

Guidance on Global Warming

Q: Are you considering increasing energy taxes?

I would note that the President just got through making budget decisions that included significant tax cuts for American families. As you heard on Monday, there are a lot of ways to deal with the climate change problem. It has never been our practice to make categorical statements. No policy decisions have been made yet. But the President has made clear that he is committed to addressing this problem in a manner that is both environmentally and economically sound.

Q: Would you rule out energy taxes?

See above.

Q: Is the President having a meeting today to discuss options?

The President has already met with advisors on a number of occasions on this issue and will continue doing so.

Q: When is the President going to announce his policy? Before the next meeting in Bonn?

The President is working actively with his advisors to develop a position to take into the Kyoto negotiations. I expect that we will probably have a position to announce during the Bonn meeting, which runs from October 20-31. [POTUS doesn't return from Latin America until Oct. 19, so there is virtually no prospect that we will have a position *before* the Bonn meeting.]

Q: Are the options as sketched out in the *New York Times* accurate?

I'm not going to get into discussing options that the President is considering. As we have said before, we are working to develop a position that is both environmentally and economically sound.

Q: Are you considering an escape hatch?

As I said, I'm not going to get into discussing the specifics of any options that we may be looking at.

Q: How would an escape hatch work?

There are a variety of variations on just about every proposal. I noted there was some discussion of this by Peter Passell in the *New York Times* last week.

Q: But wouldn't an escape hatch be inconsistent with the President's commitment to endorse a binding target and timetable for reduction of emissions?

As I said, I'm not going to get into discussing the specifics and I'm not going to start speculating about issues like that.

Q: Would other countries get an escape hatch too?

We're getting way beyond ourselves. No decisions on policy have been made and I'm not going to engage in that kind of speculation.

Q: Were the environmental groups briefed on your options?

We have not briefed the environmental community or anyone else on the specific options that are being reviewed by the President. That said, we have been very actively consulting with a variety of constituencies, including the business community, labor and environmentalists, about many aspects of this issue.

Q: Is the Vice President meeting with environmental groups today?

He'll be talking to a number of environmental leaders by phone today. They have asked for an opportunity to express their views and I understand that he has agreed to hear them out.

Agency Talking Points for Capitol Hill

Global Climate Change

- I am here today to talk to you about the issue of global climate change. This is one of the President's top priorities. In fact, he hosted on Monday an all day conference on Climate Change at Georgetown University, exploring the scientific, economic, international, and technological components of this important issue.
- I understand that the Senate also has a strong interest in global climate change and in the development of U.S. policy leading up to the Kyoto Conference this December. I thought it might be useful to take a few minutes to bring you up to speed on where we stand.
- The President has identified four principles which are guiding the development of U.S. climate change policy.
- First, the science of climate change is real. While a number of uncertainties remain, the Administration believes we know enough to justify taking sensible actions to address the problem.
- Second, the Administration is committed to proposing a binding limit on greenhouse gas emissions. We feel this is the best way to ensure that countries take serious measures to reduce their emissions.
- Third, the Administration will not propose actions which threaten economic growth. We support measures which are flexible and cost-effective. Internationally, this includes the ability to trade emission rights between countries and to undertake emissions reduction projects overseas for which we would gain credit. Domestically, we are exploring a range of options for reducing our greenhouse gas emissions.
- Fourth and finally, the Administration will not sign any agreement that does not include all nations. While developing countries cannot be expected to take the same obligations we do, it would be environmentally and economically reckless to advance a treaty without their meaningful involvement.
- The Administration is working extremely hard to turn these principles into a comprehensive U.S. proposal in time for the Kyoto Conference of the Parties this December. The earliest such a proposal would be announced is after the President returns from Latin America later this month. We will certainly keep you informed as our deliberations proceed.
- We are committed to working with you, and with the Senate Observer Group, to ensure that we advance a climate change policy that is environmentally, economically, and politically sound.

Talking Points
Global Climate Change
October 8, 1997

- Addressing the problem of global climate change is one of President Clinton's top priorities.
- On Monday, October 6, the President hosted an all day conference on climate change at Georgetown University, exploring the scientific, economic, international, and technological components of this important issue.
- This December, over 150 nations will meet in Kyoto, Japan to try to reach agreement on an international treaty to reduce the greenhouse gas emissions that cause global climate change.
- The United States is currently in the midst of an intensive policy process to develop its proposal for the Kyoto meeting.
- The President has identified four principles which are guiding the development of U.S. climate change policy.
- First, the science of climate change is real. While a number of uncertainties remain, the Administration believes we know enough to justify taking sensible actions to address the problem.
- Second, the Administration is committed to proposing a binding limit on greenhouse gas emissions. We feel this is the best way to ensure that countries take serious measures to reduce their emissions.
- Third, the Administration will not propose actions which threaten economic growth. We support measures which are flexible and cost-effective. Internationally, this includes the ability to trade emission rights between countries and to undertake emissions reduction projects overseas for which we would gain credit. Domestically, we are exploring a range of options for reducing our greenhouse gas emissions.
- Fourth and finally, the Administration will not sign any agreement that does not include all nations. While developing countries cannot be expected to take the same obligations we do, it would be environmentally and economically reckless to advance a treaty without their meaningful involvement.
- The President is committed to advancing a climate change policy that is environmentally, economically, and politically sound.

CLIMATE CHANGE: BASIC BACKGROUND ON THE SCIENCE

The greenhouse effect: Scientists have long understood that the presence of certain gases in nature (principally water vapor, carbon dioxide, methane, and nitrous oxide) act like a greenhouse by trapping heat and keeping the Earth's temperature an estimated 60 degrees Fahrenheit warmer than it would otherwise be, thus sustaining life as we know it.

Human activities have enhanced this greenhouse effect by increasing the concentrations of these gases markedly since the Industrial Revolution. The concentration of carbon dioxide (CO₂), the most important greenhouse gas, has increased 30% from 280 parts per million (ppm) to 360 ppm. Current projections indicate that a business as usual path will result in CO₂ concentrations of 700 ppm by the end of the next century. This would be the highest CO₂ level in more than 50 million years.

Where is there scientific consensus: There is no serious scientific debate about the proposition that (1) greenhouse gases are rapidly building up in the atmosphere as a result of human activities, (2) that these increased concentrations will change our climate, and (3) that these changes could have serious and disruptive consequences.

Where are there scientific uncertainties: No one knows for sure exactly how much or how fast the planet will warm. Scientists estimate a range of temperature increase of 2.0 - 6.5 degrees F by 2100, with a best guess of 3.5 degrees. By way of comparison, a cooling in average temperatures of just 9 degrees produced the last Ice Age.

No one is exactly sure how the climate will react to predicted warming and where the most noticeable impacts will be felt. The majority of scientific opinion suggests that as CO₂ concentrations approach a level of 550 ppm (or double pre-industrial levels), a number of largely negative impacts are likely. These include, but are not limited to, human health problems (increased fatalities from heat stress and the expansion in the geographic ranges of certain infectious diseases), more extreme weather such as floods and droughts, sea level rise, and the loss of a number of animal and plant species.

While the planet has clearly warmed in the past century, no one can say for certain exactly how much of this warming, or of observed climate changes, is due to human influences. The weight of scientific opinion is that human activities *have* already started to warm the planet. The intergovernmental panel of over 2000 climate experts that speaks most authoritatively on the science of this issue, states that the "balance of evidence suggests a discernible human influence on global climate."

Evidence of Climate Change Over the Past Century

- Average global temperature has increased by about 1 degree F.
- Sea level has risen by 4-10 inches.
- U.S. rainfall has increased 6%, an amount of water equal to half the yearly flow of the Mississippi River.
- Mountain glaciers are melting worldwide. For example, Glacier National Park has lost 70% of its glacial area in the last 100 years.
- The ten warmest years of the century have occurred since 1980, and 1995 was the hottest year ever on record.

What is the ultimate solution to climate change: The ultimate goal of any overall climate change strategy must be to stabilize atmospheric concentrations of greenhouse gases. Stabilizing *concentrations* is different from stabilizing *emissions*. Were we to freeze global emissions at today's level, the concentration of greenhouse gases in the atmosphere would continue to rise. This is largely because such gases remain in the atmosphere for long periods of time. Stabilizing concentrations at any reasonable level is a long-term process that will require reducing emissions over time. Kyoto, therefore, should be looked at not as an effort to find a complete solution to climate change, but rather as an important next step toward getting the world on a more sustainable emissions path.

No policy determination has yet been made about what concentration level is acceptable. The pre-industrial level of CO₂ in the atmosphere was about 280 parts per million (ppm). Today, it stands at 360 ppm. Most of the work done by the Intergovernmental Panel on Climate Change (IPCC) on the potential impacts of global warming assumes a level of 550 ppm or roughly twice the pre-industrial level. The IPCC estimates that if current emissions trends continue, we will reach 550 ppm sometime in the next century, with concentrations further increasing to almost 700 ppm by 2100.

THE WHITE HOUSE
WASHINGTON

10-8

TO: Group

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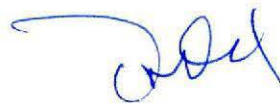
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Talking Pts

THE WHITE HOUSE
WASHINGTON

10-5

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Talking Points for Visits to Hill

Global Climate Change

- **What we've been doing.** Wanted to give you an update on what the Administration is doing on the issue of climate change and what is likely to be coming up in the period leading to the Kyoto talks.
- We have been working intensively on a couple of different fronts. First, we have been working on an interagency basis on developing policy options for the President. These options include a target and timetable for reduction of greenhouse gas emissions, various implementing policies, and proposals for developing country participation. No decisions yet.
- Second, active outreach effort. White House Conference held on Monday at Georgetown was very successful. Good, substantive discussions. People on all sides of this issue felt good about it. President said in his speech that day should be spent talking to each other rather than past each other. By that standard, a success. Before Conference, some 20 Cabinet events, weather forecasters event, many senior level meetings with business, labor, environmental community and others.
- **President's four principles.** President has identified four principles which are guiding the development of U.S. climate change policy: **First**, the science of climate change is real. While uncertainties remain, we know enough to warrant taking sensible actions to address the problem; **second**, President is committed to proposing a binding target and timetable for greenhouse gas emissions; **third**, President will not propose actions which threaten economic growth. We will support measures that are flexible and cost-effective, such as various means to get and trade credit internationally. Domestically, we are exploring a range of options for reducing our greenhouse gas emissions, including some form of permit trading; **fourth**, we will insist that all nations, developed and developing must genuinely participate in a solution. It would be environmentally and economically reckless to leave developing countries out of the equation.
- **Calendar.** The next major event on the climate change calendar is meeting in Bonn from October 20-31. This is last full preparatory meeting for Kyoto. Administration is likely to announce a policy position during Bonn meeting, though this isn't definite. Kyoto runs from December 1-12.
- **Touching base.** Wanted to touch base with you today, let you know what we are doing, see whether you have concerns, questions, ideas, suggestions. We will be back in touch with you as we get clearer idea from President of specific policy. We hope we can count on you to work with us. It's a tough issue and we need to craft a policy that is environmentally, economically, and politically sound.

Global Climate Change Questions & Answers For Hill Visits

Developing Country Participation

Q: What are you doing to ensure the meaningful participation of developing countries in a Kyoto treaty? How are you responding to the views expressed in the Byrd Resolution?

- The U.S. has led the world in pushing for the inclusion of developing countries in a new climate change agreement.
- We will not take on binding obligations until developing countries have made adequate commitments in terms of their own obligations.

Economic Damage

Q: What assurances can you provide that the U.S. will not sign an agreement in Kyoto that will have negative impacts on the U.S. economy?

- The President has devoted himself to restoring the American economy since the day he took office, and he is not about to jeopardize the progress we have made.
- The U.S. has rejected the target put forward by the European Union which calls for a 15% reduction in emissions below 1990 levels by 2010. We feel this proposal is unrealistic and unnecessarily stringent.
- We intend to propose a target and timetable that is realistic and achievable and to support implementation mechanisms that are flexible and market-based.

Economic analysis

Q: What economic analysis will the Administration produce to justify its position?

- While the Administration is not constructing its own economic model, solid economic analysis will heavily inform any policy we announce.
- The President's economic advisers are fluent with the economic literature that exists on the climate change issue and are bringing that knowledge to bear in the policy process.

Voluntary programs vs. binding limits

Q: Many companies have already taken substantial voluntary actions to cut emissions -- in a number of cases establishing successful partnerships with Federal agencies. Why not emphasize these kinds of partnerships rather than binding limits?

- Voluntary partnerships have been a useful tool for reducing emissions. They have also in many cases saved industry a lot of money. For these reasons, such partnerships will continue no matter what policy we decide.
- Unfortunately, voluntary efforts alone have not succeeded in starting to change our overall emissions path. That is why the Administration supports binding targets that are realistic and achievable.

Early Credit

Q: Shouldn't companies be given credit against future targets for early actions they take to reduce emissions?

- We are exploring ways of providing some form of credit for companies that take early action to reduce emissions.
- We would be interested in your thoughts for how such a program would work.

Science

Q: Isn't there still a tremendous amount of scientific uncertainty surrounding the issue of climate change? Don't we need to know a bit more before signing up to binding emissions limits?

- The basic science of climate change is absolutely clear. Atmospheric concentrations of greenhouse gases are rising dramatically. Human actions are responsible for these increases. These increases could have (and many scientists would argue *are already* having) serious implications for the climate system as they warm the planet.
- Uncertainties absolutely exist. We are not sure, for example, exactly how fast or how much the planet will warm or where the most severe impacts will be felt. Nevertheless, we do believe that we know enough to justify taking meaningful actions to address the problem.

THE TRUTH ABOUT THE 10 MYTHS

Truth 1: Most climate scientists agree that the climate is changing and will change much more, causing a wide range of environmental and socio-economic consequences. The recent round of IPCC assessments has involved hundreds of authors and thousands of reviewers who have worked to develop an unbiased, measured, documented, and peer-reviewed result.

Truth 2: In the United States, average temperatures have remained high even in the presence of the increasing cooling influence of sulfate aerosols, and global average temperatures have warmed significantly. The rise in sea level, the melting of mountain glaciers, and other even more subtle climate changes all match predictions.

Truth 3: The Northern and Southern Hemisphere patterns of warming correlate well with the combined effects of increasing greenhouse gases and the increasing emissions of sulfate aerosols. In addition, the vertical and latitudinal patterns of temperature change reflect these influences and the additional influence of stratospheric ozone depletion--and these patterns are unlike those associated with natural variability.

Truth 4: More carbon dioxide and other greenhouse gases create a warming influence, moderated somewhat by increasing sulfate aerosol concentrations. While feedbacks such as cloud-radiation interactions can moderate the magnitude of the change, there is no way they can change its sign--warming will be the overall response over the next century.

Truth 5: Climate models do well at representing large scale features of the present climate, and many aspects of past climates. The models indeed do less well at representing the fine scales which, due to computer resources and limitations in understanding, are harder to represent. That is why the projections are based on large-scale results and why research is needed and continuing to further improve the simulations. As it turns out, however, there is no other objective approach to making projections.

Truth 6: Climate model simulations of the past century are showing good overall agreement with observations. Models are now starting to be able to simulate the effects of volcanic eruptions and to forecast the El Nino cycle on a seasonal to interannual basis. The latitudinal patterns of precipitation show quite reasonable agreement with observations, although local values differ significantly due to model resolution and the need to better treat cloud convection.

Truth 7: Melting of mountain glaciers, thermal expansion of the oceans, and other factors (probably the melting of Greenland and/or Antarctica) have caused sea level to rise 4-8 inches in the last hundred years. While melting sea ice has no effect, melting of Greenland and further glacier melting and thermal expansion are likely to increase the rate of rise by a factor of two or more. Indeed, while some areas are melting it will likely, on average, snow more on the Antarctic continent, limiting the sea level rise from the other factors.

Truth 8: Climate variability and extremes will change as climate patterns change. Models cannot yet predict the details of all the changes, but overall warming and summer drying will intensify stress on crops, more moisture in the air will mean more intensive rainstorms when they do occur. And even less variability can be of significant concern--warmer nights will mean fewer frosts to kill off disease vectors.

Truth 9: Warming will occur in many locations and seasons, in each situation creating stresses not naturally there and thus overall exacerbating natural conditions. While sulfate aerosols will limit the warming in some locations, possibly over parts of North America, as the greenhouse gases continue to build-up, they will overwhelm the cooling influence. The warming influence of the greenhouse effect, coupled with the long distance for water to come from the oceans, will make the Great Plains drier and thereby hotter in summer.

Truth 10: While all bad weather is not evidence of global warming, all good weather is not evidence that warming and climatic change are not occurring. The changes from one year to the next are too small to sense, even with instruments, but as they accumulate over time, big changes will be occurring. For the few years after the 1991 Mt. Pinatubo eruption, we enjoyed the shading effects of its aerosols. They are now gone, and the temperature has started to rise again.

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**THE NEED FOR ACTION TO REDUCE GREENHOUSE GASES:
A Clear Consensus Among Scientists, Economists And Other Leaders**

Over 2600 American Scientists Agree On The Need For Action:

"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 climate change and consequent ecological, economic and social disruption. The risks associated with such changes justify preventive action through reductions in emissions of greenhouse gases."

-- Statement signed by over 2600 American Scientists on Global Climate Disruption, June 18, 1997 (emphasis added)

More Than 2000 Economists, Including Eight Nobel Laureates, Agree On The Need For Action:

"As economists, we believe that global climate change carries with it significant environmental, economic, social, and geopolitical risks, and that preventive steps are justified. Economic studies have found that there are many potential policies to reduce greenhouse-gas emissions for which the total benefits outweigh the total costs. 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 longer run."

-- Economists' Statement on Climate Change, January 1997, Endorsed by over 2000 Economists, including eight Nobel Laureates (emphasis added)

Many In The Business Community Agree On The Need For Action:

"[T]here 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. ...[T]here is mounting concern about two stark facts. The concentration of carbon dioxide is rising, and the temperature of the earth's surface is increasing. 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."

-- John Browne, Group Chief Executive, British Petroleum from a May 19, 1997 address at Stanford University (emphasis added)

"[International Climate Change Partnership] ICCP continues to recognize the climate change issue as an important matter with which governments should be concerned.... Our companies have determined that the current state of scientific understanding requires a prudent long-term approach to address this issue."

-- Prepared Statement of Kevin J. Fay, Executive Director International Climate Change Partnership Before the Senate Committee on Foreign Relations Subcommittee on International Economic Policy on June 19, 1997 (NOTE: Among the member of the ICCP are companies including British Petroleum, Chevron, Dupont, Enron and AT&T)

Talking Points

CLAIM ON AMERICAN JOBS MOVING OVERSEAS

CHARGE: *A global climate change treaty, particularly one without strong developing country commitments, would injure U.S. competitiveness and send jobs overseas.*

FACT: **Despite claims to the contrary, academic studies have generally found that taking steps to protect the environment need not lead to a deterioration in competitiveness. This is expected to be true with regard to climate change.**

Michele & Adele
Economists' Studies

- For most industries, energy costs are too small relative to other factors – such as labor costs, productivity, and infrastructure – to affect plant locations or trade flows. Energy costs for manufacturing industries in the United States, for example, average only roughly 2.2 percent of total costs. (Source: 1995 Annual Census of Manufacturers)
- Even for industries where energy costs are a significant share of total costs (such as aluminum production, cement, chemicals, pulp and paper, and steel), the President is committed to developing flexible, market-driven policies that minimize negative economic impacts.
- Non-tradeable sectors represent a substantial share of carbon emissions, with transportation and buildings accounting for roughly two-thirds of the U.S. total. For these sectors, competitiveness seems largely like a non-issue.

FACT: **The United States has led the world in its call for developing country obligations in any new treaty on climate change. We will not sign any agreement that leaves developing countries out of the equation.**

- Developing countries cannot at the outset be expected to take on the same commitments we do. Their contributions to global emissions are far less than ours, as are their emissions on a per capita basis. Our responsibility must be to devise sensible and meaningful steps that developing countries can take now, while reaching agreement that the obligations of such countries will increase over time.
- Addressing climate change also has the potential to provide opportunities for American business. Today the global market for environmental technologies is worth some \$4 billion annually. As countries work to increase energy efficiency and reduce their reliance on fossil fuels, this market is likely to grow dramatically. By investing in the development of such technologies, the U.S. can lead the world in marketing solutions to the climate change problem.

CLAIM ON NEW TAXES

CHARGE: *The Administration proposal is really about more taxes. Solving climate change would mean major tax increases for gas, oil, etc.*

FACT: The Administration has not endorsed any energy or carbon tax proposal to address climate change. Instead, the President has focused on market-based mechanisms such as emissions trading (which has worked well in the U.S. in reducing the sulfur dioxide emissions that cause acid rain) and joint implementation which can bring about substantial reductions at a low cost.

- Some economists have argued that energy taxes or carbon taxes of some kind (including a revenue-neutral tax that would include matching tax cuts) could be an effective option for stimulating a reduction in U.S. greenhouse gas emissions. (Source:??)



CLAIM THAT VOLUNTARY PROGRAMS ARE SUFFICIENT

CHARGE: *Voluntary actions, not binding limits and more government regulation, are the best way to obtain meaningful emissions reductions cost effectively.*

FACT: **Voluntary actions can play an important role in any plan to reduce emissions, but they are not a substitute for an international treaty with binding emissions limits.**

- Voluntary programs under the President's 1993 Climate Change Action Plan are expected to yield a 76 million metric ton reduction of carbon equivalent by 2000. (Source: U.S. Climate Action Report, 1997) This would be an important down payment on our national effort to reduce greenhouse gas emissions.
- Nevertheless, the U.S., along with most other industrialized nations, will fall substantially short of reaching the Rio goal (agreed to by President Bush and ratified by the Senate) of reducing emissions to 1990 levels by the year 2000. (Source: U.S. Climate Action Report, 1997)
- In light of this, and of the mounting scientific evidence on the seriousness of the problem, it is clear that the U.S. and other nations must do more.
- The President has committed to the concept of binding emissions limits to be achieved using market-oriented policies. Such policies, including *emissions trading* and *joint implementation*, promise to substantially lower the cost of obtaining emissions reductions.
- Emissions trading is already being used successfully in the U.S. to reduce emissions of sulfur dioxide, the primary culprit in causing acid rain.

