emerge that recently was shown to match computer predictions of greenhouse warming. As predicted, in winter the land was warming faster than the oceans, which react slowly to temperature change, and the warming was concentrated at high latitudes, where the retreat of ice and snow would reduce the amount of solar energy reflected back to space. But natural-looking circulation changes began appearing at about the same time, notes Hurrell. Low-pressure centers over the Aleutian Islands and Iceland intensified as the atmospheric oscillations there switched to new modes. The resulting changes in circulation pumped more warm, moist air over northern North America and Eurasia while sending more cold Arctic air over the North Pacific and North Atlantic oceans.

The land warms quickly, but the ocean cools slowly. Accordingly, the new circulation produced a net warming centered over the northern continents—a pattern very similar to the greenhouse fingerprint. "The changes in the Aleutian low and the [Icelandic low] explain a lot of the warming in the Northern Hemisphere of the last 2 decades," says Hurrell. He presented his case in *Geophysical Research Letters* last year, and John Wallace and Yuan Zhang of the University of Washington had reached similar conclusions in an earlier study.

These changes can't explain the whole greenhouse fingerprint, such as changes in temperature higher in the atmosphere or in the tropical Pacific. But they do present a "sort of chicken-and-egg problem," says Santer. Are the shifts in circulation entirely natural, or is greenhouse warming driving the changes in the oscillations? Computer modeling may address the issue, but as Hurrell notes, the North Atlantic may soon give its own answer. The atmospheric circulation there swung to the opposite mode about a year ago. If that shift holds, the Northern Hemisphere will cool, he says; if global warming continues apace anyway, the greenhouse will clearly be the prime suspect. Time may tell who left the fingerprint.

–R.A.K.

pressure center, strong winds blow west to east across the latitudes in between. The NAO, as meteorologists see it, is a seesaw that modulates this pressure gradient. To start, a bit of extra air mass might pile up over the Azores. Because contrasts in pressure drive winds, this "high-index" extreme of the NAO drives stronger than normal westerly winds, especially during winter when the NAO is most clearly expressed.

These westerly winds blow over warm Gulf Stream waters as they meander across the northern North Atlantic. The stronger the wind, the more of the Gulf Stream's heat is delivered to Eurasia, so the NAO's high-index years of 1980 to 1995 created unusually mild winters there. But when the NAO swings to the other extreme, as it did with a vengeance late in 1995, air pressure builds up over Iceland, filling in the low and weakening the gradient and warming winds. The effects of a record-low NAO are now on display: a bitter winter in Europe and unusual calm near Greenland.

Although meteorologists could describe the shifts in the NAO over the past century and point to their effects, the origins of the oscillation have largely eluded them. The NAO seesaws on time scales from months to decades, but the atmosphere, with its relatively small mass and rapid response time, "can't 'remember' things year to year or decade to decade, only month to month," says McCartney. So, oceanographers say that the source of long-term oscillations must be in the ocean. Ponderous flows and a huge capacity for storing heat require the ocean to react at a stately pace, providing long-term "memory" as the system operates in the same mode year after year.

McCartney's proposed oceanic oscillator is a vast "pipeline" of warm water fed by the Gulf Stream: the so-called subpolar gyre, a massive, counterclockwise system of currents spanning the ocean off Ireland to the Labrador Sea (see map). All along its route across the Atlantic, past Britain, and back westward by Iceland and the southern tip of Greenland, the pipeline continually loses its heat to the atmosphere and so moderates Europe's climate. By the time it nears completion of the loop, pipeline water is so cold and therefore dense that a single winter's chill in the Labrador Sea is enough to send it plunging beneath the surface, sliding southward out the end of the pipeline.

All told, this trip takes about 20 years, says McCartney, just the kind of timing needed for the NAO's long-term swings. To work as an NAO pacemaker, however, the pipeline would need two other working components: a means of driving the atmosphere into NAO-like modes and a way for the timer to switch between modes.

