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Folder Title:
[Climate Change Issues] [Folder 1] [2]

Stack:	Row:	Section:	Shelf:	Position:
S	21	2	3	1

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

Eastern

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

Contact List

III. Economists

DRAFT--8/18/97, 9:50 AM

Name	Title/Affiliation	Background	Phone #	Fax #	Status
General/Nation-wide					
Kenneth Arrow P	Stanford University; Nobel Laureate	Economists' Statement	415/723-9165 (CA)		YES (JG)
Stephen DeCanio PR	UC Santa Barbara	Organized Economists' Statement; staff at CEA during Reagan Admin.	805/893-3130 (CA)	805/ 893-8830	YES (JG)
Dan Dudek PRT	Environmental Defense Fund	Emissions trading proponent	203/938-3392 (CT)	203/ 938-4172	YES (JG)
Ev Ehrlich PRT (also General)	President, ESC Company; directed Administration's economic analysis	Ex-Undersecretary of Commerce	202/347-3200 (DC)	202/ 347-4334	YES (JG)
Paul Krugman PRT	MIT	One of the crafters of the Economists' Statement	617/253-1551 (MA)	617/ 253-4096	left msg (JG)
John Palmisano PR	Enron Corp.	Emissions trading proponent			in Bonn (JG)
Paul Portney	President, Resources for the Future, Washington, D.C.	Resource economist	202/328-5103 (DC)	202/ 939-3460	YES (JG)
Robert Repetto PRT	Senior Economist, World Resource Institute	Economists' Statement; authorized report explaining economic models related to climate	202/638-6300 (DC)	202/ 638-0036	YES (JG)
Richard Sandor PRT	President, Centre Financial; Vice chair, Chicago Board of Trade	Emissions trading of sulfur and carbon dioxide	(IL)		YES (JG, DF)
Robert Solow PRT	MIT, Cambridge MA; Nobel Laureate	Economists' Statement	617/253-5268 (MA)	617/ 253-0560	YES (JG)
Joseph Stiglitz PRT	Chief Economist, World Bank	Ex-chair of CEA; involved in economics section of IPCC; emissions trading, JI			
New England (CT, ME, MA, NH, RI, VT)					
Dan Dudek PRT (also in nation-wide)	Environmental Defense Fund	Emissions trading proponent	203/938-3392 (CT)	203/ 938-4172	YES (JG)
A. Myrick Freeman III	Bowdoin College	Economists' Statement; Air pollution benefits through the CAACC	(ME)		

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Name	Title/Affiliation	Background	Phone #	Fax #	Status
Paul Krugman (also in nation-wide)	MIT	One of the crafters of Economists' Statement	617/253-1551 (MA)	617/ 253-4096	left msg (JG)
✓ Richard Schmalensee	MIT	Economic benefits of action	617/253-2957 (MA)	617/ 258-6617	YES (JG)
Robert Solow (also in nation-wide)	MIT; Nobel Laureate	Economists' Statement	617/253-5268 (MA)	617/ 253-0560	YES (JG)
✓ Robert Stavins	Harvard University, Kennedy School of Government	Economists' Statement; market-based approaches, likes taxes	617/495-1820 (MA)	617/ 495-1635	
~~Robert Evenson~~	~~Yale University~~	~~CEA, Economists' Statement~~	~~(CT)~~		
○ Paul Schultz <i>Judi</i>	Yale University	CEA, Economists' Statement	(CT)		
○ W. Kip Viscusi <i>Judi</i>	Harvard Law School	CEA, Economists' Statement; cost-benefit analyses	(MA)		
✓ Gary Yohe	Wesleyan University	CEA, Economists' Statement; student of Nordhaus	(CT)		
New York/New Jersey					
✓ William J. Baumol	New York University	Economists' Statement	(NY)		
✓ Alan Blinder	Princeton University, NJ Ex-member CEA		609/258-3358 (NJ)		YES (JG)
Mid-Atlantic (DE, DC, MD, PA, VA, WV)					
○ Maureen Cropper <i>Jay</i>	U of Maryland; Chair of Clean Air Act Compliance Analysis Council	Economists' Statement	(MD)		
Peggy Duxbury	Program Manager, Redefining Progress	Organization sponsored Economists' Statement; contact for other economists	202/588-8900 (DC)	202/ 588-9711	(JG)
Ev Ehrlich PRT (also in General & nation-wide)	President, ESC Company; directed Administration's economic analysis	Ex-Undersecretary of Commerce	202/347-3200 (DC)	202/ 347-4334	YES (JG)
Paul Faeth	World Resources Institute	Economists' Statement	(DC)		
Irving Mintzer PRT (also in General)	Ex-WRI and Center for Global Change; Washington D.C.	Generalist	301/587-8714 (MD)		YES (JG)
Paul Portney (also in nation-wide)	President, Resources for the Future, Washington, D.C.	Resource economist	202/328-5103 (DC)	202/ 939-3460	YES (JG)

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Name	Title/Affiliation	Background	Phone #	Fax #	Status
Robert Repetto PRT (also in nation-wide)	Senior Economist, World Resource Institute	Economists' Statement; authorized report explaining economic models related to climate	202/638-6300 (DC)	202/ 638-0036	YES (JG)
Southeast (AL, FL, GA, KY, MS, NC, SC, TN)					
Philip J. Cook <i>Judi</i>	Duke University	CEA, Economists' Statement	(NC)		
Industrial Midwest (IL, IN, MI, MN, OH, WI)					
Richard Sandor (also in nation-wide)	President, Centre Financial; Vice chair, Chicago Board of Trade	Emissions trading of sulfur and carbon dioxide	(IL)		YES (JG, DF)
Paul N. Courant <i>Judi</i>	U of Michigan	CEA, Economists' Statement	(MI)		
Terry L. Roe <i>Jay</i>	U of Minnesota	CEA, Economists' Statement; resources, agriculture, water	(MN)		
Vernon W. Ruttan <i>Jay</i>	U of Minnesota	CEA, Economists' Statement; agriculture	(MN)		
South Central (AR, LA, NM, OK, TX)					
John Palmisano PR (also in nation-wide)	Enron Corp.	Emissions trading proponent	(TX)		in Bonn (JG)
Agricultural Midwest (IA, KS, MO, NE)					
John A. Miranowski <i>Jay</i>	Iowa State University	CEA, Economists' Statement; former USDA official	(IA)		
Southwest (AZ, CA, HI, NV, AS, GU)					
Kenneth Arrow (also in nation-wide)	Stanford University; Nobel Laureate	Economists' Statement	415/723-9165 (CA)		YES (JG)
Stephen DeCanio PR (also in nation-wide)	UC Santa Barbara	Organized Economists' Statement; staff at CEA during Reagan Admin.	805/893-3130 (CA)	805/ 893-8830	YES (JG)
Richard B. Norgaard	UC Berkeley	Economists' Statement	(CA)		
Trudy Ann Cameron <i>Judi</i>	UCLA	CEA, Economists' Statement	(CA)		
Robert T. Deacon <i>Jay</i>	UC Santa Barbara	CEA, Economists' Statement	(CA)		
Anthony Fisher <i>Jay</i>	UC Berkeley	CEA, Economists' Statement	(CA)		
Jack Hirshleifer <i>Jay</i>	UCLA	CEA, Economists' Statement	(CA)		
Gordon Rausser <i>Judi</i>	UC Berkeley <i>Dean of the School</i>	CEA, Economists' Statement; econometrics	(CA)		
Northwest (AK, ID, OR, WA)					

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III. Economists

DRAFT--8/18/97, 9:50 AM

Name	Title/Affiliation	Background	Phone #	Fax #	Status
✓ Gardner Brown	U of Washington	Economists' Statement; biodiversity, endangered species	(WA)		
✓ Emery N. Castle	Oregon State University	CEA, Economists' Statement	(OR)		
Uncertain					
✓ Dallas Burtraw	Resources for the Future	Economists' Statement; emissions trading, market mechanisms			
Joseph Stiglitz PRT (also in nation-wide)	Chief Economist, World Bank	Ex-chair of CEA; involved in economics section of IPCC; emissions trading, JI			

**White House Conference on Climate Change:
The Challenge of Global Warming
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 – 11:15 The Science of Global Warming and Climate Change

Presentation: **John Holdren**, Harvard University

Panelists: **Robert Watson**, World Bank

Tom Carl, NOAA

Diana Liverman, University of Arizona

Don Wilhite, University of Nebraska

11:30 - 11:45 Vice President Gore: *Where we've come from; Where we're going.*

11:45 - 12:45 The Role of Technology in Reducing Greenhouse Gas Emissions

Presentation: **Frederico Pena**, Secretary of Energy

Panelists: **Maxine Savitz**, Allied Signal & Presidential Commission of Advisors
on Science and Technology

Roger Sant, AES Corporation

Tom Casten, Trigen Corporation

Michael Bonsignore, Honeywell Corporation

Larry Papay, Bechtel Corporation

1:00 – 2:30 Lunch:

**Remarks by First Lady Hillary Rodham Clinton
Breakout Discussions with the Cabinet**

2:30 – 3:30 Kyoto Conference and U.S. National Interests

Presentation: **Madeleine Albright**, Secretary of State

Panelists: **William Reilly**, Fmr. EPA Administrator

[John Sweeney, AFL-CIO]

James Wolfesohn, World Bank

Linn Draper, AEP

Fred Krupp, Environmental Defence Fund

Jessica Tuchman Matthews, Carnegie Endowment for Peace

Daniel Yergin, Cambridge Energy Research Associates
[Gen. William Odom, (Ret.), Hudson Institute]

3:30 – 4:30 Climate Change Policy and the U.S. Economy

Presentation: Larry Summers, Deputy Secretary of the Treasury

Panelists: Richard Repetto, World Resources Institute

[William Nordhaus, Yale University]

[Alan Blinder, Princeton University]

Richard Sandor, Chicago Board of Trade

[Michael Porter, Harvard Business School]

10:00 - 10:20: Opening Remarks

10:00: The Vice President welcomes attendees; introduces the President.

10:05: The President speaks to the American people in a substantive way about global warming and climate change. His remarks foreshadow the day's events, endorse the scientific consensus behind climate change, assert the importance of this issue to the American people, outline that action will need to be taken, and embrace the broad outlines of the U.S. negotiating position going into Kyoto.

10:20 – 11:15: The Science of Global Warming and Climate Change: This panel will present and discuss evidence about global warming and climate change, and present 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.

10:20: John Holdren, Professor of Physics, Harvard University, will concisely describe the physical science of global warming and climate change, as well as the level of certainty about its different aspects within the scientific community.

10:35: The President asks Dr. Tom Karl, Senior Scientist at NOAA, to discuss extensive data and anecdotal evidence that something serious is starting to occur.

10:45: The Vice President asks Dr. Diana Liverman, University of Arizona, and Don Wilhite, University of Nebraska, to describe possible impacts on regions of U.S. in the next twenty to thirty years.

11:00: The Vice President can ask Dr. Robert Watson, Chair of the IPCC, to discuss what is clear and what is unclear about how rapidly the climate will change and about where impacts will be most felt, as well as what the skeptics are arguing. He also could ask who participates in the IPCC, and how it came into being.

11:10: The President asks John Holdren how policymakers should act when uncertainties about different climate scenarios.

11:30 - 11:40: Vice President Al Gore: Where we've come from; where we're going: Outlines history of how fossil fuels have been central to building modern societies and economies, and sketches where world population and development are going. He then outlines the new challenge: marshalling modern technology and entrepreneurial spirit to develop more efficient and innovative forms and uses of energy.

11:45 – 12:45: The Role of Technologies in Reducing Greenhouse Gas Emissions: This panel will discuss policy options that allow us to reduce emissions without hurting our economy.

11:45: Secretary Pena presents an overview of the sectors that are the major sources of greenhouse gas emissions, and of the technologies that could play a part in reducing emissions.

11:55: The President asks Maxine Savitz, Allied Signal and PCAST member, to discuss the potential for building cars, homes and buildings that use less fuel.

12:05: The Vice President asks [Lary Papay, Bectel or Roger Sant, AES] to discuss advances in the newest generation of coal-fired electric plants, the lessons learned from previous efforts to design plants that use less fuel, and the worldwide demand for cleaner burning power.

12:15: The Vice President asks [DuPont/Dow/Monsanto] to discuss advances being made in introducing energy efficiency into manufacturing.

12:20: The President asks Tom Casten to describe what Trigen has done to develop and market systems that recapture unused energy from power plants, and rechannel it to heat other buildings. Mr. Casten should also describe the kinds of companies that have benefited from this kind of technology, as well as to speculate on the market share for these kinds of technologies.

12:30: The Vice President asks Steve Percy, British Petroleum USA, to describe efforts to develop and market solar and other alternative fuels. Larry Papet, Bectel, could describe how much we can expect solar, wind, and other renewables to reduce our carbon emissions. Mr Papet can also describe the most effective government programs or policies in helping develop these technologies.

12:40: The Vice President asks Michael Bonsignore to discuss Honeywell's experience in trying to export technologies such as more efficient lighting and heating systems, as well as nuclear and hydro-energy power plants.

1:00 - 2:15: Lunch and Breakout discussions:

1:00: First Lady Hillary Rodham Clinton will give broad remarks, including brief mention of the health effects on children from climate change.

1:15: 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. This panel will discuss the global nature of the problem, identify key issues outstanding in the negotiations, and clearly explain the U.S. negotiating position.

2:30 - 2:35: Secretary Albright provides a brief background on the ongoing negotiations, mentioning the Rio Climate Treaty, the Berlin Mandate, and the Geneva Declaration. She describes the core elements of the U.S. position (i.e. binding targets, emissions trading, JI, developing country commitments), and summarizes the positions of key countries or country groupings (i.e., the EU, China, and the G-77).

2:35 - 2:45: Vice President Gore asks William Reilly, Fmr. EPA Administrator, why developed countries have taken the lead, and what are realistic, environmentally sound and politically equitable obligations for developing countries to adopt for current and future emissions.

[2:45 - 2:50: Vice President Gore asks John Sweeney, AFL-CIO, to discuss labor's perspective on a fair international agreement to address climate change.]

2:50 - 2:55: Secretary Albright asks James Wolfensohn, World Bank, to describe why developing countries have opposed committing to binding targets at Kyoto, and any whether we risk choking off economic development.

2:55 - 3:00: Vice President Gore asks Linn Draper, AEP, whether flexible, market oriented techniques can allow businesses such as coal burning utilities 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?

3:00 - 3:05: The Vice President asks Fred Krupp, EDF, to describe whether an international trading system could provide significant gains to the environment.

3:05 - 3:15: Secretary Albright asks Jessica Matthews, Carnegie Foundation, about the foreign policy considerations regarding climate change. Do we have a national interest in preventing climate change impacts in the developing world?

3:15 - 3:20: Vice President Gore asks Daniel Yergin, Cambridge Energy Research Associates, to talk about strategic energy considerations, especially how developing view their energy security, and what the prospects are for the current system.

3:20 - 3:25: Secretary Albright asks General William Odom, Ret., Hudson Institute, how these issues are likely to affect strategic balances in several key regions such as the Caspian Sea and South China Sea.

3:30 - 4:30: Climate Change Policy and the US 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?

3:30 - 3:35: Secretary Rubin lays out the challenge of reducing climate emissions without hurting the economy. He would summarize the economic consequences of the technology discussion: that we either have to reduce our use of fossile fuels or develop new techniques or energy supplies that emmit less carbon.

3:35 - 3:45: Vice President Gore asks Robert Repetto, WRI, how quickly it is possible to bring existing technologies on line quickly and cost-effectively to reduce our emissions.

3:45 - 3:55: Secretary Rubin asks Rich Richels, Electric Power Research Institute, what would be the most cost effective strategy for mitigating climate change. How important are time frames for bringing on new technologies? How can we know if we are exceeding a point of diminishing returns?

3:55 - 4:05: The Vice President asks Robert Solow, MIT, how, amidst uncertainty, we should craft an "insurance" strategy, and how we might design sufficiently early reductions to make an middle-term date cost effective.

4:05 - 4:15: Secretary Rubin asks Richard Sandor, Chicago Board of Trade, to talk about his experience in helping establish the sulphur dioxide trading system, including how people expected it to peform, how much people thought permits would cost, and why the cost ended up being significantly lower.

4:15 - 4:25: The Vice President asks Michael Porter what makes investors move quickly into environmental technologies, and firms and countries' find it in their competitive advantage to invest early in these technologies.

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:

Economics

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

Domestic Policy / Economics

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)

gov. of Oregon?

(2) Ken Lay, Enron: gas and renewable energy specialist (Oregon State Program)?

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 ← try to get him off

Richard Sandoz, Centre Financial & Chicago Board of Trade

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

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

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

→ William Nordhaus, Yale University ← --- naysayer

→ Robert Repetto, WRI

John Young, HP

- nuclear - CEO of GE.

- Ag - Monsanto or Georgia Pacific.

- Laura Tyson

- Norm Augustine

(1) ways to create new non-carbon energy

(2) carbon eff.

(5) trading regime

emissions trading

→ (Ishmael Sirageldin Jus. Dev. Env. & ? World Bank

Maxime Savitz, Allied Signals

Trading & Technology

Rob Shapiro

controversy on tech.

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, 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)

JF 8/14/97

Economist candidates to invite to Oct. White House conference on GCCmore senior experts on GCC
2300

some other eminent economists of

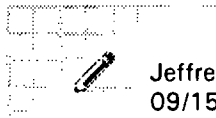
lead signers of letter

Bill Nordhaus
Dale JorgensonKen Arrow *
Paul Krugman
Robert Solow **Ask Ray
Tom Schelling MIT
Studies
oil or
climate
policy*

other signers of letter

Richard Schmalensee

William Baumol, NYU
Max Corden, SAIS
Gerard Debreu, UCB *
Frank Fisher, MIT
Claudia Goldin, Harvard
Ned Gramlich, U.Mich/ FRB nom.
Lawrence Klein, U.Penn *
Anne Krueger, Stanford
Larry Katz, Harvard
Robert Litan, Brookings
Van Ooms, CED
Jeff Sachs
James Tobin *other eminent who didn't sign
Bill Cline, IIF
Richard Cooper, HarvardJohn Harsanyi *
Wassily Leontief *
Franco Modigliani **John Whalley
- ed. of a book
U of Vancouver
may not be active*Stephen DeCanio
Robert Repetto*Harvard?
Larry
Goulders trade**Jeffrey Sachs
1995 GROUPS
report
Harvard*experts in GCC
not quite as senior/big namesigned letter
Stavinscouldn't find name on list
Goulder
Rutherford
McKibbin
Wilcoxon
Richels
Tomanformer Admin
Alan Blinder
Laura Tyson
Alicia Munnell
Ev Ehrlich
Joe Stiglitz*Oil Market
Expert**political economy of
oil policy**Daniel Yergin
The Prize
Cambridge Energy
Assoc. J.F.**McKibbin
G-cubed
EPA rules
Rutherford
U of CO**Bill Moomaw
Tufts
competitiveness*



Jeffrey A. Frankel
09/15/97 06:50:12 PM

Record Type: Record

To: William J. Antholis/OPD/EOP
cc: Adele C. Morris/CEA/EOP, Janet L. Yellen/CEA/EOP
bcc:
Subject: Re: draft conference memo

A few quick reactions to your memo re WH GCC conference.

Page 4. You have an awful lot on technology. I would be surprised if Treasury, of all agencies, would want to present what you have listed: technology, item (b), presented as if it is a policy lever to be viewed as comparable/alternative/on a parallel with the true policy options you have listed under (a). At a minimum, you should say "*subsidy* of the development and diffusion of technology", if you intend to talk about a policy. Then, under discussion, you commit the sin even more explicitly by describing emission reduction technologies as possible policy tools. We believe that suggesting technology as a way of cutting emission, independently of price (or R&D subsidies, or regulation, etc.) is like suggesting that heart/lung rate is a way of burning calories, independently of physical exertion.

page 6. Something is missing from the end of Repetto.

Under economist A, Blinder was not a co-author of the letter (or even a signer?), though he is of course very good. If you want knowledgeable co-authors of the letter, you are limited to Nordhaus and Jorgenson (or, to some extent, Krugman and Solow). I think you really have to have Nordhaus, for full credibility. Personally, I would also do Krugman. (He is nowhere near as ornery as his reputation.)

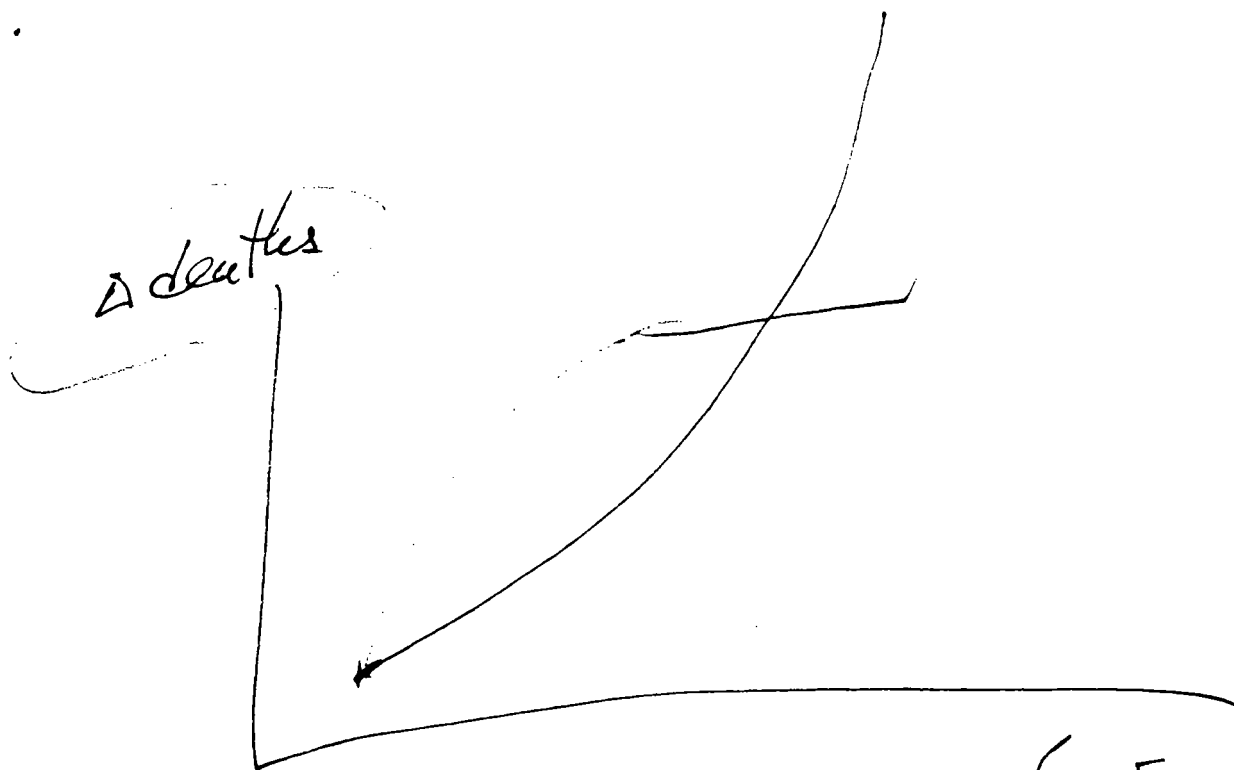
Other trade economists: Cooper, Sachs*, Max Corden*.
women: Claudia Goldin*, Anne Krueger*, Laura Tyson, Alicia Munnell
(* signed the letter)

page 9. I'm a bit surprised at the role given to national security here, since there are so many more important dimensions to this problem. In particular, I am not sure what you want Jessica Matthews (whom I think is good) to do. And I fear that the use of the word "competitiveness" here is even more dangerous (to borrow from Krugman's phrase "competitiveness: a dangerous obsession") than in the usual context.

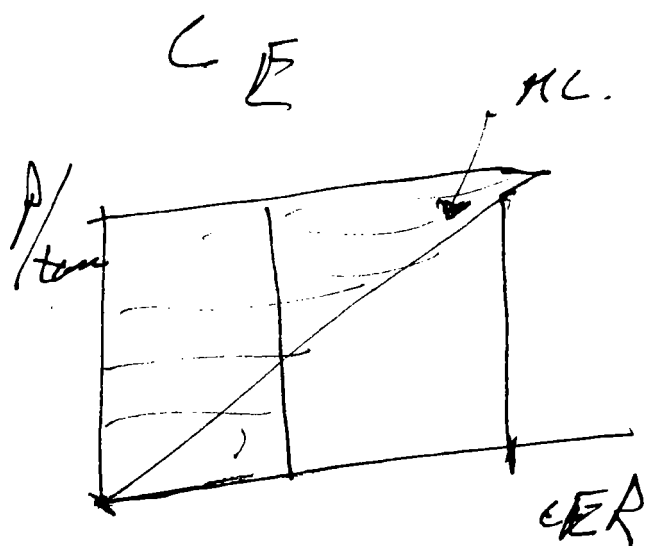
last line: drop word "both"

Under economist B, what do you mean by "helping key industries"?

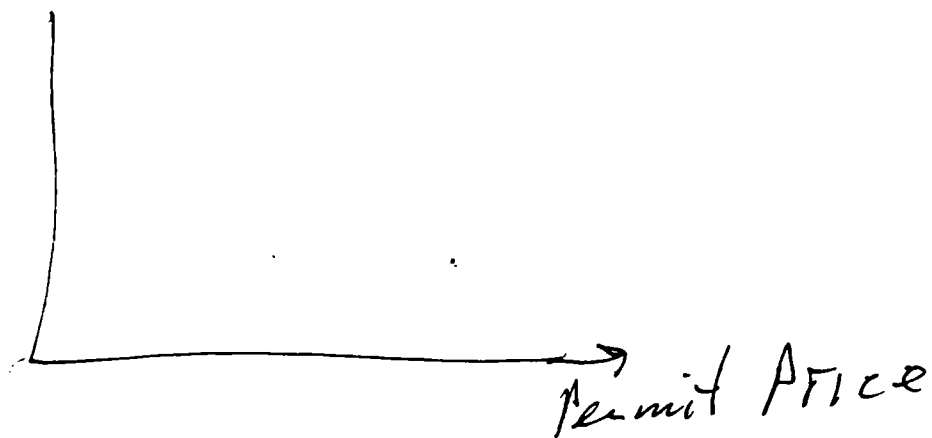
William J. Antholis



~~Δ cost~~ cost

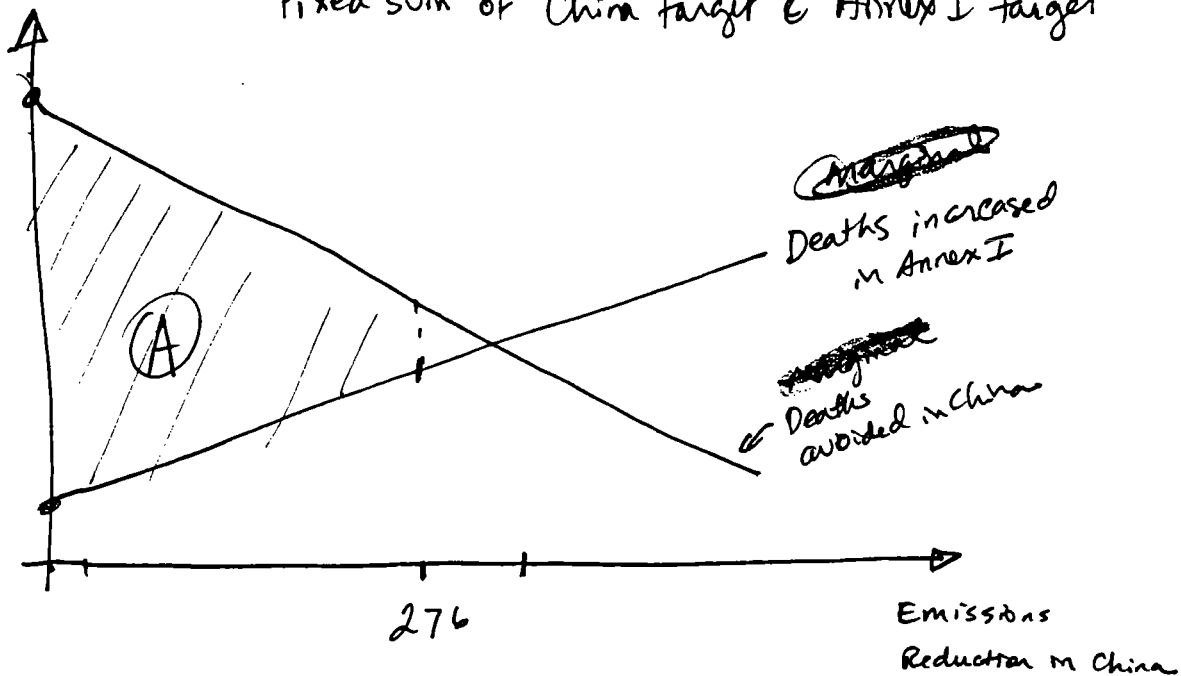


CE_{red}



Deaths

Fixed sum of China target & Annex I target



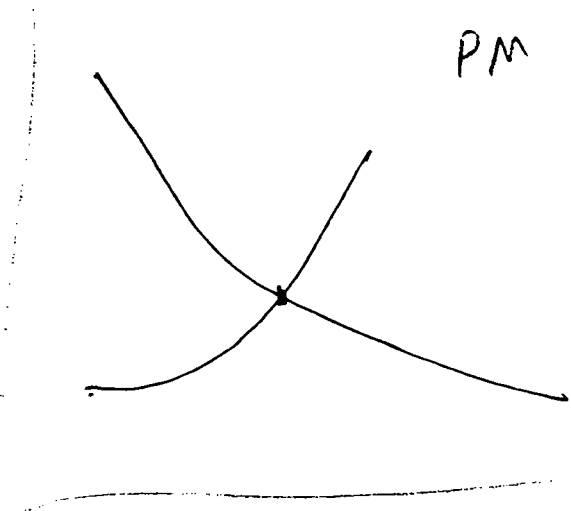
(A)