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CLAIM ON THE ARGONNE LAB STUDY

CHARGE: *A study by the Department of Energy's Argonne Lab predicts major economic disruption to key U.S. industries from a new climate change treaty.*

FACT: While it provides some valuable information, the Argonne Lab study does not take into account key policies being advocated by the Clinton Administration that will substantially reduce the cost of emissions reductions.

- The Argonne Lab study examined the possible effects of a set of hypothetical fuel price increases on six energy intensive industries that are subject to significant foreign competition: basic chemicals, iron and steel, petroleum refining, paper and allied products, aluminum, and cement.
- Overall, the participants reported negative impacts on the six industries, but, as the Department of Energy noted at the time of the report's release, the conclusions are predicated on specific energy price scenarios that do not reflect the potential impact of multi-year emissions budgets, international emissions trading, joint implementation, and other fundamental aspects of the U.S. negotiating position on climate change. (Source: ??) Neither do they factor in the U.S.'s firm commitment to secure meaningful obligations from developing countries. Taken together, these policies can substantially lower the costs of reducing U.S. emissions.
- The Argonne study underscores the critical need for flexibility in securing emissions reductions.

No relevant study
No specific
and timetables
High energy prices
strategy

yellen testimony

Source
- Framework
- Protocol
- Level memo
- Report itself

CLAIM ON THE LACK OF SCIENTIFIC CONSENSUS

CHARGE: *Proponents of climate change theory have their own scientists. Skeptics have theirs. For the average person, there is no detectable consensus that we have a problem.*

FACT: **There is a broad scientific consensus that human induced climate change is occurring. Those who disagree represent a tiny fraction of the scientific community.**

- The Intergovernmental Panel on Climate Change (IPCC), the authoritative international scientific body on this subject, has concluded that climate change is occurring, that "the balance of evidence suggests a discernible human influence on global climate," and that as greenhouse gas concentrations increase in the atmosphere additional, largely disruptive, disturbances are likely.
- In reaching its conclusions, the IPCC relied upon the preparation and review of documents by some 2,000 of the world's leading experts on climate change and its consequences from some 60 nations.
- Criticism of the IPCC's work comes from a tiny band of skeptics.
- In many cases, these skeptics are supported by energy industry groups that are opposed to any further action to address climate change.

Research

"There is no debate among any statures scientists of what is happening... The only debate is the rate at which it's happening... Scientists, by nature, are very conservative... They don't want to overstate things. In this debate, the skeptics are atypical of the general scientific community. The irony is that when you find scientists who are adamant on any side, they look very curious within the scientific community. But to the general public, they come across as the most knowledgeable and authoritative of all."

-- Harvard University earth scientist James McCarthy, The Washington Post, 5/25/97

Quote

CLAIM THAT THE UNCERTAINTY IS TOO GREAT TO ACT

CHARGE: *Enormous uncertainty exists about the probable level of future warming, and any meaningful action should wait until the science is better understood.*

FACT: Climate change has been studied perhaps as much as any other environmental problem in history, and, while uncertainties remain, the imperative for action is clear.

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Albation
& make
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is n't.
- If we continue on a "business as usual" path for the next century, we can expect an additional rise in temperature of between 2.0-6.5 degrees F. This would represent a faster rate of warming than at any time in the last 10,000 years. (Source: IPCC, 1995) According to the IPCC, the impacts are likely to include:

- ⇒ **Human health** – increased fatalities from heat stress of the kind that killed 465 in Chicago in 1995 and an expansion of the range of diseases like malaria and dengue fever.
- ⇒ **Extreme weather** – increased frequency and intensity of floods and droughts.
- ⇒ **Sea level rise** – a "best guess" estimate of 20 inches by 2100 would inundate 7,000 square miles of the United States, threatening in particular Florida and the Gulf Coast.
- ⇒ **Agricultural impacts** – regional shifts in food productivity, with decreases in food production in many of the world's poorest regions.
- ⇒ **Natural ecosystems** – the climatic zone for certain forest types will shift faster than many species can migrate. The Northeast, for example, may lose its beech trees and sugar maples.

- Uncertainty is also a two-sided coin. More than 2,000 scientists believe that, "Effects of the disruption of climate are sufficiently complicated that it is appropriate to assume there will be effects not now anticipated." (Source: Scientists' Statement on Global Climatic Disruption, June 1997) Considering that CO₂ remains in the atmosphere for long periods, the time to begin taking sensible actions is now.

CLAIM THAT CLINTON PLANS WILL DEVASTATE THE ECONOMY

CHARGE: *The Administration's plans on climate change would devastate the U.S. economy. By some estimates, they would increase U.S. unemployment by 0.25 percent and reduce the GDP by 3.3 percent, costing 250,000 American jobs.*

FACT: **These are groundless assertions.**

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- There is no "Clinton plan" yet. The Administration is examining a variety of scenarios and talking to a range of experts to determine how to achieve needed environmental benefits without sacrificing continued economic prosperity.
 - Any policy that is chosen will be consistent with the President's commitment to sustaining a healthy and robust economy. Since President Clinton took office, the private sector of the economy has grown at more than twice the rate of the previous four years, business investment has boomed at a rate not seen since the Kennedy Administration, unemployment is as low as it has been in 24 years, and 12.9 million new jobs have been created. (Sources: Bureau of Economic Analysis, Department of Commerce; Bureau of Labor Statistics, Department of Labor)
 - More than 2,300 economists, including eight Nobel Laureates, believe that taking preventive steps to confront climate change is justified and that it is possible to do so without harming American living standards. In fact, they state that long-term productivity could be improved by such steps. (Source: 1/97 Economists' Statement on Climate Change)
 - The Clinton Administration is committed to tackling climate change by maximizing efficiency and innovation. That means supporting market-based policies such as *emissions trading* and *joint implementation*, and it means making major investments in developing new energy technologies. The President is also resolved that *all* countries must take meaningful steps to address climate change.
 - Tackling climate change will entail costs to particular economic sectors, just as it is likely to create opportunities in others. No matter what specific emissions reduction policies are chosen, the Administration will work to ensure that such costs are minimized.

CLAIM THAT ANY RESPONSE WILL COST TOO MUCH

CHARGE: *Any serious effort to confront climate change would inevitably wreak havoc on the American economy.*

FACT: **More than 2,300 of the nation's top economists, including eight Nobel Laureates, disagree emphatically.**

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- "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 longer run." (Source: 1/97 Economists' Statement on Climate Change)
 - Despite claims to the contrary, taking steps to protect the environment need not jeopardize economic progress. Numerous studies have shown "that there is little to document the view that environmental regulations have had a measurably adverse effect on competitiveness." [Sources: Jaffe, Peterson, Portney, and Stavins, "Environmental Regulation and International Competitiveness: What Does the Evidence Tell Us?" Resources for the Future, Discussion Paper 94-08; Also see Palmer, Oates, and Portney, "Tightening Environmental Standards: The Benefit-Cost of the No-Cost Paradigm?" *Journal of Economic Perspectives* 9 (1995), 119-132; and Daniel Esty, *Greening the GATT* (Institute for International Economics, 1994).]
 - The United States has taken the lead in proposing market-oriented policies to ensure that emissions reductions are achieved as efficiently and cost-effectively as possible. These include the trading of emissions and the opportunity to conduct joint projects with other countries to reduce emissions.
 - President Clinton has made it clear that he will not propose specific levels of emissions reductions without ensuring that they can be attained consistent with continued economic prosperity.
 - Revitalizing the American economy has been, and will continue to be, the President's top priority. His leadership has brought strong growth, low unemployment and inflation, and millions of new jobs. He is demonstrating on this issue, as he has on many others, that economic growth and environmental protection go best when they go hand in hand.

"I have devoted my passion and the best ideas I could come up with to try to get this country in good shape economically and socially. But I do believe it is folly for us to believe that we can go into the next century without a strategy that says we're going to be responsible and we're going to do our part and lead the world on environmental issues... Let's find a way to preserve the environment, to meet our international responsibilities, to meet our responsibilities to our children, and grow the economy at the same time." — President Clinton

Global Climate Change:

Fact Sheets & Charges and Responses

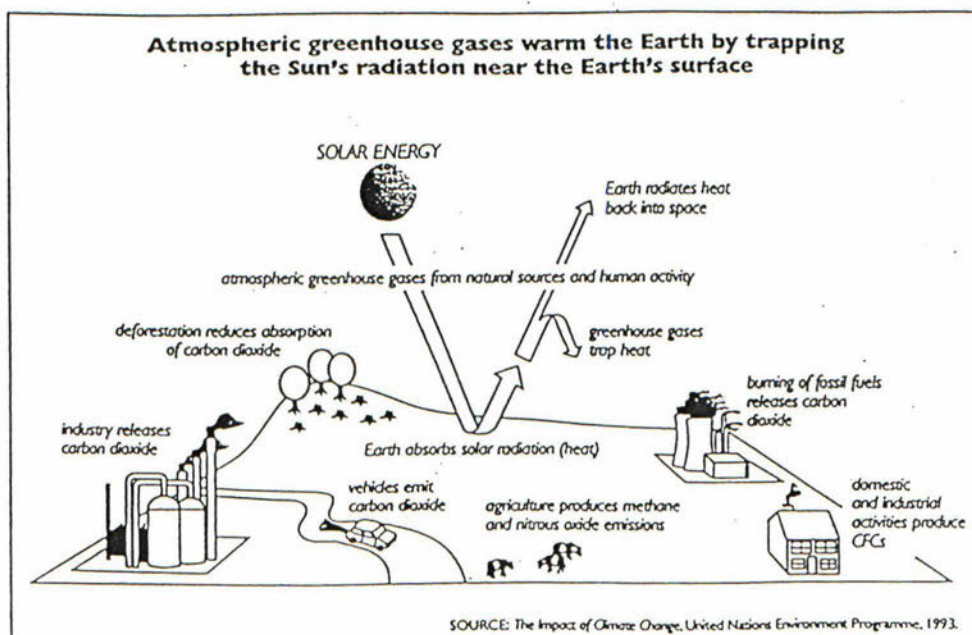
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Climate Change Fact Sheets

1. What we know about the science
2. The U.S. position on climate change
3. Climate change timeline
4. Climate change: who's saying what
 - ◆ IPCC Second Assessment Report, Summary for Policymakers
 - ◆ Scientists' Statement on Global Climatic Disruption
 - ◆ Ecologists' Statement on the Consequences of Rapid Climate Change
 - ◆ Economists' Statement on Climate Change
 - ◆ UNEP Insurance Initiative, Position Paper on Climate Change

WHAT WE KNOW ABOUT THE SCIENCE

- ◇ Scientists have long understood that greenhouse gases (principally water vapor, carbon dioxide, methane, and nitrous oxide) in nature keep the Earth's temperature an estimated 60 degrees F warmer than it would otherwise be – sustaining life as we know it.
- ◇ Human activities are dramatically increasing the build-up of these gases in the atmosphere. Since the beginning of the Industrial Revolution, CO₂ concentrations have increased 30 percent, methane levels have doubled, and nitrous oxide concentrations are up by 15 percent.
- ◇ Since 1900, average global temperature has increased 0.5 - 1.0 degree F. Eleven of the warmest years on record have occurred since 1979, with 1995 being the warmest ever. Sea level has risen 4-10 inches. (Source: IPCC, 1995) Total precipitation in the U.S. is up 6 percent, while extreme precipitation events (> 2 inches a day) have increased 20 percent. (Source: NOAA)
- ◇ The natural variability of the climate system makes it difficult to separate the contribution of human activity to these changes. Nevertheless, the international scientific consensus as reflected by the Intergovernmental Panel on Climate Change (which includes the work of more than 2,000 scientists from more than 60 countries) is that, "the balance of evidence suggests a discernible human influence on global climate."
- ◇ Current projections show that absent controls on carbon dioxide emissions, atmospheric concentrations of this greenhouse gas will more than double from today's levels (to 750 parts per million) by 2100. This is predicted to warm the planet an additional 2.0 - 6.5 degrees F – a faster rate of warming than any observed in the past 10,000 years. (Source: IPCC, 1995)
- ◇ While many uncertainties remain in our understanding of the complexities of the climate system, it is clear that warming of this magnitude will have serious consequences. Sea level rise; greater intensity and frequency of floods and droughts; human health problems; shifts in agricultural patterns; and the disappearance of many natural ecosystems are among the predicted effects. (Source: IPCC, 1995)



THE U.S. POSITION ON CLIMATE CHANGE

- ◇ The Clinton Administration is convinced that further steps are required to address climate change and supports efforts to reach a comprehensive and cost-effective international treaty this December at the Third Conference of the Parties to the Framework Convention on Climate Change in Kyoto, Japan.
- ◇ This view is based on two key points. First, the scientific evidence indicates that human actions are changing the climate system, and that unless greenhouse gas emissions are reduced, such changes threaten unacceptable impacts on the United States and the world. Second, international efforts to date have not proved effective in dealing with the problem.
- ◇ The U.S. has proposed a three-part framework for a more effective international agreement:
 1. **Binding emissions targets for developed nations.** Almost all developed countries, including the United States, will fall short of the non-binding aim in the current Climate Convention, which calls on nations to reduce emissions to 1990 levels by 2000. Shifting to a medium-term, binding, realistic, and achievable target should spur greater commitment and action by countries to limit greenhouse gas emissions.
 2. **Flexibility to achieve cost-effective reductions.** The U.S. proposal calls for emissions trading and joint implementation. As it makes no environmental difference where emissions reductions are achieved, these proposals aim to allow the greatest reductions to be gained at the least cost. The U.S. has also called for multi-year emissions targets and the possibility of banking and borrowing emissions from one period to the next.
 3. **Participation of developing countries.** Based on the principle of “common but differentiated responsibilities” contained in the Climate Convention (signed by President Bush and ratified by the Senate), the U.S. has proposed a comprehensive package of elements on developing country commitments. In the near term, all would be required to take specific actions to mitigate their emissions and report on their activities, while the more advanced economies would adopt binding targets (though these targets would be necessarily less stringent than those of developed nations). Lastly, the U.S. has stipulated that *every* developing country agree to negotiate binding targets by 2005.
- ◇ In putting forward this framework, the U.S. has rejected proposals by some for what we believe to be unrealistic near-term cuts in emissions. These include a proposal from the Association of Small Island States for a 20 percent reduction below 1990 levels by 2005 and a proposal from the European Union for a 15 percent reduction below 1990 levels by 2010.
- ◇ The Administration expects to have specific proposals for emissions cuts, as well as other initiatives, as appropriate, to present in time for the Kyoto Conference.

CLIMATE CHANGE TIMELINE

- 1896** -- Arrhenius, a Swedish chemist, first advances the notion that CO₂ emissions from the burning of coal would enhance the greenhouse effect and warm the planet.
- 1967** -- The first reliable computer model predicts an increase of 4 degrees F in global average temperature when CO₂ concentrations double from pre-industrial times.
- 1987** -- Analysis of an Antarctic ice core reveals an extremely close correlation between CO₂ concentrations and temperature going back over 100,000 years.
- 1988** -- The Intergovernmental Panel on Climate Change (IPCC) is formed to bring together the world's best climate scientists to assess, and advise the world's governments on, the state of technical and scientific knowledge on climate change.
- 1992** -- 155 nations sign the UN Framework Convention on Climate Change (FCCC) which calls on developed nations to reduce emissions to 1990 levels by 2000 and which recognizes the "common but differentiated responsibilities" of all Parties.
- The U.S. Senate ratifies the Convention later in the year.
- 1995** -- The Berlin Mandate is adopted at the First Conference of the Parties to the FCCC.
- The IPCC releases its Second Assessment Report concluding that the "balance of evidence suggests a discernible human influence on global climate."
- The year 1995 is determined to be the hottest ever recorded.
- 1996** -- The Geneva Declaration, affirming the latest science and calling on developed countries to accept binding emissions limits, is adopted at the Second Conference of the Parties to the FCCC.
- 1997** -- The U.S. submits its framework proposal for a new international agreement, emphasizing binding limits, flexibility, and global participation.
- Over 2,000 economists, including 6 Nobel Laureates, conclude that climate change is a serious problem justifying preventive steps and state that, "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 longer run."
- The nations of the world gather in Kyoto for the Third Conference of the Parties to the FCCC in hopes of reaching a new agreement on post-2000 emissions reductions.

CLIMATE CHANGE: WHO'S SAYING WHAT

"The balance of evidence suggests a discernible human influence on global climate."

-- Report of the Intergovernmental Panel on Climate Change, Summary for Policymakers, 1995.

"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." -- Scientists' Statement on Global Climatic Disruption, June 1997.

"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." -- Ecologists' Statement on the Consequences of Rapid Climatic Change, May 1997.

"As economists, we believe that global climate change carries with it significant environmental, economic, social, and geopolitical risks, and that preventive steps are justified. Economic studies have found that there are many potential policies to reduce greenhouse-gas emissions for which the total benefits outweigh the total costs. 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 longer run." -- Economists' Statement on Climate Change, January 1997.

"Based on the current status of climate research and on their experience as insurers and reinsurers, the member companies of the UNEP-Insurance Industry Initiative conclude that ... Man made climate change will lead to shifts in atmospheric and ocean circulation patterns. This will probably increase the likelihood of extreme weather events in certain areas. Such effects carry the risk of dramatically increased property damage, with serious implications for property insurers and reinsurers... We are convinced that in dealing with climate change risks, it is important to recognize the precautionary principle, in that it is not possible to quantify anticipated economic and social impacts of climate change fully before taking action. Research is needed to reduce uncertainty but cannot eliminate it entirely... We insist that in accordance with the precautionary principle, the negotiations for the Framework Convention on Climate Change must achieve early, substantial reductions in greenhouse gas emissions."

-- UNEP Insurance Initiative, Statement of Environmental Commitment by the Insurance Industry, Position Paper on Climate Change, July 1996.

Summary for Policymakers

Considerable progress has been made in the understanding of climate change¹ science since 1990 and new data and analyses have become available.

Greenhouse gas concentrations have continued to increase

Increases in greenhouse gas concentrations since pre-industrial times (i.e., since about 1750) have led to a positive *radiative forcing*² of climate, tending to warm the surface and to produce other changes of climate.

- The atmospheric concentrations of greenhouse gases, *inter alia* carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O) have grown significantly: by about 30%, 145% and 15% respectively (values for 1992). These trends can be attributed largely to human activities, mostly fossil fuel use, land-use change and agriculture.
- The growth rates of CO₂, CH₄ and N₂O concentrations were low during the early 1990s. While this apparently natural variation is not yet fully explained, recent data indicate that the growth rates are currently comparable to those averaged over the 1980s.
- The direct radiative forcing of the long-lived greenhouse gases (2.45 Wm⁻²) is due primarily to increases in the concentrations of CO₂ (1.56 Wm⁻²), CH₄ (0.47 Wm⁻²) and N₂O (0.14 Wm⁻²) (values for 1992).
- Many greenhouse gases remain in the atmosphere for a long time (for CO₂ and N₂O, many decades to centuries), hence they affect radiative forcing on long time-scales.
- The direct radiative forcing due to the CFCs and HCFCs combined is 0.25 Wm⁻². However, their *net* radiative forcing is reduced by about 0.1 Wm⁻² because they have caused stratospheric ozone depletion which gives rise to a negative radiative forcing.
- Growth in the concentration of CFCs, but not HCFCs, has slowed to about zero. The concentrations of both CFCs and HCFCs, and their consequent ozone depletion, are expected to decrease substantially by 2050 through implementation of the Montreal Protocol and its Adjustments and Amendments.
- At present some long-lived greenhouse gases (particularly HFCs (a CFC substitute), PFCs and SF₆) contribute little to radiative forcing but their projected growth could contribute several per cent to radiative forcing during the 21st century.
- If carbon dioxide emissions were maintained at near current (1994) levels, they would lead to a nearly constant rate of increase in atmospheric concentrations for at least two centuries, reaching about 500 ppmv (approaching twice the pre-industrial concentration of 280 ppmv) by the end of the 21st century.

¹ Climate change in IPCC Working Group I usage refers to any change in climate over time whether due to natural variability or as a result of human activity. This differs from the usage in the Framework Convention on Climate Change where climate change refers to a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.

² A simple measure of the importance of a potential climate change mechanism. Radiative forcing is the perturbation to the energy balance of the Earth-atmosphere system (in watts per square metre [Wm⁻²]).

- A range of carbon cycle models indicates that stabilisation of atmospheric CO₂ concentrations at 450, 650 or 1000 ppmv could be achieved only if global anthropogenic CO₂ emissions drop to 1990 levels by, respectively, approximately 40, 140 or 240 years from now, and drop substantially below 1990 levels subsequently.
- Any eventual stabilised concentration is governed more by the accumulated anthropogenic CO₂ emissions from now until the time of stabilisation, than by the way those emissions change over the period. This means that, for a given stabilised concentration value, higher emissions in early decades require lower emissions later on. Among the range of stabilisation cases studied, for stabilisation at 450, 650 or 1000 ppmv accumulated anthropogenic emissions over the period 1991 to 2100 are 630 GtC¹, 1030 GtC, and 1410 GtC respectively ($\pm$ approximately 15% in each case). For comparison the corresponding accumulated emissions for IPCC IS92 emission scenarios range from 770 to 2190 GtC.
- Stabilisation of CH₄ and N₂O concentrations at today's levels would involve reductions in anthropogenic emissions of 8% and more than 50% respectively.
- There is evidence that tropospheric ozone concentrations in the Northern Hemisphere have increased since pre-industrial times because of human activity and that this has resulted in a positive radiative forcing. This forcing is not yet well characterised, but it is estimated to be about 0.4 Wm⁻² (15% of that from the long-lived greenhouse gases). However the observations of the most recent decade show that the upward trend has slowed significantly or stopped.