Now, new oceanographic data suggest just such a potential driver, in the form of unusually warm or cold masses of water running through the pipeline. In work published last year in the *Journal of Geophysical Research*, Donald Hansen of the University of Miami and Bezdek compiled sea surface temperatures of the wintertime North Atlantic since 1949. In the records, they were able to trace a huge patch of anomalously warm water that appeared in the earliest 1950s. They followed it from the Gulf Stream to Newfoundland and across the Atlantic; by the late 1960s, the warm water had made a circuit of the subpolar gyre, following the pipeline around to the Labrador Sea. In the late 1960s, a cold patch of surface water appeared in the subtropics and followed a similar path. And in work they discussed at December's meeting of the American Geophysical Union, McCartney and Ruth Curry of WHOI took a deeper look at these anomalous masses. They used temperatures measured at a depth of 400 meters by instruments lowered from ships to show that Hansen and Bezdek's warm and cold patches are not just wimpy surface skins but are thick enough to deliver a thermal punch to the atmosphere.

WOODS HOLE OCEANOGRAPHIC INSTITUTION

An oceanic roundabout. As warm ocean currents in the subpolar gyre gradually cool (red to yellow trend), they warm Europe and may help trigger seesaws in climate.

The timing suggests that's just what they did, says McCartney. Throughout recent decades, the pipeline and the oscillation have stayed in step, although the relation might seem counterintuitive at first. As the pipeline ran warmer in the 1950s and '60s, the NAO grew progressively more negative, with weaker westerlies across the Atlantic. As the westerlies weakened, so did their influence on Europe, until more northerly winds out of the Arctic replaced them, and colder winter weather settled into Europe; when the pipeline ran cold in the next 2 decades, the NAO switched and became more and more positive. That's not so surprising, says McCartney; the crucial factor for the strength of the NAO—and for Europe's weather—is the strength and the direction of the westerlies, not the warmth of the ocean water.

Just how the pipeline running hot or cold could have tipped the oscillation isn't clear, McCartney admits: "There's a burden on the modelers to confirm or deny within the physics of the system whether [a connection] exists." That may take a while, he adds, given the difficulty modelers have had in realistically linking ocean and atmosphere.

If the pipeline's temperature does determine the NAO's state, what might trigger the temperature switch in the ocean? A deep-ocean mechanism proposed in the *Journal of Physical Oceanography* late last year by Michael Spall of WHOI might offer an answer. After the chilled water exits the pipeline in the Labrador Sea, it hugs the deep edge of North America, where it must eventually pass beneath the shallower Gulf Stream. But that's no small task, notes McCartney. In his model of western North Atlantic currents, Spall found that this Deep Western Boundary Current (DWBC) can either be caught up by the Gulf Stream and swept offshore, strengthening the Gulf Stream in the process, or continue southward unimpeded.

This duel of currents creates a valve at the beginning of the pipeline whose position—wide open or throttled down—depends in part on the thickness of the DWBC. And that raises the possibility of a 20-year feedback loop, says McCartney. A warm signal sent down the pipeline as the Gulf Stream strengthens could 20 years later make the DWBC a bit thinner and so weaken the Gulf Stream. That cold signal might then come back another 20 years later to complete the cycle.

If all this is not just plausible, but also true, then by carefully charting conditions in the Gulf Stream, DWBC, and deep North Atlantic, researchers could perhaps one day predict the North Atlantic's moods—and forecast severe winters for Europe years in advance. But at this early stage, most of McCartney's colleagues are quite cautious. Meteorologist Timothy Palmer of the European Center for Medium-Range Weather Forecasts in Reading, England, notes that it isn't clear yet that the ocean's behavior drags the atmosphere along with it. The atmosphere may still be far less predictable than in El Niño, he warns. "I want to believe" that the North Atlantic strongly affects the circulation of the atmosphere, says Bezdek, "but I don't think a concrete case has been made yet. There's evidence for [an ocean-atmosphere] connection, but it's not overwhelming." To win the day, oceanographers will need many more trips to sea, regardless of whether the NAO is calming the waters.

–Richard A. Kerr

CHARLTON
RESEARCH
COMPANY

PUBLIC OPINION ON GLOBAL CLIMATE ISSUES

Tracking Public Opinion and Attitudes — May 1997

Charlton Research has been examining public perception on environmental issues including global climate change for the past decade. Charlton Research recently conducted a nationwide public opinion study regarding global climate issues to gauge attitudes among the general public on the current debate on global climate change.

