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Tax Policy and Technological Innovation: Key Partners in Productive Climate Change Policy

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Before the Senate Governmental Affairs Committee

EXECUTIVE SUMMARY

- **Macroeconomic Effects of Caps on CO_2 Emissions Are Significant.** A wide range of economic models predict that capping U.S. carbon dioxide (CO_2) emissions at the Kyoto target (7 percent below 1990 levels) would reduce U.S. GDP and slow wage growth significantly, worsen the distribution of income, and reduce growth in living standards. Proposed future reductions of 60 percent below 1990 levels by 2050 have not been modeled, but would have extremely serious consequences for all economies dependent on fossil fuels.
- **U.S. Budget Surplus Is Reduced Sharply.** Slower economic growth means that federal tax receipts would be reduced. If implementation of the Kyoto Protocol reduces annual GDP by 3 percent per year, for example, the projected budget surplus in 2010 falls from $471 billion to only $315 billion.
- **International Emissions Trading Issues Are Major.** Major obstacles to trading include securing developing country participation, allocating CO_2 emission rights, and distributing the resulting revenue.
- **European Union Unable to Meet Targets.** Even though several EU members continue to support ratification of the Kyoto Protocol, a number of recent studies document that the EU will not be able to achieve its targets; in fact by 2010 the EU countries will be 10 to 25 percent above their targets.
- **Science of Climate Change Needs to Be Better Understood Before Costly Policies Are Implemented.** Despite the United States' intensive investment in climate change science, numerous gaps remain in our knowledge, including conflict between global atmospheric and "surface" temperature measurement, and uncertainty about the amount of carbon sequestered in the oceans and soil and about the feedbacks in the climate system that determine the magnitude and rate of temperature increase.
- **Conclusion.** A U.S. strategy for a productive climate policy providing energy security should include: fixing the U.S. tax code; expanding nuclear energy; expanding bilateral cooperation with developing countries; expanding incentives for use of landfill methane and biomass including ethanol from cellulose; implementing a multi-year plan for improvement of coal technology; removing regulatory barriers; avoiding caps on CO_2 emissions by U.S. industry; and avoiding setting targets for global CO_2 concentrations in the range of 550 ppm in the next 75–100 years. ❖

The mission of the American Council for Capital Formation is to promote economic growth through sound tax, trade, and environmental policies. For more information about the Council or for copies of this testimony please contact the ACCF, 1750 K Street, N.W., Suite 400, Washington, D.C. 20006-2302; telephone: 202/293-5811; fax: 202/785-8165; e-mail: info@accf.org; Web site: www.accf.org.

ACCF Statement

Introduction

My name is Margo Thorning and I am pleased to present this testimony to the Senate Governmental Affairs Committee.

The American Council for Capital Formation represents a broad cross-section of the American business community, including the manufacturing and financial sectors, Fortune 500 companies and smaller firms, investors, and associations from all sectors of the economy. Our distinguished board of directors includes cabinet members of prior Republican and Democratic administrations, former members of Congress, prominent business leaders, and public finance and environmental policy experts.

The ACCF is now celebrating its 28th year of leadership in advocating tax, regulatory, environmental, and trade policies to increase U.S. economic growth and environmental quality.

We commend Chairman Lieberman, Senators Byrd and Stevens and the Senate Governmental Affairs Committee for their focus on the role of technology in addressing climate mitigation. In our view, tax incentives should be a key component in the push to develop new technology. Given the ACCF's extensive studies on the impact of tax policy on investment, my testimony will develop an aspect of what should become the foundation for an integrated approach to climate change policy. We believe that progress on technology proposals such as those in S. 1008, the Climate Change Strategy and Technology Act of 2001, is vitally important.

My testimony begins with a review of the macroeconomic consequences of near-term CO_2 emission caps. It includes information from a number of analyses sponsored by the ACCF Center for Policy Research, the public policy research affiliate of the American Council for Capital Formation. These studies describe the economic costs of near-term caps on U.S. carbon emissions and the impact of emissions limits on the growth of the capital stock, as well as suggest tax incentives to encourage voluntary efforts such as the purchase of energy-efficient equipment and sequestration initiatives to reduce CO_2 emissions both in the United States and abroad. (Summaries of the Center's climate policy studies are available on our Web site, www.accf.org.) I also discuss issues related to long-term options for reducing CO_2 concentrations. Finally, strategies for a cost-effective, long-term approach to CO_2 stabilization are presented.

Macroeconomics Effects of Capping CO_2 Emissions

The Kyoto Protocol to the United Nations Framework Convention on Climate Change, which was negotiated in December 1997, calls for industrial economies such as the United States, Canada, Europe, and Japan (termed Annex B countries) to reduce their collective emissions of six greenhouse gases by an average of 5.2 percent from 1990 levels by 2008–2012. The U.S. target under the Protocol, which was rejected by the Bush Administration in March, is a 7 percent reduction from 1990 levels (or 1,251 million metric tons); this amounts to a projected 536 million metric ton cutback in carbon emissions relative to the projected amount in 2010, growing to a 728 million metric ton cutback by 2020 (see Figure 1). In 1999, U.S. emissions were 1,527 million metric tons, or 22 percent above the Kyoto target. By 2010, the U.S. Department of Energy's Energy Information Administration (EIA) projects that emissions will be 43 percent above the target, and the gap will grow to 58 percent by 2020. (In 2010, carbon emissions from the transportation and utility sectors *alone* are projected to be 1,300 million metric tons (see Figure 1). It is also worth noting that Mr. Tim Wirth, the former Clinton Administration climate policy negotiator, testified in 1997 that carbon emissions would need to be cut by up to 10 times the Kyoto targets (a 70 percent reduction). The United Kingdom has assumed it must reduce its emissions by 60 percent by 2050.

The emissions cap would, in effect, ration the use of energy in the United States and require very large taxes, either directly or indirectly through the purchase of "permits," to restrain the demand for energy. The "multi-pollutant" approach would have the same effect. Research conducted over the past decade for the ACCF Center for Policy Research by top climate policy scholars concludes that the cost of reducing carbon emissions in the near term would impose a heavy burden on U.S. households, industry, and agriculture by reducing economic growth.

