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Folder Title:
CEQ Climate Change Mtg, Fri, 2/21/97, 1-2:30pm, Rm. 231

Stack:	Row:	Section:	Shelf:	Position:
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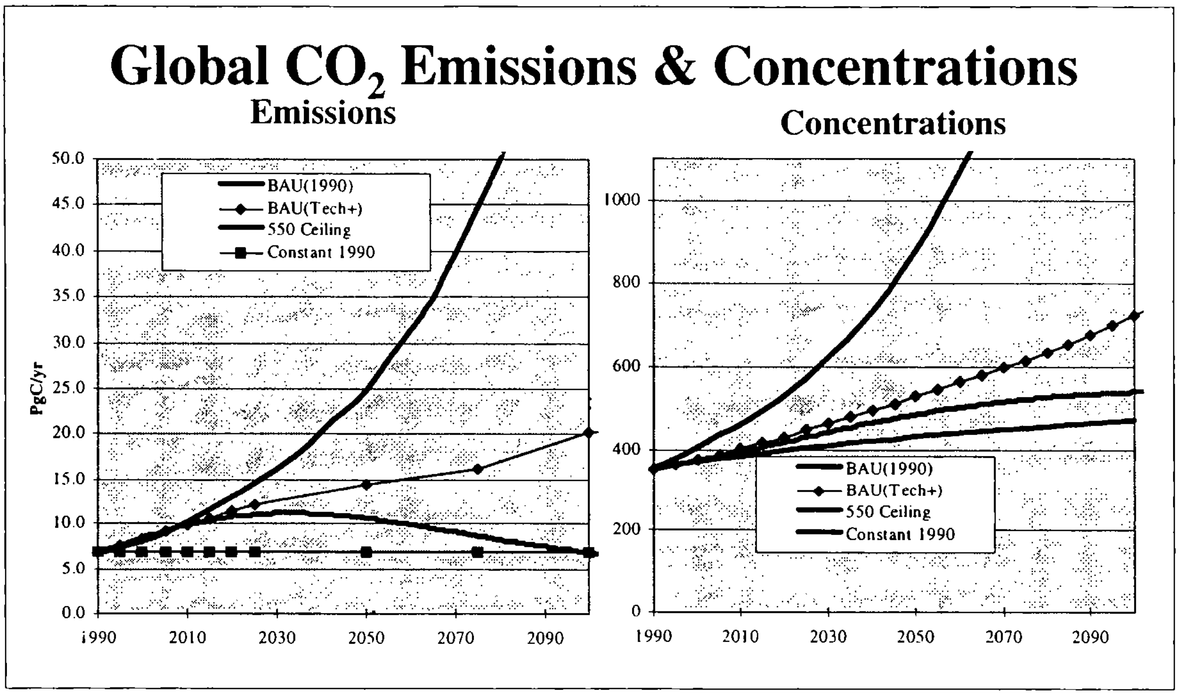
KEY POINT #1:

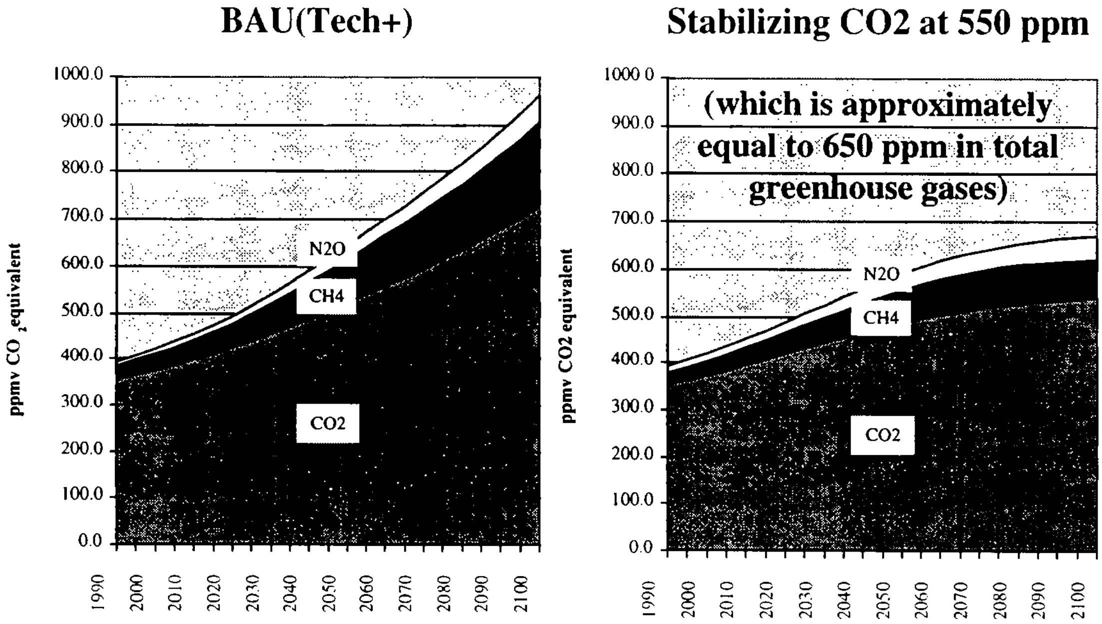


•If we continue on a Business-As-Usual (BAU) path (top 2 lines in above figures), concentrations will double over the next few decades, never achieving stabilization.

•Stabilizing emissions will not stabilize concentrations.

KEY POINT #2:

Non-CO_2 greenhouse gases make the "effective" atmospheric concentration higher.

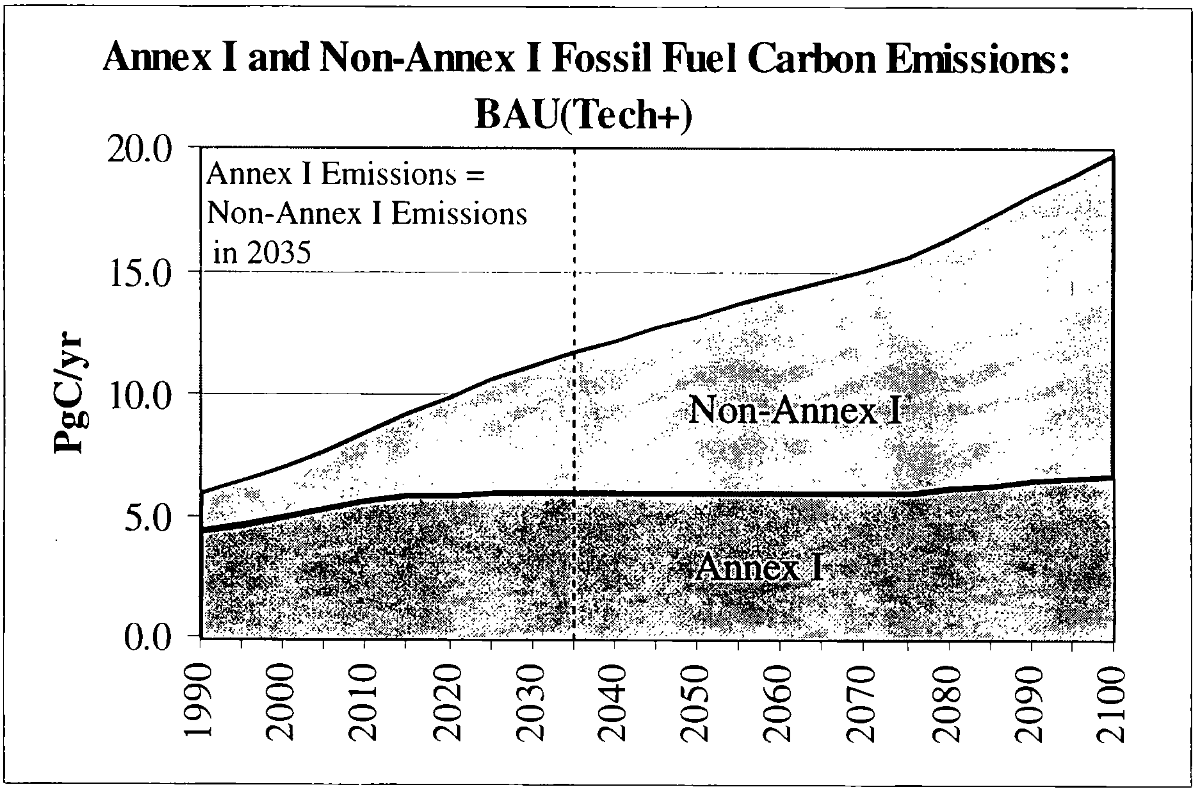


PRELIMINARY RESULTS

- Other greenhouse gases, principally methane and nitrous oxides, make the "effective" atmospheric concentrations about 20% higher than carbon dioxide alone.