EXECUTIVE SUMMARY

- Knowledge of US global climate policy is low. Further, the public does not feel represented on global climate issues.
- Americans believe that global climate change is a international issue that needs to be addressed by all nations, including developing countries.
- The public does not feel the United States should pay for other countries to obtain new technologies so they can limit their emissions of carbon dioxide.
- By two to one, repondents oppose the Clinton-Gore proposal that would require the United States to pay a fee to other countries if it uses more energy that its quota would allow.
- People feel global climate policy also needs to reflect economic considerations.
  - Policy must be market-based, cost-effective and comprehensive.
  - It should not be limited to selected countries or one economic sector.
  - It must not hinder economic and job growth.
- Americans oppose energy-use quotas and international permits.
- The public favors voluntary energy reductions, such as driving motor vehicles less often, and voluntary reduction of home heating and air conditioning.
- People oppose increasing gasoline and energy prices for individuals to reduce energy use.

A Majority of Americans Do Not Feel Represented on Global Climate Policy

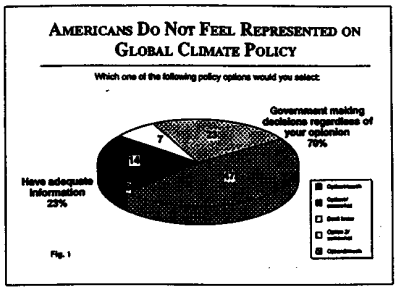
Although there has been extensive media coverage of global climate issues, public knowledge of US global climate policy is low. Only four percent of respondents said they were familiar with US global climate policy. Respondents do not feel they are being adequately represented on this issue. In fact, seven-out-of-ten respondents feel government officials are making decisions that will affect them without regard to public opinion on global climate issues. (See Figure 1)

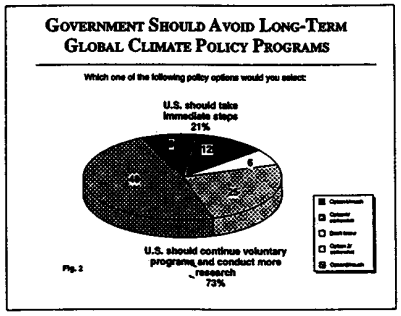
Furthermore, the public does not want government to take immediate steps to reduce global warming concerns. Instead, nearly three-fourths of respondents said the government should continue voluntary programs, continue research and avoid any treaty commitments that would lock the United States in to long-term costly programs if environmental benefits are not assured and costs would be high. (See Figure 2)

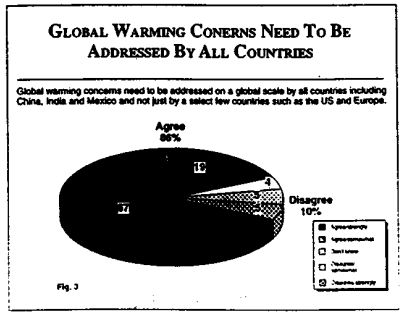
Global Climate Issues Need to be Addressed Internationally

The environment is an international issue for the American public, and Americans feel strongly that it should be addressed by all nations. Respondents do not feel that the United States and Europe should be the only nations to limit energy use. Instead, all nations, including developing countries such as China, India and Mexico, need to address global warming concerns. (Figure 3)

Further, the public strongly opposes United States taxpayers bearing the financial burden for developing nations to obtain new technologies so they can limit their emissions of carbon dioxide.







Global Climate Policy Must Not Hinder US Economic Growth

Global climate policies must have their foundations in sound economic policy and must not hinder economic growth. Three-fourths of respondents favor global climate policies that are market-based and cost effective. In addition, three-fifths oppose the Administration's international permit proposal. (See Figures 4 and 5)

Public Opposes A System of International Permits For Energy Use

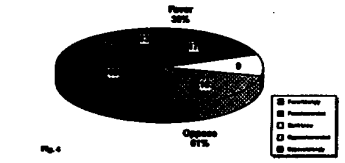


Fig. 4

Policies Should Be Market-Based And Cost-Effective

Policies developed to address global warming concerns should be market-based and cost effective.

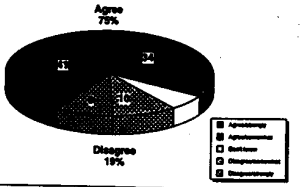


Fig. 5

Americans Oppose Increased Gasoline Prices and Mandatory Energy Restrictions

Respondents were asked a series of trade-off questions on potential methods to reduce energy use. In every situation, Americans opposed paying more for gasoline and other energy needs. For example, 53% of respondents favor giving up the use of motor vehicles one or two days every week versus only 29% of respondents who favor the government increasing the price of gasoline by 50 cents per gallon. Respondents were also more willing to reduce home heating and air conditioning by regulating their thermostats rather than paying 50% more to heat and cool their homes.