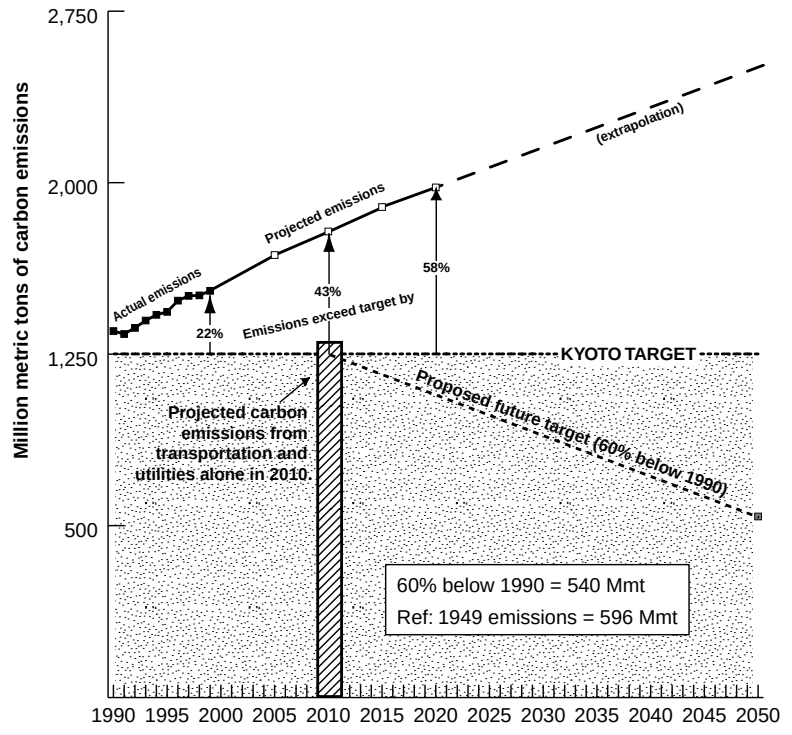
Impact on GDP

Many climate policy experts believe that the emission reductions called for in the Kyoto agreement have potentially serious consequences for all Americans. Predicting the economic impact of reducing carbon

emissions depends upon how an economic forecasting model handles several factors, including how rapidly industry and consumers respond to higher energy prices by substituting less carbon-intensive production methods and reducing the consumption of carbon-intensive goods and services. Other factors that can affect a model's results are the rate of technological change, the projected baseline greenhouse gas emissions, the amount of emissions trading, and use of carbon sinks and sequestration.

The rate of technological improvement for energy production and consumption assumed by most models under their baseline forecasts is fairly rapid. For example, the EIA's reference case assumes continued improvements in new and existing buildings, transportation, coal production, exploration for oil and gas, and electricity generation technologies. In fact, total energy intensity (defined as the ratio of primary energy consumption per dollar of GDP) declines at an average rate of 1.1 percent annually between 1998 and 2020. The faster the rate of economic growth, the faster energy intensity declines in the EIA reference cases due to the more rapid turnover of the capital stock.

Figure 1 U.S. Carbon Emissions: Projected, Kyoto Target, and Beyond
Millions of metric tons



Recent model results show that as carbon emissions are capped or constrained, economic growth slows due to lost output as new energy taxes are imposed and prices rise for carbon-intensive goods—goods that must be produced using less carbon and/or more expensive processes. In addition, the capital stock accumulates more slowly, reflecting the premature obsolescence of capital equipment due to the sharp energy price increases required to meet the carbon emission reductions mandated under the Protocol. It takes from 20 to 30 years to "turn over" or replace the entire U.S. capital stock. Thus, meeting the Protocol's 2008–2012 timetable for emission reductions would mean either continuing to utilize plant and equipment designed to use much lower-cost (pre-Kyoto) fuels, or replacing the capital stock much more rapidly than its owners had planned.

The wide range of model results by climate policy experts such as Senior Vice President Mary H. Novak of WEFA, Inc., Professor Alan S. Manne of Stanford University, Dr. Richard Richels of EPRI, Dr. W. David Montgomery of Charles River Associates (CRA), Dr. Joyce Brinner of Standard & Poor's DRI (DRI), Dr. Brian S. Fisher of the Australian Bureau of Agricultural and Resource Economics (ABARE), and others, show that complying with the Kyoto Protocol would reduce U.S. GDP by a range of 1 percent to 4 percent annually (see Figure 2). This translates into annual losses of $100 billion to almost $400 billion (in inflation-adjusted dollars) in U.S. GDP each year compared to the baseline forecast for energy use. These studies, as well as the EIA report released in October 1998, stand in sharp contrast to the optimistic projections contained in the Clinton Administration's economic analysis prepared by the Council of Economic Advisers and released in July 1998.

Starting earlier to reduce carbon emissions (in 2000 rather than 2005) only worsens the overall impact, according to an EIA report released in July 1999. The EIA results show that the discounted present value of U.S. GDP falls by $1,430 billion 1992 dollars over the 2000–2020 period compared to $1,285 billion under the 2005 start date.

Economic Impact of Additional Reductions Beyond the Kyoto Target

The economic costs of the Kyoto Protocol described above do not reflect the additional economic impact of emission reductions beyond the Kyoto target. Kyoto supporters contemplate substantial future carbon emission reductions well below 1990 levels. At least one model has analyzed this scenario. A study using the Charles River Associates model (MS-MRT) shows that the cost of going beyond the carbon emission reductions required by the Kyoto Protocol is high. For example, a target of 21 percent below 1990 emission levels (or three times the Kyoto target) would reduce U.S. GDP by 2.4 percent annually in 2020 with Annex B emission trading and by 3.0 percent with domestic abatement alone.

Figure 2 Annual Impact of Reducing Carbon Emissions to the Kyoto Target on U.S. GDP, 2008–2012
Percent of GDP

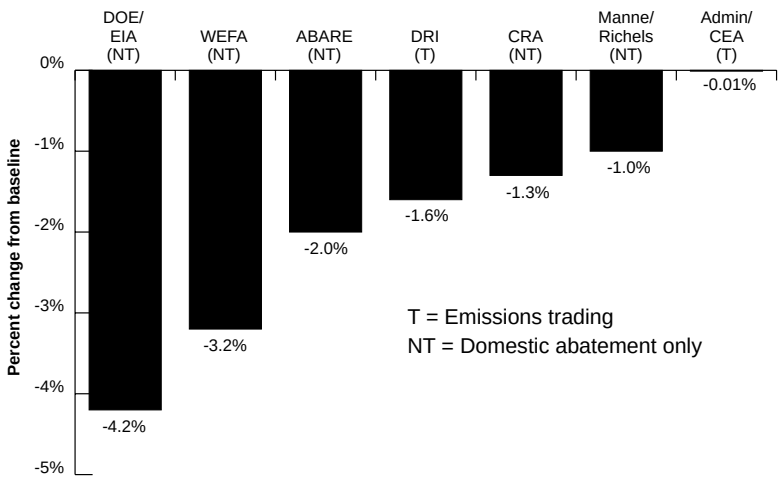


Figure compiled by Margo Thorning, Ph.D., ACCF Center for Policy Research, Washington, D.C., www.accf.org. Data source references can be found at the end of this report.

Impact on the Federal Budget Surplus

One way of assessing the impact of the Kyoto Protocol is to examine how slower economic growth would affect projected U.S. federal tax receipts and federal budget surpluses. Policymakers need to consider the potentially large negative impact of the Protocol on GDP growth and federal budget receipts, particularly since both the Administration and Congress are already chipping away at the federal budget surpluses to finance spending initiatives and tax cuts for fiscal year 2001 and beyond. Using a simple calculation based on the relationship of increases in GDP to federal tax receipts, if GDP is 3 percent lower annually, the on-budget surplus in 2010 would decline by $156 billion dollars, from $471 billion to $315 billion (see Figure 3). If, as the EIA model predicts, the Kyoto Protocol reduces GDP by 4 percent in 2010, the budget surplus drops to only $261 billion dollars.