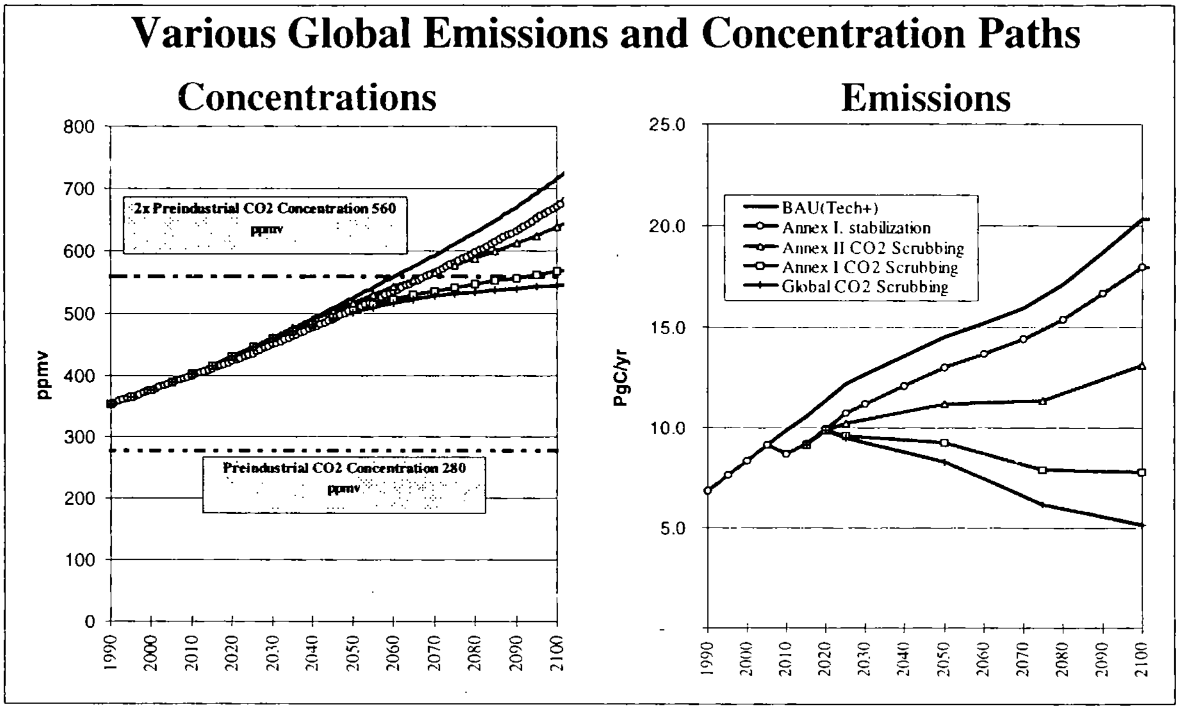
- Most stabilization scenarios have been unable to incorporate changes in all the gases simultaneously, but it is important to consider that a "550 CO_2 stabilization" scenario represents an "effective atmospheric concentration" of about 650.

KEY POINT #3:



•A Business-As-Usual path implies that over time the majority of emissions will shift from developed to developing nations.

KEY POINT #4:



•Actions by Annex I alone are insufficient to achieve stabilization

•In order to cap emissions at just under a doubling of pre-industrial CO_2 levels, actions by Annex I countries need to be coupled with actions by non-Annex I countries in the next few decades.

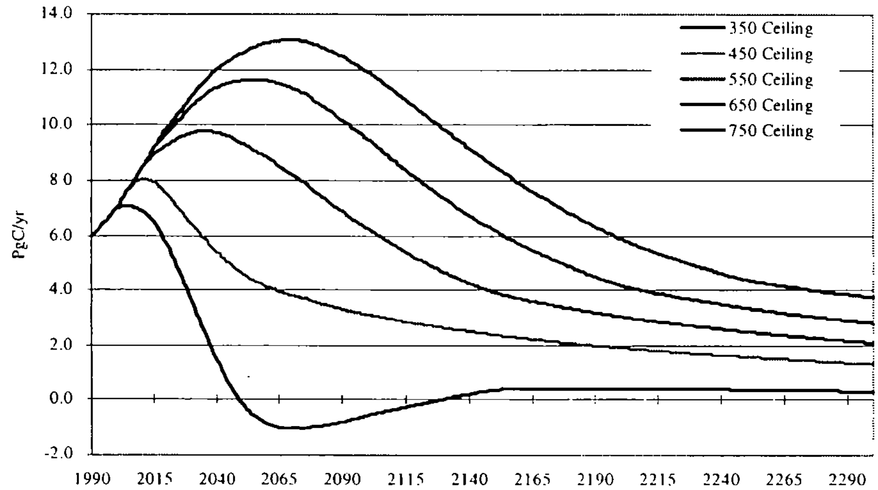
KEY POINT #5:

Energy emission pathways and stabilization concentrations

Steady State Concentration →	450 ppmv	550 ppmv	650 ppmv	750 ppmv
Deflection Date BAU (Tech+) [a]	2007	2013	2018	2023
Maximum Emission Date	2011	2033	2049	2062
Maximum Emission [b]	8.0	9.7	11.4	12.5

[a] The deflection date is the year in which emissions in the emissions stabilization trajectory first fall below BAU emissions by more than 0.1 PgC/yr.

[b] Maximum PgC/yr fossil fuel carbon emissions. If other greenhouse gases are included, emissions would be effectively 20% higher; thus, reductions would have to occur sooner than the deflection date noted to achieve a given concentration.

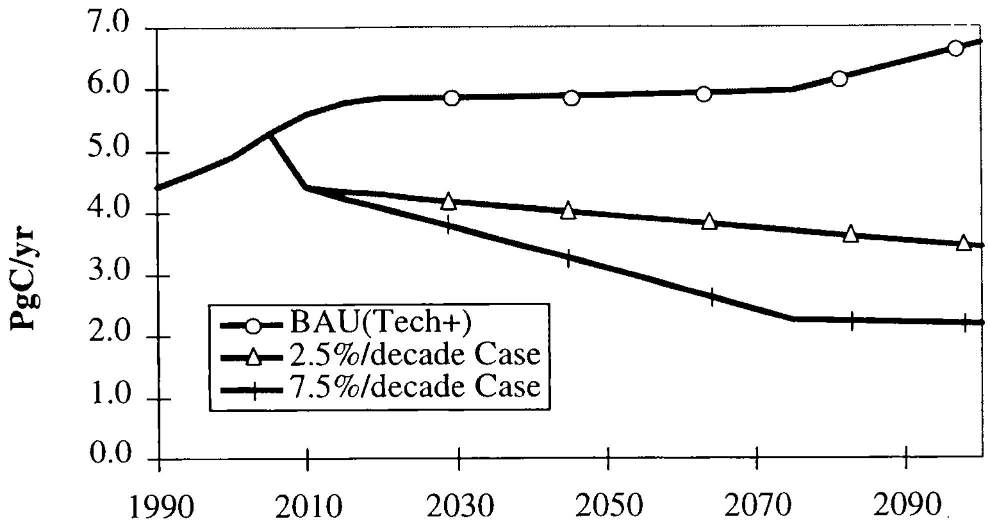


•To meet atmospheric concentrations of 450-750 ppmv CO_2 requires a significant reduction in annual emissions during the next century.

•For example, to meet a target of 550 ppmv CO_2, the table shows that global CO_2 emissions due to fossil fuel burning must begin to deflect from the business-as-usual curve by 2013. In that scenario, energy-related emissions would peak at 9.7 PgC/yr in 2033 and drop rapidly thereafter. (Because of the other greenhouse gases, the effective concentration would be about 650 ppmv.)

