

**White House Conference on
Global Warming and Climate Change
Draft Agenda**

10:00 - 10:05 Vice President Gore: *Welcome attendees; Introduces President Clinton*

10:05 - 10:20 President Clinton: *Opening Remarks:* Importance of Global Warming and Climate Change for the American People.

10:20 – 11:20 Science Panel Discussion:

Presenter: John Holdren, Harvard University:

11:30 – 12:30 Emission Reduction Technology and Policy Roundtable

Presenter: Robert Rubin, Secretary of the Treasury

12:30 – 2:00 Lunch

2:00 – 3:00 Kyoto Conference and U.S. National Interests Roundtable

Presenter: Madeleine Albright, Secretary of State

3:15 – 4:15 Breakout Sessions

4:30 – 5:00 Vice President Gore: *Closing remarks:* The Road Ahead

5:30 – 6:30 White House Reception

10:00 – 10:05: Welcome

The Vice President will welcome attendees to the conference, and introduce the President.

10:05 – 10:20: Opening Remarks:

The President's opening remarks will be his opportunity to speak to the American people in a substantive way about global warming and climate change. His remarks should foreshadow the day's events, endorsing the scientific consensus behind climate change, asserting the importance of this issue to the American people, outlining that action will need to be taken, and embracing the broad outlines of the U.S. negotiating position going into Kyoto.

10:20 – 11:20: Science presentation:

Goal: To concisely describe what global warming and climate change are, and to present conclusively the scientific case that they are occurring, that they have real consequences for the American people, and that action is needed to limit greenhouse gas emissions.

Physical science and impacts of global warming and climate change: John Holdren, Professor of Physics at Harvard University, will deliver a 15 minute lecture, using slide and video graphics to display three central aspects of global warming science: the physical processes that are underway, the impacts they may have on the United States and the rest of the world, and the level of certainty within the scientific community that global warming is really happening.

What is global warming and climate change: sources of greenhouse gases emissions; emission trends and projections; temperature and climate trends and projections;

What are the global impacts: increased storm activity; global sea rise; changes in arctic and tropical regions; changing soil, plant and water ecosystems; shifting diseases vectors; surprises.

How conclusive is scientific evidence for global warming: IPCC report; certainties and uncertainties of human fingerprint and of future projections of temperature, changing weather patterns, sea level rise, etc.

Discussion: Using Holdren's remarks as a point of departure, the President will then lead a conversation with a panel of three other scientists covering the science in more detail.

What this means for the United States: What are the likely or possible regional impacts within the U.S.? Are there any indications that climate change may already be occurring?

What most scientists say about skeptics arguments: Some say that the atmosphere is cooling rather than getting warmer: which measurements are we supposed to believe? Some people say the relevant warming has all happened before 1940, and that we may be entering a cyclical trough period: how can we tell that temperatures will continue to rise?

Why we need to act now: What will be the difference if we take steps now or twenty years from now? Won't our emissions reductions be dwarfed by the vast emissions that will come from the developing world later this century?

Panelists:

Robert Watson, Incoming Head of IPCC: nature of scientific certainty and international consensus, emissions concentrations and atmospheric temperatures.

[Diana Liverman, University of Arizona, Chair of National Academy of Science Committee on the Human Dimensions of Climate Change; or Barrien Moore, UNH]

[Jim McCarthy, Harvard University:]

11:30 – 12:30: Emission Reduction Policy Panel

Goal: To discuss policy options that allow us to reduce emissions without hurting our economy.

Opening presentation: Secretary Rubin should frame the discussion by giving an overview of where emissions come from domestically, and by reviewing what would be the key elements in a national policy to reduce emissions.

Where emissions come from: Heavy industry, broad utility energy supply to homes and businesses, and transportation account for 95% of emissions.

National targets: US will adopt a nation-wide binding emissions target.

Regulating emissions: Past regulatory experiences display a range of available options for limiting emissions: command regulation, market oriented trading system of emission permits (possibly including international trading and joint implementation), carbon tax.

How to reduce emissions: Across emissions sources, savings can be made in three key areas: more carbon-efficient uses of fossil fuels; development of alternative fuel sources (solar, wind, biomass); dissemination of existing energy efficiency technologies.

Discussion: The President would then lead a discussion that explores two central themes: possible emission reduction technologies and trading mechanisms and an assessment of the likely impact on our economy. For each theme, the President would ask key questions.

Trading and Technology: Is emissions trading the way to go? How have previous emission trading regimes worked? How can they be combined with other emission allocation systems? How can technology help reduce greenhouse gas emissions? What are the most promising technologies? Which efforts are likely to work best and how can government best support them?

Economy: Can we do this in a way that won't hurt the economy? In which industries are we likely to face challenges? In which are we likely to generate opportunities?

Participants: (ten from the following tentative list, pending review)

Ken Lay, Enron: gas and renewable energy specialist

Fred Buckman, PacifiCorps: utility participating in a CO2 offset program

Linn Draper, AEP: major coal utility that has taken voluntary actions

Johnson Controls: energy efficiency experts;

Robert Shapiro, Monsanto: strong on innovation and technology;

Michael Porter, Harvard Business School

Richard Sandor, Centre Financial & Chicago Board of Trade

Fred Krupp, EDF: working with industry to forge a consensus on early action, JI

Robert Solow, MIT: co-author of economists' letter on climate change

John Sweeney, AFL-CIO: broad overview of organized labor

William Nordhaus, Yale University

Robert Repetto, WRI

2:00 – 3:00: International Negotiations Panel

Goal: To communicate the global nature of the problem; to identify the key issues outstanding in the negotiations; and to build support for the U.S. negotiating position.

Opening Presentation: Secretary Albright would introduce the international component of the climate change debate, with a focus on the Kyoto negotiation. She would provide a brief background on the Rio Climate Treaty, the Berlin Mandate, and the Geneva Declaration as setting the scene for the ongoing negotiations. After describing the U.S. position, she would summarize the current positions of key countries or country groupings (i.e., the EU, China, and the G-77).

The presentation should outline the breakdown of current and projected emissions from the OECD vs. the developing world. While underscoring the importance of reducing developing country emissions, Secretary Albright should make clear that such emissions must peak at a later date than ours, that this is a precedent used successfully in other global agreements (i.e. ozone), and that this will protect the environment. More broadly, climate change is a major foreign policy challenge in a post-Cold War world and U.S. leadership is vital to solving it.

Discussion: The Vice President would then lead a discussion, keying off the following questions:

The EU proposes reducing emissions 15% below 1990 levels by 2010. How do they expect to do it? Is such a target possible for us? How important are our proposals on flexibility for implementing the agreement, including joint projects with developing countries, banking and borrowing, and trading. How would a trading system work?

- Environmentally, what kind of emissions path does the developing world need to follow? What are the economic implications of having their emissions peak at a later date?
- Are emissions reduction strategies underway in the developing world? What are realistic obligations for developing countries to adopt in Kyoto with respect to their current and future emissions? How can the U.S. help developing nations achieve greater reductions?
- Is there a national security dimension to climate change?

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Dan Esty, Yale University (negotiations status)

Sen. Robert Byrd (developing countries)

John Browne, BP (need for global action, EU?)

Roger Sant, AES (international energy, JI)

Michael Bonsignore, Honeywell (developing countries, flexibility)

Frank Wisner, Former US Ambassador to India (reality check on developing country participation)

Gus Speth, Director UNDP (developing countries, what US can do to help)

Jessica Matthews, Carnegie Foundation (national security)

Daniel Yergin, Author (national security)

Jonathan Lash, WRI (emissions paths for developing countries, importance of JI)

John Adams, NRDC (emission reductions)

E.O. Wilson, Harvard University (Forests)

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William Nordhaus, Yale University

Robert Repetto, WRI

- *Wacker* - CEO of GE.
- *Ag* - Monsanto or Georgia Pacific.

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 Jonathan Lash, WRI (emissions paths for developing countries, importance of II)
 John Adams, NRDC (emission reductions)

WH Conf Facs

Rosina M. Bierbaum 10/01/97 06:43:11 PM

Record Type: Record

To: Todd Stern/WHO/EOP, William J. Antholis/OPD/EOP
cc: Jonathan H. Adashek/WHO/EOP
Subject: Wolfensohn's points

FYI, as submitted by Watson somewhere between the Maldives and Munich. Rosina

----- Forwarded by Rosina M. Bierbaum/OSTP/EOP on 10/01/97 06:41 PM -----



Malegre @ worldbank.org
10/01/97 06:29:00 PM

Record Type: Record

To: Rosina M. Bierbaum
cc:
Subject: White House Climate Change Conference

MIME-Version: 1.0
Content-type: text/plain; charset=ISO-2022-JP
Content-transfer-encoding: 7BIT

Rosina,

Per your request, these are the key issues that Mr. Wolfensohn would address:

1. The IPCC makes a convincing case that human activities are already changing the Earth's Climate System, and that unless there is a concerted effort to reduce the projected emissions in greenhouse gases the Earth's climate will warm significantly, sea level will rise and precipitation patterns will change.
2. These projected changes in climate will, in many regions of the world, have adverse effects on :
 - ? human health (increase in vector borne diseases such as malaria and dengue);
 - ? ecological systems (especially coral reefs);
 - ? agriculture (decreased production in the tropics), forestry, and fisheries;
 - ? human settlements \$B!> (Btens of millions of people will be displaced by sea level rise and whole cultures may disappear \$B!> (Bsmall Island States.
3. Developing countries will be more vulnerable than developed countries, especially the poor in these countries.

4. Progress in reducing greenhouse gas emissions since Rio has been very disappointing so Kyoto needs to be successful if the climate system is to be protected.

5. While there is no debate that protection of the climate system will eventually need all countries to limit their greenhouse gas emissions, it is imperative that developed countries (in particular the U. S.) and countries with economies in transition take the lead and agree to limit their greenhouse gas emissions (This should be quite feasible given that many cost-effective strategies (technologies, policies and practices) exist to start limiting greenhouse gas emissions.

6. In the short-term, developing countries need to increase their production and consumption of energy to alleviate poverty and underdevelopment. At a later date they too will need to limit their greenhouse gas emissions, recognizing they would have differentiated responsibilities.

7. The Bank believes that the Convention would be facilitated, as would all Parties to the Convention, if joint implementation with crediting were allowed:

- ? the Bank is willing to develop a Global Carbon Fund (an approach to trading carbon whereby developing countries and countries with economies in transition get new technologies and a share of the OECD cost savings).

8. The challenge is to assist developing countries produce and consume energy in the most climate-friendly manner even if they have no specific obligations to reduce greenhouse gas emissions: In addition to the Global Carbon Fund, the World Bank is ready to assist by:

- ? Working with developing countries to develop appropriate sector and macro-economic frameworks that encourage efficient production and consumption of energy and stimulate private sector investment;
- ? Mobilizing grant resources through the Global Environment Facility to pay the incremental costs of more climate-friendly technologies.

WH Panels

September 22, 1997

Mr. James D. Wolfensohn
President, International Bank
for Reconstruction and
Development (World Bank)
1818 H Street, NW
Washington, DC 20433

Dear President Wolfensohn,

It is my honor to invite you to participate in the upcoming White House Conference on Climate Change to be held October 6, 1997 at Georgetown. The conference will include four panels, chaired by the President and/or the Vice President, focusing on science, technology, international issues and economics. We are interested in having you serve as a panelist on the international panel to discuss the Kyoto Conference and efforts to craft an international framework agreement to reduce greenhouse gases.

This panel will begin with an opening presentation by Secretary of State Madeline Albright. The goal of the panel is to discuss the global nature of the climate change problem and identify key issues outstanding in the negotiations. Having listened to your presentation at Tim Wirth's luncheon a few weeks ago at the State Department, I know you could make an important contribution by discussing among other things, the nature of a meaningful, equitable role for developing countries in a framework agreement.

As you know, we are regrettably working in a tight time frame, so I would be very grateful if you could let me know as soon as possible whether you are available to participate in this discussion. I very much hope you will be able to join us.

Sincerely,

Todd Stern,
Assistant to the President
And Staff Secretary

PODESTA
associates, inc.

WH Panels C

97 SEP 25 PM 1:28

FAX COVER PAGE

TO: TODD STERN

THE WHITE HOUSE

FAX #: 456-2215

Code: 564

DATE: 9/25

FROM: REID DETCHON

NUMBER OF PAGES INCLUDING COVER SHEET: 3

MESSAGE

HERE ARE 5 SUGGESTIONS. THANKS FOR ASKING!

PLEASE CALL IF YOU NEED ANY DETAILS

OR EXPLANATION.

Reid

IF A PROBLEM OCCURS WITH THIS TRANSMISSION, PLEASE CALL (202) 393-1010

Leading company commercializing cellulosic ethanol:

Stephen J. Gatto
President and CEO
BC International Corporation
Dedham Executive Center
990 Washington Street
Suite 104
Dedham, MA 02026
Phone: 617-461-5700
FAX: -2626

Company commercializing biomass gasification for power:

Albert J. (Bert) Smith, Jr.
President
Brightstar Synfuels Co.
2050 Post Oak Road, Suite 500
Houston, TX 77056
Phone: 713-960-7128
FAX: -7172

Company developing ethanol-based alternative fuel:

Merrick G. (Rick) Andlinger
President and CEO
Pure Energy Corporation
One World Trade Center, Suite 4573
New York, NY 10048
Phone: 212-938-6923, x223
FAX: 839-0383

Growing photovoltaic company, former Assistant Secretary for Conservation and Renewable Energy:

J. Michael Davis, P.E.
President
Golden Genesis
Golden Technologies Co., Inc.
1697 Cole Blvd., Suite 300
Golden, CO 80401
Phone: 303-384-1780

Major utility developing an energy crop (willow) for co-firing in coal boilers

Albert J. Budney
President & COO
Niagara Mohawk Power Corp.
300 Erie Blvd. West
Syracuse, NY 13202
Phone: 315-428-6489
FAX: -3406

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11:30 – 12:30 Emission Reduction Technology and Policy Roundtable

Presenter: Robert Rubin, Secretary of the Treasury

12:30 – 2:15 Lunch: Remarks by First Lady Hillary Rodham Clinton

Breakout Sessions

2:15 – 3:15 Kyoto Conference and U.S. National Interests Roundtable

Presenter: Madeleine Albright, Secretary of State

3:30 – 4:00 Vice President Gore: *Closing remarks:* Where we've come from; Where we're going?

10:00 – 10:05: Welcome

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10:25 - 10:40: Physical science of global warming and climate change.

John Holdren, Professor of Physics at Harvard University, will deliver a 15 minute lecture, using slide and video graphics to display three central aspects of global warming science: the physical processes that are underway, the impacts they may have on the United States and the rest of the world, and the level of certainty within the scientific community about the future impacts of global warming.

- **What is global warming? What is climate change? What are greenhouse gases?** An overview of the sources of greenhouse gas emissions; emission trends and projections; temperature and climate trends and projections.
- **What are the global impacts?** A catalogue of consequences: increased storm activity; global sea rise; changes in arctic and tropical regions; changing soil, plant and water ecosystems; shifting diseases vectors; surprises.
- **How conclusive is scientific evidence for global warming?** Description of the IPCC report; certainties and uncertainties of human fingerprint and of future projections of temperature, changing weather patterns, sea level rise, etc.

Discussion: Using Holdren's remarks as a point of departure, the President will then lead a conversation with a panel of three/four other scientists covering these issues in more detail.

10:40 - 10:50: Are there any indications that climate change may already be occurring?

Tom Karl, Senior Scientist, NOAA: Dr. Karl will discuss the extensive anecdotal evidence that something serious is starting occur. The presentation could include graphics about extreme events. Follow-up questions could probe how much any one of these incidents might be attributed to global warming, as well as to the probability that this many extreme incidents might happen within so short a time period.

10:50 - 11:00: What do most scientists say about skeptics arguments? Some say that the upper atmosphere is cooling rather than getting warmer: which measurements are we supposed to believe? Some people say the relevant warming has all happened before 1940, and that we may be entering a cyclical trough period: how can we tell that temperatures will continue to rise?

Robert Watson, Chair of the Intergovernmental Panel on Climate Change. Dr. Watson will discuss the nature of the scientific consensus, describe the history and composition of the IPCC, and review the certainty which exists across the range of

climate change issues. Follow-up: Some question the accuracy of the computer models upon which most climate projections are based. Can we trust them?

11:00 - 11:10: **What does this mean for the United States?** What are the likely or possible regional impacts within the U.S.?

Diana Liverman, University of Arizona. Dr. Liverman will review the range of impacts on different regions of the country, describing region-by-region what might be expected to occur in the next twenty to thirty years. She might also discuss health impacts that we might be expected to see.

Don Wilhite, Dir., National Drought Mitigation Center. Dr. Wilhite will review recent droughts and floods and suggest future impacts if trends continue.

Follow up: Will different regions differ in the amount to which they will be effected? How much certainty do we have about impacts as specific as on any one region?

11:10 - 11:20: **Why we need to act now:** What will be the difference if we take steps now or twenty years from now? What kind of action should we take, considering we won't know for another twenty years whether our actions today have had any ameliorative effect? Won't our emissions reductions be dwarfed by the vast emissions that will come from the developing world later this century?

John Holdren: Dr. Holdren could discuss time lags, broad certainties and uncertainties about different climate scenarios, risk of "climate surprises," difficulties of making decisions amidst uncertainty, need for flexibility and creativity in policy.

11:20 - 11:25: **Wrap-up:** President would summarize: Overwhelming scientific evidence points to a discernable human impact on the climate, with real effects on the American people and on our children. Action is needed to address this. Demanding absolute scientific certainty is asking for more than we have had in previous efforts to protect the environment. The key question is: how big a risk are we taking by not acting?

11:30 – 12:30: Emission Reduction Policy Panel

Goal: To discuss policy options that allow us to reduce emissions without hurting our economy.

11:30 - 11:35: **Opening presentation:** The key elements of a national policy to reduce emissions.

Robert Rubin, Secretary of the Treasury. Secretary Rubin would establish that we will adopt binding emissions targets, explain where emissions come from domestically, and outline what a national strategy to reduce emissions might look like. The presentation would include:

- **National targets:** US will adopt a nation-wide binding emissions target.
- **Where emissions come from:** 95% of US emissions come from heavy industry, broad utility energy supply to homes and businesses, and transportation.
- **How to reduce emissions:** (a) Incentives that discourage the use of carbon: Command regulation, market oriented trading system of emission permits (possibly including international trading and joint implementation), revenue-neutral auction or carbon tax; (b) climate-friendly technology, including carbon-efficient uses of fossil fuels; development of alternative fuel sources (solar, wind, biomass, nuclear); dissemination of existing energy efficiency technologies.
- **Experience in regulating emissions:** Past regulatory efforts display a range of available options for limiting emissions:.

Discussion: The President would then lead a discussion exploring (a) the likely impact on our economy of limiting carbon emissions, and (b) possible policy tools, such as emission reduction trading mechanisms and technologies.

11:35 - 11:55: **Economy:** Can we do this in a way that won't hurt the economy? Which industries are likely to face challenges? Which are likely to reap benefits?

Robert Repetto, WRI: Repetto would lay out the case that you can bring existing technologies on line quickly and cost-effectively to reduce our emissions, and that these introductions ultimately would have a positive effect on our economy. Could also address the economic costs of not doing anything. Follow-up: If these technologies are so efficient, why have companies not yet adopted them? What is the difference, from an environmental standpoint, if we bring these technologies on sooner rather than later? Can we put our finger on quantifiable environmental damage that will occur if we don't act immediately? From a technology development standpoint, how important is a rapid time line?

[Alan Blinder/Robert Solow/Paul Krugman/William Kline]; Depending on policies, mitigation does not necessarily have to harm the economy. While not endorsing a particular target date, the key is adopting "smart" approaches that bring sufficiently early reductions to make an middle-term date cost effective. Could discuss the macroeconomic impacts of command, allocated permits,

revenue neutral-auctions, and carbon taxes. Follow-up: How uniform are economists in their views about the best way to address the issue?

[Optional: William Nordhaus; "Go slow": Would argue that attempts to mitigate climate change can be done most effectively (a) if implementation is stretched out over the longest time frame available and (b) if do not go beyond a point of diminishing returns in prevention (i.e. it may be less expensive to respond to some effects of climate change than it would be to try to prevent them). Follow-up: From an economists' standpoint, will it be more difficult on the economy to take action if we allow current trends to continue? Is there value to helping key industries? How do we account for the cost of environmental loss, such as endangered species or diminishing of traditional habitats and ecosystems?]

11:55 - 12:05: **Regulation and Trading:** We have had extensive experience in trying to regulate pollution in this country. What kind of system did we set up to limit acid rain? Did it work? Is it analogous for our climate efforts, in scope and scale? If permits are applied "upstream," could such a system be combined with other measures to discourage fossil fuel use by downstream users

Richard Sandor, Chicago Board of Trade: Sandor could discuss how the sulphur dioxide trading system was designed, what the initial estimates were for permit costs, how those costs dropped as a result of fuel substitution and other factors. POTUS follow-up: Would carbon trading be more difficult in scope and scale?

Linn Draper, AEP: Draper could talk about experiences of coal-burning utilities in adjusting to acid rain; possible efficiency and trading steps (including joint implementation) under a permit system. He could also talk about efforts being considered to be more carbon-efficient in burning coal. Follow-up: What affect might energy sector restructuring have on adjusting to this kind of system?

12:05 - 12:15: **Technology:** What are the most promising technologies in reducing the emissions from fossil fuels, particularly in the different emissions sources we heard about: power generation for industry; power use in homes and offices, fuel for transportation? How about shifting to renewable sources? How much can we expect to reduce emissions by increasing our energy efficiency?

Ken Lay, Enron: Lay could address the ability to shift to alternative fuels, such as natural gas and renewable energy sources. He might also talk about the capacity for exporting such technologies overseas, and about the growth capacity for this aspect of the energy industry. Follow-up: Is solar power ready for prime-time? How about wind? How quickly can we bring them fully into the market?

Maxine Savitz, Allied Signal; co-director of PCAST study: Savitz could talk about the potential impact of technology in addressing climate emissions, and of the potentials of various efficiency technologies. Follow-up: How quickly can we

Gregory

How can
we do
better with
existing
technology?
Efficiency &
Diffusion

- Alternatives
solar
wind
biomass
- Efficiency
in factories
& consumer
- Fossil fuels
sequestration
fuel cells etc
- Nuclear
- Govt. Role

see gains from efficiency and other technologies? Would companies such as yours be subject for credit for these gains in a trading system? How would we measure such gains?

ATT/Hewlett Packard/IBM: Panelist would talk about the critical role that information technologies can play in developing, adapting, and/or disseminating energy efficiency techniques and/or alternative fuel sources. Would discuss any current projects underway with utilities or industries, and would assess the prospects for further development of these. Follow up: Does the U.S. have a comparative advantage in adapting these technologies to environmental ends?

Possible additional participants:

Michael Porter, Harvard Business School: Porter could discuss, from firms' perspective, why responding early to impending environmental/energy regulation is distinctly in the interest of businesses. Follow-up: Do government R&D programs help advance these technologies, or is regulation or a price signal the most effective way to spur investment? How quickly can we see gains from efficiency and other technologies?

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Robert Shapiro, Monsanto/Pete Correl, Georgia Pacific: Shapiro or Correl could address the ability for agribusiness not only to adapt to a new carbon regime, but to take advantage of many agricultural solutions to greenhouse gases, such as biomass or carbon sequestration. Follow-up: What is biomass, exactly? Are government R&D programs helpful in advancing these technologies?

nuclear

Jack Welch, General Electric: Welch could talk about broad innovations in energy production and consumption, ranging from fuel efficient lighting and heating to the role that nuclear and hydro-energy could play in a carbon-free future. Follow-up: How important is nuclear energy in the strategy of other developed or developing countries for reducing emissions?

[Other possible speakers: Student leader discusses local action in addressing climate change. Governor or Utilities Commissioner of Oregon discusses state

program to address these issues, and the coalition of government, businesses and environmental groups that brought it about.]

12:30 - 2:15: Lunch and Breakout discussions: First Lady Hillary Rodham Clinton: First Lady will give broad welcoming remarks. Since October 6 happens to be children's health day, she could include brief mention of the health effects on children from climate change.

Breakout sections: Cabinet members in attendance will each lead discussions at their tables, with a short list of questions tailored to economic, technological, or other scientific questions.

2:30 – 3:30: International Negotiations Panel

Goal: To communicate the global nature of the problem; to identify the key issues outstanding in the negotiations; and to build support for the U.S. negotiating position.

Opening Presentation: Introduce the international component of the climate change debate, with a focus on the Kyoto negotiation.

2:30 - 2:35: Secretary of State Madeleine Albright: Secretary Albright would provide a brief background on the Rio Climate Treaty, the Berlin Mandate, and the Geneva Declaration as setting the scene for the ongoing negotiations. After describing the U.S. position, she would summarize the positions of key countries or country groupings (i.e., the EU, China, and the G-77). She also should discuss:

- **Importance of American leadership:** Climate change is a major foreign policy challenge in a post-Cold War world and U.S. leadership is vital to solving it.
- **Developed v. Developing Country Emissions:** breakdown of current and projected emissions from the OECD vs. the developing world.
- **Timing of emission reductions:** While underscoring the importance of reducing developing country emissions, make clear that such emissions must peak at a later date than ours, that this is a precedent used successfully in other global agreements (i.e. ozone), and that this still will allow for environmental protection.

Discussion: The Vice President would then lead a discussion, keying off the following questions:

2:35 - 2:55: Developed and developing country commitments: The EU proposes reducing emissions 15% below 1990 levels by 2010. How do they expect to do it? Is this target possible for us? Environmentally, what kind of emissions path do developing countries need to follow? What are the economic and environmental implications of having their emissions peak at a later date? What are realistic obligations for developing countries to adopt in Kyoto with respect to their current and future emissions? How can the U.S. help these nations achieve reductions?

William Reilly, Fmr EPA Administrator/Dan Esty, Yale University Law School and School of Forestry: Esty could describe the origin and state of the Kyoto negotiations, discussing why developed countries have taken the lead, why the EU has staked out its position, and how this relates to future discussions. Follow-up: How involved have European businesses been in developing or adapting to Europe's policies? Where do other industrialized countries stand in the negotiations? What comes after Kyoto?

Jonathan Lash, WRI: Lash can discuss the emissions paths developing countries can legitimately adopt, and the impact it may have on their economies. He could also speak to the potential environmental advantages of JI in introducing technologies into the developing world. Follow-up: What effect would our adopting a later timetable have on the likelihood of getting developing countries to adopt binding targets?

John Sweeney, AFL-CIO: Broad overview of organized labor's position, making a broad-based case for the environmental, economic, and political need for developing country commitments. Would argue that our position should not hurt American competitiveness or move U.S. jobs overseas, nor send shockwaves through the American economy. Follow-up: What has labor's experience been with past emissions regulation? How significant is the timing of developing country commitments?

2:55 - 3:05: **Flexibility:** The U.S. domestic experience has shown that flexible, market oriented techniques have allowed businesses to adapt to environmental regulation in a cost-effective manner. What are the international prospects for establishing such market-oriented approaches, such as trading and joint implementation? How would a trading system work?

Roger Sant, AES/Michael Bonsignore, Honeywell: Sant/Bonsignore could lay out the international possibilities for existing climate-friendly technologies, including carbon sequestration, and could outline the opportunities for export of these to the developing world, particularly if joint implementation were allowed. Follow-up: Are emissions reduction strategies underway in the developing world? What do you make of the argument that U.S. industries would only help with, and profit from, making the cheapest reductions, such as converting power plants from coal to natural gas?

Gus Speth, Director UNDP/or/Fred Krupp, EDF: Can speak to multilateral efforts being taken, and to the possible nature of an international emissions trading system. Follow-up: Will supervising a trading system create a new international bureaucracy? Will the U.S. sacrifice its sovereignty if it signs onto this treaty? How difficult will it be to establish whether firms have actually achieved reduced emissions?

3:05 - 3:25: **National Security:** Is there a national security dimension to climate change?

Jessica Matthews, Carnegie Foundation: Can discuss preventing future loss of cropland, desertification, flooding, etc. She might also usefully touch on the difficult irony that while developing countries have contributed the least to current emission concentrations, they are most adversely effected by the consequences of climate change. Follow-up: Is it possible to fully protect ourselves from these consequences? Why are these developments our responsibility? How do they affect us?

Daniel Yergin, Cambridge Energy Research Associates: Can discuss nature of our reliance on foreign oil, how it has increased over the last two decades, and the structure of defense and alliances we have built to protect our access to oil. Follow-up: Were we to be completely self-sufficient for our energy needs, wouldn't we still need to care about conflict in the Persian Gulf or Caspian Sea?

Frank Wisner, Former US Ambassador to India: Wisner can speak to the energy development issues faced in developing countries, particularly those that see their energy needs expanding by as much as 7% per year. He also can discuss steps developing countries already are taking on the environment. Follow-up: How do developing countries view joint implementation? What more can we do to help them both meet their energy needs while protecting the environment?

Other possibilities

John Adams, NRDC: Adams can discuss how efforts to mitigate climate change in the developing world can help make important contributions on other critical environmental issues, such as saving forests and reducing smog and airborne pollution. Follow-up: What is an acceptable level of emissions growth for developing countries?

John Browne, BP: Browne could lay out why international businesses would benefit by getting ahead of the game, but why flexible implementation strategies are critical. Follow-up: Where do you see the greatest potentials for progress with developing countries in reducing emissions? Does JI achieve reductions that would not otherwise have occurred?

3:30 - 4:00: **Closing Remarks:** *Where we've come from; where we're going.* *Vice President Gore:* The Vice President's closing remarks would outline the historic nature of the challenge at hand. It would review, in the broadest terms, the impact of human life on the rest on the earth, and talk about what sustainable development means over the longer term. It would mark out why taking out an insurance policy on the earth's future is critical, not only for us but for generations to come.

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Discussion: The Vice President would then lead a discussion, keying off the following questions:

2:35 - 2:55: **Developed and developing country commitments:** What are the economic and environmental implications of developing countries adopting the same commitments we take on? What are realistic obligations for developing countries to adopt in Kyoto with respect to their current and future emissions? What is the best way to balance the environmental need for them to address climate change and the economic and foreign policy need for their continued economic development? How are other developed countries looking at this issue? Is their approach possible for us? How can the U.S. help these nations achieve reductions?

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WHITE HOUSE STAFFING MEMORANDUM

DATE: 9/13/77 ACTION/CONCURRENCE/COMMENT DUE BY: —SUBJECT: WH Conf. on Global Warming + Climate Change - Dat Agency

	ACTION	FYI		ACTION	FYI
VICE PRESIDENT	☐	☐	McCURRY	☐	☐
BOWLES	☐	☐	McGINTY	☐	☒
McLARTY	☐	☐	NASH	☐	☐
PODESTA	☐	☐	RADD	☐	☐
MATHEWS	☐	☐	REED	☐	☐
RAINES	☐	☐	RUFF	☐	☐
BLUMENTHAL	☐	☒	SMITH	☐	☐
BERGER	☐	☐	SOSNIK	☐	☐
ECHAVESTE	☐	☐	SPERLING	☐	☒
EMANUEL	☐	☒	STREETT	☐	☐
GIBBONS	☐	☐	TARULLO	☐	☒
HILLEY	☐	☐	VERVEER	☐	☐
IBARRA	☐	☐	WALDMAN	☐	☒
KLAIN	☐	☐	YELLEN	☐	☒
LEWIS	☐	☐	BEGALA	☐	☒
LINDSEY	☐	☐	<u>Stern</u>	☐	☒
MARSHALL	☐	☐	<u>Summers</u>	☐	☒
				☐	☐

REMARKS:

FYI - Please bring to 3:30 meeting

RESPONSE:

**White House Conference on
Global Warming and Climate Change
Draft Agenda**

10:00 - 10:05 Vice President Gore: *Welcome attendees; Introduces President Clinton*

10:05 - 10:20 President Clinton: *Opening Remarks: Importance of Global Warming and Climate Change for the American People.*

10:20 – 11:20 Science Panel Discussion:

Presenter: John Holdren, Harvard University:

11:30 – 12:30 Emission Reduction Technology and Policy Roundtable

Presenter: Robert Rubin, Secretary of the Treasury

12:30 – 2:00 Lunch: Remarks by First Lady Hillary Rodham Clinton

2:00 – 3:00 Kyoto Conference and U.S. National Interests Roundtable

Presenter: Madeleine Albright, Secretary of State

3:15 – 4:15 Breakout Sessions

4:30 – 5:00 Vice President Gore: *Closing remarks: The Road Ahead*

5:30 – 6:30 White House Reception

10:00 – 10:05: Welcome

The Vice President will welcome attendees to the conference and introduce the President.