Importance of International Emissions Trading

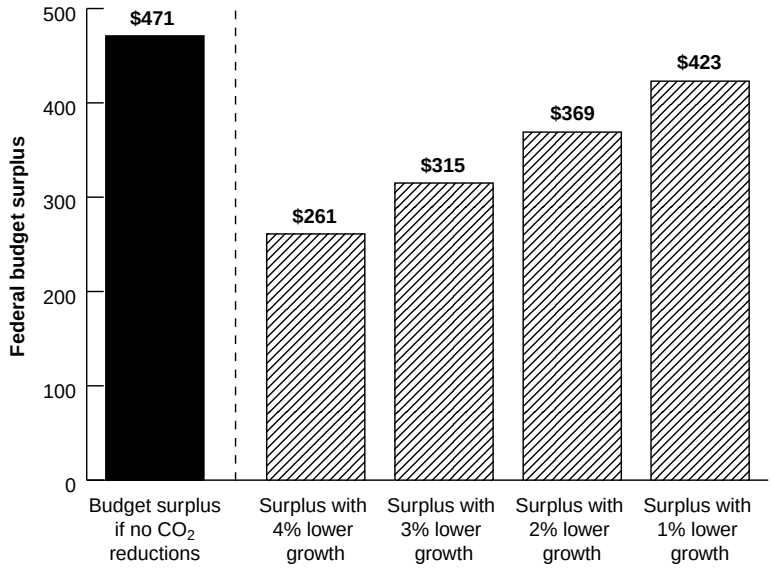
Numerous studies show that a major determinant of the cost of curbing emissions is whether the United States can purchase permits from abroad where emissions can be reduced at a lower cost than in the United States. In the absence of an unfettered international trading system, the United States would be forced to curb its own carbon emissions by about 30 percent within 10 years. Due to population growth and increases in output, the gap between projected emissions and the Kyoto target will continue to grow (see Figure 1). Neither this growing gap nor the impact of additional reductions beyond the Kyoto targets have been addressed by Kyoto advocates.

Impact on Wage Growth and Consumers

U.S. consumers suffer declines in wage growth and the distribution of income worsens under carbon stabilization policies. Wesleyan University Professor Gary Yohe estimates that reducing emissions to 1990 levels (the Clinton Administration's pre-Kyoto target) would reduce wage growth by 5 percent to 10 percent per year, and the lowest quintile of the population would see its share of the economic "pie" shrink by about 10 percent. Texas A&M University Professor John Moroney estimates that U.S. living standards would fall by 15 percent under the Kyoto Protocol compared to the base case energy forecast.

U.S. households also face much higher prices for energy under near-term reductions. A range of esti-

Figure 3 Reduction in Federal On-Budget Surplus in 2010 Due to Lower GDP Caused by Carbon Emission Reductions to the Kyoto Target
Dollars in billions



Note: "On-budget" surplus excludes Social Security and postal service contributions.

Calculations based on data from "An Analysis of the President's Budgetary Proposals for Fiscal Year 2002," Congressional Budget Office, May, 2001.

Figure 4 U.S. Household Energy Costs: Impact of Reducing Carbon Emissions to Kyoto Targets, 2008–2012
Percent change from base case

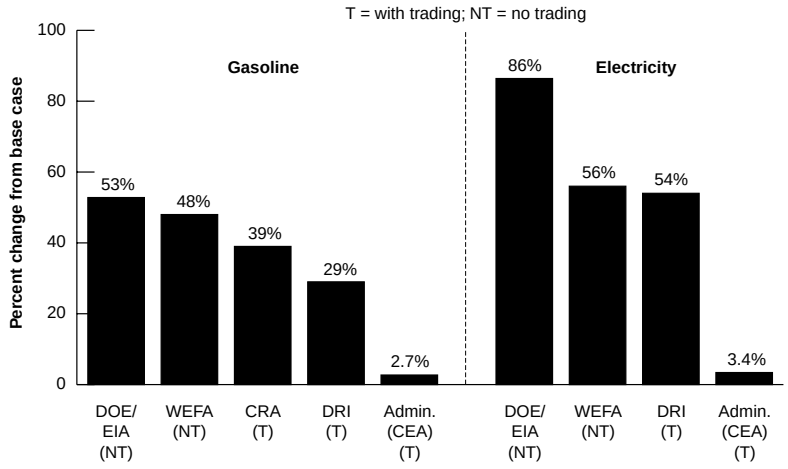


Figure compiled by Margo Thorning, Ph.D., ACCF Center for Policy Research, Washington, D.C., www.accf.org. Data source references can be found at the end of this report.

mates by various experts concludes that gasoline prices would rise from almost 30 percent to over 50 percent and that electricity prices would go up by anywhere from 50 percent over 80 percent (see Figure 4). Predictions by the Clinton Administration Council of Economic Advisers (a 2.7 percent increase in gasoline prices and 3.4 percent rise in prices for electricity) are far below those of widely respected climate policy modelers.

U.S. Competitiveness in Energy-Intensive Sectors and Agriculture

Several studies, including those by Dr. Brian Fisher and his colleagues at ABARE, University of Colorado's Professor Thomas Rutherford, DRI's Dr. Brinner, and WEFA's Ms. Novak, have concluded that near-term emission reductions would result in the migration of energy-intensive industry from the United States to non-Annex B countries (sometimes called "carbon leakage").

The 1999 study by Professor Manne of Stanford University and Dr. Richels of EPRI also analyzed this question. The Manne-Richels model results suggest that the Kyoto Protocol could lead to serious competitive problems for energy-intensive sector (EIS) producers in the United States, Japan, and OECD Europe. Meeting the emission targets in the Protocol would lead to significant reductions in output and employment among EIS producers, and there would be offsetting increases in countries with low energy costs. U.S. output of energy-intensive products such as autos, steel, paper, and chemicals could be 15 percent less than under the reference case by 2020. In contrast, countries such as China, India, and Mexico would increase their output of energy-intensive products. In its present form, the Protocol could lead to acrimonious conflicts between those who advocate free international trade and those who advocate a low-carbon environment, Professor Manne and Dr. Richels conclude.

U.S. agriculture would also lose competitiveness if the United States complied with the Kyoto Protocol. A study based on the DRI model by Terry Francl of the American Farm Bureau Federation, Richard Nadler of *K.C. Jones Monthly*, and Joseph Bast of the Heartland Institute (FNB) predicts that implementation of the Protocol would cause higher fuel oil, motor oil, fertilizer, and other farm operating costs. This would mean higher consumer food prices and greater demand for public assistance with higher costs. In addition, by increasing the energy costs of farm production in America while leaving them unchanged in developing countries, the Kyoto Protocol would cause U.S. food exports to decline and imports to rise. Reduced efficiency of the world food system could add to a political backlash against free trade policies at home and abroad.