KEY POINT #6:

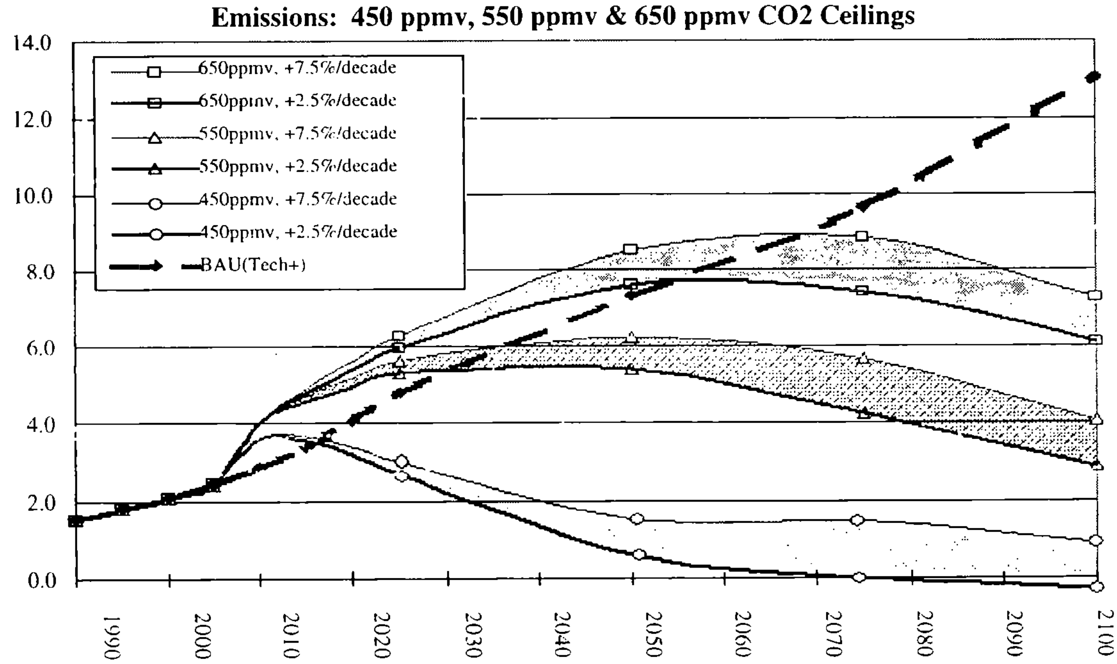
Annex I Fossil Fuel Carbon Emissions: BAU(Tech+), and 2.5%/Decade, & 7.5%/Decade Reductions



2.5%/Decade Case assumes that Annex I nations stabilize emissions at 1990 levels in 2010 and then reduce emissions at 2.5%/decade through the year 2100.

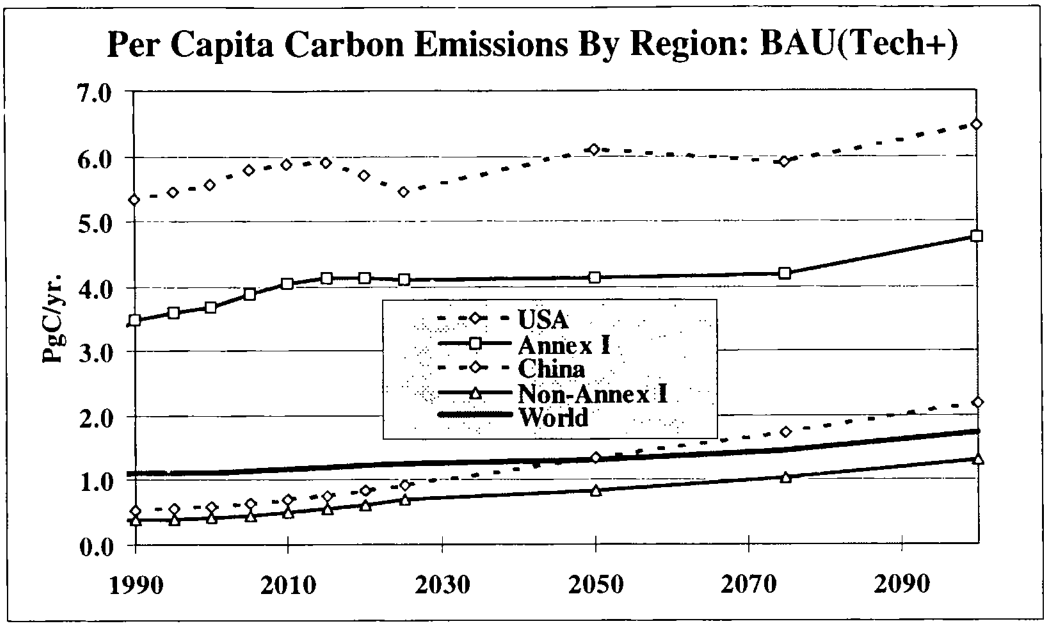
7.5%/Decade Case assumes that Annex I nations stabilize emissions at 1990 levels in 2010 and then reduce emissions at 7.5%/decade until they are 50% of 1990 levels after which time they are held constant

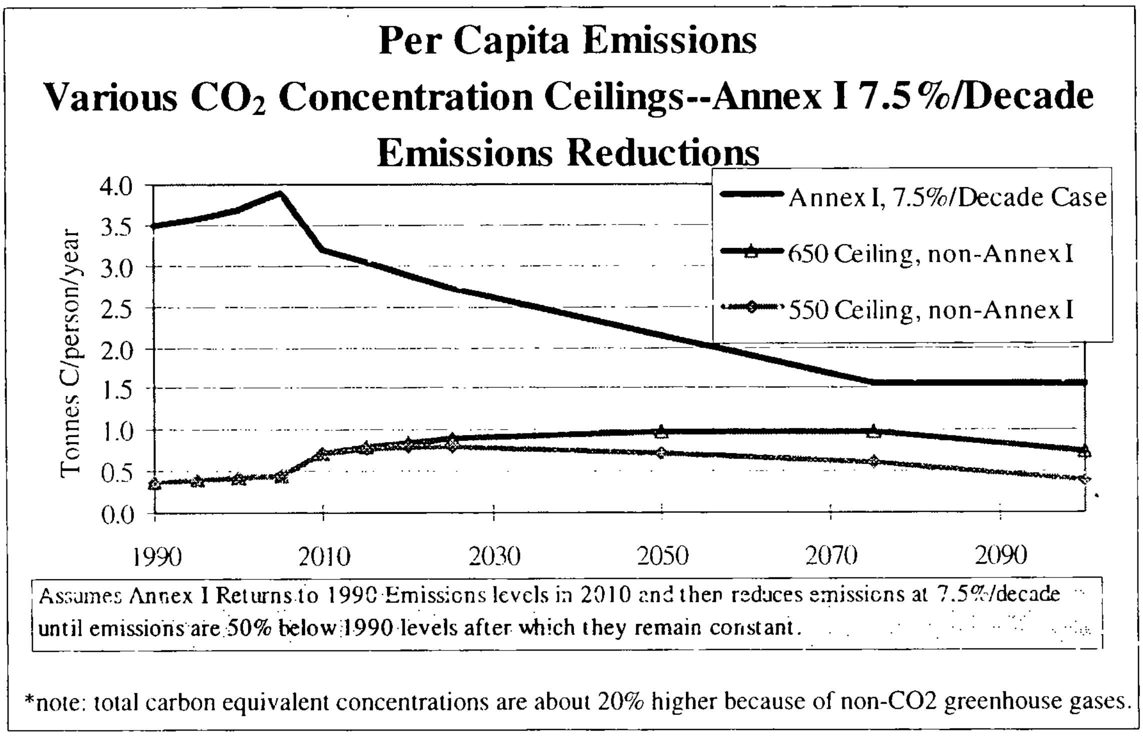
Allowable Non-Annex I Emissions if Annex I Countries Stabilize then Reduce Emissions: 450 ppmv, 550 ppmv & 650 ppmv CO2 Ceilings



- If Annex I countries freeze emissions in 2010 and then reduce steadily (upper chart), developing countries can continue on business-as-usual paths for some time before reducing emissions (lower chart).