10:05 – 10:20: Opening Remarks:

The President's opening remarks will be his opportunity to speak to the American people in a substantive way about global warming and climate change. His remarks should foreshadow the day's events, endorsing the scientific consensus behind climate change, asserting the importance of this issue to the American people, outlining that action will need to be taken, and embracing the broad outlines of the U.S. negotiating position going into Kyoto.

10:20 – 11:20: Science presentation:

Goal: To concisely describe what global warming and climate change are, and to present conclusively the scientific case that they are occurring, that they have real consequences for the American people, and that action is needed to limit greenhouse gas emissions.

Physical science and impacts of global warming and climate change:

10:20 - 10:35: *John Holdren, Professor of Physics at Harvard University*, will deliver a 15 minute lecture, using slide and video graphics to display three central aspects of global warming science: the physical processes that are underway, the impacts they may have on the United States and the rest of the world, and the level of certainty within the scientific community about the future impacts of global warming.

- **What is global warming? What is climate change? What are greenhouse gases?** An overview of the sources of greenhouse gas emissions; emission trends and projections; temperature and climate trends and projections.
- **What are the global impacts?** A catalogue of consequences: increased storm activity; global sea rise; changes in arctic and tropical regions; changing soil, plant and water ecosystems; shifting diseases vectors; surprises.
- **How conclusive is scientific evidence for global warming?** Description of the IPCC report; certainties and uncertainties of human fingerprint and of future projections of temperature, changing weather patterns, sea level rise, etc.

Discussion: Using Holdren's remarks as a point of departure, the President will then lead a conversation with a panel of three/four other scientists covering these issues in more detail.

10:35 - 10:45: **Are there any indications that climate change may already be occurring?**

Tom Karl, Senior Scientist, NOAA: Dr. Karl will discuss the extensive anecdotal evidence that something serious is starting occur. The presentation could include photographs or graphics about extreme events. Follow-up questions could probe how much any one of these incidents might be attributed to global warming, as well as to the probability that this many extreme incidents might happen within so short a time period.

10:45 - 10:55: **What do most scientists say about skeptics arguments?** Some say that the upper atmosphere is cooling rather than getting warmer: which measurements are we supposed to believe? Some people say the relevant warming has all happened before 1940, and that we may be entering a cyclical trough period: how can we tell that temperatures will continue to rise?

Robert Watson, Chair of the Intergovernmental Panel on Climate Change. Dr. Watson will discuss the nature of the scientific consensus, describe the history and composition of the IPCC, and review the certainty which exists across the range of

climate change issues. Follow-up: Some question the accuracy of the computer models upon which most climate projections are based. Can we trust them?

10:55 - 11:05: **What does this mean for the United States?** What are the likely or possible regional impacts within the U.S.?

Diana Liverman, Professor of XXX, University of Arizona. Dr. Liverman will review the range of impacts on different regions of the country, describing region-by-region what might be expected to occur in the next twenty to thirty years. She might also discuss health impacts that we might be expected to see.

Don Wilhite, Dir., National Drought Mitigation Center. Dr. Wilhite will review recent droughts and floods and suggest future impacts if trends continue.

Follow up: Will different regions differ in the amount to which they will be effected? How much certainty do we have about impacts as specific as on any one region?

11:05 - 11:15: **Why we need to act now:** What will be the difference if we take steps now or twenty years from now? What kind of action should we take, considering we won't know for another twenty years whether our actions today have had any ameliorative effect? Won't our emissions reductions be dwarfed by the vast emissions that will come from the developing world later this century?

John Holdren: Dr. Holdren could discuss time lags, broad certainties and uncertainties about different climate scenarios, risk of "climate surprises," difficulties of making decisions amidst uncertainty, need for flexibility and creativity in policy.

11:15 - 11:20: **Wrap-up:** President would summarize: Overwhelming scientific evidence points to a discernable human impact on the climate, with real effects on the American people and on our children. Action is needed to address this. Demanding absolute scientific certainty is asking for more than we have had in previous efforts to protect the environment. The key question is: how big a risk are we taking by not acting?

11:30 – 12:30: Emission Reduction Policy Panel

Goal: To discuss policy options that allow us to reduce emissions without hurting our economy.

Opening presentation: The key elements of a national policy to reduce emissions.

11:30 - 11:35: *Robert Rubin, Secretary of the Treasury.* Secretary Rubin would establish that we will adopt binding emissions targets, explain where emissions come from domestically, and outline what a national strategy to reduce emissions might look like. The presentation would include:

- **National targets:** US will adopt a nation-wide binding emissions target.
- **Where emissions come from:** 95% of US emissions come from heavy industry, broad utility energy supply to homes and businesses, and transportation.
- **How to reduce emissions:** (a) Discouraging the use of carbon: Command regulation, market oriented trading system of emission permits (possibly including international trading and joint implementation), revenue-neutral auction or carbon tax; (b) climate-friendly technology, including carbon-efficient uses of fossil fuels; development of alternative fuel sources (solar, wind, biomass, nuclear); dissemination of existing energy efficiency technologies.
- **Experience in regulating emissions:** Past regulatory efforts display a range of available options for limiting emissions.

Discussion: The President would then lead a discussion exploring (a) possible policy tools, such as emission reduction technologies and trading mechanisms, and (b) the likely impact on our economy of limiting carbon emissions.

11:35 - 11:45: **Regulation and Trading:** We have had extensive experience in trying to regulate pollution in this country. What kind of system did we set up to limit acid rain? Did it work? Is it analogous for our climate efforts, in scope and scale? If permits are applied "upstream," could such a system be combined with other measures to discourage fossil fuel use by downstream users

Richard Sandor, Chicago Board of Trade: Sandor could discuss how the sulphur dioxide trading system was designed, what the initial estimates were for permit costs, how those costs dropped as a result of fuel substitution and other factors. POTUS follow-up: Would establishing a carbon trading scheme be more difficult in scope and scale?

Linn Draper, AEP: Draper could talk about experiences of coal-burning utilities in adjusting to acid rain; efficiency and trading steps (including joint implementation) that it might take under a permit system. He could also talk about efforts being considered to be more carbon-efficient in burning coal. Follow-up: What affect might energy restructuring have on adjusting to this kind of system?

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for exporting such technologies overseas, and about the growth capacity for this aspect of the energy industry. Follow-up: Is solar power ready for prime-time? How about wind? How quickly can we bring them fully into the market?

Michael Porter, Harvard Business School: Porter could discuss, from firms' perspective, why responding early to impending environmental/energy regulation is distinctly in the interest of businesses. Follow-up: Do government R&D programs help advance these technologies, or is regulation or a price signal the most effective way to spur investment? How quickly can we see gains from efficiency and other technologies?

Rich Richels, Energy Policy Research Institute: Richels could realistically assess the possibilities of these technologies in achieving our emission reduction goals. Follow-up: How quickly can we see gains from efficiency and other technologies?

Possible additional participants:

Fred Buckman, PacifiCorp: Buckman could talk about the ability of a large utility to adapt to low emissions standards, particularly based on his experience in the Oregon program. Follow-up: Would you pursue these investments if you did not need to reduce emissions? Would you pursue them without government help?

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Maxine Savitz, Allied Signal: Savitz could talk about the number of different efficiency technologies available, and about the potential scope of this market. Follow-up: Would companies such as yours be subject for credit for these gains in a trading system? How would we measure such gains?

Jack Welch, General Electric: Welch could talk about broad innovations in energy production and consumption, ranging from fuel efficient lighting and heating to the role that nuclear and hydro-energy could play in a carbon-free future. Follow-up: How important is nuclear energy in the strategy of other developed or developing countries for reducing emissions?

ATT/Hewlett Packard/IBM: Panelist would talk about the critical role that information technologies can play in developing, adapting, and/or disseminating energy efficiency techniques and/or alternative fuel sources. Would discuss any current projects underway with utilities or industries, and would assess the prospects for further development of these. Follow up: Does the U.S. have a comparative advantage in adapting these technologies to environmental ends?

12:00 - 12:25: **Economy:** Can we do this in a way that won't hurt the economy? Which industries are likely to face challenges? Which are likely to reap benefits?

Robert Repetto, WRI: Repetto would lay out the case that you can bring existing technologies on line quickly and cost-effectively to reduce our emissions, and that these introductions ultimately would have a positive effect on our economy. Could also address the economic costs of not doing anything. Follow-up: If these technologies are so efficient, why have companies not yet adopted them? What is the difference, from an environmental standpoint, if we bring these technologies on sooner rather than later? Can we put our finger on quantifiable environmental damage that will occur if From a technology development standpoint, how important is a rapid time line?

John Sweeney, AFL-CIO: Broad overview of organized labor's position: that labor supports efforts that can be shown to help the environment, that won't hurt American competitiveness or move U.S. jobs overseas, or that won't send shockwaves through the American economy. Follow-up: What has labor's experience been with past emissions regulation?

Economist A; "Do it smart": [Alan Blinder?] A co-author of economists' letter on climate change; would argue that, depending on policies, mitigation does not necessarily have to have a negative impact on the economy. While not endorsing a particular target date, could say that "smart" approaches could bring sufficiently early reductions to make an middle-term date cost effective. Follow-up: How uniform are economists in their views about the best way to address the issue?

Economist B; "Go slow": Would argue that attempts to mitigate climate change can be done without significant adverse consequences, but the most economically effective approach is to stretch out implementation over the longest time frame available. Follow-up: From an economists' standpoint, will it be more difficult on the economy to take action if we allow current trends to continue? Is there value to helping key industries?

[Other possible speakers: Student leader discusses local action in addressing climate change. Governor or Utilities Commissioner of Oregon discusses state program to address these issues, and the coalition of government, businesses and environmental groups that brought it about.]

12:30 - 2:00: Lunch:

First Lady Hillary Rodham Clinton: October 6 happens to be Children's Health Day, and the First Lady has expressed interest in the health effects on children from climate change. She could address this topic in remarks at the conference luncheon.

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Discussion: The Vice President would then lead a discussion, keying off the following questions:

2:05 - 2:10: **Where developed countries stand:** The EU proposes reducing emissions 15% below 1990 levels by 2010. How do they expect to do it? Is this target possible for us? How important are our proposals on flexibility for implementing the agreement, including joint projects with developing countries, and trading. How would a trading system work?

Dan Esty, Yale University Law School and School of Forestry: Esty could describe the origin and state of the Kyoto negotiations, discussing why developed countries have taken the lead, why the EU has staked out its position, and how this relates to future discussions. Follow-up: How involved have European businesses been in developing or adapting to Europe's policies? Where do other industrialized countries stand in the negotiations? What comes after Kyoto?

- 2:10 - 2:30: **Developing country commitments:** Environmentally, what kind of emissions path do developing countries need to follow? What are the economic and environmental implications of having their emissions peak at a later date? What are realistic obligations for developing countries to adopt in Kyoto with respect to their current and future emissions? How can the U.S. help these nations achieve reductions?

Jonathan Lash, WRI: Lash can discuss the emissions paths developing countries can legitimately adopt, and the impact it may have on their economies. He could also speak to the potential environmental advantages of JI in introducing technologies into the developing world. Follow-up: What effect would our adopting a later timetable have on the likelihood of getting developing countries to adopt binding targets?

Advocate of Ambitious Developing Country Commitments: A second panelist would make a broad-based case for the environmental, economic, and political need for developing country commitments. Follow-up: How significant is the timing of developing country commitments?

John Adams, NRDC: Adams can discuss how efforts to mitigate climate change in the developing world can help make important contributions on other critical environmental issues, such as saving forests and reducing smog and airborne pollution. He might also usefully touch on the difficult irony that while developing countries have contributed the least to current emission concentrations, they are most adversely effected by the consequences of climate change. Follow-up: What is an acceptable level of emissions growth for developing countries?

- 2:30 - 2:40: **Flexibility:** The U.S. domestic experience has shown that flexible, market oriented techniques have allowed businesses to adapt to environmental regulation in a cost-effective manner. What are the international prospects for establishing such market-oriented approaches, such as trading and joint implementation?

John Browne, BP: Browne could lay out why international businesses would benefit by getting ahead of the game, but why flexible implementation strategies are critical. Follow-up: Where do you see the greatest potentials for progress with developing countries in reducing emissions? Does JI achieve reductions that would not otherwise have occurred?

Roger Sant, AES/Michael Bonsignore, Honeywell: Sant/Bonsignore could lay out the international possibilities for existing climate-friendly technologies, including carbon sequestration, and could outline the opportunities for export of these to the developing world, particularly if joint implementation were allowed. Follow-up: Are emissions reduction strategies underway in the developing world? What do you make of the argument that U.S. industries would only help with, and profit from, making the cheapest reductions, such as converting power plants from coal to natural gas?

Gus Speth, Director UNDP/Joseph Stiglitz, World Bank: Can speak to multilateral

efforts being taken, and to the possible nature of an international emissions trading system. Follow-up: Will supervising a trading system create a new international bureaucracy? Will the U.S. sacrifice its sovereignty if it signs onto this treaty?

2:40 - 2:55: **National Security:** Is there a national security dimension to climate change?

Jessica Matthews, Carnegie Foundation: Can discuss preventing future loss of cropland, desertification, flooding, etc. Can also discuss competitiveness benefits from making our economy more energy efficient. Follow-up: Is it possible to fully protect ourselves from these consequences? Why are these developments our responsibility? How do they affect us?

Daniel Yergin, Cambridge Energy Research Associates: Can discuss nature of our reliance on foreign oil, how it has increased over the last two decades, and the structure of defense and alliances we have built to protect our access to oil. Follow-up: Were we to be completely self-sufficient for our energy needs, wouldn't we still need to care about conflict in the Persian Gulf or Caspian Sea?

Frank Wisner, Former US Ambassador to India: Wisner can speak to the energy development issues faced in developing countries, particularly those that see their energy needs expanding by as much as 7% per year. He also can discuss steps developing countries already are taking on the environment. Follow-up: How do developing countries view joint implementation? What more can we do to help them both meet their energy needs while protecting the environment?

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MEMORANDUM

CONFIDENTIAL

TO: Sid Blumenthal
FROM: Rob
DATE: September 16, 1997
RE: *The President's Conference on Global Climate Change*

If the President is going to be properly prepared and positioned on the global climate issue for the December meetings in Kyoto, Japan, it is important that the *best experts* on this important problem be included in internal deliberations and in the White House conference planned for October 6th. In particular, it is absolutely essential that the best authorities on economic dimensions of global climate policy be included.

I fear that the White House has been relying on acknowledged *advocates* (from environmental groups, government, academia, and private industry), many of whom may not be reliable sources of unbiased assessments on this subject. If the October 6th conference is to provide an educational function, informing the President and the country, as opposed to a promotional one, then it is necessary to include not only cheer leaders, but knowledgeable and unbiased analysts. In particular, economic dimensions of the problem and the proposed policies need to be very carefully considered. Otherwise, I fear that the President will ultimately be blind-sided.

I recommend to you — or endorse, if they're already on the list — the names of some scholars who can bring dispassionate assessment and real credibility to the conference, in alphabetical order:

William Nordhaus, Yale University [an economist who has been analyzing global climate change impacts and mitigation costs longer than anyone else; the Administration may not think of him as a "friend" on this issue, but excluding him would send a very bad signal]

Richard Richels, Electric Power Research Institute [an energy modeler, with ties to the electric utility sector, but who is highly respected by all analysts; including him will greatly increase credibility among business groups]

Thomas Schelling, University of Maryland [an economist who has thought very carefully about this problem for many years]

Richard Schmalensee, Massachusetts Institute of Technology [another economist who has worked in this area; he was a Member of CEA in the Bush administration, and including him would help make this conference bipartisan and credible]

Robert Stavins, Harvard University [an economist who has worked on policy instruments for global climate change — such as tradable permits — and is concerned about cost-effective and *politically feasible* policies; probably leading economist in U.S. on "technology change and climate policy"]

I apologize for the element of apparent self-promotion; that's really not my purpose or intention. If you'd like to discuss these people or want more names, give me a call.

**White House Conference on
Global Warming and Climate Change
Draft Agenda**

10:00 - 10:05 Vice President Gore: *Welcome attendees; Introduces President Clinton*

10:05 - 10:20 President Clinton: *Opening Remarks: Importance of Global Warming and Climate Change for the American People.*

10:20 - 11:20 Science Panel Discussion:

Presenter: John Holdren, Harvard University:

11:30 - 12:30 Emission Reduction Technology and Policy Roundtable

Presenter: Robert Rubin, Secretary of the Treasury

12:30 - 2:00 Lunch: Remarks by First Lady Hillary Rodham Clinton

2:00 - 3:00 Kyoto Conference and U.S. National Interests Roundtable

Presenter: Madeleine Albright, Secretary of State

3:15 - 4:15 { **Breakout Sessions**

4:30 - 5:00 { **Vice President Gore:** *Closing remarks: The Road Ahead*

5:30 - 6:30 White House Reception

10:00 - 10:05: Welcome

The Vice President will welcome attendees to the conference and introduce the President.

10:05 - 10:20: Opening Remarks:

The President's opening remarks will be his opportunity to speak to the American people in a substantive way about global warming and climate change. His remarks should foreshadow the day's events, endorsing the scientific consensus behind climate change, asserting the importance of this issue to the American people, outlining that action will need to be taken, and embracing the broad outlines of the U.S. negotiating position going into Kyoto.

10:20 - 11:20: Science presentation:

Goal: To concisely describe what global warming and climate change are, and to present conclusively the scientific case that they are occurring, that they have real consequences for the American people, and that action is needed to limit greenhouse gas emissions.

Physical science and impacts of global warming and climate change:

10:20 - 10:35: *John Holdren, Professor of Physics at Harvard University*, will deliver a 15 minute lecture, using slide and video graphics to display three central aspects of global warming science: the physical processes that are underway, the impacts they may have on the United States and the rest of the world, and the level of certainty within the scientific community about the future impacts of global warming.

- **What is global warming? What is climate change? What are greenhouse gases?** An overview of the sources of greenhouse gas emissions; emission trends and projections; temperature and climate trends and projections.
- **What are the global impacts?** A catalogue of consequences: increased storm activity; global sea rise; changes in arctic and tropical regions; changing soil, plant and water ecosystems; shifting diseases vectors; surprises.
- **How conclusive is scientific evidence for global warming?** Description of the IPCC report; certainties and uncertainties of human fingerprint and of future projections of temperature, changing weather patterns, sea level rise, etc.

Discussion: Using Holdren's remarks as a point of departure, the President will then lead a conversation with a panel of three/four other scientists covering these issues in more detail.

10:35 - 10:45: Are there any indications that climate change may already be occurring?

Tom Karl, Senior Scientist, NOAA: Dr. Karl will discuss the extensive anecdotal evidence that something serious is starting occur. The presentation could include photographs or graphics about extreme events. Follow-up questions could probe how much any one of these incidents might be attributed to global warming, as well as to the probability that this many extreme incidents might happen within so short a time period.

10:45 - 10:55: **What do most scientists say about skeptics arguments?** Some say that the upper atmosphere is cooling rather than getting warmer: which measurements are we supposed to believe? Some people say the relevant warming has all happened before 1940, and that we may be entering a cyclical trough period: how can we tell that temperatures will continue to rise?

Robert Watson, Chair of the Intergovernmental Panel on Climate Change. Dr. Watson will discuss the nature of the scientific consensus, describe the history and composition of the IPCC, and review the certainty which exists across the range of

climate change issues. Follow-up: Some question the accuracy of the computer models upon which most climate projections are based. Can we trust them?

10:55 - 11:05: What does this mean for the United States? What are the likely or possible regional impacts within the U.S.?

Diana Liverman, Professor of XXX, University of Arizona. Dr. Liverman will review the range of impacts on different regions of the country, describing region-by-region what might be expected to occur in the next twenty to thirty years. She might also discuss health impacts that we might be expected to see.

Don Wilhite, Dir., National Drought Mitigation Center. Dr. Wilhite will review recent droughts and floods and suggest future impacts if trends continue.

Follow up: Will different regions differ in the amount to which they will be effected? How much certainty do we have about impacts as specific as on any one region?

11:05 - 11:15: Why we need to act now: What will be the difference if we take steps now or twenty years from now? What kind of action should we take, considering we won't know for another twenty years whether our actions today have had any ameliorative effect? Won't our emissions reductions be dwarfed by the vast emissions that will come from the developing world later this century?

John Holdren: Dr. Holdren could discuss time lags, broad certainties and uncertainties about different climate scenarios, risk of "climate surprises," difficulties of making decisions amidst uncertainty, need for flexibility and creativity in policy.

11:15 - 11:20: Wrap-up: President would summarize: Overwhelming scientific evidence points to a discernable human impact on the climate, with real effects on the American people and on our children. Action is needed to address this. Demanding absolute scientific certainty is asking for more than we have had in previous efforts to protect the environment. The key question is: how big a risk are we taking by not acting?

11:30 - 12:30: Emission Reduction Policy Panel

Goal: To discuss policy options that allow us to reduce emissions without hurting our economy.

Opening presentation: The key elements of a national policy to reduce emissions.

11:30 - 11:35: Robert Rubin, Secretary of the Treasury. Secretary Rubin would establish that we will adopt binding emissions targets, explain where emissions come from domestically, and outline what a national strategy to reduce emissions might look like. The presentation would include:

- **National targets:** US will adopt a nation-wide binding emissions target.
- **Where emissions come from:** 95% of US emissions come from heavy industry, broad utility energy supply to homes and businesses, and transportation.
- **How to reduce emissions:** (a) Discouraging the use of carbon: Command regulation, market oriented trading system of emission permits (possibly including international trading and joint implementation), revenue-neutral auction or carbon tax; (b) climate-friendly technology, including carbon-efficient uses of fossil fuels; development of alternative fuel sources (solar, wind, biomass, nuclear); dissemination of existing energy efficiency technologies.
- **Experience in regulating emissions:** Past regulatory efforts display a range of available options for limiting emissions.

Discussion: The President would then lead a discussion exploring (a) possible policy tools, such as emission reduction technologies and trading mechanisms, and (b) the likely impact on our economy of limiting carbon emissions.

11:35 - 11:45: **Regulation and Trading:** We have had extensive experience in trying to regulate pollution in this country. What kind of system did we set up to limit acid rain? Did it work? Is it analogous for our climate efforts, in scope and scale? If permits are applied "upstream," could such a system be combined with other measures to discourage fossil fuel use by downstream users

Richard Sandor, Chicago Board of Trade: Sandor could discuss how the sulphur dioxide trading system was designed, what the initial estimates were for permit costs, how those costs dropped as a result of fuel substitution and other factors. POTUS follow-up: Would establishing a carbon trading scheme be more difficult in scope and scale?

Linn Draper, AEP: Draper could talk about experiences of coal-burning utilities in adjusting to acid rain; efficiency and trading steps (including joint implementation) that it might take under a permit system. He could also talk about efforts being considered to be more carbon-efficient in burning coal. Follow-up: What affect might energy restructuring have on adjusting to this kind of system?

11:45 - 12:00: **Technology:** What are the most promising technologies in reducing the emissions from fossil fuels, particularly in the different emissions sources we heard about: power generation for industry; power use in homes and offices, fuel for transportation? How about shifting to renewable sources? How much can we expect to reduce emissions by increasing our energy efficiency?

Ken Lay, Enron: Lay could address the ability to shift to alternative fuels, such as natural gas and renewable energy sources. He might also talk about the capacity

human energy
or other resources.
to back

for exporting such technologies overseas, and about the growth capacity for this aspect of the energy industry. Follow-up: Is solar power ready for prime-time? How about wind? How quickly can we bring them fully into the market?

Michael Porter, Harvard Business School: Porter could discuss, from firms' perspective, why responding early to impending environmental/energy regulation is distinctly in the interest of businesses. Follow-up: Do government R&D programs help advance these technologies, or is regulation or a price signal the most effective way to spur investment? How quickly can we see gains from efficiency and other technologies?

Rich Richels, Energy Policy Research Institute: Richels could realistically assess the possibilities of these technologies in achieving our emission reduction goals. Follow-up: How quickly can we see gains from efficiency and other technologies?

Possible additional participants:

Fred Buckman, PacifiCorp: Buckman could talk about the ability of a large utility to adapt to low emissions standards, particularly based on his experience in the Oregon program. Follow-up: Would you pursue these investments if you did not need to reduce emissions? Would you pursue them without government help?

Fred Krupp, EDF: Krupp could talk about the gains to the environment from a trading system, including how national budgets would work, and how it would need to be adapted to address different emissions sources. Follow-up: How difficult will it be to ensure that we're monitoring all the emissions? How do we ensure that citizens are adequately rewarded for steps that they take on their own?

Robert Shapiro, Monsanto/Pete Correl, Georgia Pacific: Shapiro or Correl could address the ability for agribusiness not only to adapt to a new carbon regime, but to take advantage of many agricultural solutions to greenhouse gases, such as biomass or carbon sequestration. Follow-up: What is biomass, exactly? Are government R&D programs helpful in advancing these technologies?

Maxine Savitz, Allied Signal: Savitz could talk about the number of different efficiency technologies available, and about the potential scope of this market. Follow-up: Would companies such as yours be subject for credit for these gains in a trading system? How would we measure such gains?

Jack Welch, General Electric: Welch could talk about broad innovations in energy production and consumption, ranging from fuel efficient lighting and heating to the role that nuclear and hydro-energy could play in a carbon-free future. Follow-up: How important is nuclear energy in the strategy of other developed or developing countries for reducing emissions?

ATT/Hewlett Packard/IBM: Panelist would talk about the critical role that information technologies can play in developing, adapting, and/or disseminating energy efficiency techniques and/or alternative fuel sources. Would discuss any current projects underway with utilities or industries, and would assess the prospects for further development of these. Follow up: Does the U.S. have a comparative advantage in adapting these technologies to environmental ends?

12:00 - 12:25: **Economy:** Can we do this in a way that won't hurt the economy? Which industries are likely to face challenges? Which are likely to reap benefits?

Robert Repetto, WRI: Repetto would lay out the case that you can bring existing technologies on line quickly and cost-effectively to reduce our emissions, and that these introductions ultimately would have a positive effect on our economy. Could also address the economic costs of not doing anything. Follow-up: If these technologies are so efficient, why have companies not yet adopted them? What is the difference, from an environmental standpoint, if we bring these technologies on sooner rather than later? Can we put our finger on quantifiable environmental damage that will occur if From a technology development standpoint, how important is a rapid time line?

John Sweeney, AFL-CIO: Broad overview of organized labor's position: that labor supports efforts that can be shown to help the environment, that won't hurt American competitiveness or move U.S. jobs overseas, or that won't send shockwaves through the American economy. Follow-up: What has labor's experience been with past emissions regulation?

Economist A; "Do it smart": [Alan Blinder?] A co-author of economists' letter on climate change; would argue that, depending on policies, mitigation does not necessarily have to have a negative impact on the economy. While not endorsing a particular target date, could say that "smart" approaches could bring sufficiently early reductions to make an middle-term date cost effective. Follow-up: How uniform are economists in their views about the best way to address the issue?

Economist B; "Go slow": Would argue that attempts to mitigate climate change can be done without significant adverse consequences, but the most economically effective approach is to stretch out implementation over the longest time frame available. Follow-up: From an economists' standpoint, will it be more difficult on the economy to take action if we allow current trends to continue? Is there value to helping key industries?

[Other possible speakers: Student leader discusses local action in addressing climate change. Governor or Utilities Commissioner of Oregon discusses state program to address these issues, and the coalition of government, businesses and environmental groups that brought it about.]

12:30 - 2:00: Lunch:

First Lady Hillary Rodham Clinton: October 6 happens to be Children's Health Day, and the First Lady has expressed interest in the health effects on children from climate change. She could address this topic in remarks at the conference luncheon.

2:00 - 3:00: International Negotiations Panel

Goal: To communicate the global nature of the problem; to identify the key issues outstanding in the negotiations; and to build support for the U.S. negotiating position.

Opening Presentation: Introduce the international component of the climate change debate, with a focus on the Kyoto negotiation.

2:00 - 2:05: *Secretary of State Madeleine Albright:* Secretary Albright would provide a brief background on the Rio Climate Treaty, the Berlin Mandate, and the Geneva Declaration as setting the scene for the ongoing negotiations. After describing the U.S. position, she would summarize the positions of key countries or country groupings (i.e., the EU, China, and the G-77). She also should discuss:

- **Importance of American leadership:** Climate change is a major foreign policy challenge in a post-Cold War world and U.S. leadership is vital to solving it.
- **Developed v. Developing Country Emissions:** breakdown of current and projected emissions from the OECD vs. the developing world.
- **Timing of emission reductions:** While underscoring the importance of reducing developing country emissions, make clear that such emissions must peak at a later date than ours, that this is a precedent used successfully in other global agreements (i.e. ozone), and that this still will allow for environmental protection.

Discussion: The Vice President would then lead a discussion, keying off the following questions:

2:05 - 2:10: **Where developed countries stand:** The EU proposes reducing emissions 15% below 1990 levels by 2010. How do they expect to do it? Is this target possible for us? How important are our proposals on flexibility for implementing the agreement, including joint projects with developing countries, and trading. How would a trading system work?

Dan Esty, Yale University Law School and School of Forestry: Esty could describe the origin and state of the Kyoto negotiations, discussing why developed countries have taken the lead, why the EU has staked out its position, and how this relates to future discussions. Follow-up: How involved have European businesses been in developing or adapting to Europe's policies? Where do other industrialized countries stand in the negotiations? What comes after Kyoto?

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October 6 Science Panel

1. General Overview

John Holdren
Director, Program on Science, Technology, and Public Policy
Harvard University

2. Levels of Certainty

Dan Albritton
Director, NOAA Aeronomy Laboratory

Alternative:

Jerry Mahlman
Director, NOAA Geophysical Fluid Dynamics Laboratory

3. Why the Skeptics are Wrong

Bob Watson
Chair, Intergovernmental Panel on Climate Change

4. Northeast Impacts

Berrien Moore
Director, Institute for the Study of Earth, Oceans, and Space
University of New Hampshire

Alternative:

Eric Barron
Director, Earth System Science Center
Pennsylvania State University

5. Western Impacts:

Paul Risser
President
Oregon State University

Alternatives:

Jane Lubchenco
Professor of Marine Biology and Distinguished Professor of Zoology
Oregon State University

Diana Liverman
Director, Latin American Area Center
University of Arizona

6. Extreme Events:

Tom Karl
Senior Scientist
NOAA National Climatic Data Center

Alternatives:

Don Wilhite
Director, National Drought Mitigation Center
University of Nebraska

Frank Nutter
President
Reinsurance Association of America

**White House Conference on
Global Warming and Climate Change
Draft Agenda**

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10:05 - 10:20 President Clinton: *Opening Remarks: Importance of Global Warming and Climate Change for the American People.*

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Presenter: Madeleine Albright, Secretary of State

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4:30 - 5:00 Vice President Gore: *Closing remarks: The Road Ahead*

5:30 - 6:30 White House Reception

10:00 - 10:05: Welcome

The Vice President will welcome attendees to the conference, and introduce the President.

10:05 - 10:20: Opening Remarks:

The President's opening remarks will be his opportunity to speak to the American people in a substantive way about global warming and climate change. His remarks should foreshadow the day's events, endorsing the scientific consensus behind climate change, asserting the importance of this issue to the American people, outlining that action will need to be taken, and embracing the broad outlines of the U.S. negotiating position going into Kyoto.