Anthropogenic aerosols tend to produce negative radiative forcings

- Tropospheric aerosols (microscopic airborne particles) resulting from combustion of fossil fuels, biomass burning and other sources have led to a negative direct forcing of about 0.5 Wm⁻², as a global average, and possibly also to a negative indirect forcing of a similar magnitude. While the negative forcing is focused in particular regions and subcontinental areas, it can have continental to hemispheric scale effects on climate patterns.
- Locally, the aerosol forcing can be large enough to more than offset the positive forcing due to greenhouse gases.
- In contrast to the long-lived greenhouse gases, anthropogenic aerosols are very short-lived in the atmosphere, hence their radiative forcing adjusts rapidly to increases or decreases in emissions.

Climate has changed over the past century

At any one location year-to-year variations in weather can be large, but analyses of meteorological and other data over large areas and over periods of decades or more have provided evidence for some important systematic changes.

- Global mean surface air temperature has increased by between about 0.3 and 0.6°C since the late 19th century; the additional data available since 1990 and the re-analyses since then have not significantly changed this range of estimated increase.
- Recent years have been among the warmest since 1860, i.e., in the period of instrumental record, despite the cooling effect of the 1991 Mt. Pinatubo volcanic eruption.

¹ 1 GtC = 1 billion (10⁹) tonnes of carbon.

- Night-time temperatures over land have generally increased more than daytime temperatures.
- Regional changes are also evident. For example, the recent warming has been greatest over the mid-latitude continents in winter and spring, with a few areas of cooling, such as the North Atlantic Ocean. Precipitation has increased over land in high latitudes of the Northern Hemisphere, especially during the cold season.
- Global sea level has risen by between 10 and 25 cm over the past 100 years and much of the rise may be related to the increase in global mean temperature.
- There are inadequate data to determine whether consistent global changes in climate variability or weather extremes have occurred over the 20th century. On regional scales there is clear evidence of changes in some extremes and climate variability indicators (e.g., fewer frosts in several widespread areas; an increase in the proportion of rainfall from extreme events over the contiguous states of the USA). Some of these changes have been toward greater variability; some have been toward lower variability.
- The 1990 to mid-1995 persistent warm-phase of the El Niño-Southern Oscillation (which causes droughts and floods in many areas) was unusual in the context of the last 120 years.

The balance of evidence suggests a discernible human influence on global climate

Any human-induced effect on climate will be superimposed on the background “noise” of natural climate variability, which results both from internal fluctuations and from external causes such as solar variability or volcanic eruptions. Detection and attribution studies attempt to distinguish between anthropogenic and natural influences. “Detection of change” is the process of demonstrating that an observed change in climate is highly unusual in a statistical sense, but does not provide a reason for the change. “Attribution” is the process of establishing cause and effect relations, including the testing of competing hypotheses.

Since the 1990 IPCC Report, considerable progress has been made in attempts to distinguish between natural and anthropogenic influences on climate. This progress has been achieved by including effects of sulphate aerosols in addition to greenhouse gases, thus leading to more realistic estimates of human-induced radiative forcing. These have then been used in climate models to provide more complete simulations of the human-induced climate-change “signal”. In addition, new simulations with coupled atmosphere-ocean models have provided important information about decade to century time-scale natural internal climate variability. A further major area of progress is the shift of focus from studies of global-mean changes to comparisons of modelled and observed spatial and temporal patterns of climate change.

The most important results related to the issues of detection and attribution are:

- The limited available evidence from proxy climate indicators suggests that the 20th century global mean temperature is at least as warm as any other century since at least 1400 AD. Data prior to 1400 are too sparse to allow the reliable estimation of global mean temperature.
- Assessments of the statistical significance of the observed global mean surface air temperature trend over the last century have used a variety of new estimates of natural internal and externally forced variability. These are derived from instrumental data, palaeodata, simple and complex climate models, and statistical models fitted to observations. Most of these studies have detected a significant change and show that the observed warming trend is unlikely to be entirely natural in origin.

- More convincing recent evidence for the attribution of a human effect on climate is emerging from pattern-based studies, in which the modelled climate response to combined forcing by greenhouse gases and anthropogenic sulphate aerosols is compared with observed geographical, seasonal and vertical patterns of atmospheric temperature change. These studies show that such pattern correspondences increase with time, as one would expect as an anthropogenic signal increases in strength. Furthermore, the probability is very low that these correspondences could occur by chance as a result of natural internal variability only. The vertical patterns of change are also inconsistent with those expected for solar and volcanic forcing.
- 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 natural variability and the time-evolving pattern of forcing by, and response to, changes in concentrations of greenhouse gases and aerosols, and land surface changes. Nevertheless, the balance of evidence suggests that there is a discernible human influence on global climate.

Climate is expected to continue to change in the future

The IPCC has developed a range of scenarios, IS92a-f, of future greenhouse gas and aerosol precursor emissions based on assumptions concerning population and economic growth, land-use, technological changes, energy availability and fuel mix during the period 1990 to 2100. Through understanding of the global carbon cycle and of atmospheric chemistry, these emissions can be used to project atmospheric concentrations of greenhouse gases and aerosols and the perturbation of natural radiative forcing. Climate models can then be used to develop projections of future climate.

- The increasing realism of simulations of current and past climate by coupled atmosphere-ocean climate models has increased our confidence in their use for projection of future climate change. Important uncertainties remain, but these have been taken into account in the full range of projections of global mean temperature and sea level change.
- For the mid-range IPCC emission scenario, IS92a, assuming the "best estimate" value of climate sensitivity¹ and including the effects of future increases in aerosol, models project an increase in global mean surface air temperature relative to 1990 of about 2°C by 2100. This estimate is approximately one third lower than the "best estimate" in 1990. This is due primarily to lower emission scenarios (particularly for CO₂ and the CFCs), the inclusion of the cooling effect of sulphate aerosols, and improvements in the treatment of the carbon cycle. Combining the lowest IPCC emission scenario (IS92c) with a "low" value of climate sensitivity and including the effects of future changes in aerosol concentrations leads to a projected increase of about 1°C by 2100. The corresponding projection for the highest IPCC scenario (IS92e) combined with a "high" value of climate sensitivity gives a warming of about 3.5°C. In all cases the average rate of warming would probably be greater than any seen in the last 10,000 years, but the actual annual to decadal changes would include considerable natural variability. Regional temperature changes could differ substantially from the global mean value. Because of the thermal inertia of the oceans, only 50-90% of the eventual equilibrium temperature change would have been realised by 2100 and temperature would continue to increase beyond 2100, even if concentrations of greenhouse gases were stabilised by that time.

¹ In IPCC reports, climate sensitivity usually refers to the long term (equilibrium) change in global mean surface temperature following a doubling of atmospheric equivalent CO₂ concentration. More generally, it refers to the equilibrium change in surface air temperature following a unit change in radiative forcing (C/Wm⁻²).

- Average sea level is expected to rise as a result of thermal expansion of the oceans and melting of glaciers and ice-sheets. For the IS92a scenario, assuming the "best estimate" values of climate sensitivity and of ice melt sensitivity to warming, and including the effects of future changes in aerosol, models project an increase in sea level of about 50 cm from the present to 2100. This estimate is approximately 25% lower than the "best estimate" in 1990 due to the lower temperature projection, but also reflecting improvements in the climate and ice melt models. Combining the lowest emission scenario (IS92c) with the "low" climate and ice melt sensitivities and including aerosol effects gives a projected sea level rise of about 15 cm from the present to 2100. The corresponding projection for the highest emission scenario (IS92e) combined with "high" climate and ice-melt sensitivities gives a sea level rise of about 95 cm from the present to 2100. Sea level would continue to rise at a similar rate in future centuries beyond 2100, even if concentrations of greenhouse gases were stabilised by that time, and would continue to do so even beyond the time of stabilisation of global mean temperature. Regional sea level changes may differ from the global mean value owing to land movement and ocean current changes.
- Confidence is higher in the hemispheric-to-continental scale projections of coupled atmosphere-ocean climate models than in the regional projections, where confidence remains low. There is more confidence in temperature projections than hydrological changes.
- All model simulations, whether they were forced with increased concentrations of greenhouse gases and aerosols or with increased concentrations of greenhouse gases alone, show the following features: greater surface warming of the land than of the sea in winter; a maximum surface warming in high northern latitudes in winter, little surface warming over the Arctic in summer; an enhanced global mean hydrological cycle, and increased precipitation and soil moisture in high latitudes in winter. All these changes are associated with identifiable physical mechanisms.
- In addition, most simulations show a reduction in the strength of the North Atlantic thermohaline circulation and a widespread reduction in diurnal range of temperature. These features too can be explained in terms of identifiable physical mechanisms.
- The direct and indirect effects of anthropogenic aerosols have an important effect on the projections. Generally, the magnitudes of the temperature and precipitation changes are smaller when aerosol effects are represented, especially in northern mid-latitudes. Note that the cooling effect of aerosols is not a simple offset to the warming effect of greenhouse gases, but significantly affects some of the continental scale patterns of climate change, most noticeably in the summer hemisphere. For example, models that consider only the effects of greenhouse gases generally project an increase in precipitation and soil moisture in the Asian summer monsoon region, whereas models that include, in addition, some of the effects of aerosols suggest that monsoon precipitation may decrease. The spatial and temporal distribution of aerosols greatly influence regional projections, which are therefore more uncertain.
- A general warming is expected to lead to an increase in the occurrence of extremely hot days and a decrease in the occurrence of extremely cold days.
- Warmer temperatures will lead to a more vigorous hydrological cycle; this translates into prospects for more severe droughts and/or floods in some places and less severe droughts and/or floods in other places. Several models indicate an increase in precipitation intensity, suggesting a possibility for more extreme rainfall events. Knowledge is currently insufficient to say whether there will be any changes in the occurrence or geographical distribution of severe storms, e.g., tropical cyclones.

- Sustained rapid climate change could shift the competitive balance among species and even lead to forest dieback, altering the terrestrial uptake and release of carbon. The magnitude is uncertain, but could be between zero and 200 GtC over the next one to two centuries, depending on the rate of climate change.

There are still many uncertainties

Many factors currently limit our ability to project and detect future climate change. In particular, to reduce uncertainties further work is needed on the following priority topics:

- estimation of future emissions and biogeochemical cycling (including sources and sinks) of greenhouse gases, aerosols and aerosol precursors and projections of future concentrations and radiative properties;
- representation of climate processes in models, especially feedbacks associated with clouds, oceans, sea ice and vegetation, in order to improve projections of rates and regional patterns of climate change;
- systematic collection of long-term instrumental and proxy observations of climate system variables (e.g., solar output, atmospheric energy balance components, hydrological cycles, ocean characteristics and ecosystem changes) for the purposes of model testing, assessment of temporal and regional variability and for detection and attribution studies.

Future unexpected, large and rapid climate system changes (as have occurred in the past) are, by their nature, difficult to predict. This implies that future climate changes may also involve "surprises". In particular these arise from the non-linear nature of the climate system. When rapidly forced, non-linear systems are especially subject to unexpected behaviour. Progress can be made by investigating non-linear processes and sub-components of the climatic system. Examples of such non-linear behaviour include rapid circulation changes in the North Atlantic and feedbacks associated with terrestrial ecosystem changes.

Global Climatic Disruption

SCIENTISTS' STATEMENT ON GLOBAL CLIMATIC DISRUPTION

June 1997

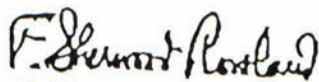
We are scientists who are familiar with the causes and effects of climatic change as summarized recently by the Intergovernmental Panel on Climate Change (IPCC). We endorse those reports and observe that the further accumulation of greenhouse gases commits the earth irreversibly to further global climatic 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 2100. 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 appropriate to assume there will be effects not now anticipated.

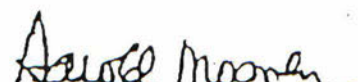
Our familiarity with the scale, severity, and costs to human welfare of the disruptions that the climatic changes threaten leads us to introduce this note of urgency and to call for early domestic action to reduce U.S. emissions via the most cost-effective means. We encourage other nations to join in 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.

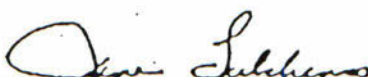
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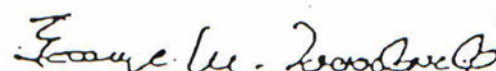

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HAROLD A. MOONEY
PAUL S. ACHILLE PROFESSOR
OF BIOLOGY

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.

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ECONOMISTS' STATEMENT ON CLIMATE CHANGE

*Endorsed by Over 2000 Economists
including six Nobel Laureates*

I. The review conducted by a distinguished international panel of scientists under the auspices of the Intergovernmental Panel on Climate Change has determined that "the balance of evidence suggests a discernible human influence on global climate." As economists, we believe that global climate change carries with it significant environmental, economic, social, and geopolitical risks, and that preventive steps are justified.

II. Economic studies have found that there are many potential policies to reduce greenhouse-gas emissions for which the total benefits outweigh the total costs. 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 longer run.

III. The most efficient approach to slowing climate change is through market-based policies. In order for the world to achieve its climatic objectives at minimum cost, a cooperative approach among nations is required—such as an international emissions trading agreement. The United States and other nations can most efficiently implement their climate policies through market mechanisms, such as carbon taxes or the auction of emissions permits. The revenues generated from such policies can effectively be used to reduce the deficit or to lower existing taxes.

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Statement of Environmental Commitment by the Insurance Industry

Preamble

The insurance industry recognizes that economic development needs to be compatible with human welfare and a healthy environment. To ignore this is to risk increasing social, environmental and financial costs. Our Industry plays an important role in managing and reducing environmental risk, in conjunction with governments, individuals and organizations. We are committed to work together to address key issues such as pollution reduction, the efficient use of resources, and climate change. We endeavour to identify realistic, sustainable solutions.

1. General Principles of Sustainable Development

1.1 We regard sustainable development, defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs, as a fundamental aspect of sound business management.

1.2 We believe that sustainable development is best achieved by allowing markets to work within an appropriate framework of cost efficient regulations and economic instruments. Government has a leadership role in establishing and enforcing long term priorities and values.

1.3 We regard a strong, proactive insurance industry as an important contributor to sustainable development, through its interaction with other economic sectors and consumers.

1.4 We believe that the existing skills and techniques of our industry in understanding uncertainty, identifying and quantifying risk, and responding to risk, are core strengths in managing environmental problems.

1.5 We recognize the precautionary principle, in that it is not possible to quantify some concerns sufficiently, nor indeed to reconcile all impacts in purely financial terms. Research is needed to reduce uncertainty but cannot eliminate it entirely.

2. Environmental Management

2.1 We will reinforce the attention given to environmental risks in our core activities. These activities include risk management, loss prevention, product design, claims handling and asset management.

2.2 We are committed to manage internal operations and physical assets under our control in a manner that reflects environmental considerations.

2.3 We will periodically review our management practices, to integrate relevant developments of environmental management in our planning, marketing, employee communications and training as well as our other core activities.

2.4 We encourage research in these and related issues. Responses to environmental issues can vary in effectiveness and cost. We encourage research that identifies creative and effective solutions.

2.5 We support insurance products and services that promote sound environmental practice through measures such as loss prevention and contract terms and conditions. While satisfying requirements for security and profitability, we will seek to include environmental considerations in our asset management.

2.6 We will conduct regular internal environmental reviews, and will seek to create measurable environmental goals and standards.

2.7 We shall comply with all applicable local, national and international environmental regulations. Beyond compliance, we will strive to develop and adopt best practices in environmental management. We will support our clients, partners and suppliers to do likewise.

3. Public Awareness and Communications

3.1 Bearing in mind commercial confidence, we are committed to share relevant information with our stakeholders, including clients, intermediaries, shareholders, employees and regulators. By doing so we will improve society's response to environmental challenges.

3.2 Through dialogue with public authorities and other bodies we aim to contribute to the creation of a more effective framework for sustainable development.

3.3 We will work with the United Nations Environment Programme to further the principles and goals of this Statement, and look for UNEP's active support.

3.4 We will encourage other insurance institutions to support this Statement. We are committed to share with them our experiences and knowledge in order to extend best practices.

3.5 We will actively communicate our environmental activities to the public, review the success of this Statement periodically, and we expect all signatories to make real progress.

Steering Committee for the UNEP Insurance Industry Initiative:

General Accident, Perth, United Kingdom.

Gerling-Konzern Globale, Cologne, Germany.

N.P.I., London, United Kingdom.

Swiss Re, Zurich, Switzerland.

Sumitomo Marine & Fire, Tokyo, Japan.

Uni Storebrand, Oslo, Norway.

United Nations Environment Programme, Geneva, Switzerland.

UNEP INSURANCE INITIATIVE
POSITION PAPER ON CLIMATE CHANGE - 9TH JULY 1996

(1) PREAMBLE

1.1 The property insurance industry is the financial sector most likely to be directly affected by climate change, since it is vulnerable to variability in the frequency and severity of extreme weather events. Life insurance and pension fund investment portfolios are also likely to be affected.

1.2 The cost of such events could escalate dramatically as a consequence of the increased greenhouse effect due to human activities. The resultant climate change may alter the frequency and/or severity of extreme weather events and/or their regional distribution. The exact influence is not yet known, due to the limitations of today's understanding of the climate system. It is clear, though, that even small shifts of regional climate zones and/or storm patterns carry the potential of increased property damage, exacerbated by inadequate planning and construction in certain areas.

1.3 The implication of climate change for other lines of insurance cannot be assessed with confidence but cannot be ignored. Changes in human health (e.g. spreading of diseases) may affect the life assurance and pension industries. Returns on long-term investments and capital projects may be affected by mitigation measures that alter the economics of whole industries - for example, shifting from carbon fuels to renewable sources. The economics of selected regions, such as coastal zones and islands, may be disadvantaged.

1.4 Through its experience in managing the risk of natural catastrophes, the insurance sector can help to improve the response to property damage from extreme events by co-operating with the relevant authorities.

1.5 It is anticipated that structural changes in energy-intensive industries in response to measures to control greenhouse gas emissions will result in opportunities and challenges for the investment community, including for example alternative energy, efficiency programmes, and public transit systems. However, without political initiatives, market forces alone may not result in the efficient use of investment potential.

(2) CONCLUSIONS

2.1 Based on the current status of climate research and on their experience as insurers and reinsurers, the member companies of the UNEP-Insurance Industry Initiative conclude that:

2.1.1 Human activity is already affecting climate on a global scale, e.g. through the enhanced greenhouse effect. According to IPCC "the balance of evidence suggests a discernable human influence on global climate"

2.1.2 Man made climate change will lead to shifts in atmospheric and oceanic circulation patterns. This will probably increase the likelihood of extreme weather events in certain areas. Such effects carry the risk of

dramatically increased property damage, with serious implications for property insurers and reinsurers.

2.1.3 Potentially there could be large implications for investment activities as society plans for, and adapts to, the new climate regime.

2.2 We are convinced that:

2.2.1 In dealing with climate change risks it is important to recognize the precautionary principle, in that it is not possible to quantify anticipated economic and social impacts of climate change fully before taking action. Research is needed to reduce uncertainty but cannot eliminate it entirely.

2.2.2 In the case of climate change risks, the most efficient precautionary measure is a substantial reduction of greenhouse gas emissions with respect to a 'business as usual' scenario of greenhouse gas emissions.

2.2.3 The problem of climate change can be counteracted only by the joint efforts of governments, political and social institutions, industrial and commercial enterprise [including insurers and reinsurers], and of all individuals. This requires an enhanced level of public discussion and international political agreement.

2.3 We insist that:

2.3.1 In accordance with the precautionary principle, the negotiations for the Framework Convention on Climate Change must achieve early, substantial reductions in greenhouse gas emissions.

2.3.2 The Framework Convention on Climate Change should urgently try to establish what concentration level and rate of increase of greenhouse gases is likely to be "dangerous", through further scientific research.

2.3.3 Mechanisms be created for direct inputs of NGOs [including business NGOs] to the negotiations, and for communicating the issues and decisions to all stakeholders.

2.3.4 The position of the insurance and reinsurance sector be represented when discussing or negotiating possible solutions.

2.3.5 A transparent framework of political, social and economic measures be established to promote sustainable development, taking into account the risks of climate change, and considerations of equity between emerging, transitional and mature economies, and over time.

This paper has been discussed and approved for publication by the members of the UNEP Insurance Industry Initiative as a contribution to the climate change debate. It does not claim to represent a unanimous view of UNEP I.I.I. members, nor does it in any way represent a UNEP position.