KEY POINT #7:

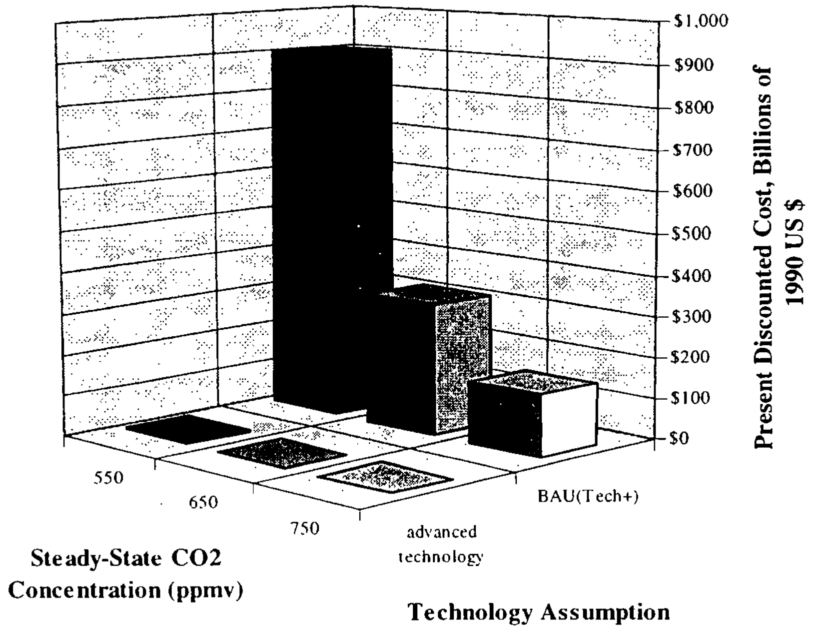




•Although they remain widely disparate, per capita emissions of Annex I and non-Annex I countries begin to converge over time. The top figure shows Business As Usual per capita emissions. The lower figure shows per capita emissions under one policy scenario.

KEY POINT #8:

The Relationship Between Technology and Minimum Cost of Stabilizing the Atmosphere Below Various Ceilings

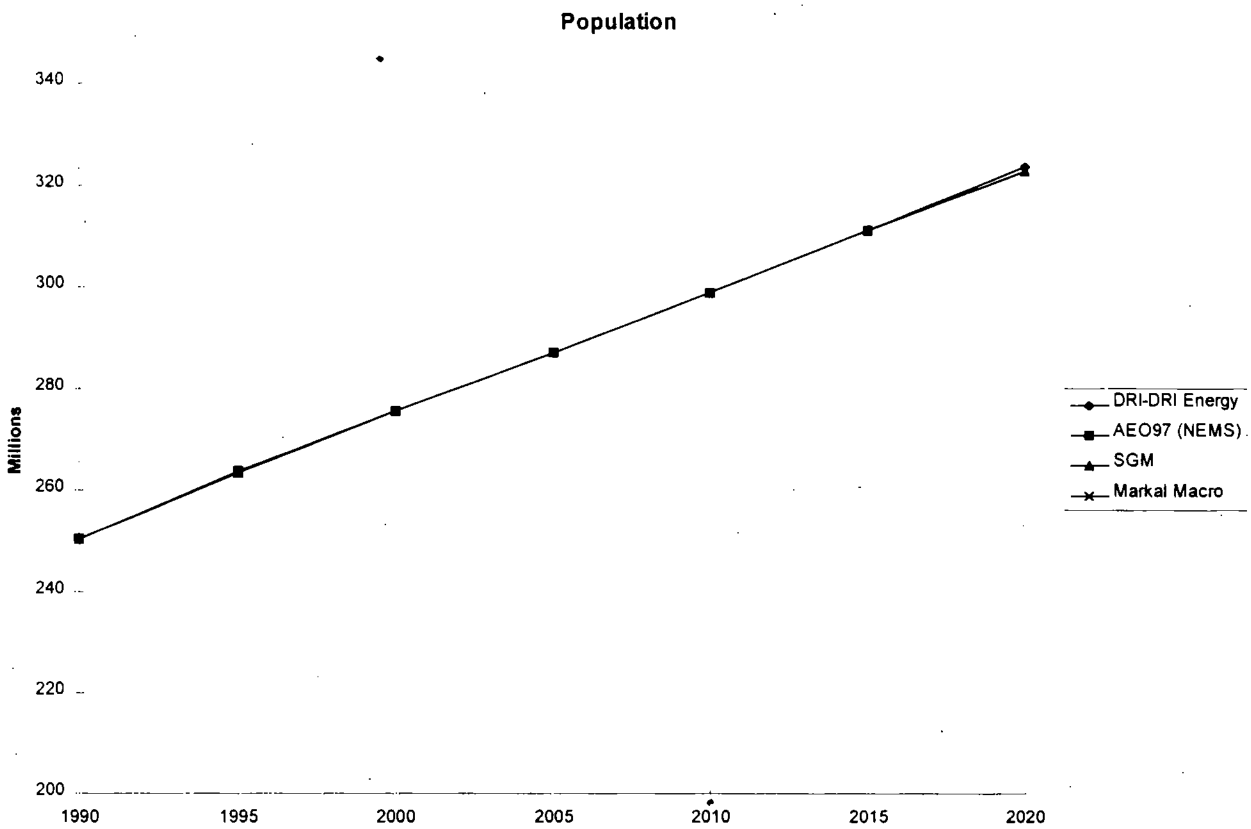


• If a functional, cost-effective cap and trade system is in place, investments in technology can greatly reduce global costs.

Interagency Analytic Team Baseline Projections

- Develop consistent baseline projections for the three IAT models: DRI, Markal Macro, and the Second Generation Model.
- Calibrate projections to the Energy Information Administration's Annual Energy Outlook for 1997

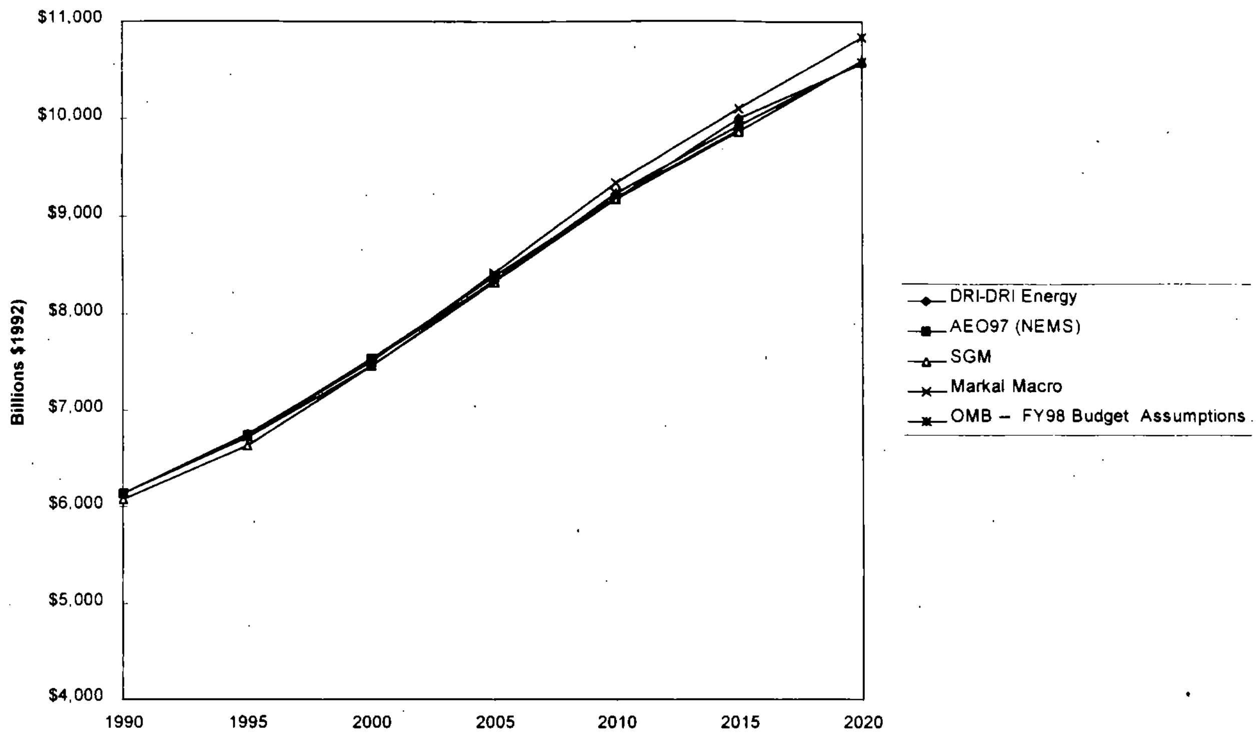
- Models will provide consistent -- but not identical -- results.
- IAT prioritized consistency in GDP, total energy consumption, and carbon emissions.
- Baseline energy price projections vary -- but are generally consistent.