= total annual ~~agg.~~ deaths avoided

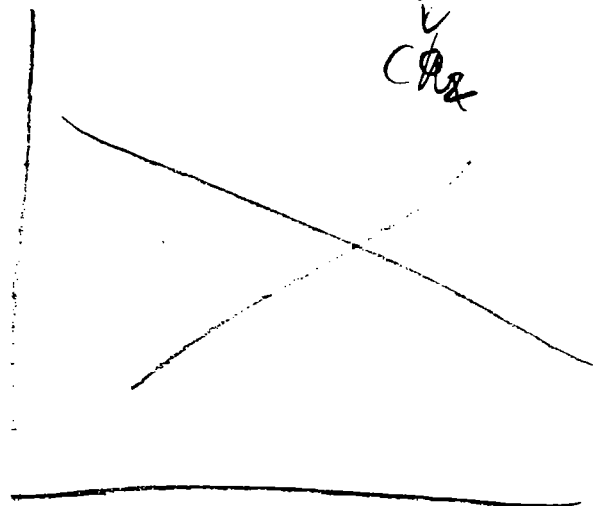
from C&T ~~etc.~~ vs. Annex I only

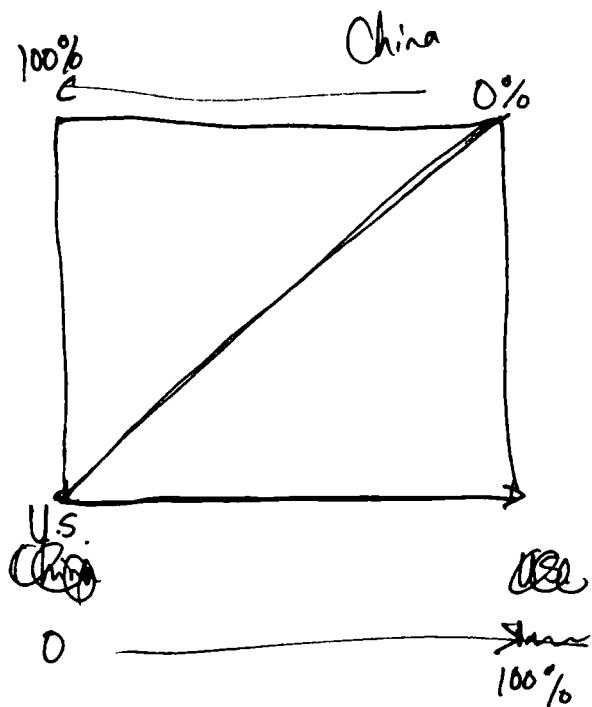
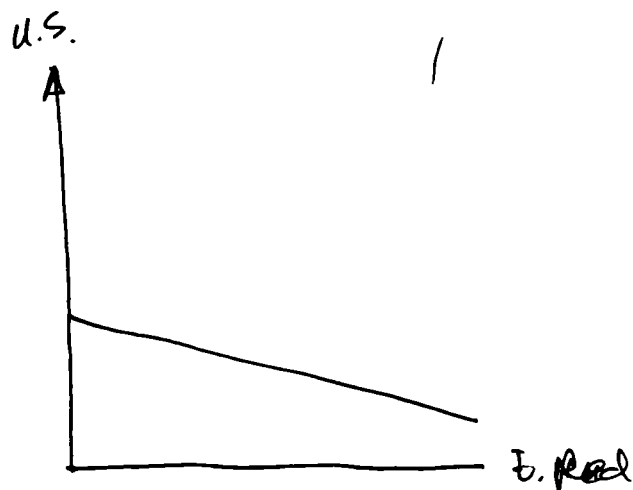
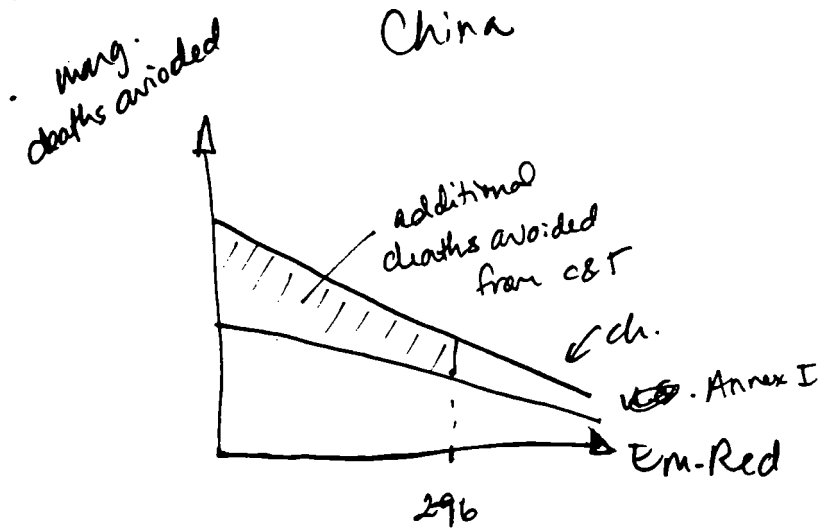
Same GHG effect

PM



CH₂



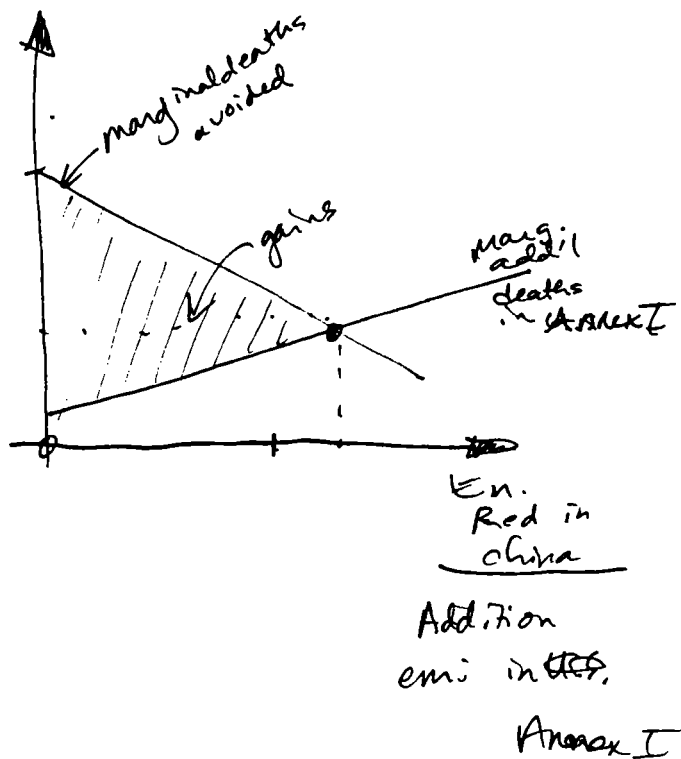


Annex I

Total emissions = U.S. target + China target

U.S. = 0

U.S. = 100%



Ancillary benefits of non-Annex I cap and trade

The reduction of greenhouse gas emissions achieved by developing countries under a cap and trade system will reduce simultaneously the concentrations of numerous other hazardous air pollutants, producing ancillary environmental and human health benefits. A recent study in the journal *Lancet* projects that by 2020, a climate change policy scenario in which developing countries reduce emissions to 10% below their BAU and developed countries reduce emissions to 15% below their 1990 levels could produce an annual reduction of 700,000 deaths by reducing airborne particulate matter (PM). Non-Annex I countries experience 563,000 of those avoided deaths. The estimations in the *Lancet* study can be adapted to estimate the deaths avoided by the emissions reductions charted in this paper.

Key assumptions in Lancet:

Earlier estimates of mortality risk associated with PM are correct.

Mortality risk associated with PM is the same around the world as it is in US.

PM reductions are proportional to emissions reductions.

Key assumptions here:

All net DC emissions reductions are from reduction in gross emissions, not increases in sinks.

Deaths avoided in a particular developing countries is equal to the total non-Annex I deaths avoided multiplied by its share of the non-Annex I population.

Trading Scenario	U.S. MMTCE reduction	U.S. PM deaths avoided	LDC % reduction from BAU	LDC population	LDC MMTCE reduced	LDC PM deaths avoided
Annex I only			0%	0	0	
Annex I + China			20%	1,357,627,000	276	
Annex I + India			18%	1,140,563,000	65	
Annex I + Mexico			19%	113,385,000	34.5	

	A	B	C	D	E	F
1	Scenario	Permit Price		CO2 Reductions (MMTC)		
2		97\$	92\$	US	W'ern Eur	E'ern Eur
3	A1	54	48	202	97	31
4	A1+China	26	23	101	49	15
5	A1+India	47	42	178	84	27
6	A1+Mexico	51	45	191	91	29

	G	H	I	J	K	L
1						
2	FSU	Canada	Japan	Australia	China	India
3	189	15	24	12		
4	108	8	12	7	276	
5	169	13	21	11		66
6	179	14	23	12		

A1 Total AA-US

570 368

300 199

503 325

539 348

	M
1	
2	Mexico
3	
4	
5	
6	34

Lancet

BAU

Policy

Annex I

15% below 1990 levels

Non-Annex I

10% below BAU

Mortality only

PM < 10 m

PM < 25 m ?

IPCC Atmospheric Stab. Framework (ASF) model
⇒ trajectories of carbon emissions

Baseline CO₂ emissions Scenarios

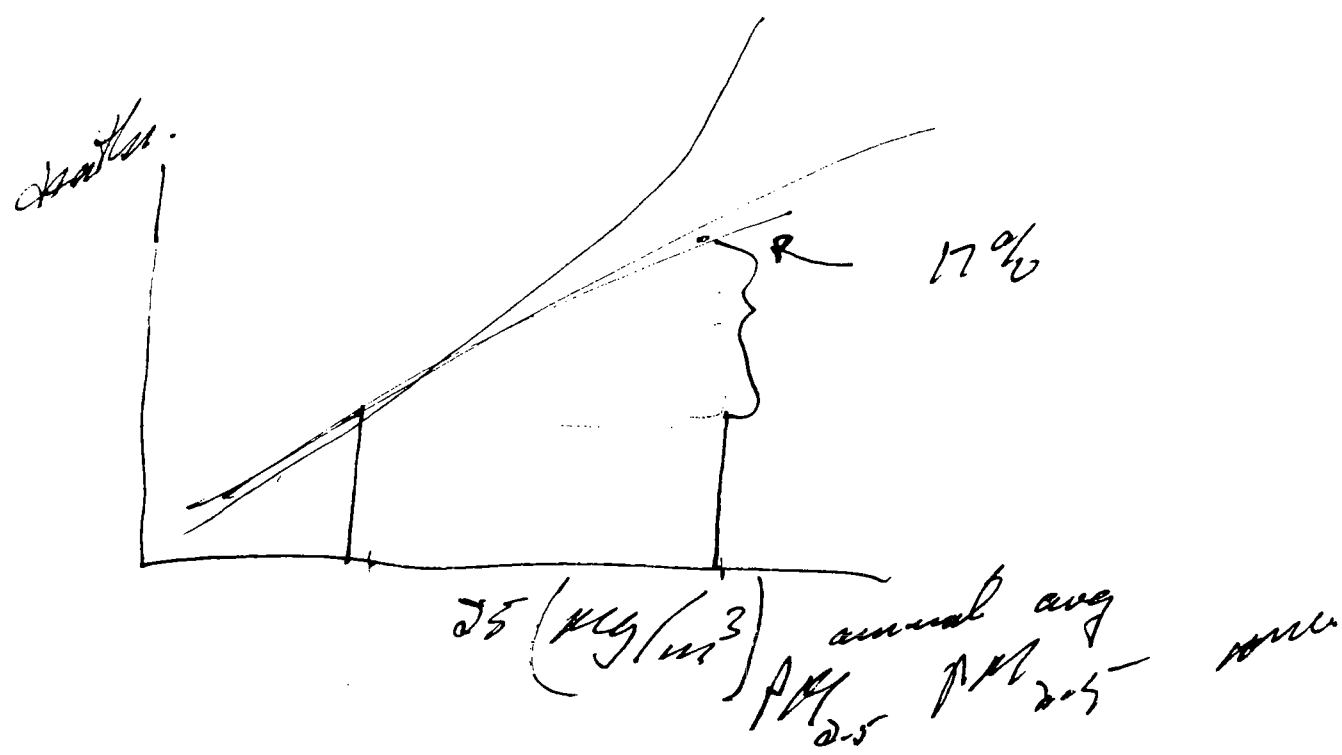
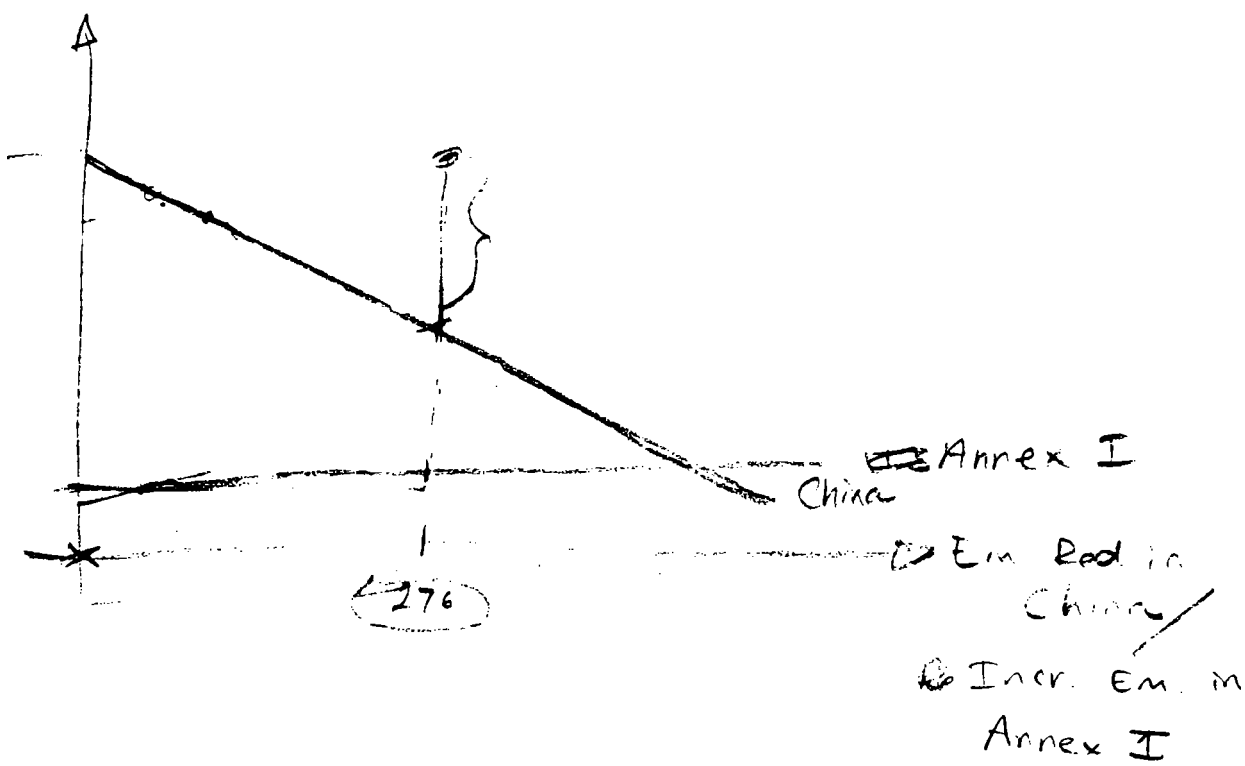
2010	83 billion tons	in paper	(88 = EIA est.)
2020	107 " "	" "	(84 in IASA/WEC)
			(105 in Shell Oil)

Spatial ~~data~~ assoc. btwn source & pop is same worldwide
as in U.S.

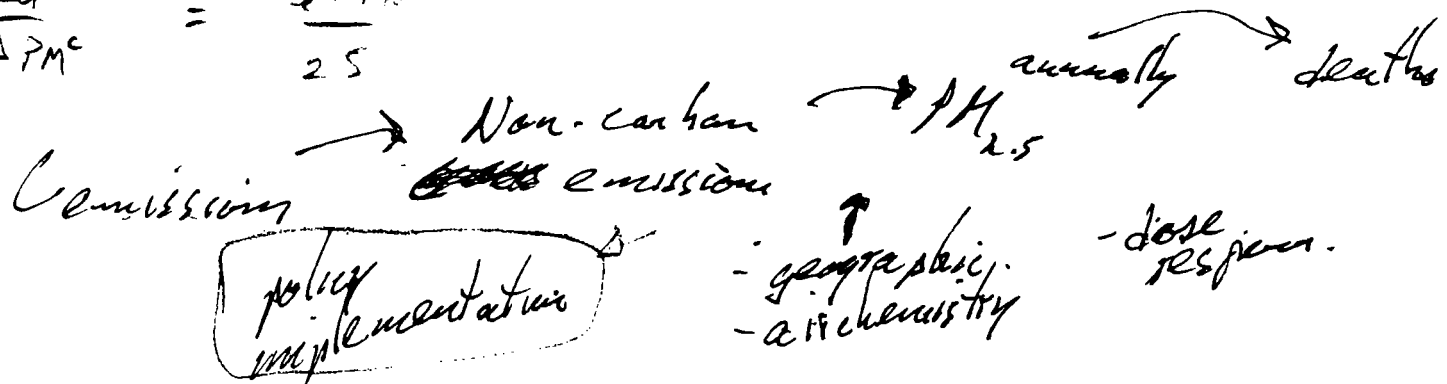
No est. of indoor PM.

Base

Red in deaths



$$\frac{\Delta d}{\Delta \text{PM}^c} = \frac{17\%}{25}$$



Share of non-Annex EDeaths avoided in 2010	Share of non-Annex EDeaths avoided in 2010	Share of non-Annex EDeaths avoided in 2020	Share of non-Annex EDeaths avoided in 2020
0.23723	136644	0.22243	250453
0.20316	105319	0.19837	201026
0.02010	10999	0.01953	20889
0.00867	4996	0.00797	8970
0.03406	19616	0.03297	37123

USDA Forest Service
Northern Global Change Program
100 Matsonford Road
5 Radnor Corporate Center, Suite 200
Radnor, PA 19087-4585
Phone: (610) 975-4092
Fax: (610) 975-4200

Attn: Joe Alaly

Date: January 30, 1998

No. of pages including this sheet: 11

To: Charlie Rawls, USDA 202-720-5437
Bill Hohenstein, EPA 202-260-6405
Adele Morris, CEA 202-395-6780
6870

cc: Bill Sommers, FS 202-205-2497

From: Rich Birdsey

This is a first attempt to to quantify the prospective U.S. forestry baseline according to the terms of the Kyoto protocol.

The accounting system I used is complete, that is, all forest and forest product sources and sinks of carbon are included. I also provide one alternative accounting that excludes harvest estimates from land that is harvested and reforested (note that the logical place to include harvested lands is with the reforestation category since it is harvest that precedes reforestation). The model I developed can be changed relatively easily to examine other alternative accounting to help analyze the vague language of the protocol.

I have included some rather cryptic accounting notes. A conference call can help clarify any questions you may have. There are numerous refinements that could be made to this model -- I have identified some of them and highlighted those that would likely make a significant difference in the results.

I have included an overall summary table and 6 additional tables providing ownership and regional detail. I've also included one sample spreadsheet (of 40 that I used) to illustrate the details of the accounting system.

Cheers, Rich Birdsey

Rich B.

Interpretation of Kyoto/Forestry Options - Accounting Notes (Draft 1/29/98)

Estimates include all lands that have had or are expected to have afforestation, reforestation, or deforestation activities from 1990 to the reporting year. The system described below is a complete accounting of all sources and sinks of CO₂ in affected forest ecosystems and product removals. All calculations are based on successive stock estimates at 5-year intervals.

REFORESTATION AFTER CLEARCUT

Definition: regeneration of forests after clearcut harvest.

Ecosystem components: trees, understory, soils, litter and woody debris. After harvest, C in soils, litter and debris may decline for several periods. Carbon accumulates as new trees become established and grow.

Harvesting components: products, landfills, energy wood, emissions. After harvest, emissions increase and the total of other categories decreases. Wood burned for energy is counted as a sink.

REFORESTATION AFTER PARTIAL CUT

Definition: regeneration of forests after partial cut harvest (50% of volume removed).

Ecosystem components: half of clearcut values.

Harvest components: half of clearcut values.

AFFORESTATION

Definition: establishment of forests on lands previously in nonforest use (cropland or pasture).

Ecosystem components: trees, understory, soils, litter and woody debris.

Harvest components: none.

DEFORESTATION

Definition: conversion of forest land to nonforest use (assumed half to developed use and half to agriculture). Excludes reclassification of timberland to reserved forest.

Ecosystem components: trees, understory, soils, litter and woody debris. Half of the C in trees is lost in the year of deforestation. Half of the C in trees is treated as harvested wood for products. Soil C declines on forest land converted to agriculture. Other components lost in period of deforestation.

Harvest components: products, landfills, energy wood, emissions. After harvest, emissions increase and the total of other categories decreases. Wood burned for energy is counted as a sink.

REFERENCE

Birdsey, R.A. 1996. Carbon storage for major forest types and regions in the conterminous United States. In: Sampson, R.N. and Hair, D. (eds), Forests and Global Change, Vol. 2: Forest Management Opportunities, American Forests, Washington, D.C., pp. 23-39 and App. 2.

REFINEMENTS NEEDED

1. Area projections (land use change) are old and need updating. Refine assumption that half of deforestation acres go to urban use and half to agriculture. Could have a major impact on results, especially for deforestation.
2. Harvesting methods are changing rapidly and projections need updating. Assumption that partial cutting = 50% removal and has 50% of effect on C needs refinement. Could have a moderate effect on estimates for reforestation.
3. Refine estimate that 50% of tree biomass is removed for products after harvest. 50% is an average for the U.S. — there are regional and forest type differences. Would not have a large effect at the national scale.
4. Estimate correct "composite" C yield table for each region and owner. I used an indicator yield table that is an approximation (e.g. I used natural pine, high site for the Southeast). Could have a moderate effect on estimates for reforestation and afforestation.
5. Alaska is not included. Could have a moderate effect on reforestation estimates. Potential major effect on C budget due to natural causes or global warming.

SOME ALTERNATE ACCOUNTING ASSUMPTIONS TO TEST

1. Not including the utilization of harvested biomass after deforestation would approximately double the estimate of impacts on C.
2. Not including harvested C that is burned for energy (which may be accounted for in the energy sector) would decrease reforestation gains by about 20% when harvest is included in the accounting system.

WHY REFORESTATION ESTIMATES SEEM CONSERVATIVE

Half or more of the harvested area is partial cut, which dampens both gains and losses of C. Ecosystem changes after harvest and regeneration (e.g. decomposition of logging debris) exert a negative influence on C accumulation for the first few periods. Tree growth is low during the establishment phase, which lasts several periods.

WHY DEFORESTATION ESTIMATES SEEM CONSERVATIVE

By the first reporting period, annual deforestation projections are low (about 600,000 acres/yr) and decline thereafter. Half of the tree biomass is assumed to be utilized for wood products (including wood burned for energy). Only half of the area deforested loses soil C. Cumulative effects are very small relative to reforestation because most of the biomass loss occurs in the year of deforestation.

Baseline Forestry Carbon Budget According to Kyoto Protocol

1/29/98

Summary Table - Conterminous U.S.

*Essential
Equilib.*

Ownership/Activity	Cumulative Area			Average Annual C Change		
	2008-2012	2013-2017	2018-2022	2008-2012	2013-2017	2018-2022
	(million ac)			(MMTC/yr)		

ALL SOURCES AND SINKS

-5

Private timberland:

Reforestation	133	181	189	14	43	76
Afforestation	22	24	24	31	33	33
Deforestation	32	35	38	-15	-15	-13
TOTAL	187	220	251	30	61	96

Public timberland:

Reforestation	29	34	40	-2	5	12
Afforestation	0	0	0	0	0	0
Deforestation	0	0	0	0	0	0
TOTAL	29	34	40	-2	5	12

All timberland:

Reforestation	162	195	229	10 12	48	88
Afforestation	22	24	24	31	33	33
Deforestation	32	35	38	-15	-15	-13
TOTAL	218	254	291	28	66	108

180

ALTERNATIVE ACCOUNTING

*would energy**-5
23*

Private timberland:

Reforestation (no harvest)	133	181	189	50	81	113
Afforestation	22	24	24	31	33	33
Deforestation	32	35	38	-15	-15	-13
TOTAL	187	220	251	66	99	133

Public timberland:

Reforestation (no harvest)	29	34	40	9	16	24
Afforestation	0	0	0	0	0	0
Deforestation	0	0	0	0	0	0
TOTAL	29	34	40	9	16	24

All timberland:

Reforestation (no harvest)	162	195	229	59	97	137
Afforestation	22	24	24	31	33	33
Deforestation	32	35	38	-15	-15	-13
TOTAL	218	254	291	75	115	157

400

Interpretation of Kyoto/Forestry Options (2008-2012)

1/29/98

Summary: U.S. Private Forest Lands

	Cumulative Area (1000 ac)	C increase in 2012: (MMTC/yr)	C decrease in 2012: (MMTC/yr)	Net change in 2012: (MMTC/yr)
Southeast:				
Reforestation	46000	19.7	-11.3	8.4
Afforestation	7275	10.2		10.2
Deforestation	9975		-2.8	-2.8
Southeast Total:	63250	29.9	-14.1	15.8
South Central:				
Reforestation	48465	20.6	-13.2	7.3
Afforestation	12190	18.5		18.5
Deforestation	16495		-4.5	-4.5
South Central Total:	77150	39.1	-17.7	21.3
Northeast:				
Reforestation	11890	1.7	-3.0	-1.2
Afforestation	180	0.2		0.2
Deforestation	1635		-3.3	-3.3
Northeast Total:	13705	1.9	-6.2	-4.4
North Central:				
Reforestation	14785	3.8	-3.3	0.5
Afforestation	1570	1.4		1.4
Deforestation	2000		-1.2	-1.2
North Central Total:	18355	5.2	-4.4	0.7
Rocky Mountains:				
Reforestation	4365	0.7	-0.4	0.3
Afforestation	0	0.0		0.0
Deforestation	135		-0.1	-0.1
Rocky Mountains Tot	4500	0.7	-0.5	0.2
Pacific Coast:				
Reforestation	7340	3.9	-5.4	-1.4
Afforestation	580	1.1		1.1
Deforestation	1905		-3.4	-3.4
Pacific Coast Total:	9825	5.0	-8.8	-3.8
United States:				
Reforestation	132845	50.4	-38.5	13.9
Afforestation	21795	31.3		31.3
Deforestation	32145		-15.3	-15.3
U.S. TOTAL:	186785	81.7	-51.8	30.0

Interpretation of Kyoto/Forestry Options (2013-2017)

1/29/98

Summary: U.S. Private Forest Lands

	Cumulative Area (1000 ac)	C Increase in 2017: (MMTC/yr)	C decrease in 2017: (MMTC/yr)	Net change in 2017: (MMTC/yr)
Southeast:				
Reforestation	55525	30.2	-11.4	18.8
Afforestation	7715	10.6		10.6
Deforestation	10710		-2.5	-2.5
Southeast Total:	73950	40.8	-13.9	27.0
South Central:				
Reforestation	59445	33.1	-13.8	19.2
Afforestation	13295	18.9		18.9
Deforestation	17540		-4.1	-4.1
South Central Total:	90280	52.0	-18.0	34.1
Northeast:				
Reforestation	14530	2.9	-3.0	-0.1
Afforestation	190	0.2		0.2
Deforestation	2380		-3.6	-3.6
Northeast Total:	17100	3.1	-6.6	-3.5
North Central:				
Reforestation	17750	5.0	-3.3	1.7
Afforestation	1780	1.8		1.6
Deforestation	2320		-1.2	-1.2
North Central Total:	21850	6.6	-4.5	2.1
Rocky Mountains:				
Reforestation	5130	1.0	-0.4	0.6
Afforestation	0	0.0		0.0
Deforestation	160		-0.1	-0.1
Rocky Mountains Total:	5290	1.0	-0.5	0.5
Pacific Coast:				
Reforestation	8490	8.3	-5.4	2.9
Afforestation	630	1.6		1.6
Deforestation	2220		-3.4	-3.4
Pacific Coast Total:	11340	9.9	-8.8	1.0
United States:				
Reforestation	160870	80.5	-37.4	43.2
Afforestation	23610	32.8		32.8
Deforestation	35330		-14.9	-14.9
U.S. TOTAL:	219810	113.4	-52.2	61.1

Interpretation of Kyoto/Forestry Options 2018-2022

1/29/98

Summary: U.S. Private Forest Lands

	Cumulative Area (1000 ac)	C increase in 2022: (MMTC/yr)	C decrease in 2022: (MMTC/yr)	Net change in 2022: (MMTC/yr)
Southeast:				
Reforestation	65045	43.3	-11.6	31.7
Afforestation	7935	10.1		10.1
Deforestation	11215		-2.0	
Southeast Total:	84195	53.4	-13.6	39.9
South Central:				
Reforestation	70690	46.2	-14.4	31.7
Afforestation	13730	18.6		18.6
Deforestation	18335		-3.4	-3.4
South Central Total:	102755	64.7	-17.9	46.9
Northeast:				
Reforestation	17055	3.7	-2.9	0.8
Afforestation	200	0.2		0.2
Deforestation	2975		-3.0	-3.0
Northeast Total:	20230	3.9	-5.9	-2.0
North Central:				
Reforestation	20525	8.4	-3.1	3.3
Afforestation	1950	1.7		1.7
Deforestation	2550		-0.9	-0.9
North Central Total:	25025	8.2	-4.0	4.1
Rocky Mountains:				
Reforestation	5740	1.3	-0.4	0.9
Afforestation	0	0.0		0.0
Deforestation	185		-0.1	-0.1
Rocky Mountains Tot	5925	1.3	-0.5	0.8
Pacific Coast:				
Reforestation	9575	12.5	-5.3	7.3
Afforestation	650	2.1		2.1
Deforestation	2510		-3.2	-3.2
Pacific Coast Total:	12735	14.6	-8.5	6.1
United States:				
Reforestation	188630	113.4	-37.7	75.7
Afforestation	24465	32.6		32.6
Deforestation	37770		-12.6	-12.6
U.S. TOTAL:	250865	146.1	-50.3	95.8