Status of the UNEP Statement of Environmental Commitment
by the Insurance Industry

30th October 1996

1. - Aachener Rückversicherungs, Germany
2. - Aachener und Münchener Versicherung, Germany
3. - AEGIS Insurance Company Ltd., South Africa
4. - Bangkok Insurance Public Company Limited, Thailand
5. - Basler Versicherungs-Gesellschaft, Switzerland
6. - Bayerische Beamten Versicherung AG, Germany
7. - CIGNA Insurance Company, Japan
8. - Daiichi Mutual Fire and Marine Insurance Company, Japan
9. - Delvag Luftfahrtversicherungs-AG, Germany
10. - Dominion of Canada General Insurance Company, Canada
11. - Elvia Versicherungen, Switzerland
12. - Employers Reinsurance Corporation, United States of America
13. - Folksam, Sweden
14. - La Fondiaria Assicurazioni S.p.A., Italy
15. - General Accident and Life Assurance Corporation, United Kingdom
16. - Gerling-Konzern, Germany
17. - Grupo Fortuna SA, Argentina
18. - Helvetia Patria Versicherungen, Switzerland
19. - Hyundai Marine and Fire Insurance Co.Ltd., South Korea
20. - Imperio S.A., Portugal
21. - Independent Insurance Company Ltd., United Kingdom
22. - Iron Trades Insurance Group, United Kingdom
23. - Istituto Nazionale delle Assicurazioni, Italy
24. - Ji Accident & Fire Insurance Co. Ltd., Japan
25. - Landesschadenhilfe Versicherung VaG, Germany
26. - Mannheimer Versicherungen, Germany
27. - MUSINI, Spain
28. - National Corporation of Tanzania Ltd., Tanzania
29. - National Insurance, New Zealand
30. - National Provident Institutions, United Kingdom
31. - NatWest Insurance Services, United Kingdom
32. - Nürnberger Allgemeine Versicherungen, Germany
33. - Overseas Union Insurance Limited, Singapore
34. - QBE Insurance Group Ltd., Australia
35. - Rentenanstalt/ Swiss Life, Switzerland
36. - Rheinland Versicherungen, Germany
37. - Riunione Adriatica di Sicurtà, Italy
38. - R&V Versicherungsgruppe, Germany
39. - Schweizerische Mobiliar, Switzerland
40. - Sibrosso Insurance Co., Russia
41. - Skandia Insurance Company Ltd., Sweden
42. - Sovereign Assurance, New Zealand
43. - Stuttgarter Allgemeine Versicherung, Germany
44. - Stuttgarter Lebensversicherung AG, Germany
45. - Sumitomo Marine & Fire Insurance Co., Japan
46. - Sumitomo Marine & Fire Insurance Co.(Europe)Ltd, United Kingdom
47. - Sumitomo Marine & Pool Insurance, Indonesia

- 48. - Sumitomo Property & Casualty insurance Co.(Hong Kong) Ltd, Hong Kong
- 49. - Swiss-Reinsurance Company, Switzerland
- 50. - Swiss Union General Insurance Company, Switzerland
- 51. - Trygg-Hansa, Sweden
- 52. - Uni Storebrand, Norway
- 53. - Vaudoise Generale Compagnie d'Assurances, Switzerland
- 54. - Vereinte Versicherung AG, Germany
- 55. - Volksfürsorge Holding AG, Germany
- 56. - WASA Försäkring, Sweden
- 57. - Wiener Städtische Allgemeine, Austria
- 58. - Winterthur Versicherungen, Switzerland
- 59. - Württembergische Versicherung AG, Germany
- 60. - Yasuda Fire and Marine Insurance Co.Ltd., Japan
- 61. - Zurich Insurance Company, Switzerland

Climate Change Charges and Responses

A. Science

1. Claim that the climate is not changing
2. Claim that any climate changes are natural
3. Claim on the lack of scientific consensus
4. Claim that the uncertainty is too great to act
5. Claim that the climate models are inaccurate
6. Claim on misinterpretation of the IPCC
7. Claim on the validity of the IPCC
8. Claim on satellite vs. surface temperature readings
9. Claim that climate changes will be positive
10. Claim that we should simply adapt to climate change

B. Economics

1. Claim on insufficient economic analysis
2. Claim that any response will cost too much
3. Claim that Clinton plans will devastate the economy
4. Claim on American jobs moving overseas
5. Claim on economic impacts on the poor
6. Claim that massive long-term reductions are in store
7. Claim on new taxes
8. Claim that voluntary efforts are sufficient
9. Claim on the Argonne Lab study
10. Claim that emissions trading & JI are not realistic

C. Developing countries

1. Claim that developing countries are exempt
2. Claim that China/India should take equal steps to ours
3. Claim on the meaning of the Byrd Resolution
4. Claim on problems with the Berlin Mandate

D. Other

1. Claim that current actions are too little, too late
2. Claim that the policy is already decided
3. Claim on loss of sovereignty
4. Claim that the President is not serious
5. Claim on the European Union position

CLAIM THAT THE CLIMATE IS NOT CHANGING

CHARGE: *The climate has not warmed as many have claimed and as dire global warming theories would predict.*

FACT: **The climate is changing, and the effects can be felt here in the U.S.**

- In this century:
 - ⇒ **Surface temperature** is as warm or warmer than in any century since 1400 AD. (Source: IPCC, 1995)
 - ⇒ **Global average temperature** has risen by almost 1 degree F. (Source: IPCC, 1995)
 - ⇒ **Sea level** has risen 4-10 inches. (Source: IPCC, 1995)
 - ⇒ **Mountain glaciers** around the world are melting. For example, Glacier National Park has lost 70 percent of its glacial area since 1900.
 - ⇒ **In the U.S., total precipitation** has increased by 6 percent, while **intense precipitation events** (over 2 inches in a day) have increased by about 20 percent. (Source: NOAA)
- The last few decades have been the warmest this century. (Source: IPCC, 1995)
- The ten warmest years since 1900 have all occurred since 1980, with **1995 being the warmest year ever on record.** (Source: IPCC, 1995)
- From 1981 to 1991, high latitudes (between 45 and 70 degrees North) sustained a longer growing season, and an advance of up to seven days in “greening” in spring and summer. (Source: *Nature*, April 17, 1997)

“So I believe in my own mind and heart that something is happening out there. Something is happening. Something is happening to our climate.”

– Senator Robert Byrd, July 25, 1997

CLAIM THAT ANY CLIMATE CHANGES ARE NATURAL

CHARGE: *Any changes in the Earth's climate reflect natural variability, not human actions.*

FACT: **The scientific evidence is clear and compelling that human activity – notably the increasing use of fossil fuels – is altering the makeup of the atmosphere and is the likely culprit behind observed changes in the last century.**

- 2,600 of the world's leading scientists have endorsed the report of the Intergovernmental Panel on Climate Change (IPCC) which concludes, **"the balance of evidence suggests a discernible human influence on climate change."**
- Since 1860, roughly the start of the Industrial Revolution, carbon dioxide concentrations in the atmosphere have increased by 30 percent. Without specific policies to reduce the growth of these emissions, it is estimated that carbon dioxide concentrations will double from today's levels by 2100. This would result in the highest levels of CO₂ in the atmosphere in 50 million years. (Source: IPCC, 1995)
- During the same period, concentrations of other greenhouse gases have also risen substantially. Methane levels have more than doubled while nitrous oxide concentrations have increased by 15 percent. (Source: IPCC, 1995)
- The magnitude, timing, and geographic pattern of recent temperature changes are unlike any ever seen in the natural record and track closely with models projecting the effects of human activities. (Source: IPCC, 1995)

What is the IPCC?

The Intergovernmental Panel on Climate Change (IPCC) was established by the United Nations Environment Programme and the World Meteorological Association in 1988. It relies upon the work of some 2,000 of the world's leading scientific experts from more than 60 countries.

The IPCC is the authoritative scientific and technical body assessing climate change. It synthesizes information on the scientific and technical literature related to all significant components of the issue, provides the scientific underpinnings for understanding global climate change, and functions as the official advisory body to the world's governments on the state of the science.

CLAIM ON THE LACK OF SCIENTIFIC CONSENSUS

CHARGE: *Proponents of climate change theory have their own scientists. Skeptics have theirs. For the average person, there is no detectable consensus that we have a problem.*

FACT: **The scientific consensus that human induced climate change is occurring is overwhelming. Those who disagree represent a tiny fraction of the scientific community.**

- The Intergovernmental Panel on Climate Change (IPCC), the authoritative international scientific body on this subject, has concluded that climate change is occurring, that “the balance of evidence suggests a discernible human influence on global climate,” and that as greenhouse gas concentrations increase in the atmosphere additional, largely disruptive, disturbances are likely.
- In reaching its conclusions, the IPCC relied upon the preparation and review of documents by some 2,000 of the world’s leading experts on climate change and its consequences from some 60 nations.
- Criticism of the IPCC’s work comes from a tiny band of skeptics.
- In many cases, these skeptics are supported by energy industry groups that are opposed to any further action to address climate change.

“There is no debate among any statures scientists of what is happening... The only debate is the rate at which it’s happening... Scientists, by nature, are very conservative... They don’t want to overstate things. In this debate, the skeptics are atypical of the general scientific community. The irony is that when you find scientists who are adamant on any side, they look very curious within the scientific community. But to the general public, they come across as the most knowledgeable and authoritative of all.”

-- Harvard University earth scientist James
McCarthy, *The Washington Post*, 5/25/97

CLAIM THAT THE UNCERTAINTY IS TOO GREAT TO ACT

CHARGE: *Enormous uncertainty exists about the probable level of future warming, and any meaningful action should wait until the science is better understood.*

FACT: **Climate change has been studied perhaps as much as any other environmental problem in history, and, while uncertainties remain, the imperative for action is clear.**

- If we continue on a “business as usual” path for the next century, we can expect an additional rise in temperature of between 2.0-6.5 degrees F. This would represent a faster rate of warming than at any time in the last 10,000 years. (Source: IPCC, 1995) According to the IPCC, the impacts are likely to include:
 - ⇒ **Human health** – increased fatalities from heat stress of the kind that killed 465 in Chicago in 1995 and an expansion of the range of diseases like malaria and dengue fever.
 - ⇒ **Extreme weather** – increased frequency and intensity of floods and droughts.
 - ⇒ **Sea level rise** – a “best guess” estimate of 20 inches by 2100 would inundate 7,000 square miles of the United States, threatening in particular Florida and the Gulf Coast.
 - ⇒ **Agricultural impacts** – regional shifts in food productivity, with decreases in food production in many of the world’s poorest regions.
 - ⇒ **Natural ecosystems** – the climatic zone for certain forest types will shift faster than many species can migrate. The Northeast, for example, may lose its beech trees and sugar maples.
- Uncertainty is also a two-sided coin. More than 2,000 scientists believe that, “Effects of the disruption of climate are sufficiently complicated that it is appropriate to assume there will be effects not now anticipated.” (Source: Scientists Statement on Global Climatic Disruption, June 1997) Considering that CO₂ remains in the atmosphere for long periods, the time to begin taking sensible actions is now.

“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 a part.”

-- John Browne, Group Chief Executive, British Petroleum

CLAIM THAT THE CLIMATE MODELS ARE INACCURATE

CHARGE: *Climate models cannot be trusted to provide accurate predictions of future climate changes. The climate system is simply too complex. These models are no more useful than the economic models which the Administration admits cannot accurately represent the costs of taking action.*

FACT: **Climate models have proved highly accurate in providing insight into how the Earth's climate system works.**

- Climate models are based on fundamental physical and thermodynamic laws. The processes that determine temperature, winds, and pressure, and their distribution over the planet, are quite well understood and, to a large extent, their global scale influences can be represented in the climate models.
- Climate models are largely self-consistent, responsive to changes in physical and chemical parameters (like the carbon dioxide concentration) and effective in giving indications of how the weather and climate will change as a result of human influences.
- Economic models are fundamentally based on rules derived from observed social and economic behavior, which are generally not universal and may change over time.
- When tested against the historical climate record, the most recent general circulation climate models tend to *underestimate* changes, suggesting that predictions of future changes may be conservative rather than overstated, as charged by many skeptics.
- Still, modeling future climate changes as many as 100 years into the future is highly complex, and uncertainties do exist. In the IPCC estimates of climate change by the year 2100, uncertainties in the scenarios of human activities and uncertainties in the responsiveness of the climatic system to changes in atmospheric concentration contributed about equally to the range of predicted temperature increases.
- The U.S. spends about \$1.8 billion annually on global change research. This effort already has and will continue to vastly improve our understanding of climate change and the tools for predicting future climatic responses.

CLAIM ON MISINTERPRETATION OF THE IPCC

CHARGE: *The level of certainty attributed to the conclusions of the Intergovernmental Panel on Climate Change (IPCC) has been overstated. The IPCC has not in fact determined that humans are influencing the climate system.*

FACT: **In the Summary for Policymakers of the IPCC's Second Assessment Report, the scientists clearly conclude that "the balance of evidence suggests a discernible human influence on global climate."**

- While few things in science are absolutely certain, the IPCC suggests that the sum of evidence makes it virtually impossible to conclude that observed warming over the past century is primarily a natural phenomenon. (Source: IPCC, 1995)
- Even more important, the IPCC report concludes that we are only in the early stages of seeing the effects from human-induced warming. As concentrations of greenhouse gases continue to rise in the next century, the resulting disruption of the climate will become more and more noticeable. (Source: IPCC, 1995)

"It would be unfortunate if the current debate over this ultimately transitory issue [the statistical uncertainties in the detection of anthropogenic climate change] should distract from the far more serious problem of the long-term evolution of global warming once the signal has been unequivocally detected above the background noise."

– Klaus Hasselman, *Science*, 9 May 1997

CLAIM ON THE VALIDITY OF THE IPCC

CHARGE: *The IPCC is not the authoritative scientific body it has been made out to be. Many of its key conclusions are the work of selective rewriting that has hidden the range of uncertainty that exists within its ranks.*

FACT: **The overall IPCC report is based on the contributions of over 2,000 of the best scientists in the world. Its conclusions, including the statement suggesting a human influence on climate, reflect the consensus view of the expert scientists in each area of study.**

- The IPCC report translates key scientific conclusions and findings into the best available guidance for policymakers. While the report makes it abundantly clear that many detailed uncertainties remain in the scientific understanding of climate change, the main findings are clearly stated and widely agreed to.
- The IPCC report has been unanimously approved by over 100 governments, each of which asked its best scientists to contribute to and review it.
- Allegations that key parts of the IPCC Second Assessment Report were changed at the last minute to hide scientific uncertainties are entirely unfounded. Modifications and editorial changes were made to the final draft to reduce repetition and clarify the agreed views of the scientists concerned.

CLAIM ON SATELLITE VS. SURFACE TEMPERATURE READINGS

CHARGE: *While surface measurements may in fact show some recent warming, far more accurate satellite measurements reflect a slight cooling over the same period.*

FACT: **While differences exist, both the satellite and surface records indicate that human activities are having a warming influence.**

- Satellite and surface observations measure different aspects of global temperature, and both techniques are influenced by a range of different factors.
- Surface measurements show a clear warming in both the Northern and Southern Hemispheres over the past century. The consistency of these measurements across wide geographic regions eliminates the possibility of their being influenced by urban heat islands or other localized factors.
- At the higher altitudes where the satellites measure, the wide range of temperature fluctuations and the relatively short record make it difficult to separate the human-induced warming trend from normal climate variability. However, when natural variations are taken into account, an underlying global warming trend in the satellite record that is roughly consistent with model predictions is evident.
- While there are very strong indications of the human influence on climate, continued research efforts are needed to further reduce uncertainties and to detect potential surprises that may emerge.

CLAIM THAT CLIMATE CHANGES WILL BE POSITIVE

CHARGE: *If man-made climate changes do occur, they are likely on balance to be positive.*

FACT: **This is entirely incorrect. The projected impacts of increased climate change are overwhelmingly negative, affecting human health, food security, water resources, coastal areas, and natural ecosystems.**

- The impacts of climate change will vary greatly from region to region, and it is difficult today to say with certainty how and when any given region will be affected. Nevertheless, we can make some fairly safe broad predictions.
- Certain regions may experience benefits from climate change. For example, in areas where it is now too cold for agriculture, climate change may lengthen the growing season. Furthermore, increased carbon dioxide concentrations in the atmosphere may stimulate plant growth under certain conditions.
- In most areas, however, the impacts are likely to be highly negative. Consider the United States:
 - ⇒ **In the arid West**, changing precipitation patterns are likely to result in less snow accumulation at higher elevations. The corresponding reduction in summer runoff could have **disastrous impacts on agriculture and urban water supplies**.
 - ⇒ **In the Midwest**, increased heat and generally drier conditions could reduce soil moisture, **threatening agricultural production**.
 - ⇒ **In the Southeast**, rising sea levels could **flood large areas of low-lying coastal wetlands and estuaries**, while further exposing coastal communities to **damage from hurricanes and storm surges**.
 - ⇒ **In the Northeast**, increasing temperatures are predicted to **alter forest composition**, while changing ocean temperatures could force **shifts in traditional fisheries**.

"Global climatic change is probably the single most important issue facing the world today... If we don't do something about the climatic changes on a global level, we will see some changes that will alter the lifestyle of our children and grandchildren." -- Kaj Ahlmann, President, Employers Reinsurance Corp.

CLAIM THAT WE SHOULD SIMPLY ADAPT TO CLIMATE CHANGE

CHARGE: *The best way of coping with climate change is to adapt to it rather than to promote expensive policies which are unlikely to solve the problem anyway.*

FACT: **Some adaptation is inevitable, as even the world's strongest effort cannot avert at least a certain level of human-induced warming. Unchecked global warming, however, has the potential to impose almost unthinkable economic, environmental, and social costs on the United States and the world.**

- Societies everywhere depend on the climates they have known for centuries.
 - ⇒ For example, Africa, India, and China depend entirely on the timing of heavy seasonal rains for their agricultural production.
 - ⇒ Cities and communities around the world, particularly in arid regions, need recurring rains to fill reservoirs, rivers, and groundwater aquifers.
- Predicted climate disruptions could threaten these precipitation patterns, with severe consequences for hundreds of millions of people who depend on them.
- Arguably, the most devastating effects of climate change will occur in the developing world where most countries are ill-equipped to take even basic adaptation measures.
- Responding to natural disasters is a hugely expensive undertaking in the United States. In 1996 alone, five weather-related disasters – from drought in the Southern Plains to flooding in the Pacific Northwest – did an estimated \$16 billion worth of damage. (Source: NOAA) These costs are likely to escalate as climate change brings more extreme weather events and sea level rise.
- Over 2,300 economists, including six Nobel Laureates, have argued that responding to climate change is justified and that sensible measures can be taken that will not negatively affect the U.S. economy and may, over the long run, strengthen it. (Source: 1/97 Economists Statement on Climate Change)

CLAIM ON INSUFFICIENT ECONOMIC ANALYSIS

CHARGE: *The Administration has not done sufficient analysis to understand what a treaty that binds us to specific emissions reductions could mean for the domestic economy.*

FACT: **The Administration has carefully examined a range of economic models and emissions reduction scenarios to look at possible effects on the economy of meaningful actions to address climate change.**

- Our review of the economic literature clearly indicates that there are sensible steps that can be taken to slow climate change without causing damage to the economy. This conclusion has been validated by over 2,300 economists.
(Source: 1/97 Economists Statement on Climate Change)
- The long-term nature and range of variables inherent in economic modeling on climate change make it impossible to reliably estimate the exact costs of tackling the problem. We can come up with a range of economic impacts but not with a precise cost.
- Several broad conclusions are almost universally agreed:
 - ⇒ **flexibility matters** – taking advantage of market-based options such as emissions trading and joint implementation can make an enormous difference in lowering the cost of emissions reductions.
 - ⇒ **technology is vital** – the speed at which new technologies can be developed and deployed that improve energy efficiency and increase reliance on renewable energy sources, will play a major role in determining the costs of needed emissions reductions
 - ⇒ **all countries must participate** – developed and developing countries must both be part of the process if environmental gains are to be achieved, if a level playing field is to be created, and if American competitiveness is to be preserved.
- U.S. climate change policy under President Clinton has consistently emphasized these points.
- Before specific emissions reduction policies are chosen, the President has committed to engaging the American people and listening to a wide range of interests to ensure that the most sensible options are selected.

CLAIM THAT ANY RESPONSE WILL COST TOO MUCH

CHARGE: *Any serious effort to confront climate change would inevitably wreak havoc on the American economy.*

FACT: **More than 2,300 of the nation's top economists, including six Nobel Laureates, disagree emphatically.**

- “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 longer run.” (Source: 1/97 Economists Statement on Climate Change)
- Despite claims to the contrary, taking steps to protect the environment need not jeopardize economic progress. Numerous studies have shown “that there is little to document the view that environmental regulations have had a measurably adverse effect on competitiveness.” [Sources: Jaffe, Peterson, Portney, and Stavins, “Environmental Regulation and International Competitiveness: What Does the Evidence Tell Us?” Resources for the Future, Discussion Paper 94-08; Also see Palmer, Oates, and Portney, “Tightening Environmental Standards: The Benefit-Cost of the No-Cost Paradigm?” *Journal of Economic Perspectives* 9 (1995), 119-132; and Daniel Esty, *Greening the GATT* (Institute for International Economics, 1994).]
- The United States has taken the lead in proposing market-oriented policies to ensure that emissions reductions are achieved as efficiently and cost-effectively as possible. These include the trading of emissions and the opportunity to conduct joint projects with other countries to reduce emissions.
- President Clinton has made it clear that he will not propose specific levels of emissions reductions without ensuring that they can be attained consistent with continued economic prosperity.
- Revitalizing the American economy has been, and will continue to be, the President's top priority. His leadership has brought strong growth, low unemployment and inflation, and millions of new jobs. He is demonstrating on this issue, as he has on many others, that economic growth and environmental protection go best when they go hand in hand.