10:20 - 11:20: Science presentation:

Goal: To concisely describe what global warming and climate change are, and to present conclusively the scientific case that they are occurring, that they have real consequences for the American people, and that action is needed to limit greenhouse gas emissions.

Physical science and impacts of global warming and climate change: John Holdren, Professor of Physics at Harvard University, will deliver a 15 minute lecture, using slide and video graphics to display three central aspects of global warming science: the physical processes that are underway, the impacts they may have on the United States and the rest of the world, and the level of certainty within the scientific community that global warming is really happening.

What is global warming and climate change: sources of greenhouse gases emissions; emission trends and projections; temperature and climate trends and projections;

What are the global impacts: increased storm activity; global sea rise; changes in arctic and tropical regions; changing soil, plant and water ecosystems; shifting diseases vectors; surprises.

How conclusive is scientific evidence for global warming: IPCC report; certainties and uncertainties of human fingerprint and of future projections of temperature, changing weather patterns, sea level rise, etc.

Discussion: Using Holdren's remarks as a point of departure, the President will then lead a conversation with a panel of three other scientists covering the science in more detail.

What this means for the United States: What are the likely or possible regional impacts within the U.S.? Are there any indications that climate change may already be occurring?

What most scientists say about skeptics arguments: Some say that the atmosphere is cooling rather than getting warmer: which measurements are we supposed to believe? Some people say the relevant warming has all happened before 1940, and that we may be entering a cyclical trough period: how can we tell that temperatures will continue to rise?

Why we need to act now: What will be the difference if we take steps now or twenty years from now? Won't our emissions reductions be dwarfed by the vast emissions that will come from the developing world later this century?

Panelists:

Robert Watson, Incoming Head of IPCC: nature of scientific certainty and international consensus, emissions concentrations and atmospheric temperatures.

[Diana Liverman, University of Arizona, Chair of National Academy of Science Committee on the Human Dimensions of Climate Change; or Barrien Moore, UNH]

[Jim McCarthy, Harvard University:]

11:30 – 12:30: Emission Reduction Policy Panel

Goal: To discuss policy options that allow us to reduce emissions without hurting our economy.

Opening presentation: Secretary Rubin should frame the discussion by giving an overview of where emissions come from domestically, and by reviewing what would be the key elements in a national policy to reduce emissions.

Where emissions come from: Heavy industry, broad utility energy supply to homes and businesses, and transportation account for 95% of emissions.

National targets: US will adopt a nation-wide binding emissions target.

Regulating emissions: Past regulatory experiences display a range of available options for limiting emissions: command regulation, market oriented trading system of emission permits (possibly including international trading and joint implementation), carbon tax.

How to reduce emissions: Across emissions sources, savings can be made in three key areas: more carbon-efficient uses of fossil fuels; development of alternative fuel sources (solar, wind, biomass); dissemination of existing energy efficiency technologies.

Discussion: The President would then lead a discussion that explores two central themes: possible emission reduction technologies and trading mechanisms and an assessment of the likely impact on our economy. For each theme, the President would ask key questions.

Trading and Technology: Is emissions trading the way to go? How have previous emission trading regimes worked? How can they be combined with other emission allocation systems? How can technology help reduce greenhouse gas emissions? What are the most promising technologies? Which efforts are likely to work best and how can government best support them?

Economy: Can we do this in a way that won't hurt the economy? In which industries are we likely to face challenges? In which are we likely to generate opportunities?

Participants: (ten from the following tentative list, pending review)

Ken Lay, Enron: gas and renewable energy specialist

Fred Buckman, PacifiCorps: utility participating in a CO2 offset program

Linn Draper, AEP: major coal utility that has taken voluntary actions

Johnson Controls: energy efficiency experts;

✓ Robert Shapiro, Monsanto: strong on innovation and technology;

Michael Porter, Harvard Business School

Richard Sandor, Centre Financial & Chicago Board of Trade

Fred Krupp, EDF: working with industry to forge a consensus on early action, JI

Robert Solow, MIT: co-author of economists' letter on climate change

John Sweeney, AFL-CIO: broad overview of organized labor

William Nordhaus, Yale University

Robert Repetto, WRI

- Wicksen - CEO of GE.
- Ag - Monsanto or Genia Partner.

2:00 – 3:00: International Negotiations Panel

Goal: To communicate the global nature of the problem; to identify the key issues outstanding in the negotiations; and to build support for the U.S. negotiating position.

Opening Presentation: Secretary Albright would introduce the international component of the climate change debate, with a focus on the Kyoto negotiation. She would provide a brief background on the Rio Climate Treaty, the Berlin Mandate, and the Geneva Declaration as setting the scene for the ongoing negotiations. After describing the U.S. position, she would summarize the current positions of key countries or country groupings (i.e., the EU, China, and the G-77).

The presentation should outline the breakdown of current and projected emissions from the OECD vs. the developing world. While underscoring the importance of reducing developing country emissions, Secretary Albright should make clear that such emissions must peak at a later date than ours, that this is a precedent used successfully in other global agreements (i.e. ozone), and that this will protect the environment. More broadly, climate change is a major foreign policy challenge in a post-Cold War world and U.S. leadership is vital to solving it.

Discussion: The Vice President would then lead a discussion, keying off the following questions:

- The EU proposes reducing emissions 15% below 1990 levels by 2010. How do they expect to do it? Is such a target possible for us? How important are our proposals on flexibility for implementing the agreement, including joint projects with developing countries, banking and borrowing, and trading. How would a trading system work?
- Environmentally, what kind of emissions path does the developing world need to follow? What are the economic implications of having their emissions peak at a later date?
 - Are emissions reduction strategies underway in the developing world? What are realistic obligations for developing countries to adopt in Kyoto with respect to their current and future emissions? How can the U.S. help developing nations achieve greater reductions?
 - Is there a national security dimension to climate change?

Participants: (ten from the following tentative list, pending review)

Dan Esty, Yale University (negotiations status)
 Sen. Robert Byrd (developing countries)
 John Browne, BP (need for global action, EU?)
 Roger Sant, AES (international energy, II)
 Michael Bonsignore, Honeywell (developing countries, flexibility)
 Frank Wisner, Former US Ambassador to India (reality check on developing country participation)
 Gus Speth, Director UNDP (developing countries, what US can do to help)
 Jessica Matthews, Carnegie Foundation (national security)
 Daniel Yergin, Author (national security)
 Jonathan Lash, WRI (emissions paths for developing countries, importance of II)
 John Adams, NRDC (emission reductions)

October 6 Science Panel

1. General Overview

John Holdren
Director, Program on Science, Technology, and Public Policy
Harvard University

2. Levels of Certainty

Dan Albritton
Director, NOAA Aeronomy Laboratory

Alternative:

Jerry Mahlman
Director, NOAA Geophysical Fluid Dynamics Laboratory

3. Why the Skeptics are Wrong

Bob Watson
Chair, Intergovernmental Panel on Climate Change

higher altitudes

4. Northeast Impacts

Berrien Moore
Director, Institute for the Study of Earth, Oceans, and Space
University of New Hampshire

very sunny
before 1980s

Alternative:

Eric Barron
Director, Earth System Science Center
Pennsylvania State University

water vapor
not lost

5. Western Impacts:

Paul Risser
President
Oregon State University

Public
Health

Alternatives:

Jane Lubchenco
Professor of Marine Biology and Distinguished Professor of Zoology
Oregon State University

Impacts

Diana Liverman
Director, Latin American Area Center
University of Arizona

6. Extreme Events:

Tom Karl
Senior Scientist
NOAA National Climatic Data Center

Alternatives:

Don Wilhite
Director, National Drought Mitigation Center
University of Nebraska

Anecdotal
Evidence

Frank Nutter
President
Reinsurance Association of America

the
midwest

Cheryl M. Carter

09/08/97

01:34:09 PM

*Sept 16
Environ
Spectrum*

Record Type: Record

To: Shelley N. Fidler/CEQ/EOP, William J. Antholis/OPD/EOP, Peter O'Keefe/WHO/EOP, Beth A. Viola/CEQ/EOP

cc: Maria Echaveste/WHO/EOP, Mark Hunker/WHO/EOP

Subject: proposed agenda for Sept. 11

Proposed agenda for Thursday, September 11 briefing follows:

2:00 pm Welcome
Maria Echaveste

sum session why we're here Kyoto etc.

2:05 - 2:20 pm "Why Climate Change is important to The President." and Q&A
Todd Stern

2:20 - 3:00 pm Science presentation and Q&A
TBD (Gibbons or Carl)

3:00 - 3:30 pm Impacts and Q&A
James Lee Witt

Babbitt

3:30 - 3:45 pm Break

3:45 - 4:15 pm Solutions & Q&A
Katie McGinty

Leading Technology Int'l

4:15 - 5:00 pm Vice President's presentation

List of potential speakers on Climate Change from the Administration:

Marie Echaveste

Todd Stern

Jack Gibbons

Katie McGinty

Gene Sperling

Dan Turullo

VP

Cabinet -- Rubin/Daley/Pena/Browner/Babbitt/Witt

Janet Yellen

Tim Wirth

Stu Eizenstat

Sandy Berger/Jim Steinberg - NSC

Dirk Forrester

Betsy Moeller - DOT

Fred Hanson - DOT

Garamendi - DOT



CENTER FOR HEALTH AND THE GLOBAL ENVIRONMENT

HARVARD MEDICAL SCHOOL

197 AUG 21 14:19

August 18, 1997

Mr. Todd Stern
Staff Secretary
Ground Floor, West Wing
The White House
1600 Pennsylvania Avenue, N.W.
Washington, DC 20503
Fax 202- 456 - 2215
total pages--14

Dear Mr. Stern,

As a follow-up to our conversation at the White House Scientists' Meeting on Climate Change on July 24th, I am sending you some materials from our Center.

1. the program of our briefing for the Vice President in October of 1994 on "Climate Change and Human Health,"
2. a page from the Summary Proceedings of the Conference on Human Health and Global Climate Change at the Institute of Medicine/National Academy of Sciences in September, 1995 which was organized as a result of the above briefing,
3. a letter from Jack Gibbons about our help in planning, organizing, and participating in the Conference,
4. a notice of our Congressional Briefing held on March 10th of this year,
5. an Op/Ed Paul Epstein and I did in **The Boston Globe**,
6. and a letter of invitation from Carol Browner to brief the Environmental Ministers of the G7 (plus Russia and the European Union) about the health effects of climate change.

I am enclosing these items to make the case that the subject of human health figure prominently in the October 6th White House Conference. This is critically important for two reasons--1. by

DIRECTOR

ERIC CHIVIAN M.D.
Assistant Clinical Professor of Psychiatry

ASSOCIATE DIRECTOR

PAUL R. EPSTEIN M.D., M.P.H.
Instructor in Medicine

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Associate Professor of Occupational and Environmental Medicine

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Assistant Professor of Medicine

DANIEL A. GOODENOUGH PH.D.
Takeda Professor of Cell Biology

JENNIFER LEANING M.S., M.D.
Assistant Professor of Medicine

MARY E. WILSON M.D.
Assistant Clinical Professor of Medicine

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Taro Takemi Professor of International Health

DAVID C. CHRISTIANI M.D., M.P.H.
Professor of Occupational Medicine and Epidemiology

THOMAS B. FITZPATRICK M.D., PH.D.
Edward Wigglesworth Professor of Dermatology, Emeritus

TIMOTHY E. FORD PH.D.
Associate Professor of Environmental Microbiology

JOHN P. HOLDREN PH.D.
Teresa and John Heinz Professor of Environmental Policy

ALEXANDER LEAF M.D.
Jackson Professor of Clinical Medicine, Emeritus

RICHARD LEVINS PH.D., M.P.H.
John Rock Professor of Population Sciences

JAMES J. MCCARTHY PH.D.
Alexander Agassiz Professor of Biological Oceanography

MICHAEL B. McELROY PH.D.
Abbott Lawrence Rotch Professor of Atmospheric Science

FRANK E. SPEIZER M.D.
Edward H. Kass Professor of Medicine

TIMOTHY C. WEISKEL D.PHIL.
Research Associate in Environmental Ethics

EDWARD O. WILSON PH.D.
Mellon Professor of the Sciences

discussing human health, one is able to translate the abstract, technical science of climate change into concrete, personal terms that people can relate to and 2. people are unlikely to make the changes necessary to reduce greenhouse gas emissions until they have understood the risks to themselves and their children.

Both Paul Epstein and I are extremely well informed about the potential human health consequences of climate change, and have spoken and written extensively on the subject. I hope you will consider one or both of us for the upcoming White House Conference.

I have also enclosed the text (without the slides) of my talk at Carol Browner's Environmental Leaders' Summit so that you can get an idea of what I would cover if I were to speak.

I will be in Washington from September 4th through September 8th, as we are holding another Congressional Briefing, entitled "The Value of Plant, Animal, and Microbial Species to Human Health." If I don't hear from you before then, I will try to set up a meeting at that time.

With best wishes,

A handwritten signature in black ink, appearing to read "Eric Chivian". The signature is stylized with a large, sweeping initial "E" and a cursive "Chivian".

Eric Chivian M.D.

Vice President's Technical Science Breakfast October 7, 1994
274 OEOB, 7:45 AM
Climate Change and Human Health

Speakers:

Dr. Eric Chivian, Assistant Clinical Professor of Psychiatry, Harvard.
Staff Psychiatrist, MIT.

Dr. Mary Wilson, Chief, Infectious Diseases, Mt. Auburn Hospital Cambridge.
Assistant Professor of Medicine and Assistant Professor of Population
and International Health, Harvard.

Dr. Robert Shope, Professor of Epidemiology, Yale School of Medicine.
Director of the Yale Arbovirus Unit.

Today's speakers will discuss the interplay of climate change, ozone depletion, and environmental degradation on current and future incidence of disease. Environmental factors contribute to the occurrence, spread, and intensity of human infectious diseases. The recent resurgence of old diseases we thought we had conquered (TB and measles), the emergence of new diseases (Legionnaire's and AIDS), and the discovery of new mechanisms to spread disease (cholera in algal blooms), all point to the need for increased attention to the relationship between environment and human health.

Climate change adds an additional layer of concern. Changing temperature and precipitation patterns world-wide could have direct impacts such as changing the distribution of disease organisms. Less directly, a decrease in world-wide agricultural productivity could result in nutritional deficiency and increased hunger. Rising sealevel will flood low-lying islands and could lead to "ecological" refugees and migrating populations.

Little research has been directed at studying the impacts of climate change on human health. The three guest breakfast speakers have helped to focus attention on this important issue.

coordination among nations and scientific disciplines; (c) multidisciplinary research on the links between global climate change and human health; (d) improved environmental health training for health professionals; and (e) an outreach program to inform and educate the public about the effects of global climate change on human health. In the face of current fiscal constraints, these efforts must be based on identifying and linking together existing activities, facilities, organizations, and funding agencies.

BACKGROUND AND OVERVIEW

In October 1994, following a meeting with concerned scientists and medical experts (Eric Chivian, Bob Shope, and Mary Wilson), Vice President Gore asked the Office of Science and Technology Policy (OSTP) and the Council on Environmental Quality (CEQ) to organize a conference on the potential human health risks posed by global climate change, and strategies to address them—such as global health surveillance, public outreach, and education. Members of the NSTC, OSTP and CEQ formed a working group to develop a preliminary agenda for the conference and later requested that the IOM join in planning, organizing, and conducting the conference. (Appendix A presents a list of the sponsoring agencies, the IOM steering committee, and conference organizing staff.)

The purpose of the conference was twofold:

1. To bring together a diverse, interdisciplinary group of experts to address the potential effects of global climate change and ozone depletion on the current and future incidence of disease, heat stress, food and water supplies, and air pollution; and
2. To discuss initial strategies for improving research and development (R&D), global health surveillance systems, health care and disease prevention, medical and public health community education, international cooperation, and public outreach.

It is important to note that the focus of the conference was human health. Presenting evidence of whether or not global climate change is, has, or will occur, was not the primary focus. Participants were asked rather to work within an “if/then” type of scientific exercise: If global climate change occurs, what are the potential adverse human health effects and what strategies should be developed to address them?

The first day of the two-day conference was filled with scientific presentations and a plenary discussion on the current state of knowledge about global climate change and its potential risks for human health (see the agenda, Appendix B), including a presentation by Vice President Gore (see Box 1). On the second day, participants discussed health policy implications and potential intervention strategies in a series of panels. Each panel’s findings were presented and discussed by the conference participants in a final plenary session. Approximately 300 scientists, health care providers, policymakers, academicians, federal and state officials, industry representatives, and others attended the conference and participated in developing the strategies (see Appendix C).

THE WHITE HOUSE
WASHINGTON

September 22, 1995

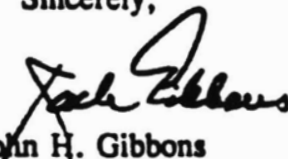
Dr. Eric Chivian
Assistant Clinical Professor
Department of Psychiatry
Harvard Medical School
56 Hawes Street
Brookline, MA 02146

Dear Dr. Chivian:

On behalf of Dr. Ken Shine and myself, I want to thank you for all your work and participation in the Conference on Human Health and Global Climate Change which contributed to its tremendous success. By bringing together the diverse communities of educators, scientists, researchers, and NGOs from industry and the medical and national security communities, the conference afforded an opportunity to discuss the broad array of issues associated with human health and climate change. Your talk on the role of the medical and public health communities and the need for increased education in environmental issues helped set the stage for the discussions at the conference and for continuing efforts.

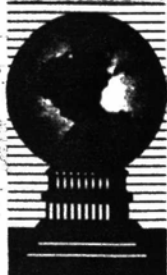
For your information, I am enclosing a transcript of the Vice President's talk. Again, thank you for all your hard work.

Sincerely,



John H. Gibbons
Assistant to the President
for
Science and Technology

Enclosure



ENVIRONMENTAL AND ENERGY STUDY INSTITUTE

NOTICE

KEN MURPHY, EXECUTIVE DIRECTOR ■ 122 C ST., N.W., STE 700 ■ WASH., D.C., 20001 ■ (202) 628-1400

POTENTIAL HUMAN HEALTH EFFECTS OF GLOBAL CLIMATE CHANGE

Monday, March 10

1:30-3:30 p.m., SD 215 Dirksen Senate Office Building

The potential effects of global climate change on human health will be presented in a briefing co-sponsored by EESI and Harvard Medical School's Center for Health and the Global Environment.

As nations from around the globe prepare to adopt a global climate treaty late this year, more attention is being paid to the potential health impacts of extreme weather events and of other possible manifestations of the "greenhouse effect."

This briefing features presentations on key topics by some of the nation's leading scientific and medical experts:

- Overview, Prof. Barry Levy, President, American Public Health Association.
- Greenhouse gases and extreme weather events, Dr. Thomas Karl, Senior Scientist, National Climatic Data Center, Asheville, N.C.
- Heat waves and mortality, Prof. Laurence Kalkstein, Director, Center for Climatic Research, University of Delaware.
- Air pollution, the greenhouse effect and human health, Prof. Arden Pope, Brigham Young University.
- Climate change and infectious disease, Dr. Paul Epstein, Instructor in Medicine, Harvard Medical School.
- Climate change and species loss: implications for human health, Dr. Eric Chivian, Director of the Center for Health and the Global Environment, Harvard Medical School.

(over)

The Boston Globe

THURSDAY, APRIL 10, 1997

*Warm and wet conditions
spell trouble for the world.*

Weather alert

**ERIC CHIVIAN
and PAUL EPSTEIN**

Last week's record snowstorm was another reminder that in recent years we have endured the most variable and extreme weather in memory. The same has been true in other parts of the country and the world: Witness the succession of storms and snow melts in the Pacific Northwest in January and the record-setting floods along the Ohio River last month.

This instability is considered to be an early manifestation of the warming of the atmosphere and the oceans over the last 100 years, resulting from our burning fossil fuels and rapidly increasing atmospheric carbon dioxide concentrations.

Worldwide, 1995 was the warmest year since global temperatures were first kept in 1856. For the Northeast, 1996 was the wettest year on record. What people don't realize is that these changes in climate carry unprecedented potential risks for human health.

For one: Warm, wet weather, especially warm winters and wet springtimes, produces ideal breeding conditions for mosquitoes, which in New England can carry Eastern equine encephalitis, a disease with a 50-percent mortality mainly affecting children and leaving many with severe, chronic neurological problems. Warm, wet conditions also favor increased populations of ticks, which can transmit several infections, including Lyme disease.

Prior to the 1970s, Lyme disease was unheard of, but in each subsequent decade the number of cases has steadily climbed. In 1994, the Centers for Disease Control reported 13,000 cases nationwide, a 26-fold increase over 1962.

While tick-borne diseases are highly sensitive to human settlement patterns and populations of host species like deer and mice, climatologic factors are likely to play an increasingly important role.

Higher global temperatures can also increase the number of heat-related deaths, as we saw in Chicago during the

July 1995 heat wave, when more than 700 people died. Currently in Boston, there are about 90 people on average who die each summer from the heat. If global warming continues at its current pace, this figure may double by the year 2050. Additional illness and death may result from increasing levels of air pollution, exacerbated by the warming, affecting those with chronic respiratory diseases, such as children with asthma and the elderly with bronchitis and emphysema.

The world scientific community has warned that present trends of fossil fuel use may result in average global temperatures by the year 2100 that are 2 to 6 degrees warmer than they are now. It has been more than 120,000 years since the earth was this warm. Because species often live within narrow temperature ranges, such warming – and more extreme weather – may compromise food sources, affecting agricultural productivity and marine life, and threaten countless numbers of species with extinction.

In addition to the unforeseeable ecological consequences of such extinctions, direct implications for human health include the loss of valuable medical research models that help us understand human physiology and disease and the loss of potential new medicines.

Consider two New England species that may be endangered by greenhouse warming – the white birch and the dogfish shark. Researchers have found in the bark of white birch trees an acid that in laboratory tests has shown great promise in fighting malignant melanomas, a cancer that is increasing in incidence at a faster rate than any other in the United States, doubling in the past decade.

The fact that sharks rarely get infections or tumors, presumably the result of 400 million years of highly successful evolution of their immune systems, has led to the discovery of "squalene" in the dog-

fish shark, an antibiotic that is highly potent against a wide variety of bacteria, fungi, and parasites and that seems to work through pathways different from those of all other known antibiotics.

As infectious agents are acquiring resistance to currently used medications, this discovery has special significance.

Finally, species loss may disrupt vital life support systems as species interact with one another and with their environments to provide such services as regulating the concentration of atmospheric gases and water vapor, maintaining soil fertility, filtering pollutants, breaking down wastes, and controlling pests.

With our failure to heed the warnings of the world's scientific community to reduce our burning of fossil fuels, we are in effect conducting a global experiment with all life on earth, including human life,

the outcome of which no one can fully predict. What we can predict – about changes in the incidence and distribution of infectious diseases, about heat waves and air pollution, and about the effects of species loss – suggest a future with enormous dangers for human beings.

With a recognition of the medical consequences involved from our damaging the ozone layer, the world community agreed to control the release of ozone-depleting chemicals. Will it respond with the same urgency to the human health risks predicted from our changing the global climate and draft a strong treaty to control greenhouse gases?

Eric Chivian and Paul R. Epstein are faculty members at Harvard Medical School, where they direct the Center for Health and the Global Environment.



PAUL LACHNE ILLUSTRATION



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

APR 25 1997

THE ADMINISTRATION

Eric Chivian, M.D.
Director
Center for Health and the Global Environment
Harvard Medical School
56 Hawes Street
Brookline, Massachusetts 02146

Dear Dr. Chivian:

It is my pleasure to invite you to participate in a discussion of the Impacts of Climate Change at the upcoming Environment Leaders' Summit, to be held in Miami, Florida, May 5-6, 1997.

The agenda item on the Impacts of Climate Change is scheduled for Monday afternoon on May 5. The exact time is yet to be determined. I would like you to give a 10-minute presentation on the health effects of climate change. This will be followed by a 10-minute presentation by Tom Karl of the National Oceanic and Atmospheric Administration on the effects of climate change on global weather. The remainder of the session will be devoted to an exchange of views by the Environment Leaders. A background paper which is being prepared for the Environment Leaders on the impacts of climate change will be sent to you in advance of the meeting.

A meeting schedule is enclosed with this letter, along with information on hotel accommodations and other logistical matters.

I very much hope you will be able to accept this invitation, as I believe you will make an important contribution to the discussion of this particular agenda item at the Environment Leaders' Summit. The U.S. Environmental Protection Agency will be responsible for your travel. Jeff Shulman of my staff will make the arrangements for you. He can be contacted at (202) 260-4369.

I look forward to seeing you in Miami.

Sincerely,

A handwritten signature in black ink, appearing to read "Carol M. Browner".
Carol M. Browner

Enclosures

THE POTENTIAL HUMAN HEALTH EFFECTS OF GLOBAL CLIMATE CHANGE

Eric Chivian M.D.

Briefing Talk for

The Environment Leaders' Summit [environmental ministers of the G7, Russia, and the European Union]

Miami, Florida

May 5, 1997

Introduction

I'm delighted and honored to be here--thank you Carol Browner and Bill Nitze for inviting me. I'm also delighted that the health impacts of global climate change are central to these discussions. This is critically important because environmental decisions must be based ultimately on what the effects of those decisions are on human beings, and because people are unlikely to change their behaviors or support policies necessary to control greenhouse gases until they have begun to recognize the risks to their health and lives, and to those of their children. Moreover, by discussing the effects on health, one has the potential of translating the abstract, technical, complex science of global climate change into concrete, personal terms that people can relate to and understand.

That is why we formed the Center for Health and the Global Environment at Harvard Medical School - to promote a wider understanding of these issues. We are a collaborating center of the United Nations Environment Programme and work closely with the World Health Organization and with the IPCC.

Today I will briefly review some of the potential human health effects of global climate change. This is a highly complicated subject with an enormous number of uncertainties. I have included some background materials in your packets. For those wanting a more complete review of this subject, I refer you to chapter 18 in the IPCC working Group II 2nd Assessment Report and to this superb WHO/WMO/UNEP book (1996) Climate Change and Human Health. I also urge you to obtain this newly published Island Press book Biodiversity and Human Health (edited by F. Grifo and J. Rosenthal, 1997).

Background

Because of the natural heat-trapping effect of atmospheric gases, the average global surface air temperature has been approximately 15 degrees C. for the past 10,000 years. Without this natural greenhouse effect, the average temperature would be minus 18 degrees C. and most of the Earth's surface would be frozen.

Since the Industrial Revolution, the emission of greenhouse gases has risen dramatically, secondary to industrial and agricultural production and the use of fossil fuels for heating, producing electricity, and transportation. CO₂, the main greenhouse gas, has increased in the atmosphere by roughly 30% in the past 100 years, increasing from about 270 parts per million by volume (ppmv) to an atmospheric concentration in 1994 of around 360 ppmv.

In the last 100 years, average global surface temperatures have warmed approximately 0.5 degrees C. or 1 degree F.

1995 was the warmest year globally since records were first kept in 1866, and the 1990's will clearly be the warmest decade. Over the past century, sea levels have risen globally about 18 cm., and weather patterns have changed, as you will hear from Tom Karl.

slide 6

The IPCC has concluded that "the balance of evidence suggests a discernible human influence on global climate," and recent work by Benjamin Santer and his colleagues, comparing the predictions from global circulation models, taking sulfate aerosols and stratospheric ozone into account, with observed temperatures shows a striking similarity, offering the best evidence to date of an anthropogenic effect. The IPCC has predicted, with a scenario of doubling atmospheric CO₂ concentrations by 2100, we can expect mean temperatures to increase approximately 2 degrees C. with a range of 1-3.5 degrees C.

Now, to many people, this may not sound like something to be worried about, but we need to keep in mind that:

1. these are mean global increases and that they will be greater than the mean nearer the poles

slide 7

2. the difference between average temperatures during the last ice age, 20,000 years ago, when glaciers up to a mile thick covered much of Canada, northern United States, and northern Europe and now is only about 5 degrees C.

slide 8

3. and temperatures 2 degrees C. warmer than now have not been present for more than 120,000 years, during the Eemian interglacial period when *Homo Sapiens* first evolved. Look at today's CO₂ concentration--it is greater than at any time during the past 160,000 years, and with the doubling predicted, we are in totally uncharted territory.

The IPCC has also predicted an increase in sea levels of about 1/2 meter, with a range of 15 cm. to more than 1 meter, more climate variability and extreme weather events like heat waves, such as that experienced during the summer of 1994 in Europe,

slide 9

drought, such as that which occurred in the U.S. 1 yr. ago in the plains states

or that presently occurring in Western Europe, especially in Portugal, France, and in the United Kingdom, which is having its longest dry spell in more than 200 years.

slide 10

An absence of rainfall can create the conditions for wildfires, such as those we experienced in the western U.S. last summer when more than 6 million acres burned, nearly double the average acreage burned each year during this decade in the Amazon.

slide 11

We can also see extremely heavy rains and snows with flooding such as that which occurred in the Mississippi valley in 1993,

slide 12

across Germany, France, Belgium and the Netherlands in January of 1995,

and in the Red River Valley during the last month after the river rose 25 feet above its floodstage, devastating large areas of North Dakota.

These changes in temperature, precipitation, soil moisture, sea level, and extreme weather events will have both direct and indirect effects on human health.

Direct Effects on Human Health

slide 13

For one, there will be an increased frequency and intensity of heat waves, which are likely to lead to dramatic increases in summer deaths. By the year 2050, the excess summer mortality from heat-related causes in several major American cities could double over present levels.

In Chicago, for example, during the 5 day heat wave in July 1995, over 700 people died from heat-related causes. Major urban centers in the developing world such as Shanghai and Cairo could see increases of 3 to 4 fold over background levels.

The elderly, the very young, those with impaired mobility, and people suffering from cardiovascular and respiratory disease are the most at risk. Poor urban populations in industrialized and developing countries alike are also more vulnerable to heat waves, because of poor housing and a lack of access to air conditioning.

Slide 14

These extreme weather events will cause additional direct health effects, from injuries and electrocutions from storms, to drownings from the flooding.

Indirect Effects on Human Health

The potential indirect health effects from global climate change are large in number and difficult to predict, as they are often the product of multiple variables, many of which are poorly understood.

For the purposes of our discussion, I will divide these into the following categories:

1. those from the effects of air pollution
2. those secondary to sea level rise and flooding events
3. those which are the result of disturbances to ecosystems

Air Pollution

The dynamics of the relationship between climate change and air pollutants have not been fully studied. What can be said is that the chemical reactions forming secondary air pollutants are accelerated by higher temperatures. Climate change, therefore, may lead to increased concentrations of photochemical oxidants, including ground level ozone (also increased by increased Ultraviolet B radiation on the ground), and to higher levels of sulfate and nitrate particulates, causing increases in the frequency and intensity of asthma attacks (which in the U.S. is the single greatest cause of childhood hospitalizations), and in an increased risk of respiratory and cardiovascular illness and premature death.

Pollens and spores may also increase as a result of warm weather and changes in precipitation patterns, worsening allergies and causing increases in the risk of some windborne fungal diseases. As an example, an epidemic of the fungal disease coccidiomycosis broke out in the American southwest a few years ago, attributed to a protracted drought followed by heavy rains. As new fungal pathogens are emerging and old ones re-emerging and as fungi are developing increasing resistance to antifungal medications, one has to be concerned about the potential for increased fungal infections secondary to climate change.

Sea Level Rise and Flooding Events

Sea level rise will have a wide range of effects on human health, including: nutritional loss from a flooding of agricultural lands and from a loss of fish breeding areas, such as coastal wetlands and mangroves; and from the reduced availability of drinking water, due to salt water intrusion and a rise in the water table in low-lying coastal areas, releasing infectious contaminants from septic systems into waterways and increasing the risk of waterborne infectious disease.

In addition, there will be all the health problems associated with millions of environmental refugees escaping flooded and storm destroyed areas.