Interpretation of Kyoto/Forestry Options (2008-2012)

1/29/98

Summary: U.S. Public Forest Lands

	Cumulative Area (1000 ac)	C increase in 2012: (MMTC/yr)	C decrease in 2012: (MMTC/yr)	Net change in 2012: (MMTC/yr)
Southeast:				
Reforestation	2375	1.1	-0.8	0.5
Afforestation	0	0.0		0.0
Deforestation	0		0.0	0.0
Southeast Total:	2375	1.1	-0.8	0.5
South Central:				
Reforestation	2375	1.4	-0.7	0.7
Afforestation	0	0.0		0.0
Deforestation	0		0.0	0.0
South Central Total:	2375	1.4	-0.7	0.7
Northeast:				
Reforestation	2775	0.4	-0.5	-0.2
Afforestation	0	0.0		0.0
Deforestation	0		0.0	0.0
Northeast Total:	2775	0.4	-0.5	-0.2
North Central:				
Reforestation	2775	0.6	-0.5	0.1
Afforestation	0	0.0		0.0
Deforestation	0		0.0	0.0
North Central Total:	2775	0.6	-0.5	0.1
Rocky Mountains:				
Reforestation	5725	0.8	-0.5	0.4
Afforestation	0	0.0		0.0
Deforestation	0		0.0	0.0
Rocky Mountains Tot	5725	0.8	-0.5	0.4
Pacific Coast:				
Reforestation	12475	4.8	-8.6	-3.8
Afforestation	0	0.0		0.0
Deforestation	0		0.0	0.0
Pacific Coast Total:	12475	4.8	-8.6	-3.8
United States:				
Reforestation	28500	9.1	-11.4	-2.3
Afforestation	0	0.0		0.0
Deforestation	0		0.0	0.0
U.S. TOTAL:	28500	9.1	-11.4	-2.3

Interpretation of Kyoto/Forestry Options (2013-2017)

1/29/98

Summary: U.S. Public Forest Lands

	Cumulative Area (1000 ac)	C Increase in 2017: (MMTC/yr)	C decrease in 2017: (MMTC/yr)	Net change in 2017: (MMTC/yr)
Southeast:				
Reforestation	2850	1.6	-0.6	1.1
Afforestation	0	0.0		0.0
Deforestation	0		0.0	0.0
Southeast Total:	2850	1.6	-0.6	1.1
South Central:				
Reforestation	2850	2.0	-0.7	1.3
Afforestation	0	0.0		0.0
Deforestation	0		0.0	0.0
South Central Total:	2850	2.0	-0.7	1.3
Northeast:				
Reforestation	3330	0.8	-0.5	0.1
Afforestation	0	0.0		0.0
Deforestation	0		0.0	0.0
Northeast Total:	3330	0.6	-0.5	0.1
North Central:				
Reforestation	3330	0.8	-0.5	0.3
Afforestation	0	0.0		0.0
Deforestation	0		0.0	0.0
North Central Total:	3330	0.8	-0.5	0.3
Rocky Mountains:				
Reforestation	6870	1.1	-0.5	0.6
Afforestation	0	0.0		0.0
Deforestation	0		0.0	0.0
Rocky Mountains Tot	6870	1.1	-0.5	0.6
Pacific Coast:				
Reforestation	14970	10.2	-8.8	1.4
Afforestation	0	0.0		0.0
Deforestation	0		0.0	0.0
Pacific Coast Total:	14970	10.2	-8.8	1.4
United States:				
Reforestation	34200	16.4	-11.6	4.8
Afforestation	0	0.0		0.0
Deforestation	0		0.0	0.0
U.S. TOTAL:	34200	16.4	-11.6	4.8

Interpretation of Kyoto/Forestry Options
2018-2022

1/29/98

Summary: U.S. Public Forest Lands

	Cumulative Area (1000 ac)	C increase In 2022: (MMTC/yr)	C decrease in 2022: (MMTC/yr)	Net change In 2022: (MMTC/yr)
Southeast:				
Reforestation	3325	2.3	-0.8	1.7
Afforestation	0	0.0		0.0
Deforestation	0		0.0	
Southeast Total:	3325	2.3	-0.8	1.7
South Central:				
Reforestation	3325	2.7	-0.7	2.0
Afforestation	0	0.0		0.0
Deforestation	0		0.0	0.0
South Central Total:	3325	2.7	-0.7	2.0
Northeast:				
Reforestation	3885	0.7	-0.6	0.2
Afforestation	0	0.0		0.0
Deforestation	0		0.0	0.0
Northeast Total:	3885	0.7	-0.6	0.2
North Central:				
Reforestation	3885	1.0	-0.5	0.5
Afforestation	0	0.0		0.0
Deforestation	0		0.0	0.0
North Central Total:	3885	1.0	-0.5	0.5
Rocky Mountains:				
Reforestation	8015	1.4	-0.5	0.9
Afforestation	0	0.0		0.0
Deforestation	0		0.0	0.0
Rocky Mountains Tot	8015	1.4	-0.5	0.9
Pacific Coast:				
Reforestation	17465	15.4	-8.9	6.4
Afforestation	0	0.0		0.0
Deforestation	0		0.0	0.0
Pacific Coast Total:	17465	15.4	-8.9	6.4
United States:				
Reforestation	39900	23.5	-11.8	11.7
Afforestation	0	0.0		0.0
Deforestation	0		0.0	0.0
U.S. TOTAL:	39900	23.5	-11.8	11.7

South Central

Interpretation of Kyoto/forestry Options
(2008-2012)

1/29/98

U.S. private forest lands
SOUTH CENTRAL

Reforestation/clearcut:

	Area: (1000 ac)	C growth In 2012: (mt/ac/yr)	C loss In 2012: (mt/ac/yr)	C inc. In 2012: (MMTC/yr)	C dec. In 2012: (MMTC/yr)	Net change in 2012: (MMTC/yr)	(p.272) Forest C yield table (age) 1000 lbs/ac	Products C disp. table 1000 lbs/ac	(p.21) S/P+S/S emissions (%)	(p.272) age 45 removed C 1000 lbs/ac
1990-1995	3530	1.72	-0.04	6.08	-0.14	5.95	30		0.308	122
1995-2000	4315	1.45	-0.04	6.26	-0.18	6.08	25	137	0.301	61
2000-2005	5783	0.91	-0.04	5.25	-0.24	5.01	20	118	0.294	61
2005-2010	5245	0.00	-0.13	0.00	-0.68	-0.68	15	102	0.287	61
2010-2015	5360	-0.73	-1.41	-3.89	-7.58	-11.47	10	92	0.279	61
2010-2015	5360						5	92	0.258	61
TOTAL	24233			13.70	-8.82	4.89	0	100	0.232	61

Reforestation/Partial Cut:

	Area: (1000 ac)	C growth In 2012: (mt/ac/yr)	C loss In 2012: (mt/ac/yr)	C inc. In 2012: (MMTC/yr)	C dec. In 2012: (MMTC/yr)	Net change in 2012: (MMTC/yr)
1990-1995	3530	0.86	-0.02	3.04	-0.07	2.97
1995-2000	4315	0.73	-0.02	3.13	-0.09	3.04
2000-2005	5783	0.45	-0.02	2.62	-0.12	2.50
2005-2010	5245	0.00	-0.07	0.00	-0.34	-0.34
2010-2015	5360	-0.36	-0.71	-1.95	-3.79	-5.73
TOTAL	24233			6.85	-4.41	2.44

GRAND TOTAL REFORESTATION: 20.58 -13.22 7.33

Afforestation:

	Area: (1000 ac)	C growth In 2012: (mt/ac/yr)	C inc. In 2012: (MMTC/yr)	(p.311) Forest C yield table (age) 1000 lbs/ac
1990-1995	4255	1.54	8.58	30
1995-2000	4255	1.91	8.11	25
2000-2005	1290	1.81	2.34	20
2005-2010	1290	0.54	0.70	15
2010-2015	1100	0.73	0.80	10
2010-2015	1100			5
TOTAL	12190		18.51	0

GRAND TOTAL AFFORESTATION: 18.51

Deforestation:

	Area: (1000 ac)	C loss In 2012: (mt/ac/yr)	C dec. In 2012: (MMTC/yr)	(p.272) Other lost biomass 1000 lbs/ac	Products C disp. table 1000 lbs/ac	(p.21) S/P+S/S emissions (%)	(p.272) age 45 removed C 1000 lbs/ac
1990-1995	5455	-0.04	-0.21			0.308	122
1995-2000	5455	-0.04	-0.23	0	42.639	0.301	61
2000-2005	2270	-0.04	-0.09	0	43.068	0.294	61
2005-2010	2275	-0.40	-0.92	0	43.524	0.287	61
2010-2015	1040	-2.96	-3.07	3	43.981	0.279	61
2010-2015	1040			17	45.415	0.258	61
TOTAL	16495		-4.52		46.848	0.232	61

GRAND TOTAL DEFORESTATION: -4.52

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Projection with CCAP measures

	1990	1995	2000	2005	2010	2015	2020	(projection source)
Carbon from Energy	1345.8	1411.4	1577.3	1688.8	1803.2	1888.3	1956.2	(AEO98)
international bunkers	21.9	22.7	25.8	28.6	31.8	34.4	36.7	(from GDP trend)
US territories	9.1	11.2	12.5	13.4	14.3	15.0	15.5	(from national trend)
cement	8.9	9.9	11.2	12.5	13.8	15.0	16.0	(from GDP trend)
industrial	8.0	8.5	9.6	11.0	12.4	13.4	14.3	(from industry trend)
flaring	1.8	3.7	4.0	4.4	4.9	5.2	5.5	(from natural gas trend)
Adjusted Carbon	1351.7	1422.0	1588.9	1701.4	1817.0	1902.5	1970.8	(subtotal)
CCAP adjustments								
EIA estimates			9.8	21.2	34.2	45.4	54.6	(EIA)
USCAR estimates			33.0	64.0	95.0	119.9	144.7	(USCAR, EPA)
Electricity restructuring			0.0	0.0	0.0	0.0	0.0	(interagency estimate)
Adjusted C from Energy	1351.7	1422.0	1555.9	1658.7	1756.2	1828.0	1880.7	(add EIA, sub CAR)
Methane (CH ₄)	170.0	178.0	150.0	152.0	152.0	153.0	154.0	(USCAR, EPA)
Nitrous oxide (N ₂ O)	105.9	126.4	122.4	132.4	144.2	156.5	169.8	(EPA:90,95; rest calc'd)
HFCs	10.0	15.0	28.0	53.0	72.0	95.0	112.0	(EPA)
PFCs	5.0	7.0	7.0	6.0	7.0	8.0	9.0	(EPA)
SF ₆	8.0	11.0	5.0	6.0	7.0	8.0	9.0	(EPA)
Total (MMTCe)	1650.6	1759.4	1868.3	2008.1	2138.4	2248.5	2334.5	(total)
With measures GAP		213.4	322.3	462.1	592.4	702.5	788.5	from Kyoto target
percent reduction		12.1%	17.3%	23.0%	27.7%	31.2%	33.8%	from w/measures proj'n

Building the Kyoto Target

(source: EIA '96 GHG emissions report, Oct 97)

	1990	1995	Kyoto Target	(comment)
Carbon from Energy	1345.8	1411.4	/	
international bunkers	21.9	22.7		(subtract)
US territories	9.1	11.2		
cement	8.9	9.9		
industrial	8.0	8.5		
flaring	1.8	3.7		
Adjusted Carbon	1351.7	1422	1257.1	(93% of '90)
Methane (CH₄)	170.0	178.0	158.1	(93% of '90)
Nitrous oxide (N₂O)	109.0	120.0	101.4	(93% of '90)
HFCs	10.0	15.0	14.0	(93% of '95)
PFCs	5.2	7.0	6.5	(93% of '95)
SF₆	8.0	11.0	10.2	(93% of '95)
Total (MMTCe)	1653.9	1753.0	1547.2	

— Δ bc of new methodology, IPCC

Baseline projection: without CCAP measures

	1990	1995	2000	2005	2010	2015	2020	(projection source)
Carbon from Energy	1345.8	1411.4	1577.3	1688.8	1803.2	1888.3	1956.2	(AEO98)
international bunkers	21.9	22.7	25.8	28.6	31.8	34.4	36.7	(from GDP trend)
US territories	9.1	11.2	12.5	13.4	14.3	15.0	15.5	(from national trend)
cement	8.9	9.9	11.2	12.5	13.8	15.0	16.0	(from GDP trend)
industrial	8.0	8.5	9.6	11.0	12.4	13.4	14.3	(from industry trend)
flaring	1.8	3.7	4.0	4.4	4.9	5.2	5.5	(from natural gas trend)
Adjusted Carbon	1351.7	1422.0	1588.9	1701.4	1817.0	1902.5	1970.8	(subtotal)
CCAP adjustments								
EIA estimates			7.7	18.2	29.7	39.1	46.4	(EIA, w/o trans est)
USCAR estimates			33.0	64.0	95.0	119.9	144.7	(USCAR)
Adjusted C from Energy	1351.7	1422.0	1596.6	1719.7	1846.7	1941.6	2017.1	(add AEO est to C)
Methane (CH ₄)	170.0	178.0	166.0	170.7	176.0	178.0	179.0	(EPA)
Nitrous oxide (N ₂ O)	109.0	121.5	113.9	119.0	124.0	124.0	124.0	(EPA; 90,95; rest calc'd)
HFCs	10.0	15.0	33.0	56.0	74.0	96.0	113.0	(EPA)
PFCs	5.0	7.0	16.0	30.0	35.0	38.0	43.0	(EPA)
SF ₆	8.0	11.0	15.0	18.0	21.0	24.0	26.0	(EPA)
Total (MMTCe)	1653.7	1754.5	1940.5	2113.4	2276.7	2401.6	2502.2	(total)
Baseline GAP		207.5	393.5	566.4	729.7	854.6	955.2	
percent reduction		11.8%	20.3%	26.8%	32.1%	35.6%	38.2%	

*note: italicized numbers are interpolations

* preliminary N₂O projections

will be worked on this week

Projection with CCAP measures

	1990	1995	2000	2005	2010	2015	2020	(projection source)
Carbon from Energy	1345.8	1411.4	1577.3	1688.8	1803.2	1888.3	1956.2	(AEO98)
international bunkers	21.9	22.7	25.8	28.6	31.8	34.4	36.7	(from GDP trend)
US territories	9.1	11.2	12.5	13.4	14.3	15.0	15.5	(from national trend)
cement	8.9	9.9	11.2	12.5	13.8	15.0	16.0	(from GDP trend)
industrial	8.0	8.5	9.6	11.0	12.4	13.4	14.3	(from industry trend)
flaring	1.8	3.7	4.0	4.4	4.9	5.2	5.5	(from natural gas trend)
Adjusted Carbon	1351.7	1422.0	1588.9	1701.4	1817.0	1902.5	1970.8	(subtotal)
CCAP adjustments								
EIA estimates			7.7	18.2	29.7	39.1	46.4	(EIA; w/o trans est)
USCAR estimates			33.0	64.0	95.0	119.9	144.7	(USCAR, EPA)
Adjusted C from Energy	1351.7	1422.0	1555.9	1655.7	1751.7	1821.8	1872.4	(add EIA, sub CAR)
Methane (CH ₄)	170.0	178.0	150.0	152.0	152.0	153.0	154.0	(USCAR, EPA)
Nitrous oxide (N ₂ O)	109.0	120.0	108.6	113.7	118.7	118.7	118.7	(EPA:90,95; rest calc'd)
HFCs	10.0	15.0	28.0	53.0	72.0	95.0	112.0	(EPA)
PFCs	5.0	7.0	7.0	6.0	7.0	8.0	9.0	(EPA)
SF ₆	8.0	11.0	5.0	6.0	7.0	8.0	9.0	(EPA)
Total (MMTCe)	1653.7	1753.0	1776.6	1905.0	2023.6	2119.7	2190.3	(total)
with measures GAP		206.0	229.6	358.0	476.6	572.7	643.3	
percent reduction		11.8%	12.9%	18.8%	23.6%	27.0%	29.4%	

- will be worked on

*note: italicized numbers are interpolations

Building the Kyoto Target

(source: EIA '96 GHG emissions report, Oct 97)

	1990	1995	Kyoto Target	(comment)
Carbon from Energy	1345.8	1411.4		
international bunkers	- 21.9	-22.7		(subtract)
US territories	9.1	11.2		
cement	8.9	9.9		
industrial	8.0	8.5		
flaring	1.8	3.7		
Adjusted Carbon	1351.7	1422	1257.1	(93% of '90)
Methane (CH₄)	180.9	177.1	168.2	(93% of '90)
Nitrous oxide (N₂O)	38.0	38.4	35.3	(93% of '90)
HFCs	13.3	21.1	19.7	(93% of '95)
PFCs	5.2	6.4	6.0	(93% of '95)
SF₆	6.5	8.41	7.8	(93% of '95)
Total (MMTCe)	1595.6	1673.4	1494.1	

CAR97: 1484.3

DRAFT

Baseline projection: without CCAP measures

	1990	1995	2000	2005	2010	2015	2020	(projection source)
Carbon from Energy	1345.8	1411.4	1577.3	1688.8	1803.2	1888.3	1956.2	(AEO98)
international bunkers	21.9	22.7	25.8	28.6	31.8	34.4	36.7	(from GDP trend)
US territories	9.1	11.2	12.5	13.4	14.3	15.0	15.5	(from national trend)
cement	8.9	9.9	11.2	12.5	13.8	15.0	16.0	(from GDP trend)
industrial	8.0	8.5	9.6	11.0	12.4	13.4	14.3	(from industry trend)
flaring	1.8	3.7	4.0	4.4	4.9	5.2	5.5	(from natural gas trend)
Adjusted Carbon	1351.7	1422.0	1588.9	1701.4	1817.0	1902.5	1970.8	(subtotal)
CCAP adjustments								
EIA estimates			0.0	15.0	30.0	37.8	45.7	(AEO 98)
USCAR estimates			33.0	64.0	95.0	119.9	144.7	(USCAR)
Adjusted C from Energy	1351.7	1422.0	1588.9	1716.4	1847.0	1940.3	2016.5	(add AEO est to C)
Methane (CH ₄)	180.9	177.1	166.0	170.7	176.0	177.5	179.0	(USCAR, EPA)
Nitrous oxide (N ₂ O)	38.0	38.4	36.0	37.6	39.2	39.2	39.2	(USCAR, EPA)
HFCs	13.3	21.1						
PFCs	5.2	6.4						
SF ₆	6.5	8.4	13.0	15.1	17.1	18.9	20.6	(USCAR, EPA)
HFC + PFC			49.4	88.5	114.4	138.2	161.9	(USCAR, EPA)
Total (MMTCe)	1595.6	1673.4	1853.3	2028.3	2193.7	2314.0	2417.2	(total)
Baseline GAP		179.4	359.3	534.3	699.7	820.0	923.2	(Kyoto Target)
percent reduction		10.7%	19.4%	26.3%	31.9%	35.4%	38.2%	(from Baseline)

*note: italicized numbers are interpolations

Projection with CCAP measures

	1990	1995	2000	2005	2010	2015	2020 (projection source)
Carbon from Energy	1345.8	1411.4	1577.3	1688.8	1803.2	1888.3	1956.2 (AEO98)
international bunkers	21.9	22.7	25.8	28.6	31.8	34.4	36.7 (from GDP trend)
US territories	9.1	11.2	12.5	13.4	14.3	15.0	15.5 (from national trend)
cement	8.9	9.9	11.2	12.5	13.8	15.0	16.0 (from GDP trend)
industrial	8.0	8.5	9.6	11.0	12.4	13.4	14.3 (from industry trend)
flaring	1.8	3.7	4.0	4.4	4.9	5.2	5.5 (from natural gas trend)
Adjusted Carbon	1351.7	1422.0	1588.9	1701.4	1817.0	1902.5	1970.8 (subtotal)
CCAP adjustments							
EIA estimates			0.0	15.0	30.0	37.8	45.7 (AEO98)
USCAR estimates			33.0	64.0	95.0	119.9	144.7 (USCAR, EPA)
Adjusted C from Energy	1351.7	1422.0	1555.9	1652.4	1752.0	1820.5	1871.8 (add EIA, sub CAR)
Methane (CH ₄)	180.9	177.1	150.0	151.7	152.0	153.0	154.0 (USCAR, EPA)
Nitrous oxide (N ₂ O)	38.0	38.4	30.7	32.3	33.9	33.9	33.9 (USCAR, EPA)
HFCs	13.3	21.1					
PFCs	5.2	6.4					
HFC + PFC			38.1	63.9	86.1	106.8	127.4 (USCAR, EPA)
SF ₆	6.5	8.4	4.2	4.6	4.9	5.4	5.9 (USCAR, EPA)
Total (MMTCe)	1595.6	1673.4	1778.9	1904.9	2028.9	2119.5	2193.0 (total)
with measures GAP		179.4	284.9	410.9	534.9	625.5	699.0 (Kyoto Target)
percent reduction		10.7%	16.0%	21.6%	26.4%	29.5%	31.9% (from BASE)

*note: italicized numbers are interpolations



william.breed @ hq.doe.gov
04/02/98 09:07:00 AM

Record Type: Record

To: Joseph E. Aldy

cc:

Subject: notes on nitrous emissions changes

Joe:

here are some quick notes on the changes in estimated N2O emissions in the inventory -- I have sent these to Wiley for comments, but he is too busy right now -- if he has anything to change, I or he will get that to you pronto -- if you have any questions, please call --

Bill (586-4763)

Notes on Nitrous Oxide in the GHG Inventory

- Emissions estimates for Nitrous oxide (N2O) have risen dramatically from the levels reported in '97 and earlier GHG and climate change reports -- this is due to application of the revised 1996 IPCC guidelines
- increases come mainly in mobile source emissions, and in the agriculture sector -- there are also increases in emissions associated with waste streams (manure and human wastewater treatment)
- points to new importance for N2O as a GHG, now is about the same magnitude of total GHGs as Methane
- points to need to better characterize these sources and generate new data to examine these sources better;
- which then points to need for policy action

Mobile source emissions

- N2O is formed when combustion gases containing NOx and N pass over a not-quite-up-to-operating-temperature catalyst -- large amounts of N2O are formed in cold start conditions
- when the catalyst gets up to temperature, all the NOx is destroyed, forming atmospheric N
- problem with coefficients in the IPCC guidelines:
 - derived in part from measurements on European technology
 - derived in part from engineering estimations (inflating measured values for findings from Euro cold start situation)

- application of cold start problem across entire driving cycle (kg/mi) does not hold up to examination - would be more appropriate to apply a coefficient for number of cold starts or trips, then a driving cycle coefficient
- data available ends for 92 technology
- little data is available
- values end up VERY high

Wastewater

- N₂O is formed due to intent to rid wastewater stream of excess nitrogen as part of treatment -- some of excess nitrogen is changed from ammonia (NH₃) to other nitrate/nitrite forms that are releasable to the environment, some of the nitrogen is lost to the environment as gaseous N₂O (appearing as an efficient N treatment outside of the context of climate change)
- new category for the inventory, now becoming apparent as a significant source
- high coefficient
- needs further examination

Manure Application

- when manure is applied as a fertilizer, in the proper conditions some of the nitrogen is transformed to N₂O and lost to the atmosphere -- some is converted to N₂O as the fertilizer/ manure washes off into the watershed (pointing at both a need to control manure application & runoff for atmospheric and water quality concerns)
- new category
- high coefficient?
- needs further examination

Fertilizer application

- new IPCC coefficient is much higher than in previous guidelines, new method accounts for downstream gas generation (pointing at both a need to control fertilizer application & runoff for atmospheric and water quality concerns)
- major source in CCAP analysis,
 - thus had an action (#17)
 - question of funding and operation for action at USDA



U.S. DEPARTMENT OF AGRICULTURE

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MESSAGE: _____

USDA-FS, NEFES

FAX NO. 2159754095

P.01

**USDA Forest Service
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Date: January 12, 1998

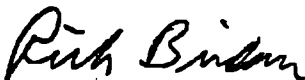
No. of pages including this sheet: 4

To: Charlie Rawls, USDA
To: Bill Hohenstein, EPA
To: Bill Breed, DOE
cc: Carol Whitman, USDA
cc: Bill Sommers, USDA-FS
cc: Fred Kaiser, USDA-FS
cc: Bev Eav, USDA-FS

Here are some PRELIMINARY estimates of the effect of various forestry activities on carbon sequestration. Estimated costs of some of the options are included. These estimates are summarized from a draft paper by Birdsey, Alig, and Adams that will be part of the next FS RPA Assessment. The paper has not yet been through technical review or agency policy review. However, since the estimates are based on numerous published studies from the last decade, that this table can now be used to gain a sense of the approximate magnitudes and costs of various options for forest sinks. In the accompanying notes I have defined the options and tried to briefly address issues of verification and uncertainty.

Exercise caution in comparing the different options because the individual studies that provide the basis for these estimates used different accounting methods.

Because this is preliminary information, I request that distribution be limited.



Richard Birdsey
Program Manager

JAN-12-98 MON 14:30

USDA-FS, NEFES

FAX NO. 2159754095

P. 02

Summary of forestry options to increase carbon storage. Each option would be phased in over a 10-year period (from Birdsey et al. 1998 Review Draft).

Option	Size of Program	Change in C storage (MMTC/yr)	Annual cost (\$million)	Years to achieve target
Afforestation of marginal cropland and pasture ¹	23-45 million ac	50	350-770	20-30
Reforestation and improved forest management ¹	30-50 million ac	50	40-80	0-10
Reduce harvest	220 million cu ft	50	?	0-10
Increase recycling of fiber	from 40 to 45% of all fiber used	10	?	0-10
Increase C in durable wood products	Increase by 50%	10	?	0-10
Urban forestry ²	Plant 100 million trees	10	500-2500	20-30
Increased use of biomass energy ²	1.25 million ac of plantations	30	?	10-20

¹Acceptable under Kyoto terms for forestry sinks.

²Acceptable under Kyoto terms for energy emissions reduction.

JAN-12-98 MON 14:31

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P.03

FORESTRY OPTIONS INCLUDED IN TABLE

Afforestation of marginal cropland and pasture -- Substantial gains in carbon storage in biomass and soils are possible and are relatively easy to quantify. This technology is limited primarily by the availability of suitable land (for ecological or economic reasons), and nursery capacity. Size of program and cost estimates vary widely because of differences in how and where proposed programs would be implemented, and because of differences in C accounting.

Reforestation and improved forest management -- Because of the variety of silvicultural practices applied to various site conditions, there are many opportunities to improve C storage, especially on forest lands that are severely over- or understocked. The magnitude of increased C storage may be difficult to quantify since the practices are usually designed to increase timber growth and will not necessarily increase biomass growth. Costs are much lower than afforestation because there are no conversion costs (land rent, tree planting, etc.).

Reduce harvest -- Reducing the area harvested can cause an immediate short-term increase in the amount of C stored in forests because losses of C to the atmosphere during the removal of biomass and processing are avoided. Over the long term, a continuous cycle of harvest, efficient utilization of biomass, and regrowth can sequester more C than not harvesting. Reduced harvest in one region may be offset by increased harvest elsewhere (increased imports) or by changes in wood processing technology. Periodic forest resource inventories can detect the effects of large changes in timber harvest.

Increase paper and wood recycling -- Recycling wood fiber and wood products may reduce CO₂ emissions in 2 ways: by reducing the area harvested to provide virgin fiber, and by using less energy to convert recycled products versus growing, harvesting, and processing virgin fiber. Paper recycling is already common. Most solid wood products are currently disposed of in landfills and debris dumps and not recycled. The forest products industry is reluctant to endorse increased recycling at this time. Model estimates are used to quantify effects of recycling.

Increase proportion of C in durable wood products -- After harvest, forest C passes through a series of conversion processes to yield wood products and byproducts. Maximizing the amount of C in products through efficient utilization of raw material, increasing the use of byproducts for energy substitution, and ensuring that unused byproducts are disposed in sealed landfills, will minimize the amount of CO₂ emitted. The longer wood products are used, the less new timber must be harvested for replacement products. Model estimates are used to quantify effects of changes in the disposition of harvested carbon.

Plant trees in urban and suburban areas -- Trees affect urban climate by shading, reducing wind, and evapotranspiration. Proper placement of trees and use of the correct tree species can substantially reduce the energy needed to heat and cool residential and small commercial buildings, with the magnitude of the energy reduction dependent on the local climate. Large-scale tree planting programs near urban areas may impact whole towns or cities. Models are available to quantify the effects of tree planting on energy use.

Substitute renewable biomass for fossil fuel energy -- Increased use of renewable sources of energy such as fuelwood and hydropower reduces the use of non-renewable fossil fuels. When biomass is grown sustainably and used to displace fossil fuels, net carbon emissions are avoided since the CO₂ released in converting the biomass to energy is sequestered in the regrowing biomass through photosynthesis. There is not a one-to-one substitution because of differential conversion efficiencies and unpredictable energy markets. Past simulations have shown that biomass-fueled power is not very competitive with coal without subsidies.

ADDITIONAL FORESTRY OPTIONS NOT INCLUDED IN TABLE

Substitute wood products for more energy-intensive products -- Some wood products used in construction can be manufactured with far less energy than non-wood substitutes such as aluminum and cement. To the extent that such substitution is practical and economic, an increase in these wood products and a corresponding decrease in their substitutes reduces energy demand and associated emissions. The effectiveness of product substitution is based on a number of factors such as relative costs of inputs and elasticity of demand.

Reduce demand for energy in growing timber, harvesting and wood processing -- Energy is used in establishing plantations, managing forests, harvesting timber, and manufacturing wood products. Efficiency can be increased at each step in the manufacturing process, and in addition, biofuels may be substituted for fossil fuels especially in the pulp and paper industry, which has access to waste biomass produced during manufacturing.