“I have devoted my passion and the best ideas I could come up with to try to get this country in good shape economically and socially. But I do believe it is folly for us to believe that we can go into the next century without a strategy that says we're going to be responsible and we're going to do our part and lead the world on environmental issues... Let's find a way to preserve the environment, to meet our international responsibilities, to meet our responsibilities to our children, and grow the economy at the same time.” -- President Clinton

CLAIM THAT CLINTON PLANS WILL DEVASTATE THE ECONOMY

CHARGE: *The Administration's plans on climate change would devastate the U.S. economy. By some estimates, they would increase U.S. unemployment by 0.25 percent and reduce the GDP by 3.3 percent, costing 250,000 American jobs.*

FACT: **These are groundless assertions.**

- There is no "Clinton plan" yet. The Administration is examining a variety of scenarios and talking to a range of experts to determine how to achieve needed environmental benefits without sacrificing continued economic prosperity.
- Any policy that is chosen will be consistent with the President's commitment to sustaining a healthy and robust economy. Since President Clinton took office, the private sector of the economy has grown at more than twice the rate of the previous four years, business investment has boomed at a rate not seen since the Kennedy Administration, unemployment is as low as it has been in 24 years, and 12.9 million new jobs have been created. (Sources: Bureau of Economic Analysis, Department of Commerce; Bureau of Labor Statistics, Department of Labor)
- More than 2,300 economists believe that taking preventive steps to confront climate change is justified and that it is possible to do so without harming American living standards. In fact, they state that long-term productivity could be improved by such steps. (Source: 1/97 Economists Statement on Climate Change)
- Providing a definitive answer on how much it will cost to slow climate change is virtually impossible. Different economic models come up with different numbers based on different assumptions. Common sense dictates that the cost will depend on several broad factors, including the manner in which a policy is implemented and the speed at which the economy adapts.
- The Clinton Administration is committed to tackling climate change by maximizing efficiency and innovation. That means supporting market-based policies such as *emissions trading* and *joint implementation*, and it means making major investments in developing new energy technologies. The President is also resolved that *all* countries must take meaningful steps to address climate change. Otherwise, it will be impossible to solve the environmental problem and to ensure a level international playing field.
- Tackling climate change will entail costs to particular economic sectors, just as it is likely to create opportunities in others. No matter what specific emissions reduction policies are chosen, the Administration will work to ensure that such costs are minimized.

CLAIM ON AMERICAN JOBS MOVING OVERSEAS

CHARGE: *A global climate change treaty, particularly one without strong developing country commitments, would injure U.S. competitiveness and send jobs overseas.*

FACT: **Despite claims to the contrary, academic studies have generally found that taking steps to protect the environment need not lead to a deterioration in competitiveness. This is expected to be true with regard to climate change.**

- Non-tradeable sectors represent a substantial share of carbon emissions, with transportation and buildings accounting for roughly two-thirds of the U.S. total. For these sectors, competitiveness seems largely like a non-issue.
- For most industries, energy costs are too small relative to other factors – such as labor costs, productivity, and infrastructure – to affect plant locations or trade flows. Energy costs for manufacturing industries in the United States, for example, average only roughly 2.2 percent of total costs. (Source: 1995 Annual Census of Manufacturers)
- For several industries – accounting for perhaps 2 to 3 percent of total industrial output – energy costs *are* a significant share of total costs. This is particularly true for primary aluminum production (21.4 percent), hydraulic cement (20.5 percent), and inorganic chemicals (13.7 percent). It also includes industries such as pulp and paper and steel. The impact of climate policies on these industries will depend on how such policies are implemented.

FACT: **The United States has led the world in its call for developing country obligations in any new treaty on climate change. We will not sign any agreement that leaves developing countries out of the equation.**

- It must be recognized that developing countries cannot at the outset be expected to shoulder the same commitments we do. Their contributions to global emissions are far less than ours, as are their emissions on a per capita basis. Our responsibility must be to devise sensible and meaningful steps that developing countries can take now, while reaching agreement that the obligations of such countries will increase over time.
- Addressing climate change also has the potential to provide opportunities for American business. Today the global market for environmental technologies is worth some \$4 billion annually. As countries work to increase energy efficiency and reduce their reliance on fossil fuels, this market is likely to grow dramatically. By investing in the development of such technologies, the U.S. can lead the world in marketing solutions to the climate change problem.

CLAIM ON ECONOMIC IMPACTS ON THE POOR

CHARGE: *Lower income Americans, specifically those just coming off the welfare rolls, would be particularly hard-hit by any effort to address climate change as they would be forced to pay more for heating, cooling, and transportation.*

FACT: **The President is not going to support policies that disproportionately affect lower income Americans.**

- No specific policies for attaining further emissions reductions have been decided. And they will not be decided until the President has heard from the American people and developed an approach that protects the environment, ensures continued economic prosperity, and guarantees fairness in distributing the costs.
- Since taking office, the President's top priority has been sustaining a healthy and robust economy. In the past four and a half years, the private sector of the economy has grown at more than twice the rate of the previous four years, business investment has boomed at a rate not seen since the Kennedy Administration, unemployment is as low as it has been in 24 years, and 12.9 million new jobs have been created. (Sources: Bureau of Economic Analysis, Department of Commerce; Bureau of Labor Statistics, Department of Labor)
- The substantive economic literature on climate change indicates that a number of ways exist to achieve substantial reductions in U.S. emissions without imposing severe economic costs.

CLAIM THAT MASSIVE LONG-TERM REDUCTIONS ARE IN STORE

CHARGE: *At least one Administration official has suggested that solving this problem means eventually reducing our consumption of fossil fuels by 70%. Such a goal is unattainable, and efforts to reach it are destined to cause major economic disruption.*

FACT: **The Administration has not settled on any specific emissions reduction target, either medium-term binding limits to be negotiated in Kyoto or a longer-term objective.**

- Solving climate change is a long-term proposition that will require a progressive series of steps over a sustained period.
- The Administration is not about to propose Draconian measures that would needlessly jolt the economy or diminish American living standards. Any policy that is chosen will be consistent with the President's commitment to sustaining a healthy and robust economy. Since President Clinton took office, the private sector of the economy has grown at more than twice the rate of the previous four years, business investment has boomed at a rate not seen since the Kennedy Administration, unemployment is as low as it has been in 24 years, and 12.9 million new jobs have been created. (Sources: Bureau of Economic Analysis, Department of Commerce; Bureau of Labor Statistics, Department of Labor)
- It is true that over the long-term the only way to address climate change responsibly is to substantially reduce our emissions of greenhouse gases. Otherwise it would not be possible to stabilize concentrations of these gases in the atmosphere at a safe level.
- The key to these reductions will be the development and deployment of new technologies that use energy far more efficiently and that emphasize renewable energy sources.
- Our challenge today is to make the right kinds of investments to encourage these technologies, so that substantial emissions reductions can be achieved down the road with minimal economic cost.

CLAIM ON NEW TAXES

CHARGE: *The Administration proposal is really about more taxes. Solving climate change would mean major tax increases for gas, oil, etc.*

FACT: **The Administration does not believe that new taxes are the best approach for solving the problem. Instead, we prefer the use of market-based mechanisms that encourage innovation and efficiency.**

- Energy taxes or carbon taxes of some kind are clearly one of a number of options that could stimulate a reduction in U.S. greenhouse gas emissions. Accordingly, a wide range of economists have speculated on what levels of new taxes could be imposed to generate given levels of emission reductions.
- The Administration has not endorsed any energy or carbon tax proposal to address climate change. Instead, the President has focused on concepts such as emissions trading and joint implementation which can bring about substantial reductions without the imposition of new taxes.
- The President has also demonstrated a commitment to investing in tomorrow's technologies to stimulate the kind of innovation and efficiency that will be vital if we are to achieve serious emissions reductions over the long-term.
- Furthermore, through the President's 1993 **Climate Change Action Plan (CCAP)**, it has been shown that meaningful emissions reductions can be achieved through voluntary partnerships between government and industry. By 2000, it is estimated that CCAP programs will have provided 76 million metric tons of CO₂ reductions. This is true even Congress has cut funding for CCAP programs 40 percent below requested levels in recent years.

CLAIM THAT VOLUNTARY PROGRAMS ARE SUFFICIENT

CHARGE: *Voluntary actions, not binding limits and more government regulation, are the best way to obtain meaningful emissions reductions cost effectively.*

FACT: **Voluntary actions are an important component in any plan to reduce emissions, but on their own are not sufficient to produce the needed environmental benefits.**

- Voluntary programs under the President's 1993 Climate Change Action Plan will have provided a 76 million metric ton reduction of carbon equivalent by 2000. (Source: U.S. Climate Action Report, 1997) This is an important down payment on our national effort to reduce greenhouse gas emissions.
- Nevertheless, the U.S. will fail to meet the Rio goal (agreed to by President Bush and ratified by the Senate) of reducing emissions to 1990 levels by the year 2000. (Source: U.S. Climate Action Report, 1997) Most other industrialized nations will likewise fail to do so.
- In light of this, and of the mounting scientific evidence on the seriousness of the problem, it is clear that the U.S. and other nations must do more.
- The President has committed to the concept of binding emissions limits to be achieved using market-oriented policies. Such policies, including *emissions trading* and *joint implementation*, promise to substantially lower the cost of obtaining emissions reductions.
- The concept of emissions trading is already being used successfully in the U.S. to reduce emissions of sulfur dioxide, the primary culprit in causing acid rain.

CLAIM ON THE ARGONNE LAB STUDY

CHARGE: *A study by the Department of Energy's Argonne Lab predicts major economic disruption to key U.S. industries from a new climate change treaty.*

FACT: **While it provides some valuable information, the Argonne Lab study does not take into account key policies being advocated by the Clinton Administration that will substantially reduce the cost of emissions reductions.**

- The Argonne Lab study examined the possible effects of a set of hypothetical fuel price increases on six energy intensive industries that are subject to significant foreign competition: basic chemicals, iron and steel, petroleum refining, paper and allied products, aluminum, and cement.
- Overall, the participants reported negative impacts on the six industries, predicting reductions in output and employment and an increasing share of the respective markets for developing countries. They also speculated that some industries would build new plants in developing countries, while others would increase the utilization of existing facilities already located in these areas.
- Significantly, the study's conclusions are predicated on specific energy price scenarios that do not reflect the potential impact of multi-year emissions budgets, international emissions trading, joint implementation, and other fundamental aspects of the U.S. negotiating position on climate change. Neither do they factor in the U.S.'s firm commitment to secure meaningful obligations from developing countries. Taken together, these policies will substantially lower the costs of reducing U.S. emissions.
- In the Administration's view, the Argonne study points to important economic risks in key industrial sectors from certain climate change policies and underscores the critical need for flexibility in securing emissions reductions.

CLAIM THAT EMISSIONS TRADING & JI ARE NOT REALISTIC

CHARGE: *Key elements of the U.S. proposal, namely emissions trading and joint implementation, are unworkable and would cost a fortune to monitor effectively.*

FACT: **Emissions trading and joint implementation represent the best way to use market forces to obtain the greatest emissions reductions at the least cost.**

- *Emissions trading* involves placing a cap on total carbon emissions and allowing the trading of emissions permits between entities. The U.S. envisions domestic trading of emissions between U.S. companies as well as a mechanism to provide for international trading.
- Emissions trading has been used very successfully in the U.S. to reduce the sulfur dioxide emissions that cause acid rain. Since trading became effective in 1995, SO₂ emissions have been reduced substantially below the allowable cap at costs well below what was expected.
- *Joint implementation* refers to cooperative efforts between countries or entities within them to reduce net greenhouse gas emissions. In addition to offering significant potential to combat climate change in a highly cost-effective way, JI projects promote sustainable development, encourage private sector investment in developing countries, and provide local health, environmental, and economic benefits.
- Through the U.S. Initiative on Joint Implementation (USIJI), a part of the President's Climate Change Action Plan, the U.S. has proven the effectiveness of joint implementation in achieving measurable emissions reductions.
- Since 1994, USIJI has accepted 25 projects in eleven countries. These projects apply a variety of technologies and practices, including wind, geothermal, hydroelectric, and solar energy; coal to natural gas fuel switching, methane gas capture; and sustainable forest management and preservation.

(Source: U.S. Climate Action Report, 1997)

Joint Implementation Case Study – The Czech Republic: *The City of Decin in the Czech Republic supplies both heat and potable hot water to local apartment blocks. This project has converted the district heating plant from coal to natural gas. A cogeneration facility has also been built to provide steam and electricity. USIJI partners include the City of Decin, Center for Clean Air Policy, Wisconsin Electric Power Company, Commonwealth Edison Company, and NIPSCO Development Company. (Source: U.S. Climate Action Report, 1997)*

CLAIM THAT DEVELOPING COUNTRIES ARE EXEMPT

CHARGE: *The U.S. position in the climate negotiations would force developed countries to accept binding emissions targets while giving developing nations a free ride.*

FACT: **This is simply not true.**

- The United States has consistently maintained that meaningful obligations from developing countries must be a cornerstone of any treaty we would sign.
- The Framework Convention on Climate Change, signed by President Bush in 1992 and ratified by the Senate, recognizes that developed and developing nations have different capabilities and responsibilities to reduce emissions. This reflects the reality that developed nations today emit the vast majority of greenhouse gases and also have the greatest capacity for emissions reductions.
- Any new climate agreement must likewise recognize these differences. Nevertheless, it is clear that as the emissions from nations like China and India increase over time, so too must the obligations of those nations.
- The current U.S. proposal has three specific elements relating to developing country commitments. They go far beyond what others have put forward in the negotiations and are designed to ensure that these countries take serious steps today while agreeing that their obligations will increase with time.
 - ⇒ First, the U.S. calls on all Convention Parties to take a series of **specific actions to mitigate their emissions and report on their activities.**
 - ⇒ Second, the U.S. proposes that the **more advanced developing country economies accept binding targets today** (i.e. those seeking admittance to the OECD).
 - ⇒ Third, the U.S. stipulates that **all developing nations should agree to binding targets by the year 2005.**
- Another key aspect of our proposal is the concept of *joint implementation*, by which American companies would receive credit for undertaking projects in the developing world to reduce emissions.
- In working to develop a more specific policy, the U.S. will also consider, as appropriate, further initiatives, including on developing countries.

CLAIM THAT CHINA/INDIA SHOULD TAKE EQUAL STEPS TO OURS

CHARGE: *The U.S. should not agree to any international agreement unless China, India, and other developing nations take on the same level of commitment.*

FACT: **This is neither realistic nor equitable.**

- Climate change is a global issue, requiring a global response. We must, however, keep several facts in mind:
 - ⇒ **Developed countries have contributed 75 percent** of total greenhouse gas emissions since the beginning of the Industrial Revolution.
 - ⇒ With 4 percent of the world's population, the **U.S. is today responsible for over 20 percent** of worldwide emissions.
 - ⇒ Our per capita emissions are **more than eight times** that of China.
- For these reasons, China, India, and other developing nations cannot be expected to assume the same commitments as the United States in the initial stages of an effort to combat global warming. We must take the lead.
- Nevertheless, emissions from the developing world are likely to exceed those of the developed world by 2035 (though their contribution to atmospheric concentrations of such gases will not match ours until well after).
- Accordingly, the environmental problem cannot be solved if developing countries will not agree to participate meaningfully in a global agreement and to recognize that their commitments must increase over time.
- That is why the United States has made the involvement of developing countries a cornerstone of our position. Our proposal includes provisions for developing nations to take concrete steps to mitigate and report on their emissions. It calls for the more advanced nations, such as those seeking admittance to the OECD, to accept binding emissions targets. And it calls for a next negotiation by which all countries will accept binding targets by 2005.
- In working over the coming months to develop a more specific policy, the U.S. will also consider, as appropriate, further initiatives, including on developing countries.

CLAIM ON THE MEANING OF THE BYRD RESOLUTION

CHARGE: *The Byrd Resolution, passed by the Senate 95-0, is effectively a repudiation of the approach taken by the Administration in dealing with the developing country issue in the negotiations.*

FACT: **The Administration has consistently supported the thrust of the Byrd Resolution, namely that developing nations must commit to meaningful steps to address the problem of climate change.**

- The level of developing country commitments in any new climate change agreement is the most difficult issue in the international negotiations.
 - ⇒ **Developed nations have done by far the most to cause the problem,** and have basically failed to live up to their commitments to reduce emissions.
 - ⇒ **Developing countries are rapidly increasing their emissions,** and it is clear that climate change cannot be solved unless they take meaningful steps.
 - ⇒ **Complicating the issue is the importance of energy use** to every nation's economy, and the concern that imbalanced actions will result in a shift in economic strength.
- The United States has been pushing harder than any other Party for developing countries to take meaningful actions. Our proposal includes provisions for developing nations to take concrete steps to mitigate and report on their emissions. It calls for the more advanced nations, such as those seeking admittance to the OECD, to accept binding emissions targets. And it calls for a next negotiation by which all countries will accept binding targets by 2005.
- Any difference with the Senate is not over the *whether* of developing country commitments but instead over the *how* and the *when*. The President has committed to working intensively over the next few months to consult with the Congress, to further explain the Administration position, and to develop, as appropriate, further initiatives, including on developing countries.

CLAIM ON THE PROBLEMS WITH THE BERLIN MANDATE

CHARGE: *The Clinton Administration sealed our fate two years ago by agreeing to the Berlin Mandate which calls for stringent actions by industrialized nations while effectively exempting developing countries from further obligations.*

FACT: **The Clinton Administration has consistently taken the position that developing countries must take on meaningful obligations to limit their emissions.**

- The Berlin Mandate recognizes that developed and developing nations have different responsibilities and capabilities in reducing emissions. This principle was enshrined in the 1992 Framework Convention on Climate Change, signed by President Bush and ratified by the Senate.
- Current and historic emissions from the industrialized world far exceed those of the developing world. With 4 percent of the world's population, the U.S. alone is responsible for over 20 percent of global emissions. That is why we have a special responsibility to take the lead in addressing climate change.
- Developing country emissions are increasing fast and will overtake those from the industrialized world by 2035 (even though it will take another half century for their contribution to atmospheric concentrations of such gases to equal ours). It, therefore, is imperative that developing countries also start soon to take steps to reduce their emissions.
- The United States has been the world's leading proponent for developing countries to take meaningful actions. Our proposal includes provisions for developing nations to take concrete steps to mitigate and report on their emissions. It calls for the more advanced nations, such as those seeking admittance to the OECD, to accept binding emissions targets. And it calls for a next negotiation by which all countries will accept binding targets by 2005.
- The President has committed to working intensively over the next few months to consult with the Congress, to further explain the Administration position, and to develop, as appropriate, further initiatives, including on developing countries.

CLAIM THAT CURRENT ACTIONS ARE TOO LITTLE, TOO LATE

CHARGE: *The President's actions on this issue are too little, too late. He is trying to rush the U.S. into signing a treaty that cannot possibly be good for the American economy and that will have little chance of solving the environmental problem.*

FACT: **The United States will be prepared to go to Kyoto with a policy that protects the environment and ensures continued economic prosperity. We will not sign a treaty that does not accomplish these dual objectives.**

- The President believes the scientific evidence is clear and compelling that climate change is a real and serious threat and that we must begin taking meaningful actions to address it.
- At the same time, the President's top priority since being elected has been to restore the vitality of the American economy. And the results of his effort are clear: strong economic growth, unemployment at its lowest rate in a quarter century, 12.9 million new jobs, and low inflation.
- Whether in setting standards for clean air, improving the quality of drinking water, or protecting America's natural heritage, the President has proven that environmental protection and economic growth can go hand-in-hand. He is bringing the same philosophy to the issue of climate change.
- Over a year ago, the Administration proposed a framework for a Kyoto agreement that emphasizes environmental protection, flexible implementation, and global participation. We have been working ever since to refine this framework and to develop specific policies that support it.
- A large part of this effort has been soliciting the views of industry, environmentalists, Congress, and the American people. This outreach effort will culminate with a Presidential Conference on Climate Change in early October, the purpose of which is to help inform our climate change policy.
- When we go to Kyoto, it will be with a strong position that reflects the best interests of the environment, the economy, and the American people. The U.S. will not sign an agreement that fails to serve each of these interests.

CLAIM THAT THE POLICY IS ALREADY DECIDED

CHARGE: *The Administration has already locked in a policy on climate change without consulting Congress, industry, or the American people.*

FACT: **Not true.**

- The Clinton Administration *has not* decided on any specific policy related to levels of emissions reductions.
- The Clinton Administration *has* proposed a broad framework to guide the international negotiations aimed at reaching a new agreement to reduce emissions after the year 2000.
- This framework was developed after extensive consultations with industry, the environmental community, and other stakeholders. It reflects the compelling scientific evidence that climate change is a serious and growing problem, the fact that international actions to date have not been fully successful, and the need to achieve emissions reductions as cost-effectively as possible.
- The Administration is currently undertaking a major effort to develop specific policies on levels and timetables of emissions reductions and on mechanisms for achieving them. Throughout this process, the President and others in the Administration are actively soliciting the views of a wide range of outside groups.
- The goal of this effort is to develop a sensible, comprehensive U.S. position that protects the environment, ensures continued economic prosperity, and is in the overall best interests of the American people. The President has committed to developing such a position in time for the climate change negotiations in Kyoto this December.

CLAIM ON LOSS OF SOVEREIGNTY

CHARGE: *By signing an international treaty mandating reductions in greenhouse gases, the U.S. is ceding authority over domestic policy to the United Nations.*

FACT: **There is no truth to this assertion, whatsoever.**

- Any climate change treaty that the U.S. would agree to would be implemented at the national level. While certain other nations have called for internationally standardized policies and measures to reduce emissions, the United States has made clear that such proposals are out of the question.
- The U.S. approach is to allow each country to take advantage of its own economic circumstances to fashion a response to climate change.
- While arguing that nations must accept binding emissions limits that are internationally agreed, the U.S. is pursuing policies that ensure maximum domestic flexibility in reaching such limits, including through the trading of emissions.
- And the President has made clear that any binding limits that are agreed to must not only produce needed environmental benefits but also must provide for continued economic growth.
- Any treaty that is signed would also, of course, require the advice and consent of the U.S. Senate.