Flooding from extreme precipitation events will also diminish the quantity and quality of drinking water supplies, which will be contaminated by toxic chemicals, by animal and human waste, and by the floating carcasses of dead animals.

An outbreak in 1994 of lung bleeding in infants in Cleveland Ohio killing 1/3 of those affected, was traced to a previously undiscovered black mold growing in water damaged homes, illustrating again how little we know about some of the health effects of such events.

Ecosystem Disturbance

Finally, I want to cover the implications for human health from disturbances to ecosystems secondary to climate change. This is an area that worries many of us the most, as such disturbances may carry the greatest risks of human health. It is also perhaps the least well understood aspect of global climate change.

Let me begin by mentioning 3 models of infectious disease transmission that may be affected by climate change.

slide 15
1. More than 350,000 people in Central America became infected with dengue fever during the hot wet summer of 1995, and there was serious concern that there could be scattered outbreaks of dengue along the entire gulf coast of the U.S. from Texas to Florida. Some cases were, in fact, reported in Texas. Dengue, a severe viral disease of the tropics and subtropics, carried by mosquitoes currently infects 50 million people each year. Initial dengue infections cause pain, fever, and prostration, but are not associated, in general, with mortality. Subsequent dengue infections, however, can cause dengue hemorrhagic fever, which is one of the leading causes of hospitalization and mortality for children in South East Asia.

slide 16
In most parts of the world, dengue is carried by *Aedes aegypti*, the famous carrier of yellow fever, but this mosquito, *Aedes albopictus*, the Asian tiger mosquito, brought to the U.S. from Asia in 1985 in a shipment of used tires, can also transmit dengue.

slide 17
The tiger mosquito has proliferated rapidly in southern states, reaching as far north as Nebraska and Iowa. It has also been found in Italy.

slide 18
The range of this mosquito, and that of *Aedes aegypti*, is limited by frost and sustained cold temperatures which kill adults and prevent the survival of eggs and larvae through the winter. With the increased temperatures from climate change, we may expect their ranges to enlarge as they move to higher latitudes into temperate zones, and to higher altitudes. Such shifts have already been observed, for example, during the unseasonably warm summer of 1988, when dengue reached previously unaffected areas in Mexico at altitudes of 1700 m.

The increased temperatures from climate change can also intensify mosquito-borne diseases by increasing mosquito reproduction, increasing biting rates, and enhancing the proportion of mosquitoes that become infected.

Up to World War II, many parts of the industrialized world had outbreaks of malaria, including the USA, and Western and Southern Europe.

slide 19
This slide shows malaria mortality in the U.S. from 1919 to 1921, with the dark areas in some southern states being counties with more than 5 malaria deaths per 10,000 population.

Malaria causes 300-500 million new cases per year and an estimated 2 million deaths annually, more than 1/2 of whom are young children, mostly in Africa.

We have seen some cases of locally-acquired malaria in the U.S. for the first time in decades--in New York, New Jersey, and Texas during the hot wet summers of 1991, 1993 and 1994.

Estimates by the WHO have predicted an additional 50-80 million cases of malaria by the year 2100 with climate change.

2. We will also see an effect on waterborne infectious diseases.

slide 20

This NOAA satellite photo shows in red and orange the worldwide distribution of algal blooms, which have increased dramatically in recent years, it is believed, because of sewage and fertilizer discharge into coastal waters, overfishing, the loss of wetlands that filter out nitrates and phosphates, and warmer sea surface temperatures.

slide 21

This is the coast of Peru in 1991, showing an intense algal bloom. In that year, cholera struck Peru. Apparently the cholera bacteria, initially transported in the bilge water of a freighter from Bangladesh, proliferated rapidly in the unusually warm and nutrient rich Peruvian waters, where algal blooms provided an ideal medium for them to thrive. As a result of poor sanitation, urban crowding and an inadequate medical infrastructure, cholera quickly spread to 19 Latin American nations, following rivers and streams, eventually affecting 1/2 million people and killing 5000.

3. The final infectious disease model I will mention concerns the hantavirus outbreak in the U.S.

The story went like this:

slide 22

Six years of drought in the Four Corners area of the American Southwest, where Utah, Arizona, Colorado and New Mexico meet, ended in the late winter and early spring of 1993, when unusually heavy snows and rains drenched the region, resulting in a very heavy crop of pine nuts and a super-abundance of grasshoppers, both food for the native deer mouse.

Now, the drought had led at the same time to a marked reduction in the mouse's usual predators - foxes, snakes, owls, and coyotes and as a result, the mouse population exploded, increasing 10 fold by May of 1993 over levels of the previous year. Deer mice, it turns out, carry a virus from the hantavirus family, which they shed through their saliva, urine, and feces, and as a consequence of the greatly increased exposure by people in the area to the huge mouse population, an epidemic of a rapidly fatal pneumonia (or pulmonary syndrome), developed--17 previously healthy people initially got the disease, 13 of them died.

slide 23

As of now, 145 people in 25 states in the U.S. have been diagnosed with hantavirus pulmonary syndrome, with a mortality rate of around 50%. No one knows how many other viruses or other infectious agents in the environment, potentially harmful to man, are being held in check by the natural balances among species, in this case disrupted by a regional change in climate.

And that leads me to my final comments.

Other Ecosystem Effects

Many paleontologists believe that climate change was the dominant factor in the great species extinctions of the past. Species adapted to the changes in temperature by shifting their ranges--during warming they moved towards the poles or to higher altitudes. During cooling periods they retreated. But many species were lost because they could not adapt, either because their rates of migration were too slow or because geographical barriers stood in their way.

By contrast to past temperature changes, however, those expected for the next century will be 10-100 times faster than those that have occurred before, and in addition to geographical barriers,

there are man-made ones everywhere--cities, roads, agricultural lands. In fact, global climate change could become one of the most significant factors in ecosystem disruption and species loss in the next 100 years.

slide 24

slide 25

We are already seeing evidence of such shifts in the range of species in response to warming temperatures, in the move to higher elevations of some plant species in the alps, and in the northward migration of a butterfly, the Edith's Checkerspot, in western states in the U.S.

Disruptions of species functions and of the composition of species populations in ecosystems that we may see with global climate change have very worrisome implications for agriculture and for the marine food supply. Such disruptions may also interfere with the ways species interact with each other and with their environments to provide vital life support services, such as regulating the composition of gases and water vapor in the atmosphere, maintaining soil fertility, filtering pollutants,, controlling pests, and breaking down wastes.

With our continued discharge of ever increasing amounts of CO₂ into the atmosphere, affecting global temperatures, precipitation patterns, soil moisture, sea levels, and causing potentially serious disruptions to terrestrial and marine ecosystems, we are, in effect, conducting a massive experiment with all life on this planet, including human life, the outcome of which no one can fully predict.

What we can predict suggests a future with enormous, and, I believe unacceptable, risks for human beings. These risks for our children and for generations to come may dwarf all other presently known environmental health threats.

When the world community began to recognize the magnitude of the danger from ozone depletion, it adopted the Vienna Convention to control the emission of chlorofluorocarbons, saving, it has been recently estimated, more than 1 million cases of skin cancer each year in the U.S. alone by the year 2100, and almost 400,000 in Northwest Europe.

Let us hope it will respond with the same sense of urgency to the public health warnings about global climate change from the WHO and health scientists, and from a growing chorus of physicians, and move to set significant and binding targets to curb greenhouse gasses.

Draft Conference Agenda

10:00 - 10:15 President Clinton: *Opening Remarks:* Importance of Global Warming and Climate Change for the American people.

10:15 – 11:15 Science Panel Discussion:

Presenter: John Holdren, Harvard University: *The physical science of global warming and climate change; will then lead a discussion with other leading scientists.*

11:30 – 12:30 Emission Reduction Technology and Policy Roundtable

Presenter: Robert Rubin, Secretary of the Treasury

12:30 – 2:00 Lunch

2:00 – 3:00 Kyoto Conference and U.S. National Interests Roundtable

Presenter: Madeleine Albright, Secretary of State

3:15 – 4:15 Breakout Sessions

4:30 – 5:00 Vice President Gore: *Closing remarks:* The Road Ahead

5:30 – 6:30 White House Reception

10:00 – 10:15: Opening Remarks:

The President's opening remarks will be his opportunity to speak to the American people in a substantive way about global warming and climate change. His remarks should foreshadow the day's events, endorsing the scientific consensus behind climate change, asserting the importance of this issue to the American people, outlining that action will need to be taken, and embracing the broad outlines of the U.S. negotiating position going into Kyoto.

10:15 – 11:15: Science presentation:

Goal: To concisely describe what global warming and climate change are, and to present conclusively the scientific case that they are occurring, that they have real consequences for the American people, and that action is needed to limit greenhouse gas emissions.

Physical science and impacts of global warming and climate change:

- **What is global warming and climate change:** sources of greenhouse gases emissions; emission trends and projections; temperature and climate trends and projections;
- **What are the impacts:** increased storm activity; global sea rise; changes in arctic and tropical regions; changing soil, plant and water ecosystems; shifting diseases vectors; surprises.
- **How conclusive is scientific evidence for global warming:** IPCC report; certainties and uncertainties of human fingerprint and of future projections of temperature, changing weather patterns, sea level rise, etc..

add co'ing

Discussion:

- **What does this mean for the United States:** What are the likely or possible regional impacts within the U.S.? Are there any indications that climate change may already be occurring?
- **Why do we need to act now:** What will be the difference if we take steps now or twenty years from now?

Presenter: John Holdren, Professor of Physics, Harvard University

Panelists: Robert Watson, Incoming Head of IPCC
Jane Lubchenko, University of Oregon
Steven Schnieder, Stanford University

BRIC
Chrism?

11:30 – 12:30: Emission Reduction Policy Panel

Goal: To discuss policy options that allow us to reduce emissions without hurting our economy.

Opening presentation: To frame the discussion, the first speaker should demonstrate the scale of effort needed to reverse our growing national carbon emissions. The presentation should canvass the steps needed to protect the environment, and outline previous regulatory efforts that have used flexible, transparent, and accountable market-based solutions.

- **National targets:** US will adopt a nation-wide binding emissions target, requiring us to stabilize and reduce our emissions in coming decades.
- **Where emissions come from:** Heavy industry, broad utility energy supply to homes and businesses, and transportation account for 95% of emissions.
- **Where reductions must come from:** Across emissions sources, savings can be made in three key areas: more carbon-efficient uses of fossil fuels; development of alternative fuel sources (solar, wind, biomass); dissemination of existing energy efficiency technologies.
- **Regulating emissions:** Past regulatory experiences display a range of available options for limiting emissions: command regulation, market oriented trading system (possibly including international trading and joint implementation), carbon tax.

Presenter: Secretary Robert Rubin

What are the elements
of a national policy

Discussion: The discussion that follows should have two focal themes: possible emission reduction technologies and trading mechanisms and an assessment of the likely impact on our economy. For each theme, the President would guide the discussion with a set of key questions.

Technology and Trading: How can technology help reduce greenhouse gas emissions? What are the most promising technologies? Which efforts are likely to work best and how can government best support them? How have previous emission trading regimes worked? How can they be combined with other emission allocation systems?

Participants:

Ken Lay, Enron: gas and renewable energy specialist;
Fred Buckman, PacifiCorps: utility participating in a CO2 offset program
Johnson Controls: energy efficiency experts;
Linn Draper, AEP: major coal utility that has taken voluntary actions
Robert Shapiro, Monsanto: strong on innovation and technology;
Michael Porter, Harvard Business School
Richard Sandor, Centre Financial & Chicago Board of Trade
Fred Krupp, EDF: working with industry to forge a consensus on early action, JI

why?
nuclear

ADRIAN!
BRT

Economy: Can we do this in a way that won't hurt the economy? In which industries are we likely to face challenges? In which are we likely to generate opportunities?

Participants:

Robert Solow, MIT: co-author of economists' letter on climate change
John Sweeney, AFL-CIO: broad overview of organized labor
William Nordhaus, Yale University
Robert Repetto, WRI

2:00 – 3:00: *International Negotiations Panel*

Goal: To communicate the importance of global participation in solving the climate change problem; to identify the key issues outstanding in the negotiations; and to build support for the U.S. negotiating position, most particularly on the role of developing countries.

Opening Presentation: The opening presentation should introduce the international component of the climate change debate, with a focus on the Kyoto negotiation. Brief background should be provided on the Rio Climate Treaty, on the Berlin Mandate, and on the Geneva Declaration as setting the scene for the ongoing negotiations. After describing the U.S. position, a summary of the current positions of key countries or country groupings (i.e., the EU, Japan, Australia, OPEC, China, and the G-77) should also be provided.

The presentation should set up a discussion of the developing country issue by outlining the breakdown of current and projected emissions from the OECD vs. the developing world. While

underscoring the importance of reducing developing country emissions, the speaker should make clear that such emissions must, by necessity, peak at a later date than ours, that this is a precedent used successfully in other international agreements (i.e. Montreal Protocol), and that this still allows for solving the environmental problem.

A slightly broader case could also be made that climate change is the kind of global issue that poses a major foreign policy challenge for the U.S. in a post-Cold War world and that U.S. leadership is vital to solving it.

Presenter: Secretary Madeleine Albright

Questions for Discussion:

- The EU has proposed reducing emissions 15% below 1990 levels by 2010. How do they expect to achieve such dramatic reductions and is such a target remotely possible for us? How does the EU, G-77, Japan, etc. take to our proposals on flexibility for how the agreement is implemented, including joint projects with developing countries, banking and borrowing, and international trading. How would an international trading system work? How critical are these elements?
- Assuming that the developed world stabilized emissions somewhere between 2010-2020, what kind of emissions path does the developing world need to follow to achieve needed environmental benefits? What are the domestic economic implications of having their emissions peak at a later date?
- Are emissions reduction strategies of any kind underway in the developing world? What obligations is it realistic to expect developing countries to adopt in Kyoto with respect to their current and future emissions? How can the U.S. help developing nations achieve greater reductions?
- Is there a national security dimension to climate change?

Participants:

- Dan Esty, Yale University (negotiations status)
- Sen. Robert Byrd (developing countries)
- John Browne, BP (need for global action, EU?)
- Roger Sant, AES (international energy, II)
- Michael Bonsignore, Honeywell (developing countries, flexibility)
- Frank Wisner, Former US Ambassador to India (reality check on developing country participation)
- Gus Speth, Director UNDP (developing countries, what US can do to help)
- Jessica Matthews, Carnegie Foundation (national security)
- Daniel Yergin, Author (national security)
- Jonathan Lash, WRI (emissions paths for developing countries, importance of II)
- John Adams, NRDC (emission reductions)
- E.O. Wilson, Harvard University (Forests)

fax transmission

August 30, 1997

To: Todd Stern - Em: 737 208 622-2030 (fax) (208) 622-4111
 From: Bill Antholis 202 456-1198

Subject: Conference Agenda

Attached is a draft agenda. As you'll see, I've drafted this one on the model that Holdren and Watson would share responsibilities. While I'm not fully satisfied with this approach, it at least breaks down where their respective strengths may lie, and would allow us to use each of them (respectively) to anchor the two discussions roundtables.

On regional impacts, I've included Rosina's preliminary list, but I have not had a chance to go over the scope of their presentations in detail. I'll try to do that over the phone tomorrow or Monday.

Finally, on the two roundtables, this is my tentative list. Maybe we could chat tomorrow morning about what sort of process you want to establish to vet these names; I can also give you a fuller description of why each of these people might be appropriate. (I had a dog of a time putting this list together as my computer crashed on me all morning).

I'm off to today's O's-Mets game, and will be back around 4pm; I'll work on early action credit paper before tomorrow's game. (Go Mets!)

For all panels, we have to answer Q: What we want to accomplish; what should messages of panel be; how ~~to generate~~ ^{to generate} at substance avoid substance contrary to what we need ^{see} the proposed panelists be worked with so we keep to approximate script.

re each person think precisely about what s/he's going to say & whether it fits.

Any diversity?

DRAFT conference agenda**10:00 - 10:15****President Clinton:** *Opening Remarks:* Importance of Global Warming and Climate Change for the American people.**10:15 - 10:35****John Holdren:** *Physical science of Global Warming:* What is global warming and climate change: sources of greenhouse gases emissions; emission trends and projections; temperature and climate trends and projections.**10:35 - 10:50****Robert Watson:** *Global impacts of Climate Change:* What are the global impacts of climate change: increased storm activity; global sea rise; changing soil, plant and water ecosystems.**10:50 - 11:30****U.S. Regional Impact Panel:***Northeast:* **Berrien Moore**, Director, Institute for the Study of Earth, Oceans and Space. University of New Hampshire*Southeast:* **Stephen Leatherman**, University of Miami*Northwest:* **Jane Lubchenco**, Professor of Marine Biology, Oregon State University*Southwest:* **Helen Ingram**, Director, Udall Studies in Public Policy, University of Arizona*Midwest:* **Don Wilhite**, Director, International Drought Information Center, University of Nebraska*Nationwide Damage History:* **Franklin Nutter**, Executive Director, Reinsurance Industry Association**11:45 - 12:45****Emission Reduction Technology and Policy Roundtable****1:00 - 2:00****Lunch****2:00 - 3:00****Kyoto Conference and U.S. National Interests Roundtable****3:15 - 4:15****Breakout Sessions****4:30 - 5:00****Vice President Gore:** *Closing remarks:* The Road Ahead

G.U. -
 The Bush Science
 Panel
 The Science of G.U.
 • The Bush Science
 • Potential impacts
 of G.U.

Policies to reduce emissions
 Int'l issues

Emissions Reduction Technology and Policy Panel

Specialization	Panelist	Strengths/weaknesses
Emissions Overview: Technology and Policy	John Holdren, Professor Harvard	+ good presenter, knows issues - may also have to give science overview
Alternative Energy	Ken Lay, Enron	+ gas and renewables specialist, especially wind and solar - may push back on early targets and timetables
	John Berger, Author "Charging Ahead"	+ renewables, energy efficiency, environmental science
	ARCO	+ owns Solarex, photovoltaic manufacturer
Fossil fuel company experimenting w/ carbon-free approaches	Fred Buckman, PacifiCorp	+ participates in Oregon's CO2 offsets program
	Richard Abdo, Wisconsin Electric	+ upgrading foreign electric plants; sequestration + JI pioneer
	Charles Bayliss, Tucson Electric	+ experience with JI, biomass, wind
Efficiency dissemination	Johnson Controls	+ active worldwide on efficiency controls; big player - cautious about not angering auto manufacturers
	George David, United Technologies	+ own Carrier Air Conditioners; International Fuel Cells - CEO may be out of country during conference
	Thomas Casten, Trigen	+ waste-heat recovery systems for electricity generation, innovative conservation technology message - company/technology small scale
	Bud Cherry, Oxbow Power	+ international power plants experimenting in renewables + strong on JI
	Tom Gridcl, ATT	+ systems engineer, developed 'industrial ecology' program
Utilities	Linn Draper, American Electric Power	+ major coal utility, has taken voluntary actions + will discuss JI and flexibility - not likely to support binding target
	Glenn English, National Rural Electric	+ has consulted widely with developing countries
Manufacturing	John Krol, DuPont	+ corporate goal of improving efficiency by 20% by 2000; + experience with CFC regulations
	William Stavropoulos, Dow	+ corporate goal of improving efficiency by 20% by 2000; leader in PCSD
	Robert Shapiro, Monsanto	+ strong on innovation and technology + leads health sciences/biotechnology portion of company
	Walter Young, Champion Homes	
Autos	John Eaton, Chrysler	+ fuel cells
Labor	John Sweeney, AFL-CIO	+ broad overview of organized labor
Emissions trading and/or regulation	Richard Sandor, Centre Financial, Vice Chair, Chicago Board of Trade	+ helped establish SO2 trading program and Chicago Board of Trade auction; + helped develop GHG trading system papers for UNCTAD

Overview: Economist

Limits on Carbon Trading - Sandor + 1

Technology: gen'l: M. Porter

- Fossil fuel: ~~Target~~ ~~gas~~ ~~sequestration/decarbon~~
- Alternatives: Biomass - Tucson, gas, solar
Solar - Enron

- Efficiency:

Int'l

This misses pt - ~~what~~

conceptual should be:

- (1) several promising technologies plus a technology generalist
- (2) emissions trading domestic + int'l + JI
- (3) macro econ.

	Carlton Bartels, Cantor-Fitzgerald	+ active in SO2 trading; already trading CO2
	William Reilly, Fmr EPA Administrator	+ helped establish the SO2 program
Economist	Robert Solow, MIT	+ co-author of economists' letter on climate change
	Michael Porter, Harvard Business School	+ bullish on potential for development of climate technologies
Environmental Rep	Fred Krupp, EDF	+ working with industry to forge consensus on early action, JI
Student Rep:	Student Environmental Action Coalition	+ largest student environmental group in US,
		+ comprised mostly of 30electronic electronic mailing lists

International Negotiation Panel

Specialization	Panelist	Strengths/weaknesses
International climate treaty negotiation	Jonathan Lash, World Resources Institute	
	Michael Oppenheimer, EDF	+ climate science and impacts
	Robert Watson, IPCC	+ can speak to global impacts, IPCC report/consensus
	Dan Esty, Yale University	+ expert on Kyoto round, role of developing countries
Foreign Policy	Jessica Matthews, Carnegie Foundation	+ President of "cutting edge" think tank, articulate + former Administration official - former Administration official
	Daniel Yergin, Author	+ international oil politics
	John Steinbruner, Brookings	+ foreign policy analyst, interested in environmental issues
	Ambassador (ret.) Frank Wisner	+ former Ambassador to India + established US-India Common Agenda on environment
Development economist	Paul Krugman, MIT	+ co-author of economists' letter on climate change + expert on competitiveness, technology, labor
Senate	Richard Lugar, IN	+ favors internationalist approach + represents agricultural interests
	Robert Byrd, WV	+ big coal
International energy company	Riley Bechtel, Bechtel	+ joint worldwide renewable energy venture with PG&E + big growth company, diverse holdings, - don't know their climate change interests
	Roger Sant, AES	+ major international energy company; + pioneered forest sequestration. + Sant is also chairman of WWF
	Michael Bonsignore, Honeywell	+ major energy efficiency firm; active in developing world - may not want to alienate auto manufacturers
	Royal Dutch Shell	+ projects that renewables will replace fossils by end of 21st C
Multinational manufacturing	Cargill	+ international agriculture and agriculture products company + active on environmental issues
	Jack Creighton, Weyerhaeuser	+ major forest products company; supportive of Administration's environ technology
	Boeing	
Environmental scientist	John Adams, NRDC	+ energy efficiency solutions in developing world
	E.O. Wilson, Harvard University	+ role of forests
	Donald Kennedy, Stanford University	+ former head of FDA, President Emeritus of Stanford + directed study of climate change and political stability + speaks to relationship of climate change to infectious disease

THE WHITE HOUSE

WASHINGTON

September 2, 1997

MEMORANDUM FOR TODD STERN

FROM: Maria Echaveste ~~SA~~

SUBJECT: Climate Change outreach meetings

Throughout the Fall, we will be hosting a series of outreach meetings as part of the Administrations effort to educate key opinion leaders on the severity of the climate change issue. I am providing the following schedule of briefings for your review. As you can see, I have included a description of the proposed audience and a list of potential Administration speakers for each briefing. Our outreach strategy focuses on three groups: constituent opinion leaders, regional environmental activists and newspaper editorial writers. I am working closely with Cabinet Affairs, CEQ, the Climate Change Task Force and the Vice President's office to coordinate the list of invitees, cabinet schedules, press opportunities and, of course, to ensure the participation of the Vice President in each of these events.

September 11th:

Constituent Leaders Briefing

The Indian Treaty Room (and room 450)

Description: This event will provide a briefing for key opinion leaders from among the following communities: religious, African American, Ethnic Europeans, health, women, youth, Jewish, seniors and disabled Americans among others.

Requested speakers: The Vice President, Secretary Babbitt

*(Business
Ins.
1 Farmers
[Labor])*

September 16th:

Environmental Opinion Leaders

The Indian Treaty Room (and room 450)

Description: Briefing for regional environmental leaders, sportsman, renewable resources representatives and cultural leaders.

Requested speakers: Vice President Gore, Katie McGinty

September 22nd-26th:

Editorial Writers Briefing

Roosevelt Room or Vice Presidential Ceremonial office

Description: Briefing for national environmental editorial writers.

Requested Speakers: Vice President Gore . . .

Possible Post-Conference Briefings:

- *Inter Governmental briefing with Mayors and Governors
- *Business briefing with Electric Power, Manufacturing, Transportation and Oil & Gas Industries
- *Labor leaders



CENTER FOR HEALTH AND THE GLOBAL ENVIRONMENT

HARVARD MEDICAL SCHOOL

August 18, 1997

Mr. Todd Stern
Staff Secretary
Ground Floor, West Wing
The White House
1600 Pennsylvania Avenue, N.W.
Washington, DC 20503
Fax 202- 456 - 2415
total pages--14

Dear Mr. Stern,

As a follow-up to our conversation at the White House Scientists' Meeting on Climate Change on July 24th, I am sending you some materials from our Center.

1. the program of our briefing for the Vice President in October of 1994 on "Climate Change and Human Health,"
2. a page from the Summary Proceedings of the Conference on Human Health and Global Climate Change at the Institute of Medicine/National Academy of Sciences in September, 1995 which was organized as a result of the above briefing,
3. a letter from Jack Gibbons about our help in planning, organizing, and participating in the Conference,
4. a notice of our Congressional Briefing held on March 10th of this year,
5. an Op/Ed Paul Epstein and I did in **The Boston Globe**,
6. and a letter of invitation from Carol Browner to brief the Environmental Ministers of the G7 (plus Russia and the European Union) about the health effects of climate change.

I am enclosing these items to make the case that the subject of human health figure prominently in the October 6th White House Conference. This is critically important for two reasons--1. by

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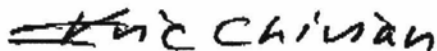
discussing human health, one is able to translate the abstract, technical science of climate change into concrete, personal terms that people can relate to and 2. people are unlikely to make the changes necessary to reduce greenhouse gas emissions until they have understood the risks to themselves and their children.

Both Paul Epstein and I are extremely well informed about the potential human health consequences of climate change, and have spoken and written extensively on the subject. I hope you will consider one or both of us for the upcoming White House Conference.

I have also enclosed the text (without the slides) of my talk at Carol Browner's Environmental Leaders' Summit so that you can get an idea of what I would cover if I were to speak.

I will be in Washington from September 4th through September 8th, as we are holding another Congressional Briefing, entitled "The Value of Plant, Animal, and Microbial Species to Human Health." If I don't hear from you before then, I will try to set up a meeting at that time.

With best wishes,

A handwritten signature in dark ink, appearing to read "Eric Chivian". The signature is stylized with a long horizontal stroke at the beginning.

Eric Chivian M.D.

10/06/94 11:00

Vice President's Technical Science Breakfast October 7, 1994
274 OEOB, 7:45 AM
Climate Change and Human Health

Speakers:

Dr. Eric Chivian, Assistant Clinical Professor of Psychiatry, Harvard.
Staff Psychiatrist, MIT.

Dr. Mary Wilson, Chief, Infectious Diseases, Mt. Auburn Hospital Cambridge.
Assistant Professor of Medicine and Assistant Professor of Population
and International Health, Harvard.

Dr. Robert Shope, Professor of Epidemiology, Yale School of Medicine.
Director of the Yale Arbovirus Unit.

Today's speakers will discuss the interplay of climate change, ozone depletion, and environmental degradation on current and future incidence of disease. Environmental factors contribute to the occurrence, spread, and intensity of human infectious diseases. The recent resurgence of old diseases we thought we had conquered (TB and measles), the emergence of new diseases (Legionnaire's and AIDS), and the discovery of new mechanisms to spread disease (cholera in algal blooms), all point to the need for increased attention to the relationship between environment and human health.

Climate change adds an additional layer of concern. Changing temperature and precipitation patterns world-wide could have direct impacts such as changing the distribution of disease organisms. Less directly, a decrease in world-wide agricultural productivity could result in nutritional deficiency and increased hunger. Rising sealevel will flood low-lying islands and could lead to "ecological" refugees and migrating populations.

Little research has been directed at studying the impacts of climate change on human health. The three guest breakfast speakers have helped to focus attention on this important issue.

CONFERENCE ON HUMAN HEALTH AND GLOBAL CLIMATE CHANGE

coordination among nations and scientific disciplines; (c) multidisciplinary research on the links between global climate change and human health; (d) improved environmental health training for health professionals; and (e) an outreach program to inform and educate the public about the effects of global climate change on human health. In the face of current fiscal constraints, these efforts must be based on identifying and linking together existing activities, facilities, organizations, and funding agencies.

BACKGROUND AND OVERVIEW

In October 1994, following a meeting with concerned scientists and medical experts (Eric Chivian, Bob Shope, and Mary Wilson), Vice President Gore asked the Office of Science and Technology Policy (OSTP) and the Council on Environmental Quality (CEQ) to organize a conference on the potential human health risks posed by global climate change, and strategies to address them—such as global health surveillance, public outreach, and education. Members of the NSTC, OSTP and CEQ formed a working group to develop a preliminary agenda for the conference and later requested that the IOM join in planning, organizing, and conducting the conference. (Appendix A presents a list of the sponsoring agencies, the IOM steering committee, and conference organizing staff.)

The purpose of the conference was twofold:

1. To bring together a diverse, interdisciplinary group of experts to address the potential effects of global climate change and ozone depletion on the current and future incidence of disease, heat stress, food and water supplies, and air pollution; and
2. To discuss initial strategies for improving research and development (R&D), global health surveillance systems, health care and disease prevention, medical and public health community education, international cooperation, and public outreach.

It is important to note that the focus of the conference was human health. Presenting evidence of whether or not global climate change is, has, or will occur, was not the primary focus. Participants were asked rather to work within an "if/then" type of scientific exercise: If global climate change occurs, what are the potential adverse human health effects and what strategies should be developed to address them?

The first day of the two-day conference was filled with scientific presentations and a plenary discussion on the current state of knowledge about global climate change and its potential risks for human health (see the agenda, Appendix B), including a presentation by Vice President Gore (see Box 1). On the second day, participants discussed health policy implications and potential intervention strategies in a series of panels. Each panel's findings were presented and discussed by the conference participants in a final plenary session. Approximately 300 scientists, health care providers, policymakers, academicians, federal and state officials, industry representatives, and others attended the conference and participated in developing the strategies (see Appendix C).

THE WHITE HOUSE
WASHINGTON

September 22, 1995

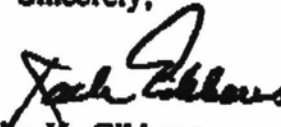
Dr. Eric Chivian
Assistant Clinical Professor
Department of Psychiatry
Harvard Medical School
56 Hawes Street
Brookline, MA 02146

Dear Dr. Chivian:

On behalf of Dr. Ken Shine and myself, I want to thank you for all your work and participation in the Conference on Human Health and Global Climate Change which contributed to its tremendous success. By bringing together the diverse communities of educators, scientists, researchers, and NGOs from industry and the medical and national security communities, the conference afforded an opportunity to discuss the broad array of issues associated with human health and climate change. Your talk on the role of the medical and public health communities and the need for increased education in environmental issues helped set the stage for the discussions at the conference and for continuing efforts.

For your information, I am enclosing a transcript of the Vice President's talk. Again, thank you for all your hard work.

Sincerely,


John H. Gibbons
Assistant to the President
for
Science and Technology

Enclosure



ENVIRONMENTAL AND ENERGY STUDY INSTITUTE

NOTICE

KEN MURPHY, EXECUTIVE DIRECTOR ■ 122 C ST. NW, STE 700 ■ WASH. D.C. 20001 ■ (202) 628-1400

POTENTIAL HUMAN HEALTH EFFECTS OF GLOBAL CLIMATE CHANGE**Monday, March 10****1:30-3:30 p.m., SD 215 Dirksen Senate Office Building**

The potential effects of global climate change on human health will be presented in a briefing co-sponsored by EESI and Harvard Medical School's Center for Health and the Global Environment.