Reduce biomass burning (wildfires) -- Protecting forests from wildfire maintains standing biomass or allows biomass to increase. In some cases, such as overstocked ponderosa pine forests in the Western U.S., there may be too much biomass in dead and dying trees, posing a substantial risk of catastrophic wildfire or other natural disturbance such as an insect or disease outbreak. This could cause more C release than if fire were allowed to occur on a natural cycle.

Reduce conversion of forest land to nonforest use (reduce deforestation) -- Deforestation, primarily an issue in the tropics, is responsible for a large portion of the increase in atmospheric CO₂. Conversion of forest land to nonforest use usually means permanent loss of all or a substantial part of live biomass, and reduction of organic matter in soils and the forest floor. CO₂ and other greenhouse gases are emitted when the removed biomass and organic matter is burned or decomposes. Some C may be sequestered for a time in wood products if the removed biomass is utilized. When part of a mitigation strategy, controlling deforestation is sometimes referred to as protecting/conserving existing forests. Protecting and conserving forests should maintain or increase C pools in the short term, as long as natural disturbance rates do not reach catastrophic levels.

Increase agroforestry -- While not common in the U.S., agroforestry can add biomass to otherwise low-biomass agro-ecosystems, and can reduce the need to clear forest land for agriculture. These C benefits can accrue along with increases in crop yields.

Sheet2

DRAFT

US Sink Source

Annual MMTCE Carbon Sequestration or Emissions in the BAU

Option 1: All Activities

	2008-2012	2013-2017	2018-2022
Afforestation (Established since 1990)	30	33	36
Reforestation (Established since 1990)	240	290	340
Deforestation (w/out Harvesting)	-40	-40	-40
Deforestation (w/ Harvesting)	-370	-370	-370
Kyoto Total w/out harvesting	230	283	336
Kyoto Total w/harvesting	-100	-47	6

Option 2: Define "Activities" as "Projects"

	2008-2012	2013-2017	2018-2022
Afforestation (Established since 1990)	10	15	20
Reforestation (Established since 1990)	0	0	0
Deforestation (w/out Harvesting)	0	0	0
Deforestation (w/ Harvesting)	0	0	0
Kyoto Total w/out harvesting	10	15	20
Kyoto Total w/harvesting	10	15	20

OPTIONAL FORM 99 (7-90)

FAX TRANSMITTAL

of pages 1

To <i>Carol Morris</i>	From <i>Bill Hokenstein</i>
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NSN 7510-01-317-7360	5099-101

GENERAL SERVICES ADMINISTRATION

CLIMATE TECHNOLOGY INITIATIVE

INTRODUCTION

Global emissions of GHGs are expected to grow rapidly over the next several decades. This upward trend will only be broken by the accelerated development and diffusion of technologies that help control GHG emissions. Many of such technologies can profitably move countries towards efficient and sustainable economic growth.

OBJECTIVE

The Climate Technology Initiative (CTI) would be a linked set of unilateral and multilateral programs designed to accelerate the development and diffusion of beneficial technologies worldwide. The CTI would:

- help reduce emissions of GHGs globally
- remove barriers and stimulate markets for U.S. business
- be central to the U.S. position at the first CoP in Berlin.

BENEFITS

The CTI would offer benefits for the U.S. and its international partners. These would include:

- Global Environmental Benefits -- Accelerated development and diffusion of beneficial technologies can offer enormous GHG reductions. Rapid adoption of these technologies can begin moving global economic development to a substantially lower emissions path.
- Benefits to US Industry -- The programs will facilitate the export of knowledge and technology gained through the Climate Change Action Plan, existing R&D activities, etc. They will develop capacity and market conditions abroad which will make investment in new technologies profitable. These host country activities provide connections to programs under the U.S. Environmental Technology Export Strategy.

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- Benefits for International Partners -- Profitable GHG reductions can contribute to economic development and help improve the local environment. Many of the specific programs will greatly increase capacity in developing countries to identify, promote and sustain technologies which provide economic as well as global and local environmental benefits.

INTERNATIONAL CONTEXT/STRATEGY

At the recent OECD Environment Policy Committee (EPOC) meeting, Germany tabled a Technology Initiative for Berlin. Many of the specific elements of the German proposal went beyond technology programs to policy measures. The initiative in its proposed form was not accepted by the U.S. However, the general concept of an initiative was endorsed by the EPOC, and it is expected that a meeting will be held among OECD countries on January 16-18 to further elaborate a possible initiative.

Once basic outlines of a CTI are agreed, the U.S. should seek to forge a consensus among OECD and key developing countries prior to CoP-I. The goal would be to announce the CTI as a linked set of unilateral actions and proposals in partnership with other parties. This could include:

- testing elements of the proposal with US business community
- utilizing the OECD/IEA process to promote concepts and forge consensus
- using bilateral channels to get buy-in from key developing countries

PROGRAM OPTIONS

During the past month, an ad hoc interagency working group has identified the following possible components of a Climate Technology Initiative. Components ultimately selected for inclusion in a CTI could be packaged into a smaller number of thematic areas or approaches. In developing this list, the ad hoc working group assumed that federal government funding for an initiative would be very limited.

1) **TRANSFER OF VOLUNTARY PROGRAMS** - Transfer voluntary program approaches (e.g. Green Lights and Energy Star) to governments, quasi-government and private entities which are interested in actively promoting profitable technology diffusion in other countries. This would result in increase penetration of low-GHG technologies, many of which are produced by U.S. firms. U.S. could offer to host an international conference on voluntary programs. Approximate cost to U.S. government: \$1 million/year, 5 FTE (FY97-2001).

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2) **TECHNOLOGY COUNTRY STUDIES** - Announce a new program to focus on national plans and technology assessments under the FCCC, and to identify projects for investments in new technologies. This would be expected to produce over 100 specific proposals for projects which will support national strategies and reduce emissions. These project ideas would be available to interested U.S. partners cooperating in export promotion programs. Approximate cost to U.S. government: \$5 million/year (FY96-99).

3) **WORLDWIDE NETWORK OF REGIONAL RENEWABLE AND ENERGY EFFICIENCY CENTERS ("GREAT NET")** - Lend strong support to an existing application for GEF funding. The application seeks support for a program to augment existing governmental and private institutions with expertise in renewable energy and energy efficiency and to provide these institutions with common resources including computer links. The network would provide technology information and experience in successful policies to host countries, identify investment opportunities for private technology suppliers, and promote innovative financing approaches. Approximate cost to U.S. government: \$500K/year, 1 FTE (FY96-98).

4) **MAGIC (Market Aggregation: Incentives for Climate) TECHNOLOGIES** - Promote development of innovative mechanisms to match prospective buyers and sellers of clean and profitable technologies. In particular, develop mechanisms for aggregate purchase commitments for such technologies. The program might be run under the auspices of the SBSTA and/or IFC. The U.S. could call upon the FCCC parties to endorse the concept, ask the SBSTA to address institutional options and report by the next session of the CoP, and call for national efforts to promote bundling of customers to form large scale markets. Approximate cost to U.S. government: \$1 million/year, 1 FTE (FY96-98).

5) **INTERNATIONAL GOLDEN CARROT** - Announce intention to establish a Golden Carrot for a specific technology, in combination with several partners. This could be done in coordination with the announcement of the MAGIC Technologies initiative described above.

6) **FCCC TECHNOLOGY PRIZE** - Propose the creation of a Climate Technology Prize, to be awarded at each session of the Conference of the Parties. Prizes could be awarded to (i) an individual, organization or country that makes a significant contribution to a proven technology, and/or (ii) an individual, organization or country that makes a significant contribution to a technology with great promise. Although recognition alone would be a substantial reward, contributions of between \$10,000 and \$25,000 per FCCC (or Annex I) party would provide a substantial cash incentive.

7) **TECHNOLOGY DEMONSTRATIONS** - Provide funds for co-financing of focused demonstrations where resulting local capacity development, risk reduction,

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economies of scale, information transfer, etc. will bring U.S. technologies rapidly into commercial markets. Results would stimulate markets for U.S. technology by improving host country capacity and reducing financial risks for similar investments. Approximate cost to U.S. government: \$10-30 million/year (FY97-2006).

8) MDB POLICY AND PROGRAM REFORMS - Propose policy and program changes in the MDBs, possibly including quantitative targets for efficiency and renewables lending over the next decade. Recognize and support some of the existing and proposed innovative approaches developed by MDBs, e.g., IFC proposed capital fund for renewables and efficiency, the World Bank's proposed Solar Initiative, FINESSE. This would result in increased flows of financing into investments in low GHG technologies stimulating development of commercial markets worldwide.

Market AGgregation: Incentives for Climate Technologies (MAGIC Technologies)

Issue: Market aggregation could clearly bring down the costs of many existing technologies, including non-environmentally sound technologies. For example, aggregation of markets could reduce the price of coal-fired plants as well as of solar PV systems. To assure that the intent of the program -- generating environmental benefits -- is met, a method must be developed to differentiate between technologies, and to support those that are environmentally friendly. This could be done, for example, by establishing minimum environmental standards.

However, setting standards may conflict with one of the strong points of the proposal -- that it is market-based, and encourages the development of least-cost technologies. There may be objections by some (including some developing countries) if the bundling of markets favors more expensive technologies rather than driving down the price of "dirtier" -- but ultimately cheaper options. There may exist a threshold beyond which a developing country may reject the process if it knows that a brokerage could have provided a cheaper, higher carbon technology but instead chose a lower emitting one.

Recommendations:

- Governments are appropriately in the business of making policy recommendations and choices; this one must be sold as being a no- or low-cost method for promoting environmental sustainability.
- To ensure that developing countries support the process, they must be fully engaged in the development of standards.
- Some basic agreed minimum criteria could be set to strike an appropriate balance between cost and environmental benefit, for example:
 - Do not accept technologies which increase CO2 emissions.
 - Set minimum improvement standards over existing technologies to qualify for inclusion in bundling efforts (with standards to be set by experts including those from the business community)
 - Where multiple technologies exist which meet standards, allow the market to choose; in these circumstances, cost can become the determining factor.
 - Examine life-cycle costs (including environmental costs) in prioritizing options. This should include a critical screen on the basis of capital fixity and irreversibility (i.e., if the cheaper but higher carbon option also involves a long-term commitment, this must be accounted for in the analysis).

Issue: How and where should/could minimum standards be set?

Options:

- Set standards in international negotiation through the COP or its subsidiary bodies. Specific standards could be set in the Subsidiary Body for Scientific and Technological Advice (SBSTA), with input from and in conjunction with private sector advisory panels.
- Allow standards to be set by the implementing agency (e.g. the IFC). Agency could be urged to provide mechanism for private sector input into standards.
- Allow for individual national standards. This would not be desirable, as it diminishes the value of the brokerage by setting competing standards between nations. However, it may be easiest to adopt, and could have the advantage of promoting national programs.

Issue: Should the focus of MAGIC Technologies be on developing new technologies, or on marketing existing technologies which are non-commercial only due to costs?

Answer:

- It is up to the private sector to assess the competitiveness of their bids -- and compete in the market-place the brokerage will promote.
- In the near term, it may be expected that existing technologies would win an open competition. Ultimately, however, by setting new, regularly revised and more stringent standards, the brokerage will create an incentive for the development of new technologies.

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THE GREAT NET: A Regional Network to Accelerate the Deployment of Energy Efficiency Measures and Renewable Energy Technologies

Objective

This initiative will promote international cooperation in applied research on cost-effective energy efficiency measures and renewable energy technologies as a means for reducing emissions of greenhouse gases and achieving the objective of the Framework Convention on Climate Change. The specific objective of this initiative is to promote the growth of regional Centers of Excellence from within existing institutions so as to support the design, deployment, and co-development of these technologies through innovative partnerships between commercial enterprises in industrialized countries and public or private counterpart organizations in developing countries and economies in transition.

Background

The Objective of the Framework Convention on Climate Change is to stabilize atmospheric concentrations of greenhouse gases at levels that will avoid dangerous anthropogenic interference with the climate system and will allow sustainable development to occur. The First Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) concludes that stabilizing atmospheric concentrations of greenhouse gases (GHGs) will require a reduction in annual global emissions of these long-lived gases by 60-80% from their 1990 levels. The IPCC also noted that energy demands in developing countries and economies in transition were likely to continue to rise during the next thirty years as a result of changes in the level and composition of economic activities in these countries. This situation presents a new and serious challenge: the rates of emission of greenhouse gases in industrial countries will need to fall dramatically if the objective of the Climate Change Convention is to be achieved. In addition, new and less carbon-intensive technologies will be needed to meet the increasing demands for energy in developing countries if these economies are to slow the rates of growth in GHG emissions that would otherwise be associated with rising per capita use of energy.

There is a growing recognition in the US and in many industrialized countries that sustaining economic development while reducing emissions of greenhouse gases will require the increased use of energy efficiency measures as well as the subsequent deployment of renewable energy technologies. Many of these technologies are at or near levels of economic viability and may be able to achieve significant market penetration in OECD countries if (1) structural market failures can be removed and (2) specific applications of these technologies can be closely fitted to the existing institutional infrastructure and the perceived requirements and desires of end-users.

If industrial countries are able to accelerate the deployment of renewable energy and energy efficiency technologies in their home markets and thus to demonstrate leadership in reducing greenhouse gas emissions, developing countries are much more likely to engage actively in global efforts to achieve the objectives of the Framework Convention. As the commercial attractiveness of these technologies is demonstrated in the US and in other OECD markets, developing countries will proceed to introduce similar systems in their own domestic markets as a way of meeting growing demands for clean, environmentally-friendly sources of commercial energy.

An important and timely opportunity now exists for the US to exert leadership in a direction which could simultaneously promote the reduction of greenhouse gas emissions worldwide while facilitating the increased use and export of US technologies. A number of important international institutions are beginning to recognize the vast potential of renewable energy systems but are not yet influencing the extent of diffusion or rate of deployment for these technologies. The Global Environment Facility (GEF) has recently been restructured and refunded but is searching for an investment strategy that can simultaneously promote economic development and reduce GHG emissions. The World Bank and other multilateral development institutions are showing increased interest in the use of renewable energy systems and energy efficiency measures but have had little success in deploying these technologies. The first Conference of the Parties (CoP) to the Framework Convention will occur in March 1995 and would be an auspicious time to announce a major technology development initiative that has the potential to increase substantially the likelihood of achieving the overall objective of the Convention. Support from the US government for the GREAT NET initiative could help to catalyze significant progress on all of these fronts.

Approach

The GREAT NET Initiative is a program designed to promote international cooperation in applied research on energy efficiency measures and renewable energy technologies. The focus of this initiative is the formation and funding of an international network of regional Centers of Excellence organized to facilitate the commercialization and deployment of cost-effective applications of these technologies. The Centers of Excellence would be systematically developed out of existing institutions through a program of long-term, capacity-building investments. The Network would be open for participation by all institutions which have demonstrated strong capabilities in the engineering, applications development, financing, or policy research areas related to deployment of energy efficiency measures and renewable energy technologies. However, not all members of the Network would be funded by the Net to accelerate deployment of renewable energy systems and energy efficiency measures. The funded Centers would be located principally in developing countries with a small number of partner institutions housed in industrialized countries.

A report completed by the UN Consultative Group on New and Renewable Sources of Energy recommended in 1992 that the UN create an international solar energy agency to take the lead in applied research on renewable energy technologies. The report proposed the formation of a decentralized network of research, development, and demonstration centers located in key regional focal points around the world, but the recommendation was never implemented. By building on the report's analysis, and focusing the effort in a more systematic way, the US could spear-head a global effort to stimulate the deployment of renewable energy technologies through the evolution of the GREAT Net (i.e., the Global Renewable energy and Energy efficiency Applications and Technologies) Initiative. The GREAT Net Initiative will promote the formation of a worldwide network of "Centers of Excellence" in applied research on renewable energy systems and energy efficiency technologies. With support from the US government, the GEF and the multilateral development assistance institutions, the GREAT Net could promote innovative partnerships between manufacturers and systems developers in the industrialized countries and their counterparts in developing countries and economies in transition.

The development of the GREAT Net would build on and profit from the lessons learned in the evolution of the UN Consultative Group on International Agricultural Research (CGIAR). The GREAT Net would fund the activities of a small number of existing institutions in developing countries with a limited number of partner institutions in industrialized countries. The members of the network would engage in applied research on renewable energy systems and energy efficiency technologies in order to develop and demonstrate cost-effective applications for these systems. Each member of the network would maintain a regional focus. In addition, each member would further develop its

existing competence in one area of renewable energy systems or energy efficiency technologies while extending its expertise (although to a lesser extent) to complementary areas. All the network members would carry out regionally- and nationally-focused exercises in policy analysis and policy development designed to elaborate policies that can simultaneously address local development priorities while accelerating the co-development and deployment of these advanced technologies. The network members would also maintain on-going programs in renewable resource assessment, system design, and demonstration.

Perhaps most important, the network members would act as honest brokers in promoting new partnerships between private enterprises from the North and their counterpart institutions in developing countries and countries with economies in transition. The network members would help to bring potential partners together and assist them in negotiating legal, administrative, and financial support for proposed projects.

Requiring that the World Bank and other regional development banks devote a fixed fraction, say 10%, of their new power sector loans to investments in energy efficiency and renewable starting in 1995 could be an important complement to the GREAT Net Initiative. This type of requirement could provide a gradual increase in the funding base for international renewable energy and energy efficiency projects. The new investments could quickly exploit the applied research and applications development activities of the GREAT Net members, whose development

Resources

The GREAT Net Initiative would acquire its initial resource base from the Track 2 funding cycle of the GEF, as an enabling or capacity-building activity. Additional funds will be sought from bilateral development assistance programs, from private charitable foundations, and from other private sector sources.

The US government would not be required to make any major commitment of new funds in order to launch the GREAT Net Initiative. It would only need to make a commitment to support the GEF application for initial funding in this tranche. A proposal to support an initiative along these general lines has been proposed as part of the UNEP GEF Work Programme in the Climate Change focal area. It would be important for the US to support this activity and help to shape the GREAT Net Initiative into a practical and efficient thrust that could make the maximum possible contribution to international efforts aimed at achieving the objective of the Framework Convention.

Although the US government would not have to support the GREAT Net Initiative with substantial sums of money now, demonstrating national leadership on renewable energy technologies and energy efficiency measures could be critical at this time. Other ways to demonstrate that leadership and to promote the accelerated deployment of cost-effective energy efficiency measures and renewable energy technologies in the US could include a Presidential commitment to institute "full-cost" pricing for commercial energy supplies and to reduce structural imperfections in US energy markets. The US could also support a firm commitment by the World Bank and other regional development banks to commit a fixed fraction of their new energy sector loans to investments in renewable and energy efficiency projects. It would be an attractive bonus if the US were to support the development of one or more domestic Centers of Excellence in the US which would have similar missions and direct funding from the US DoE, but no commitment to support these Centers would be necessary at this time.

Key Technology Market Areas

Broad Emission Trends

The most recent IPCC (1992) emission scenarios illustrate a wide range of possible future GHG emissions profiles showing

all scenarios and gases increase by 2025 - CO₂ by 19 - 100%, CH₄ by 15-38%, and N₂O by 16-26%.

non-OECD countries represent a larger share of emissions over time

rapid growth, and especially in non-OECD countries continues through the next century in most scenarios.

In contrast, the IPCC (1994) Report on Radiative Forcing shows that reductions in emissions of global CO₂ below 1990 levels would be required in order to stabilize concentrations at any level up to double today's level over the next century.

Technology Markets

To achieve such significant changes from current trends can only be accomplished with rapid diffusion of advanced technology in a number of key growing market areas. It is possible to identify, within the broad scenarios several key technology applications which account for the largest components of this growth, or alternatively the growing markets for advanced technology. A key issue is to move advanced technologies into the rapidly growing markets of the developing and transition countries, before major new investments are made in infrastructure and manufacturing capacity based on soon to be obsolete technologies. A preliminary analysis of these areas identifies the following:

Sustainable Cities

A broad trend is the increasing urbanization of non-OECD countries. With urbanization and rising incomes virtually all developing and transition countries are expected to see rapid growth in penetration of:

1) Private Automobiles: Increases in automobile ownership and use can increase energy consumption, local pollution and congestion, as well as GHG emissions.

2) Appliances: Residential and commercial electric equipment, from computers to refrigerators;

3) Residential and Commercial Buildings: Space conditioning, lighting and other aspects of building energy consumption;

4) Municipal Waste Management: Increasing concentrations of waste can cause methane and other emissions, or can be a source of methane recovery for energy consumption.

Industrial Development

Rapid industrial development, and, in the transition countries restructuring, is a fundamental goal of virtually all countries. Choices of technology can greatly influence the environmental and resource consumption implications:

5) Industrial Production Processes: It is possible to identify processes for key industries which reflect the current state of the art, and expected advances over the next decade or two. Substitution of industrial plants with these advanced technologies could reduce growth in industrial energy consumption to less than half of that projected in baseline scenarios.

6) Freight Transport: Associated with economic development and higher patterns of production and consumption, are large increases in transport of raw materials and goods. This could be a substantial component of growth in GHG emissions or an opportunity to reduce growth through efficient technology and infrastructure investment.

Rural Development

For many developing countries, one part of sustainable development strategies will be programs to increase the quality of life, and economic development in rural areas as a way of discouraging overly rapid urbanization. These strategies, like many others can also have GHG emissions benefits in slowing the growth in emissions from cars, buildings, and centrally generated electric power.

7) Renewable Electrification: In those countries pursuing a rural development strategy, a key component is clearly the provision of electricity and associated amenities to rural locations.

8) Agriculture and Forestry: In most rural areas the agriculture and forestry are primary economic activities. Extrapolation of current trends in these areas leads to significant increases in GHG emissions in developing countries. Alternative technologies and practices exist which can promote greater long-run economic benefits, reduce GHG growth and enhance sinks.

Sustainable Energy Supply

9) Alternative Energy Conversion Technologies: In the long run it is clear that large increases in energy consumption will be necessary to support global economic development. Where fossil fuels are used, large improvements in efficiency can reduce emissions. Over time larger fractions energy supply must be from renewable energy sources.

10) Fuels Production and Distribution - Production of fuels -- coal, oil, gas, and biomass can increase GHG emissions unless new technologies and practices are adopted. In particular, methane can be recovered and used for energy rather than vented or otherwise lost in coal, oil and gas systems. Efficient and environmentally sound biomass production technologies can support a sustainable biomass energy system with no net GHG emissions.

MEMORANDUM

DRAFT

TO: Distribution

SUBJECT: Nordhaus's arguments against strict action.

See June 5

Executive Summary and Key Findings

- Nordhaus finds that the optimal policy, given the current state of knowledge and ignoring uncertainty, is to do very little in the short term (a \$6/ton tax in 2005) and only marginally more in the long term. While his mild long-term policy suggestion helps to inform the basis of his short term recommendations, Nordhaus only intends to propose a short-term strategy and emphasizes that policies should change as we learn more.
- Recognizing wide-ranging uncertainties and the possibility of calamity, Nordhaus investigates optimal policy choices over a reasonable distribution of possible states of the world. He shows that while the median optimal carbon tax is on the order of \$6/ton in 2005, the mean optimal carbon tax is somewhat larger, at \$18/ton in 2005.
- His conclusions are viewed with skepticism by some critics, who believe some or all of the following: he overstates control costs, he understates control benefits, and his choice of a positive pure rate of time preference is indefensible. Others find his results and methodology more robust.

Introduction

In a 1994 book¹, Nordhaus calculates an optimal policy response to the problem of climate change. A distinguishing feature of this work is that it aims to uncover a truly optimal policy — that is, one that maximizes *net* benefit as opposed to one that merely minimizes the cost of achieving an *ad hoc* CO₂ concentration target.

Basic Results

Ignoring uncertainty and with a best guess of costs and benefits (based on a wide purview of existing studies) Nordhaus finds that the optimal policy is to do close to nothing. With the optimal policy, carbon taxes rise from \$6 per ton in 2005 to \$20 per ton (1989 dollars) in 2100. Global average temperature under this policy increases 3.2°C — only 0.2°C less than in the baseline case. On net, the world economy under this scenario enjoys a small net benefit relative to the baseline case. See Table 1.

Restricting emissions of greenhouse gases to 1990 levels, on the other hand, inflicts relatively large net costs. Carbon taxes rise to \$400/ton in 2100, and the increase in global average temperature is limited to only 2.4°C — a full degree less than in the baseline.

Given that the optimal policy is much closer to doing nothing than to restricting to 1990 levels, it appears that literally doing nothing in the short term is superior to current proposals oriented on 1990 emissions levels.

Table 12

	Global Net Benefit ³			Carbon Tax (\$/ton)		
	NPV (\$billions)	Annualized (\$billions)	NPV as % of PV of baseline output	2005	2055	2105
Optimal Policy (no uncertainty)	271	11	0.04	6	15	21
Restrict to 1990 levels	- 7,069	- 283	- 0.98	50	230	400
Stabilize at 1.5°C increase	- 40,980	- 1,639	- 5.94	200	700	800

It is worth emphasizing that Nordhaus's result is not simply a matter of delaying controls. While the typical *cost-minimization* exercise also shows that carbon emissions should be allowed to follow a near-baseline path at first, Nordhaus's result goes further: he finds that relatively little should be done even over the long term. In his optimal scenario, carbon concentrations are allowed to grow without apparent bound.

Incorporating uncertainty, Nordhaus's results change though the basic message of modest short-term measures does not.

- Nordhaus examines how the optimal policy changes when key parameter values vary from his best guess and finds that the mean optimal policy calls for higher carbon taxes than he finds for the best-guess case. The mean optimal policy calls for a carbon tax of \$18/ton in 2005 and \$53/ton in 2045.
- The "mean" result differs from the "best guess" result because the distribution of outcomes is skewed so that favorable climate change scenarios are similar to the best-guess case and occur with high probability while extremely unfavorable scenarios occur with low probability.
- Nordhaus finds that only 2% of possible scenarios -- the least favorable -- would call for a carbon tax in 1995 of over \$100/ton.

Basis for Results

Nordhaus's results derive from three key assumptions:

- that the *costs* of reducing carbon emissions are relatively high;
- that the *benefits* of carbon control (in the form of averted damages) are relatively low; and
- that the social rate of discount is greater than zero.

Critics have attacked Nordhaus on all three points, and it is worth examining each point in greater detail.

1. Costs

The cost of reducing carbon emissions is determined by the responsiveness of the economy to a given level of carbon-control effort. For example, if a \$10 carbon fee elicits a large response in terms of lower carbon emissions, the cost of carbon control will be low. Conversely, if a \$10 carbon fee elicits a small response, program cost will be high.

The impact on the economy of a carbon-control program in Nordhaus's model is determined by two key assumptions — one concerning the “static” response, given current technologies and carbon use, the other concerning the “dynamic” response, reflecting induced changes in carbon use and advances in technology.

- Nordhaus bases his assumption about static responses on existing empirical studies. His assumptions here are not particularly contentious.
- Nordhaus attempts to capture dynamic responses by assuming that technology will improve at about the same rate in the future as it has done in the past. Importantly, the trend rate of improvement is not allowed to vary depending on the price of carbon permits or the level of a carbon tax. Critics find fault with this approach, since his model thus assumes that carbon taxes will in no way accelerate the development of non-carbon technologies — in stark contrast to the “technologist” view.

Nordhaus notes that his results are sensitive to assumptions about technology, but he does not document the extent of that sensitivity in isolation from other uncertainties.

2. Benefits

The benefits of carbon control are determined by the magnitude of damages averted -- that is, damages that would have occurred in the absence of a control program. Nordhaus calculates that these damages would be relatively modest. For example, he estimates that a 3°C temperature increase results in only a 1.3 percent loss of output per year.

Some critics feel that damages averted will be greater than Nordhaus assumes. They note that SO₂ and particulate emissions will be reduced, biodiversity will be better maintained, and negative health effects will be avoided.

In a survey of experts, Nordhaus finds that the median cost prediction for a 3°C rise in temperature is 1.9 percent of output annually -- 40% higher than his own. The mean prediction is much higher, at 3.6 percent.

3. The social rate of discount

System Benefits Charges

Many states are considering establishing a "universal wires charge" that would collect a standard fee from all electricity customers to fund ratepayer programs that may no longer be feasible for the utility to provide in a more competitive electricity market. The institution of a wires charge arises most often in discussions of a utility's "stranded costs" for which a "competition transition fee" would be collected from ratepayers to recover uneconomic costs that might result from exposing the utility company to greater competition.

The wires charge concept is also relevant as a "system benefits charge" for the provision of public programs, such as energy conservation, renewables and low-income assistance, that have previously been supported in utility rates. In Arizona, a customer surcharge has been adopted to fund a utility's Energy Efficiency and Solar Energy Fund. In addition to recovery of demand-side management expenses, the surcharge covers all capitalized and expensed program costs associated with the development and implementation of renewable energy projects.

Portfolio Standard

A renewables portfolio standard would impose a minimum renewable energy requirement for the state's (or the nation's) electricity mix. Every entity participating as an electricity supplier would be required to provide and maintain a certain percentage of its supply from renewable energy sources. However, the renewables obligation would be tradeable so that all electricity suppliers need not become renewables providers. For example, electricity suppliers could contract with dedicated renewables developers to meet their renewables obligation. Such a trading scheme would enhance the value of renewable energy resources and at the same time use market forces to minimize the costs of developing and maintaining the supply portfolio. The trading element of the portfolio standard is patterned after the sulfur dioxide (SO₂) trading program contained in the Clean Air Act Amendments of 1990. The establishment of a renewables portfolio standard has been proposed as an element of the California PUC's recent electric industry restructuring decision.

Net Energy Metering

Net energy metering (or billing) is a policy under which smaller electricity generators pay a single rate for the net difference between the amount of energy that they use from the utility and the amount that they supply to the grid. The small generator, who is also a utility customer, is reimbursed for the electricity supplied to the utility at the utility's (and customer's) retail rate instead of at the traditional avoided cost (or wholesale) rate. This policy is also known as reverse metering because the customer's electric meter essentially runs in reverse when power is supplied to the utility.

Net energy metering provides an important incentive to small-scale renewable generators by allowing these generators to displace power normally provided by the utility company at the prevailing retail rate, rather than the traditional utility avoided cost rate, which tends to be much

lower. The higher the rate being avoided by the customer, the more attractive the renewable investment will be. Net energy metering policies for small renewable generators have already been implemented in 10 states.