Population

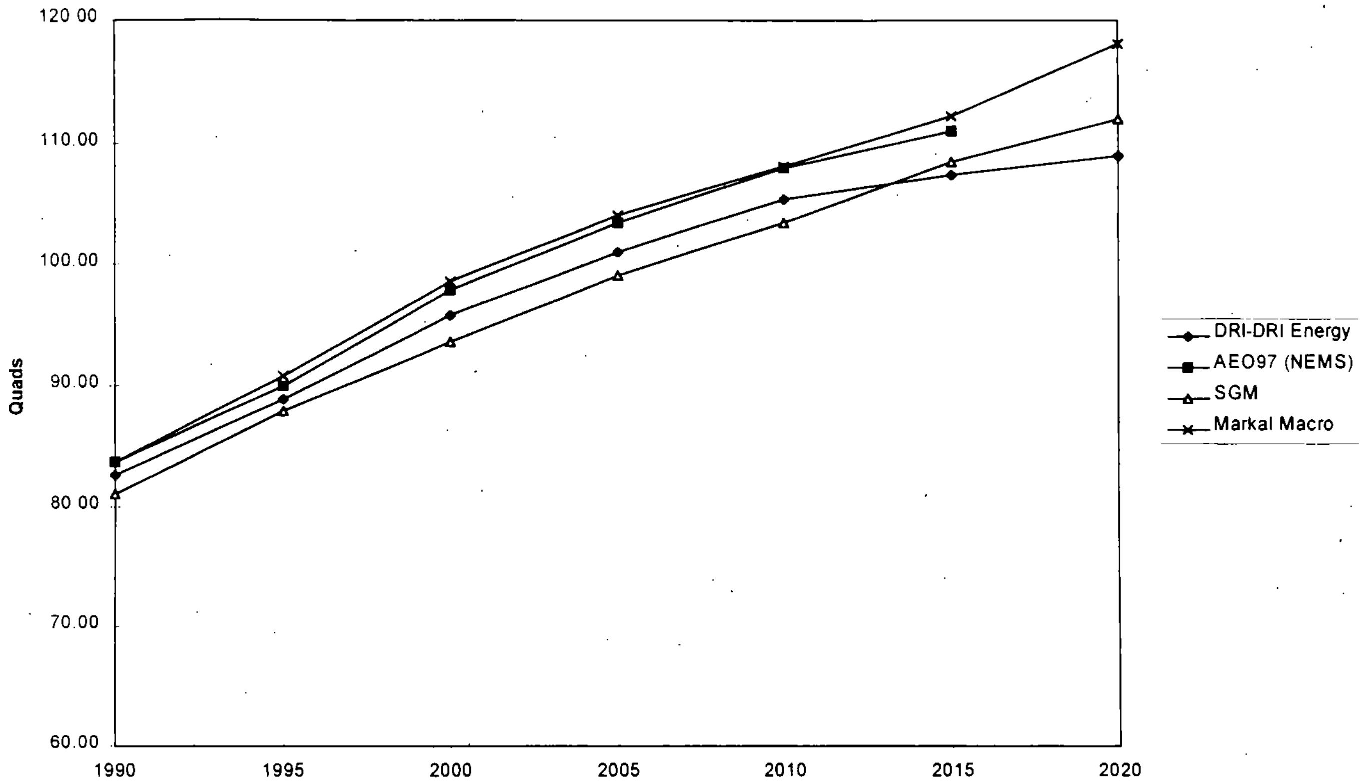
	1990	1995	2000	2005	2010	2015	2020
DRI-DRI Energy	250	264	276	287	299	311	324
AEO97 (NEMS)	250	264	276	287	299	311	
SGM	250	263	276	287	299	311	323
Markal Macro	250	263	276	287	299	311	323

GDP (Billions $1992)



GDP ($Billion 1992)	1990	1995	2000	2005	2010	2015	2020
DRI-DRI Energy	$6,139	$6,743	$7,522	$8,337	$9,172	$10,003	$10,574
AEO97 (NEMS)	$6,139	$6,739	$7,544	$8,390	$9,185	$9,880	
SGM	$6,077	$6,635	$7,464	$8,324	$9,172	$9,873	$10,593
Markal Macro	$6,139	$6,739	$7,514	$8,418	$9,340	$10,112	$10,840
OMB -- FY98 Budget Assumptions	$6,142	$6,721	$7,470	$8,343	$9,225	$9,929	$10,581

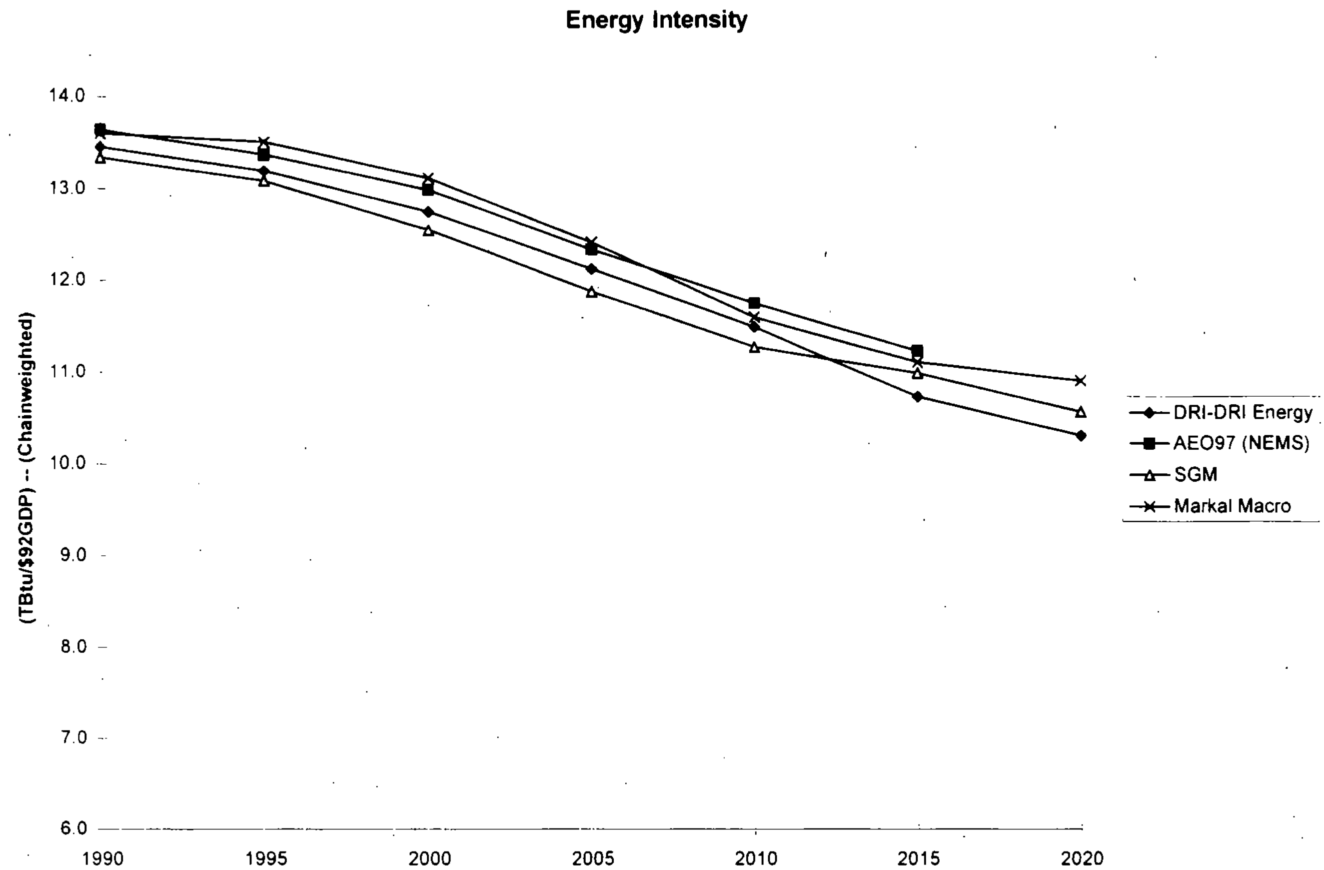
Total Energy Consumption



Total Energy Consumption (Quads)

	1990	1995	2000	2005	2010	2015	2020
DRI-DRI Energy	82.60	88.90	95.80	101.00	105.40	107.30	108.90
AEO97 (NEMS)	83.73	90.03	97.85	103.40	107.90	110.90	
SGM	81.06	87.89	93.63	99.05	103.37	108.44	111.85
Markal Macro	83.73	90.90	98.60	104.00	108.00	112.10	118.10

SGM Projections do not include: geothermal, wind, biomass waste, and other municipal waste energy.