Respondents were also read a list of energy saving measures that could be used to reduce energy consumption and address global warming. Eighty-eight percent of respondents were not at all willing to allow the government to limit the size home they could buy. Eighty-two percent of respondents were also not at all willing to pay 75 cents more per gallon of gasoline, and 68% opposed a 50 cent per gallon of gas increase. (See Figure 6)

Individuals Unwilling To Make Financial And Lifestyle Sacrifices

Now I am going to read you a list of things that you could personally do to address the issues of global warming. Please tell me on a scale of one to ten with one meaning "not at all willing" and ten meaning "extremely willing" how willing you would be to ...

Let the government limit the size home you buy	88	6	4	2
Pay 75 cents more per gallon of gasoline	82	10	8	*
Pay 50 cents more per gallon of gasoline	68	18	13	1
Agree to a rationing plan-- reducing vehicle use to 1-2 days a week	57	23	18	2
Index home mortgages so that people who live close to work will pay less interest	56	20	21	3
Commit your family to use vehicle less and public transportation, walking, and biking more	51	26	20	3
Restrict drivers' licenses to people over 21 and under 80	45	20	32	3

Fig. 6

METHODOLOGY

A national telephone survey was conducted from May 17 - 23, 1997 among 800 adults 18 years and older. The margin of error for a sample of this size is ±3.5%. The sample was proportionate to the country's demographics, including geography, gender and ethnicity.

Charlton Research Company is a research and consulting firm which has been developing campaign and communications strategies for business and political clients since 1983. The company specializes in analyzing changes in today's socio-political and economic environments. By combining research findings with public policy issues and political insights, we provide clients with timely, cost-effective, intelligence and advice.

If there are any immediate issues or projects on which Charlton Research Company could be of assistance to your organization, please contact Charles F. Rund, President, or Tracey Soeth, Marketing Director.

® CHARLTON RESEARCH COMPANY

1460 Maria Lane, Suite 410 • Walnut Creek, CA 94596 • 510/274-5900 phone • 510/937-9895 fax
2300 M Street, N.W., Suite 800 • Washington, D.C. 20037 • 202/973-2849 phone • 202/452-8832 fax

GLOBAL CLIMATE COALITION

February 14, 1997

The Honorable Eileen Claussen
Assistant Secretary of State for Oceans
and International Environmental
and Scientific Affairs
Room 7831
U.S. Department of State
2201 C Street, NW
Washington, D.C. 20520

Dear Ms. Claussen:

On behalf of the Global Climate Coalition, I want to thank you and other State Department officials for the time you set aside January 17 to brief interested parties about provisions in the "U.S. Draft Protocol Proposal" to the Framework Convention on Climate Change. In the interest of continuing that dialogue, I want to express several general impressions and to pose a number of questions prompted by this latest U.S. proposal and its predecessor last December.

First, we note the impressive effort evident in the proposal's elaborate policy architecture, given the short time allowed by the Secretariat to submit such documents. However, it is difficult to analyze the draft protocol and its implications until we are fully informed about the Administration's proposed target, timetables and policy tools--such as emissions trading--that have been proposed to implement a Kyoto agreement. The lack of detail denies the American public, labor and industry groups such as ours the ability to fully assess the merits of the U.S. draft protocol proposal, especially its implications for our nation's economic well-being. In our view, any protocol of this nature, were it ratified, may well result in policies, regulations and other measures many times more costly than they need be. Certainly, the growing body of economic analyses argues strongly against early actions that would be many times more costly but would produce no greater benefits than policies that were based on optimal timing.

As you know, our members strongly share the view that developing nations need to be part of any new Kyoto agreement. We have attached questions on

1331 Pennsylvania Avenue, NW • Suite 1300 • North Tower • Washington, DC 20004-1703
Telephone: (202) 637-3152 • Fax: (202) 638-1032 • Fax: (202) 638-1043

this matter, as well as others. It is vitally important to establish in advance of the Kyoto meeting appropriate criteria for including developing countries and the resolve not to support any agreement that does not involve a specific schedule for active developing country participation. There is a political and equity argument why developing countries must be included in any new commitments. Would Americans accept a U.N. agreement that requires substantial personal, economic and lifestyle sacrifices, yet allows environmental gains, however distant or few, to first be marginalized and then completely overrun by the absence of active participation by developing nations, which will be the major emission sources in the next century? We think not, and urge the Administration to stand firm on developing country participation in any new agreement. At home, we urge you to make public as soon as possible the economic analyses on which your draft protocol proposal is based.