Performance-Based Ratemaking

Regulators are currently investigating the use of performance-based ratemaking (PBR) as a substitute for the traditional system of electricity regulation that ties utility earnings to investment and sales. Under a PBR system, a utility would be penalized or rewarded based on its performance on a variety of cost and quality of service indicators. Renewables deployment and other environmental factors should be included in the performance measures by which future earnings would be determined.

Summary of Greenhouse Gas Emissions-Reduction Actions

Million Metric Tons of Carbon Equivalent

Source: U.S. Climate Action Report—1997

Action Number	Action Title	1993 Action Plan Estimate for 2000	1997 U.S. CAR Revised Estimate for 2000	Actual Reductions to Date
Residential & Commercial Sector Actions		26.9	10.3	--
New	Rebuild America	2.0	1.6	--
1 and 2	Expanded Green Lights and Energy Star Buildings	3.6	3.3	1.5
3	State Revolving Fund for Public Buildings	1.1	Terminated	
4	Cost-Shared Demonstrations of Emerging Technologies	3.8	0.0	--
5	Operation and Maintenance Training for Commercial Building Facility Managers and Operators			
6	Energy Star Products	5.0	4.3	1.9
7	Residential Appliance Standards	6.8	0.2	--
8 and 11	Energy Partnerships for Affordable Housing	4.4	0.4	--
9	Cool Communities			
10	Update State Building Codes			
New	Construction of Energy-Efficient Commercial and Industrial Buildings		0.1	--
New	Superwindow Collaborative		0.0	--
New	Expand Markets for Next-Generation Lighting Products		0.2	--
New	Fuel Cells Initiative		0.0	--
Industrial Sector Actions		19.0	4.8	--
12	Motor Challenge	8.8	1.8	--
13	Industrial Golden Carrot Programs	2.9	Merged into Action 12 Terminated	
14	Accelerate the Adoption of Energy-Efficient Process Technologies			
15	Industrial Assessment Centers	0.5	CCAP Component Terminated	
16	Waste Minimization	4.2	2.1	--
17	Improve Efficiency of Fertilizer Nitrogen Use	2.7	0.8	--
18	Reduce the Use of Pesticides			
Transportation Sector Actions		8.1	5.3	--
19	Cash Value of Parking	6.6	4.6	--
20	Innovative Transportation Strategies			
21	Telecommuting Program			
22	Fuel Economy Labels for Tires	1.5	0.7	--
Energy Supply Actions		10.8	1.3	--
23	Increase Natural Gas Share of Energy Use Though Federal Regulatory Reform	2.2	Terminated	

Action Number	Action Title	1993 Action Plan Estimate for 2000	1997 U.S. CAR Revised Estimate for 2000	Actual Reductions to Date
24	Promote Seasonal Gas Use for Control of Nitrogen Oxides	2.8	0.5	--
25	High-Efficiency Gas Technologies	0.6	Terminated	
26	Renewable-Energy Commercialization	0.8	0.3	--
27	Expand Utility Integrated Resource Planning	1.4	Terminated	
28	Profitable Hydroelectric Efficiency Upgrades	2.0	0.0	--
29	Energy-Efficient Distribution Transformer Standards	0.8	0.5	0.0
30	Energy Star Distribution Transformers			
31	Transmission Pricing Reform	0.8	Terminated	
New	Green Power Network	Not included	0.0	--
Land-Use Change & Forestry Actions		10.0	2.4	--
43	Private Depletion of Nonindustrial Private Forests	4.0	Terminated	
44	Accelerate Tree Planting in Nonindustrial Private Forests	0.5	0.4	--
16	Waste Minimization	4.2	2.0	--
9	Expand Cool Communities	0.5	To be determined	
Methane Actions		16.3	15.5	--
32	Expand Natural Gas STAR	3.0	3.4	1.6
33	Increase Stringency of Landfill Rule	4.2	6.3	0.0
34	Landfill Methane Outreach Program	1.1	1.9	0.1
35	Coalbed Methane Outreach Program	2.2	2.6	1.9
36	RD&D for Coal Mine Methane	1.5	Terminated	
37	RD&D for Landfill Methane	1.0	Terminated	
38	AgSTAR Program	1.5	0.3	0.0
39	Ruminant Livestock Efficiency Program	1.8	1.0	0.0
Actions to Address Other Greenhouse Gases		16.3	25.4	--
17	Improved Fertilizer Management	4.5	5.3	--
40	Significant New Alternatives Program	5.0	6.4	--
41	HFC-23 Partnerships	5.0	5.0	--
42	Voluntary Aluminum Partnership	1.8	2.2	2.9
New	Environmental Stewardship Initiative	Not included	6.5	--
Foundation Actions			11.3	--
	Climate Wise	Not estimated	1.8	--
	Climate Challenge	Not estimated	7.6	--
	State and Local Outreach Programs	Not estimated	1.9	--
Total GHG Emission Reductions From CCAP		108.6	76.0	15.0

Data are not immediately available for cumulative emissions reductions for many CCAP programs. Cumulative emissions reductions of about 5 MMTCE can be attributed to DOE's CCAP programs, but are not available at the program level. EPA's Office of Air and Radiation (OAR) is responsible for cumulative emissions reductions of about 10 MMTCE through their CCAP programs. OAR's HFC programs are currently verifying emission reduction achievements, and are expected to affect cumulative totals.

Office of Economic Policy

Department of the Treasury
Washington, D.C. 20220FAX

Date: _____

Number of pages including cover sheet: _____

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<i>Joe Aldy</i>	<i>395-6853</i>	<i>395-1455</i>
From: <i>Robert Gillingham</i>	<i>202-622-2633</i>	<i>622-0563</i>

REMARKS: ☐ Urgent ☐ For your review ☐ Reply ASAP ☐ Please comment

DEPARTMENT OF THE TREASURY
WASHINGTON, D.C. 20220

September 4, 1997

MEMORANDUM FOR T. J. GLAUTHIER

FROM:

Robert Gillingham
Jonathan Gruber *RG*

SUBJECT:

5-Labs Revision

We think this revision is a substantial improvement. Most of our comments are editorial (see attached draft). The major exceptions revolve, not surprisingly, around the treatment of "cost" estimates. We continue to feel that the analysis presents scenarios that *could* be achieved, rather than scenarios that *should* be achieved—regardless of climate benefits—on the basis of cost savings. To address this concern, we recommend (1) eliminating the modifier "cost-effective" when referring to technologies, (2) deleting Table 1.5 and substantially modifying or eliminating the discussion of costs on pp. 15 through 18, and (3) weakening the claim of rough cost/benefit parity in the second overarching conclusion in the executive summary (e.g., recognizing that energy savings are a substantial offset without arguing relative magnitude).

We continue to believe the scenarios are informative primarily in terms of what is technically feasible. We do not believe the paper demonstrates the validity of the criteria used for selecting "cost-effective" technologies. The reasons for this skepticism are outlined in our earlier comments - the underlying model of the costs of technology adoption is not economically rigorous, with limitations that include low discount rates, and in particular extremely low implementation costs.

We view these criteria as one way of selecting technologies that could be adopted; the paper then does a very good job of quantifying the impact of adopting these technologies on energy use and carbon emissions. A possible substitute for Table 1.5 might be a table of reductions in energy consumption valued at today's (or 2010's) prices to quantify the *energy-cost* saving, with the appropriate caveat that it would take a full-blown general-equilibrium analysis (beyond the scope of the paper) to determine what prices would actually obtain. Going further than that, in our opinion, is too ambitious and—for the purposes of this paper—is not critical.

MEMORANDUM

August 29, 1997

TO: T.J. Glauthier (OMB), Jeff Frankel (CEA), Robert Gillingham and Jon Gruber (Treasury),
Peter Orszag (NEC)

FROM: Mark D. Levine and Marilyn Brown

RE: Executive Summary and Chapter 1 of the Report "Scenarios of U.S. Carbon
Reductions"

CC: Joe Romm, Eric Petersen, Mark Mazur

We are faxing to you a modified version of the Executive Summary and Chapter 1 of the referenced report. In this version, we have attempted to respond to the concerns expressed in the meeting on August 19 while still expressing the major findings of the report.

We have received two sets of comments from you and expect to give you substantive responses to these comments in the near future.

EXECUTIVE SUMMARY

This report presents the results of a study conducted by five U.S. Department of Energy national laboratories that quantifies the potential for energy-efficient and low-carbon technologies to reduce carbon emissions in the United States.¹ The study documents in detail how four key sectors of the economy - buildings, transportation, industry, and electric utilities - could respond to directed programs and policies to expand adoption of energy-efficiency and low-carbon technologies, an increase in the relative price of carbon-based fuels by \$25 or \$50/tonne (e.g., as a result of a cap on domestic carbon emissions and a market for carbon "permits"), and an aggressive program of targeted research and development. Current projections suggest that a carbon emissions reduction of 380 million metric tons per year (MtC/year) is required to stabilize U.S. emissions in 2010 at 1990 levels. *partially in response to*

The study, which has been peer-reviewed by industry and academic experts, uses a technology-by-technology assessment as well as an engineering-economic modeling approach. It draws upon a wide variety of technology cost and performance information to assess potential impacts. Analysis of the buildings, industry, and transportation sectors quantifies the impacts of end-use energy-efficiency improvements on carbon emissions. The utility sector analysis estimates the impacts of those improvements on utility carbon emissions, and quantifies additional emissions reductions through conversion of a number of coal power plants to natural gas, dispatching of the utility grid with \$25 and \$50/tonne carbon permit prices, the accelerated use of biomass cofiring and wind energy, and other low-carbon electricity supply options. Finally, a number of other promising low-carbon technologies are examined to determine their potential for reducing emissions in the end-use sectors, including advanced gas turbines in industry, transportation biofuels, and fuel cells in buildings. *do we have more than what was given out?*

Three overarching conclusions emerge from the analysis of alternative carbon scenarios. First, a vigorous national commitment to develop and deploy cost-effective energy-efficient and low-carbon technologies has the potential to restrain the growth in U.S. energy consumption and carbon emissions such that levels in 2010 are close to those in 1997 (for energy) and 1990 (for carbon). We analyze a case in which energy efficiency can reduce carbon emissions by 120 MtC/year by 2010. We analyze a second case, with policies that promote adoption of energy-efficient and low carbon technologies and a \$25/tonne carbon permit price, with emission reductions of 230 MtC/year in 2010. Under a \$50/tonne carbon permit price and aggressive policies, 2010 emissions could be cut by about 380 MtC/year. The analysis also suggests that substantial additional savings are available if permit prices were to begin to rise above the \$50/tonne level. *based on current projections, it is technically feasible*

weaker The second conclusion is that, if feasible ways are found to implement the carbon reductions as described above, all the cases (with reductions varying between 120 and 380 MtC/year by 2010) can produce direct benefits that are roughly equal to or exceed costs.² The analysis includes only technologies estimated to be cost-effective under 2010 energy prices (with a \$25/tonne and \$50/tonne carbon permit price for the respective cases); it has not, however, analyzed specific policies to achieve the cases, identified the political feasibility of policies, or described a pathway to achieve the cases. *Carbon*

The third conclusion is that a next generation of energy-efficient and low-carbon technologies promises to enable the continuation of an aggressive pace of carbon reductions over the next quarter century. This report documents a wide array of advanced technology options that could be cost-competitive by the year 2020, assuming a vigorous and sustained program of energy R&D beginning now and extending beyond 2010.

¹ The five national laboratories participating in the study were: Argonne National Laboratory (ANL), Lawrence Berkeley National Laboratory (LBNL), National Renewable Energy Laboratory (NREL), Oak Ridge National Laboratory (ORNL), and Pacific Northwest National Laboratory (PNNL). LBNL and ORNL were the co-leaders of the effort.

² Here we count as benefits only the energy savings to the nation. We have not credited reduced CO₂ emissions or other external benefits. Costs include the increased technology cost plus an approximate estimate of the costs of program and policy implementation.

Chapter 1

ANALYSIS RESULTS

This report presents the results of a study conducted by five U.S. Department of Energy national laboratories that quantifies the potential for energy-efficient and low-carbon technologies to reduce carbon emissions in the United States.¹ The stimulus for this study derives from a growing recognition that any national effort to reduce the growth of greenhouse gas emissions must consider ways of increasing the productivity of energy use. To add greater definition to this view, we quantify the reductions in carbon emissions that can be attained through the improved performance and increased penetration of efficient and low-carbon technologies by the year 2010. We also take a longer-term perspective by characterizing the potential for future research and development to produce further carbon reductions over the next quarter century. As such, this report underscores the value of energy technology research, development, demonstration, and diffusion *as a public response in mitigating* to global climate change.

Three overarching conclusions emerge from our analysis of alternative carbon reduction scenarios. First, a vigorous national commitment to develop and deploy ~~cost-effective~~ energy-efficient and low-carbon technologies could reverse the trend toward increasing carbon emissions. Along with utility sector investments, such a commitment could halt the growth in U.S. energy consumption and carbon emissions so that levels in 2010 are close to those in 1997 (for energy) and in 1990 (for carbon). It must be noted that such a vigorous national commitment would have to go far beyond current efforts. Second, if feasible ways are found to implement the carbon reductions, the cases analyzed in the study are judged to yield direct benefits that *are roughly equal to or greater than costs*. Third, a next generation of energy-efficient and low-carbon technologies promises to enable the continuation of an aggressive pace of carbon reductions over the next quarter century.

substantially offset

1.1 OBJECTIVES OF THE REPORT

The purposes of this study are threefold:

1. To provide a quantitative assessment of the reduction in energy consumption and carbon emissions that could result by the year 2010 from a vigorous national commitment to accelerate the development and deployment of cost-effective energy-efficient and low-carbon technologies;
2. To document the ~~costs and~~ performance of the technologies that underpin a year 2010 scenario in which substantial energy savings and carbon emissions reductions are achieved;
3. To illustrate the potential for energy-efficiency and renewable energy R&D to produce further reductions in energy use and carbon emissions by the year 2020.

1.2 METHODOLOGY

To achieve these objectives, we started with the Annual Energy Outlook 1997 (AEO97) reference case forecasts for the year 2010 (Energy Information Administration, 1996). After thoroughly reviewing these forecasts on a sector-by-sector basis, and working with EIA staff, we chose to accept the EIA "business-as-usual" (BAU) scenario as is for buildings and industry. We modified some of

Chapter 1

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the assumptions and data to produce a new BAU case - not greatly different from the EIA case - for the transportation and the electric utility sectors.

We then assembled existing information on the performance and costs of technologies to increase energy efficiency or, for selected end-uses, to switch from one fuel to another (e.g., from electricity to natural gas for residential end-uses or from gasoline to biofuels for transportation). For the buildings sector, the technology performance and cost data base is extensive. For transportation, the data base - although less fully developed than for buildings - is sufficient for our purposes. For industry, only partial information on technologies and costs is presently available. As a result, the analysis for industry relies primarily on historical relations between energy use and economic activity and much less on explicit technological opportunities. The industrial analysis also includes some examples of industrial low-carbon technologies. The analysis of low-carbon supply technologies in the electricity sector is based on a review of the literature including detailed technology characterizations prepared by DOE in conjunction with its national laboratories and industry.

Next we created scenarios of increased energy efficiency and lower carbon emissions using the technology data (or, in the industrial sector, historical relations) as key inputs. We chose to run three scenarios other than the BAU case. We have termed the first the "efficiency" (EFF) case. It assumes that the United States increases its emphasis on energy efficiency through enhanced public- and private-sector efforts. The general philosophy of the efficiency case is that it reduces, but does not eliminate, various market barriers and lags to the adoption of cost-effective energy efficiency technology.²

The other two cases, dubbed the \$25 permit and the \$50 permit "high-efficiency/low-carbon" (HE/LC) cases, describe a world in which, as a result of commitments made on a climate treaty or other factors, the nation has embarked on a path to reduce carbon emissions. Both of these cases assume a major effort to reduce carbon emissions through federal policies and programs (including environmental regulatory reform), strengthened state programs, and very active private sector involvement. Both also include a focused national R&D effort to develop and transform markets for low-carbon energy options (e.g., fuel cells for microcogeneration in buildings and advanced turbine systems for combined heat and power in industry). The difference between the two HE/LC cases is in the assumption of a carbon permit price resulting from a domestic trading scheme for carbon emissions with a cap on U.S. emissions (or from equivalent policy measures that increase the price of carbon-based fuels relative to those with less carbon). We assume a domestic permit price of \$25 and \$50 per tonne of carbon for the two cases. Both of these HE/LC cases include a program of research, development, demonstration and diffusion that is more vigorous than in the efficiency case. In the buildings and industry sectors, the carbon price signal, combined with policies promoting energy efficiency, is believed to trigger most of the additional carbon reductions. In the transportation sector, it is the R&D-driven technology breakthroughs that generate the bulk of the carbon reductions beyond the efficiency case. For the electricity sector, higher prices for carbon-based fuels cause larger shifts from coal to natural gas; for this sector, these same higher relative prices combined with federal and private research, development, and demonstration can bring advanced low-carbon technologies to market.

Although most of the analysis focuses on 2010, we also look beyond this date. Here we describe new technologies, materials, processes, manufacturing methods, and other R&D advances that promise to offer significant energy benefits by the year 2020; for this time period, we make no effort to forecast specific levels of market penetration, energy savings, or carbon reductions. Thus, instead of creating scenarios we describe the technological innovations that could enable the continuation of an aggressive pace of decarbonization well into the next quarter century, if appropriate investments in R&D were made.

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1.3 BACKGROUND

The decade of gains in energy productivity achieved by the U.S. following the 1973-74 Arab oil embargo represents a period of economic growth that was decoupled from increases in energy consumption, resulting in substantial economic benefits. Between 1973 and 1986, the nation's consumption of primary energy froze at about 74 quads - while the GNP grew by 35%. Starting in 1986, energy prices began a descent in real terms that has continued to the present. As a result, energy demand grew from 74 quads in 1986 to 91 quads in 1995, and carbon emissions have been increasing at a similar pace.

Despite the growth in energy consumption since 1986, the U.S. economy *has continued to improve its energy productivity.* today remains more energy productive than it was 25 years ago. In 1970, 19.6 thousand Btu of energy were consumed for each (1992) dollar of GDP. By 1995, the energy intensity of the economy had dropped to 13.4 thousand Btu of energy per (1992) dollar of GDP. The U.S. Department of Energy (DOE) estimates that the country is saving \$150 to \$200 billion annually as a result of these improvements.

Nevertheless, many cost-effective energy-efficient technologies remain underutilized, as discussed in Chapter 2. *[A host of market barriers account for these lost opportunities. And declining energy R&D expenditures may cause promising technology options to be foregone.]*

There are not reasons support energy efficiency R&D
The rationale for government support of energy-efficiency R&D is strong. Much energy-efficiency research is both long-term and high-risk and therefore is not adequately funded by the private sector - despite the possibility of sizable gains in the long run. Furthermore, advances in energy efficiency offer substantial public benefits (such as carbon reductions and improved national security through greater oil independence) that cannot be fully captured in the private marketplace.

The benefits of past public investments in energy-efficiency R&D have been well documented. Between 1978 and 1996, DOE spent approximately \$8 billion on energy-efficiency research, development and demonstration (RD&D). Just five of the technologies that were developed or demonstrated with a fraction of this DOE support have resulted in net benefits of \$28 billion through 1996. Many other R&D successes have produced technologies yielding substantial energy and cost savings in the market. The DOE RD&D portfolio has also led to significant environmental, health, productivity, and economic competitiveness benefits.

1.4 RESULTS

1.4.1 Prospects for Improved Efficiencies by the Year 2010

Table 1.1 and Figure 1.1 compare the nation's primary energy use in quads for the years 1990 and 1997 (projected) with the results of three scenarios for 2010. (We have included only the high-efficiency/low-carbon case at \$50/tonne in the table and figure for simplicity.) The \$50/tonne HE/LC case shown below does not reflect the energy impacts of the selected low-carbon technologies described later in this summary (e.g., stationary fuel cells for buildings, advanced turbine systems and biomass gasification in industry) or the supply-side options shown in Table 1.4.

Analysis Results

Table 1.1 Primary Energy Use in Quads: 1990-2010

	1990	1997	2010	
			Business-as-Usual Case	High-Efficiency/Low-Carbon Case (\$50/tonne C)
Buildings	29.4	33.7	36.0	32.0
Industry	32.1	32.6	37.4	33.6
Transportation	22.6	25.5	32.3	27.8
Total	84.2	91.8	105.7	93.4

Source: Energy use estimates for 1990 come from EIA (1996a, Table 2.1, p. 39).
Energy use estimates for 1997 come from forecasts conducted for EIA (1996b).
Numbers may not add to the totals due to rounding.

The major observations are as follows:

- In the business-as-usual case, energy use increases by 22 quads (26%) between 1990 and 2010; 8 quads of this increase have occurred during the first seven years of this 20-year period. The fastest growing sector during these initial seven years has been buildings (4.3 quads) followed by transportation (2.9 quads) and industry (0.5 quads). In the BAU case, the fastest growing sector during the remaining 13 years is transportation (6.8 quads). This is followed by industry (4.8 quads) and then buildings (2.3 quads). The rapid projected growth in the energy consumed for transportation is driven by estimates of increased per capita travel and minimal fuel efficiency gains.
- The efficiency scenario cuts the overall growth between 1990 and 2010 from 22 to 15 quads. This is a 17% increase over the level of energy consumption in 1990, down from a 26% increase in the BAU case. Relative to the BAU case, the efficiency scenario for transportation delivers slightly more energy savings (3.1 quads) than do the same scenarios for the industrial (2.0) or buildings (1.9) sectors. Compared with 1997 levels, the smallest increase in energy growth for this case is in buildings (0.4 quads), followed by industry (2.8 quads), and transportation (3.7 quads).
- The high-efficiency/low-carbon scenario with \$50/tonne carbon charge further decreases the overall growth between 1990 and 2010, reducing it from 22 to 9 quads. This is an 11% increase over the level of energy consumption in 1990. Relative to the BAU case, the high-efficiency/low-carbon scenario for buildings, industry, and transportation delivers energy savings ranging from 3.8 to 4.5 quads for each sector. Compared with 1997 levels, the buildings sector is down about 2 quads and industry and transportation are up 1 and 2 quads, respectively.

Figure 1.1 Primary Energy Use in Quads: 1990-2010

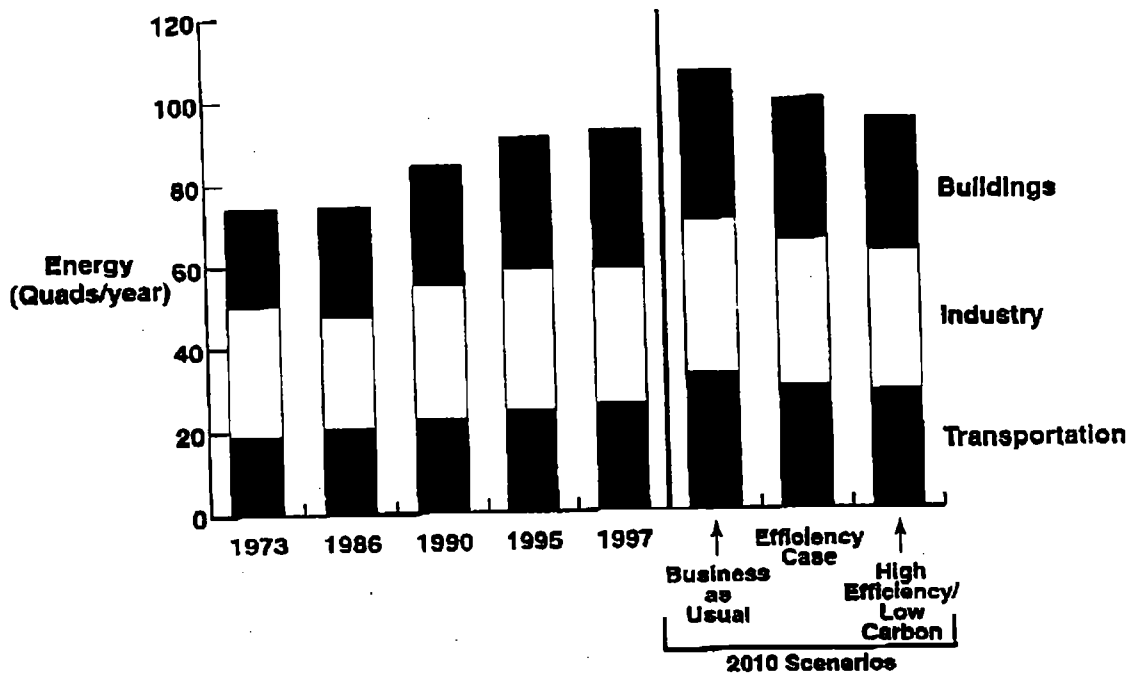


Table 1.2 documents the impact of these projected energy savings in 2010 on carbon emissions in that same year. It also presents the results of the HE/LC scenarios with both \$25 and \$50 per tonne carbon charges. These scenarios show significant carbon reductions from the combination of greater efficiency improvements and increased use of advanced low-carbon technologies.³ In these cases, a number of low-carbon technologies have high rates of adoption (e.g., advanced turbine systems and biomass gasification in industry), the utility grid is dispatched to reduce carbon emissions (by using many coal plants for intermediate power and by running more natural gas plants as base load), a set of coal-based power plants are repowered, nuclear plant lifetimes are extended, and key renewable energy technologies are deployed. In all cases, these technologies and measures are estimated to be cost-effective with a differential carbon fee of \$50/tonne.

Analysis Results

Table 1.2 Carbon Emissions (MtC): 1990-2010

	1990	1997	2010			
			Business-as-Usual (BAU) Case	Efficiency Case	High-Efficiency/Low-Carbon ^a	
					\$25/tonne	\$50/tonne
Buildings	460	511	571	546	527	509
Industry	452	482	534	512	488	452
Transportation	432	486	616	543	528	513
Utilities ^b	-	-	-	-	-48	-136
Total (rounded)	1340	1480	1720	1600	1490	1340
Change from 1990		140	380	260	150	0
Change from BAU	-	-	-	-120	-230	-380

^aThis scenario includes the carbon emission reductions resulting from a carbon permit price of \$25 or \$50/tonne: (1) dispatch of power plants in which natural gas is favored relative to coal, (2) repowering and partial repowering of coal-based power plants to convert to natural gas, and (3) introduction of selected low-carbon technologies to replace conventional ones, primarily in the industrial and utility sectors.

^bThe entries in the last two columns are negative as they correspond to reductions in carbon emissions resulting from the increased use of natural gas and low-carbon technology for electricity generation as a result of the \$50/tonne carbon permit price in this scenario.

Table 1.2 presents results for the business as usual and three efficiency and/or low carbon cases in 2010 as point estimates, because they are meant to be scenarios. When we use these scenarios for analysis, in section 1.5, we describe sources of uncertainty and the effects of uncertainty on our understanding of the implications of these cases. For now, we only describe the different cases.

Figures 1.2 and 1.3 complement the above table by illustrating the carbon emissions reductions from each scenario. The major observations are:

- In the BAU case, carbon emissions are forecast to increase by approximately 380 million tonnes.
- The energy-efficiency gains incorporated in the efficiency case cut overall growth between 1990 and 2010 by one-third (from 380 to 260 million tonnes). This represents a carbon increase of 19% above 1990 emissions.
- The HE/LC scenario with \$25/tonne carbon charge has the potential to reduce carbon emissions by 230 million tonnes from the BAU case in 2010. The largest part of these carbon reductions are from increased efficiency, but major changes in electricity supply (carbon-based dispatching and repowering) contribute nearly 35 million tonnes, and other low-carbon technology, particularly renewables and advanced turbine systems, produce approximately another 25 million tonnes.
- The HE/LC scenario with \$50/tonne carbon charge has the potential to reduce carbon emissions by approximately 380 million tonnes, thereby achieving 1990 carbon emission levels in 2010. Of this 380 million tonne carbon reduction, about 190 million tonnes are from increased energy efficiency, 140 million tonnes results from increases in the use of low-carbon fuels and technologies in the utility sector, and 50 million tonnes results from the use of low-carbon technology in industry and transportation.

Chapter 1

Analysis Results

Figure 1.2 Reductions in Carbon Emissions from Each Scenario

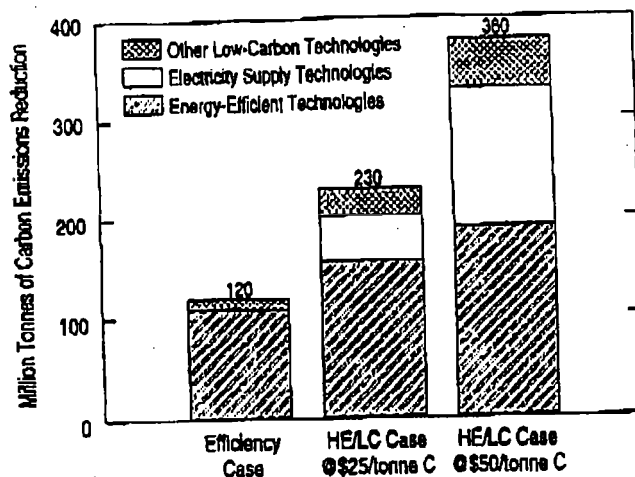
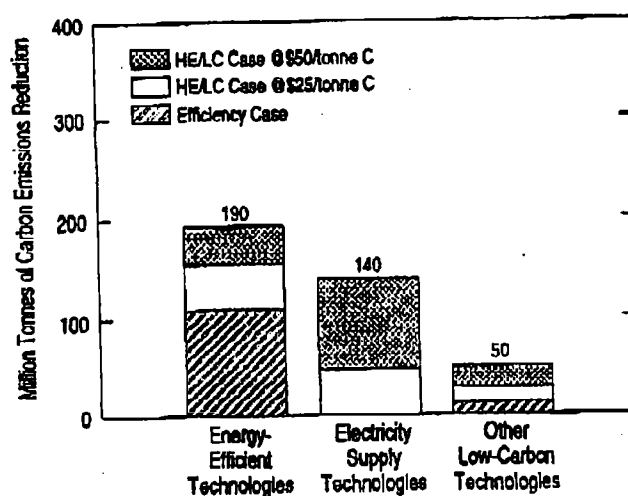


Figure 1.3 Reductions in Carbon Emissions from Each Type of Technology



100 million of the 140 million tonnes of carbon reductions in the utility sector comes from redispatching the utility system (favoring the use of low-carbon fuels) and from repowering coal plants with natural gas. Both are cost-effective with a \$50/tonne carbon charge. The remaining 40 million tonnes are from renewables (wind, co-firing coal-based power plants with biofuels, expansion of hydropower capacity), nuclear power plant life extensions, and power plant efficiency improvements.