The FNB analysis, which concludes that U.S. agriculture would be adversely affected by the Kyoto Protocol, stands in sharp contrast with the May 1999 report by the U.S. Department of Agriculture (USDA), which finds that the Kyoto Protocol would have "relatively modest" impacts on U.S. agriculture. The USDA report is seriously flawed for two reasons, according to a recent analysis by Mr. Francl. First, the USDA report relies on the unrealistic assumptions about the impact of the Kyoto Protocol on energy prices contained in the Administration's 1998 CEA analysis. Second, the USDA report makes the heroic assumption that U.S. farmers will have unrestricted access to carbon credit trading.

Flaws in the Clinton Administration CEA Analysis

The Clinton Administration Council of Economic Advisers' July 1998 economic analysis of the impact of reducing carbon emissions to 7 percent below 1990 levels, mentioned earlier, is seriously flawed for three reasons.

First, CEA cost estimates assume full global trading in tradable emission permits (including trading with China and India). Most top climate policy experts conclude that this assumption is extremely unrealistic, because the Protocol does not require developing nations—who will be responsible for most of the growth in future carbon emissions—to reduce their emissions, and many have stated that they will not do so.

Second, the CEA's cost estimates assume that an international carbon emissions trading system can be developed and operating by 2008–2012. This assumption is unrealistic, according to analysis by Massachusetts Institute of Technology's Professor A. Denny Ellerman.

Third, the cost estimates are based on the Second Generation Model (SGM) developed by Battelle Memorial Institute. The SGM appears to assume costless, instantaneous adjustments in all markets; the model is not appropriate for analyzing the Protocol's near-term economic impacts, according to CRA's Dr. Montgomery. As Massachusetts Institute of Technology Professor Henry Jacoby observes, there are no short-term technical changes that would significantly lower U.S. carbon emissions.

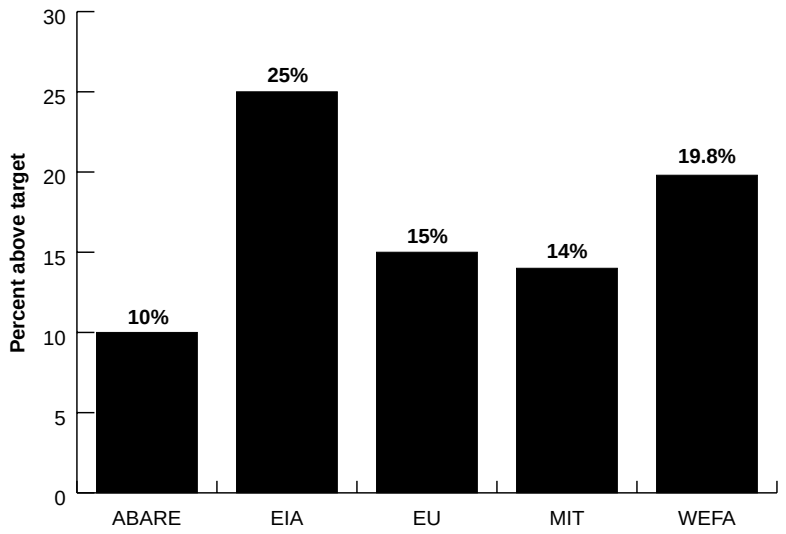
Finally, a former Clinton Administration official acknowledged that the CEA estimates understated the cost of the Kyoto Protocol by a factor of ten in a *USA Today* article (June 12, 2001).

European Union Unable to Meet Targets

Even though several EU members continue to support ratification of the Kyoto Protocol, a number of recent studies document that the EU will not be able to achieve its Kyoto CO_2 emission reduction targets by 2008–2012 (see Figure 5). These studies include:

- European Commission, "Towards a European Strategy for the Security of Energy Supply" (November 28, 2000). The EU's own report shows that their CO_2 emissions will be 15 percent above their Kyoto target by 2010, rising to almost 20 percent above by 2020. While stressing the need to reduce CO_2 emissions, the EU report cautions that climate change policy should not be allowed to "endanger economic development."
- The Pew Center on Global Climate Change, "The European Union & Global Climate Change" (June 2000). In an analysis of five major EU member states (Germany, United Kingdom, Netherlands, Austria, and Spain) responsible for 60 percent of CO_2 emissions in 1990, Pew concludes that only the United Kingdom has a good chance of meeting its targets and Germany will find it "difficult." The other three countries are "not on track"; emissions in the Netherlands currently exceed 1990 levels by 17 percent; Austria has no plans in place to meet its target; and Spain is already close to reaching its allowed growth in CO_2 emissions (a concession to its relative poverty), meaning that Spain is likely to be well above its emission target by 2010.

Figure 5 European Union CO_2 Emissions in 2010 Compared to the Kyoto Target, According to Recent Studies



Source: Figure compiled by Margo Thorning, Ph.D., ACCF Center for Policy Research, Washington, D.C., www.accf.org. Data source references can be found at the end of this report.

- MIT Joint Program on the Science and Policy of Global Change, "Carbon Emissions and the Kyoto Commitment in the European Union" (February 2001). According to the results of the MIT Emissions Prediction and Policy Analysis model, CO_2 emissions in the EU will rise by 14 percent above the 1990 levels in 2010 instead of decreasing by 8 percent as required by the Kyoto Protocol.
- The Australian Bureau of Agricultural and Resource Economics, "Climate Change Policy and the European Union" (September 2000). ABARE's report concludes CO_2 emissions in the EU will increase by an average of 0.3 percent per year from 1990 to 2010 unless stringent new measures are undertaken. (In other words, emissions will rise by about 10 percent rather than fall to 8 percent below 1990 levels).
- U.S. Department of Energy, Energy Information Administration, *International Energy Outlook* (March 2001). The EIA analysis predicts that by 2010, emissions in Western Europe will be almost 25 percent higher than they were in 1990, falling far short of their Kyoto targets.
- WEFA, "The Kyoto Protocol: Can Annex B Countries Meet Their Commitments?" (October 1999). WEFA surveys five other government reports, including an EU study (as well as its own analysis), and concludes that Western Europe is unlikely to meet its targets. Emissions would need to fall by 15 percent to 30 percent, which would constrain economic growth in politically unacceptable terms.

While a new European Commission report from the European Climate Change Programme (June 2001) analyzed measures affecting all sectors of their economy and concluded that "the potential of cost-effective options is twice the size of the EU's required emission reductions," the EU's new report is flawed for several reasons, including:

- "Cost-effective" is defined as policies that cost no more than 20 euros per metric ton of avoided CO_2 emissions, or $62 per metric ton of carbon in U.S. dollars. Most experts consider $62 per metric ton of carbon "expensive." (Some of the suggested policies cost up to $312 per metric ton of carbon to put in place.)
- The policy yielding the largest impact affects buildings. The costs of these policies was calculated with a very low discount rate (4 percent), a rate of return that no private investor would accept.

Thus, the new EU study is actually a "wish list" of policies the environmental ministry "wishes" that businesses and households would adopt, but that are not likely to be undertaken voluntarily because of their high costs.