As nations from around the globe prepare to adopt a global climate treaty late this year, more attention is being paid to the potential health impacts of extreme weather events and of other possible manifestations of the "greenhouse effect."

This briefing features presentations on key topics by some of the nation's leading scientific and medical experts:

- Overview, Prof. Barry Levy, President, American Public Health Association.
- Greenhouse gases and extreme weather events, Dr. Thomas Karl, Senior Scientist, National Climatic Data Center, Asheville, N.C.
- Heat waves and mortality, Prof. Laurence Kalkstein, Director, Center for Climatic Research, University of Delaware.
- Air pollution, the greenhouse effect and human health, Prof. Arden Pope, Brigham Young University.
- Climate change and infectious disease, Dr. Paul Epstein, Instructor in Medicine, Harvard Medical School.
- Climate change and species loss: implications for human health, Dr. Eric Chivian, Director of the Center for Health and the Global Environment, Harvard Medical School.

(over)

The Boston Globe

THURSDAY, APRIL 10, 1997

*Warm and wet conditions
spell trouble for the world.*

Weather alert

**ERIC CHIVIAN
and PAUL EPSTEIN**

Last week's record snowstorm was another reminder that in recent years we have endured the most variable and extreme weather in memory. The same has been true in other parts of the country and the world. Witness the succession of storms and snow melts in the Pacific Northwest in January and the record-setting floods along the Ohio River last month.

This instability is considered to be an early manifestation of the warming of the atmosphere and the oceans over the last 100 years, resulting from our burning fossil fuels and rapidly increasing atmospheric carbon dioxide concentrations.

Worldwide, 1996 was the warmest year since global temperatures were first kept in 1856. For the Northeast, 1996 was the warmest year on record. What people don't realize is that these changes in climate carry unprecedented potential risks for human health.

For one: Warm, wet weather, especially warm winters and wet springtimes, produces ideal breeding conditions for mosquitoes, which in New England can carry Eastern equine encephalitis, a disease with a 50-percent mortality mainly affecting children and leaving many with severe, chronic neurological problems. Warm, wet conditions also favor increased populations of ticks, which can transmit several infections, including Lyme disease.

Prior to the 1970s, Lyme disease was unheard of, but in each subsequent decade the number of cases has steadily climbed. In 1994, the Centers for Disease Control reported 13,000 cases nationwide, a 26-fold increase over 1962.

While tick-borne diseases are highly sensitive to human settlement patterns and populations of host species like deer and mice, climatologic factors are likely to play an increasingly important role.

Higher global temperatures also increase the number of heat-related deaths, as we saw in Chicago during the

July 1995 heat wave, when more than 700 people died. Currently in Boston, there are about 90 people on average who die each summer from the heat. If global warming continues at its current pace, this figure may double by the year 2050. Additional illness and death may result from increasing levels of air pollution, exacerbated by the warming, affecting those with chronic respiratory diseases, such as children with asthma and the elderly with bronchitis and emphysema.

The world scientific community has warned that present trends of fossil fuel use may result in average global temperatures by the year 2100 that are 2 to 6 degrees warmer than they are now. It has been more than 120,000 years since the earth was this warm. Because species often live within narrow temperature ranges, such warming — and more extreme weather — may compromise food sources, affecting agricultural productivity and marine life, and threaten countless numbers of species with extinction.

In addition to the unforeseeable ecological consequences of such extinctions, direct implications for human health include the loss of valuable medical research models that help us understand human physiology and disease and the loss of potential new medicines.

Consider two New England species that may be endangered by greenhouse warming — the white birch and the dogfish shark. Researchers have found in the bark of white birch trees an acid that in laboratory tests has shown great promise in fighting malignant melanomas, a cancer that is increasing in incidence at a faster rate than any other in the United States, doubling in the past decade.

The fact that sharks rarely get infections or tumors, presumably the result of 400 million years of highly successful evolution of their immune systems, has led to the discovery of "squalene" in the dog-

fish shark, an antibiotic that is highly potent against a wide variety of bacteria, fungi, and parasites and that seems to work through pathways different from those of all other known antibiotics.

As infectious agents are acquiring resistance to currently used medications, this discovery has special significance.

Finally, species loss may disrupt vital life support systems as species interact with one another and with their environments to provide such services as regulating the concentration of atmospheric gases and water vapor, maintaining soil fertility, filtering pollutants, breaking down wastes, and controlling pests.

With our failure to heed the warnings of the world's scientific community to reduce our burning of fossil fuels, we are in effect conducting a global experiment with all life on earth, including human life.

the outcome of which no one can fully predict. What we can predict — about changes in the incidence and distribution of infectious diseases, about heat waves and air pollution, and about the effects of species loss — suggest a future with enormous dangers for human beings.

With a recognition of the medical consequences involved from our damaging the ozone layer, the world community agreed to control the release of ozone-depleting chemicals. Will it respond with the same urgency to the human health risks predicted from our changing the global climate and draft a strong treaty to control greenhouse gases?

Eric Chivian and Paul R. Epstein are faculty members at Harvard Medical School, where they direct the Center for Health and the Global Environment.



PHIL LACHNER ILLUSTRATION



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

APR 25 1997

THE ADMINISTRATOR

Eric Chivian, M.D.
Director
Center for Health and the Global Environment
Harvard Medical School
56 Hawes Street
Brookline, Massachusetts 02146

Dear Dr. Chivian:

It is my pleasure to invite you to participate in a discussion of the Impacts of Climate Change at the upcoming Environment Leaders' Summit, to be held in Miami, Florida, May 5-6, 1997.

The agenda item on the Impacts of Climate Change is scheduled for Monday afternoon on May 5. The exact time is yet to be determined. I would like you to give a 10-minute presentation on the health effects of climate change. This will be followed by a 10-minute presentation by Tom Karl of the National Oceanic and Atmospheric Administration on the effects of climate change on global weather. The remainder of the session will be devoted to an exchange of views by the Environment Leaders. A background paper which is being prepared for the Environment Leaders on the impacts of climate change will be sent to you in advance of the meeting.

A meeting schedule is enclosed with this letter, along with information on hotel accommodations and other logistical matters.

I very much hope you will be able to accept this invitation, as I believe you will make an important contribution to the discussion of this particular agenda item at the Environment Leaders' Summit. The U.S. Environmental Protection Agency will be responsible for your travel. Jeff Shulman of my staff will make the arrangements for you. He can be contacted at (202) 260-4369.

I look forward to seeing you in Miami.

Sincerely,

A handwritten signature in cursive script, reading "Carol M. Browner".
Carol M. Browner

Enclosures

THE POTENTIAL HUMAN HEALTH EFFECTS OF GLOBAL CLIMATE CHANGE

Eric Chivian M.D.

Briefing Talk for

The Environment Leaders' Summit [environmental ministers of the G7, Russia, and the European Union]

Miami, Florida

May 5, 1997

Introduction

I'm delighted and honored to be here--thank you Carol Browner and Bill Nitzte for inviting me. I'm also delighted that the health impacts of global climate change are central to these discussions. This is critically important because environmental decisions must be based ultimately on what the effects of those decisions are on human beings, and because people are unlikely to change their behaviors or support policies necessary to control greenhouse gases until they have begun to recognize the risks to their health and lives, and to those of their children. Moreover, by discussing the effects on health, one has the potential of translating the abstract, technical, complex science of global climate change into concrete, personal terms that people can relate to and understand.

That is why we formed the Center for Health and the Global Environment at Harvard Medical School - to promote a wider understanding of these issues. We are a collaborating center of the United Nations Environment Programme and work closely with the World Health Organization and with the IPCC.

Today I will briefly review some of the potential human health effects of global climate change. This is a highly complicated subject with an enormous number of uncertainties. I have included some background materials in your packets. For those wanting a more complete review of this subject, I refer you to chapter 18 in the IPCC working Group II 2nd Assessment Report and to this superb WHO/WMO/UNEP book (1996) Climate Change and Human Health. I also urge you to obtain this newly published Island Press book Biodiversity and Human Health (edited by F. Grifo and J. Rosenthal, 1997).

Background

Because of the natural heat-trapping effect of atmospheric gases, the average global surface air temperature has been approximately 15 degrees C. for the past 10,000 years. Without this natural greenhouse effect, the average temperature would be minus 18 degrees C. and most of the Earth's surface would be frozen.

Since the Industrial Revolution, the emission of greenhouse gases has risen dramatically, secondary to industrial and agricultural production and the use of fossil fuels for heating, producing electricity, and transportation. CO₂, the main greenhouse gas, has increased in the atmosphere by roughly 30% in the past 100 years, increasing from about 270 parts per million by volume (ppmv) to an atmospheric concentration in 1994 of around 360 ppmv.

In the last 100 years, average global surface temperatures have warmed approximately 0.5 degrees C. or 1 degree F.

1995 was the warmest year globally since records were first kept in 1866, and the 1990's will clearly be the warmest decade. Over the past century, sea levels have risen globally about 18 cm., and weather patterns have changed, as you will hear from Tom Karl.

slide 6

The IPCC has concluded that "the balance of evidence suggests a discernible human influence on global climate," and recent work by Benjamin Santer and his colleagues, comparing the predictions from global circulation models, taking sulfate aerosols and stratospheric ozone into account, with observed temperatures shows a striking similarity, offering the best evidence to date of an anthropogenic effect. The IPCC has predicted, with a scenario of doubling atmospheric CO₂ concentrations by 2100, we can expect mean temperatures to increase approximately 2 degrees C. with a range of 1-3.5 degrees C.

Now, to many people, this may not sound like something to be worried about, but we need to keep in mind that:

1. these are mean global increases and that they will be greater than the mean nearer the poles

slide 7

2. the difference between average temperatures during the last ice age, 20,000 years ago, when glaciers up to a mile thick covered much of Canada, northern United States, and northern Europe and now is only about 5 degrees C.

slide 8

3. and temperatures 2 degrees C. warmer than now have not been present for more than 120,000 years, during the Eemian interglacial period when *Homo Sapiens* first evolved. Look at today's CO₂ concentration--it is greater than at any time during the past 160,000 years, and with the doubling predicted, we are in totally uncharted territory.

The IPCC has also predicted an increase in sea levels of about 1/2 meter, with a range of 15 cm. to more than 1 meter, more climate variability and extreme weather events like heat waves, such as that experienced during the summer of 1994 in Europe,

slide 9

drought, such as that which occurred in the U.S. 1 yr. ago in the plains states

or that presently occurring in Western Europe, especially in Portugal, France, and in the United Kingdom, which is having its longest dry spell in more than 200 years.

slide 10

An absence of rainfall can create the conditions for wildfires, such as those we experienced in the western U.S. last summer when more than 6 million acres burned, nearly double the average acreage burned each year during this decade in the Amazon.

slide 11

We can also see extremely heavy rains and snows with flooding such as that which occurred in the Mississippi valley in 1993,

slide 12

across Germany, France, Belgium and the Netherlands in January of 1995,

and in the Red River Valley during the last month after the river rose 25 feet above its floodstage, devastating large areas of North Dakota.

These changes in temperature, precipitation, soil moisture, sea level, and extreme weather events will have both direct and indirect effects on human health.

Direct Effects on Human Health

slide 13

For one, there will be an increased frequency and intensity of heat waves, which are likely to lead to dramatic increases in summer deaths. By the year 2050, the excess summer mortality from heat-related causes in several major American cities could double over present levels.

In Chicago, for example, during the 5 day heat wave in July 1995, over 700 people died from heat-related causes. Major urban centers in the developing world such as Shanghai and Cairo could see increases of 3 to 4 fold over background levels.

The elderly, the very young, those with impaired mobility, and people suffering from cardiovascular and respiratory disease are the most at risk. Poor urban populations in industrialized and developing countries alike are also more vulnerable to heat waves, because of poor housing and a lack of access to air conditioning.

Slide 18 These extreme weather events will cause additional direct health effects, from injuries and electrocutions from storms, to drownings from the flooding.

Indirect Effects on Human Health

The potential indirect health effects from global climate change are large in number and difficult to predict, as they are often the product of multiple variables, many of which are poorly understood.

For the purposes of our discussion, I will divide these into the following categories:

1. those from the effects of air pollution
2. those secondary to sea level rise and flooding events
3. those which are the result of disturbances to ecosystems

Air Pollution

The dynamics of the relationship between climate change and air pollutants have not been fully studied. What can be said is that the chemical reactions forming secondary air pollutants are accelerated by higher temperatures. Climate change, therefore, may lead to increased concentrations of photochemical oxidants, including ground level ozone (also increased by increased Ultraviolet B radiation on the ground), and to higher levels of sulfate and nitrate particulates, causing increases in the frequency and intensity of asthma attacks (which in the U.S. is the single greatest cause of childhood hospitalizations), and in an increased risk of respiratory and cardiovascular illness and premature death.

Pollens and spores may also increase as a result of warm weather and changes in precipitation patterns, worsening allergies and causing increases in the risk of some windborne fungal diseases. As an example, an epidemic of the fungal disease coccidiomycosis broke out in the American southwest a few years ago, attributed to a protracted drought followed by heavy rains. As new fungal pathogens are emerging and old ones re-emerging and as fungi are developing increasing resistance to antifungal medications, one has to be concerned about the potential for increased fungal infections secondary to climate change.

Sea Level Rise and Flooding Events

Sea level rise will have a wide range of effects on human health, including: nutritional loss from a flooding of agricultural lands and from a loss of fish breeding areas, such as coastal wetlands and mangroves; and from the reduced availability of drinking water, due to salt water intrusion and a rise in the water table in low-lying coastal areas, releasing infectious contaminants from septic systems into waterways and increasing the risk of waterborne infectious disease.

In addition, there will be all the health problems associated with millions of environmental refugees escaping flooded and storm destroyed areas.

Flooding from extreme precipitation events will also diminish the quantity and quality of drinking water supplies, which will be contaminated by toxic chemicals, by animal and human waste, and by the floating carcasses of dead animals.

An outbreak in 1994 of lung bleeding in infants in Cleveland Ohio killing 1/3 of those affected, was traced to a previously undiscovered black mold growing in water damaged homes, illustrating again how little we know about some of the health effects of such events.

Ecosystem Disturbance

Finally, I want to cover the implications for human health from disturbances to ecosystems secondary to climate change. This is an area that worries many of us the most, as such disturbances may carry the greatest risks of human health. It is also perhaps the least well understood aspect of global climate change.

Let me begin by mentioning 3 models of infectious disease transmission that may be affected by climate change.

slide 15
1. More than 350,000 people in Central America became infected with dengue fever during the hot wet summer of 1995, and there was serious concern that there could be scattered outbreaks of dengue along the entire gulf coast of the U.S. from Texas to Florida. Some cases were, in fact, reported in Texas. Dengue, a severe viral disease of the tropics and subtropics, carried by mosquitoes currently infects 50 million people each year. Initial dengue infections cause pain, fever, and prostration, but are not associated, in general, with mortality. Subsequent dengue infections, however, can cause dengue hemorrhagic fever, which is one of the leading causes of hospitalization and mortality for children in South East Asia.

slide 16
In most parts of the world, dengue is carried by *Aedes aegypti*, the famous carrier of yellow fever, but this mosquito, *Aedes albopictus*, the Asian tiger mosquito, brought to the U.S. from Asia in 1985 in a shipment of used tires, can also transmit dengue.

slide 17
The tiger mosquito has proliferated rapidly in southern states, reaching as far north as Nebraska and Iowa. It has also been found in Italy.

slide 18
The range of this mosquito, and that of *Aedes aegypti*, is limited by frost and sustained cold temperatures which kill adults and prevent the survival of eggs and larvae through the winter. With the increased temperatures from climate change, we may expect their ranges to enlarge as they move to higher latitudes into temperate zones, and to higher altitudes. Such shifts have already been observed, for example, during the unseasonably warm summer of 1988, when dengue reached previously unaffected areas in Mexico at altitudes of 1700 m.

The increased temperatures from climate change can also intensify mosquito-borne diseases by increasing mosquito reproduction, increasing biting rates, and enhancing the proportion of mosquitoes that become infected.

Up to World War II, many parts of the industrialized world had outbreaks of malaria, including the USA, and Western and Southern Europe.

slide 19
This slide shows malaria mortality in the U.S. from 1919 to 1921, with the dark areas in some southern states being counties with more than 5 malaria deaths per 10,000 population.

Malaria causes 300-500 million new cases per year and an estimated 2 million deaths annually, more than 1/2 of whom are young children, mostly in Africa.

We have seen some cases of locally-acquired malaria in the U.S. for the first time in decades--in New York, New Jersey, and Texas during the hot wet summers of 1991, 1993 and 1994.

Estimates by the WHO have predicted an additional 50-80 million cases of malaria by the year 2100 with climate change.

2. We will also see an effect on waterborne infectious diseases.

5/1/96 20 This NOAA satellite photo shows in red and orange the worldwide distribution of algal blooms, which have increased dramatically in recent years, it is believed, because of sewage and fertilizer discharge into coastal waters, overfishing, the loss of wetlands that filter out nitrates and phosphates, and warmer sea surface temperatures.

5/1/96 21 This is the coast of Peru in 1991, showing an intense algal bloom. In that year, cholera struck Peru. Apparently the cholera bacteria, initially transported in the bilge water of a freighter from Bangladesh, proliferated rapidly in the unusually warm and nutrient rich Peruvian waters, where algal blooms provided an ideal medium for them to thrive. As a result of poor sanitation, urban crowding and an inadequate medical infrastructure, cholera quickly spread to 19 Latin American nations, following rivers and streams, eventually affecting 1/2 million people and killing 5000.

3. The final infectious disease model I will mention concerns the hantavirus outbreak in the U.S.

The story went like this:

5/1/96 22 Six years of drought in the Four Corners area of the American Southwest, where Utah, Arizona, Colorado and New Mexico meet, ended in the late winter and early spring of 1993, when unusually heavy snows and rains drenched the region, resulting in a very heavy crop of pine nuts and a super-abundance of grasshoppers, both food for the native deer mouse.

Now, the drought had led at the same time to a marked reduction in the mouse's usual predators - foxes, snakes, owls, and coyotes and as a result, the mouse population exploded, increasing 10 fold by May of 1993 over levels of the previous year. Deer mice, it turns out, carry a virus from the hantavirus family, which they shed through their saliva, urine, and feces, and as a consequence of the greatly increased exposure by people in the area to the huge mouse population, an epidemic of a rapidly fatal pneumonia (or pulmonary syndrome), developed--17 previously healthy people initially got the disease, 13 of them died.

5/1/96 23 As of now, 145 people in 25 states in the U.S. have been diagnosed with hantavirus pulmonary syndrome, with a mortality rate of around 50%. No one knows how many other viruses or other infectious agents in the environment, potentially harmful to man, are being held in check by the natural balances among species, in this case disrupted by a regional change in climate.

And that leads me to my final comments.

Other Ecosystem Effects

Many paleontologists believe that climate change was the dominant factor in the great species extinctions of the past. Species adapted to the changes in temperature by shifting their ranges--during warming they moved towards the poles or to higher altitudes. During cooling periods they retreated. But many species were lost because they could not adapt, either because their rates of migration were too slow or because geographical barriers stood in their way.

By contrast to past temperature changes, however, those expected for the next century will be 10-100 times faster than those that have occurred before, and in addition to geographical barriers,

there are man-made ones everywhere—cities, roads, agricultural lands. In fact, global climate change could become one of the most significant factors in ecosystem disruption and species loss in the next 100 years.

5/1/00 29 We are already seeing evidence of such shifts in the range of species in response to warming temperatures, in the move to higher elevations of some plant species in the alps, and in the northward migration of a butterfly, the Edith's Checkerspot, in western states in the U.S.

5/1/00 25 Disruptions of species functions and of the composition of species populations in ecosystems that we may see with global climate change have very worrisome implications for agriculture and for the marine food supply. Such disruptions may also interfere with the ways species interact with each other and with their environments to provide vital life support services, such as regulating the composition of gases and water vapor in the atmosphere, maintaining soil fertility, filtering pollutants,, controlling pests, and breaking down wastes.

With our continued discharge of ever increasing amounts of CO2 into the atmosphere, affecting global temperatures, precipitation patterns, soil moisture, sea levels, and causing potentially serious disruptions to terrestrial and marine ecosystems, we are, in effect, conducting a massive experiment with all life on this planet, including human life, the outcome of which no one can fully predict.

What we can predict suggests a future with enormous, and, I believe unacceptable, risks for human beings. These risks for our children and for generations to come may dwarf all other presently known environmental health threats.

When the world community began to recognize the magnitude of the danger from ozone depletion, it adopted the Vienna Convention to control the emission of chlorofluorocarbons, saving, it has been recently estimated, more than 1 million cases of skin cancer each year in the U.S. alone by the year 2100, and almost 400,000 in Northwest Europe.

Let us hope it will respond with the same sense of urgency to the public health warnings about global climate change from the WHO and health scientists, and from a growing chorus of physicians, and move to set significant and binding targets to curb greenhouse gasses.

Rosina said you
would like to see at
least the Summary of the
IPCC Regional Report.

We can provide you the
rest of the document if
necessary. —

- Susan Bosson, OSTP
6-6083

Science -

Impacts

8/27 [200, na - never got
1 pages on regional
impacts]

IPCC Working Group II: Special Report on the Regional Impacts of Climate Change

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SUMMARY FOR POLICYMAKERS

1. Scope of the Assessment

This report has been prepared at the request of the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) and its subsidiary bodies (specifically the Subsidiary Body for Scientific and Technological Advice–SBSTA). The special report provides, on a regional basis, a review of state-of-the-art information on the vulnerability to potential changes in climate of ecological systems, socio-economic sectors (including agriculture, fisheries, water resources, and human settlements), and human health. The report reviews the sensitivity of these systems as well as options for adaptation. Though drawing heavily upon the sectoral impact assessments of the Second Assessment Report (SAR), the report also draws upon more recent peer-reviewed literature (*inter alia*, country studies programs).

2. Nature of the Problem

Human activities, primarily the burning of fossil fuels and changes in land-use and land-cover, are increasing the atmospheric concentrations of greenhouse gases, which alter radiative balances and tend to warm the atmosphere; and, in some regions, aerosols, which have an opposite effect on radiative balances and tend to cool the atmosphere. At present, in some locations primarily in the Northern Hemisphere, the cooling effects of aerosols can be large enough to more than offset the warming due to greenhouse gases, although aerosols do not remain in the atmosphere for long periods, and thus will not offset the long-term effects of greenhouse gases, which are long-lived. Aerosols can have important consequences for continental-scale patterns of climate change.

These changes in greenhouse gases and aerosols, taken together, are projected to lead to regional and global changes in temperature, precipitation, and other climate variables, resulting in global changes in soil moisture, an increase in global mean sea level, and the prospects for more severe extreme high temperature events, floods, and droughts in some places. Based on the range of sensitivities of climate to changes in the atmospheric concentrations of greenhouse gases (SAR, WG I) and plausible changes in emissions (IS 92a-f), climate models project that the mean annual global surface temperature will increase by between 1.0 and 3.5 degrees Centigrade by 2100, and that global mean sea level will rise by between 15 and 95 cm. The average rate of warming would probably be greater than any seen in the last 10,000 years, although the actual annual to decadal rate would include considerable natural variability, and regional changes could differ substantially from the global mean value. These long-term, large-scale, human-induced changes will interact with higher-frequency natural variability on timescales of days to decades (e.g., the El Nino Southern Oscillation – ENSO), and thus influence social and economic well-being.

Scientific studies show that human health, ecological systems, and socio-economic sectors (e.g., agriculture, water resources, forestry, industry, and financial services such as insurance), which are all vital to sustainable development, are sensitive to changes in climate, including both the magnitude and rate of climate change, as well as to changes in climate variability. Hence, climate change represents an important additional stress on systems already affected by increasing resource demands, unsustainable management practices, and pollution. These stresses will interact in different ways across the regions but can be expected to reduce the ability of environmental systems to provide, on a sustained basis, key goods and services needed for successful economic and social development, including adequate food, clean air and water, energy, safe shelter, low levels of disease, and employment opportunities. Climate change also will take place in the context of economic development, which may make some groups or countries less vulnerable to climate change, for example by increasing the resources available for adaptation; while those that experience low rates of growth, rapid increases in population, and ecological degradation may become increasingly vulnerable to potential changes.

3. Approach of the Assessment

A quantitative assessment of the implications of changes in climate by sector and by region requires accurate projections of baseline socio-economic conditions and the regional patterns of climate change. Unfortunately, there

are uncertainties associated with socio-economic projections of factors such as population, income, land-use, technologies, and economic activity by sector; as well as with projections of climate change. Confidence is higher in the hemispheric-to-continental-scale projections of coupled atmosphere-ocean climate models than in regional projections, where confidence remains low. There is more confidence in temperature projections than in hydrological changes, and the degree to which climate variability will change is also still uncertain. Topographical features (e.g., mountains, large lakes, narrow land masses) not included in current general circulation models (GCMs) have been shown to significantly affect local and regional climate. Most GCM experiments have not accounted for human-induced landscape changes, and aerosol emissions have only recently been included. These factors contribute to the uncertainties surrounding regional projections of climate.

Therefore, this IPCC assessment primarily focuses on the *vulnerability* of systems to changes in climate, i.e., the extent to which climate change may affect a system or sector. Vulnerability depends not only on the *sensitivity* of a system to climate change (the degree to which a system or sector will respond to a given change in climate), but also on its ability to adapt (the degree to which adjustments in practices, processes, or structures are possible). To the extent permitted by the scientific literature, the report uses ecological and socio-economic models in conjunction with a range of GCM model results to assess the potential implications of a range of emissions scenarios, both with and without the influence of sulfate aerosols. It is important to note that the question of vulnerability can be addressed without using GCM results: The response of systems to different levels of change (e.g., a 2° centigrade temperature increase and a 20 percent precipitation decrease) and the options for adaptation to these levels of change will indicate vulnerability. GCM results are used in this analysis to justify the order of magnitude of the changes used in the sensitivity analyses. They are not predictions that climate will change by specific magnitudes in particular countries or regions.

4. Anticipatory Adaptation in the Context of Current Policies and Conditions

A key message of the regional assessments in this report is that many systems and policies are not well-adjusted even to today's climate and climate variability. Increasing costs in terms of both human life and capital due to floods, storms, and droughts demonstrate current vulnerability. This situation suggests that there are adaptation options which would make many sectors more resilient to today's conditions, and which would thus help in adapting to future changes in climate (these options – so-called “win-win” or “no-regrets” options – could have multiple benefits and would most likely prove to be beneficial even in the absence of climate change impacts).

In many countries, the economic policies and conditions (e.g., taxes, subsidies, transfers, and regulations) that shape private decision-making, development strategies, resource-use patterns, and hence environmental conditions, hinder implementation of adaptation measures. For example, in many countries, water is subsidized, encouraging its over-use (which draws down existing sources) and discouraging conservation measures, which may well be an element of a future adaptation strategy. Another example is inappropriate land-use zoning and/or subsidized disaster insurance, which encourage development of infrastructure in areas prone to flooding or other natural disasters—areas which could become even more vulnerable as a result of climate change. Improvements in domestic policies that promote adaptation and better incorporate the long-term environmental consequences of resource use can be encouraged through a range of approaches including strengthening legal and institutional frameworks, removing pre-existing market distortions (e.g., subsidies), correcting market failures (e.g., failure to reflect environmental damage or resource depletion in prices or inadequate economic valuation of biodiversity), and promoting public participation and education. These types of actions would adjust resource-use patterns to current environmental conditions and better prepare systems for potential future changes.

The challenge is to identify opportunities that facilitate sustainable development by making use of existing technologies and developing policies that make climate-sensitive sectors resilient to today's climate variability. This will require many regions of the world to have more access to the appropriate technologies, information, and adequate financing. In addition, the regional assessments suggest that adaptation will require anticipation and planning; failure to prepare systems for projected changes in climate means, variability, and extremes could lead to capital-intensive development of infrastructure or technologies that are ill-suited to future conditions, and to missed opportunities to lower the costs of adaptation. Additional analysis of current vulnerability to today's climate fluctuations and existing

1 coping mechanisms is needed and will offer lessons for the design of effective adaptation options to potential future
2 changes in climate.

5. Vulnerability to Climate Change

7 Article 2 of the UNFCCC explicitly acknowledges the importance of natural ecosystems, food production, and
8 sustainable economic development (see Box 1). This report's assessment of regional vulnerability to climate change
9 focuses on ecosystems, water resources, food and fiber production, coastal systems, human settlements, human
10 health, and other sectors or systems important to ten regions that encompass the Earth's land surface. Wide variation
11 in the vulnerability of similar sectors or systems is to be expected across the regions, due to regional differences in
12 local environmental conditions, pre-existing stresses to ecosystems, current resource use patterns, and the framework
13 of factors affecting decision-making, including government policies, prices, preferences, and values. Nonetheless,
14 some general observations, based on information contained in the Second Assessment Report and synthesized from
15 the regional analyses in this assessment, provide a global context for the assessment of each region's vulnerability.

Box 1. Article 2 of the UNFCCC: Objective

The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere 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 allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.

Ecosystems

17 Ecosystems provide many goods and services critical to individuals and societies. These goods and services include:
18 (i) providing food, fiber, medicines, and energy; (ii) processing and storing carbon and nutrients; (iii) assimilating
19 wastes; (iv) purifying water, regulating water runoff, and controlling floods; (v) building soils and controlling soil
20 degradation; (vi) providing opportunities for recreation and tourism; and (vii) housing the Earth's entire reservoir of
21 genetic and species diversity. In addition, natural ecosystems have cultural, religious, aesthetic, and intrinsic
22 existence values. Changes in climate have the potential to affect the geographic location of ecological systems, the
23 mix of species which they contain, and their ability to provide the wide range of benefits on which societies rely for
24 their continued existence. Ecological systems are intrinsically dynamic and are constantly influenced by climate
25 variability. The primary influence of anthropogenic climate change on ecosystems is expected to be through the rate
26 and magnitude of change in climate means and extremes – climate change is expected to occur at a rapid rate relative
27 to the speed at which ecosystems can adapt and reestablish themselves – and through the direct effects of increased
28 atmospheric CO₂ concentrations, which increase the productivity and efficiency of water use in some plant species.
29 Secondary effects of climate change involve changes in soil characteristics and disturbance regimes (e.g., fires, pests,
30 and diseases), which would favor some species over others and thus change the species composition of ecosystems.

31 Based on model simulations of vegetation distribution, which use GCM-based climate scenarios, large shifts of
32 vegetation boundaries into higher latitudes and elevations can be expected. The mix of species within a given
33 vegetation class will likely change. Under equilibrium GCM climate scenarios, large regions show drought-induced
34 declines in vegetation, even when the direct effects of CO₂ fertilization are included. By comparison, under transient
35 climate scenarios, in which trace gases increase slowly over a period of years, the full effects of changes in
36 temperature and precipitation lag behind the effects of a change in atmospheric composition by a number of decades;
37 hence the positive effects of CO₂ precede the full effects of changes in climate.

38 Climate change is projected to occur at a rapid rate, relative to the speed at which forest species grow, reproduce, and
39 reestablish themselves (past tree species migration rates are believed to be on the order of 4–200 km per century).
40 For mid-latitude regions, an average warming of 1–3.5° C over the next 100 years would be equivalent to a poleward

shift of the present geographic bands of similar temperatures (or "isotherms") by approximately 150-550 km, or an altitude shift of about 150-550 meters. Therefore, the species composition of forests is likely to change; in some regions entire forest types may disappear, while new assemblages of species and hence new ecosystems may be established. As a consequence of possible changes in temperature and water availability under doubled equivalent-carbon dioxide equilibrium conditions, a substantial fraction (a global average of one-third, varying by region from one-seventh to two-thirds) of the existing forested area of the world would likely undergo major changes in broad vegetation types—with the greatest changes occurring in high latitudes and the least in the tropics. In tropical rangelands, mean temperature increases should not lead to major alterations in productivity and species composition, but altered rainfall amount and seasonality and increased evapotranspiration would.