CLAIM THAT THE PRESIDENT IS NOT SERIOUS

CHARGE: *The Administration's recent overtures on climate change reflect an attempt to make the President appear engaged, even though he hasn't done much on this issue.*

FACT: **The Clinton Administration has a strong record in confronting climate change.**

- In 1993, President Clinton developed the **Climate Change Action Plan (CCAP)** with the goal of returning total U.S. greenhouse gas emissions to their 1990 levels by 2000. Although lower-than-expected fuel prices and higher-than-expected economic growth and electricity demand have caused CCAP to fall short of its goal, its programs will result in a reduction of 76 million metric tons of carbon equivalent. (Source: U.S. Climate Action Report, 1997)
- Through almost 50 initiatives with a wide range of industry sectors, this effort has demonstrated that government and the private sector can work together successfully to cut emissions.
- Had the Congress not substantially cut funding for these programs (about 40% in recent years), they would have brought the U.S. closer to the objective of lowering emissions to 1990 levels by the year 2000.
- Additional initiatives, including the **Partnership for a New Generation of Vehicles** and the **Million Solar Roofs**, demonstrate the President's commitment to developing the technologies that will ultimately be needed to solve the climate change problem.

CLAIM ON THE EUROPEAN UNION POSITION

CHARGE: *The European Union has proposed an emissions target of 15 percent below 1990 levels by 2010. If they can make those kinds of cuts, why can't the U.S.?*

FACT: **The U.S. believes that the EU position is unrealistic and unnecessarily stringent. We will not support binding targets that cannot be achieved or that would impose undue costs on the economy.**

- The EU target represents a target for the block as a whole, not for each country. While some nations within the EU are to reduce their emissions, others will actually increase theirs. The ultimate goal is to have a total reduction of 15 percent below 1990 levels.
- Despite this “bubble” concept, the EU has not supported the proposals put forward by the U.S. to allow other nations to trade emissions, nor have they endorsed the concept of joint implementation.
- Amongst themselves, the EU has only been able to work out burden sharing that would take them to 10 percent below 1990 levels by 2010. Nevertheless, they still advocate a 15 percent cut in the negotiations.
- The EU favors a set of mandatory, harmonized policies and measures for reducing emissions. These include carbon taxes, energy efficiency standards, and other mechanisms.
- The U.S. has not seen evidence to convincingly demonstrate how the policies advanced by the EU, if indeed they could even succeed in putting them in place, would result in the kinds of emissions cuts they have advocated.
- The EU has been virtually silent on the issue of developing country commitments.
- The U.S. will not propose a target that we believe to be unrealistic or overly stringent. The Administration is carefully considering what level of cuts we would find acceptable. Furthermore, the U.S. will not sign an agreement that prescribes internationally mandated policies and measures for reducing emissions. We believe strongly that those decisions must be left to individual governments which should be given the widest range of options possible for attaining cuts cost-effectively. Lastly, the U.S. will not consider an agreement that exempts developing countries. This is neither environmentally nor economically justifiable.

August 5, 1997

Note to: Nicholas L.

From: Rosina Bierbaum 

Subject: Climate Material

Attached and on the enclosed disk you will find the following OSTP-generated climate documents:

1. A general set of summary level climate Q&A's. *(simple)*
2. A set of climate science Q&A's that goes into more detail on science issues. *(more complex)*
3. A climate science background paper.

We are also working on a variety of additional documents:

1. A set of Q&As focused on responding to skeptic issues.
2. A one pager on "why act now"
3. A new "State of Knowledge" document based on our graphics materials.
4. A document on 10 myths promoted by skeptics.

Please call me or Peter Backlund if you need further information.

cc: Todd Stern

Simple

Climate Change Questions and Answers (8/4/97 Draft do not cite or quote)

THE PROBLEM

Is climate changing?

Yes. The global climate is changing because of the increasing atmospheric concentrations of greenhouse gases, and so is climate in the U.S. Observations show that temperatures and total rainfall are increasing; and patterns of rainfall are changing. Over the last century:

- Global average surface temperature increased by about 0.5 - 1.0 degree F.
- U.S. total precipitation has increased by about 6%.
- US intense precipitation events (over 2 inches in a day) have increased by about 20%.

The last few decades have been the warmest this century, the ten warmest years this century all occurred since 1980, and 1995 was the warmest year on record. The average rate of warming in the next century will probably be greater than any seen in the last 10,000 years.

Even climate is changing, how do we know that humans are responsible?

The 1995 Second Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), the most rigorously and thoroughly reviewed compilation of climate change science ever produced, concluded that "the balance of evidence suggests a discernible human influence on climate." Many pieces of evidence point to a human role:

- Observations show that fossil fuel combustion and other industrial and agricultural processes have increased atmospheric concentrations of greenhouse gases. CO₂ has increased 30% since 1860.
- Observations also show that the world is warming at an unusually rapid rate, has been warming over a long period, and is warmer this century than it has been since at least 1400 AD.
- The magnitude, timing, and geographic pattern of observed temperature changes closely matches the changes that models project from human activities, and does not match well with model simulations of natural change or changes seen in the natural record.

Why should we care if it gets a little bit warmer, especially if the changes are mainly nighttime and winter temperatures?

Societies around the world are dependent on the climates that they have experienced for centuries. For example, US agriculture relies on the timely occurrence, extent, and amount of winter snows and summer rains. Communities are dependent on recurring

rains to full their reservoirs, rivers, and groundwater. Changes in the patterns and frequency of extreme weather events could cause societal disruption, threatening human lives and infrastructure. Changes in seasonal and nighttime minimum temperatures can increase the range of diseases bearing pests that affect crops and human health. Although technology can provide some buffer against climate fluctuations and change, many societal activities are dependent on the long-term climate that currently exists in each region.

TECHNOLOGY

If these energy efficient and renewable technologies are so cost-effective, how come they are not succeeding in the marketplace?

First off, some new energy technologies are succeeding, like energy efficient windows and compact fluorescent lights, which to date have saved consumers more than \$10 billion in energy costs (A return of more than double the whole energy efficiency budget for the last 15 years).

However, there are significant barriers to market acceptance of efficiency and renewable technologies, such as the fragmentation of the building industry (almost 400,000 builders) and differing local building code, which makes it difficult to successfully introduce new technologies and practices and get them approved.

Most renewable energy sources are currently more expensive than fossil sources, particularly natural gas. However, if environmental costs were considered, some renewables would be cost-effective today, and investing in renewable energy R&D is the best way to assure affordable clean energy in the future.

Why should we worry about relying on foreign sources of oil, especially when the price of oil is cheaper than it has been in a long time?

It is true that the oil market today is robust and providing cheap oil prices, and forecasts expect it to stay that way. However, the increasing U.S. reliance on imported oil leaves us increasingly vulnerable to supply shortages and price increases brought about by political instability in other nations. Persian Gulf oil now supplies less than 50% of the world market and about 10% of US imports. This could increase to 75% of the world market and over 25% of U.S. imports by 2005, which is cause for concern.

Why should the government be helping big corporations develop technologies they will sell for a profit?

For the most part, energy efficiency and renewable energy firms are small, entrepreneurial companies. They are usually under-capitalized and often are struggling to make profits. If government R&D investments help them with establishing markets and stable business conditions the American economy benefits.

There are also substantial economic and environmental benefits to R&D cost sharing and partnership with larger corporations. Such arrangements enable the best talent in the private and public sectors to cooperate in the development of environmentally benign technologies reducing the R&D costs for both parties.

OUTREACH ACTIVITIES

Aren't all these workshops and meetings just an attempt to convince people to support the Administration's left wing position on climate change?

The Global Change Research Act of 1990 charges the United States Global Change Research Program (USGCRP) with providing to the President and Congress an U.S. National Assessment of Climate Change Impacts. As part of this mandated responsibility, the USGCRP is sponsoring a series of regional workshops to examine regional vulnerabilities of various regions of the United States to climate change. The logical next step in climate change science is to extend global-scale investigations to the regional level, and the workshops are part of this process. A National Climate Change Impacts Workshop this fall will synthesize the regional results into a national picture.

SCIENCE OF THE GREENHOUSE EFFECT

Some scientists say that climate change is just natural variability. Why should I believe the scientists who say the greenhouse effect is getting worse?

The climate system's substantial natural variability does make it difficult to precisely separate the contributions of human activity and natural variations. Nevertheless, **almost all** of the scientists who study climate change believe that the dramatic increases in the atmospheric concentrations of greenhouse gases caused by human activities are in turn causing climate change above and beyond natural variation.

- Thousands of peer-reviewed articles present consistent, well-documented evidence of past and ongoing change and plausible projections of future changes.
- The work of the Intergovernmental Panel on Climate Change (IPCC), is a critical re-examination and synthesis of these results conducted by over 2,000 scientists from more than 50 nations.

More than 2,600 of the world's leading scientists have endorsed the IPCC findings. The burden of proof is on those who insist that this impressive body of work is wrong to produce compelling, peer-reviewed evidence to back up their assertions.

How can humans have such a big effect when natural sources account for 97% of the carbon emissions in a year?

Humans have such a big effect because human activities have been increasing emissions

of carbon dioxide and other greenhouse gases in the atmosphere faster than natural sinks can absorb them. This is why the concentrations of such gases are rising. The Earth's carbon budget is out of balance, and getting more so each year as we continue to add CO₂ to the atmosphere. The concentration of CO₂ has grown by about 30% since 1860 and will continue to grow if emissions continue to increase.

How can we predict the future climate, when we can't even predict the weather for next week?

While we can only accurately predict the weather, which is the specific state of the atmosphere, several days into the future, modeling and observations have enabled the prediction up to a year in advance of more general climate conditions, such as a wet or dry spring.

We are able to predict climate conditions further into the future by using General Circulation Models (GCMs) which simulate the working of the global climate. These models are certainly not perfect simulations, but they do a pretty good job of representing the observed long-term changes in past climate. Tests show that they slightly underestimate past climate changes, suggesting that their predictions of future warming may also be a bit low -- not that the models are overestimating future changes as some critics suggest.

Given all the uncertainty, how can the IPCC say that human activities are influencing climate change?

There are numerous uncertainties that remain in climate change science, as there are in all sciences. This does not change the fact that we have a very good understanding of many aspects of the climate system. Many of the most certain results point to human influence on climate, and this is the basis for the IPCC statement that "the balance of evidence points to a discernible human influence on global climate."

- Observations show that fossil fuel combustion and other industrial and agricultural processes have increased atmospheric concentrations of greenhouse gases. CO₂ has increased 30% since 1860.
- Observations also show that the world is warming at an unusually rapid rate, has been warming over a long period, and is warmer this century than it has been since at least 1400 AD.
- The magnitude, timing, and geographic pattern of observed temperature changes closely matches the changes that models project from human activities, and does not match well with model simulations of natural change or changes seen in the natural record.

Isn't it true that most of the scientists who signed the "scientists letter" aren't climate specialists? What makes them qualified to speak out on this subject?

A wide variety of researchers signed the Scientists Statement on Global Climate Disruption (dated June 18, 1997). Many of them are climate researchers; all of them are individuals trained in the evaluation of evidence and theory, and their opinion should not be taken lightly. Because of their reliance on evidence, scientists are typically very cautious in their judgements. The fact that over 2600 of them have chosen to speak out on climate change is a powerful argument for the seriousness of this issue. Finally, "climate specialist" is an interesting term: the highly inter-disciplinary nature of climate change means that "climate specialists" include people trained in biology, ecology, physics, sociology, chemistry, geology, economics, geography, oceanography, meteorology, medicine, political science, and other disciplines, as well as climatology.

Isn't it true that we don't really know if observed climate changes are caused by increases in greenhouse gases?

We know that increases in greenhouse gases are contributing to observed climate changes. The basic physics of the greenhouse effect is well established. We know that Earth would be about 66 degrees F colder if there were no greenhouse gases in the atmosphere at all, and that life as we know it would not exist. We know that increasing the atmospheric concentration of greenhouse gases will warm our planet. We know that we have already added significant amounts of greenhouse gases to the atmosphere: the level of carbon dioxide in the atmosphere has increased from 280 parts per million by volume (ppmv) prior to industrialization to over 360 ppmv at the present time. And we know that the Earth has warmed during this same period of time.

If we don't even know how much climate will change, how can we project what the effects will be?

We can use General Circulation Models (GCMs) to simulate the future climate changes that would occur from various levels greenhouse gas concentrations in the atmosphere. This permits us to project many of the large-scale effects that would occur from different levels warming, even though we don't know what the actual level will be at any given time in the future. Precise projection of regional-scale effects will require further improvements in modeling and computational capability.

How can any projections of impacts be accurate when climate models don't give an accurate picture of regional changes?

Although detailed predictions of what might happen in specific regions of the world are not yet possible, plausible estimates of possible changes are starting to emerge. Climate change is already contributing to more rainfall in intense downpours and warmer temperatures, and affecting water resources, agriculture, low-lying coastal regions, natural ecosystems, the potential range of disease-carrying insects, and many other sectors of the environment and society. We can extrapolate these effects into the future, even though we cannot yet accurately simulate future climates on a regional-scale.

How can anyone isolate the role of climate change from all the other illnesses and conditions that can affect people's health?

Although climate change is a part of a complex system of factors that can affect people's health through the outbreak and spread of disease, scientists using forecasts of short-term climate variability, such as those associated with El Niño, have been able to indicate the climatic potential of a disease outbreak. Climatic events, such as changes in temperature, precipitation, humidity, and storm patterns, have been shown to contribute to increased incidences of water-borne diseases such as hepatitis, shigella dysentery, typhoid, and cholera as well as vector-borne diseases such as malaria, dengue, yellow fever, and the plague.

Won't warmer weather increase agricultural productivity? And aren't warm weather and CO₂ it good for plants?

Warming will increase agricultural productivity in some regions and decrease it in others. Warmer weather can cause changes in growing seasons, water availability, soil moisture, and precipitation, which will affect different agriculturally productive regions in varying degrees. And while it is true that CO₂ is good for plants, the ability of plants to take advantage of additional CO₂ can be prevented by other stresses caused by climate change, such soil moisture deficits. Although it appears that agricultural production can be maintained at the global level in a warmer world, there will be significant regional shifts in productivity, and it appears that many of the poorest regions of world are likely to experience decreases in agricultural production.

How do we have any idea what emissions might be in 50 to 100 years?

We have a highly developed understanding current and historical emissions of most greenhouse gases, and especially good data for carbon dioxide, which makes up about 85% of US greenhouse gas emissions. We also have a good understanding of how economic activity and technological innovation have affected emissions. It is thus possible to create plausible scenarios for future levels of emissions that would occur from different combinations of technological development, economic growth, and population growth.

THE FRAMEWORK CONVENTION ON CLIMATE CHANGE (FCCC) (OSTP-DRAFTED ANSWERS, DOS HAS NOT YET CLEARED)

Why do we need an international agreement on climate change?

Climate change is a global problem that demands a global response. Emissions from all nations contribute to climate change, and all nations are affected by climate change. The only way to solve this problem is through effective, long-term international cooperation on research, adaptation and mitigation.

Won't such an agreement benefit other countries more than the US?

All nations will benefit from avoiding climate change impacts. One of the primary means of mitigating greenhouse gas emissions, and thus limiting the extent of climate change, will be through the development and use of advanced energy technologies. Given the United States' world leadership in innovation and high technology, a worldwide commitment to deploy new low-impact energy technologies could be very beneficial to the U.S.

Why should we take actions that will benefit other nations?

Many actions that benefit other nations also benefit the U.S. It is true that some of the worst direct effects of climate change appear to threaten lower-latitude, developing nations more than the U.S., but it is clearly in the U.S. national interest to promote long-term economic growth and environmental quality, and thus stability, in these nations. The mitigation of climate change is likely to be a win/win proposition for all nations.

Isn't it true that developed world actions can't solve the climate problem? If so, why aren't we making developing countries take action?

It is certainly true that the developed world cannot solve this problem alone; that is why the U.S. has consistently maintained that developing nations should begin mitigation actions in the near-term and minimize environmental degradation to the extent possible as they develop their economies. U.S. joint implementation projects are already helping introduce low impact technologies in developing nations.

However it is also true that developed nations have largely caused today's climate change problem, and that the vast majority of emissions continue to come from developed nations; in fact, the average person in the developed world emits about ten times more greenhouse gases than the average person in the developing world. So we have to take the lead in limiting our own emissions while we work with the developing world to provide the energy they need without the further emissions that will accelerate climate change over the next century.

What incentive do the developing nations have to act if we take action first?

Action by developed countries, including the US, adds to the incentives for action by developing nations. By agreeing to take the initial steps in climate change mitigation, the US is taking the lead in addressing the climate change issue. This demonstrates our commitment to solving the problem, and reinforces our credibility in the ongoing process of negotiations. The US has consistently made it clear that our actions are an initial step, and that significant mitigation steps by developing nations in the near-term future are a necessary part of solving the climate change problem.

What difference does it make to have a binding target when the agreement is unenforceable anyway?

Adoption of binding targets is clearly a more serious commitment than the existing system of non-binding efforts. Nations have the power to enforce their treaty commitments at the national-scale. Furthermore, the international emissions trading advocated by the US lends itself to a variety of potential compliance mechanisms related to trading privileges and budget allocations.

Doesn't trading just mean that big polluters can just keep on polluting?

Only if their emissions are offset by verifiable reductions elsewhere. Trading in itself does not affect the level of emissions; what it does is to harness the power of the marketplace to ensure that the emissions reduction targets nations agree on are met in the most economically efficient way.

Why should the developing countries agree to do anything at all if it will hurt their potential for future growth?

Developing countries will benefit from climate change mitigation; many of the most serious impacts of climate change will fall disproportionately on the developing world. Furthermore, it is by no means clear that climate change mitigation will hurt the future growth of the developing world; the fact that much past growth has been associated with high emissions levels doesn't mean that future growth will have far lower levels of emissions. Clean energy technologies hold tremendous promise, and will be much cheaper to implement in the developing world. US proposals for emissions trading and joint implementation would contribute to creation of an advanced, highly efficient energy infrastructure in much of the developing world.

ECONOMICS (CEA ANSWERS)

Q: The U.S. economy is the healthiest in a generation. Won't climate change policies --like carbon taxes --kill economic growth and destroy jobs?

A: My top priority, since this Administration's first days in office, has been revitalizing the economy, creating jobs and investing in people and technology to enhance long-term growth. And, we have made tremendous progress: growth is strong, unemployment is down to 4.8%, and 12.9 million jobs have been created since January, 1993. I am not going to do anything to jeopardize that progress. Any policy on climate change that I endorse will be consistent with my commitment to sustaining a healthy and robust economy.

Q: How much is it going to cost?

A: Over 2,300 economists --including 8 Nobel Laureates -- signed a statement concluding 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 longer run."

There is no definitive answer as to how much it will cost to slow climate change. Different economic models come up with different numbers based on different assumptions. Economists are able to come up with a range of economic impacts using certain models. But, it is impossible to come up with an answer as to the exact cost.

Instead, the cost of slowing climate change will depend greatly on a number of different factors --factors such as: .

- the manner in which a policy is implemented. In short, if we do it dumb, it could cost a lot; but, if we do it smart, it will cost less and indeed could even produce benefits for our economy in the long run.
- the speed at which the economy adapts. For instance: if firms in the economy can shift from high carbon to low carbon energy sources quickly, the costs of climate protection will be lower; if there are opportunities to use energy-saving technology at low or even negative costs, the costs of climate protection will be lower; if technological change occurs at a rapid rate, or is highly responsive to increases in the price of carbon emissions, the costs will be reduced.

Q: What does it mean to "do it smart"? What is an example of a policy approach that will cost less?

Climate change policies that are based on market-based mechanisms will be less costly to the U.S. economy, because they are more flexible on the timing and location of emission reductions. The speed at which emissions reductions occur has large effects on the estimated costs. If emissions reductions are phased in over a longer period of time, the natural turnover of the capital stock will incorporate newer, energy-efficient technology, lowering the ultimate economic cost of meeting any specified emissions target. Similarly, longer lead times before emissions constraints are binding allows new technologies to be developed and allows a more orderly fuel-switching process, preventing bottlenecks that can drive up the estimated costs.

Q: If you don't know how much it will cost to slow climate change, how can you justify going forward with a policy?

Yes, it is difficult to determine the exact cost of policies designed to slow climate change. Global climate change involves economic and physical processes that operate globally and over decades, if not centuries.

But, the science is clear and compelling: we humans are changing the global climate. Concentrations of greenhouse gases in the atmosphere are at their highest levels in more than 200,000 years, and climbing sharply. Over time, climate changes will disrupt agriculture, cause droughts and floods and the spread of infectious diseases.

We must take steps now to reduce greenhouse gas emissions. And we can do this in a way that will not impose dramatic and crippling costs to our economy. More than 2,300 economists agree: if implemented properly, emissions reductions would "slow climate change without harming American living standards, and these measures may in fact improve U.S. productivity in the longer run."

Q: If developing countries aren't included in efforts to reduce greenhouse gas emissions, U.S. businesses are not going to be competing on a level playing field. Aren't policies to reduce greenhouse gases going to hurt U.S. competitiveness?

A: The Administration believes that both developed and developing countries must be part of the process. While developed countries are responsible for most of the greenhouse gas currently in the atmosphere, developing countries will catch up. The sooner developing countries move away from carbon intensive energy sources, the less likely it is that they will become dependent on those types of fuels to spur their economic growth.

Q: Would energy-intensive American companies relocate to the developing world in order to avoid more restrictive climate change policies in the United States?

My top priority, since the first days of this Administration, has been revitalizing the economy, creating jobs and investing in people and technology to enhance long-term growth. I am not going to do anything to jeopardize that progress. Any policy on climate change that I endorse will be consistent with my commitment to sustaining a healthy and robust economy.