Science of Climate Change Needs to Be Better Understood

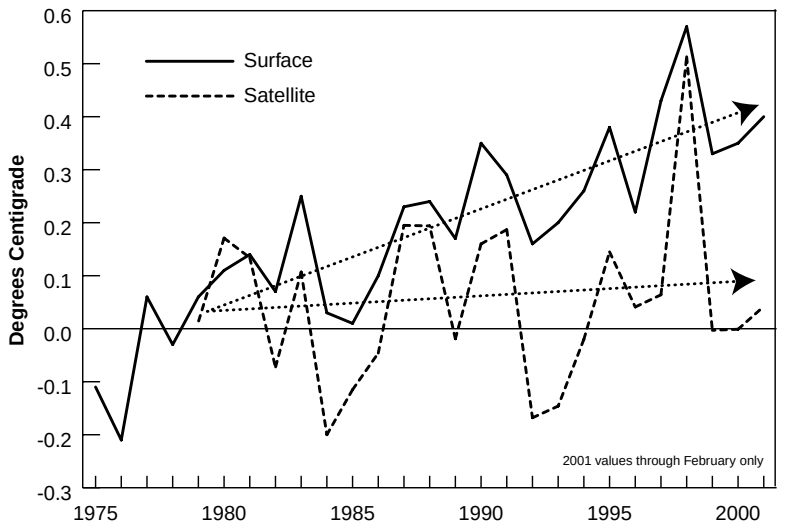
Despite the United States' intensive investment in climate change science over the past decade, numerous gaps remain in our understanding of climate change. The National Academy of Sciences' National Research Council identified critical uncertainties about the science of climate change in its white paper, *Climate Change Science: An Analysis of Some Key Questions:*

- Conflict between global atmospheric and "surface" temperature measurements (see Figure 6);
- Uncertainty about how much carbon is sequestered by oceans and terrestrial sinks and how much remains in the atmosphere;

- Uncertainty about feedbacks in the climate system that determine the magnitude and rate of temperature increases;
- Uncertainty about the direct and indirect effects of aerosols;
- Uncertainty about the details and impacts of regional climate change resulting from global climate change;
- Uncertainty about the nature and causes of the natural variability of climate, including the sun, and its interactions with forced changes;
- Uncertainty about the emissions and usage of fossil fuels and future emissions of methane.

These science questions must be addressed before the United States and its allies embark on a path as nonproductive as that of the Kyoto Protocol. (For more detail, please see the Appendix to this testimony.)

Figure 6 Surface vs. Satellite Global Temperatures



Source: John R. Christy, University of Alabama in Huntsville.

Greenhouse Gas Emission Targets Premature and Unjustified

According to scholars such as Brookings Institution economist Dr. Robert Crandall, setting targets and timetables for U.S. greenhouse gas emissions is premature. He bases this conclusion on:

- The uncertainty about whether or the extent to which global warming is occurring (see Figure 6); new data from climatologist and U.N. Intergovernmental Panel on Climate Change author Professor John Christy of the University of Alabama demonstrates that while surface-based measures show warming, satellite data shows little warming; and
- The high cost of foregone investment if the United States sacrifices badly needed economic growth to reduce emissions.

In a 1999 report, Dr. Crandall observes that the economic estimates of the costs and benefits of reducing emissions to 1990 levels that are in the literature are not particularly supportive of going ahead immediately with any policy of abatement. For example, as an analysis by Brookings Institution fellows Drs. Warwick McKibben and Peter Wilcoxen points out, the estimates of the costs of capping emissions at 1990 levels generally range from 1 to 2 percent of GDP per year, while the benefits, estimated at most to be 1.3 percent of GDP, will not arise for at least 30 to 50 years. Dr. Crandall notes that "Every dollar dedicated to greenhouse gas abatement *today* could be invested to grow into $150 in the next 50 years at a 10 percent social rate of return, even at a puny 5 percent annual return, each dollar would grow into $12 in 50 years. Therefore, we need to be sure that the prospective benefits, when realized, are at least 12 to 150 times the current cost of securing them. Otherwise, we should simply not act, but use our scarce resources in other ways." Moreover, the climate models generally forecast that it would require far greater reductions than a return to 1990 emissions to stabilize the climate. Dr. Crandall concludes, "We cannot justify a return to 1990 emissions based on the average estimates in the literature, no matter how efficiently it is done."

It is clear that the marginal costs of abatement in low-income societies such as China and India are substantially below those in developing countries, Dr. Crandall notes. Economists envision a marketable permits program as being global in scope. The United States, France, Japan, and Germany, for example, would buy permits from China, India, or Bangladesh. The latter would, in turn, reduce their CO_2 or other greenhouse gas emissions by this amount over the levels that would have occurred without the permits policy in all future years. The difficulties involved in such a future program would be immense: measuring emissions from millions of sources from motor scooters to

bovine animals; forecasting emission levels for the uncontrolled scenario; and, finally, enforcing the reductions from these myriad sources. If enforcing nuclear nonproliferation treaties is difficult, enforcing a global greenhouse gases trading program would be incomparably more complicated.

Yale University Professor William D. Nordhaus has also analyzed the costs and benefits of CO_2 emission limits. Dr. Nordhaus' research shows that the costs of even an efficiently designed emission reduction program exceed the value of environmental benefits by a ratio of 7 to 1 and that the United States would bear almost two-thirds of the global cost.

Targets and timetables for emission reductions would also tend to discourage businesses and households from investing now in new equipment and processes that would reduce greenhouse gas emissions. This unfortunate result stems from the fact that tax depreciation schedules for many types of investments that could reduce CO_2 emissions are very slow. Slow capital cost recovery means that investments that are deemed "risky" because of possible future emission caps face a much higher hurdle rate to gain acceptance than would an investment whose cost could be recouped immediately through expensing (first-year write-off). The prospect of emission constraints in the future will tend to retard the very type of capital expenditures that many believe would facilitate emission reductions without curtailing economic growth.

Table 1 International Comparison of the Present Value of Pollution Control Equipment
As a percent of cost

	Wastewater Treatment for Chemical Production	Wastewater Treatment for Pulp and Paper Equipment	Scrubbers Used in Electricity Plants
United States			
1985 Law	100.1	100.1	89.7
MACRS[1]	85.2	80.8	54.5
AMT[2]	83.0	78.0	54.5
Brazil	74.7	74.7	79.4
Canada	85.3	85.3	85.3
Germany	71.8	69.7	68.9
Japan	84.6	83.7	82.4
Korea (w/3% ITC)	95.2	93.9	92.2
Singapore	91.7	91.7	91.7
Taiwan	147.0	147.0	147.0

Notes: 1. MACRS = Modified Accelerated Cost Recovery System (current law) for regular taxpayers included in TRA '86.
2. AMT = Alternative minimum tax (current law, Taxpayer Relief Act of 1997).

Source: Stephen R. Corrick and Gerald M. Godshaw, "AMT Depreciation: How Bad Is Bad?" in *Economic Effects of the Corporate Alternative Minimum Tax* (Washington, D.C.: American Council for Capital Formation Center for Policy Research, September 1991); and unpublished data incorporating the AMT provisions of OBRA 1993. Updated by Arthur Andersen LLP, Office of Federal Tax Services, Washington, D.C., January, 1998.