The GCC is encouraged by the stipulation that all greenhouse gases be included in any new agreement and by the attention given to the "free rider" problem. However, the GCC believes a number of points in this document require additional comment so that policymakers and the public may more precisely understand what U.S. representatives are preparing to negotiate in Kyoto. For example, how are the results of the Administration's economic analyses linked to the policy choices outlined in this draft protocol proposal? What, if any, institutional organizations need to be created or strengthened to implement the proposed tradable permits initiative? If international oversight is not contemplated, how would the integrity of such a system be protected, and by whom? Given the myriad of proposals now before the Parties, is the Administration concerned that important issues will not be resolved at the December meeting in Kyoto? If key issues are left unresolved, would the "Kyoto Agreement" be contingent on the satisfactory resolution of those issues by a time certain?

In short, we are encouraged by the Administration's January 17 effort to clarify its position regarding post-2000 greenhouse gas emissions, but we also are concerned by the important questions the draft protocol raises and does not answer. Rather than dwell on those concerns here, we enclose a list of some of the questions that we hope you can respond to before or after the Bonn meeting late this month.

The Global Climate Coalition appreciates this opportunity to comment on the U.S. draft protocol proposal. Be assured we will continue to participate

constructively in this national and international debate seeking to identify realistic, flexible climate policies whose benefits are commensurate with costs.

Sincerely,

William F. O'Keefe
Chairman

Attachment

cc: Federal Interagency Group on Climate Change Policy

February 14, 1997

GLOBAL CLIMATE COALITION ENCLOSURE

RE: SOME ISSUES CONCERNING U.S. NON-PAPER OF DECEMBER 1996 AND U.S. DRAFT PROTOCOL FRAMEWORK OF JANUARY 17, 1997

In asking these questions, we, of course, recognize that, in some cases, (such as Articles 2.7 and 4.6) you have not had an opportunity to spell out all of the details in the draft protocol and, of course, the specific target and timetable are absent. However, in other Articles, the lack of details raises issues and serious concerns. Our primary interest is in understanding what you intend or what you were thinking in crafting any particular Article, Annex, or provision in order for industry, labor and others to better understand the impact of the draft U.S. proposal and how it would be implemented from a practical sense should it or elements of it combined with proposals by other Parties be adopted in Kyoto.

Article 1 - Definitions

A. The draft defines "Party" to mean a "Party to the Protocol". Annex A includes the Annex I Parties to the Convention that sign and ratify or accept the Protocol and Annex B includes such non-Annex I Parties to the Convention that want to be included in Annex B. Article 5.5 and 5.6 seem to suggest that other Convention Parties may become Parties to the Protocol. Is that intended? If the U.S. draft protocol or significant elements thereof are agreed to in Kyoto, could non-Annex I Parties to the Convention sign and ratify or accept the Protocol, have equal voting rights, and also not agree to be included in either Annex A or B?

Article 5 - Advancement of the Implementation of Article 4.1 of the Convention

B. As drafted, Article 5 of the draft Protocol only applies to those Convention Parties who become Parties to the Protocol. Since Article 5 seems to impose new requirements or obligations, which you presumably believe are consistent with section 2.(b) of the Berlin Mandate Decision, on Protocol Parties in regards to Article 4.1 of the Convention, what is the incentive for non-Annex I Parties to the Convention (i.e. developing countries) to become Parties to the U.S. draft protocol and be subject to such requirements?

C. Article 5.5 applies to non-Annex A and B Parties, while Article 5.7 applies to all Parties to the draft Protocol. Both include the words "no regrets measures" which are not defined. What are such measures? Is it true that "no regrets measures" are not necessarily "no risk measures"? Does Article 4.1 of the Convention provide for or require "no regrets measures" for any Party? If not, what is the application of Article 5.7(b) to Parties not subject to Article 5.5 of the draft Protocol?