The remaining 50 million tonnes of carbon reductions in industry and transportation are about equally divided among three sets of fuels/technologies: (1) advanced combustion turbine cogenerators in industry, (2) biomass and black liquor gasification and low-carbon industrial processes, and (3) cellulosic ethanol/gasoline blends for automobiles.

- Approximately 140 MtC of the increase in carbon emissions between 1990 and 2010 will have occurred by the end of 1997; thus, it is useful to look at the 13-year forecast starting with 1997.

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The carbon reductions incorporated in the efficiency case cut the overall *growth* in carbon emissions between 1997 and 2010 from 240 million tonnes (as forecast in the BAU case) to 120. The HE/LC scenario with \$50/tonne carbon charge reduces carbon emissions in 2010 by about 130 million tonnes (compared with the 1997 level).

Table 1.3 provides a comparison of the growth rate in energy and in carbon emissions for the four cases, from 1990 to 2010. For the BAU and efficiency cases, the growth in carbon emissions is slightly more rapid than the increase in energy demand. For the HE/LC cases, carbon emissions decline while energy consumption rises. The carbon reduction reflects the increased deployment of low-carbon fuels and technologies as a consequence of the relative increase in price of carbon-based fuels precipitated by the \$50/tonne incentive.

Table 1.3 Average Annual Energy and Carbon Growth Rates, 1997 to 2010, for Four Cases

	Business-As-Usual (BAU)	Efficiency Case	High Efficiency/ Low Carbon Case (\$25/tonne)	High Efficiency/ Low Carbon Case (\$50/tonne)
Gross Domestic Product (GDP) ^a	1.88%	1.88%	1.88%	1.88%
Energy Demand	1.09%	0.56%	0.34%	0.13%
Carbon Emissions	1.16%	0.60%	0.05%	-0.76%
Energy Consumption Per GDP (E/GDP)	-0.77%	-1.30%	-1.51%	-1.71%
Carbon Emissions Per GDP (C/GDP) ^b	-0.70%	-1.25%	-1.79%	-2.59%

^a The Gross Domestic Product (GDP) in 1995 was \$7251 billion in 1995 dollars. The 1.88% annual growth was assumed to apply to the entire period, 1995-2010 to derive the results above.

^b The carbon decrease per unit GDP growth for 1990 to 2010 is 0.7%, 1.1%, 1.4% and 1.9% per year for the reference, efficiency, \$25/tonne HE/LC, and \$50/tonne HE/LC cases, respectively.

It is useful to compare the scenarios in this study to those of other studies. The 1991 report by the Office of Technology Assessment (OTA) titled *Changing by Degrees* (U.S. Congress, 1991) analyzed the potential for energy efficiency to reduce carbon emissions by the year 2015, starting with the base year of 1987. Its "moderate" scenario results in a 15% rise in carbon emissions, from 1300 MtC/year of carbon in 1987 to 1500 MtC/year of carbon in 2015 (compared to a BAU forecast of 1900 MtC/year). Its "tough" scenario results in a 20% to 35% emissions reduction relative to 1987 levels, or emissions levels of 850 to 1000 MtC/year of carbon in 2015. Our efficiency and HE/LC cases ranging from 1.3 to 1.6 billion tonnes of carbon emissions in 2010 are comparable to OTA's "moderate" case and show considerably higher emissions than OTA's "tough" case.

Another benchmark is provided by the 1992 National Academy of Sciences (NAS) report on *Policy Implications of Greenhouse Warming* (National Academy of Sciences, 1992). This study identified a set of energy conservation technologies that had either a positive economic return or that had a cost of less than \$2.50 per tonne of carbon. Altogether, NAS concluded that these technologies offer the potential to reduce carbon emissions by 463 million tonnes, with more than half of these reductions arising from cost-effective investments in building energy efficiency. Our efficiency and HE/LC cases suggest the potential for reducing carbon emissions by between 120 and 380 million tonnes by the year 2010. One reason that the NAS estimate is higher is because it is not limited to the 2010 time

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frame, but rather characterizes the full potential for carbon reductions. Thus, it did not take into account the replacement rates for equipment and processes, and other factors that prevent the instantaneous, full market penetration of cost-effective energy-efficient and low-carbon technologies.

1.4.2 R&D's Potential for Further Benefits by 2020

If carbon reductions in 2010 and beyond are to be sustained at reasonable cost, vigorous R&D efforts are needed to fill the pipeline of next-generation energy technologies. It is difficult to estimate the carbon savings that will accrue from these technologies; however, our effort to characterize their features suggests that an aggressive pace of carbon reductions over the next quarter century can be sustained, with a sufficient investment in R&D. Our analysis of R&D potential for the year 2020 focuses on opportunities for improved energy-efficiency and renewable energy technologies. The potential long-term contributions of carbon sequestration, advanced coal technologies, and nuclear power may also be significant. However, the treatment of vigorous R&D initiatives to improve these supply options beyond 2010 is beyond the scope of this report.

Renewable energy technologies will likely play a crucial role in limiting carbon emissions over the long term. Low-carbon energy supply options are needed to fuel domestic and international economic development without stimulating further global warming. Although renewable resources account for only 7% of the nation's total energy consumption at present, many believe that they are at the beginning of a long-term growth trajectory. With continuing technological development and cost reductions, renewables could become preferred energy resources some time within the next several decades. Early evidence of this transition is seen in the continuing adoption of renewable power systems, including especially wind farms and biomass power systems, even in the face of low gas-fired power generation costs and considerable uncertainty in today's electric energy sector.

With a vigorous and sustained program of research, development and deployment, biomass, wind, photovoltaics, geothermal, and solar thermal technologies could deliver significant quantities of electricity in 2020, thereby substantially displacing carbon emissions. For example, the use of forestry and agricultural residues in biomass power systems continues to be an attractive power option where those residues exist. The successful development of higher-efficiency biomass gasification systems would make this technology competitive in a wider range of applications, including for power systems using dedicated feed stock supply systems. At the same time, biological and agricultural research on biomass production will lead both to higher biomass yields and better species for energy conversion purposes in the future.

A second area in which a vigorous and sustained R&D effort could spawn a range of key improvements is in wind power systems. Potential improvements include

- Advanced blade shapes that increase wind power capture while reducing stress loads
- Elimination of gearboxes through development of direct-drive generators
- Variable speed turbines, and
- Better resource prediction that will increase the value of wind power to power systems operators.

A third area of renewables development that is at the beginning of a long-term growth path is the use of renewables in buildings. Solar daylighting, passive solar designs, solar water heating, and geothermal heat pumps already are cost-competitive in many applications, but are not yet widely

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used. R&D advances could substantially accelerate their market penetration. In addition, building-integrated photovoltaic products will benefit directly from advances in materials research. The ultimate vision is that many buildings will become "net energy generators" through a combination of renewable energy and energy-efficiency technologies.

In the next quarter century, improved energy-efficiency technologies will result from a combination of incremental advances and fundamental breakthroughs. Incremental improvements in all sectors can be achieved by the greater reliance on more precise and reliable sensors and controls or on lower-cost sensors and controls, often integrated into industrial processes, transportation systems, and buildings. Advanced manufacturing technologies, including rapid prototyping and ultraprecision fabrication, also offer broad opportunities for continuous incremental improvements in energy efficiency and renewable energy. Breakthroughs in bioprocessing, separations, superconductivity, catalysts, and materials can have wide-ranging impacts on energy efficiency and carbon emissions by the year 2020. Examples of specific technology opportunities are described in this report, by sector.

Five R&D areas offer great promise to reduce significantly the energy requirements of our nation's buildings in 2020:

- Advanced construction methods and materials
- Adaptive building envelopes
- Multi-functional equipment
- Integrated, advanced lighting systems, controls and communications and
- Self-powered buildings.

In addition to the broad application of better process modeling, sensors, and controls in industry, many process/industry-specific opportunities for efficiency gains exist. These are described for each of DOE's targeted industries of the future: pulp and paper, chemicals, petroleum refining, glass, aluminum, iron and steel, and metal casting.

Many of the advanced technologies that have the potential to significantly improve the energy efficiency of transportation need considerable R&D investment before they can become commercially available in the year 2020. For example, to achieve fuel economies in the 60-80 miles per gallon (MPG) range and remain affordable and safe, light-duty vehicles will need

- Breakthroughs in manufacturing processes for composite materials
- Large reduction in fuel cell costs and/or cost reductions and performance gains in batteries
- Ultra-low rolling resistance tires
- High-efficiency accessories and
- Highly aerodynamic designs.

Opportunities for R&D to lead to improvements in the energy efficiency of other transportation modes are also described in this report.

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In all, the continued adoption of energy efficient and renewable energy technologies and a steady flow of technology improvements from collaborative R&D programs with industry could make such environmentally friendly technology an attractive option for domestic and global energy economies in the future. With strong public-private partnerships to support the necessary R&D and market transformation activities, ample cost-effective energy products and practices will be available in 2020.

1.5 ASSESSMENT OF COSTS AND SOURCES OF CARBON REDUCTIONS

The business-as-usual scenario projects an increase of 380 MtC/year between 1990 and 2010. In our efficiency scenario, in which the nation actively pursues policies and programs to promote market acceptance of energy efficiency while expanding commitments to research and development, energy-efficient technologies reduce this growth in carbon emissions by 120 MtC/year. Under a carbon cap and trading system, in which permits for carbon sell for either \$25 or \$50/tonne C, very substantial carbon reductions appear possible. Detailed results for these cases, showing the sources of the carbon reductions, are contained in Table 1.4. (Summaries of these results were presented in Figures 1.2 and 1.3.) Results indicate that, for the \$50/tonne HE/LC case, there is a potential to roughly return to 1990 levels of carbon emissions in 2010. About two-thirds of the increase in carbon emissions is eliminated in the case with a \$25/tonne carbon charge (Table 1.4).

The estimates in Table 1.4 include ranges for most of the electricity supply options and the other low-carbon technologies. There are no ranges for the efficiency technologies because the models used to estimate their penetration are nonstochastic. When selecting a single estimate for the \$50/tonne case, numbers from the low end of the ranges were generally selected in order to be cautious. Because we did not conduct an integrating analysis in which supply options compete against one another, we felt it important to minimize potential overlap by entering the supply options in conservative quantities. Also note that several renewable resources that could play a greater role by 2010 are omitted from Table 1.4; these resources include include photovoltaics, geothermal, solar thermal, and landfill gas.

One should not ascribe too much significance to specific entries in Table 1.4. There are many different technologies, both on the supply and demand side of the energy system, that will compete to achieve carbon reductions in an environment in which policies and economic signals favor such reductions. Thus, for example, Table 4.1 shows advanced turbine systems in industry cutting carbon emissions by 17 MtC/year in 2010, co-firing coal with biomass reducing emissions by the same amount, and other low-carbon supply technologies (wind, nuclear plant extensions, hydropower expansion, and power plant efficiency) contributing 24 MtC/year. The actual choice of technology depends on how the economics of the different systems evolve over time, how the industry to supply technology develops, the nature and speed of deregulation within the utility industry, and numerous other factors that cannot be known today. As such, we do not intend the results in Table 1.4 to be taken as a prediction of one technology over another to achieve carbon reductions. In this instance, we have posited one of many possible mixes of supply technologies. These same comments apply to the demand-side sectors and technologies.

We summarize below the expected technology costs in 2010, as well as the cost of implementing a carbon permit system. While these costs are necessarily uncertain, they are our best estimates and, in our view, as likely to be high as to be low. We note, however, that we have focused our analysis on technology costs, and have not assessed the viability of specific policies or programs to achieve market acceptance. As described below, we do account for program and policy costs in an approximate manner.

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Table 1.4 Potential Annual Reductions in Carbon Emissions in 2010, Compared to the Business-As-Usual Forecast for 2010 (MtC)

	High-Efficiency/Low-Carbon Case		
	Efficiency Case	\$25/tonne	\$50/tonne*
Buildings			
Energy efficiency	25	42	59
Fuel cells		2	3
	25	44	62
Industry			
Energy efficiency	22	36	51
Advanced turbine systems		5	17 (15-26)
Biomass and black liquor gasification, cement clinker replacement, and aluminum technologies		5	14 (13-16)
	22	46	82
Transportation			
Energy efficiency	61	74	87
Ethanol	12	14	16
	73	88	103
Utility Supply Options			
Carbon-ordered dispatching		25	55
Converting coal-based power plants to natural gas		9	40 (25-66)
Co-firing coal with biomass		5	17 (16-24)
Wind		2	7 (6-20)
Extending the life of existing nuclear plants		3	5 (4-7)
Hydropower expansions		2	4 (3-5)
Power plant efficiency		2	8 (7-13)
		48	136
Total (rounded)	120	226	383

*Numbers in parenthesis are ranges, as documented in the text of the report. See Appendix A-1 for a description of the derivation of the results in this table.

Appendix A-2 describes the full set of calculations used to derive the direct costs and benefits of the cases. The costs considered include the incremental technology investment by consumers and businesses, fuel price increases, and the estimated cost of federal, state, and local programs required to achieve the carbon emissions reductions. These constitute the direct costs of the scenarios. The highest of these by far is the incremental investment costs. However, the generally higher first cost of these technologies is counterbalanced by substantially lower operating costs. The benefits considered are limited to the savings in operating (energy) costs from the technology investments.

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Using these factors as the direct costs and benefits of the scenarios, we have analyzed the economics of carbon emissions reductions from two different perspectives in order to establish a credible range of costs. In the first, which we label "optimistic," we evaluate all costs and benefits with a real discount rate that approximates the cost of capital for efficiency investments for the different end-use sectors:

- 7% for buildings
- 10% for transportation
- 12.5% for industry.

The lowest discount rate, for buildings, is based on the fact that the money for residential buildings is derived from home mortgages or home improvement loans. The higher rate for industry reflects the fact that energy-efficiency investments have to compete with investments for other projects. These discount rates are not those that describe current market behavior, but rather are reflective of costs of capital if the market did invest in the energy-efficiency measures. For the "optimistic" case, we assume costs for efficiency measures brought about by utility, federal programs, and state programs (e.g., demand-side management programs by utilities, federal market transformation programs) to be 15% of technology costs. We also assume that at least half of the efficiency occurs as a result of federal policies (e.g., standards or carbon permit charges) which add very low direct program costs. Thus, the overall costs of implementation are taken to be about 7% in the "optimistic" case. The electric supply-side technologies are assumed to add an incremental cost of \$30/tonne carbon in 2010, based on an average estimate of the incremental costs of the technologies from the appropriate sections of this report.

These programs and policies are not specified in this study, but the broad nature of the actions could include technology R&D partnerships such as the current Partnership for a Next Generation of Vehicles and Industries of the Future; energy efficiency codes and standards; expanded partnerships, technical assistance, and information programs to accelerate the adoption of energy-efficient technologies; incentives through the tax system directed at investments in energy-efficient technology in industry; and a variety of non-federal programs to accelerate market diffusion of energy-efficient and low-carbon technologies.

The second perspective, which we label "pessimistic," assumes that there are hidden costs associated with achieving widespread market acceptance of many of the efficiency and low-carbon technologies, even after the imposition of a carbon charge and the implementation of major policies and programs to promote a low-carbon future. In this perspective, we evaluate costs and benefits at a real discount rate of 15% for buildings and 20% for transportation and industry. Program costs are increased to 30% of the cost of efficiency measures, an estimate that is a high bound compared with federal, state, and utility experience. Overall implementation costs (programs and directed policies) are taken to be 15% of technology investments in this case. Other data and assumptions in this case are the same as for the "optimistic" case.

The results of the economic analysis are presented in Table 1.5. Estimated direct costs are \$26-\$49 billion per year for the efficiency scenario and \$51 to \$88 billion per year for the high-efficiency/low-carbon scenario. Estimated savings per year in 2010 are \$42 to \$51 billion per year in the efficiency case and \$70-\$88 billion per year for the high-efficiency/low-carbon case. The costs, which are a small portion of annual gross private domestic investment of about \$1.4 trillion in 2020, are likely to be more than balanced by savings in energy bills. Thus, net costs to the U.S. economy are near or below zero in this time frame.

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Table 1.5 Estimated Costs and Benefits of the Efficiency and High-Efficiency/Low-Carbon Scenarios: Optimistic and Pessimistic View Estimates (billions of 1995\$, annualized)

	Efficiency Case ^a			High-Efficiency/Low-Carbon Case ^b		
	Benefits ^c (billion 1995\$)	Costs ^d (billion 1995\$)	Carbon ^c Savings MtC	Benefits (billion 1995\$)	Costs (billion 1995\$)	Carbon Savings MtC
Energy Efficiency						
Buildings	14-17	7-14	20-25	26-33	14-26	49-62
Industry	6-7	3-5	18-22	12-15	8-13	66-82
Transportation	22-27	16-30	58-73	32-40	23-43	82-103
Electricity Dispatch	0	0	0	0	2	44-55
Electricity Repowering	0	0	0	0	2	32-40
Other Low-Carbon Technologies	0	0	0	0	2	33-41
Total	42-51	26-49	96-120	70-88	51-88	306-383

^a Energy efficiency category includes ethanol in transportation.

^b Benefits and carbon savings in the HE/LC case are relative to BAU case.

^c Benefits are calculated as annual energy savings. The scenarios are meant to be point estimates. In the "pessimistic" case, we have assumed that only 80% of the carbon savings are achieved, even though the technology and implementation costs are unchanged. The range on carbon savings represents this assumption.

^d Costs are calculated from differing viewpoints: the "optimistic" case uses discount rates that vary between 7% and 12.5% for the different sectors, as described in the text. For the "pessimistic" case, the discount rates used to annualize costs vary between 15% and 20%. Also in this case, the cost of implementing programs (30%) and an overall package of programs and policies (15%) is taken to be twice that of the "optimistic" case.

The range of estimates in Table 1.5 reflects our attempt to "bound" optimistic and pessimistic assessments. There are clearly other ways in which these bounds could be described, just as there are many scenarios that could have been analyzed. However, we believe that the assumption that 80% of the carbon reductions are achieved at the costs identified, valuation of costs and benefits at discount rates noticeably higher than the likely cost of capital, and doubling the cost of programs and policies from typical experience today is a strong reflection of pessimism in costs for our cases. It is worth noting that if the implementation costs were taken to be much higher than we believe to be reasonable – 50% of investments costs for programs and 25% overall – this would add about \$10 billion per year to the costs of the high-efficiency/low-carbon in the pessimistic case.

In addition to these costs, one needs to calculate the impact of the cases on natural gas demand. In all of these cases, natural gas replaces very large quantities of coal. Higher natural gas demand would result in higher natural gas prices, which in turn would increase the cost of substituting natural gas for coal in power production, etc. As it turns out, our scenarios have somewhat reduced gas demand compared with the BAU case (or with AEO97 baseline for 2010, on which the price of natural gas in our work is based). Specifically, demand for natural gas in the HE/LC (\$50/tonne) case declines in 2010 by 2 quads compared with the business-as-usual case. This is the result of declines of 0.5 quads for buildings, 1.0 quads for industry, and 0.5 quads for electricity. The latter occurs because of the balance among three factors:

- Increase in gas demand because of the large-scale substitution of natural gas for coal
- Decrease of gas demand because of the use of many low-carbon technologies that do not use natural gas (wind, nuclear power plant extensions, power plant efficiency upgrades, hydropower expansion, co-firing with biofuels), and

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- The large increase in cogeneration, which reduces demand for natural gas for heating applications.

The sum of the second and third effects are somewhat greater than the first, and thus total natural gas demand associated with electricity generation declines. This will reduce the cost of natural gas, a benefit that we have not included in

The \$50/tonne carbon charge, while not constituting a direct cost, does represent a potentially large transfer payment. The magnitude of the transfer payment, as well as the losers and winners from the transfers, depends on the nature of policy and its implementation as a cap and trade system or some alternative. The amount of money that could be in play is very large: \$50/tonne times 1.3 billion tonnes per year equals \$65 billion per year.

In short, while there will surely be winners and losers for these energy-efficiency and low-carbon scenarios, our analysis shows that their net economic costs – under a range of assumptions and alternative methods of cost analysis – are favorable.

The achievability of the cases depends on many factors. In all cases, carbon reductions require the nation to embark on an aggressive set of policies and programs. Such efforts could occur in response to an international agreement on climate change or to other events that result in a national determination to reduce the growth of carbon emissions. In the high-efficiency/low-carbon cases, we assume a vigorous national program of research, development, demonstration, and diffusion, and a trading regime for carbon with a domestic permit price of either \$25/tonne or \$50/tonne carbon. Without some scheme that provides strong incentives for switching from coal to natural gas, and for deploying other low-carbon technologies, much of the potential for carbon reductions will not be realized.

Government policies and programs that encourage and/or require the adoption of energy-efficiency and low-carbon technologies will be needed, along with incentives for industry to invest more in these technologies. Additional private and public investments are necessary, not only to accelerate the introduction of new technologies into the market before 2010 but also to ensure the availability of technologies for the period after 2010. The transportation and utility sectors are especially dependent on early technological advances to achieve the scenario results in 2010.

There is no assurance that these and other driving forces will cause the scenarios we have described to take place. Our major conclusion is that cost-effective technology can be deployed to achieve major reductions in carbon emissions by 2010. Cost-effective energy efficiency alone can take the nation 30 to 50% of the way to 1990 levels. Two additional utility sector measures can reduce carbon emissions by another 30% at an estimated cost of \$50/tonne carbon: carbon-based dispatch and conversion of existing power plants from coal to natural gas.⁴ Finally, we identify several additional technologies that can contribute up to 20% of the several carbon reductions, also for less than \$50/tonne. A next generation of advanced energy-efficiency and renewable energy technologies promises to enable the continuation of an aggressive pace of energy and carbon reductions over the next quarter century.

1.6 REFERENCES

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National Academy of Sciences (NAS). 1992. *Policy Implications of Greenhouse Warming: Mitigation, Adaptation, and the Science Base* (Washington, DC: National Academy Press).

Office of Technology Assessment (OTA). 1991. *Changing by Degrees: Steps to Reduce Greenhouse Gases*, OTA-0-482 (Washington, DC: U.S. Government Printing Office) February.

ENDNOTES

¹ The five national laboratories participating in the study were: Argonne National Laboratory (ANL), Lawrence Berkeley National Laboratory (LBNL), National Renewable Energy Laboratory (NREL), Oak Ridge National Laboratory (ORNL), and Pacific Northwest National Laboratory (PNNL). LBNL and ORNL were the co-leaders of the effort.

² See Section 2.2.3 for a definition of cost-effective energy efficiency technology.

³ \$50 per tonne of carbon corresponds to 12.5 cents per gallon of gasoline or 0.5 cents per kilowatt-hour for electricity produced from natural gas at 53% efficiency (or 1.3 cents per kilowatt-hour for coal at 34% efficiency). \$25 per tonne would cut these gasoline and electricity price increments in half.

⁴ The cost curve for repowering is relatively flat; as such, considerable additional reductions are possible at a cost not too different from \$50/tonne. The results are highly sensitive to the price differential between coal and natural gas; at a lower (higher) price differential, a higher (lower) permit price of carbon is needed.

 Jeffrey A. Frankel
08/29/97 08:42:28 AM

Record Type: Record

To: Jon D. Haveman/CEA/EOP
cc: Joseph E. Aldy/CEA/EOP, Randall W. Lutter/CEA/EOP
bcc:
Subject: Re: Net Exports of energy intensive industries 

Jon

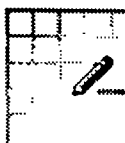
Thanks for your memo. Very interesting. It confirms surprisingly strongly our suspicions that adverse "competitiveness" effects on a few energy-intensive industries might be offset in other sectors. (You mention that checking whether net exports are positive is not the same as comparative advantage. How seriously do you think we should take this, in practice?) Regarding your last sentence, do you think this line of argument is too "superficial" to allow us to say "there is evidence against the view that excluding LDCs would have a substantial adverse effect on overall US "competitiveness" "? As opposed to "we can't say anything."?

Your list of energy-intensive industries overlaps almost perfectly with the list of six that we cited in a paper (author Peter Orszag, NEC) on LDC participation and US competitiveness. The only exceptions are Glass is on your list and not ours, and petroleum refining was on our list but not yours. (Obviously we import crude; but I don't know if we import or export refining services?) So you might add oil refining.

Should we correct for the fact that, these days, the US is a net importer of the average industry (i.e., we run a trade deficit)? This would be the easiest first step to generalizing the analysis to more sectors. Another possibility would be to figure out what are the LEAST energy intensive industries, and to see whether we import or export them.

Make any revisions to your memo appropriate. Include at the beginning a couple paragraphs explaining the relevance. (The conclusion at the end shouldn't pertain to whether we care at all on economic grounds, but whether we care regarding "competitiveness", or – if you'd rather avoid the word – regarding trade effects. We certainly care a lot whether the LDCs are in terms of economic cost per unit reduction in GHG concentrations.) Then let's send a copy to Orszag, and Gruber at Treasury.
JF

Jon D. Haveman

 Jon D. Haveman
08/28/97 08:48:51 PM

Record Type: Record

To: Jeffrey A. Frankel/CEA/EOP
cc:
Subject: Net Exports of energy intensive industries

Jeff,

I have generated some net-exports data for the following industries:

Paper and Allied Industries (SIC 26)

Chemicals and Allied Products (SIC 28)

Inorganic Chemicals (SIC 281)

Stone, Clay, and Glass Products (SIC 32)

Cement, Hydraulic (SIC 3241)

Primary Metal Industries (SIC 33)

Blast Furnace and Basic Steel Products (SIC 331)

Primary Aluminum (SIC 3334)

If these are not the industries that I should have been focusing on, please let me know. The data can very easily be altered to cover an alternative set of industries. The data are enclosed in the following WP document.

Jon



EMITNEX.WP

August 19, 1997

Comments on "Additionality in the Context of Joint Implementation", August 13 Draft
Office of Economic Policy, Treasury Department

1) The central problem with this paper is that it does not sufficiently acknowledge the *fundamentally difficult task of establishing that emissions reductions are incremental*. Each of the approaches proposed involves comparisons to a counterfactual that is not observed, only modelled. As such, the guarantee of additionality is only as good as the models themselves. The memo presents no evidence on the quality of the predictions from these types of models, nor a sufficiently rich discussion of the technical difficulties inherent in applying these types of modelling exercises in the context of JI.

To see this, compare the approaches listed in this paper to the best possible approach: JI with binding developing country commitments on emissions levels. This simply amounts to international trading with developing countries included. In such a world, we are guaranteed incrementality: to claim credit for a unit of emissions reduction, a company in the U.S. will have to buy a permit in the developing country for one unit of emissions. This will by definition guarantee that emissions in the developing country drop by one unit, since there is a fixed total of emissions credits in that country. Thus, additionality is assured, since there is now one fewer units of total emissions from other sources in the developing country.

Now, compare to this the best possible modelling approach. Under this approach, engineering specialists draw up a prediction about the future path of generation power sources (for example) in the developing country. But any prediction is just that, and as such will have some error. In some cases, the prediction will understate the pace of technological advance in the developing country, so that companies will get credit for building a type of plant that would have been built anyway. In some cases, the prediction will overstate the pace, so that companies will not build a plant because they are not getting credit. In any case, given that all models make prediction errors, there will be resulting error rates in our ability to assign JI credit. So there is *no way to guarantee additionality without binding developing country commitments*.

This is not to say that there is JI is completely non-additional under the proposed approaches. Indeed, the methodologies suggested are clever and are probably the best that we can do without commitments from developing countries. But while the paper acknowledges potential problems such as those described above in the fourth paragraph, it then immediately turns into the fifth to "assuring additionality". A footnote in that paragraph offers the appropriate caveat, but the implication is that additionality can be assured nonetheless.

This problem can be partially addressed by making three straightforward changes:

a) A new fourth paragraph on the first page should discuss the benchmark case: international trading. It should bring out the key points made above: that any JI approach which revolves around modelling baselines can only approach, and can never achieve, the additionality that would be guaranteed if developing countries were brought into an international trading regime.

b) Footnote 4 should be brought into the text and amplified.

c) Terms like “high accuracy” should be prefaced by “relatively”; these options are the highest accuracy of those listed, but may be very low accuracy relative to the ideal benchmark of international trading.

2) Do we have any evidence on how accurate the forecasts of counterfactual technology paths are likely to be? If we had done forecasts based on available data for the U.S. or some other country 10 years ago, would we have predicted anything like our current pattern of technology adoption for generation and other activities? This goes to the heart of these type of modelling approaches to establishing additionality.

3) As CEA and Treasury highlighted in their comments on an earlier draft, different approaches to modelling the processes of technological diffusion are likely to yield very different answers for the counterfactual. How will this uncertainty be resolved? This is a particularly salient question given the “all or nothing” aspect of JI. If there is some penetration of a particular type of generation, but it has not fully diffused, the company might get no credit at all. This will provide a particularly strong incentive for firms to promote the engineering estimates that support their case. How will these pressures be resisted, given the true uncertainty in the estimates?

One particular logistical difficulty will be deciding which country will be responsible for determining the counterfactual. If we let the developing countries themselves model the counterfactual, one could imagine an “engineering bidding war”, where each of several countries engineers compete to make their baseline look the least advanced (thus making their country more attractive for investment by presenting more opportunity for additionality). This could be rectified by an objective U.S. or third party engineer, but this might raise a difficult set of sovereignty issues.

4) Option 3 provides the closest alternative to true additionality through developing country commitments, by measuring changes in sector specific emissions patterns. But once again, it must be recognized that emissions are projected based on out of sample modelling. How accurate are our models? Once again, it would be constructive to assess how well existing models would do at predicted observed emissions history based on data that ended 10 years ago.