Tax Policy for Voluntary Action

Current U.S. tax policy treats capital formation—including investments that increase energy efficiency and reduce pollution—harshly compared with other industrialized countries and with our own recent past. For example, before the 1986 Tax Reform Act (TRA '86), the United States had one of the best capital cost-recovery systems in the world.

Under the strongly pro-investment tax regime in effect during 1981–85, the present value of cost-recovery allowances for wastewater treatment facilities used in pulp and paper production was about 100 percent (meaning that the deductions were the equivalent of an immediate write-off of the entire cost of the equipment), according to an analysis by Arthur Andersen LLP (see Table 1).

Under TRA '86, the present value for wastewater treatment facilities fell to 81 percent for pulp and paper, dropping the U.S. capital cost recovery system to near the bottom ranking of an eight-country international survey. Allowances for scrubbers used in the production of electricity were 90 percent before TRA '86; the present value fell to 55 percent after TRA '86, ranking the United States at the bottom of the survey. As is true in the case of productive equipment, both the loss of the investment tax credit and the lengthening of depreciable lives enacted in TRA '86 raised effective tax rates on new investment in pollution-control and energy-efficient equipment. Slower capital cost recovery means that equipment embodying new technology and energy efficiency will not be put in place as rapidly as it would be under a more-favorable tax code. A variety of tax incentives such as expensing, accelerated depreciation, tax-exempt bond financing,

or more-generous loss carrybacks that reduce the cost of capital for voluntary efforts to reduce greenhouse gas emissions, such as those included in S. 1777, the Climate Change Tax Amendment introduced in the 106th Congress by Senator Larry Craig (R-ID), would be more effective than the "credit for early action" regulatory framework proposal or the multi-pollutant approach proposed by some in Congress.

Conclusions: A Partnership Between Tax Policy and Technological Innovation

If, as knowledge of the climate system increases, policy changes to reduce carbon emissions become necessary, these changes should be implemented in a way that minimizes damage to the U.S. economy. Above all, experts agree that voluntary measures clearly and cost-effectively reduce the growth in greenhouse gas emissions, as the U.S. Second National Communication to the Framework Convention on Climate Change noted in 1997.

A U.S. strategy for reducing CO_2 emissions and providing energy security should include:

- **Fix the U.S. Tax Code:** Providing expensing (first-year write-off) or faster depreciation for new investments that reduce CO_2 can reduce the cost of capital by 20–30 percent.
- **Expand Nuclear Energy:** Nuclear power expansion has a vital role to play in managing CO_2 emissions while strengthening U.S. energy security.
- **Expand Bilateral Cooperation With Developing Countries:** Promoting the use of existing and emerging technology in developing countries for clean coal, natural gas, and hydro electricity production could substantially slow the growth of global CO_2 emissions.
- **Expand Incentives for use of landfill methane and biomass** including ethanol from cellulose. The EIA's April 2000 Climate Change Technology Initiative report shows that these programs are the most efficient use of tax incentives to reduce CO_2 emissions.
- **Implement Multi-Year Plan for Improvement of Coal Technology:** In the short term, focus on new clean coal technology, co-firing with biomass, and coal to gas; in the long term, institute a capture target of 50 percent (converts coal emissions to the equivalent of natural gas).
- **Remove Regulatory Barriers:** New Source Review is impeding the retrofitting and expansion of U.S. electricity generating, refining, and manufacturing capacity and making it more difficult to put in place the kinds of changes that would reduce CO_2 for each unit produced.
- **Avoid Caps on CO_2 Emissions** by U.S. industry. Such a policy will have a negative impact on the willingness of industry to invest here in the United States in the new technologies because of the concern that "voluntary" emission cuts will become mandatory. Allowing industry to recover its costs faster will spur the kind of investments that reduce CO_2 and expand output of energy as well as other products and services.
- **Avoid Setting Targets for Global CO_2 Concentrations** in the range of 550 ppm in the next 75–100 years. Such targets would require the developed countries' CO_2 emissions to fall to zero by about 2050 and would likely severely constrain U.S. economic growth. Models which show that their targets can be achieved at low cost, such as the Second Generation Model used by Jae Edmonds at Battelle Memorial Institute, are seriously flawed. The SGM model assumes costless, instantaneous adjustments in all markets and does not specify how the new technology required to move off carbon-based fuels is to be developed.

The consensus of the noted climate policy scholars whose work is discussed in this report is clear. Given the need to maintain strong U.S. economic growth to address such challenges as a growing population, the retirement of the baby boom generation, and a persistent trade deficit, policymakers need to weigh carefully the Kyoto Protocol's negative economic impacts and its failure to engage developing nations in full participation. Adopting a thoughtfully timed climate change policy—based on accurate science, improved climate models, global participation, tax incentives to accelerate investment in energy efficiency and sequestration, and new technology—is essential, both to U.S. and global economic growth and to eventual stabilization of the carbon concentration in the atmosphere, if growing scientific understanding indicates such a policy is needed. ❖

Sources and Additional Reading

Data Sources, Figures 2 & 4

DOE/EIA: U.S. Department of Energy, Energy Information Administration, Office of Integrated Analysis and Forecasting.

1998 (October). Impacts of the Kyoto Protocol on U.S. Energy Markets and Economic Activity. Washington, D.C.

WEFA: Novak, Mary H. 1998. Global Warming: The High Cost of the Kyoto Protocol—National and State Impacts. Eddystone, Penn.: WEFA, Inc.

ABARE (Australian Bureau of Agricultural and Resource Economics): Tulpulé, Vivek, Stephen Brown, Jaekyu Lim, Cain Polidano, Hom Pant, and Brian S. Fisher. 1999. The Kyoto Protocol: An Economic Analysis Using GTEM. *The Energy Journal* (Special Issue: The Costs of the Kyoto Protocol) 257–286.

DRI (Standard & Poor's DRI): Brinner, Joyce Y. 1999. Commentary: The Impact of Meeting the Kyoto Protocol on Energy Markets and the Economy. In *Climate Change Policy: Practical Strategies to Promote Economic Growth and Environmental Quality,* 63–72. Washington, D.C.: American Council for Capital Formation Center for Policy Research.

CRA (Charles River Associates): Bernstein, Paul M., W. David Montgomery, Thomas F. Rutherford, and Gui-Fang Yang. 1999. Effects of Restrictions on International Permit Trading: The MS-MRT Model. *The Energy Journal* (Special Issue: The Costs of the Kyoto Protocol) 221–256.

Manne/Richels: Manne, Alan S. and Richard G. Richels. 1999. The Kyoto Protocol: A Cost-Effective Strategy for Meeting Environmental Objectives? In *Climate Change Policy: Practical Strategies to Promote Economic Growth and Environmental Quality,* 3–23. Washington, D.C.: American Council for Capital Formation Center for Policy Research.

Admin/CEA: Council of Economic Advisers. 1998 (July). The Kyoto Protocol and the President's Policies to Address Climate Change: Administration Economic Analysis.