Article 16 - Evolution

D. There is concern that greenhouse gas emissions are growing rapidly in developing countries and that the Berlin Mandate precludes any new commitments applicable to such countries in any AGBM protocol or other legal instrument with the result that any such

instrument will not be fully global, will create economic and competitive disadvantages and will not be environmentally sound. We think a provision like Article 16 is needed for the developing countries, although we realize that it is only an agreement to agree. It does not, for example, include even a hint as to whether the agreement might, as minimum, be patterned after Article 5 of the Montreal Protocol. However, we are concerned that Article 16 (which, as drafted, now applies only to Protocol Parties) will not apply to developing country Parties to the Convention unless they become Protocol Parties and become Annex B Parties. Is it your intention that Article 16 should apply to developing country Parties to the Convention? What if they are not included in Annex B of the Protocol? Would that intention be better achieved by converting Article 16 to an amendment to the Convention?

E. Do you contemplate that the process of implementation of Article 16 would be spelled out in a decision at COP3 by the Convention Parties or by the Parties to the Protocol at their first meeting after entry into force? Are you concerned that some Parties to the Convention might delay signing and ratifying the draft Protocol until they see the results of the process under Article 16, particularly if the delaying Parties are developing countries with significant growth in greenhouse gases?

F. Annex B states that it includes Convention Parties "not listed in Annex A" that "indicate" they want to be "included" in Annex B. One country that immediately comes to mind because of its recent accession to the OECD would, based on Administration testimony in the House Commerce Committee last September, seem to be Korea which is a U.S. trading partner. However, we understand that an OECD document entitled "Korea's Accession Revised Draft Report to the Council" and dated last August states in paragraph 24 of an Annex entitled "Korean Undertakings" that: "For purposes of future negotiations and agreements, Korea would not choose to be classified as a developing country, except in the areas of agriculture and the UN Framework Convention on Climate Change." If the U.S. draft protocol was agreed to in Kyoto, is Korea committed as an OECD member to becoming a Party subject to Articles 5 and 16, but not Annex A or B, or does it mean that, as a developing country Korea could choose not to become a Protocol Party?

G. As you know, non-Annex I Parties are participating in negotiations for new commitments for Annex I Parties, while they enjoy an exemption from new commitments. However, Article 16 provides no similar exemption for Annex I Parties. Why should Article 16 which calls for new and progressive "quantitative greenhouse gas emissions obligations" based on some future "agreed criteria" be applicable to Annex A Parties to the Protocol, including the U.S., since the U.S. draft of the Kyoto protocol otherwise applies to them and imposes new obligations on them beyond those in Article 4.1 and 2 of the Convention? What new obligations for Annex A Parties do you contemplate in the Article 16 process? Does, for example, this mean that under Article 4.1(b) Annex I Parties, like the U.S., by signing the Protocol are agreeing to reductions beyond the requirements of Article 2 of the draft protocol?

February 14, 1997

Article 2 - Emissions Budgets

H. We observe that Section III of the December Non-Paper called for "focusing" negotiations on a "binding, medium-term emissions target" and expressed interest in working toward a "longer-term concentration goal". However, Article 2.3 appears to call for a second target or "budget period" before there is an agreement by non-Annex A and B Parties to the Protocol that are developing countries to negotiate "quantitative greenhouse gas emissions obligations" under Article 16 and to adopt such obligations by [2005]. Does this second target send the wrong signals to the developing countries who agree to become Parties to the draft protocol and are subject to Article 16? Why is it in the best economic and competitive interests of the United States to offer a second target and timetable before negotiations with all Parties to the Convention in the AGBM begin and before the U.S. analysis and assessment and its assumptions are provided to Congress, industry, labor, environmentalists, and others? What is the need?

I. The Non-Paper states that the U.S. "strongly urges consideration of banking" and that multi-year averaging would give Parties "important flexibility". However, Article 2.5 seems to weaken that support for banking by providing that emissions of tonnes "may" (not "shall") be carried over and added to the "next budget period". That leaves uncertainty for industry and suggests that a Party like the U.S., might retire such tonnes rather than bank them which could have future economic and competitive consequences. Why did you take this discretionary approach? Why not follow the mandatory approach of Article 2.6? The Article does not specifically mention multi-year averaging. Why? Is it implied?