Inland aquatic ecosystems will be influenced by climate change through altered water temperatures, flow regimes, water levels, and thawing of permafrost at high latitudes. In lakes and streams, warming would have the greatest biological effects at high latitudes, where biological productivity would increase and lead to expansion of coolwater species' ranges, and at the low-latitude boundaries of cold- and coolwater species ranges, where extinctions would be greatest. Increases in flow variability, particularly the frequency and duration of large floods and droughts, would tend to reduce water quality and biological productivity and habitat in streams. The geographical distribution of wetlands is likely to shift with changes in temperature and precipitation, with uncertain implications for net greenhouse gas emissions from non-tidal wetlands. Some coastal ecosystems (saltwater marshes, mangrove ecosystems, coastal wetlands, coral reefs, coral atolls, and river deltas) are particularly at risk from climate change and other stresses. Changes in these ecosystems would have major negative effects on freshwater supplies, fisheries, biodiversity, and tourism.

Adaptation options for ecosystems are limited and their effectiveness is uncertain. Options include establishment of corridors to assist "migration" of ecosystems, land-use management, plantings, and restoration of degraded areas. Because of the projected rapid rate of change relative to the rate at which species can reestablish themselves, the isolation and fragmentation of many ecosystems, the existence of multiple stresses (e.g., land-use change, pollution), and limited adaptation options, ecosystems (especially forested systems, montane systems, and coral reefs) are vulnerable to climate change.

Hydrology and Water Resources

Water availability is an essential component of welfare and productivity. Currently, 1.3 billion people do not have access to adequate supplies of safe water, and 2.0 billion people do not have access to adequate sanitation. While these individuals are dispersed throughout the globe, reflecting sub-national variation in water availability and quality, some 19 countries (primarily in the Middle East and North Africa) face such severe shortfalls that they are classified as either water scarce or water stressed; this number is expected to roughly double by 2025, in large part due to increases in demand due to economic and population growth.

Changes in climate could exacerbate periodic and chronic shortfalls of water, particularly in arid and semi-arid areas of the world. Developing countries are highly vulnerable to climate change because many are located in arid and semi-arid regions, and most derive their water resources from single-point systems such as bore holes or isolated reservoirs. These systems, by their nature, are vulnerable because there is no redundancy in the system to provide resources, should the primary supply fail. Also, given the limited technical, financial, and management resources possessed by developing countries, adjusting to shortages and/or implementing adaptation measures will impose a heavy burden on their national economies. In many temperate regions, there is evidence that flooding is likely to become a larger problem, requiring adaptations not only to droughts and chronic water shortages, but also to floods and associated damages, raising concerns about dam and levee failures.

A variety of approaches are available to reduce the potential vulnerability of water systems to climate change. Options include pricing systems, water efficiency initiatives, engineering and structural improvements to water supply infrastructure, agriculture policies, and urban planning/management. At the national/regional level, priorities include placing greater emphasis on integrated, cross-sectoral water resources management, using river basins as resource management units, and encouraging sound pricing and management practices. Given increasing demands, the prevalence and sensitivity of many simple water management systems to fluctuations in run-off and precipitation,

and the considerable time and expense required to implement many adaptation measures, the water resources sector in many regions and countries is vulnerable to potential changes in climate.

Food and Fiber Production

Currently, 800 million people are malnourished and, as the world's population increases and incomes in some countries rise, food consumption is expected to double over the next three to four decades. The last doubling in food production occurred over a 25-year period, using irrigation, chemical inputs, and high-yielding crop varieties. Whether a new "green revolution" will be able to repeat the remarkable gains of the last 25 years is uncertain, as problems associated with intensifying production on land already in use (e.g., chemical and biological runoff, waterlogging and salinization of soils, soil erosion and compaction) are becoming increasingly evident. Expanding the amount of land under cultivation (including by reducing land deliberately taken out of production to reduce agricultural output) is also an option for increasing total crop production, but it could lead to increases in competition for land and pressure on natural ecosystems, increased agricultural emissions of greenhouse gases, a reduction in natural sinks of carbon, and expansion of agriculture to marginal lands, all of which could undermine the ability to sustainably support increased agricultural production.

Changes in climate will interact with the stresses which result from actions to increase agricultural production, affecting crop yields and productivity in different ways, depending on the types of agricultural practices and systems in place. The main direct effects will be through changes in such factors as temperature, precipitation, length of growing season, and the timing of extreme or critical threshold events relative to crop development, as well as through changes in atmospheric CO₂ concentration (which has a beneficial effect on the growth of many crop types). Indirect effects will include potentially detrimental changes in diseases, pests, and weeds, the effects of which have not yet been quantified in most available studies. Evidence continues to support the findings of the IPCC Second Assessment Report that "global agricultural production could be maintained relative to baseline production" for a growing population under 2xCO₂ equilibrium climate conditions. In addition, the regional findings of this special report lend strong support to concerns over the "potential serious consequences" of increased risk of hunger and famine in some regions, particularly the tropics and sub-tropics. Generally, mid-to-high latitudes may experience increases in productivity, depending on crop type, growing season, changes in temperature regimes, and the seasonality of precipitation. In the tropics and sub-tropics, where some crops are near their maximum temperature tolerance and where dryland, non-irrigated agriculture predominates, yields are likely to decrease. The livelihood of subsistence farmers and pastoral peoples, who make up a large portion of rural populations in some regions, also could be negatively affected. In regions where there is a likelihood of decreased rainfall, agriculture could be significantly affected.

Fisheries and fish production are sensitive to changes in climate and are currently at risk from pervasive overfishing, diminishing nursery areas, and extensive inshore and coastal pollution. Globally, marine fisheries production is expected to remain about the same in response to changes in climate; high-latitude freshwater and aquaculture production is likely to increase, assuming that natural climate variability and the structure and strength of ocean currents remain about the same. The principal impacts will be felt at the national and local levels as centers of production shift. The positive effects of climate change—such as longer growing seasons, lower natural winter mortality, and faster growth rates in higher latitudes—may be offset by negative factors such as changes in established reproductive patterns, migration routes, and ecosystem relationships.

Given the many forces bringing profound changes to the agricultural sector, adaptation options that enhance resilience to today's natural climate variability and potential changes in means and extremes, and which address other concerns (e.g., soil erosion, salinization), offer no- or low-regret options. For example, linking agricultural management to seasonal climate predictions can assist in incremental adaptation, particularly in regions where climate is strongly affected by El Niño-Southern Oscillation (ENSO) conditions. The suitability of these options for different regions varies, in part due to differences in the financial and institutional ability of the private sector and governments in different regions to implement them. The options include changes in crops and crop varieties, changes in planting schedules and tillage practices, the introduction of new bio-technologies, and improved water-management and irrigation systems, which have high capital costs and are limited by availability of water resources.

Other options, such as minimum- and reduced-tillage technologies, do not require such extensive capitalization, but do require high levels of agricultural training and support.

In regions where agriculture is well adapted to current climate variability, and where a variety of market and institutional factors are in place to redistribute agricultural surpluses to make up for shortfalls, vulnerability to changes in climate means and extremes is generally low. However, in regions where agriculture is unable to cope with existing extremes, where markets and institutions to facilitate redistribution of deficits and surpluses are not in place, and where adaptation resources are limited, vulnerability of the agricultural sector to climate change should be considered high. Other factors also will influence the vulnerability of agricultural production in a particular country or region to climate change, including the extent to which current temperatures or precipitation patterns are close to or exceed tolerance limits for important crops; per capita income; the percentage of economic activity based on agricultural production; and the pre-existing condition of the agricultural land base.

Coastal Systems

Coastal zones are characterized by a rich diversity of ecosystems and a great number of socio-economic activities. Coastal human populations in many countries have been growing at double the national rate of population growth. It is currently estimated that more than half of the global population lives in coastal zones, although there is large variation among countries. Changes in climate will affect coastal systems through sea-level rise and possible changes in the frequency and/or intensity of extreme events, including precipitation, hurricanes/cyclones, wave characteristics, and storm surges.

Coasts in many countries currently face severe sea-level rise problems due to tectonically and anthropogenically induced subsidence. Estimates put about 46 million people per year currently at risk of flooding due to storm surges. Climate change will exacerbate these problems, leading to potential impacts on both ecosystems and human coastal infrastructure. Large numbers of people also are potentially affected by sea-level rise—for example, about 70 million in Bangladesh would be displaced by a 1-meter increase (the top of the range of IPCC Working Group I estimates for 2100) in the absence of adaptation measures. A growing number of extremely large cities are located in coastal areas, which means that large amounts of infrastructure may be affected. Although annual protection costs for many nations are relatively modest (about 0.1% of GDP), the average annual costs to many small island states total several percent of GDP. For some island nations, the high cost of providing storm-surge protection would make it essentially infeasible, especially given the limited availability of capital for investment.

Beaches, dunes, estuaries, and coastal wetlands adapt naturally and dynamically to changes in prevailing winds and seas, and sea level changes; in areas where infrastructure development is not extensive, planned retreat and accommodation to changes may be possible. It also may be possible to rebuild/relocate capital assets at the end of their design life. In other areas, however, accommodation or planned retreat are not viable options, and protection using hard structures (e.g., dikes, levees, floodwalls, and barriers) and soft structures (e.g., beach nourishment, dune restoration, and wetland creation) will be necessary. Factors that limit the implementation of these options include inadequate financial resources, limited institutional capability, and shortages of trained manpower. In most regions at present, current coastal management and planning frameworks do not take account of the vulnerability of key systems to changes in climate and sea level, and the long lead times for implementation of many adaptation measures. Inappropriate policies and systems of property rights encourage development in impact-prone areas. Given increasing population density in coastal zones, the long lead times for implementation of many adaptation measures, and institutional/financial limitations (particularly in many developing countries), coastal systems should be considered to be vulnerable to changes in climate.

Human Health

In much of the world, life expectancy is increasing; in addition, infant and child mortality in most developing countries is dropping. However, against this positive backdrop, there appears to be a widespread increase in new and resurgent vector-borne and infectious diseases, such as dengue, malaria, hantavirus, and cholera. In addition, the percentage of the developing world's population living in cities is expected to increase from 25% (in 1960) to over 50% by 2020, with percentages in some regions far exceeding these averages. These changes will bring benefits only

1 if accompanied by increased access to services such as sanitation and supply of potable water, but also can lead to
2 serious urban environmental problems, including air pollution (e.g., particulates, surface ozone, and lead), poor
3 sanitation, and associated problems in water quality and potability, if access to services is not improved.

4
5 Climate change could affect human health through increases in heat-stress mortality, tropical vector-borne diseases,
6 urban air pollution problems, and decreases in cold-related illnesses. Compared to the total burden of ill-health, these
7 problems are not likely to be large. However, in the aggregate, the direct and indirect impacts of climate change on
8 human health do constitute a hazard to human population health, especially in developing countries in the tropics
9 and sub-tropics, with considerable potential to lead to significant loss of life, and to affect communities and increase
10 costs. Projections by models (that entail necessary simplifying assumptions) indicate that the geographical zone of
11 potential malaria transmission in response to world temperature increases at the upper part of the IPCC-projected
12 range (3-5°C by 2100) would expand, increasing the affected percent of the world's population from approximately
13 45% to approximately 60% by the latter half of the next century. This could lead to increases in malaria incidence
14 (on the order of 50-80 million additional annual cases, relative to an estimated global background total of 500
15 million cases), primarily in tropical, subtropical, and less well-protected temperate-zone populations. Some increases
16 in non-vector-borne infectious diseases—such as salmonellosis, cholera, and giardiasis—also could occur as a result
17 of elevated temperatures and increased flooding. However, quantifying the projected impacts is uncertain because the
18 extent of climate-induced health disorders depends on other factors, such as migration, provision of clean urban
19 environments, improved nutrition, increased availability of potable water, improvements in sanitation, the extent of
20 disease vector-control measures, changes in resistance of vector organisms to insecticides, and more wide-spread
21 availability of health care. For example, modernization of the energy system in urban environments—including
22 improvements in efficiency and increases in the use of electricity and other modern energy carriers—could reduce
23 levels of indoor and outdoor air pollution. Human population health is vulnerable to changes in climate, particularly
24 in urban areas, where access to space conditioning may be limited; and in areas where exposure to vector-borne and
25 communicable diseases may increase and health-care delivery and basic services, such as sanitation, are poor.

6. Regional Perspectives

Africa

32 Several climate regimes characterize the African continent, with the wet tropical, dry tropical, and alternating wet and
33 dry climates being the most common. Many countries on the continent are prone to recurrent droughts, with some of
34 the drought episodes, particularly in southeast Africa, being associated with the occurrence of the El Niño-Southern
35 Oscillation (ENSO) phenomena. Deterioration in terms of trade, inappropriate policies, high population growth
36 rates, and lack of significant investment, coupled with a highly variable climate, have made it difficult for several
37 countries to develop patterns of livelihood that would reduce pressure on the natural resource base. Although Africa
38 has contributed the least to the threat of climate change, it is the continent most vulnerable to the risks of projected
39 changes because widespread poverty limits capabilities for adaptation.

41 *Ecosystems:* In Africa today, tropical forests and rangelands are under threat from population pressures and systems
42 of land use. The generally apparent effects of these threats has been the loss of biodiversity, rapid deterioration in
43 land cover, and depletion of water availability through destruction of catchments and aquifers. Changes in climate
44 projected by GCMs will interact with these baseline trends. A sustained increase in mean ambient temperatures
45 beyond 1°C would cause significant changes in forest and rangeland cover, and species distribution, composition, and
46 migration patterns, as well as biome distribution. Many organisms in the deserts are already near their tolerance
47 limits and some may not be able to adapt further under hotter conditions. Arid to semi-arid sub-regions and the
48 grassland areas of eastern and southern Africa, as well as areas currently under threat from land degradation and
49 desertification, are particularly vulnerable. Were rainfall to increase as projected by some GCMs in the highlands of
50 East Africa and equatorial Central Africa, marginal lands would become more productive than they are at the
51 moment. However, these effects are likely to be negated by population pressure on the marginal forests and
52 rangelands. Adaptive options include control of deforestation, improved rangeland management, expansion of
53 protected areas, and sustainable management of forests.

Hydrology and Water Resources: Of the 19 countries in the world currently classified as water stressed, the greatest number are in Africa, and this number is likely to increase independent of climate change, as a result of increases in demand due to population growth, degradation of watersheds due to land-use change, and siltation of river basins. A reduction in precipitation projected by some GCMs for the Sahel and southern Africa, if accompanied by high interannual variability, could be detrimental to the hydrological balance of the continent and disrupt various water-dependent socio-economic activities. Variable climatic conditions may render the management of water resources more difficult both within and between countries. The drop in water level in dams and rivers could adversely affect the quality of water by increasing the concentrations of sewage waste and industrial effluents, thereby raising the potential for the outbreak of diseases and also reducing the quality and quantity of freshwater available for domestic use. Adaptation options include water harvesting, management of water outflow from dams, and more efficient water usage.

Food and Fiber Production: With the exception of oil exporting countries, agriculture is the economic mainstay in most African countries, contributing 20-30% of gross domestic product (GDP) in sub-Saharan Africa, and 55% of the total value of African exports. In most of the countries, farming depends entirely on the quality of the rainy season, a situation that makes Africa particularly vulnerable to climate change. In sub-tropical Africa, warmer winters would reduce the incidence of damaging frosts, making it possible to grow horticultural produce susceptible to frosts at higher levels than is possible at present. However, a rise in mean winter temperatures would be detrimental to the production of winter wheat and fruits that need the winter chill. Increased droughts could seriously impact on the availability of food, as was evident in the horn of Africa and southern Africa during the 1980s and 1990s. Warm-water lakes generally have higher fish productivity than cold-water lakes, and existing warm-water lakes are located in areas with the smallest projected changes in temperature; thus productivity of freshwater fisheries may increase, although the distribution patterns could be altered. Changes in ocean dynamics could lead to changes in migratory patterns of fish, and could possibly lead to reduced fish landings, especially in the coastal artisanal fisheries.

Coastal Systems: Several African coastal zones, most of which already are under stress from population pressure and conflicting uses, would be adversely affected by sea level rise associated with climate change. The coastal nations of West and Central Africa (e.g. Senegal, Gambia, Sierra Leone, Nigeria, Cameroon, Gabon, Angola), have low-lying lagoonal coasts that are susceptible to erosion and hence are threatened by sea-level rise, particularly since most of the countries in this area have major and rapidly expanding cities on the coast. The west coast is often buffeted by storm surges and is currently at risk from erosion, inundation, and extreme storm events. The coastal zone of East Africa will also be affected, although this area experiences calm conditions through much of the year. However, sea level rise and climatic variation may reduce the buffer effect of the coral and patch reefs along the coast, increasing the potential for erosion of the east coast. A number of studies indicate that a sizable proportion of the northern part of the Nile delta will be lost due to a combination of inundation and erosion, with consequent loss of agricultural land and urban areas. Adaptation measures in the African coastal zones are available but would be very costly as a percentage of GDP for many countries. The measures could include the erection of sea walls and relocation of vulnerable human settlements and other socio-economic facilities.

Human Settlement, Industry, and Transportation: The main challenges likely to face African populations will emanate from extreme climate events, such as floods (and resulting landslides in some areas), strong winds, droughts, and tidal waves. Individuals living in marginal areas may be forced to migrate to urban areas (where infrastructure is already approaching its limits as a result of population pressure) if marginal lands become less productive under new climate conditions. Climate change could worsen current trends in leading to depletion of biomass energy resources. Reduced stream flows would cause reductions in hydropower production, leading to negative effects on industrial productivity and costly relocation of some industrial plants. The management of pollution, sanitation, waste disposal, water supply, public health, and provision of adequate infrastructure in urban areas could become more difficult and costly under changed climate conditions.

Human Health: Africa is expected to be primarily at risk from increased incidence of vector-borne diseases and reduced nutritional status. A warmer environment could open up new areas for malaria, whereas altered temperature and rainfall patterns could increase the incidence of yellow fever, dengue fever, onchocerciasis, and trypanosomiasis. Increased morbidity and mortality in sub-regions where vector-borne diseases increase following climatic changes

would have far-reaching economic consequences. In view of the poor economic status of most African nations, global efforts will be necessary to tackle the potential health effects.

Tourism and Wildlife: Tourism, one of Africa's fastest-growing industries, is based on wildlife, nature reserves, and an abundant water supply for recreation. The projected droughts and/or reduction in precipitation in the Sahel, eastern and southern Africa, would devastate wildlife and reduce the attractiveness of some nature reserves, thereby reducing income from current vast investments in tourism.

Conclusions: Widespread poverty, inherent proneness to drought, imbalances in land distribution, and over-dependence on rain-fed agriculture are some of the factors that make the African continent particularly vulnerable to climate change. While adaptation options are theoretically available, in practice they could be well beyond the economic means of some countries.

Arctic/Antarctica

The Arctic is defined as the area within the Arctic Circle. It is a frozen ocean surrounded by land. By contrast, Antarctica is a frozen continent surrounded by ocean, including the area within the Antarctic Circle and the Southern Ocean and the sub-Antarctic islands. Projected warming is greater for many parts of these polar regions than for any other region of the world.

Ecosystems: Major physical and ecological changes are expected in the Arctic. Frozen areas close to freezing point will thaw and undergo substantial changes with warming. Substantial loss of sea ice is expected in the Arctic ocean. If warming occurs, there will be considerable thawing of permafrost leading to changes in drainage, increased slumping, and altered landscapes over large areas. Polar warming will probably increase biological production, but may lead to different species composition on land and in the sea. On land, there will be a tendency for polar shifts in major biomes such as tundra and boreal forest and associated animals. However, the Arctic Ocean geographically limits northward movement. Much smaller changes are likely for the Antarctic, but there may be species shifts. In the sea, marine ecosystems will move poleward. Animals dependent on ice may be disadvantaged in both polar areas.

Hydrology and water resources: Increasing temperature will thaw permafrost and melt more snow and ice. There will be more running and standing water. Drainage systems in the Arctic are likely to change at the local scale. River and lake ice will break-up earlier and freeze later.

Food and fiber production: Agriculture is severely limited by the harsh climate. Many of these limitations will remain in the future, but some small northern extension of farming may be possible into the Arctic. In general, marine ecological productivity should rise. Warming should increase growth and development rates of non-mammals; however, UV-B is still increasing, which may constrain primary productivity as well as fish productivity.

Coastal systems: If there is warming, the Arctic could experience a thinner and reduced ice cover. Coastal and river navigation will increase, with new opportunities for water transport, tourism, and trade. The Arctic Ocean could become a major global trade route. Less ice will benefit offshore oil production. Increased erosion of Arctic shorelines is expected from a combination of rising sea level, thaw of permafrost, and increased wave action due to increased open water. Further breakup of ice shelves in the Antarctic Peninsula is likely. Elsewhere in Antarctica, little change is expected in coastlines and probably in its large ice shelves.

Human settlements: Human communities in the Arctic will be substantially affected by these physical and ecological changes. Effects will be particularly important for indigenous peoples leading traditional lifestyles.

Human health: Climate change is expected to have little impact on human health, except for increasing UV-B radiation at high latitudes.

Integration: Climate change will bring economic benefits and costs. Benefits include new opportunities for shipping through Arctic waters, lower operational costs for the oil and gas industry, lower heating costs, and easier access for both Arctic and Antarctic tourism. Increased costs can be expected from disruptions caused by thawing of permafrost

and reduced transportation capabilities across frozen ground and water. There will be winners and losers. As examples: a reduced and thinning ice cover will disadvantage polar bears, while sea otters will have new habitats; communities on new shipping routes will grow while those built on permafrost will have difficulties.

Conclusion: The Arctic and Antarctic Peninsula are very vulnerable to projected climate change and its impact. While the number of people involved is relatively small, many native communities will face profound changes impacting on traditional lifestyles. Direct effects could include: ecosystem shifts, sea and river ice loss, and permafrost thaw. Indirect effects could include feedbacks to the climate system such as further release of greenhouse gases, changes in ocean circulation drivers and increased temperature and higher precipitation with loss of ice. There will be new opportunities for shipping, the oil industry, fishing, mining, tourism, and migration of people. Sea ice changes projected for the Arctic have major strategic implications for trade, especially between Asia and Europe, and for naval defense. Antarctica is less vulnerable to climate change, because the temperature changes envisaged over the next century are likely to have little impact and very few people are involved. However, there are considerable uncertainties about future behavior of the West Antarctic ice sheet and the mass ice balance of the whole continent. Changes in both could affect sea level and southern hemisphere climates.

Australasia

Australasia includes Australia, New Zealand, and their outlying islands. The region spans from the tropics to mid-latitudes, and has varied climates and ecosystems, ranging from interior deserts to mountain rainforests. The climate is strongly affected by the oceanic environment and the El Niño-Southern Oscillation (ENSO) phenomenon.

Ecosystems: Some of the region's ecosystems appear be very vulnerable to climate change, at least in the long term, since alterations to soils, plants, and ecosystems are highly likely, and there may be increases in fire occurrence and insect outbreaks. Many species will be able to adapt, but in some instances, a reduction of species diversity is highly likely. Any changes will occur in a landscape already fragmented by agricultural and urban development, and will add to existing problems such as land degradation, weeds, and pest infestations. Impacts on aquatic ecosystems from changes in riverflow, flood frequency, and nutrient and sediment inputs are likely to be greatest in the drier parts of the region. Coastal ecosystems are vulnerable to the impacts of sea level rise and possible changes in local meteorology. Tropical coral reefs, including the Great Barrier Reef, may be able to keep pace with sea level rise, but will be vulnerable to bleaching and death of corals induced by episodes of higher sea temperatures and other stresses. Measures to facilitate adaptation include better rangeland management, plantings along waterways, and research, monitoring and prediction. Active manipulation of species will generally not be feasible in the region's extensive, natural and lightly-managed ecosystems.

Hydrology and Water Resources: Potentially high vulnerability appears to be present. Any reduction of water availability, especially in Australia's extensive drought-prone areas, would sharpen competition among uses, including agriculture and wetland ecosystem needs. More frequent high-rainfall events may enhance groundwater recharge and dam-filling events, but increase the impacts of flooding, landslides and erosion, with flood-prone urban areas being heavily exposed to financial loss. Reduced snowpack and a shorter snow season appear likely, and New Zealand's glaciers are likely to shrink further. Freshwater supplies on low-lying islands are also vulnerable. Some adaptation options are available, but the cost involved would be high.

Food and Fiber Production: Vulnerability appears to be low, at least in the next few decades. Agriculture in the region is adaptable and in some cases production increases are likely. However, there may be a trend toward increased vulnerability in the longer term, especially in the warmer and more water-limited parts of Australia, where initial gains for some crops are eroded later as the delayed full effects of climate change (e.g., changes in temperature and precipitation) are felt along with the immediate benefits of increased atmospheric CO₂ concentrations. Impacts will vary widely from district to district, and crop to crop. There will be changes in growth and quality of crops and pastures, shifts in the suitability of districts for particular crops, and possibly increased problems with weeds, pests and diseases. Rangeland pastoralism and irrigated agriculture will be especially affected where rainfall changes occur. Changes in global food production, and hence prices, would have major economic impacts on the region. With forestry, the long time to reach maturity results in a very large exposure to financial loss from extreme events, fire, or any locally rapid change in climate conditions.

Coastal Systems: Parts of the region's coasts and rapidly-growing coastal settlements and infrastructure are very vulnerable to any increase in coastal flooding and erosion arising from sea level rise and meteorological changes. Indigenous coastal and island communities in the Torres Strait and in New Zealand's Pacific island territories are especially vulnerable. Many adaptation options exist, although these are not easily implemented on low-lying islands. Moreover, climate change and sea level rise are generally not well accommodated in current coastal management planning frameworks.

Human Settlements: In addition to hydrological and coastal risks, moderate vulnerability is present from a variety of impacts on air quality, drainage, waste disposal, mining, transport, insurance and tourism. Overall, these effects are likely to be small relative to other economic influences, but may still represent significant costs for large industries.

Human Health: Some degree of vulnerability is apparent. Indigenous communities and the economically disadvantaged may be more at risk. Increases are expected in heat stress mortality, vector-borne diseases such as dengue, water and sewage-related diseases, and urban pollution-related respiratory problems. While small compared to the total burden of ill-health, these have the potential to cause considerable community impact and cost.

Integration: Integrated or multi-sector studies are at an early stage of development. Those currently available generally do not consider multi-national interactions or the ameliorating effects of potential adaptations.

Conclusion: Australia's relatively low latitude makes it particularly vulnerable to impacts on its scarce water resources and on crops growing near or above their optimum temperatures, while New Zealand's cooler, wetter mid-latitude location may provide some benefit through the ready availability of suitable crops and likely increases in agricultural production. However, in both countries there is a wide range of situations where vulnerability is thought to be moderate to high, particularly in ecosystems, hydrology, coastal zones, human settlements, and human health.

Europe

This regions consist of the western fifth of the Eurasian land mass.

Ecosystems: Natural ecosystems are generally fragmented, disturbed and confined to poor soils. This makes them sensitive to climate change. Mediterranean and boreal grasslands would shift in response to changes in the amount and the seasonal distribution of precipitation. The northern boundaries of forests in Fennoscandia and northern Russia would expand into tundra regions, reducing the extent of tundra, mires, and permafrost areas. Survival of some species and forest types may be endangered by the projected movement of climate zones at rates faster than migration speeds. Alpine ecosystems and species are particularly vulnerable, as these have nowhere to migrate. An increase in temperature, accompanied by decreases in soil moisture, would lead to a substantial reduction in peat formation in Fennoscandian and northern Russian peatlands. Thawing of the permafrost layer would lead to lowered water tables in some areas and flood thaw lakes in others, altering current wetland ecosystem types. While it is possible that the diversity of freshwater species may increase in a warmer climate, particularly in middle and high latitudes, there may be an initial reduction in species diversity in cool temperate and boreal regions.

Hydrology and Water Resources: Water supply may be affected by possible increases in floods in northern and northwest Europe, and droughts in southern portions of the continent. Many flood plains in western Europe are already overpopulated, which hampers effective additional flood protection. Pollution is a major problem for many rivers; a warmer climate could lead to reduced water quality, particularly if accompanied by reduced runoff. Warmer summers would lead to increased water demand; increased demand for irrigation would be at least partly offset by increased water-use efficiency of many crops associated with CO₂ fertilization. Water management is partly determined by legislation and cooperation among government entities, both within countries and internationally. Altered water supply and demand would call for a reconsideration of existing legal and cooperative arrangements.

Food and Fiber Production: Risks of frost would be reduced in a warmer climate, allowing winter cereals and other winter crops to expand to areas such as southern Fennoscandia and western Russia. Potential yields of winter crops are expected to increase, especially in central and southern Europe, assuming that neither precipitation nor irrigation

are limiting, and that water-use efficiency increases with the ambient atmospheric concentration of CO₂. Increasing spring temperatures would extend suitable zones for most summer crops. Summer crop yield increases are possible in central and eastern Europe, and decreases in western Europe. Decreases in precipitation in southern Europe would reduce crop yields, and make irrigation an even larger competitor to domestic and industrial water use. Next to potential crop yields, farmer adaptation, agricultural policy, and world markets are important factors in the economic impact of climate change on the agricultural sector.

Coastal Systems: Coastal zones are important ecologically and economically. Settlement and economic activity have reduced the resilience and adaptability of coastal systems to climate variability and change, as well as to sea level rise. Some coastal areas are already beneath mean sea level, while many more are vulnerable to storm surges. Areas most at risk include the Dutch, German and Ukrainian coastlines, some Mediterranean deltas, and Baltic coastal zones. Storm surges, changes in precipitation, and changes in wind speed and direction add to the concern of coastal planners. In general, major economic and social impacts can be contained at a relatively low investment. This is not true for ecosystems, particularly coastal wetlands, which may be even further damaged by protective measures.

Human settlements: Supply and demand for cooling water will change. Energy demand may increase in summer (cooling) and decrease in winter (heating), and peak energy demand will shift. Infrastructure, buildings, and cities, designed for cooler climates, will have to be adjusted to warming, particularly heat waves, in order to maintain current functions.

Human Health: Heat-related deaths would increase under global warming, and may be exacerbated by worsening air quality in cities. There would be a reduction in cold-related deaths. The net effect for Europe is uncertain. Vector-borne diseases would expand. Public health care may need to be strengthened.

Integrated assessment: Integrated studies on the impact of climate change on Europe are few and limited to small areas. Integrated studies based on economic valuation suggest that the overall impact of a doubling of atmospheric carbon dioxide would amount to an equivalent of -2% to 1% of gross domestic product per year.

Latin America

Latin America includes all continental countries of the Americas from Mexico to Chile and Argentina, and adjacent seas. The region is highly heterogeneous in terms of climate, ecosystems, human population distribution, and cultural traditions. Several Latin American countries, especially those of the Central American Isthmus, Peru, Brazil, Chile, and Argentina, are significantly affected by seasonal to inter-annual climate variability, i.e., the ENSO phenomenon. Most production is based on the region's extensive natural ecosystems, and impacts of current climate variability on natural resources suggest that the impacts of the projected climate changes could be important enough to be taken into account in national and regional planning initiatives. Land use is a major force driving ecosystem change at present, interacting with climate in complex ways. This makes the task of identifying common patterns of vulnerability to climate change very difficult.

Ecosystems: Large forest and rangeland areas are expected to change as a result of projected changes in climate in Mexico, Costa Rica, Nicaragua, Venezuela, Brazil, Bolivia, and Argentina, with mountain ecosystems and transitional zones between vegetation types being highly vulnerable. Climate change could add an additional stress to the adverse effects of continued deforestation in the Amazonian rainforest. This has the potential to lead to biodiversity losses, to reduce rainfall and runoff within and beyond the Amazon basin (reduced precipitation recycling through evapotranspiration), and to affect the global carbon cycle.