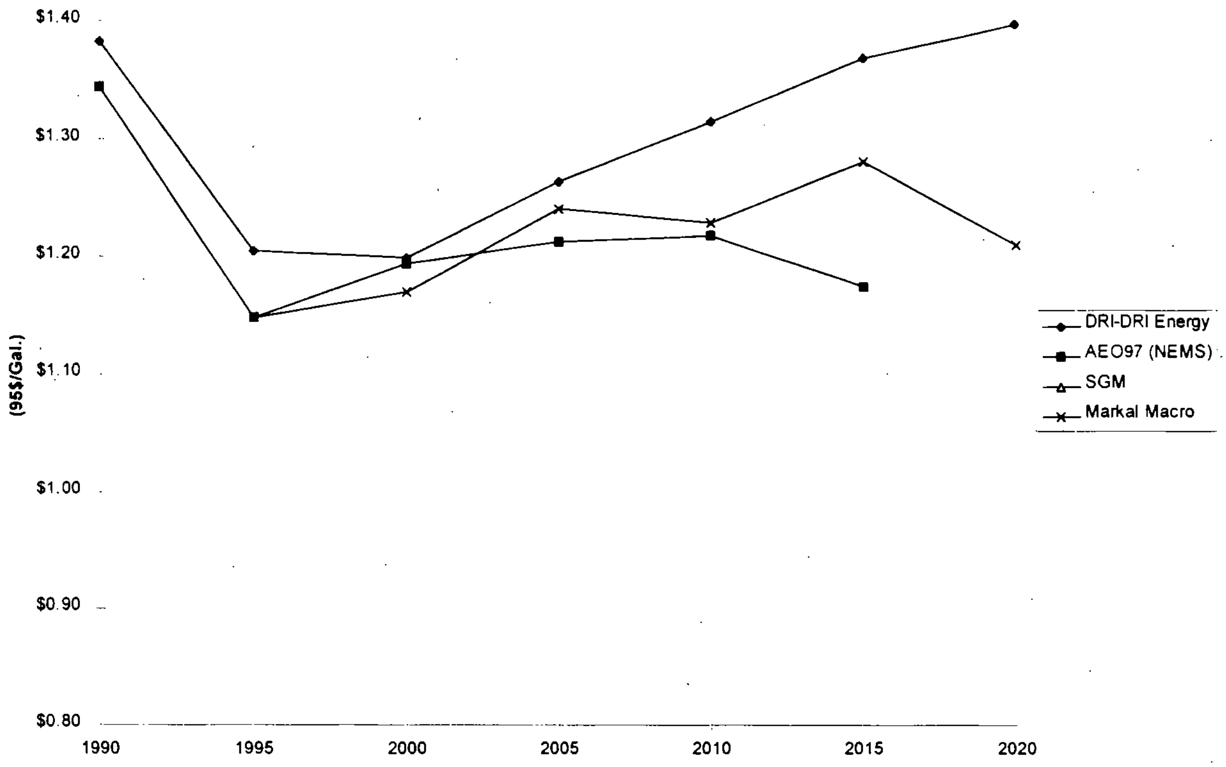


Energy Intensity

(TBtu/$92GDP)

	1990	1995	2000	2005	2010	2015	2020
DRI-DRI Energy	13.5	13.2	12.7	12.1	11.5	10.7	10.3
AEO97 (NEMS)	13.6	13.4	13.0	12.3	11.7	11.2	
SGM	13.3	13.1	12.5	11.9	11.3	11.0	10.6
Markal Macro	13.6	13.5	13.1	12.4	11.6	11.1	10.9

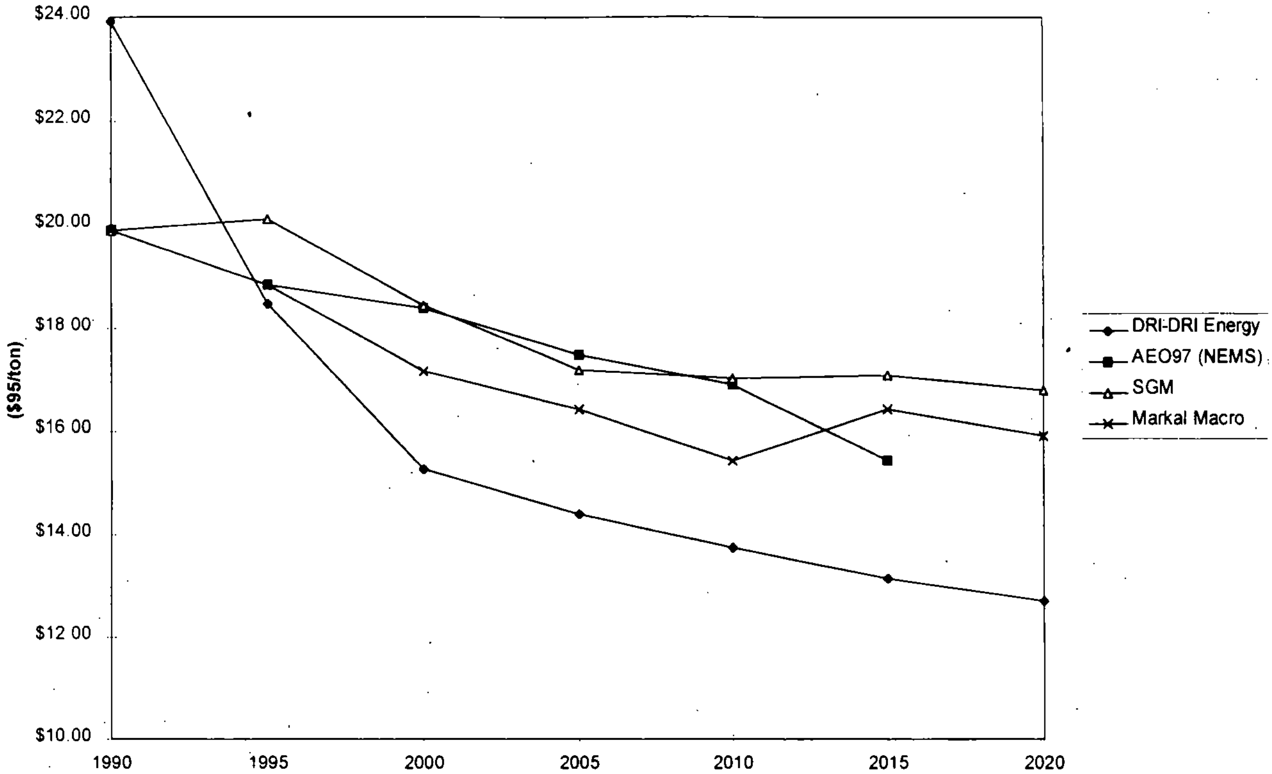
Gasoline Prices



Gasoline Prices ($95/Gal)

	1990	1995	2000	2005	2010	2015	2020
DRI-DRI Energy	$1.38	$1.21	$1.20	$1.26	$1.31	$1.37	$1.40
AEO97 (NEMS)	$1.34	$1.15	$1.19	$1.21	$1.22	$1.17	
SGM							
Markal Macro	$1.34	$1.15	$1.17	$1.24	$1.23	$1.28	$1.21