Article 6 - International Emissions Trading

J. As the chief proponent of an emissions trading program, the U.S. in its December Non-Paper said it was "critical" that provisions for "international" emissions trading "be included in the Kyoto agreement." When Title IV of the Clean Air Act (CAA) was signed into law, it spelled out in great detail the allowance program for existing and new electric utility units, including the timetable, the target, the cap, the trading system, the nature of the allowances, the rights of allowance holders, the tracking system, and the limitations. Upon enactment, the utility industry knew the program details and could plan their future. That program, which applied equally to all covered units of the electric utility industry, is for one industry with an identified and limited number of sources and it is a national trading program. Presumably, an international trading program will cover many industries, sectors, and gases on an international scale. However, our review of Article 6 of the draft protocol provides none of the details of an international trading program. It merely authorizes trading between Annex A and B Parties that establish a "mechanism" for certifying and verifying trades. It does not require that a trading program be established by all such Parties or that such a "mechanism" be put "in place" or that it be operated uniformly. All the important details are missing.

Do you intend to include these "critical" provisions in the protocol to be adopted in Kyoto or do you plan to defer development of such provisions to a post Kyoto legal instrument, to a decision of the Parties to the Protocol after it enters into force, to bilateral negotiations between Parties, or some other means?

K. Article 6 provides that a Party "may authorize" any domestic entity to participate in actions "leading to transfer" of tonnes. What "actions" do you have in mind for this entity? In the case of the CAA, the trades are between utilities with reporting to the Environmental Protection Agency. Is that same approach likely to be accepted on an international scale if the domestic entity is a non-governmental organization in one country and a government agency in another?

L. As noted, Article 6 authorizes trading between Parties. However, unlike the CAA no mention is made of trading by private sector entities that will likely need such trading to operate. Also, unlike the CAA it does not allocate, or provide for an allocation of, the initial tonnes for various industries and sources to operate or indicate whether such industries and sources will be faced with penalties for continuing to operate without such allocation if such a program is initiated.

It only allows private sector entities, after receiving authorization from a Party, to "participate in actions leading to transfer and receipt..." of carbon equivalent emissions. Therefore, it appears that private sector entities can only suggest to Parties that certain emissions trading transactions take place. This imposes significant constraints on private sector international emissions trading, establishes a bureaucracy involving two separate governments or their designees between the private sector and the completion of trades, lowers any possible expectation that private sector entities would receive any benefit from trades, and makes the private sector subservient to the political and policy whims of governments in order to carry out what industry does best, i.e., produce goods and services and employ workers.

The wording of Article 7 on Joint Implementation carries the same structure and constraints. Under Article 7.1, any Party can generate tonnes of carbon equivalent emissions. Under Article 7.5, only Annex A or B Parties may acquire those tonnes of carbon equivalent emissions. And under Article 7.6, private sector entities, even after receiving authorization from a Party, are limited to "participat[ing] in actions leading to generation, transfer and receipt under this Article of tonnes of carbon equivalent emissions." Again, the private sector entities cannot, themselves, engage in emissions trading.

The proposed construction of Articles 6 and 7 and lack of details would appear to virtually eliminate the functioning of an international market in tradable permits. Instead, trading, as noted, can occur only between governments. The type of trading activity that would occur between governments, as a practical matter, would likely bear little resemblance to the trading activity that would be expected to occur in a private sector international tradable permits market if the program works as its proponents contend. Is the Administration intending an international governmental trading system? Who will

make the trades, pay for the tonnes, and receive the tonnes and money? If not, when will we learn the details for evaluation by industry, labor, and others?

Article 3 - Measurement and Reporting

M. Article 3.5 suggests that the transfers of tonnes of carbon equivalent emissions under Articles 6 and 7 would be reported to the Convention Secretariat annually. Do you intend that the Secretariat would perform the role in trading that EPA does under Title IV of the CAA and if so is annual reporting adequate? If not, what entity should perform that role and what is the purpose and need for a Party to also report to the Secretariat? What are the advantages and disadvantages to the U.S. of an international entity performing the EPA-type role in trading?

Article 7 - Joint Implementation (JI)

N. Article 7.2(b) uses the term "additional" which is not defined or explained. The definition of "additional" and the methodology for calculating greenhouse gas reductions from JI projects must be determined in order to estimate the magnitude of the cost savings due to JI. How will the Administration obtain this information in order to factor the cost savings of JI into its economic analysis?

○