Hydrology and Water Resources: Climate change impacts on hydrological cycles could alter the intensity and temporal and spatial distribution of precipitation, surface runoff, and ground-water recharging. Arid and semi-arid areas are particularly vulnerable to changes in water availability. Sensitivity studies based on incremental scenarios (variation of temperature and precipitation) referenced to GCM outputs, have shown that climate change may produce important changes in runoff, with various impacts on different natural ecosystems and human activities. Hydropower generation and grain and livestock production are particularly vulnerable to changes in water supply, particularly in Costa Rica, Panama, and the Andes piedmont and adjacent areas in Chile and western Argentina between 25° and 37°

South. The impacts on the water resources could be sufficient to lead to conflicts among users, regions, and countries.

Food and Fiber Production: Decreases in agricultural production, even after allowing for the positive effects of elevated CO₂ on crop growth and moderate levels of adaptation at the farm level, are projected for several major crops in Mexico, countries of the Central American Isthmus, Brazil, Chile, Argentina, and Uruguay. In addition, livestock production would decrease if temperate grasslands have to face substantial decreases in water availability. Extreme events (e.g., floods, droughts, frosts, storms) have the potential to adversely affect rangelands and agricultural production (e.g., banana crops in Central America). The livelihoods of traditional peoples, such as many Andean communities, would be threatened if the productivity or surface area of rangelands or traditional crops are reduced.

Coastal Systems: Losses of coastal land and biodiversity (including coral reefs, mangrove ecosystems, estuarine wetlands, and marine mammals and birds), damage to infrastructure, and saltwater intrusion due to sea level rise could occur in low-lying coasts and estuaries in countries such as those of the Central American Isthmus, Venezuela, Argentina, and Uruguay. Sea level rise blocking the runoff of flatland rivers into the ocean could increase the risks of floods in their basins (e.g., the Argentine Pampas).

Human Health: Projected changes in climate could increase the impacts of already serious chronic malnutrition and diseases for some Latin American populations. The geographical distribution of vector-borne diseases (e.g., malaria, dengue, chagas) and infectious diseases (e.g., cholera) would expand southward and to higher altitudes if temperature and precipitation increase. Pollution and high concentrations of ground-level ozone, exacerbated by increasing surface temperature and increased penetration of UV-B radiation, would have the potential to negatively affect human health and welfare, especially in urban areas.

Integration: Increasing environmental deterioration arising from climate variability, climate change, and land-use practices, such as changes in water availability and losses of agricultural lands as a result of coastal, riverine, and flatland flooding, would aggravate socio-economic and health problems, furthering migrations of rural and coastal populations, and deepening national and international conflicts.

Additional efforts in monitoring, research, and sensitivity analyses are needed in order to allow decision makers and other stakeholders to assess the risks associated with changes in climate and climate variability, to prepare to take advantage of potential benefits, to minimize negative impacts, and to identify promising adaptation options. Some specific priorities include: organization and/or updating of bio-geo-physical observation networks and monitoring systems, development of regional climate models, sensitivity studies of the most vulnerable sectors -from ecosystems to infrastructure, and the development of suitable adaptation options. These efforts include both the creation of new technologies or the adaptation of existing technologies generated within or beyond the region. Initiatives to encourage cooperation within countries of the region or with other regions of the world (e.g., Valdivia Group), appear promising.

Middle East/Arid Asia

This region includes 21 countries of the predominantly arid and semi-arid areas of the Middle East and central Asia. The region extends from Turkey in the west to Kazakstan in the east, and from Yemen in the south to Kazakstan in the north.

Ecosystems: Little change is expected in the location of the grassland, rangeland, woodland and desert vegetation types that dominate the region. Small increases in precipitation are projected but these are likely to be countered by increased temperature and evaporation. Improved water use efficiency by some plants under elevated CO₂ may lead to some improvement in plant productivity and changes in ecosystem composition. Grasslands, livestock, and water resources are likely to be the most vulnerable to climate change in this region because they are located mostly in marginal areas. Management options, such as better stock management and more integrated agro-ecosystems, could improve land conditions and counteract pressures arising from climate change. The region is an important refuge for wild relatives of many important crop species, and with appropriate conservation measures may continue to provide a source of genetic material for future climatic conditions.

Hydrology and Water resources: Water shortage is already a problem in many countries and is unlikely to be reduced by climate change. Changes in cropping practices and improved irrigation practices could significantly improve efficiency of water use in some countries. Glacial melt is projected to increase under climate change, leading to increased flows in some river systems for a few decades, followed by a reduction in the flow as the glaciers disappear.

Food and Fiber Production: Land degradation problems and limited water supplies restrict present agricultural productivity and threaten the food security of some countries. Many of the options available to combat existing problems would contribute to reducing the anticipated impacts of climate change. Reliance on more suitable and more intensively managed land areas for food and fiber production would allow greater reliability in food production and less detrimental impact of extreme climatic events. Countries of the former Soviet Union are undergoing major economic changes, including in their agricultural systems and management. This transition is likely to provide opportunities to change crop types and to introduce more efficient irrigation thus providing significant win-win options for conservation of resources to offset the projected impacts of climate change.

Human Health: Heat stress and possible spread in vector borne diseases are likely to result from changes in climate. Decrease in water availability and food production would lead to indirect impacts on the populations through hygiene problems and malnourishment.

Conclusions: Water is limited in this arid and semi-arid region and this restriction is unlikely to be relieved by climate change. There are win-win opportunities available to reduce current pressures on food and fiber production, ecosystems, and water resources that will help combat the anticipated effects of climate change.

North America

This region consists of Canada and the United States south of 60°N latitude. Within the region, vulnerability to, and the impacts of, climate change varies significantly from sector-to-sector and from sub-region to sub-region. This "texture" is important in understanding the potential effects of climate change on North America, and in formulating and implementing viable response strategies.

Ecosystems: The composition and geographic distribution of many ecosystems will shift as individual species respond to changes in climate. There will likely be reductions in biological diversity and in goods and services that non-forest terrestrial ecosystems provide society. Changes are likely in the growth and regeneration capacity of forests in many sub-regions. In some cases, this will alter the function and composition of forests significantly. Aquatic ecosystem functions will be affected by climate change, although the effects are likely to vary in magnitude and direction depending on the sub-region being considered.

Hydrology and Water Resources: Water quantity and quality, a "linchpin" that integrates many sub-regions and sectors, are particularly vulnerable. Available water supplies will also be affected by changes in demand from multiple sectors competing for water resources. Projected changes in the hydrologic cycle will affect changes in ecosystems, food and fiber, and human settlements, which could, in turn, affect human health (e.g., by altering the geographic distribution of infectious diseases) and biological diversity.

Food and Fiber Production: As climate warms, food and fiber resources (agriculture, production forests, and fisheries) are expected to shift northward. Most studies of the impacts on these resources have focused on the effects of changes in the average climate at the national/global level and have assumed effective adaptation. They have not fully accounted for potential changes in climate variability, water availability, the effects of changes in pest and diseases, impacts at the sub-regional level, and their social, economic and environmental costs and benefits, nor the possibility of imperfect responses, all of which could change the impacts and their costs. The most intensively managed food and fiber resources may be least at risk, as the relatively high value of these resources will ensure that adaptive management strategies will be developed and implemented. There will likely be relatively small economic and food and fiber supply consequences at the regional/national level; however, impacts are expected to be more pronounced at the sub-regional and community levels.

Coastal Systems: In the next century, rising sea level could inundate coastal wetlands and dry land areas currently below 50 cm above sea level. The projected changes in sea level would also put at risk human settlements, infrastructure, natural ecosystems, and marine mammals in these vulnerable coastal areas. Salt water intrusion, both upstream and inland, is likely to occur due to sea-level rise. This, in turn, could affect drinking water quality and coastal ground water.

Human Settlements: Projected changes in climate could have both positive and negative impacts on the operation and maintenance costs of North American land and water transportation. They could also increase the risks to property and human health/life as a result of possible increased exposure to natural hazards (e.g., wildfire, landslides, and extreme weather events) and result in increased demand for cooling and decreased demand for heating energy, with the overall net effect varying with geographic regions.

Human Health: Climate can have wide ranging and potentially adverse effects on human health via both direct (e.g., thermal stress and extreme weather/climate events) and indirect (e.g., disease vectors and infectious agents, environmental and occupational exposures to toxic substances, and food production) pathways.

Integration: Taken individually, any one of the impacts discussed here may be within the capabilities of a sub-region or sector to respond. The fact that they are projected to occur simultaneously and in concert with changes in population, technology, economics, and other environmental and social changes, adds to the complexity of the impacts assessment and to the choice of appropriate responses. The characteristics of the sub-regions and sectors of North America suggest that neither the impacts of climate change nor response options will be uniform. The technological capacity to adapt to climate change and many of its impacts is likely to be readily available in North America, but its application will be realized only if the necessary information is available in a timely manner (i.e., sufficiently far in advance in relation to the planning horizons and lifetimes of investments) and if the institutional and financial capacity to manage change exists.

Conclusion: While many sectors/regions are sensitive to climate change, the technological capability to adapt to climate change is, for the most part, readily available, although uncertainties exist about the feasibility of certain options, especially those for natural ecosystems. Once current adaptive capability has been factored in, the most vulnerable sectors and regions include: long-lived natural forest ecosystems in the east and interior west, water resources in the southern plains, agriculture in the southeast and southern plains, human health in areas currently experiencing diminished urban air quality, northern ecosystems and habitats, estuarine beaches in developed areas, and low latitude cool and cold-water fisheries. Other sectors and sub-regions may benefit from opportunities associated with warmer temperatures or potentially, from CO₂ fertilization, including: west coast coniferous forests, some western rangelands, reduced energy costs for heating in the northern latitudes, salting and snow clearance costs, open water season in northern channels and ports, and agriculture in the northern latitudes, the interior west, and west coast.

Small Island States

With the exception of Malta and Cyprus in the Mediterranean, all of the Small Island States considered in this report are located within the tropics. About one-third of the states comprise a single main island; the others are made up of several or many islands. While some states are experiencing relative sea-level fall, others, primarily low-lying island states and atolls, are especially vulnerable to climate change and associated sea-level rise because in many cases (e.g. the Bahamas, Kiribati, Maldives, Marshall Islands) much of the land area rarely exceeds 3–4 m above present mean sea level. Many islands at higher elevation are also vulnerable to climate change effects, particularly in their coastal zones, where the main settlements and vital economic infrastructure are almost invariably concentrated.

Ecosystems: While projected temperature rise is not anticipated to have widespread adverse consequences, some critical ecosystems, such as coral reefs, are highly sensitive to temperature changes. Although some reefs have the ability to keep pace with the projected rate of sea-level rise, in many parts of the Tropics (e.g. the Caribbean, Pacific) some species of corals live near their limits of tolerance to temperature. Elevated sea water temperatures (above seasonal maxima) can impair the reproductive functions of corals, and lead to increased mortality. The adaptive capacity of mangroves to climate change is expected to vary by species and according to local site conditions

(e.g. presence or absence of sediment-rich, macro-tidal environments, the availability of adequate freshwater to maintain the salinity balance). The natural capacity of mangroves to adapt and migrate landward is also expected to be reduced by coastal land loss and the presence of infrastructure in the coastal zone. On some islands, ecosystems are already being harmed by other anthropogenic stresses (e.g. pollution), which may pose as great a threat as climate change itself. Climate change would add to these stresses and further compromise the long-term viability of these tropical ecosystems.

Coastal systems: Higher rates of erosion and coastal land loss are expected in many small islands as a consequence of the projected rise in sea-level. In the case of the Marshall Islands and Kiribati, it is estimated that as much as 80% and 12.5% (respectively) of total land could be lost. Generally, beach sediment budgets are expected to be adversely affected by reductions in sediment deposition. However, on high islands, increased sediment yield from streams will help to compensate for sand loss from reefs. The low-reef islands and low-lying atolls are also expected to experience increased sea flooding, inundation, and salinization (of soils and freshwater lenses), as a direct consequence of sea-level rise.

Human settlements and infrastructure: In a number of islands, much vital infrastructure and major concentrations of settlements are likely to be at risk, given their location at or near present sea-level, and their proximity to the coast (often within 1-2 km, e.g. Kiribati, Tuvalu, Maldives, the Bahamas). Moreover, vulnerability assessments also suggest that shore and infrastructure protection costs could prove to be financially burdensome for some Small Island States.

Tourism: Tourism is the dominant economic sector in a number of small island states in the Caribbean, Pacific and Indian Ocean. It is the single largest contributor to GNP and foreign exchange earnings in many countries. In 1995 for instance, tourism accounted for 69%, 53% and 50% of GNP in Antigua, Bahamas and Maldives, respectively. The sector also earns considerable foreign exchange for a number of small island states, many of which are heavily dependent on imported food, fuel, and a range of other vital goods and services. In the same year, the sector earned \$US 181 million and \$US 1.3 billion in foreign exchange in the Maldives and Bahamas respectively, amounting to more than 50% of total Government revenues in each country. Climate change and sea level rise would affect tourism both directly and indirectly: Loss of beaches to erosion and inundation, increasing stress on coastal ecosystems, damage to infrastructure and an overall loss of amenity, would jeopardize the viability of this important industry in many small islands.

Integration and adaptation: In order to evaluate the risk of island states to projected climate change, a fully integrated approach to vulnerability assessments is needed. The sensitivity of small islands to climate change cannot be attributed to any single factor. Rather, it is the interaction of various biophysical attributes (e.g. size, elevation, relative isolation) with their economic and socio-cultural character which ultimately determines the vulnerability of these islands. Moreover, some islands are prone to periodic non-climate related hazards (e.g. earthquakes, volcanic eruptions, tsunamis); the overall vulnerability of these islands cannot be accurately evaluated in isolation from such threats. Similarly, vulnerability assessments for the Small Island States should take into consideration the value of 'non-marketed' goods and services (e.g. subsistence assets, community structure, traditional skills and knowledge) which may also be at risk from climate change. In some island societies these assets are just as important as marketed goods and services.

While a range of adaptation measures is theoretically available, the 'costs' of adaptation are often high in relation to the small size and limited human and financial resources of Small Island States. On the very small, low-lying islands and atolls, where sea-level rise is projected to be a threat, retreat away from the coast is rarely an option given the limited physical size of many islands. In such extreme cases, migration and resettlement outside of national boundaries might have to be considered.

Uncertainties in climate change projections may discourage adaptation, especially since some options may be costly or require changes in societal norms and behavior. For example, attempts to enhance the health and resilience of natural ecosystems such as coral reefs, mangroves and beaches by reducing activities that increase their vulnerability, would be an effective adaptation strategy, but there would be some monetary and 'social costs' associated with their implementation. As a guiding principle, policies which seek to use resources in a sustainable manner, and which can

respond effectively to changing conditions such as climate change, would be beneficial to the Small Islands States, even if climate change did not occur. Integrated coastal management is an example of one such policy initiative, whose implementation the Small Islands States might wish to consider.

Temperate Asia

Temperate Asia includes countries in Asia between 18°N and the Arctic Circle, including the Japanese Islands, Korean Peninsula, Mongolia, most parts of China, and Russian Siberia. The east-west distance of the area is about 8000km and its north-south extent is about 5000 km. Distinct sub-regions include arid/semi-arid, monsoonal, and Siberian regions.

Ecosystems: Although the area of potential distribution of temperate forests in Temperate Asia is to a large extent cleared and used for intensive agriculture, global warming can be considered sufficient to trigger structural changes in the remaining temperate forests. However, the nature and magnitude of these changes depends on the associated changes in water availability, as well as in water use efficiency. Shifts in temperature and precipitation in temperate rangelands may result in altered growing seasons and boundary shifts between grasslands, forests and shrublands. Under 2xCO₂ equilibrium conditions (UKMO-H3, GFDL-A2), there would be a large reduction in the area (up to 50%) and productivity of boreal forests, primarily in the Russian Federation, accompanied by a significant expansion of grasslands and shrub lands. There would be also a decrease in the area of the tundra zone by up to 50%, accompanied by the release of CH₄ from deep peat deposits, and a modest increase, less than 25%, of present emission of CO₂.

Hydrology and Water Resources: Overall, most 2x CO₂ equilibrium scenario simulations show a decrease in water supply, except for a few river basins. Warmer winters may affect water balances since water demands are higher in spring and summer. Equilibrium climate conditions for doubled CO₂ concentrations indicate a decrease of up to 25% in present mountain glacier mass is possible by 2050. Initially, runoff from glaciers in Central Asia is projected to increase threefold by 2050, but by 2100 would taper off to two-thirds of its present value. Model results suggest that runoff in the northern part of China is quite vulnerable to climate change, mainly due to changes in precipitation in spring, summer and autumn, especially during the floods. To balance water supply with water demand, increasingly efficient water management is likely the approach for Japan. In other parts of Temperate Asia, water resource development will remain important, and the central adaptation issue is how the design of new water resource infrastructure should be adjusted to account for uncertainties resulting from climate change. The most critical uncertainties are the lack of credible projections of the effects of global change on either the Asia monsoon or ENSO, which have great influence on river runoffs. Multiple-stress impact studies on water resources in international river basins are needed in the future.

Food and Fiber Production: Changes in crop yields from different GCMs vary widely in range. For example, in China, across different scenarios and different sites, the changes for several crop yields by 2050 are found to be: rice (-78% to +15%); wheat (-21% to +55%); and maize (-9% to +5%). An increase in productivity may occur if the positive effects of CO₂ on crop growth are considered, but its magnitudes remain uncertain. A northward shift of crop zones is expected to increase agricultural productivity in northern Siberia, but to decrease (about 25%) grain production in southwestern Siberia because of a more arid climate. Aquaculture is particularly important to Temperate Asia. Climate change impacts generally will be positive through faster growth, lower winter mortality rates, less ice-cover and reduced energy costs, with expanded regions of warmer water. Greater cultivation of warm water species could develop. Warming will require greater attention to possible oxygen depletion, fish diseases, and introduction of unwanted species, as well as to potential negative factors such as changes in established reproductive patterns, migration routes, and ecosystem relationships.

Coastal Systems: An increase in sea level will exacerbate the current severe problems of tectonically - and anthropogenically - induced land subsidence in delta areas of China. Saltwater intrusion would also become more serious. A sea level rise of one meter would threaten the Japanese coastal zone on which 50% of Japan's industrial production is located (Tokyo, Osaka and Nagoya). In addition, about 80% of the remaining sandy beaches in Japan would be in danger of disappearing.

Human Health: A several-fold increase in mortality and illness (predominantly cardio-respiratory) due to an increased frequency or severity of heat waves by 2050 is possible under 2xCO₂ equilibrium climate conditions. Net climate change-related increases in the geographic distribution (altitude and latitude) of the vector organisms of infectious diseases (e.g., malarial mosquitoes, schistosome-spreading snails) and changes in the life-cycle dynamics of both the vector and infective parasites would, in aggregate, increase the potential transmission of many vector-borne diseases. Increases in non-vector-borne infectious diseases such as cholera, salmonellosis, and other food- and water-related infections could also occur, because of climatic impacts on water distribution, temperature and microorganism proliferation. Disease surveillance could be strengthened and integrated with other environmental monitoring to design early warning systems; develop early environmentally sound public health interventions; and develop anticipatory societal policies to reduce the risk of outbreaks and subsequent spread of epidemics

Conclusion: Major impacts in the Temperature Asia under global warming will likely be found in the large shifts of the boreal forests, the disappearance of significant portions of the mountain glaciers and the shortage of water supply. The most critical uncertainty in these estimates is the lack of credible projection of the hydrological cycle under global warming scenarios. The effects of global change on both the Asian Monsoon and ENSO are among the major uncertainties in the modeling of the hydrological cycle. Projection for agriculture crop yields is uncertain, not only because of the uncertainty in the hydrological cycle but also because of the potential positive effects of CO₂ and production practices. As to the coastal zones, sea-level rise endangers sandy beaches but remains an anthropogenically induced problem in delta areas. Integrated impact study considering multi-stress factor is needed.

Tropical Monsoon Asia

The 16 countries of Tropical Asia are physio-graphically diverse and ecologically rich, both in natural and crop-related biodiversity. The present total population of the region is about 1.6 billion, and is projected to increase to 2.4 billion by 2025. The population is principally rural-based, even though in 1995, the region included six of the 25 largest cities in the world. Climate in Tropical Asia is characterized by seasonal weather patterns associated with the two monsoons and the occurrence of tropical cyclones in the two core areas of cyclogenesis (Bay of Bengal and Western Pacific). Climate change will add to other stresses such as rapid urbanization, industrialization, and economic development, which contribute to unsustainable exploitation of natural resources, increased pollution, land degradation and other environmental problems.

Ecosystems: Substantial altitudinal shifts of ecosystems in the mountains and uplands of Tropical Asia are projected. At high altitude weedy species can be expected to displace tree species though the rates of vegetation change could be slow and constrained by increased erosion in the Greater Himalayas. Changes in the distribution and health of rain forest and drier monsoon forest will be complex. For instance, in Thailand the area of tropical forest could increase from 45% to 80% of total forest cover, while in Sri Lanka, a significant increase in dry forest and decrease in wet forest could occur. Projected increases in evapotranspiration and rainfall variability are likely to have a negative impact on the viability of freshwater wetlands resulting in shrinkage and desiccation. Sea-level rise and increases in sea-surface temperature are the most probable major climate change-related stresses on coastal ecosystems. Coral reefs may be able to keep up with the rate of sea-level rise but suffer bleaching from higher temperatures. Landward migration of mangroves and tidal wetlands is expected to be constrained by human infrastructure and human activities.

Hydrology and Water Resources: The Himalayas have a critical role in the provision of water to continental Monsoon Asia. Increased temperature and increased seasonal variability in precipitation is expected to result in increased recession of glaciers and increasing danger from glacial lake outburst floods. A reduction in average flow of snow-fed rivers coupled with an increase in peak flows and sediment yield would have major impacts on hydropower generation, urban water supply, and agriculture. Availability of water from snow-fed rivers may increase in the short term but decrease in the long-run. Runoff from rain-fed rivers may continue to increase. A reduction in snow-melt water will put dry season flow of these rivers under more stress than is the case now. Increased population and increasing demand in the agriculture, industry, and hydropower sectors will put additional stress on water resources. Pressure on the drier river basins and those subject to low seasonal flows will be most acute. Hydrological changes in island and coastal drainage basins are expected to be small apart from those associated with sea-level rise.

Food and Fiber Production: The sensitivity of the major cereal and tree crops to changes in temperature, moisture, and CO₂ concentration of the magnitudes projected for the region has been demonstrated in many studies. For instance, impacts on rice yield, wheat yield, and sorgham yield suggest that any increase in production associated with CO₂ fertilization is more than offset by reductions in yield from temperature and/or moisture changes. Although it is evident that climate change impacts could result in significant changes in crop yields, production, storage, and distribution, the net effect of the changes region-wide is uncertain because of (i) varietal differences; (ii) local differences in growing season, crop management, etc.; (iii) the lack of inclusion of possible diseases, pests, and micro-organisms in crop model simulations; and (iv) the vulnerability of agricultural areas to episodic environmental hazards, including floods, droughts, and cyclones. Low-income rural populations dependent on traditional agricultural systems or on marginal lands are particularly vulnerable.

Coastal Systems: The coastal lands are particularly vulnerable, with sea-level rise being the most obvious climate-related impact. The densely-settled and intensively-used low-lying coastal plains and deltas are especially vulnerable to coastal erosion and land loss, inundation and sea flooding, upstream movement of the saline/fresh water front, and sea-water intrusion into freshwater lenses. Especially at risk are the large delta regions of Bangladesh, Myanmar, Vietnam, and Thailand. Socio-economic impacts could be felt in the major cities and ports, tourist resorts, artisanal and commercial fishing, coastal agriculture, and infrastructure developments. International studies have projected the displacement of several millions of people from the region's coastal zone, assuming a 1 m rise in sea level. The costs of response measures to reduce the impact of sea-level rise in the region could be immense.

Human Health: The incidence and extent of vector-borne diseases are expected to increase with global warming. Malaria, schistosomiasis, and dengue, which are a significant cause of mortality and morbidity in Tropical Asia, are highly sensitive to climate change and are likely to spread into new regions on the margins of the presently endemic areas. Newly-affected populations would initially experience higher fatality rates. In presently-vulnerable regions, an increase in epidemic potential of 12-27% for malaria and 31-47% for dengue and decrease of schistosomiasis of between 11 to 17% are anticipated under a range of GCM scenarios. Water-borne and water-related infectious diseases, which already account for the majority of epidemic emergencies in the region, are also expected to increase when higher temperatures and higher humidity are superimposed on existing conditions and projected increases in population, urbanization, declining water quality, etc.

Adaptation and Integration: Individual countries, regions, resources, sectors, and systems will not be affected by climate change in isolation, but rather in interaction with one another. The potential direct effects of climate change assessed here, such as changes in rice crop yields and inundation of coastal areas, will all have further indirect effects. Suitability of adaptation strategies to a different climatic environment will vary across the diverse sub-regions and land-uses of the region. Options include: new temperature and pest resistant crop varieties, new technologies to reduce crop yield loss, improvements in irrigation efficiency from current levels in order to reduce the total water requirements, integrated approaches to river basin management, and integrated approaches to coastal zone management taking account of both current and longer-term issues, including climate change and sea-level rise.

Facing - binding for each - need to have some form

Domestic Policy Panel

*How can technology help solve problem.
- How can govt.*

The opening presentation should demonstrate the scale of the effort needed to restrain and reverse our emissions growth in the next century, but should also demonstrate that, based on past experience of efforts to address environmental problems, we can protect the environment without threatening our economy if we plan wisely and use flexible, transparent, and accountable market-based solutions.

The discussion that follows should be guided by a series of questions which will illuminate how government and the private sector can work-together to solve the problem.

- I. What specifically can government and business do to encourage technological advances that will help us to slow carbon emissions? How important is it for Federal efforts to supplement and catalyze market incentives for technology improvements? In addition to providing the right market incentives for technological development, where specifically are the Federal government's efforts best focused?**

Macro-technology specialist: the role and economics of tech in environmental remediation:
Alternative energy corporation (i.e. solar, biomass, etc.):
Fossil fuel company experimenting with more efficient approaches:
Efficiency technology specialist:

- II. What can we do to ensure the U.S. industry remains competitive? In which industries are we likely to face challenges? In which are we likely to generate opportunities? Can you recommend any kind of safety valve to protect the economy against unexpectedly high costs of reducing emissions?**

International trade economist
Utility industry representative
Manufacturing industry representative
Labor representative

- IV. What is the most efficient way of reducing carbon emissions?**

Wall street firm specializing in regulatory trading
Emissions regulatory expert
Macroeconomist
Atmospheric scientist

- V. Are there suggestions you have for how the U.S. Government itself can be more efficient in using energy?**

Former senior government officials:
Student leader of a university effort to increase energy efficiency

International Panel

The opening presentation should compare developed v. developing countries emissions, demonstrating that OECD have historically emitted the most (and the US as the biggest emitter of OECD), but that developing countries will surpass the developed world sometime early in the twenty-first century. The speaker should demonstrate not only that developing countries' emissions need to be reduced but also that their emissions can peak at a later time than ours.

- **Do we really need an international treaty? Why do we need a treaty now?**

International environmental advocate(s)
Foreign Policy (transnational affairs) specialist

- **What obligations is it realistic to expect developing countries to take at Kyoto with respect to their current and future emissions? What implications will their action have for the ultimate success of efforts to reduce our own emissions? How can the US help encourage developing countries begin to take action on their emissions? What we can do with respect to China and India, in particular?**

Development economist
Senate skeptic of developing world commitments
International energy specialist
China/India specialist
International energy company
Multinational manufacturing company

- **The U.S. has insisted that a final agreement have elements that ensure flexibility for how the agreement is implemented, including developing country commitments, banking and borrowing, international trading, and an escape clause. How would an international trading system work? How critical are these elements?**

International environmental expert
International lawyer
International securities broker

- **The Europeans have proposed to reduced emissions to 15% below 1990 levels by the year 2010. Is that realistic? How are they going to reach this goal?**

European financial/economic forecaster
Comparative policy analyst

- **Is there a national security dimension to climate change?**

Foreign Policy (transnational affairs) scholar
International oil and energy specialist

Domestic Policy Panel

In order to lead the international action necessary to begin to address climate change, it is clear that the United States will have to restrain and reverse our emissions growth in the next century. Our ultimate goal must be to stabilize atmospheric concentrations of greenhouse gasses at an acceptable level. Our past efforts to address difficult environmental problems have shown that if we plan wisely and use flexible, transparent, and accountable market-based solutions, we can protect the environment without threatening our economy.

I. What specifically can I do to encourage technological advances that will help us to slow carbon emissions? How important is it for Federal efforts to supplement and catalyze market incentives for technology improvements? In addition to providing the right market incentives for technological development, where specifically are the Federal government's efforts best focused?

Holdren
Jorgensen
Get names of other technology people from TJ et. al.
Solow
Munnell

II. Very specifically, balancing the benefits of acting against the costs of doing so, how aggressive should we be in reducing carbon emissions?

Cline
Nordhaus
Jorgensen
Dudek (EDF)
Blinder
Solow
Katz
Tyson

III. What can we do to ensure the U.S. industry remains competitive? In which industries are we likely to face challenges? In which are we likely to generate opportunities?

Krugman
Esty (?) -- good because he has links to the greens
AFL-CIO
Ehrlich
Cooper
Repetto
Sachs
Stiglitz

IV. What is the most efficient way of reducing carbon emissions?

>>[Follow-up: How much can we learn from the SO2 trading program that we already have, to ensure that carbon reductions are undertaken efficiently?]

V. Are there suggestions you have for how the U.S. Government itself can be more efficient in using energy?

Former government officials: Deutsch

VI. Can you recommend any kind of safety valve to protect the economy against unexpectedly high costs of reducing emissions?

Nordhaus

Katz

Tyson

August 19, 1997
International Panel

For starters, it will be useful to have someone (either the President or a kick-off panelist) sketch a comparison of developed v. developing countries emissions, demonstrating that OECD have historically emitted the most (and the US as the biggest emitter of OECD), but that developing countries will surpass the developed world sometime early in the twenty-first century. The speaker should demonstrate not only that developing countries' emissions need to be reduced but also that their emissions can peak at a later time than ours. The discussion would then explore several key questions:

- Do we really need an international treaty? Why do we need a treaty now?

Daniel Lashoff
 Jonathan Lasch
 Jessica Matthews

- The Europeans have proposed to reduced emissions to 15% below 1990 levels by the year 2010. Is that realistic? How are they going to reach this goal?

Eileen Claussen
 Wolfgang Reineke
 Joseph Stiglitz

- Will action we take change our relationship with OPEC and other energy producing nations (including some traditional allies, such as Australia)?

Ross Gelbspan (?)
 Daniel Yergin

- What obligations is it realistic to expect developing countries to take at Kyoto with respect to their current and future emissions? What implications will this action have for the ultimate success of our own efforts to reduce emissions? That is, how much will we diminish the benefits from our efforts to reduce emissions if we do not have some commitment from developing countries?

John Browne
 Sen. Byrd
 Sen. Lugar

How can the US help encourage developing countries begin to take action on their emissions? Are there particular things we can do with respect to China and India, in particular? (Joint implementation; GEF) How would an international trading system work?

Nat'l Security

Dan Dudek
Enron
Joe Stiglitz

- Our negotiators have been asking that a final agreement have several important elements that ensure flexibility for how the agreement is implemented, including developing country commitments, banking and borrowing, international trading, and an escape clause. How critical are these elements?



CENTER FOR HEALTH AND THE GLOBAL ENVIRONMENT

HARVARD MEDICAL SCHOOL

August 18, 1997

Mr. Todd Stern
Staff Secretary
Ground Floor, West Wing
The White House
1600 Pennsylvania Avenue, N.W.
Washington, DC 20503
Fax 202- 456 - 2215
total pages--14

Dear Mr. Stern,

As a follow-up to our conversation at the White House Scientists' Meeting on Climate Change on July 24th, I am sending you some materials from our Center.