5) Options 4 and 5 strike us as the most problematic, since they are the most subjective. Any option which is strongly influenced by the type of proposal made by the firm, rather than by objective evidence to support additionality, will simply reward firms that are best at making their case, not those that are guaranteeing the most additionality. This will lead to huge inefficiencies (“rent-seeking losses”) as firms devote substantial resources to making a case look as good as possible, rather than devoting those resources to the investment itself.

FAX

JIDate: August 12, 1997Number of pages including cover sheet: 1*Com*
Shaw
Little
ddy

	Name	FAX Number	Phone Number
To:	Jeff Frankel	395-6947	
From:	David Wilcox	202-622-2633	

REMARKS: ☐ Urgent ☐ For your review ☐ Reply ASAP ☐ Please comment

Comments are due on this cob today. We should coordinate this afternoon on what comments we want to deliver.

Wilcox

Additionality in the Context of Joint Implementation

Issue:

Kyoto The United States is calling for joint implementation (JI) ~~with credit~~ to be included in the ~~agreement negotiated in Kyoto under the Framework Convention on Climate Change~~. Joint Implementation is a mechanism by which a private entity in a country with an emissions budget (developed countries) invests in greenhouse gas mitigation projects in a country without a budget (developing countries). In exchange, the investor (and its country) would receive credit towards its emission budget.

There is a broad consensus among countries and private parties that for JI to make sense, the emission reductions that give rise to JI credit must be "additional" to -- above and beyond -- reductions that would have happened anyway in the baseline case. Consider the case where a developer wants credit for building a low-GHG-emitting plant rather than a high-GHG-emitting plant. If the high-emitting plant truly represents what would have happened in the baseline case, then it would be appropriate to give the developer of the low-emitting plant credit for the difference. But if the low-emitting plant would have been built anyway (because its technology represents the business-as-usual case), then credit would not be appropriate. In that case, the project would ~~have no environmental benefit~~ *actually result in environmental*

harm: emissions in the developing country would be the same as in the

The principal problem identified to date is that the question "what would have happened ~~anyway~~ *BAU*" is extraordinarily difficult to answer at the project level. Experience in the US pilot program on JI indicates that reasonable analysts can differ over whether a proposal offers *case,* sufficient financial return that it should be expected to go forward without the additional reward *while* of JI credit, or conversely that it will be implemented only if credit is available. While baseline *is the* trend projections can be made for sectors, countries, or regions, the question is often *developed* imponderable at the project level. *country would be*

with JI is that it is extremely difficult to estimate the baseline is a credible fashion at the project level, which is what would be required. higher.

are The consequences of "getting it wrong" are large in both directions. If credit is given ~~systematically~~ for projects that would happen anyway, then the use of these credits to meet developed country obligations will result in higher global emissions. Consider only one area in which JI projects may be undertaken, energy efficiency improvements. The energy efficiency and emissions intensity of electric power projects and other industrial projects in developing countries *are* expected to improve significantly over the next 10-20 years, reflecting the normal penetration of better technologies. Indeed, a key part of the US negotiating position is to require countries to undertake "no regrets" reductions in emissions that are economically justified on their own. Preliminary analysis by EPA with one economic model (SGM) suggests that currently anticipated improvements in the efficiency of energy production and use in developing countries will reduce their expected emissions ~~growth~~ in 2010 by as much as 865 million tons of carbon, as compared with ~~growth~~ on the basis of existing technologies. If credit were given for projects in developing countries without accounting for these currently expected improvements, a large amount of excess carbon emission credits ~~could~~ *would* be awarded. Developed countries only need 750 million tons of

the level that would be attained with

carbon reductions to reach 1990 levels by 2010.

On the other hand, if the standard of "additionality" is set too high (i.e., if unrealistic improvements are taken into the baseline case), or if projects are choked off by transaction costs associated with resolving baselines and additionality on a project-by-project basis, then the large potential savings associated with JI will be lost.

The issue discussed in this paper is how "additionality" can be assured on a practical basis within the framework for JI that is negotiated in Kyoto. Since there are a large number GHG mitigation opportunities available in the developing world which are inexpensive compared to domestic options, it would greatly benefit the U.S. if practical methods could be developed to assure additionality. To that end, this paper presents and develops the most widely-discussed option for addressing JI additionality: "benchmarking". Several other options for addressing additionality are also briefly presented, but are not developed in detail. [Two attachments to the paper present recent stakeholder positions on JI and on additionality in particular, to the extent that agencies are familiar with them.]

Benchmarking

A set of benchmarks could be developed and agreed to for technologies and practices associated with joint implementation projects. These benchmarks would be internationally-agreed-upon determinations for specific technologies or practices. JI projects would be considered additional if the technology they employed were lower-emitting (more efficient) than the benchmark level. Credits would be calculated as the difference between the performance of the JI technology or practice and the benchmark performance level.

From a practical standpoint, these benchmarks would have to be developed and negotiated following the Kyoto meeting in December. JI provisions in the Kyoto agreement would have to include necessary criteria and call for the subsequent adoption of guidelines by the Parties to the agreement. The first set of benchmarks would be applicable to JI projects undertaken in the first budget period. They would need to be updated and renegotiated for subsequent budget periods, reflecting improvements in the baseline ("would have happened anyway") case over time.

Although more elaboration is necessary, several examples may serve to illustrate the benchmark concept.

Some JI proposals involve upgrades of existing energy production facilities. Consider a proposal to reduce the emissions of an electric power plant or district heating plant, by increasing the efficiency (improving the heat-rate) of the generator, or by switching fuels. A benchmark would be developed regarding the expected future of such facilities. For illustration, that might take two forms:

- Based on economic forecasts, estimated technology penetration rates, and other factors, it

may be agreed that in the business-as-usual case, these facilities would continue to be operated indefinitely without upgrade. In that case, the benchmark would reflect the emissions rate of the current facilities and credit would be given for improvements made.

- Alternatively, forecasts may show that the proposed technologies are already penetrating these markets and that these upgrades are expected to take place in the business-as-usual case. In that case, the benchmark would reflect these improvements, and no credit would be given for making them.

Other JI proposals involve projects to meet new power demand with lower emissions. Proposals include building lower emitting power projects in place of building relatively inefficient coal-fired plants (e.g., renewable, gas-fired, or even more efficient coal-fired plants). A benchmark would be developed for the emissions-intensity of base case power production facilities, with credit given for lower-emitting projects. For illustration:

- Based on economic forecasts, estimated technology penetration rates, and other factors, it may be agreed that the baseline case is the construction of high-emitting plants, with credit given for alternative technologies with lower emissions per kilowatt-hour output. On the other hand, it may be agreed that a certain penetration of gas, wind, or other technologies is already expected, and thus should not be given JI credit.
- but not 100%? I f not 100% how would it be decided in any individual case whether that plant would have been biomass or the baseline?*

Similar benchmarks could be developed for other technologies, such as new automobiles (carbon per mile per vehicle), or steel mills (tonnes carbon per tonne of steel). Similar issues are presented by projects to enhance the sequestration of carbon in forests or soils. A range of projects have been proposed, from preservation of existing forests, to changing logging practices (e.g., selective logging rather than clear-cutting), to the creation of tree plantations. Benchmarks might reflect tonnes of carbon emissions per board feet of lumber.

Forecasting and negotiating benchmarks for these expected emissions futures will be complex. Consideration should be given to whether a single set of global benchmarks can be used, or whether they will need to be regionally- or nationally-specific.

Other Potential Options For Addressing Additionality

Several other approaches to additionality have been suggested, but do not seem as attractive as the benchmark approach:

1. *Defining additionality as overcoming project-specific barriers*

One option, which is being advanced internationally by the International Energy Agency, would involve assessing whether a project breaks ground by overcoming barriers (institutional, financial, technological, informational, policy, financing, or market) specific to that project in the country where it is proposed. A project would be deemed additional if it is demonstrated that the existence of such barriers is inhibiting the project from going forward, that the project would represent an innovation in overcoming those barriers, and that JI credit would supply the necessary incentive to go forward. The IEA's research in this area, which defines and categorizes generic barrier types for specific sectors (power generation, transport, etc.), provides developers and evaluators with a framework for identifying and evaluating barriers.¹

2. *Measuring additionality from quantitative, sector-specific baselines*

This option would involve the development of sector-specific, rather than project-specific, baselines in countries which wish to host JI ~~for the sectors in which the countries wish to pursue~~. These baselines would constitute a quantitative determination of projected future GHG emissions from relevant sectors in such countries. The quantitative baseline for each sector would be based on such factors as expected penetration rates of technologies or practices, estimates of capital stock turnover, and adopted and projected policies and measures or legally required performance standards affecting the sector. For a JI project to be deemed additional, a determination would have to be made that the project is not already accounted for in the baseline projection for that sector in that country.

3. *Assess additionality using a general set of guidelines*

This option would provide for project by project judgments of additionality based on information provided by project developers. Project developers and evaluators would use a general set of guidelines to develop and evaluate additionality arguments. This is be similar to the approach currently used by the United States Initiative on Joint Implementation. For example, in the original guidelines for development of a USJI project proposal USJI asks, regarding additionality, that project developers include a discussion of the following subjects in their project proposal:

(1) How the existence of the USJI program helped or could help overcome any barriers to develop or implement the project;

(2) A discussion of whether the specific measures taken by the project to reduce or sequester greenhouse gas emissions are required by existing laws or regulations applicable in the U.S. or host country

¹Not yet published International Energy Agency paper titled "Activities Implemented Jointly Under the FCCC."

For each of (1), (2), & (3), it would be helpful to explain why they were rejected in favor of benchmarking.

(3) A description of the prevailing technologies and management practices now used in the host country and how the specific measures proposed in the project differ from them.²

Employing safeguards such as discounting

Given that any method to determine additionality is likely to be imperfect, this option would employ safeguards such as discounting to reduce the chance of giving credit for emission reductions happening anyway. In this way the overall quantity of excess credits created through JI could be reduced. Other options for safeguards include phasing out JI in some future year, or limiting the scope of JI (e.g. developed countries might be limited to meeting 10% of their emission reduction targets through JI).

My sense is that the costs of implementing the "benchmarks" approach need to be spelled out much more completely.

- administrative burden

[would engineers have to be on staff? presumably so]

- range of possibilities extends only as far as list of eligible projects

- distortions between included vs not included projects

- heterogeneities — every project is unique

- how to deal with penetration ratios less than 100%.

²Description of the U.S. Initiative on Joint Implementation, 1994.

Stakeholder Positions on Joint Implementation In General

Opposed to JI with credit in Kyoto

Sierra Club³

Climate Action Network

Atmospheric Alliance

Center for International Environmental Law

Biomass Energy Advocates

Environmental and Energy Study Institute

Friends of the Earth

Greenpeace

Natural Resources Defense Council

Ozone Action

Physicians for Social Responsibility⁴

In favor of JI with credit in Kyoto

International Climate Change Partnership⁵

Global Climate Coalition⁶

Edison Electric Institute⁷

³Comments of Carl Pope, Executive Director, Sierra Club titled "Evaluation and Assessment of the U.S. Initiative on Joint Implementation" and dated January 24, 1997, in response to USIJI request for comments on the U.S. Initiative on Joint Implementation in 61 Federal Register 5940-81 on November 22, 1996.

⁴Letter to Eileen B. Claussen, Assistant Secretary of State for Oceans and International Environmental and Scientific Affairs, May 2, 1997, from the U.S. Climate Action Network

⁵"International Climate Change Partnership Views on Key Issues in the Climate Change Protocol Negotiations" June 1997

⁶GCC Home page (<http://www.worldcorp.com/dc-online/gcc/ji.html>) subpage titled "Joint Implementation: A Strategy Option for Global Emissions Reductions"

⁷Letter to Eileen B. Claussen, Assistant Secretary of State for Oceans and International Environmental and Scientific Affairs, March 24, 1997 from Edison Electric Institute, titled "EEI Recommended Clarifications of Proposed Protocol"

Conditionally in favor of JI with credit in Kyoto

Business Council for Sustainable Energy (BCSE)

"...market-based tools such as joint implementation should be allowed between Parties with obligations under the protocol, but only for clearly verifiable and quantifiable emissions reduction projects."

Environmental Defense Fund

"There are strong environmental and development policy reasons to favor such joint implementation....In the absence of an adequate rule-based framework, joint implementation between budget and non-budget nations will neither provide credible environmental benefits nor foster a culture of compliance in participating countries."

*BCSE "Position Statement -- Global Climate Change" 1997.

*Facsimile from Annie Personk of the Environmental Defense Fund to Lisa Carter of the U. S. Environmental Protection Agency dated February 7, 1997

Stakeholder Positions On Additionality And Benchmarking:

Edison Electric Institute

"...the protocol text should reflect workable criteria for joint implementation (JI) that enhance, rather than inhibit, development of overseas projects and recognition of full credit for those projects. In particular, the additionality criteria under the ground rules for the U.S. Initiative on Joint Implementation (USII) have proved to be a barrier to widespread development of JI projects. In the enclosed clarifications we suggest alternative language...."

The alternative language deletes Section 2(b) of the Article on joint implementation which reads "Projects must produce a reduction in emission that is additional to any that would otherwise occur."

The alternative language also suggests that for projects involving the electric power sector the greenhouse gas benefits of a project be determined "by calculating the difference in carbon emissions per KWH between that of the project (after its completion) and the national average of generating facilities in the Party in which the project is located that were producing electricity during the year that construction of the project was authorized at higher costs (cents per KWH) than the project (after its completion)."¹⁰

Environmental Defense Fund

[EDF has developed extensive comments on ~~additionality~~ this subject. ~~It is attempted here~~ *This excerpt* ~~to show the general flavor of their comments and to provide their comments on the benchmark option.~~]

"How should what would have occurred be determined? The question of "what would have occurred" in the absence of any particular JI project is a highly project-specific one, and will vary from nation to nation, and even across regions within nations, according to levels of development, availability of capital, and other constraints. Thus it is not a question that can be answered by a single formula. It must be analyzed on a project-by-project or case-by case basis...."

"....Other proposals suggest that there should be an agreed international construct defining the best available technology (BAT) that might otherwise have been implemented, and that JI credit should only be awarded for activities that are more efficient than this collectively-defined BAT. The past twenty years of environmental policy in the United States,

¹⁰Letter to Eileen B. Claussen, Assistant Secretary of State for Oceans and International Environmental and Scientific Affairs, March 24, 1997 from Edison Electric Institute.

however, have demonstrated that centrally-defined BAT approaches all too often lead to costly, innovation-stifling regulation, and should therefore be avoided. Moreover, a one-size-fits-all approach to BAT overlooks the differences among nations and among regions within nations... Finally, in the international arena, efforts to develop centralized definitions of BAT will likely deteriorate into difficult and divisive trade negotiations."¹¹

Center for Clean Air Policy

"We recommend that the U.S. drop the additionality test for 1) projects that reduce net emissions (fuel switching, efficiency improvement and other projects that reduce emissions at existing facilities); and 2) all renewable energy projects, which clearly do not increase GHG emissions. Dropping the additionality test would make credits produced by these projects more fungible, increase transparency and reduce the transaction costs associated with the current JI process both here and abroad. We also recommend the discounting of JI project credits to account for uncertainty and to improve the credibility of JI generally."¹²

U.S. Climate Action Network

"...if emission credits are to be considered for JI projects, we believe that they must be based on clear criteria and benchmarks, rather than an inherently subjective and unverifiable project-by-project determination of what would otherwise have happened."¹³

¹¹Facsimile from Annie Petsonk of the Environmental Defense Fund to Lisa Carter of the U.S. Environmental Protection Agency dated February 7, 1997.

¹²Letter to Bob Dixon from Edward A. Helme, Director, Center for Clean Air Policy, dated June 26, 1997 which accompanies a paper titled "Integration of Joint Implementation into an Annex I Greenhouse Gas Trading System."

¹³Letter to Eileen B. Claussen, Assistant Secretary of State for Oceans and International Environmental and Scientific Affairs, May 2, 1997 from the U.S. Climate Action Network.

CCAP CASE 4/26/97

TABLE 1: KEY ECONOMIC DATA AND ASSUMPTIONS

	1990	2000	2005	2010	2015	2020	2025
GDP (BILLIONS 1987\$)	4897	6144	6833	7480	8046	8642	n/a
GDP (BILLIONS 1995\$)	6084	8005	8902	9745	10483	11259	n/a
POPULATION (MILLIONS)	250	276	287	299	311	324	n/a
DISPOSABLE INCOME (BILLIONS 1987\$)	3525	4470	4972	5494	5949	6350	n/a
HOUSING STOCK (MILLIONS)	94.0	103.0	108.8	114.7	120.6	125.4	n/a
COM. FLOOR SPACE (BILL SQ FT)	64.3	72.3	75.4	78.5	81.9	85.3	n/a
INDUSTRIAL PROD INDEX (1990=100)	100.0	123.0	137.8	151.9	163.0	174.0	n/a

TABLE 2: PRIMARY ENERGY CONSUMPTION AND PRODUCTION (QUADS)

	1990	2000	2005	2010	2015	2020	2025
PRIMARY ENERGY CONSUMPTION							
OIL	33.51	37.65	39.69	41.30	42.64	43.82	n/a
GAS	19.42	23.95	25.37	27.15	29.99	30.21	n/a
COAL	19.01	20.99	21.50	22.23	22.50	23.23	n/a
NUCLEAR	6.16	7.34	7.34	6.39	4.67	3.80	n/a
RENEWABLE	6.23	6.97	7.51	7.73	8.12	9.28	n/a
METHANOL	0.00	0.01	0.03	0.03	0.03	0.02	n/a
NET ELECTRICITY							
IMPORTS	0.01	0.14	0.12	0.11	0.09	0.09	n/a
TOTAL	84.33	97.04	101.56	104.93	108.04	110.44	n/a
ENERGY INTENSITY							
(BTU/\$GDP in 1995\$)	13861	12123	11408	10767	10306	9809	n/a
PRIMARY DOMESTIC ENERGY PRODUCTION AND IMPORTS							
PRODUCTION							
OIL	17.74	14.54	13.34	12.77	11.86	10.82	n/a
GAS	18.34	20.82	21.86	23.09	25.49	25.36	n/a
COAL	22.46	23.26	24.10	25.20	25.83	26.92	n/a
NUCLEAR	6.16	7.34	7.34	6.39	4.67	3.80	n/a
RENEWABLE	6.93	6.97	7.51	7.73	8.12	9.28	n/a
TOTAL	71.63	72.93	74.15	75.18	75.97	76.18	n/a
NET IMPORTS							
OIL	15.43	23.11	26.28	28.38	30.55	32.66	n/a
GAS	1.47	3.00	3.39	3.93	4.36	4.71	n/a
COAL	-2.88	-2.22	-2.54	-2.90	-3.26	-3.62	n/a
ALCOHOL/OTHER	0.09	0.15	0.15	0.13	0.12	0.11	n/a
TOTAL	14.12	24.04	27.28	29.55	31.76	33.87	n/a
ADJUSTMENTS							
OIL	-.30	0.00	0.00	0.00	0.00	0.00	0.00
GAS	-.30	0.00	0.00	0.00	0.00	0.00	0.00
COAL	-.45	0.00	0.00	0.00	0.00	0.00	0.00
OTHER	-.37	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	-1.42	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL ENERGY SUPPLIED							
	84.33	96.97	101.44	104.73	107.73	110.04	n/a

TABLE 3: ENERGY PRICES BY SECTOR

	1990	2000	2005	2010	2015	2020	2025
ENERGY PRICES (1995\$/ MILLION BTU)							
RESOURCE PRICES							
REFINER CRUDE	4.12	3.14	3.39	3.50	3.68	3.82	n/a
WELLHEAD GAS	1.85	1.80	1.90	1.92	2.04	2.32	n/a
MINEMOUTH COAL	1.11	0.84	0.80	0.77	0.72	0.71	n/a
RESIDENTIAL							
DISTILLATE	8.39	7.76	8.15	8.28	8.45	8.59	n/a
OTHER LIQUID FUELS	11.99	11.18	11.67	11.82	12.04	12.22	n/a
NATURAL GAS	6.17	6.03	6.05	5.94	6.06	6.33	n/a
ELECTRICITY	25.24	23.82	23.22	22.78	21.86	21.71	n/a
COMMERCIAL							
DISTILLATE	6.13	5.48	5.85	5.96	6.13	6.28	n/a
RESIDUAL FUEL OIL	3.75	2.90	3.15	3.22	3.39	3.54	n/a
NATURAL GAS	5.14	4.98	5.04	4.96	5.08	5.35	n/a
ELECTRICITY	22.98	21.40	20.93	20.41	19.53	19.40	n/a
INDUSTRIAL							
DISTILLATE	6.16	5.48	5.87	5.99	6.16	6.31	n/a
RESIDUAL FUEL OIL	3.38	2.76	3.00	3.07	3.25	3.39	n/a
OTHER LIQUID FUELS	5.94	6.55	7.02	7.17	7.38	7.55	n/a
NATURAL GAS							
BOILER	2.94	2.79	2.86	2.87	2.99	3.27	n/a
NON-BOILER	2.94	2.79	2.86	2.87	2.99	3.27	n/a
STEAM COAL	1.63	1.35	1.34	1.24	1.19	1.18	n/a
ELECTRICITY	15.49	14.29	13.84	13.71	13.08	12.99	n/a
TRANSPORTATION							
GASOLINE	10.25	10.96	11.32	11.12	11.29	11.44	n/a
DIESEL	9.30	9.23	9.39	9.32	9.49	9.63	n/a
RESIDUAL FUEL OIL	3.26	2.58	2.82	2.92	3.09	3.23	n/a
JET FUEL	6.23	5.78	6.28	6.33	6.50	6.64	n/a
ELECTRICITY	15.62	14.42	14.64	14.07	13.44	13.35	n/a
UTILITY SECTOR							
OTHER LIQUID FUELS	3.55	2.74	2.99	3.12	3.29	3.43	n/a
NATURAL GAS	2.56	2.26	2.33	2.35	2.54	2.88	n/a
STEAM COAL	1.54	1.41	1.26	1.17	1.12	1.11	n/a
NUCLEAR	0.65	0.38	0.40	0.42	0.40	0.38	n/a
AVERAGE ELEC. PRICE	21.09	19.70	19.11	18.71	17.92	17.80	n/a
ENERGY PRICES (1995\$/PHYSICAL UNIT)							
RESOURCE							
WORLD OIL PRICE							
(\$/BBL)	23.87	18.20	19.67	20.33	21.33	22.16	n/a

WELLHEAD NATURAL

GAS (\$/MCF)	1.91	1.85	1.96	1.98	2.11	2.39	n/a
MINEMOUTH COAL							
(\$/TON)	23.93	17.96	17.12	16.52	15.42	15.31	n/a

END-USE

AVERAGE PRICE

ELECTRICITY (C/KWH)	7.20	6.72	6.52	6.38	6.11	6.07	n/a
AVERAGE PRICE							
GASOLINE (\$/GAL)	1.28	1.37	1.42	1.39	1.41	1.43	n/a

TABLE 4: END-USE ENERGY CONSUMED BY FINAL CUSTOMERS (QUADS)

	1990	2000	2005	2010	2015	2020	2025
CONSUMPTION BY SECTOR							
RESIDENTIAL	9.65	10.96	11.01	11.21	11.62	12.00	n/a
COMMERCIAL	6.53	7.44	7.66	7.78	7.96	8.18	n/a
INDUSTRIAL	24.84	28.09	29.53	30.38	31.28	31.78	n/a
TRANSPORTATION	22.55	26.75	28.82	30.43	31.82	33.16	n/a
TOTAL END-USE CONSUMPTION	63.57	73.23	77.02	79.80	82.68	85.11	n/a
TRANS. & DIST. LOSSES	-20.76	-23.81	-24.54	-25.13	-25.36	-25.33	n/a
TOTAL PRIMARY CONSUMPTION	84.33	97.04	101.56	104.93	108.04	110.44	n/a
ENERGY USED BY FINAL CONSUMER (EXCL. INPUTS TO UTILITIES)							
OIL	32.30	36.99	39.16	40.70	41.81	43.09	n/a
NATURAL GAS	16.43	19.54	20.43	21.19	22.08	22.37	n/a
COAL	2.91	2.66	2.54	2.46	2.44	2.48	n/a
ELECTRICITY	9.26	11.27	11.99	12.62	13.41	14.08	n/a
RENEWABLE	2.67	2.77	2.87	2.81	2.90	3.06	n/a
METHANOL	0.00	0.01	0.03	0.03	0.03	0.02	n/a
TOTAL END-USE CONSUMPTION	63.57	73.23	77.02	79.80	82.68	85.11	n/a
TRANS. & DIST. LOSSES	-20.76	-23.81	-24.54	-25.13	-25.36	-25.33	n/a
TOTAL PRIMARY CONSUMPTION	84.33	97.04	101.56	104.93	108.04	110.44	n/a

TABLE 5: OIL CONSUMPTION AND PRODUCTION (MILL. BARRELS/DAY)

	1990	2000	2005	2010	2015	2020	2025
INDIGENOUS OIL PRODUCTION							
LOWER 48	4.81	3.79	3.47	3.23	2.73	2.26	n/a
ALASKA	1.77	1.11	0.78	0.71	0.65	0.59	n/a
ENHANCED OIL RECOVERY	0.77	0.76	0.74	0.65	0.54	0.59	n/a
TAR SANDS	0.00	0.00	0.00	0.00	0.00	0.00	n/a
SHALE OIL	0.00	0.00	0.00	0.00	0.00	0.00	n/a
NATURAL GAS LIQUIDS	1.56	1.85	1.99	2.18	2.55	2.54	n/a
TOTAL OIL PRODUCTION	8.91	7.50	6.98	6.78	6.48	5.99	n/a
OTHER SOURCES							
NET OIL IMPORTS	7.17	10.67	12.14	13.10	14.10	15.08	n/a
STOCK CHANGES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OTHER	0.76	0.84	0.88	0.91	0.95	0.97	n/a
TOTAL IMPORTS & STOCK CHANGES	7.93	11.51	13.02	14.02	15.05	16.05	n/a
TOTAL PRIMARY OIL CONSUMPTION	16.84	19.01	20.00	20.80	21.52	22.04	n/a
OIL TRANSFORMATION TO ELECTRICITY	-0.54	-0.29	-0.23	-0.26	-0.36	-0.31	n/a
TO GAS	-0.00	-0.04	-0.04	-0.04	-0.04	-0.04	n/a
TOTAL END-USE OIL CONSUMPTION	16.30	18.64	19.69	20.46	21.09	21.65	n/a

TABLE 6: GAS CONSUMPTION AND PRODUCTION (TRILLION CU. FT.)