Report Sources

ACCF Center for Policy Research. 2000. *The Kyoto Commitments: Can Nations Meet Them With the Help of Technology?* Washington, D.C.: American Council for Capital Formation Center for Policy Research.

Australian Bureau of Agricultural and Resource Economics. 2000 (September). Climate Change Policy and the European Union. www.abareconomics.com

Bernstein, Paul M., and W. David Montgomery. 1998. How Much Could Kyoto Really Cost? A Reconstruction and Reconciliation of Administration Estimates. Washington, D.C.: Charles River Associates.

Bernstein, Paul M., W. David Montgomery, Gui-Fang Yang, Thomas F. Rutherford, and James L. Sweeney. 1998. Trade and Industry Impacts of the Kyoto Protocol. Washington, D.C.: The Business Roundtable.

Bernstein, Paul M., W. David Montgomery, Thomas F. Rutherford, and Gui-Fang Yang. 1999. Effects of Restrictions on International Permit Trading: The MS-MRT Model. *The Energy Journal* (Special Issue: The Costs of the Kyoto Protocol) 221–256.

Brinner, Joyce Y. 1999. Commentary: The Impact of Meeting the Kyoto Protocol on Energy Markets and the Economy. In *Climate Change Policy: Practical Strategies to Promote Economic Growth and Environmental Quality,* 63–72. Washington, D.C.: American Council for Capital Formation Center for Policy Research.

Business Roundtable. 2001 (April). Unleashing Innovation: The Right Approach to Global Climate Change. White Paper. Washington, D.C.

Climate Action Report. 1997. Second national communication submitted to the Framework Convention on Climate Change by the United States. Washington, D.C.: U.S. Department of State.

Council of Economic Advisers. 1998 (July). The Kyoto Protocol and the President's Policies to Address Climate Change: Administration Economic Analysis.

Crandall, Robert. 1997. Economists and the Global Warming Debate. In Jonathan Adler, ed., *The Costs of Kyoto.* Washington, D.C.: Competitive Enterprise Institute.

Ellerman, A. Denny. 1999. Obstacles to Global CO_2 Trading: A Familiar Problem. In *Climate Change Policy: Practical Strategies to Promote Economic Growth and Environmental Quality.* Washington, D.C.: American Council for Capital Formation Center for Policy Research.

European Climate Change Programme. 2001 (June). Report. http://europa.eu.int/comm/environment/climat/eccp.htm.

European Commission. 2000 (November). Towards a European Strategy for the Security of Energy Supply.

Francl, Terry, Richard Nadler, and Joseph Bast. 1999. The Kyoto Protocol and U.S. Agriculture. Heartland Policy Study No. 87. Chicago: The Heartland Institute.

Gummer, John, and Robert Moreland. 2000 (June). The European Union and Global Climate Change: A Review of Five National Programmes. Arlington, Virginia: Pew Center on Global Climate Change.

Jacoby, Henry D. 1999. The Uses and Misuses of Technology Development as a Component of Climate Policy. In *Climate Change Policy: Practical Strategies to Promote Economic Growth and Environmental Quality,* 151–169. Washington, D.C.: American Council for Capital Formation Center for Policy Research.

Jotzo, Frank, Edwina Heyhoe, Kate Woffenden, Stephen Brown, and Brian S. Fisher. 2000. Commentary: The Kyoto Protocol—Impact on Developing Countries and Some Implications for the Design of the Kyoto Mechanisms. In *The Kyoto Commitments: Can Nations Meet Them With the Help of Technology?,* 75–107. Washington, D.C.: American Council for Capital Formation Center for Policy Research.

Manne, Alan S. and Richard G. Richels. 1999. The Kyoto Protocol: A Cost-Effective Strategy for Meeting Environmental Objectives? In *Climate Change Policy: Practical Strategies to Promote Economic Growth and Environmental Quality,* 3–23. Washington, D.C.: American Council for Capital Formation Center for Policy Research.

McKibben, Warwick J., and Peter J. Wilcoxen. 1997. A Better Way to Slow Global Climate Change. Brookings Policy Brief No. 17. Washington, D.C.: Brookings Institution.

Montgomery, W. David. 1996. Developing a Framework for Short- and Long-Run Decisions on Climate Change Policies. In *An Economic Perspective on Climate Change Policies*, 15–43. Washington, D.C.: American Council for Capital Formation Center for Policy Research.

Moroney, John R. 1999. Energy, Carbon Dioxide Emissions, and Economic Growth. In *Climate Change Policy: Practical Strategies to Promote Economic Growth and Environmental Quality*, 41–62. Washington, D.C.: American Council for Capital Formation Center for Policy Research.

National Academy of Sciences, Committee on the Science of Climate Change, National Research Council. 2001. *Climate Change Science: An Analysis of Some Key Questions*. Washington, D.C.: National Academy Press.

Nordhaus, William and Joseph Boyer. 1999. Requiem for Kyoto: An Economic Analysis. In *The Costs of the Kyoto Protocol: A Multi-Model Evaluation*, ed. John P. Weyant. *The Energy Journal*, Special Issue.

Novak, Mary H. 1998. Global Climate Change, Environmental Quality, and U.S. Living Standards: The Impact on Consumers. In *The Impact of Climate Change Policy on Consumers: Can Tradable Permits Reduce the Cost?*, 3–18. Washington, D.C.: American Council for Capital Formation Center for Policy Research.

Novak, Mary H. 2000. The Kyoto Protocol: Can Annex B Countries Meet Their Commitment? In *The Kyoto Commitments: Can Nations Meet Them With the Help of Technology?*, 13–66. Washington, D.C.: American Council for Capital Formation Center for Policy Research.

Novak, Mary H. 1998. Global Warming: The High Cost of the Kyoto Protocol—National and State Impacts. Eddystone, Penn.: WEFA, Inc.

Rutherford, Thomas. 1996. Carbon Dioxide Emission Restrictions in the Global Economy: Leakage, Competitiveness, and the Implications for Policy Design. In *An Economic Perspective on Climate Change Policies*, 203–222. Washington, D.C.: American Council for Capital Formation Center for Policy Research.

Tulpulé, Vivek, Stephen Brown, Jaekyu Lim, Cain Polidano, Hom Pant, and Brian S. Fisher. 1999. The Kyoto Protocol: An Economic Analysis Using GTEM. *The Energy Journal* (Special Issue: The Costs of the Kyoto Protocol) 257–286.

U.S. Department of Agriculture. 1999 (May). Economic Analysis of U.S. Agriculture and the Kyoto Protocol. Washington, D.C.

U.S. Department of Energy, Energy Information Administration, Office of Integrated Analysis and Forecasting. 2001 (March). *International Energy Outlook*. Washington, D.C.

U.S. Department of Energy, Energy Information Administration, Office of Integrated Analysis and Forecasting. 2000 (December). *Annual Energy Outlook 2000*. Washington, D.C.

U.S. Department of Energy, Energy Information Administration, Office of Integrated Analysis and Forecasting. 2000 (April). Analysis of the Climate Change Technology Initiative. Washington, D.C.