1. the program of our briefing for the Vice President in October of 1994 on "Climate Change and Human Health,"
2. a page from the Summary Proceedings of the Conference on Human Health and Global Climate Change at the Institute of Medicine/National Academy of Sciences in September, 1995 which was organized as a result of the above briefing,
3. a letter from Jack Gibbons about our help in planning, organizing, and participating in the Conference,
4. a notice of our Congressional Briefing held on March 10th of this year,
5. an Op/Ed Paul Epstein and I did in *The Boston Globe*,
6. and a letter of invitation from Carol Browner to brief the Environmental Ministers of the G7 (plus Russia and the European Union) about the health effects of climate change.

I am enclosing these items to make the case that the subject of human health figure prominently in the October 6th White House Conference. This is critically important for two reasons--1. by

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ASSOCIATE DIRECTOR

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Edward H. Kass Professor of Medicine

TIMOTHY C. WEISKEL D.PHIL.
Research Associate in Environmental Ethics

EDWARD O. WILSON PH.D.
Mellen Professor of the Sciences

discussing human health, one is able to translate the abstract, technical science of climate change into concrete, personal terms that people can relate to and 2. people are unlikely to make the changes necessary to reduce greenhouse gas emissions until they have understood the risks to themselves and their children.

Both Paul Epstein and I are extremely well informed about the potential human health consequences of climate change, and have spoken and written extensively on the subject. I hope you will consider one or both of us for the upcoming White House Conference.

I have also enclosed the text (without the slides) of my talk at Carol Browner's Environmental Leaders' Summit so that you can get an idea of what I would cover if I were to speak.

I will be in Washington from September 4th through September 8th, as we are holding another Congressional Briefing, entitled "The Value of Plant, Animal, and Microbial Species to Human Health." If I don't hear from you before then, I will try to set up a meeting at that time.

With best wishes,

Eric Chivian

Eric Chivian M.D.

Vice President's Technical Science Breakfast October 7, 1994
274 OEOB, 7:45 AM
Climate Change and Human Health

Speakers:

Dr. Eric Chivian, Assistant Clinical Professor of Psychiatry, Harvard.
Staff Psychiatrist, MIT.

Dr. Mary Wilson, Chief, Infectious Diseases, Mt. Auburn Hospital Cambridge.
Assistant Professor of Medicine and Assistant Professor of Population
and International Health, Harvard.

Dr. Robert Shope, Professor of Epidemiology, Yale School of Medicine.
Director of the Yale Arbovirus Unit.

Today's speakers will discuss the interplay of climate change, ozone depletion, and environmental degradation on current and future incidence of disease. Environmental factors contribute to the occurrence, spread, and intensity of human infectious diseases. The recent resurgence of old diseases we thought we had conquered (TB and measles), the emergence of new diseases (Legionnaire's and AIDS), and the discovery of new mechanisms to spread disease (cholera in algal blooms), all point to the need for increased attention to the relationship between environment and human health.

Climate change adds an additional layer of concern. Changing temperature and precipitation patterns world-wide could have direct impacts such as changing the distribution of disease organisms. Less directly, a decrease in world-wide agricultural productivity could result in nutritional deficiency and increased hunger. Rising sealevel will flood low-lying islands and could lead to "ecological" refugees and migrating populations.

Little research has been directed at studying the impacts of climate change on human health. The three guest breakfast speakers have helped to focus attention on this important issue.

CONFERENCE ON HUMAN HEALTH AND GLOBAL CLIMATE CHANGE

coordination among nations and scientific disciplines; (c) multidisciplinary research on the links between global climate change and human health; (d) improved environmental health training for health professionals; and (e) an outreach program to inform and educate the public about the effects of global climate change on human health. In the face of current fiscal constraints, these efforts must be based on identifying and linking together existing activities, facilities, organizations, and funding agencies.

BACKGROUND AND OVERVIEW

In October 1994, following a meeting with concerned scientists and medical experts (Eric Chivian, Bob Shope, and Mary Wilson), Vice President Gore asked the Office of Science and Technology Policy (OSTP) and the Council on Environmental Quality (CEQ) to organize a conference on the potential human health risks posed by global climate change, and strategies to address them—such as global health surveillance, public outreach, and education. Members of the NSTC, OSTP and CEQ formed a working group to develop a preliminary agenda for the conference and later requested that the IOM join in planning, organizing, and conducting the conference. (Appendix A presents a list of the sponsoring agencies, the IOM steering committee, and conference organizing staff.)

The purpose of the conference was twofold:

1. To bring together a diverse, interdisciplinary group of experts to address the potential effects of global climate change and ozone depletion on the current and future incidence of disease, heat stress, food and water supplies, and air pollution; and
2. To discuss initial strategies for improving research and development (R&D), global health surveillance systems, health care and disease prevention, medical and public health community education, international cooperation, and public outreach.

It is important to note that the focus of the conference was human health. Presenting evidence of whether or not global climate change is, has, or will occur, was not the primary focus. Participants were asked rather to work within an "if/then" type of scientific exercise: If global climate change occurs, what are the potential adverse human health effects and what strategies should be developed to address them?

The first day of the two-day conference was filled with scientific presentations and a plenary discussion on the current state of knowledge about global climate change and its potential risks for human health (see the agenda, Appendix B), including a presentation by Vice President Gore (see Box 1). On the second day, participants discussed health policy implications and potential intervention strategies in a series of panels. Each panel's findings were presented and discussed by the conference participants in a final plenary session. Approximately 300 scientists, health care providers, policymakers, academicians, federal and state officials, industry representatives, and others attended the conference and participated in developing the strategies (see Appendix C).

THE WHITE HOUSE
WASHINGTON

September 22, 1995

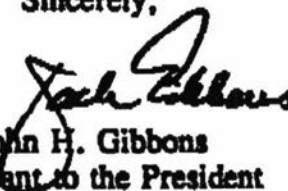
Dr. Eric Chivian
Assistant Clinical Professor
Department of Psychiatry
Harvard Medical School
56 Hawes Street
Brookline, MA 02146

Dear Dr. Chivian:

On behalf of Dr. Ken Shine and myself, I want to thank you for all your work and participation in the Conference on Human Health and Global Climate Change which contributed to its tremendous success. By bringing together the diverse communities of educators, scientists, researchers, and NGOs from industry and the medical and national security communities, the conference afforded an opportunity to discuss the broad array of issues associated with human health and climate change. Your talk on the role of the medical and public health communities and the need for increased education in environmental issues helped set the stage for the discussions at the conference and for continuing efforts.

For your information, I am enclosing a transcript of the Vice President's talk. Again, thank you for all your hard work.

Sincerely,



John H. Gibbons
Assistant to the President
for
Science and Technology

Enclosure

**ENVIRONMENTAL AND ENERGY STUDY INSTITUTE****NOTICE****KEN MURPHY, EXECUTIVE DIRECTOR ■ 122 C ST. NW, STE 700 ■ WASH. D.C. 20001 ■ (202) 628-1400****POTENTIAL HUMAN HEALTH EFFECTS OF GLOBAL CLIMATE CHANGE****Monday, March 10****1:30-3:30 p.m., SD 215 Dirksen Senate Office Building**

The potential effects of global climate change on human health will be presented in a briefing co-sponsored by EESI and Harvard Medical School's Center for Health and the Global Environment.

As nations from around the globe prepare to adopt a global climate treaty late this year, more attention is being paid to the potential health impacts of extreme weather events and of other possible manifestations of the "greenhouse effect."

This briefing features presentations on key topics by some of the nation's leading scientific and medical experts:

- Overview, Prof. Barry Levy, President, American Public Health Association.
- Greenhouse gases and extreme weather events, Dr. Thomas Karl, Senior Scientist, National Climatic Data Center, Asheville, N.C.
- Heat waves and mortality, Prof. Laurence Kalkstein, Director, Center for Climatic Research, University of Delaware.
- Air pollution, the greenhouse effect and human health, Prof. Arden Pope, Brigham Young University.
- Climate change and infectious disease, Dr. Paul Epstein, Instructor in Medicine, Harvard Medical School.
- Climate change and species loss: implications for human health, Dr. Eric Chivian, Director of the Center for Health and the Global Environment, Harvard Medical School.

(over)

The Boston Globe

THURSDAY, APRIL 10, 1997

*Warm and wet conditions
spell trouble for the world.*

Weather alert

**ERIC CHIVIAN
and PAUL EPSTEIN**

Last week's record snowstorm was another reminder that in recent years we have endured the most variable and extreme weather in memory. The same has been true in other parts of the country and the world: Witness the succession of storms and snow melts in the Pacific Northwest in January and the record-setting floods along the Ohio River last month.

This instability is considered to be an early manifestation of the warming of the atmosphere and the oceans over the last 100 years, resulting from our burning fossil fuels and rapidly increasing atmospheric carbon dioxide concentrations.

Worldwide, 1995 was the warmest year since global temperatures were first kept in 1856. For the Northeast, 1996 was the wettest year on record. What people don't realize is that these changes in climate carry unprecedented potential risks for human health.

For one: Warm, wet weather, especially warm winters and wet springtimes, produces ideal breeding conditions for mosquitoes, which in New England can carry Eastern equine encephalitis, a disease with a 50-percent mortality mainly affecting children and leaving many with severe, chronic neurological problems. Warm, wet conditions also favor increased populations of ticks, which can transmit several infections, including Lyme disease.

Prior to the 1970s, Lyme disease was unheard of, but in each subsequent decade the number of cases has steadily climbed. In 1994, the Centers for Disease Control reported 13,000 cases nationwide, a 25-fold increase over 1962.

While tick-borne diseases are highly sensitive to human settlement patterns and populations of host species like deer and mice, climatologic factors are likely to play an increasingly important role.

Higher global temperatures can also increase the number of heat-related deaths, as we saw in Chicago during the

July 1995 heat wave, when more than 700 people died. Currently in Boston, there are about 90 people on average who die each summer from the heat. If global warming continues at its current pace, this figure may double by the year 2050. Additional illness and death may result from increasing levels of air pollution, exacerbated by the warming, affecting those with chronic respiratory diseases, such as children with asthma and the elderly with bronchitis and emphysema.

The world scientific community has warned that present trends of fossil fuel use may result in average global temperatures by the year 2100 that are 2 to 6 degrees warmer than they are now. It has been more than 120,000 years since the earth was this warm. Because species often live within narrow temperature ranges, such warming - and more extreme weather - may compromise food sources, affecting agricultural productivity and marine life, and threaten countless numbers of species with extinction.

In addition to the unforeseeable ecological consequences of such extinctions, direct implications for human health include the loss of valuable medical research models that help us understand human physiology and disease and the loss of potential new medicines.

Consider two New England species that may be endangered by greenhouse warming - the white birch and the dogfish shark. Researchers have found in the bark of white birch trees an acid that in laboratory tests has shown great promise in fighting malignant melanomas, a cancer that is increasing in incidence at a faster rate than any other in the United States, doubling in the past decade.

The fact that sharks rarely get infections or tumors, presumably the result of 400 million years of highly successful evolution of their immune systems, has led to the discovery of "aqualumene" in the dog-

fish shark, an antibiotic that is highly potent against a wide variety of bacteria, fungi, and parasites and that seems to work through pathways different from those of all other known antibiotics.

As infectious agents are acquiring resistance to currently used medications, this discovery has special significance.

Finally, species loss may disrupt vital life support systems as species interact with one another and with their environments to provide such services as regulating the concentration of atmospheric gases and water vapor, maintaining soil fertility, filtering pollutants, breaking down wastes, and controlling pests.

With our failure to heed the warnings of the world's scientific community to reduce our burning of fossil fuels, we are in effect conducting a global experiment with all life on earth, including human life.

the outcome of which no one can fully predict. What we can predict - about changes in the incidence and distribution of infectious diseases, about heat waves and air pollution, and about the effects of species loss - suggest a future with enormous dangers for human beings.

With a recognition of the medical consequences involved from our damaging the ozone layer, the world community agreed to control the release of ozone-depleting chemicals. Will it respond with the same urgency to the human health risks predicted from our changing the global climate and draft a strong treaty to control greenhouse gases?

Eric Chivian and Paul R. Epstein are faculty members at Harvard Medical School, where they direct the Center for Health and the Global Environment.



PHIL LACHNEE ILLUSTRATION



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

APR 25 1997

THE ADMINISTRATION

Eric Chivian, M.D.
Director
Center for Health and the Global Environment
Harvard Medical School
56 Hawes Street
Brookline, Massachusetts 02146

Dear Dr. Chivian:

It is my pleasure to invite you to participate in a discussion of the Impacts of Climate Change at the upcoming Environment Leaders' Summit, to be held in Miami, Florida, May 5-6, 1997.

The agenda item on the Impacts of Climate Change is scheduled for Monday afternoon on May 5. The exact time is yet to be determined. I would like you to give a 10-minute presentation on the health effects of climate change. This will be followed by a 10-minute presentation by Tom Karl of the National Oceanic and Atmospheric Administration on the effects of climate change on global weather. The remainder of the session will be devoted to an exchange of views by the Environment Leaders. A background paper which is being prepared for the Environment Leaders on the impacts of climate change will be sent to you in advance of the meeting.

A meeting schedule is enclosed with this letter, along with information on hotel accommodations and other logistical matters.

I very much hope you will be able to accept this invitation, as I believe you will make an important contribution to the discussion of this particular agenda item at the Environment Leaders' Summit. The U.S. Environmental Protection Agency will be responsible for your travel. Jeff Shulman of my staff will make the arrangements for you. He can be contacted at (202) 260-4369.

I look forward to seeing you in Miami.

Sincerely,

A handwritten signature in cursive script, reading "Carol M. Browner".
Carol M. Browner

Enclosures

THE POTENTIAL HUMAN HEALTH EFFECTS OF GLOBAL CLIMATE CHANGE

Eric Chivian M.D.

Briefing Talk for
The Environment Leaders' Summit [environmental ministers of the G7, Russia, and the European Union]
Miami, Florida
May 5, 1997

Introduction

I'm delighted and honored to be here--thank you Carol Browner and Bill Nitze for inviting me. I'm also delighted that the health impacts of global climate change are central to these discussions. This is critically important because environmental decisions must be based ultimately on what the effects of those decisions are on human beings, and because people are unlikely to change their behaviors or support policies necessary to control greenhouse gases until they have begun to recognize the risks to their health and lives, and to those of their children. Moreover, by discussing the effects on health, one has the potential of translating the abstract, technical, complex science of global climate change into concrete, personal terms that people can relate to and understand.

That is why we formed the Center for Health and the Global Environment at Harvard Medical School - to promote a wider understanding of these issues. We are a collaborating center of the United Nations Environment Programme and work closely with the World Health Organization and with the IPCC.

slide 1
slide 2
slide 3
Today I will briefly review some of the potential human health effects of global climate change. This is a highly complicated subject with an enormous number of uncertainties. I have included some background materials in your packets. For those wanting a more complete review of this subject, I refer you to chapter 18 in the IPCC working Group II 2nd Assessment Report and to this superb WHO/WMO/UNEP book (1996) Climate Change and Human Health. I also urge you to obtain this newly published Island Press book Biodiversity and Human Health (edited by F. Grifo and J. Rosenthal, 1997).

Background

Because of the natural heat-trapping effect of atmospheric gases, the average global surface air temperature has been approximately 15 degrees C. for the past 10,000 years. Without this natural greenhouse effect, the average temperature would be minus 18 degrees C. and most of the Earth's surface would be frozen.

Since the Industrial Revolution, the emission of greenhouse gases has risen dramatically, secondary to industrial and agricultural production and the use of fossil fuels for heating, producing electricity, and transportation. CO₂, the main greenhouse gas, has increased in the atmosphere by roughly 30% in the past 100 years, increasing from about 270 parts per million by volume (ppmv) to an atmospheric concentration in 1994 of around 360 ppmv.

slide 4
In the last 100 years, average global surface temperatures have warmed approximately 0.5 degrees C. or 1 degree F.

slide 5
1995 was the warmest year globally since records were first kept in 1866, and the 1990's will clearly be the warmest decade. Over the past century, sea levels have risen globally about 18 cm., and weather patterns have changed, as you will hear from Tom Karl.

slide 6

The IPCC has concluded that "the balance of evidence suggests a discernible human influence on global climate," and recent work by Benjamin Santer and his colleagues, comparing the predictions from global circulation models, taking sulfate aerosols and stratospheric ozone into account, with observed temperatures shows a striking similarity, offering the best evidence to date of an anthropogenic effect. The IPCC has predicted, with a scenario of doubling atmospheric CO₂ concentrations by 2100, we can expect mean temperatures to increase approximately 2 degrees C. with a range of 1-3.5 degrees C.

Now, to many people, this may not sound like something to be worried about, but we need to keep in mind that:

1. these are mean global increases and that they will be greater than the mean nearer the poles

slide 7

2. the difference between average temperatures during the last ice age, 20,000 years ago, when glaciers up to a mile thick covered much of Canada, northern United States, and northern Europe and now is only about 5 degrees C.

slide 8

3. and temperatures 2 degrees C. warmer than now have not been present for more than 120,000 years, during the Eemian interglacial period when *Homo Sapiens* first evolved. Look at today's CO₂ concentration—it is greater than at any time during the past 160,000 years, and with the doubling predicted, we are in totally uncharted territory.

The IPCC has also predicted an increase in sea levels of about 1/2 meter, with a range of 15 cm. to more than 1 meter, more climate variability and extreme weather events like heat waves, such as that experienced during the summer of 1994 in Europe,

slide 9

drought, such as that which occurred in the U.S. 1 yr. ago in the plains states

or that presently occurring in Western Europe, especially in Portugal, France, and in the United Kingdom, which is having its longest dry spell in more than 200 years.

slide 10

An absence of rainfall can create the conditions for wildfires, such as those we experienced in the western U.S. last summer when more than 6 million acres burned, nearly double the average acreage burned each year during this decade in the Amazon.

slide 11

We can also see extremely heavy rains and snows with flooding such as that which occurred in the Mississippi valley in 1993,

slide 12

across Germany, France, Belgium and the Netherlands in January of 1995,

and in the Red River Valley during the last month after the river rose 25 feet above its floodstage, devastating large areas of North Dakota.

These changes in temperature, precipitation, soil moisture, sea level, and extreme weather events will have both direct and indirect effects on human health.

Direct Effects on Human Health

slide 13

For one, there will be an increased frequency and intensity of heat waves, which are likely to lead to dramatic increases in summer deaths. By the year 2050, the excess summer mortality from heat-related causes in several major American cities could double over present levels.

In Chicago, for example, during the 5 day heat wave in July 1995, over 700 people died from heat-related causes. Major urban centers in the developing world such as Shanghai and Cairo could see increases of 3 to 4 fold over background levels.

The elderly, the very young, those with impaired mobility, and people suffering from cardiovascular and respiratory disease are the most at risk. Poor urban populations in industrialized and developing countries alike are also more vulnerable to heat waves, because of poor housing and a lack of access to air conditioning.

Slide 14 These extreme weather events will cause additional direct health effects, from injuries and electrocutions from storms, to drownings from the flooding.

Indirect Effects on Human Health

The potential indirect health effects from global climate change are large in number and difficult to predict, as they are often the product of multiple variables, many of which are poorly understood.

For the purposes of our discussion, I will divide these into the following categories:

1. those from the effects of air pollution
2. those secondary to sea level rise and flooding events
3. those which are the result of disturbances to ecosystems

Air Pollution

The dynamics of the relationship between climate change and air pollutants have not been fully studied. What can be said is that the chemical reactions forming secondary air pollutants are accelerated by higher temperatures. Climate change, therefore, may lead to increased concentrations of photochemical oxidants, including ground level ozone (also increased by increased Ultraviolet B radiation on the ground), and to higher levels of sulfate and nitrate particulates, causing increases in the frequency and intensity of asthma attacks (which in the U.S. is the single greatest cause of childhood hospitalizations), and in an increased risk of respiratory and cardiovascular illness and premature death.

Pollens and spores may also increase as a result of warm weather and changes in precipitation patterns, worsening allergies and causing increases in the risk of some windborne fungal diseases. As an example, an epidemic of the fungal disease coccidiomycosis broke out in the American southwest a few years ago, attributed to a protracted drought followed by heavy rains. As new fungal pathogens are emerging and old ones re-emerging and as fungi are developing increasing resistance to antifungal medications, one has to be concerned about the potential for increased fungal infections secondary to climate change.

Sea Level Rise and Flooding Events

Sea level rise will have a wide range of effects on human health, including: nutritional loss from a flooding of agricultural lands and from a loss of fish breeding areas, such as coastal wetlands and mangroves; and from the reduced availability of drinking water, due to salt water intrusion and a rise in the water table in low-lying coastal areas, releasing infectious contaminants from septic systems into waterways and increasing the risk of waterborne infectious disease.

In addition, there will be all the health problems associated with millions of environmental refugees escaping flooded and storm destroyed areas.

Flooding from extreme precipitation events will also diminish the quantity and quality of drinking water supplies, which will be contaminated by toxic chemicals, by animal and human waste, and by the floating carcasses of dead animals.

An outbreak in 1994 of lung bleeding in infants in Cleveland Ohio killing 1/3 of those affected, was traced to a previously undiscovered black mold growing in water damaged homes, illustrating again how little we know about some of the health effects of such events.

Ecosystem Disturbance

Finally, I want to cover the implications for human health from disturbances to ecosystems secondary to climate change. This is an area that worries many of us the most, as such disturbances may carry the greatest risks of human health. It is also perhaps the least well understood aspect of global climate change.

Let me begin by mentioning 3 models of infectious disease transmission that may be affected by climate change.

slide 15
1. More than 350,000 people in Central America became infected with dengue fever during the hot wet summer of 1995, and there was serious concern that there could be scattered outbreaks of dengue along the entire gulf coast of the U.S. from Texas to Florida. Some cases were, in fact, reported in Texas. Dengue, a severe viral disease of the tropics and subtropics, carried by mosquitoes currently infects 50 million people each year. Initial dengue infections cause pain, fever, and prostration, but are not associated, in general, with mortality. Subsequent dengue infections, however, can cause dengue hemorrhagic fever, which is one of the leading causes of hospitalization and mortality for children in South East Asia.

slide 16
In most parts of the world, dengue is carried by *Aedes aegypti*, the famous carrier of yellow fever, but this mosquito, *Aedes albopictus*, the Asian tiger mosquito, brought to the U.S. from Asia in 1985 in a shipment of used tires, can also transmit dengue.

slide 17
The tiger mosquito has proliferated rapidly in southern states, reaching as far north as Nebraska and Iowa. It has also been found in Italy.

slide 18
The range of this mosquito, and that of *Aedes aegypti*, is limited by frost and sustained cold temperatures which kill adults and prevent the survival of eggs and larvae through the winter. With the increased temperatures from climate change, we may expect their ranges to enlarge as they move to higher latitudes into temperate zones, and to higher altitudes. Such shifts have already been observed, for example, during the unseasonably warm summer of 1988, when dengue reached previously unaffected areas in Mexico at altitudes of 1700 m.

The increased temperatures from climate change can also intensify mosquito-borne diseases by increasing mosquito reproduction, increasing biting rates, and enhancing the proportion of mosquitoes that become infected.

Up to World War II, many parts of the industrialized world had outbreaks of malaria, including the USA, and Western and Southern Europe.

slide 19
This slide shows malaria mortality in the U.S. from 1919 to 1921, with the dark areas in some southern states being counties with more than 5 malaria deaths per 10,000 population.

Malaria causes 300-500 million new cases per year and an estimated 2 million deaths annually, more than 1/2 of whom are young children, mostly in Africa.

We have seen some cases of locally-acquired malaria in the U.S. for the first time in decades--in New York, New Jersey, and Texas during the hot wet summers of 1991, 1993 and 1994.

Estimates by the WHO have predicted an additional 50-80 million cases of malaria by the year 2100 with climate change.

2. We will also see an effect on waterborne infectious diseases.

5/1/96 20 This NOAA satellite photo shows in red and orange the worldwide distribution of algal blooms, which have increased dramatically in recent years, it is believed, because of sewage and fertilizer discharge into coastal waters, overfishing, the loss of wetlands that filter out nitrates and phosphates, and warmer sea surface temperatures.

5/1/96 21 This is the coast of Peru in 1991, showing an intense algal bloom. In that year, cholera struck Peru. Apparently the cholera bacteria, initially transported in the bilge water of a freighter from Bangladesh, proliferated rapidly in the unusually warm and nutrient rich Peruvian waters, where algal blooms provided an ideal medium for them to thrive. As a result of poor sanitation, urban crowding and an inadequate medical infrastructure, cholera quickly spread to 19 Latin American nations, following rivers and streams, eventually affecting 1/2 million people and killing 5000.

3. The final infectious disease model I will mention concerns the hantavirus outbreak in the U.S.

The story went like this:

5/1/96 22 Six years of drought in the Four Corners area of the American Southwest, where Utah, Arizona, Colorado and New Mexico meet, ended in the late winter and early spring of 1993, when unusually heavy snows and rains drenched the region, resulting in a very heavy crop of pine nuts and a super-abundance of grasshoppers, both food for the native deer mouse.

Now, the drought had led at the same time to a marked reduction in the mouse's usual predators - foxes, snakes, owls, and coyotes and as a result, the mouse population exploded, increasing 10 fold by May of 1993 over levels of the previous year. Deer mice, it turns out, carry a virus from the hantavirus family, which they shed through their saliva, urine, and feces, and as a consequence of the greatly increased exposure by people in the area to the huge mouse population, an epidemic of a rapidly fatal pneumonia (or pulmonary syndrome), developed--17 previously healthy people initially got the disease, 13 of them died.

5/1/96 23 As of now, 145 people in 25 states in the U.S. have been diagnosed with hantavirus pulmonary syndrome, with a mortality rate of around 50%. No one knows how many other viruses or other infectious agents in the environment, potentially harmful to man, are being held in check by the natural balances among species, in this case disrupted by a regional change in climate.

And that leads me to my final comments.

Other Ecosystem Effects

Many paleontologists believe that climate change was the dominant factor in the great species extinctions of the past. Species adapted to the changes in temperature by shifting their ranges--during warming they moved towards the poles or to higher altitudes. During cooling periods they retreated. But many species were lost because they could not adapt, either because their rates of migration were too slow or because geographical barriers stood in their way.

By contrast to past temperature changes, however, those expected for the next century will be 10-100 times faster than those that have occurred before, and in addition to geographical barriers,

there are man-made ones everywhere—cities, roads, agricultural lands. In fact, global climate change could become one of the most significant factors in ecosystem disruption and species loss in the next 100 years.

Slide 24 We are already seeing evidence of such shifts in the range of species in response to warming temperatures, in the move to higher elevations of some plant species in the alps, and in the northward migration of a butterfly, the Edith's Checkerspot, in western states in the U.S.

Disruptions of species functions and of the composition of species populations in ecosystems that we may see with global climate change have very worrisome implications for agriculture and for the marine food supply. Such disruptions may also interfere with the ways species interact with each other and with their environments to provide vital life support services, such as regulating the composition of gases and water vapor in the atmosphere, maintaining soil fertility, filtering pollutants, controlling pests, and breaking down wastes.

With our continued discharge of ever increasing amounts of CO₂ into the atmosphere, affecting global temperatures, precipitation patterns, soil moisture, sea levels, and causing potentially serious disruptions to terrestrial and marine ecosystems, we are, in effect, conducting a massive experiment with all life on this planet, including human life, the outcome of which no one can fully predict.

What we can predict suggests a future with enormous, and, I believe unacceptable, risks for human beings. These risks for our children and for generations to come may dwarf all other presently known environmental health threats.

When the world community began to recognize the magnitude of the danger from ozone depletion, it adopted the Vienna Convention to control the emission of chlorofluorocarbons, saving, it has been recently estimated, more than 1 million cases of skin cancer each year in the U.S. alone by the year 2100, and almost 400,000 in Northwest Europe.

Let us hope it will respond with the same sense of urgency to the public health warnings about global climate change from the WHO and health scientists, and from a growing chorus of physicians, and move to set significant and binding targets to curb greenhouse gasses.

**UNDER SECRETARY
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97 AUG 26 PM 3:18

W. H. Carl Fane/S

TO:

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FROM:

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Number of Pages (including cover):

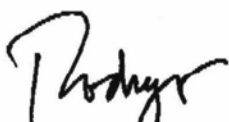
4

COMMENTS:

Todd:

Tim asked me to send over the attached letter and asked that you think about adding a public health angle to the White House Conference. If you decide to do so, Dr. Chivian is your man. His work on climate and public health (i.e. rise in disease vectors, heat related illness, etc) is the tops. I hope you will give it some consideration.

All the best and see you soon.

A handwritten signature in black ink, appearing to read 'Rodrigo', with a stylized, cursive script.

Rodrigo Prudencio



CENTER FOR HEALTH AND THE GLOBAL ENVIRONMENT

HARVARD MEDICAL SCHOOL

August 18, 1997

The Honorable Timothy E. Wirth
Under Secretary of State for Global Affairs
Fax 202-647-0753
Total pages--11

Dear Tim,

I am sending you some materials from our Center on global climate change:

1. a Notice of our Congressional Briefing on the health effects of global climate change on March 10
2. an Op/Ed in *The Boston Globe* that Paul Epstein and I wrote
3. and the invitation to me from Carol Browner to brief the Environmental Ministers of the G7 plus Russia and the European Union in early May.

I am writing to ask if you would speak to Todd Stern, who I understand is coordinating the planning for the upcoming White House Conference on Global Climate Change on October 6, to request that the subject of human health be given significant attention at the Conference. I think this is important on two counts--1. by discussing the human health effects of climate change, one is able to translate the abstract, technical science into concrete, personal terms that people can relate to, and 2. people are unlikely to make the changes necessary to reduce greenhouse gas emissions until they have understood the risks to themselves and their children.

Would you also be willing to put in a plug for either Paul Epstein or myself? I don't know if you heard my remarks at the two recent conferences we both spoke at (the National Solar Energy Forum and the New York Academy of Medicine's "Five Years after Rio" Conference), or Paul speak to your group at the State Department, but we are both very extremely well informed about

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Mellon Professor of the Sciences

human health and global climate change and have written and spoken widely on the subject.

Also enclosed is the text (without the many slides I showed) of my talk at the Environmental Leaders' Summit, so that you can get an idea of what I might say.

I hope this is not being too presumptuous of me, but I am concerned that human health may not get enough attention at the Conference, and feel strongly that it should.

My wife and I look forward to seeing you at Roger and Vicki Sant's home for dinner on the 4th of September.

With best wishes and with great admiration for your work,



Eric Chivian M.D.

W.H. Con & Pand

cc: Todd Starn

Oregon

August 25, 1997

DEPARTMENT OF
ENERGY

'97 AUG 26 PM 1:28

Mr. Frederick P. DuVal
Deputy Assistant to the President
Deputy Director for Intergovernmental Affairs
Old Executive Office Building, Room 106
Washington, DC 20502

Dear Mr. DuVal:

I am writing you about the White House conference on climate change on October 6. I request that you consider placing on the agenda a presentation about Oregon's new carbon dioxide reduction law.

Oregon recently passed a law to control carbon dioxide emissions from new power plants. The law requires developers to reduce the carbon dioxide emissions from each new power plant by 17 percent. Power plant developers can meet the standard through increased plant efficiency, co-generation that offsets fossil fuels, and other offset projects in the U.S. or other countries.

The law was developed through an extensive public review. It was crafted by a group of power plant developers, environmental groups and state agencies, who refined the standard to ensure that it is workable. The bill had strong support from all parties. Significantly, industry accepted the standard as achievable in a competitive power market. The bill passed the Oregon Legislature by unanimous votes in each chamber.

I believe the message of how and why Oregon adopted the standard in order to "do its share to address climate change," as Governor John Kitzhaber characterized the legislation, is worth highlighting at the White House conference. If you any questions about the standard or my request, please call me at (503) 378-4128; or, you may call Sam Sadler at (503) 373-1034. Thank you for your consideration of my request.

Sincerely,

John Savage
John Savage
Administrator

John A. Kitzhaber
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