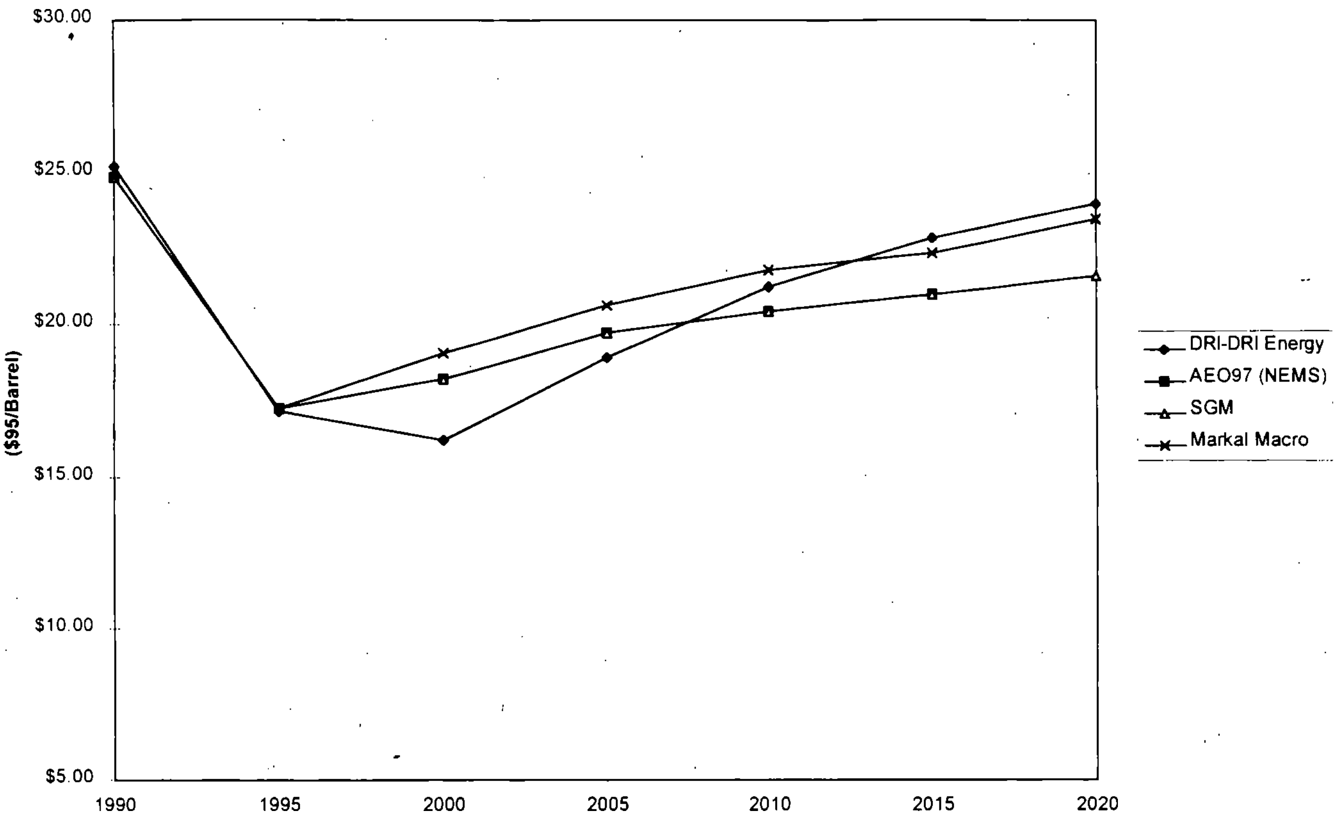
MineMouth Coal Prices



Minemouth Coal Price ($95/ton)

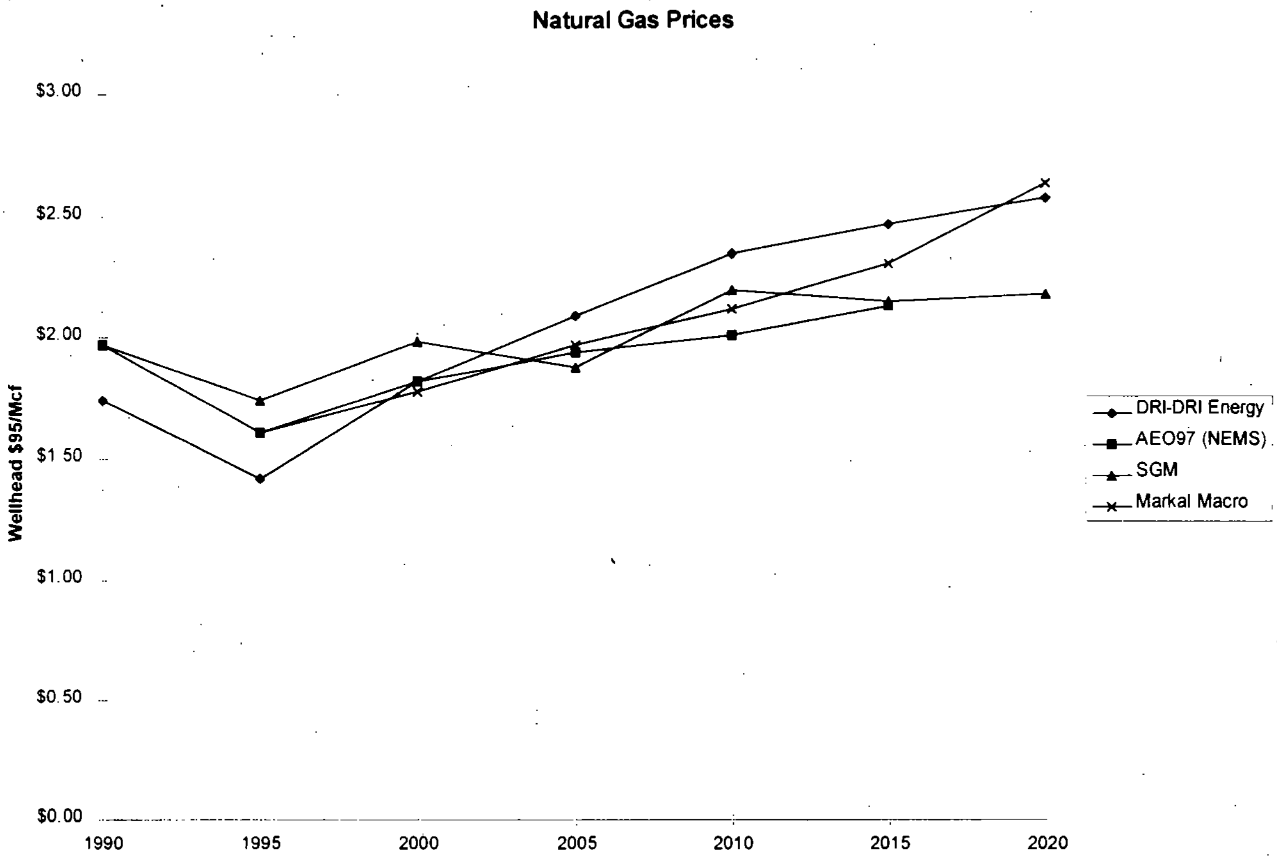
	1990	1995	2000	2005	2010	2015	2020
DRI-DRI Energy	$23.92	$18.45	$15.28	$14.41	$13.76	$13.16	$12.70
AEO97 (NEMS)	$19.88	$18.83	$18.38	$17.47	$16.92	$15.46	
SGM	$19.88	$20.10	$18.44	$17.21	$17.04	$17.08	$16.81
Markal Macro	$19.88	$18.83	$17.16	$16.43	$15.45	$16.43	$15.94