U.S. Department of Energy, Energy Information Administration, Office of Integrated Analysis and Forecasting. 1999 (July). Analysis of the Impacts of an Early Start for Compliance with the Kyoto Protocol. Washington, D.C.

U.S. Department of Energy, Energy Information Administration, Office of Integrated Analysis and Forecasting. 1998 (October). Impacts of the Kyoto Protocol on U.S. Energy Markets and Economic Activity. Washington, D.C.

Viguier, Laurent L., Mustafa H. Babiker, and John M. Reilly. 2001 (February). Carbon Emissions and the Kyoto Commitment in the European Union. Report No. 70. Cambridge, Mass.: MIT Joint Program on the Science and Policy of Global Change.

Yohe, Gary W. 1997. Climate Change Policies, the Distribution of Income, and U.S. Living Standards. In *Climate Change Policy, Risk Prioritization, and U.S. Economic Growth*, 13–54. Washington, D.C.: American Council for Capital Formation Center for Policy Research.

APPENDIX: KEY GAPS IN THE SCIENCE OF CLIMATE CHANGE

Despite the United States' intensive investment in climate change science over the past decade, numerous gaps remain in our understanding of climate change. The National Academy of Sciences' National Research Council identified in its June 2001 white paper, *Climate Change Science: An Analysis of Some Key*, critical uncertainties about the science of climate change.

The National Research Council paper goes on to identify a range of specific areas of scientific uncertainty that require additional study and research. These gaps include (page references are from the source document):

■ Conflict exists between global atmospheric and "surface" temperature measurements:

"Although warming at the Earth's surface has been quite pronounced during the past few decades, satellite measurements beginning in 1979 indicate relatively little warming of air temperature in the troposphere [see Figure 6 in this testimony]. … The finding that surface and troposphere temperature trends have been as different as observed over intervals as long as a decade or two is difficult to reconcile with our current understanding of the processes that control the vertical distribution of temperature in the atmosphere." (p. 17)

■ How much carbon is sequestered by oceans and terrestrial sinks and how much remains in the atmosphere are uncertain:

"How land contributes, by location and processes, to exchanges of carbon with the atmosphere is still highly uncertain…" (p. 11)

"These estimates [of future carbon dioxide climate forcings] … are only approximate because of uncertainty about how efficiently the ocean and terrestrial biosphere will sequester atmospheric CO_2." (p. 13)

"How much of the carbon from future use of fossil fuels will be seen as increases in carbon dioxide in the atmosphere will depend on what fractions are taken up by land and by the oceans. The exchanges with land occur on various time scales, out to centuries for soil decomposition in high latitudes, and they are sensitive to climate change. Their projection into the future is highly problematic." (p. 18)

■ The feedbacks in the climate system that determine the magnitude and rate of temperature increases are uncertain:

"Because there is considerable uncertainty in current understanding of how the climate system varies naturally and reacts to emissions of greenhouse gases and aerosols, current estimates of the magnitude of future warming should be regarded as tentative and subject to future adjustments (either upward or downward)." (p. 1)

"Much of the difference in predictions of global warming by various climate models is attributable to the fact that each model represents these [feedback] processes in its own particular way. These uncertainties will remain until a more fundamental understanding of the processes that control atmospheric relative humidity and clouds is achieved." (p. 4)

"The warming that has been estimated to have occurred in response to the buildup of greenhouse gases in the atmosphere is somewhat greater than the observed warming." (p. 17)

■ The direct and indirect effects of aerosols are uncertain:

"The greatest uncertainty about the aerosol climate forcing—indeed, the largest of all the uncertainties about global climate forcings—is probably the indirect effect of aerosols on clouds." (p. 14)

"The great uncertainty about this indirect aerosol climate forcing presents a severe handicap both for the interpretation of past climate change and for future assessments of climate changes." (p. 14)

"Climate forcing by anthropogenic aerosols is a large source of uncertainty about future climate change." (p. 13)

"Because of the scientific uncertainties associated with the sources and composition of carbonaceous aerosols, projections of future impacts on climate are difficult." (p. 12)

"The conclusion is that the black carbon aerosol forcing is uncertain but may be substantial. Thus there is the possibility that decreasing black carbon emissions in the future could have a cooling effect that would at least partially compensate for the warming that might be caused by a decrease in sulfates." (p. 13)

■ **The details and impacts of regional climate change resulting from global climate change are uncertain:**

"On the regional scale and in the longer term, there is much more uncertainty" with respect to effects on agriculture and forestry. (p. 19)

"The Northern Hemisphere as a whole experienced a slight cooling from 1946–75, and the cooling during that period was quite marked over the eastern United States. The cause of this hiatus in the warming is still under debate." (p. 16)

"Health outcomes in response to climate change are the subject of intense debate. … The understanding of the relationships between weather/climate and human health is in its infancy and therefore the health consequences of climate change are poorly understood. The costs, benefits, and availability of resources for adaptation are also uncertain." (p. 20)

"Changes in storm frequency and intensity are one of the more uncertain elements of future climate change prediction." (p. 20)

■ **The nature and causes of the natural variability of climate, including the sun, and its interactions with forced changes are uncertain:**

"Because of the large and still uncertain level of natural variability inherent in the climate record and the uncertainties in the time histories of the various forcing agents (and particularly aerosols), a causal linkage between the buildup of greenhouse gases in the atmosphere and the observed climate changes during the 20th century cannot be unequivocally established." (p. 17)

The value of indirect effect of ozone changes induced by solar ultraviolet irradiance variations "remains highly uncertain." (p. 14)

■ **The emissions and usage of fossil fuels and the future emissions of methane are uncertain:**

"The increase of global fossil fuel CO_2 emissions in the past decade, averaging 0.6 percent per year, has fallen below the IPCC scenarios. The growth of atmospheric CH_4 has fallen well below the IPCC scenarios." (p. 19)

"With a better understanding of the sources and sinks of methane, it may be possible to encourage practices … that lead to a decrease in atmospheric methane and significantly reduce future climate change." (p. 13)

"There is no definitive scientific basis for choosing among several possible explanations for these variations in the rates of change of global methane contributions, making it very difficult to predict its future atmospheric concentrations." (p. 11)

In response to these gaps in our knowledge, the NRC paper also recommends "research that couples physical, chemical biological and human systems; an improved capability of integrating scientific knowledge, including its uncertainty, into effective decision support systems, and an ability to conduct research at the regional or sectoral level that promotes analysis of the response of human and natural systems to multiple stresses."

The NRC study also indicates that to advance the understanding of climate change, it will be necessary to have "a global observing system in support of long term climate monitoring and prediction [and] concentration on large-scale modeling through increased, dedicated supercomputing and human resources." In addition to the recent NRC paper, the U.S. Global Change Research Program has updated its 10-year plan and submitted it to the National Research Council (NRC) for review. High priority areas for further research are identified in numerous recent reports and documents, such as:

- "Global Environmental Change: Research Pathways for the Next Decade" (NRC, 1998);
- "Capacity of U.S. Climate Modeling to Support Climate Change Assessment Activities" (NRC, 1998); and
- "Adequacy of Climate Observing Systems" (NRC, 1999).