It is also important to recognize that for most industries, energy costs are too small relative to other factors --such as labor costs, productivity, and infrastructure --to affect plant locations or trade flows. [According to the 1995 Annual Census of Manufactures, energy costs for manufacturing industries averaged just 2.2 percent of total costs.] Reflecting this fact, economists have generally found that tightening

pollution rules does not cause industries to move to other countries --which suggests that policies restricting the use of fossil fuels are not likely to cause a massive shift of energy-intensive production abroad. If we do it smart, we're confident we can address the critical challenge of reducing greenhouse gases while continuing the strong economic performance we've been enjoying.

DOMESTIC IMPLEMENTATION POLICIES (OSTP-DRAFTED ANSWERS, CLEARED BY CLIMATE CHANGE TASK FORCE):

Isn't trading of CO₂ and other greenhouse gases going to be a lot more complicated than trading of other air pollution rights?

No. Once the emissions targets and the list of gases are agreed upon, greenhouse gas trading will be quite similar to other emissions trading arrangements, which have proven remarkably cost-effective in the U.S. The only real difference is that this arrangement will be larger in scale.

Isn't this whole trading scheme just a tax increase in disguise?

No. A trading system sets a cap on total emissions, and allows private parties, or nations, to sell emissions allocations to each other within the total. The government can distribute emissions allocations based on current emissions or other criteria, which results in no revenue to the government at all, or it can auction them and use the proceeds to reduce taxes, which is revenue neutral. Another option is to use the proceeds of an auction to provide transition assistance for affected industries.

What makes you think the government can accelerate the development of commercially viable technology? How will you avoid picking losers?

Government-funded R&D has made, and continues to make, substantial contributions to American industrial and economic productivity. In the area of energy efficiency technologies, innovations developed in government laboratories have already proven successful in the marketplace. Support of a broad spectrum of energy efficiency and renewable energy R&D activities will provide a wide array of technological innovations that can contribute to the creation new industrial opportunities, and thus to economic growth and prosperity.

How is the government going to provide relief for industries that are put out of business without raising taxes?

We are confident that we can craft responses to the climate change problem that are good for the economy as a whole. If adverse impacts are experienced by any sector, we anticipate that transition assistance can be provided without any tax increases.

More Complex

Science Background Questions

1. Is the climate changing?

Yes, the global climate is changing in many ways: atmospheric concentrations of greenhouse gases are rising, temperatures are increasing, total rainfall is increasing, and patterns of rainfall are changing. The climate has historically fluctuated, however it is now starting to change at a rate faster than anytime in the last ten thousand years. Since the beginning of the Industrial Era over 140 years ago, we have been burning fossil fuels at an ever-increasing rate, substantially altering our atmosphere. It appears that the climate conditions that have prevailed during the development of modern society are unlikely to persist into the future.

2. What is the cause of global climate change?

A variety of natural factors can influence climate, including changes in the amount of solar radiation given off by the sun, variations in the Earth's orbit, and volcanic activity. While some of the present change is the result of natural influences, we have compelling evidence that human activities are affecting the global climate system.

Human activities have been increasing the concentrations of carbon dioxide and other gases in the atmosphere (including methane, nitrous oxide, and chlorofluorocarbons and their substitutes). The rising concentrations are mainly caused by the burning of fossil fuels, but other industrial activities and certain land use practices are also contributors.

These gases are known as greenhouse gases because they trap heat near the Earth's surface, preventing it from re-radiating back into space. The natural concentrations of these gases result in a natural greenhouse effect that has made the Earth hospitable to life, but the additional emissions are contributing to an enhanced greenhouse effect that is leading to increased global temperatures and other related global and regional changes in the climate.

In contrast to the warming influences of greenhouse gases, there are some kinds of pollution and naturally occurring substances that have a cooling influence. For instance, some industrial processes, burning of trees and plants, and volcanic eruptions all result in increased amounts of aerosols (small particles) in the atmosphere, which reflect solar radiation. These aerosols are causing a direct cooling influence equal to about half of the warming influence of greenhouse gases.

3. What's the difference between climate change and global warming?

"Global warming" is a phrase that refers primarily to the most direct consequence of an enhanced greenhouse effect: a rise in global annual average temperature.

"Climate change" is a broader term that refers to a broad range of responses to an enhanced greenhouse effect, including changes in the amount and location of rainfall, in the occurrence of extreme events like floods and droughts, in seasonal temperature patterns, and in sea level rise, all of which can have further effects on agriculture, water supply, human health, and natural ecosystems.

4. What evidence suggests that the climate is changing?

A wide array of evidence indicates that the climate is starting to change outside the range of natural variability as a result of human activities. First and foremost, the level of carbon dioxide in the atmosphere has increased from 280 parts per million by volume (ppmv) prior to industrialization to over 360 ppmv at the present time. Human activities have also increased the concentrations of other greenhouse gases, including methane (by 145%), nitrous oxide (by 15%), and chlorofluorocarbons and their substitutes, which were once not present in the atmosphere. If emissions continue to grow at current rates, the level of carbon dioxide will exceed 710 ppmv by 2100. This would be the highest level since 50 million years ago.

Observations also indicate that the decade of the 1980s was the warmest on record and 1990 was the hottest single year, until it was topped by 1995 (the cooling in between was primarily the result of the 1991 Mt. Pinatubo volcano eruption). Recent years have been the warmest since 1860, and the mean global temperature for the 20th century is at least as warm as for any other century since at least 1400 AD (which is as far back as global temperatures can be estimated accurately). In addition, the observed global warming over the past 100 years is larger than our best estimates of natural climate variations over at least the last 600 years.

There are also many additional pieces of evidence that are consistent with an enhanced greenhouse effect: the rise in sea level, the melting back of mountain glaciers, the retreat of Arctic sea ice, the deterioration of ice shelves in the Antarctic, lengthening of growing seasons, and widespread coral bleaching throughout the world. Careful studies are underway to determine to what degree these events can be associated with the changes in primary variables attributable to the enhanced greenhouse effect.

5. Have humans caused the change in climate?

Yes. In late 1995, the Intergovernmental Panel on Climate Change (IPCC) released its Second Assessment Report, which contained the statement that "the balance of evidence suggests that there is a discernible human influence on global climate." The IPCC is a large international group of many of the very best scientists from around the world. Their conclusion is based on evidence that the human-induced climate change is becoming identifiable and distinguishable from the natural fluctuations.

Further information: The IPCC relied on a five-point approach before drawing its carefully and conservatively stated conclusion:

- The world is warming at an unusually rapid rate and has been warming over a long period;
- The world is warmer this century (particularly over the past few decades) than it has been since at least 1400 AD, and perhaps since many millennia before that when long-term changes in the Earth's orbit had caused quite different global climates;
- The geographic pattern of the temperature changes, with cooling over and downwind of industrialized regions and strong warming over much of the rest of the world, is statistically similar to changes that models project would result from simultaneously increasing concentrations of greenhouse gases and aerosols. Additionally, the observed patterns of change are statistically different from changes that would be expected from natural fluctuations such as solar variations, volcanic eruptions, and atmosphere-ocean interactions;
- The global patterns of atmospheric temperature changes are statistically similar to model predictions for a world with increasing concentrations of greenhouse gases and aerosols along with the depletion of the protective stratospheric ozone layer. Namely, the Southern Hemisphere has initially warmed more than the Northern Hemisphere, although this process has moderated as CO₂ emissions have continued to rise. Additionally, the high-altitude atmospheric layer called the stratosphere has cooled somewhat while the lower atmosphere has warmed; and
- The magnitude and timing of the observed long-term changes in temperature over the past 140 years are similar to those that are expected from the increasing concentrations of greenhouse gases and aerosols, and are unlike changes that either have been seen in the natural record or are simulated by models trying to represent the natural climate. However, the year to year and decadal fluctuations in the temperature record do show evidence of influences due to solar variability, volcanic eruptions, and atmosphere-ocean variations such as intermittent El Niño warming events.

The first two points are strong indications that climate change is occurring; the next three points strongly suggest that the changes can be attributed to human factors. Together, these findings led the IPCC to conclude that humans are indeed inducing a discernible change on the global climate system.

6. Is the future climate predictable?

Yes, but only in a general sense at this time. While we can only accurately predict the weather (i.e., the specific state of the atmosphere) several days into the future, advances in modeling and observations have enabled more general climate conditions (such as a wet or dry spring) to be predicted up to a year in advance. Other models based on the complex laws of atmospheric physics and chemistry and other climate properties are being used to project climate further into the future, up to decades and centuries. These models are called General Circulation Models, or GCM's. The dominant influences of atmospheric composition, oceans and land surface, and the fundamental laws of chemistry and physics are well represented in these models, and they can accurately describe today's climate and past climate changes.

Further information:

Projecting the future climate is a two-step process:

The first step is to project how human use of fossil fuels (and the resulting emissions of greenhouse gases and sulfate aerosols) will change over the next century. These projections are in turn dependent on changes in population, technologies, and standards of living. Because of the many possibilities about what could occur, scientists have developed a range of plausible estimates (or scenarios) to use in projecting possible future conditions;

The second step requires predicting how a particular emissions scenario will change the climate, which is done using the General Circulation Models. These models have been tested by their ability to simulate past changes in atmospheric composition and the climate (such as the climate changes that have occurred through the seasons, after a volcanic eruption, or over the past century or even over geological times).

There are a number of uncertainties involved in both steps. In predicting the course of human activities, it is difficult to foresee economic, social, and environmental conditions. To deal with this problem, the IPCC has developed different scenarios to illustrate a range of plausible future population, technology, and energy use. Models to predict the response of the climate are still limited by their ability to represent complex processes, especially those related to clouds and to regional-scale feedbacks and processes. However, climate models have gone through significant testing and development in the past decade and are now better able to reproduce both large-scale and subtle features of climatic behavior. In addition, various "nesting" techniques (i.e., embedding models with finer resolution into larger-scale models) have shown significant progress in capturing regional processes and effects.

7. What do the models predict for the future climate?

General circulation models project an increase in the global average temperature of about 1.6 to 6.3 degrees F over the next century. These projections stem from model runs using a range of assumptions about technology, emissions, and population and a range of sensitivities of the climate to changes in atmospheric composition. This temperature rise compares to the warming over the past century of about 0.6 to 1.1 degrees F. For reference, since the last ice age about 21,000 years ago when there was at least 1 km deep ice over much of what is currently New York State, the average global warming is estimated to have been about 5 to 9 degrees F. The warming out of that last ice age obviously led to many major environmental changes; consequently, the projected changes over the next century must be viewed as potentially highly significant.

Increased temperatures will lead to changes in precipitation systems, affecting the location, amounts, and seasonal patterns of rain and snow. Precipitation belts will likely shift poleward. Precipitation patterns will change because the warmer atmosphere can hold more water. This will make convective rain and storm systems more intense and may lead to increased flooding in some areas. In other areas, the warmer climate may lead to more severe and prolonged drought conditions. The warming will also likely lead to changes in the frequency and severity of heat waves.

The sea level will continue to rise at an increasing rate (by about 6 to 38 inches over the next century compared to about 4 to 10 inches over the past century) because warmer water expands, and because polar ice sheets may melt more rapidly. Sea level rise will lead to greater beach erosion, and more severe flooding during coastal storms. The warmer weather will also exacerbate problems associated with air pollution and heat stress in urban areas. Additional effects on human activities and populations are discussed below.

8. Should we be concerned about these predictions?

Yes, we should be concerned. Societies around the world have developed in ways such that they are dependent on the climates that they have experienced for centuries. European agriculture is dependent on a relatively mild winter climate even though it is located at a moderately high latitude. African, Indian, and Chinese agriculture is dependent on the monsoons coming at particular times. U.S. agriculture is dependent on the timely occurrence, extent, and amount of winter snows and summer rains. Cities and communities are dependent on recurring rains to fill their water reservoirs, rivers, and groundwater.

While technology, bioengineering, and other measures can provide some buffer against climate fluctuations and change, many societal activities are highly dependent on the long-term climate that currently exists in each region. Changes in climate will necessarily alter those relationships in ways that may significantly disrupt current activities. Furthermore, changes in the patterns and frequency of extreme events could cause severe disrupting effects on societies around the world, directly affecting human lives and infrastructure.

9. How will climate change affect human activities?

Human-induced regional and global changes in temperature, precipitation, soil moisture, and sea level will add important new stresses on ecological and socio-economic systems that are already affected by pollution, increasing resource extraction, and non-sustainable management practices. Climate change will generally require adjustments in many types of human activities. While these adjustments can provide new, beneficial opportunities in some regions (e.g., the growing season may become longer in regions currently too cold for agriculture, and increased concentrations of CO₂ can enhance plant growth under certain conditions), many changes are likely to be detrimental.

The IPCC has summarized potential global-scale impacts as follows:

- Human Health will be adversely affected through increases in the rate of heat-related mortality and the potential spread of both vector-borne diseases, such as malaria, dengue, yellow fever, and encephalitis and non-vector-borne diseases such as cholera and salmonellosis.
- Food Security will be threatened in some regions of the world, especially in the tropics and subtropics, where many of the world's poorest people live. The total global food production may remain steady with climate change; however, in some areas agricultural production will increase while in other areas agricultural production will decline or even collapse.
- Water Resources will be increasingly stressed, leading to substantial economic, social, and environmental costs, especially in regions that are already water-limited and where there is strong competition among users.
- Human Habitat Loss will occur in regions where small islands and coastal plain and river areas are particularly vulnerable to sea level rise.
- Natural Ecosystems such as forests, rangelands, deserts, mountains, lakes, streams and wetlands will be degraded because the composition, geographic distribution, and productivity of many ecosystems will shift as individual species respond to changes in climate. This may lead to reductions in biological diversity and in the goods and services ecosystems can provide for society.

10. How might climate change affect the United States?

Detailed predictions of what might happen in specific regions of the world are not yet possible, mainly due to uncertainties in the projections of future emissions (especially sulfate aerosols) and to the limitations of current GCMs. However, plausible estimates of possible changes are starting to emerge.

In general, the U.S. can expect the following trends:

- More rainfall in intense downpours;
- Warmer temperatures due to both global warming and reductions in sulfate aerosols. Efforts in this country to minimize acid deposition by reducing emissions of sulfate aerosols will add to the effects of global warming;
- Drier soils because of the increased rates of evaporation during the warm season. The greater evaporation would likely more than offset the general tendency toward more wintertime precipitation; and
- Further sea level rise generally at the global average rate. In some areas the apparent sea level rise may be amplified or diminished by local changes in the rise or subsidence of particular coastal regions (e.g., in southern Louisiana, subsidence of the land will make coastal inundation more severe).

These climatic changes in turn will affect water resources, agriculture, low-lying coastal regions, natural ecosystems, the potential range of disease-carrying insects, and many other sectors of the environment and society. A National Assessment of the Impacts of Climate Change is currently underway to further assess the following regionally specific trends of the impacts of climate change in the U.S.:

- In the dry western states, the most important consequences of climate change likely relate to water resources, which provide the basis for agriculture, society, and keeping ecosystems healthy and resistant to massive fires.
- In the Northwest, the most important consequences will likely relate to the health of the forests and the types of trees that will become dominant. Other issues will likely relate to water resources, fisheries, and flooding.
- In the Midwest, the most important consequences may relate to limitations in the amount of soil moisture in the summer and whether agricultural production can be sustained.
- In the Southeast, sea level rise may lead to the most important consequences. The projected rise would start to inundate many coastal ecosystems and wetlands and further expose coastal communities to damage from hurricanes and storm surges. In addition, the warming climate may affect the mix of trees making up the forests.
- In the Northeast, the most important consequences would likely relate to effects on forest composition, water resources, and river runoff. In addition, changing ocean temperatures may lead to additional impacts on fisheries.

11. Can we do anything about global warming?

Yes, much can be done about global warming, and much needs to be done to have a significant influence. It will take collective global action to significantly limit the growth in greenhouse gas emissions because: 1) fossil fuels provide more than 80% of the world's energy and combustion of fossil fuels is responsible for most emissions of greenhouse gases; 2) the world population is rapidly growing; and 3) developing nations are industrializing and in some cases drastically increasing their emissions rates.

Perhaps the most important action we can take is to reduce our emissions of greenhouse gases. To do this we can increase our use of energy efficient technologies and renewable energy sources (like wind and solar power) for many of our energy uses such as automobiles, heating and cooling, refrigerators, and lighting. We can also preserve our current forests and plant additional trees, which remove CO₂ from the atmosphere through photosynthesis.

Further information:

The current total emission from fossil fuels use is almost six billion tons of carbon per year. There are almost six billion people in the world; thus, on average, each person on Earth emits about one metric ton of carbon per year. (These totals are sometimes expressed in terms of tons of CO₂ rather than tons of carbon. To convert to tons of CO₂, multiply by 3.67). However, these emissions are not distributed evenly around the globe. In the developing world, the per capita level is about half a ton of carbon per year, in Europe it is about three tons per person per year, and in the US and Canada it is about five tons per person per year. If the world population doubles and everyone uses as much carbon as do people in the United States, the total of global emissions would be about eight times today's global total.

Stabilizing the concentration of CO₂ in the atmosphere, which is required to stabilize the climate, will necessitate both substantial improvements in energy efficiency as well as moving away from fossil fuels as the primary source of energy for society. In addition, stabilizing the atmospheric carbon dioxide concentration at twice its preindustrial level (i.e., at about 550 ppmv) will probably require emissions of carbon dioxide to be significantly reduced, perhaps by 50 to 80% below today's levels, and reduced even more below these projected levels during the next century.

The options for reducing emissions include producing energy more efficiently, using energy more efficiently, using less energy through conservation and recycling, and producing energy in ways that do not involve the burning of fossil fuels. Capturing carbon dioxide emissions as other pollutants are captured is possible, but quite expensive. For greenhouse gases other than CO₂, it is also possible to achieve reductions by, for example, reducing leakage of natural gas, reducing emissions from soils and changing agricultural practices. Quite clearly, significant overall reductions will require a broad range of approaches.

Because societies may not be able to do as much as needed to limit global warming, preparations will need to be made to reduce potential adverse consequences. These efforts are termed "adaptation" or "adaptive responses". Options include limiting construction on low-lying lands, developing agricultural crop strains that are more tolerant of hot and/or dry conditions, increasing the resilience of human infrastructure, altering forest management practices to accommodate change, and more flexibly managing water resource systems.

12. There is a discrepancy between satellite and surface temperature data. In contrast to land and ocean measurements, some people believe that satellite measurements show that the temperature of the earth has been cooling. Why is there a difference between these two measurement techniques?

Yes, there is a discrepancy between surface measurements of temperature and satellite observations because these techniques measure different aspects of the global temperature. The issue is very complex. Both techniques of measuring temperature are influenced by a variety of sources such as localized pollution or aerosols, volcanic eruptions, and inherent differences in temperature variability depending on the nature of the substance being measured (e.g., ocean water, land, or air). When these and other factors are taken into account, however, both records indicate a warming trend over land.

Further information:

In 1979, researchers added measurements from satellite-mounted Microwave Sounding Units (MSUs) to their arsenal of global climate monitoring systems. Instead of measuring the surface temperature, these satellite instruments measure the temperature of the earth's atmosphere on a global scale. Specifically, the MSUs on the satellites are being used to calculate temperatures in two atmospheric layers: the lower troposphere, from 1-7 km above ground (or ~5,000 to 30,000 feet), and the lower stratosphere, which is between 17 and 21 km above ground. These layers of the atmosphere and the earth's surface differ in their patterns of temperature variation.

This record is expected to differ from the surface temperature record for several reasons. For example, over continental regions, the surface temperature shows greater variation in response to warming from solar energy than does the thick layer of air above the land; in contrast, the sea-surface temperature shows even less temperature variability because of the oceans' great thermal inertia. Additionally, surface temperature records do not have complete geographical coverage, and may be overly influenced by problems such as changing land use adjacent to the thermometer station, and an urban heat-island effect. Despite these differences, the MSU dataset is perhaps the most robust measure of the Earth's bulk atmospheric temperature, because of its precision and global coverage.

Relatively short-term, major events such as the volcanic eruptions of Mt. Pinatubo (1991) and El Chicon (1982), as well as the oceanic cooling during El Niño events, explain over 60% of the monthly variation in the MSU tropospheric temperature record. Additionally, air pollutants such as aerosols tend to cool the surface and lower troposphere. Without these "cooling" effects, the global temperature record (as measured by the MSU satellite) has risen over the last 18 years by $+0.06^{\circ}\text{C}/\text{decade}$, while GCM's have predicted a warming rate of $+0.08$ to $+0.30^{\circ}\text{C}/\text{decade}$ over the last few decades.

That the MSU satellite measurements differ from the land- and ocean-based temperature records, as well as from GCM predictions of past climate, underscores the need for further research to better understand the complexity of the Earth system and the global temperature record.

13. Who are the global warming skeptics? Do they have a "hidden agenda"?

In the United States, the vast majority of scientists support the conclusions presented in the IPCC Assessment Reports. A relatively small group of organized and very vocal scientific skeptics have managed to make their voices heard, which has resulted in confusion for many policy makers, media people, as well as the general public. In many cases, these skeptics are either members of the fossil fuel industries, or directly funded by these industries. For example, the Global Climate Coalition is comprised of people from coal, oil, utility, railroad, and manufacturing companies. Their campaign tends to misrepresent the science as quite uncertain, as well as exaggerate the economic costs of shifting away from the coal and oil energy resources. Clearly, they have a vested interest in clouding the state of the science, and scaring policy makers and the public into inaction. Continuing to burn large quantities of fossil fuels ensures their financial future.