	1990	2000	2005	2010	2015	2020	2025
INDIGENOUS PRODUCTION OF CONVENTIONAL GAS							
LOWER 48	17.81	20.20	21.20	22.39	24.72	24.59	n/a
NORTH ALASKA	0.00	0.00	0.00	0.00	0.00	0.00	n/a
TOTAL CONVENTIONAL GAS PRODUCTION	17.81	20.20	21.20	22.39	24.72	24.59	n/a
ADDITIONAL SOURCES OF CONVENTIONAL GAS							
PIPELINE	1.45	2.62	2.76	3.08	3.44	3.74	n/a
LNG	0.00	0.30	0.53	0.73	0.79	0.83	n/a
STOCK CHANGE	-0.51	0.00	0.00	0.00	0.00	0.00	0.00
OTHER	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL IMPORTS AND OTHER	0.94	2.91	3.29	3.81	4.23	4.57	n/a
TOTAL CONVENTIONAL GAS CONSUMPTION	18.75	23.11	24.49	26.21	28.94	29.16	n/a
TRANSFORMATION TO OR FROM GAS							
SYNTH FROM OIL	0.10	0.06	0.06	0.06	0.06	0.06	n/a
SYNTH FROM COAL	0.00	0.05	0.06	0.07	0.07	0.07	n/a
TOTAL SYNTHETICS	0.10	0.11	0.12	0.13	0.13	0.13	n/a
TO ELECTRICITY	-2.79	-4.28	-4.80	-5.78	-7.67	-7.60	n/a
TOTAL GAS USED BY FINAL CONSUMERS	16.06	18.80	19.67	20.39	21.17	21.46	n/a
TOTAL PRIMARY GAS CONSUMED	18.85	23.22	24.61	26.34	29.08	29.30	n/a

TABLE 7: COAL CONSUMPTION AND PRODUCTION

	1990	2000	2005	2010	2015	2020	2025

COAL PRODUCTION AND CONSUMPTION (QUADS)							
TOTAL PRIMARY							
PRODUCTION	22.46	23.26	24.10	25.20	25.83	26.92	n/a
NET IMPORTS	-2.88	-2.22	-2.54	-2.90	-3.26	-3.62	n/a
STOCK CHANGES	-0.45	0.00	0.00	0.00	0.00	0.00	0.00
OTHER	-0.12	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL PRIMARY							
CONSUMPTION	19.01	21.04	21.56	22.30	22.57	23.30	n/a
TRANSFORMATION							
TO ELECTRICITY	16.10	18.32	18.96	19.77	20.05	20.75	n/a
TO SYNTHETIC FUELS	0.00	0.08	0.10	0.12	0.12	0.12	n/a
COAL USED BY							
FINAL CONSUMERS	2.91	2.64	2.51	2.42	2.40	2.44	n/a
COAL PRODUCTION AND CONSUMPTION (MILLION SHORT TONS)							
TOTAL PRIMARY							
PRODUCTION	1029.0	1095.2	1134.8	1186.6	1215.4	1266.2	n/a
NET IMPORTS	-103.0	-84.7	-97.0	-110.7	-124.4	-138.2	n/a
STOCK CHANGES	-31.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER	-0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL PRIMARY							
CONSUMPTION	895.0	1010.4	1037.9	1075.9	1091.0	1128.1	n/a
TRANSFORMATION							
TO ELECTRICITY	774.0	875.5	905.9	944.8	958.1	991.2	n/a
TO SYNTHETIC FUELS	0.0	3.6	4.5	5.4	5.4	5.4	n/a
COAL USED BY							
FINAL CONSUMERS	121.0	131.3	127.5	125.7	127.5	131.4	n/a

TABLE 8: RENEWABLE ENERGY CONSUMPTION AND PROD. (QUADS)

	1990	2000	2005	2010	2015	2020	2025

RENEWABLE INPUTS TO ELECTRICITY GENERATION							
HYDROPOWER	2.94	3.13	3.15	3.16	3.17	3.18	n/a
GEOHERMAL	0.32	0.53	0.60	0.63	0.64	0.63	n/a
BIOMASS/MSW	0.26	0.46	0.77	0.96	1.16	2.02	n/a
SOLAR THERMAL	0.01	0.02	0.03	0.03	0.04	0.05	n/a
PHOTOVOLTAIC	0.00	0.00	0.01	0.01	0.03	0.10	n/a
WIND	0.02	0.07	0.09	0.12	0.18	0.24	n/a
TOTAL	3.55	4.20	4.64	4.92	5.21	6.22	n/a
RENEWABLE ENERGY USED BY FINAL CONSUMERS							
BIOMASS WOOD	2.56	2.71	2.73	2.57	2.47	2.42	n/a
INDUSTRIAL HYDRO	0.01	0.01	0.01	0.01	0.01	0.01	n/a
ETHANOL	0.00	0.02	0.08	0.17	0.37	0.56	n/a
SOLAR	0.06	0.02	0.02	0.02	0.02	0.02	n/a
GEOHERMAL	0.01	0.01	0.02	0.04	0.04	0.05	n/a
PHOTOVOLTAIC	0.00	0.00	0.00	0.00	0.00	0.00	n/a
WIND	0.00	0.00	0.00	0.00	0.00	0.00	n/a
TOTAL	2.75	2.77	2.87	2.81	2.90	3.06	n/a
PRIMARY RENEWABLE							
TOTAL	6.30	6.97	7.51	7.73	8.12	9.28	n/a

** Industrial cogeneration fuel consumption included with final consumers, not electricity generation.

TABLE 9: ENERGY CONSUMPTION IN BUILDINGS

	1990	2000	2005	2010	2015	2020	2025
RESIDENTIAL ENERGY USE (QUADS)							
OIL	1.27	1.27	1.21	1.16	1.14	1.12	n/a
NATURAL GAS	4.52	5.15	5.08	5.13	5.22	5.26	n/a
COAL	0.06	0.06	0.05	0.04	0.04	0.03	n/a
ELECTRICITY	3.15	3.89	4.09	4.28	4.64	5.01	n/a
RENEWABLES	0.65	0.58	0.59	0.59	0.58	0.58	n/a
TOTAL	9.65	10.96	11.01	11.21	11.62	12.00	n/a
COMMERCIAL ENERGY USE (QUADS)							
OIL	0.91	0.75	0.74	0.72	0.70	0.69	n/a
NATURAL GAS	2.70	3.13	3.21	3.26	3.33	3.42	n/a
COAL	0.09	0.08	0.08	0.08	0.07	0.07	n/a
ELECTRICITY	2.82	3.45	3.61	3.70	3.83	3.97	n/a
RENEWABLE	0.01	0.03	0.03	0.03	0.03	0.03	n/a
TOTAL	6.53	7.44	7.66	7.78	7.96	8.18	n/a
PHYSICAL UNITS							
RESIDENTIAL							
OIL (MMBD)	0.66	0.60	0.57	0.55	0.54	0.53	n/a
GAS (TCF)	4.38	5.00	4.93	4.97	5.06	5.10	n/a
ELECTRICITY (BKWH)	924.0	1140.8	1199.3	1255.4	1360.1	1467.0	n/a
COMMERCIAL							
OIL (MMBD)	0.48	0.35	0.34	0.33	0.32	0.32	n/a
GAS (TCF)	2.62	3.03	3.11	3.17	3.23	3.32	n/a
ELECTRICITY (BKWH)	826.0	1009.6	1057.3	1083.1	1121.5	1162.2	n/a

TABLE 10: ENERGY/NON-ENERGY CONSUMPTION IN INDUSTRIAL (QUADS)

	1990	2000	2005	2010	2015	2020	2025
ENERGY USE (EXCLUDING NON-ENERGY FEEDSTOCKS)							
OIL	4.63	4.73	4.81	4.79	4.77	4.86	n/a
GASES	7.45	9.16	9.84	10.24	10.63	10.62	n/a
COAL	1.71	1.72	1.68	1.68	1.74	1.85	n/a
ELECTRICITY	3.23	3.84	4.15	4.42	4.67	4.78	n/a
RENEWABLE	2.00	2.14	2.18	2.02	1.93	1.89	n/a
TOTAL	19.01	21.59	22.66	23.15	23.74	24.01	n/a
NON-ENERGY USE							
ASPHALT	1.17	1.16	1.20	1.24	1.27	1.30	n/a
OTHER	2.53	3.25	3.56	3.88	4.18	4.45	n/a
SUBTOTAL	3.70	4.41	4.76	5.12	5.45	5.75	n/a
GASES	1.07	1.29	1.38	1.45	1.49	1.49	n/a
METALL. COAL	1.05	0.81	0.73	0.66	0.59	0.53	n/a
TOTAL	5.82	6.51	6.87	7.23	7.53	7.77	n/a
ENERGY & NON-ENERGY USE							
OIL	8.33	9.13	9.58	9.91	10.23	10.61	n/a
GAS	8.52	10.45	11.22	11.69	12.11	12.11	n/a
COAL	2.76	2.52	2.41	2.34	2.33	2.38	n/a
ELECTRICITY	3.23	3.84	4.15	4.42	4.67	4.78	n/a
RENEWABLE	2.00	2.14	2.18	2.02	1.93	1.89	n/a
TOTAL PRIMARY	24.83	28.09	29.53	30.38	31.28	31.78	n/a

TABLE 11: ENERGY CONSUMPTION IN TRANSPORTATION (QUADS)

	1990	2000	2005	2010	2015	2020	2025
OIL	21.81	25.83	27.64	28.91	29.74	30.68	n/a
MOTOR GASOLINE	13.58	15.64	16.27	16.41	16.75	17.18	n/a
DIESEL	3.83	4.71	5.18	5.63	5.78	6.03	n/a
JET FUEL	3.14	3.86	4.33	4.70	4.83	4.87	n/a
RESIDUAL FUEL	1.03	1.30	1.46	1.65	1.77	1.90	n/a
LPG	0.01	0.05	0.12	0.21	0.30	0.39	n/a
OTHER	0.22	0.26	0.28	0.30	0.31	0.31	n/a
METHANOL	0.00	0.01	0.03	0.03	0.03	0.02	n/a
ETHANOL	0.00	0.02	0.08	0.17	0.37	0.56	n/a
NATURAL GAS	0.68	0.80	0.93	1.11	1.41	1.57	n/a
ELECTRICITY	0.06	0.09	0.15	0.22	0.28	0.33	n/a
COAL	0.00	0.00	0.00	0.00	0.00	0.00	n/a
TOTAL CONSUMPTION	22.55	26.75	28.82	30.43	31.82	33.16	n/a

ADDITIONAL DATA -- TRANSPORTATION SECTOR

LIGHT DUTY VEHICLES

OPERATING VEHICLES (MILLIONS)	186.7	211.3	228.1	242.5	255.6	267.4	n/a
VEHICLE MILES (BILLIONS)	1940	2373	2639	2885	3148	3368	n/a
FLEET EFFICIENCY (EPA ESTIMATED MPG)	22.2	24.7	25.9	27.1	28.0	28.7	n/a
FUEL CONSUMPTION (QUADS)	12.72	14.98	15.94	16.66	17.41	18.23	n/a

HEAVY DUTY VEHICLES

OPERATING VEHICLES (MILLIONS)	4.4	4.8	5.1	5.4	5.7	6.0	n/a
VEHICLE MILES (BILLION)	151	181	199	211	224	238	n/a
FLEET EFFICIENCY (ON ROAD MPG)	5.60	5.79	5.80	5.81	5.83	5.83	n/a
FUEL CONSUMPTION (QUADS)	3.64	4.34	4.75	5.03	5.34	5.66	n/a

	1990	2000	2005	2010	2015	2020	2025
AIR TRAVEL							
PASSENGER REV. MILES (BILLIONS)	472	786	904	1011	1058	1090	n/a
FLEET EFFICIENCY INDEXED TO 1990	1.00	1.10	1.11	1.12	1.14	1.16	n/a
FUEL CONSUMPTION (QUADS)	3.20	3.87	4.34	4.71	4.84	4.88	n/a
RAILROADS							
RAIL FREIGHT TON-MILES	1034	1210	1323	1408	1491	1585	n/a
FUEL EFFICIENCY INDEXED TO 1990	1.00	1.10	1.12	1.14	1.23	1.34	n/a
FUEL CONSUMPTION (QUADS)	0.57	0.64	0.69	0.71	0.70	0.69	n/a
WATERBORNE							
FUEL CONSUMPTION (QUADS)	1.57	1.93	2.12	2.34	2.48	2.63	n/a
PIPELINE							
FUEL CONSUMPTION (QUADS)	0.68	0.72	0.72	0.69	0.76	0.76	n/a
OTHER MODES							
FUEL CONSUMPTION (QUADS)	0.17	0.25	0.27	0.29	0.29	0.30	n/a

TABLE 11P: TRANSPORTATION ENERGY CONSUMPTION (PHYS. UNITS)

	1990	2000	2005	2010	2015	2020	2025
OIL (MMBPD)	10.96	12.96	13.81	14.37	14.73	15.15	n/a
MOTOR GASOLINE	7.08	8.16	8.49	8.56	8.74	8.96	n/a
DIESEL	1.80	2.21	2.43	2.65	2.72	2.84	n/a
JET FUEL	1.51	1.88	2.11	2.29	2.35	2.37	n/a
RESIDUAL FUEL	0.45	0.57	0.64	0.72	0.77	0.83	n/a
LPG	0.01	0.03	0.06	0.11	0.15	0.19	n/a
OTHER	0.11	0.13	0.14	0.15	0.15	0.16	n/a
METHANOL (MMBPD)	0.00	0.01	0.03	0.03	0.02	0.02	n/a
ETHANOL (MMBPD)	0.00	0.01	0.06	0.12	0.27	0.42	n/a
NATURAL GAS (TCF)	0.67	0.78	0.90	1.08	1.37	1.52	n/a
ELECTRICITY (BKWH)	17.58	25.75	42.53	63.49	81.65	95.33	n/a
COAL (MMT)	0.00	0.00	0.00	0.00	0.00	0.00	n/a

ADDITIONAL DATA -- TRANSPORTATION SECTOR

LIGHT DUTY VEHICLES

OPERATING VEHICLES (MILLIONS)	186.7	211.3	228.1	242.5	255.6	267.4	n/a
VEHICLE MILES (BILLIONS)	1940	2373	2639	2885	3148	3368	n/a
FLEET EFFICIENCY (EPA ESTIMATED MPG)	22.2	24.7	25.9	27.1	28.0	28.7	n/a
FUEL CONSUMPTION (MMBOE)	2193	2583	2748	2872	3002	3142	n/a

HEAVY DUTY VEHICLES

OPERATING VEHICLES (MILLIONS)	4.4	4.8	5.1	5.4	5.7	6.0	n/a
VEHICLE MILES (BILLION)	151	181	199	211	224	238	n/a
FLEET EFFICIENCY (ON ROAD MPG)	5.60	5.79	5.80	5.81	5.83	5.83	n/a
FUEL CONSUMPTION (MMBOE)	628	749	818	868	920	977	n/a

	1990	2000	2005	2010	2015	2020	2025
AIR TRAVEL							
PASSENGER REV.	472	786	904	1011	1058	1090	n/a
MILES (BILLIONS)							
FLEET EFFICIENCY	1.00	1.10	1.11	1.12	1.14	1.16	n/a
INDEXED TO 1990							
FUEL CONSUMPTION	552	668	748	812	834	841	n/a
(MMBOE)							
RAILROADS							
RAIL FREIGHT	1034	1210	1323	1408	1491	1585	n/a
TON-MILES							
FUEL EFFICIENCY	1.00	1.10	1.12	1.14	1.23	1.34	n/a
INDEXED TO 1990							
FUEL CONSUMPTION	98.3	111.2	118.2	123.2	121.1	119.1	n/a
(MMBOE)							
WATERBORNE							
FUEL CONSUMPTION	270.7	332.8	365.9	402.6	426.9	453.3	n/a
(MMBOE)							
PIPELINE							
FUEL CONSUMPTION	117	124.3	123.3	118.6	130.7	131.6	n/a
(MMBOE)							
OTHER MODES							
FUEL CONSUMPTION	29.3	43.1	46.5	50.0	50.9	51.7	n/a
(MMBOE)							

TABLE 12: PRIMARY INPUTS TO EL. GEN. & EL. SALES (QUADS)

	1990	2000	2005	2010	2015	2020	2025

PRIMARY INPUTS TO UTILITIES AND NON-UTILITIES							
OIL	1.20	0.66	0.52	0.60	0.83	0.72	n/a
GAS	2.99	4.42	4.94	5.96	7.91	7.84	n/a
COAL	16.10	18.32	18.96	19.77	20.05	20.75	n/a
NUCLEAR	6.16	7.34	7.34	6.39	4.67	3.80	n/a
RENEWABLE	3.55	4.20	4.64	4.92	5.21	6.22	n/a
TOTAL PRIMARY INPUTS	30.00	34.94	36.41	37.64	38.68	39.32	n/a
ELECTRICITY LOSSES	20.73	23.81	24.54	25.13	25.36	25.33	n/a
NET ELEC. IMPORTS	0.01	0.14	0.12	0.11	0.09	0.09	n/a
TOTAL ELEC. SALES (BKWH)	9.26 2713	11.27 3302	11.99 3515	12.62 3698	13.41 3932	14.08 4128	n/a n/a

TABLE 13: UTILITY & NON-UTILITY NET SUMMER CAPACITY (GW)

	1990	2000	2005	2010	2015	2020	2025
OIL/GAS STEAM	144.50	123.29	110.24	102.37	93.04	78.45	n/a
OIL/GAS TURBINE	50.80	75.28	107.94	115.90	126.21	135.89	n/a
GAS/OIL COMB. CYCLE	11.20	37.86	58.66	62.58	68.99	72.53	n/a
TOTAL OIL	62.20	33.74	35.93	41.15	51.83	61.91	n/a
OIL STEAM	37.40	22.44	19.74	17.97	16.49	14.35	n/a
OIL TURBINE	24.80	11.29	16.19	23.18	35.34	47.56	n/a
TOTAL GAS	144.30	212.44	277.74	287.04	312.29	341.21	n/a
GAS STEAM	107.10	100.84	90.50	84.40	76.55	64.10	n/a
GAS COMBINED CYCLE	11.20	37.86	58.66	62.58	68.99	72.53	n/a
STIG/ISTIG	0.00	9.66	36.36	46.74	74.89	114.09	n/a
GAS TURBINE	26.00	63.98	91.75	92.72	90.87	88.33	n/a
GAS FUEL CELLS	0.00	0.05	0.33	0.42	0.76	1.88	n/a
WB/SB TURBINES	0.00	0.04	0.14	0.19	0.23	0.28	n/a
TOTAL COAL	302.17	298.02	302.39	305.76	310.33	319.96	n/a
PULVERIZED COAL	302.17	297.15	298.36	298.78	298.83	297.48	n/a
AFB	0.00	0.54	2.06	3.07	4.26	6.36	n/a
IGCC	0.00	0.33	1.61	2.67	4.28	8.31	n/a
COAL ISTIG	0.00	0.00	0.35	1.25	2.96	7.80	n/a
TOTAL NUCLEAR	99.60	99.35	99.37	86.50	63.25	51.39	n/a
LIGHT WATER	99.60	99.35	99.34	86.38	63.01	50.98	n/a
ADVANCED LT WATER	0.00	0.00	0.03	0.12	0.24	0.41	n/a
TOTAL RENEWABLES	103.99	111.30	116.73	120.92	127.29	147.05	n/a
HYDROPOWER	76.37	79.36	79.73	79.83	80.12	80.40	n/a
PUMPED & OTHER							
STORAGE	18.80	20.00	20.00	20.00	20.00	20.00	n/a
GEOTHERMAL	3.01	3.47	3.57	3.63	3.67	3.62	n/a
PHOTOVOLTAIC	0.00	0.01	0.31	0.47	1.16	4.04	n/a
SOLAR THERMAL	0.34	0.63	0.93	1.07	1.21	1.37	n/a
BIOMASS							
WOOD & WASTE	3.72	4.35	5.85	6.32	6.54	6.52	n/a
BIOMASS IGCC	0.00	0.29	1.87	3.07	4.30	12.76	n/a
ATS BIOMASS IGCC	0.00	0.00	0.95	2.55	4.19	10.10	n/a
WIND	1.75	3.21	3.51	3.99	6.11	8.23	n/a
TOTAL CAPACITY	712.26	754.8	832.2	841.4	865.0	921.5	n/a

TABLE 14: UTILITY & NON-UTILITY GENERATION (THOUSAND GWH)

	1990	2000	2005	2010	2015	2020	2025
TOTAL OIL	118.0	63.1	50.9	58.9	82.2	73.2	n/a
OIL STEAM	104.7	51.0	34.1	33.8	36.5	25.4	n/a
OIL TURBINE	12.8	8.3	9.6	15.2	30.1	29.0	n/a
OIL COMBINED CYCLE	0.5	3.0	4.5	5.7	7.5	7.3	n/a
OIL STIG/ISTIG	0.0	0.8	2.8	4.2	8.1	11.5	n/a
TOTAL GAS	272.0	466.8	569.6	710.5	1018.8	1101.5	n/a
- PC PLANT COFIRING	0.0	5.4	0.0	0.0	0.0	0.0	n/a
- GAS BACKUP FOR SOLAR	0.0	0.1	0.5	0.6	0.8	1.0	n/a
- GAS BACKUP FOR WIND	0.0	0.0	0.0	0.0	0.0	0.0	n/a
GAS STEAM	234.0	229.0	156.2	158.7	169.5	113.6	n/a
GAS COMBINED CYCLE	24.0	147.1	219.4	278.6	366.7	356.9	n/a
STIG/ISTIG	0.0	37.5	136.0	208.1	398.1	561.4	n/a
GAS TURBINE	14.0	47.1	54.5	60.8	77.3	53.9	n/a
GAS FUEL CELLS	0.0	0.4	2.4	3.1	5.6	13.8	n/a
TOTAL COAL	1561.0	1790.5	1856.3	1940.1	1974.6	2060.7	n/a
PULVERIZED COAL	1561.0	1784.1	1826.6	1888.5	1889.0	1894.3	n/a
BIOMASS & MSW	0.0	0.0	0.0	0.0	0.0	0.0	n/a
AFB	0.0	3.9	15.1	22.5	31.4	46.6	n/a
IGCC	0.0	2.5	12.0	19.9	32.0	61.8	n/a
COAL ISTIG	0.0	0.0	2.6	9.3	22.1	58.0	n/a
TOTAL NUCLEAR	577.0	687.6	687.8	598.7	437.9	355.8	n/a
LIGHT WATER	577.0	687.6	687.6	597.9	436.1	352.8	n/a
ADVANCED LT WATER	0.0	0.0	0.2	0.9	1.7	3.0	n/a
TOTAL RENEWABLES	318.6	362.3	398.6	427.9	460.5	581.8	n/a
HYDROPOWER	285.1	303.1	305.2	306.3	307.4	308.5	n/a
PUMPED & OTHER							
STORAGE	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	n/a
GEOTHERMAL	15.5	20.9	21.8	22.1	22.4	22.1	n/a
PHOTOVOLTAIC	0.0	0.0	0.7	1.1	2.6	9.2	n/a
SOLAR THERMAL	0.7	1.5	2.6	3.0	3.5	4.0	n/a
BIOMASS							
WOOD & WASTE	17.1	30.2	40.6	43.9	45.3	45.2	n/a
BIOMASS IGCC	0.0	2.1	14.0	22.9	32.2	95.4	n/a
ATS BIOMASS IGCC	0.0	0.0	7.1	19.1	31.4	75.5	n/a
WIND	2.2	6.5	8.6	11.5	17.7	23.8	n/a
TOTAL GENERATION	2846.6	3370.3	3563.2	3736.3	3974.0	4173.0	n/a

TABLE 15: CARBON EMISSIONS BY END-USE SECTOR & SOURCE
(Million Metric Tons per Year)

	1990	2000	2005	2010	2015	2020	2025
RESIDENTIAL							
PETROLEUM	24.0	24.2	22.9	22.1	21.7	21.2	n/a
NATURAL GAS	65.1	74.6	73.6	74.3	75.6	76.2	n/a
COAL	1.6	1.4	1.3	1.1	1.0	0.9	n/a
ELECTRICITY	162.2	189.8	194.6	206.2	224.0	235.3	n/a
TOTAL	252.9	290.0	292.4	303.8	322.3	333.6	n/a
COMMERCIAL							
PETROLEUM	18.0	14.8	14.6	14.2	13.8	13.6	n/a
NATURAL GAS	38.8	45.3	46.4	47.3	48.3	49.6	n/a
COAL	2.4	2.2	2.1	1.9	1.8	1.7	n/a
ELECTRICITY	145.2	167.9	171.6	177.9	184.7	186.4	n/a
TOTAL	204.4	230.3	234.7	241.3	248.6	251.3	n/a
INDUSTRIAL							
PETROLEUM	99.3	97.9	100.5	101.3	102.1	104.6	n/a
NATURAL GAS	118.5	145.2	155.9	162.4	168.3	168.3	n/a
COAL	68.5	64.9	61.9	60.1	60.1	61.2	n/a
ELECTRICITY	166.3	187.1	197.1	212.7	225.2	224.8	n/a
TOTAL	452.6	495.1	515.4	536.5	555.7	559.0	n/a
TRANSPORTATION							
PETROLEUM	422.7	499.6	534.7	559.3	575.3	593.4	n/a
NATURAL GAS	9.8	11.6	13.4	16.1	20.5	22.8	n/a
COAL	0.0	0.0	0.0	0.0	0.0	0.0	n/a
ALCOHOL FUELS	0.0	0.0	0.0	0.0	0.0	0.0	n/a
ELECTRICITY	3.1	4.3	6.9	10.4	13.4	15.3	n/a
TOTAL	435.6	515.5	555.1	585.8	609.3	631.5	n/a
TOTAL CARBON EMISSIONS (DELIV. CONSUMPTION BASIS)							
PETROLEUM	564.0	636.4	672.7	696.9	712.9	732.9	n/a
NATURAL GAS	232.2	276.8	289.3	300.0	312.8	316.9	n/a
COAL	72.5	68.5	65.3	63.2	62.9	63.8	n/a
ALCOHOL FUELS	0.0	0.0	0.0	0.0	0.0	0.0	n/a
ELECTRICITY	476.8	549.1	570.1	607.3	647.4	661.8	n/a
TOTAL	1345.5	1530.9	1597.5	1667.4	1735.8	1775.5	n/a
ELECTRIC GENERATORS							
PETROLEUM	26.6	13.8	10.9	12.4	17.1	14.6	n/a
NATURAL GAS	41.2	64.0	71.6	86.3	114.5	113.6	n/a
STEAM COAL	409.0	471.3	487.6	508.6	515.7	533.6	n/a
TOTAL	476.8	549.1	570.1	607.3	647.4	661.8	n/a
TOTAL CARBON EMISSIONS (PRIMARY BASIS)							
PETROLEUM	590.6	650.3	683.6	709.3	729.9	747.5	n/a
NATURAL GAS	273.4	340.8	361.0	386.3	427.3	430.5	n/a
COAL	481.5	539.8	552.9	571.7	578.6	597.4	n/a
ALCOHOLS	0.0	0.0	0.0	0.0	0.0	0.0	n/a
TOTAL	1345.5	1530.9	1597.5	1667.4	1735.8	1775.5	n/a

INTL. BUNKER FUEL	20.8	26.8	30.1	33.9	36.4	39.0	n/a
TOTAL U.S. NET	1324.7	1504.1	1567.4	1633.5	1699.4	1736.4	n/a



Jeffrey A. Frankel
11/05/97 08:24:55 AM

Record Type: Record

To: Joseph E. Aldy/CEA/EOP
cc: Adele C. Morris/CEA/EOP, Randall W. Lutter/CEA/EOP, Janet L. Yellen/CEA/EOP
bcc:
Subject: Re: McGinty's GCC testimony

**** RESPONSES MARKEED BELOW**

jf

Joseph E. Aldy



Joseph E. Aldy
11/04/97 10:13:14 PM

Record Type: Record

To: Jeffrey A. Frankel/CEA/EOP, Adele C. Morris/CEA/EOP, Randall W. Lutter/CEA/EOP
cc:
Subject: McGinty's GCC testimony

I am going over Katie McGinty's testimony before the House Science Committee, and I have a couple of questions. There are several statements on the economics, so I am reviewing this in the context of Janet's testimony this summer, and intend on making comments to ensure that there are no inconsistencies -- especially since Janet may have to testify again. (Note, the comments are due back to OMB by noon Wednesday). Jeff -- was the testimony discussed at any of your 2pm meetings? **** NO, IT WASN'T. AT THIS A.M. WH STAFF MTG. JACK GIBBONS SAID SOME GCC TESTIMONY SCHEDULED FOR TODAY WAS CANCELLED ; BUT KATIE DIDN'T SAY ANYTHING ABOUT HERS**

First, the testimony states:

"The U.S. has proposed emissions banking and limited borrowing to allow for cost saving transfers of reductions over time."

-- I was not aware that banking and borrowing made into the U.S. proposal -- is this true? **** I THINK THIS IS TRUE. LEAVE IT.**

Second, the testimony states:

"The plan was developed following extensive consultations with all interested parties. What the experts -- and the economic models -- told us is that there are smart ways and dumb ways to address climate change. The President's plan harnesses all of the smart ways: it provides incentives through budget cuts [note: this should be tax cuts] and research and development; it

allows for flexibility by proposing budget periods instead of rigid targets for emissions reductions; it taps the power of the marketplace through emissions trading both domestically and internationally; and it recognizes the global nature of the problem by insisting on the participation of all countries."

--The "smart way, dumb way" is an obvious reference to Janet's testimony. I think it is difficult to say that the plan harnesses ALL OF THE SMART WAYS. For example, the first bullet point in Janet's testimony under the "smart way, dumb way" statement has to do with the speed of emissions reductions (emissions path). As we all know, the results from the economic models are robust regarding the finding that a moderate path to a specific concentration goal is economically superior to 1990 in 2010. I suggest that we rework the language so it does not imply that it is completely smart, because it's not.

** I AGREE. ASK THEM AT LEAST TO DROP THE WORD "ALL". THEY SHOULDN'T OBJECT TO THAT.

-- I did not think that the plan insisted participation of all countries, rather, that it required "meaningful participation by key developing countries." Since our developing country stance got trounced in Bonn, shouldn't we fall back to this more amorphous description of developing country participation?

** I THINK THE STRONGER THE LANGUAGE HERE THE BETTER. (THO THERE IS STILL WIGGLE ROOM IN WHAT "P[ARTICIPATION]" MEANS.)

-- Does the Administration really want to mention economic models? Eventually, they may ask what we looked at (e.g., through a document request, Q&As, subsequent testimony, or by requiring an economic analysis of the U.S. position). Instead, should we suggest a reference to the Economists Statement on Climate Change? e.g.,

** YOU HAVE A POINT. LET'S SUGGEST THE POSSIBILITY OF DROPPING "MODELS" FOR THAT REASON.

"The plan was developed following extensive consultations with all interested parties. Consistent with the Economists' Statement on Climate Change that recommended market-based incentives, the President's plan harnesses many smart approaches to implementing a climate change goal: it provides incentives..."

This way, they get to keep "smart", they get to make a reference to experts (2300 economists), and the smart reference is specific to implementing a goal, not setting one.

** MAYBE. BUT LARRY HAS SUGGESTED THAT WE COOL IT ON THE 2300 ECONOMISTS, SINCE MANY OF THE LEAD SIGNERS WOULD LIKELY OPPOSE OUR POLICY. SO LET'S NOT SUGGEST ADDING SUCH A REFERENCE.

Third, the testimony states, as a part of the Administration's 9 point plan:

"4. Encouraging the Use of Energy Efficient Products: we are committed to working to remove barriers that exist to expanded markets for existing energy efficient technologies."

--This is listed under a distinct bullet from the \$5 b over 5 years on tax cuts and R&D and the industry partnerships. What does this mean? Appliance standards? Building codes?

** I AGREE. TELL THEM THAT WE HAVE NEVER UNDERSTOOD/AGREED WITH THIS BARRIERS BUSINESS, AND SUGGEST THAT THEY REMOVE THAT LANGUAGE.

In general, I feel like the testimony oversells the economic benefits of climate change (e.g., "a comprehensive strategy... that will be good for both our economy and our environment", "It is designed to enhance our role as the world's number one economic power by ensuring our continued competitive edge in developing and marketing technologies in an increasingly global marketplace in the 21st century."). However, I'm not sure if I should recommend deleting those references, since

the free lunch rhetoric has been overflowing of late. On the other hand, if Janet has to testify, overselling the economics now may make her experience less comfortable.

** I SHARE YOUR CONCERNS. BUT I DON'T THINK WE CAN DO ANYTHING ABOUT THIS. THIS IS THE SORT OF THING WE HAVE ALREADY LOST ON. WE WANT TO MAKE AN EFFORT AT SEEMING TEAM PLAYERS. SO MY INCLINATION IS TO LET IT PASS. (AFTER ALL, IT IS KATIE'S TESTIMONY, AND NOT JANET'S)

I CAN LOOK OVER WHAT YOU WRITE UP, IF THERE IS TIME.
BUT LET'S GET IT IN ON TIME.

If you can get me comments/suggestions by 11ish (just call me and I'll stop by if you want to talk about it) so I can type up the response to OMB by noon I would appreciate it (note: Randy, I know you are busy with that conference tomorrow, so if you can't get to this, don't worry about it).
Thanks,

Joe