Further information:

The IPCC and the "scientific consensus"

The Intergovernmental Panel on Climate Change evolved as a mechanism to bring together the leading scientists involved in the study of climate change, and draw conclusions about what is known and unknown about the issue. Rather than predicting exactly what will happen, the IPCC uses various techniques to reflect uncertainties: illustrating multiple scenarios of plausible futures, using ranges rather than point estimates, and developing language to denote levels of confidence in different conclusions. Based on this rigorous process involving extensive review, the vast majority of scientists involved in the relevant research agree with the IPCC findings and with the tone of the conclusions that human influences will affect the global climate.

For virtually all issues, there typically will remain critics whose focus is nearly exclusively on what is not known rather than what is known. These critics seem to get a lot of attention simply because they challenge the majority. In this case there are major economic decisions involved. The basic argument of the critics is that climate change is not an issue that should be occupying society's scarce resources either because (a) it won't happen; (b) something may happen, but it is unlikely to be significant (or may be beneficial); or (c) something will happen, but the costs of solving the problem are not worth the benefits. They frequently challenge the evidence that any documented change can be attributed to a human influence, argue that the available models cannot be relied upon to simulate future changes, and question the findings and procedures of the IPCC. While some climate change critics can point to valuable gaps in our knowledge, they often do not mention all of the supporting evidence and focus instead on the unexplained results. They often present uncertainties in ways that ignore how the IPCC authors have addressed their concerns.

It is, however, not useful to argue that the majority of scientists are correct and the minority of critics are incorrect, simply because of the numbers. Science is not a democratic process depending on a vote. Rather, we must look at the strength of the evidence, the specific arguments of the critics (and responses to these arguments), and the nature of what is being debated. Some arguments appear to be legitimate attempts to offer original evidence, while others seem to be intentional efforts to distort information and statistics.

14. How can one say that the warming since the last century is due to greenhouse gases when most of the warming occurred before about 1940 while most of the increase in greenhouse gases has been since that time?

One of the tests of the greenhouse theory is whether the temperature record of the past century is consistent with what we would expect, given the additional emissions of greenhouse gases from human sources. The past century is a useful testing ground because this is when we began emitting additional gases and because we have instrument-based temperature records for this period of time. So in addition to the magnitude of the change, we are particularly interested in the patterns and timing of the temperature increase over this period of time.

Some argue that most of the net warming that has taken place occurred before 1940 and yet most of the increase in greenhouse gases has been since that time, which would thus contradict the theory that the warming was attributable to the increased emissions from human activities. However, this is not a careful reading of the actual record, nor is it a good understanding of the temperature trend.

In the surface station temperature record, about half of the warming since the middle of the last century occurred before the 1940s and about half has occurred since. The first decade of this century was relatively cold -- possibly due to the large volcanic eruptions during this period -- making the temperature change and the trend from early this century to about 1940 look particularly steep. It is this anomalously large change that the critics subtract off from the IPCC change from 1860 to the present, giving an overly small estimate of greenhouse-induced warming.

Another issue is the addition of aerosols to the atmosphere, which reflect solar energy and tend to cool the earth. Starting near the middle of this century, emissions of sulfur dioxide (a precursor of sulfate aerosols) introduced a strong cooling influence. This was particularly significant where the emissions came from elevated stacks that increased the lifetime of the sulfate aerosols from a few days to roughly a week. There are significant differences in the Northern and Southern Hemispheres: between the 1940s and the early 1970s, there was a cooling of the Northern Hemisphere while Southern Hemisphere temperatures remained nearly constant from the 1940s to about 1970. This trend is just what scientists would have predicted because, far more sulfur dioxide is emitted in the Northern Hemisphere than in the Southern Hemisphere, causing more aerosol cooling in the North. Since 1970 warming in the Southern Hemisphere has been observed that has sustained.

I. THE CLIMATE SYSTEM AND THE GREENHOUSE EFFECT

(DRAFT - NOT FOR QUOTATION OR ATTRIBUTION)

A natural greenhouse effect keeps the Earth about 60°F warmer than it otherwise would be. Without this greenhouse effect, life as we know it would not be possible. Water vapor, carbon dioxide (CO₂) and other trace gases, such as methane, nitrous oxide, and hydrofluorocarbons (HFCs), trap heat as it is re-radiated from the Earth back to space. Since pre-industrial times, human activities have added to the natural greenhouse effect by releasing greenhouse gases into the atmosphere. These emissions have led to a steady increase in the concentrations of greenhouse gases in the atmosphere (figure 1).

- The atmospheric concentration of carbon dioxide (CO₂) has increased by about 30%.
- Methane concentration has more than doubled.
- Nitrous oxide concentration has risen by 15%.

The burning of fossil fuels (coal, oil, and gas) for energy is the primary source of CO₂ emissions, accounting for about 85% of US annual totals; changing land-use patterns through agriculture and deforestation also contribute a significant share.

On a global scale, burning of fossil fuels releases about 6 billion metric tons of carbon into the atmosphere each year. Changing land use patterns from forestry and agriculture contribute about another 1-2 billion metric tons per year. Emissions of other greenhouse gases from a variety of industrial and agricultural processes effectively add about 20% to these totals.

Without intervention, the level of emissions and concentrations of greenhouse gases will continue to increase, resulting in a variety of global, regional and local effects. Global average temperature will rise, although there will be considerable variation of temperature increases on the regional scale. The Earth's water cycle will intensify, with an overall increase in evaporation and transpiration (water loss from plants), as well as precipitation -- both rain and snow. More precipitation will occur in "extreme" downpours, where large amounts of rain fall in a short period. Some areas will be threatened by increased flooding, while others will suffer through an increased incidence of drought as the interior of continents warms and dries. Sea level will rise, due primarily to the thermal expansion of the oceans and the melting and retreating of glaciers.

The Second Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) describes a series of changes that have already been observed:

- Over the last century, the global mean (average) surface temperature increased by about 0.5° - 1.0°F.
- Over the same period, global mean sea level has already risen 4 to 10 inches.
- Mountain glaciers have retreated world-wide this century.
- The surface temperature this century is as warm or warmer than any century since at least 1400 AD.

- The last few decades have been the warmest in this century, the ten warmest years this century have all occurred since 1980, and 1995 was the warmest on record.

A paper published in the April 17, 1997 issue of *Nature* (Mynemi, et al) presented compelling evidence of significant regional ecosystem response to warming experienced during the period 1981-1991:

- Over that 10 year period, high latitudes (between 45° and 70° North) sustained a longer growing season, and an advance of up to seven days in “greening” in spring and summer,
- These latitudes appear to be experiencing an increase of approximately 10% in photosynthetic activity, possibly due to the longer growing season and increased CO₂ fertilization.

Precipitation trends over the last century show that global precipitation has increased. Change can also be seen in United States precipitation trends. In the May 1997 issue of *Scientific American*, Tom Karl reviews the records of total rainfall and extreme rainfall for the United States over the last century:

- Total precipitation has increased by about 6 percent since the beginning of the century, as has the frequency of heavy downpours.
- Since the beginning of this century, these intense precipitation events have increased by about 20%. Such events lead to flooding, soil erosion and even loss of life.

Global warming, the global intensification of the water cycle, and the rise in sea level observed over the past century are all consistent with predictions from global climate change models. Estimates of future changes include:

- Global surface temperature is projected to increase an average of another 2-6° F by 2100, with significant variation by region. Temperature change of this magnitude would be faster than any observed changes in the last 10,000 years.
- Global mean sea level is projected to rise another 6 to 38 inches by the end of the next century.
- The rate of evaporation is expected to increase as the climate warms, leading to an increase in average global precipitation as well as frequency of intense rainfall and floods in some regions. In some regions, the soil moisture will decrease, leading to increased frequency and intensity of droughts.

Most of the climate impacts have been evaluated for a world at equilibrium after a doubling of greenhouse gases. But a doubled greenhouse gas world is one in which intervention has occurred. A continuation of business as usual implies a world with far higher concentrations and far greater effects. The Geophysical Fluid Dynamics Laboratory at Princeton has recently modeled the effects of doubling and quadrupling the level of greenhouse gases and compared the results:

- A quadrupling of such concentrations is likely to increase temperatures in North America by 15 to 20° F, as opposed to the 2 - 6° F expected from doubling.
- In the growing season, soil moisture deficits would approach 30 - 50%, as opposed to 10 - 30 % for a doubling.

II. GLOBAL EMISSIONS & ATMOSPHERIC CONCENTRATIONS

(DRAFT - NOT FOR QUOTATION OR ATTRIBUTION)

Models have been used to project future emissions and atmospheric concentrations of CO₂ and other greenhouse gases. These models incorporate assumptions about future population growth, per capita energy demand, and changes in technology. In the most widely reviewed of these activities, the Intergovernmental Panel on Climate Change (IPCC) defined a “business-as-usual” case which assumed that technology continues to improve at historical rates. The IPCC business as usual simulations show that current annual emissions of 6 billion metric tons of carbon could grow to 15 billion tons per year by 2050 and 20 billion tons per year by the end of the next century. Carbon Dioxide is clearly the most important greenhouse gas.

Over the same period, human-related emissions of other greenhouse gases is also likely to increase. Despite the fact that their emissions are lower, these other gases play a significant role in greenhouse warming, adding about 20% to the effect of CO₂ alone. Methane has a much shorter atmospheric lifetime than CO₂, but is estimated to be 21 times more effective at trapping heat in the atmosphere over a 100-year period. Nitrous oxide is 320 times more powerful than CO₂ over a 100-year period. Some of the hydrofluorocarbons are thousands of times more powerful, and once emitted, effectively reside in the atmosphere permanently.

These large increases in emissions would lead to an increase in the atmospheric concentration of CO₂ and other greenhouse gases, and increase the radiative forcing (or warming potential) of the atmosphere. The IPCC business as usual scenario indicates that even with continued technological improvement, unless policies to control emissions greenhouse gases are implemented, the atmospheric concentrations of these gases will be much higher by 2100 (Figure 2):

- CO₂ concentrations would reach about 710 parts per million by volume (ppmv).
- Other gases will add at least 20% to this total on a carbon equivalent basis.
- For context, pre-industrial levels of CO₂ were about 280 ppmv, and have increased to the current level of about 360 ppmv.

Even if it were possible to freeze global emissions today, concentrations would nonetheless continue to rise throughout the next century and beyond, eventually exceeding a doubling of pre-industrial CO₂ levels. Freezing emissions, which continues to add greenhouse gases to the atmosphere at a constant rate, will not lead to a stabilization of atmospheric concentrations (Figure 3).

Since the IPCC Second Assessment report was published in 1996, the relationship between annual emissions and stabilization of greenhouse gas concentrations in the atmosphere has been examined. Figure 3 shows the results of one analysis that tried to outline the optimal economic pathways (Wigley, Richels, Edmonds, *Science*, 1996) to meet atmospheric carbon concentration targets of 450 to 750 ppmv (for CO₂ only).

- Each target requires significant reductions in projected global carbon emissions; and all of them require dramatic reductions in annual emissions rates sometime during the next century .
- To achieve a 450 ppmv target – which represents a two-thirds increase in atmospheric concentrations over pre-industrial levels – reductions in the growth rate of worldwide annual emissions must begin by 2007, and emissions must fall to about half of current levels by 2100.
- To achieve a 550 ppmv target – which represents about a doubling in atmospheric CO₂ concentrations – reductions in the growth rate of worldwide annual emissions must begin by 2013, and overall emissions must begin declining steeply during the second quarter of the century.

If we look at emissions on a global scale:

- Of the 6 billion tons of carbon currently emitted each year, approximately 65% come from developed countries, and 35% from developing countries.
- The U.S. is currently the largest emitter of carbon dioxide, with China the second largest source.
- If current trends continue, developing countries will account for 50% of total global emissions by 2035, and China will have become the largest emitter (Figure 4).
- Because of the long-lived nature of these gases, the atmospheric reservoir of carbon in 2100 will remain dominated by decades of emissions from the developed world .

If emissions are examined on a per capita basis, there is a dramatic difference between the developed countries and the developing world. Despite substantial growth in total emissions from developing countries, per capita differences between Annex I and non-Annex I countries would remain large under a business as usual scenario.

- On a per person basis, the U.S. currently emits about 5 tons of carbon per person, compared to an average of approximately 3 tons per person in Japan and Western Europe, and 0.4 tons per person in developing countries.
- If current trends continue, in the year 2100 developing countries would be emitting slightly more than 1 ton of carbon dioxide per person each year whereas the developed world would be emitting close to 5 tons per year for each individual.
- If the world wanted to keep CO₂ from exceeding a doubling, per capita emissions would have to approach .5 tons per person per year.

III. VULNERABILITIES TO AND IMPACTS OF CLIMATE CHANGE

Although there is scientific uncertainty about exactly how and when the Earth's climate will respond to increased concentrations of greenhouse gases in the future, observations clearly show that detectable changes are underway and that ecological systems are responding to these changes. Numerous efforts are underway to assess the vulnerability of ecological, social and economic systems to future changes by defining plausible future scenarios of climate change and using model simulations to evaluate sensitivities to various levels and types of change.

An extensive body of research suggests that human health and ecological systems are vulnerable to climate change. The human-induced climate changes that are expected will add important new stresses on ecological and socio-economic systems that are already affected by pollution, increasing resource extraction, and non-sustainable management practices. The magnitude of climate change impacts will be determined by the degree of vulnerability, and the amount and rate of change that is experienced in addition to existing stresses.

Most estimates of the effects of climate change are those associated with a doubling of the pre-industrial concentration of carbon dioxide to approximately 550 ppmv, or an increase in all greenhouse gas concentrations that together would have an equivalent capacity to trap heat. These analyses also assume that the sensitivity of the climate system itself to this change falls in the middle of the range outlined by the IPCC. If the actual sensitivity is lower than projected, impacts will be less; if it is higher, impacts will be more severe than described here.

The climatic changes that would result from an equivalent doubling of carbon dioxide would have pervasive effects, some of them irreversible, on ecological systems, human health, and socio-economic sectors. A lower atmospheric concentration could result in less severe impacts, while a higher concentration would likely have more severe impacts. The following sections describe a range of climate change vulnerabilities and predicted impacts of a doubling of the atmospheric concentrations of greenhouse gases.

Health Effects

According to the World Health Organization, the vulnerability of human populations to climate change varies across populations depending on environmental circumstances, social resources, and preexisting health status. In general, developing countries are more vulnerable to climate change than developed countries because of their limited capital and their greater dependence on natural resources. The elderly and children are the most vulnerable segments of the population. Climate change increases the risk of heat-related mortality and the potential for the spread of vector-borne diseases, such as malaria, dengue and yellow fever, and encephalitis, and non-vector borne diseases such as cholera and salmonellosis. The incidence of infectious diseases, which are still the world's leading cause of fatalities, may also increase .

- A study of deaths associated with summer time heat stress and winter time illnesses in 44 US cities estimated that climate change could double the number of weather related deaths (See Figure 6). The elderly are at greatest risk in the US and urban populations in developing countries are also especially vulnerable to heat stress.
- Climate change is likely to extend the geographic ranges of disease-carrying vectors such as mosquitoes, which can increase the populations exposed to diseases such as malaria, dengue and yellow fever. Globally, the population potentially exposed to malaria could increase by one-third, with a possibility of 50-80 million additional malaria cases per year.
- Climate change can reduce air quality and increase levels of air borne pollen and spores which exacerbate respiratory disease, asthma, and allergic disorders.

Water Resources

Among the most fundamental effects of climate change is an intensification of the hydrological cycle. Changes in precipitation, and increased evaporation and transpiration due to higher temperatures, can be expected to reduce water runoff, affecting the quantity and quality of water supplies for domestic and industrial uses, irrigation, hydropower generation, navigation, stream ecosystems and water based recreation. These affects will vary region by region. Increased variability in the hydrologic cycle is expected to result in more severe droughts and/or floods in some places but less severe in others. Impacts and mitigation expenses for such events are significant; damage estimates from the Mississippi flood of 1993 range from \$10 billion to \$20 billion. Areas of greatest vulnerability are those where water supplies and quality are already problems, such as arid and semi-arid regions of the world and some low lying coastal areas, deltas and small islands.

- Climate change would likely add to the stress in several US river basins, such as the Great Basin, California, Missouri, Arkansas, Texas Gulf, Rio Grande, and Lower Colorado.
- The Colorado River Basin would suffer decreased summer runoff, coinciding with peak demand for irrigation, unless precipitation also increases substantially. Reductions in runoff of up to 25 percent in the basin are projected under some scenarios of doubled CO₂ equivalent climate change.
- Runoff losses of this magnitude in water short regions such as the Colorado River basin are likely to adversely affect water deliveries, exacerbate salinity problems, reduce hydropower generation, and reduce water storage in reservoirs.
- Water scarcity in Middle Eastern and African countries also is likely to be exacerbated by climate change. Countries which are highly dependent on water originating in areas outside their borders include Syria, Sudan, Egypt and Iraq.

Forests

One-third of the Earth's forests would undergo a major change in the type of vegetation that could be supported as a result of an equivalent doubling of CO₂. In northern forests, which are the forests most vulnerable to climate change, two-thirds of the currently forested area may undergo a change in vegetation type. Climate change can dramatically alter the geographic distributions of individual tree species and of forest and vegetation types (Figure 7). Mountain-top species and isolated populations are particularly vulnerable (Figure 8)

Over the next century, the ideal range for some North American forest species will shift by as much as 300 miles to the north, exceeding the ability of forests and other ecological communities to migrate. In some instances, a change in vegetation type will result in a loss of forest area as the land converts to grassland or shrubland (Figure 8).

- Globally, forested areas may decline 10 percent after forests reach a new equilibrium under a new doubled CO₂ climate.
- In the United States, western conifer forests could decrease in area and be replaced by broadleaf forests; eastern hardwood forests may be replaced by grasslands along their western boundary because of mid-continental drying. Forest damage from fire and diebacks driven by drought, insects and disease could increase.

Other Natural Areas

Natural ecosystems are highly vulnerable to degradation from climate change. Federally protected natural areas have become a repository for the Nation's rarest species and are critical for the conservation of biological diversity. Nearly \$3 billion is spent annually to manage, maintain, restore, and protect these lands. Climate change may threaten this substantial national investment. The composition, geographic distribution, and productivity of many ecosystems will shift as individual species respond to changes in climate. This will likely lead to reductions in biological diversity and in the goods and services ecosystems provide for society, such as clean water and recreation. Freshwater wetlands are particularly at risk from climate change. IPCC findings show that:

- Precipitation changes and salt water intrusion from sea level rise could adversely affect the ecological communities of the Florida Everglades and degrade the habitat for many species of wading birds.
- The wetlands of the prairie pothole region of North America, which support half the waterfowl population of this continent, could diminish in area and change dramatically in character in response to climate change.

Coastal Areas

Even if concentrations of greenhouse gases are stabilized in the future, sea level would continue to rise long after, perhaps for several centuries, and reach levels much higher than projected for the next 100 years. For example, after an equivalent doubling of CO₂, the IPCC expects sea level to rise by 15 - 95 cm over the next century, with a “best estimate” of 50 cm, but the equilibrium sea level rise several centuries in the future is estimated to be at least 2 meters. Rising sea level erodes beaches and coastal wetlands, causes the gradual inundation of low lying areas, leading to human habitat loss and increasing the vulnerability of coastal areas to flooding from storm surges and intense rainfall. The IPCC estimates that 50 cm of sea level rise would double the population at risk from storm surges, from roughly 45 million at present to over 90 million world-wide. A one meter rise would triple the number of people exposed. Increases in coastal area populations are likely to further increase the number of people at risk.

- Along US coasts, a 50 cm rise could inundate more than 5000 square miles of dry land, and an additional 4000 square miles of wetlands if not protective measures are taken. A 1 meter rise would have greater impact. Figure 9 illustrates the effect of a 1 meter rise on Florida.
- Internationally, low-lying areas, such as parts of the Maldives and Bangladesh, would be completely inundated by a 1 meter sea level rise, creating large numbers of environmental refugees which put stress on governments and social structures.
- A 1 meter sea level rise would affect 72 million people in China, assuming existing levels of coastal development.

Agriculture and Food Supply

Agriculture is highly dependent on a number of variables that are likely to be affected by climate change, including weather patterns, longer term patterns of climate variability, and, most importantly, water availability. Climate strongly affects crop yields. Doubling of equivalent CO₂ are likely to lead to increased crop yields in many areas, but decreased yields in others, even for the same crop. The magnitude of these changes can exceed +/- 30 or 40 percent for some crops and locations.

Despite these potentially large changes in yields, average global food production is not expected to change substantially. This is because farming practices are considered to be highly adaptable to different climates, because production of important food crops can shift to new locations in response to changes in climate, and because CO₂ has beneficial effects for plant photosynthesis and water use efficiency that can offset some deleterious effects of changes in climate. Impacts are likely to vary considerably across regions and some regions may suffer substantial reductions in agricultural production.

- Large reductions in soil moisture could significantly reduce flexibility in crop distribution and increase demands on water resources infrastructure.

- Increases in the range of pest habitat could increase vulnerabilities to pests and demand for, and use of, pesticides.
- In the United States, large areas of the eastern and central regions of the country face moderate to severe drying. Drought could become more frequent, particularly in the great plains.
- Developing countries are more vulnerable to losses than are developed countries (See Figure 10).

Conclusion

The ultimate aim of the Framework Convention on Climate Change is "... stabilization of greenhouse gas concentrations at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to: (i) allow ecosystems to adapt naturally to climate change; (ii) ensure that food production is not threatened; and (iii) enable economic development to proceed in a sustainable manner."

The rates of change already imposed on the climate system are the faster than any experienced during 10,000 years, during which modern civilization has developed. Current emissions trajectories, if not altered, could take us to an atmospheric concentration of CO₂ not seen on this planet during the last 50 million years. While much work remains to be done to improve the precision of impacts estimates, the increasingly apparent risk of the rapidly changing atmosphere argues that mitigation and adaptation measures are warranted.