World Oil Price

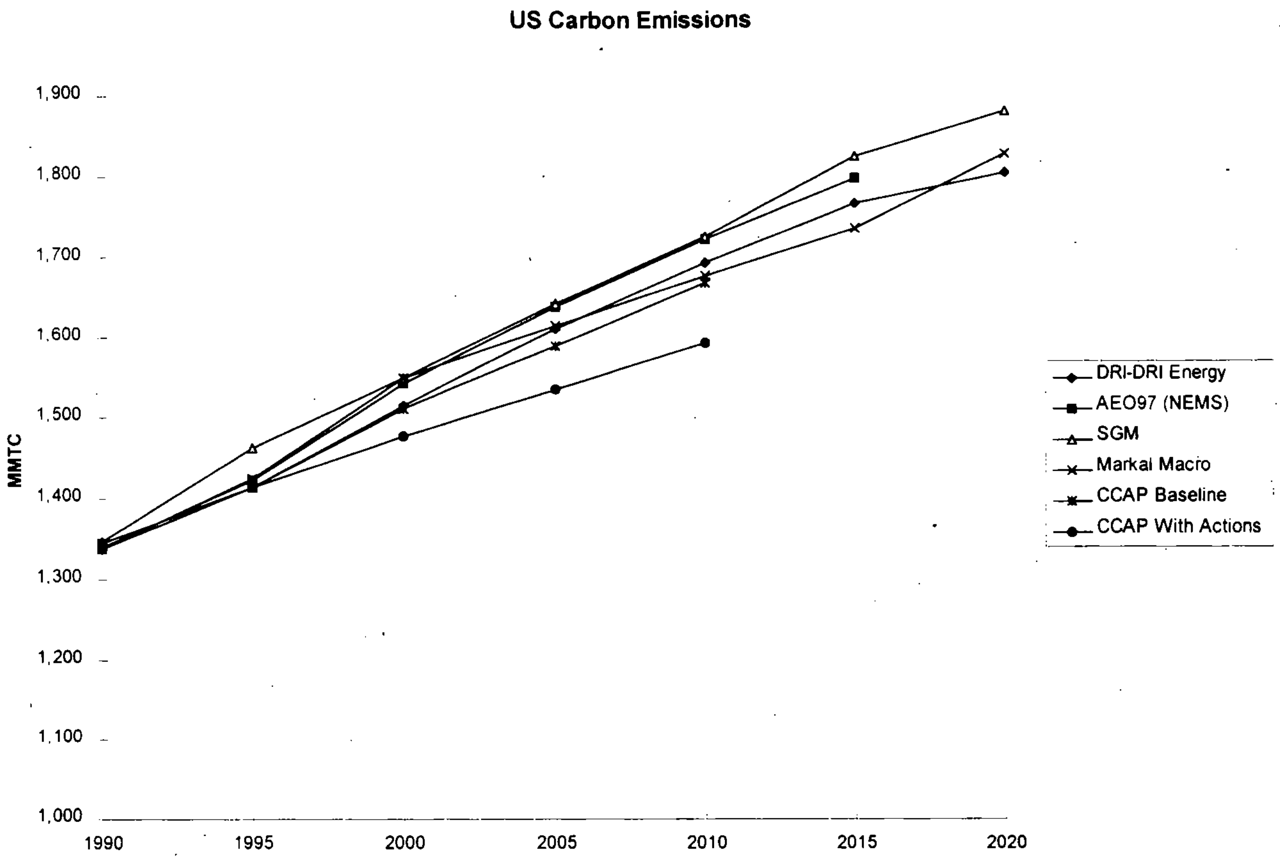


World Oil Price ($95/Barrel)

	1990	1995	2000	2005	2010	2015	2020
DRI-DRI Energy	$25.23	$17.14	$16.18	$18.93	$21.24	$22.86	$23.95
AEO97 (NEMS)	$24.87	$17.26	$18.20	$19.72	$20.41	$20.98	
SGM	$24.87	$17.26	$18.20	$19.72	$20.41	$20.98	$21.57
Markal Macro	$24.87	$17.26	$19.05	$20.63	$21.79	$22.33	$23.43



Natural Gas Price (wellhead $95/Mcf)	1990	1995	2000	2005	2010	2015	2020
DRI-DRI Energy	$1.74	$1.42	$1.82	$2.09	$2.35	$2.47	$2.58
AEO97 (NEMS)	$1.97	$1.61	$1.82	$1.94	$2.01	$2.13	
SGM	$1.97	$1.74	$1.98	$1.88	$2.20	$2.15	$2.18
Markal Macro	$1.97	$1.61	$1.78	$1.97	$2.12	$2.31	$2.64



Carbon Emissions (MMTC) -- Total

	1990	1995	2000	2005	2010	2015	2020
DRI-DRI Energy	1,338	1,413	1,516	1,612	1,693	1,767	1,805
AEO97 (NEMS)	1,339	1,424	1,543	1,639	1,722	1,799	
SGM	1,346	1,464	1,549	1,642	1,727	1,826	1,883
Markal Macro	1,338	1,424	1,550	1,615	1,677	1,737	1,830
CCAP Baseline	1,344	1,414	1,512	1,589	1,667		
CCAP With Actions	1,344	1,414	1,477	1,535	1,593		

Non-CO2 Greenhouse Gas Emissions and Sinks

Gas/Source	1990	1995	2000		2010		2020	
			No CCAP Actions	With CCAP Actions	No CCAP Actions	With CCAP Actions	No CCAP Actions	With CCAP Actions
Methane	169	177	170	148	182	151	186	154
Nitrous Oxides	37	37	36	31	39	34	43	37
HFCs/PFCs/SF6	24	N/A	62	42	132	91	183	133
Total	**230**	**214**	**268**	**221**	**352**	**276**	**412**	**325**
Sinks	-136	N/A	-121	-131	-119	-129	-103	-113

cc: JAF
SS
mnn

THE WHITE HOUSE
WASHINGTON

February 20, 1997

MEMORANDUM FOR DISTRIBUTION

FROM: ELGIE HOLSTEIN
DAVID SANDALOW

SUBJECT: Climate Change

Please see attached for discussion at our meeting tomorrow.

2/20/97

CLIMATE CHANGE WORKPLAN

The overview paper on domestic policies has now been circulated to the Deputies. The next step is to begin a more detailed assessment of the major policy alternatives described in that paper.

I. DOMESTIC POLICY OPTIONS

1. Emissions trading program design: Develop and evaluate options for auctions, allocations and combinations of the two. Options should also include a comprehensive trading regime and one that is limited to sectors. Where feasible, options should be evaluated through the Interagency Analytical Team (IAT) models to assess economic impacts including impacts on key sectors.

LEAD: EPA with DOE, Commerce

2. Technology diffusion: Develop options for expanding technology diffusion programs, drawing on the experience of such programs to date and on existing analyses (e.g, post-2000 analyses). Efforts should focus on options that could result in significant reductions and should include estimates of costs and potential greenhouse gas reductions or enhancements of sinks by sector.

LEAD: EPA with DOE, USDA and Commerce

3. Regulatory and standards approaches: Develop and evaluate the costs and impacts of policies that would achieve substantial reductions in greenhouse gases in significant sectors. Analysis should not duplicate work already done (e.g. , options examined in the context of Car Talk) and should include options in areas where legislation is pending.

LEAD: DOE with EPA, USDA and Commerce

4. Auction revenue options: Develop and evaluate options related to the reflow of revenues that would be generated if an emissions trading regime were instituted and designed to include auctions. This work should be coordinated with the emissions trading design options and with the IAT modeling.

LEAD: Treasury with DOE and EPA

5. Sectoral impacts: This paper will draw from the work described above and present policy options, with estimated costs and emissions reductions, by sector.

LEAD: Dept of Commerce with OSTP, DOE, USDA, and EPA.

Timetable: Draft of papers with a first cut on costs and impacts of options by March 14 for Assistant Secretary review. Revised papers for Deputies by March 31. This schedule recognizes that detailed proposals will require a longer period to develop and would be prepared with guidance from the Deputies.

II. TECHNOLOGY RESEARCH AND DEVELOPMENT

A range of options are being developed on climate technology research and development for possible inclusion on the agenda at the upcoming G-7 meeting. CEQ will be chairing a senior meeting on this topic next week.

III. LONG-TERM CONCENTRATIONS/EMISSIONS AND IMPACTS

OSTP is completing a redraft of its paper on the emissions and concentrations and will present it at the Assistant Secretaries meeting on Friday, February 21. An initial paper on health and environmental impacts has been prepared and circulated by EPA. A more extensive paper reflecting additional work underway at a number of agencies in response to a request from the Vice President is being coordinated by OSTP and should be available in several weeks.

IV. PUBLIC OUTREACH

EPA will circulate a draft Federal Register notice based on the overview paper, seeking public input in the form of written comments. Work is underway to prepare a Hill/NGO briefing on the economic analysis. A public outreach plan will be presented to the Assistant Secretaries in the near future.

DISTRIBUTION:

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USAID	David Hales	703-875-4639
DOL	Andrew Samet	219-5980

STATUS OF MODELING EXERCISE

- First set of benchmark runs (1990 emission levels achieved in 2010) have been completed. Additional sensitivity analyses are being done. These include: different reaction functions for the Federal Reserve in implementing monetary policy (in response to the introduction of tradeable permits); different price expectations for consumers and producers when tradeable permits are introduced; 5 and 10 year ramp-ups to binding emission constraints; annual efficiency gains in the use of energy of 1.75 percent (compared to 1.25 percent in benchmark case); and different international trading regimes (e.g., Annex I trading and joint implementation).

- Next round of runs includes:
  - 90 percent of 1990 emission levels in 2010
  - 1990 emission levels in 2015 (and 2020, for the models that can accommodate this)

- The complete set of benchmark runs should be available by the next Deputies meeting; but not the second round of model runs.

Fri, 2/21/97, 1pm

cc: JS
MM

THE WHITE HOUSE

WASHINGTON

Technology

February 20, 1997

MEMORANDUM FOR DISTRIBUTION

FROM: ELGIE HOLSTEIN
DAVID SANDALOW

SUBJECT: Climate Change

There will be a meeting tomorrow, Friday, February 21 from 1:00-2:30 in OEOB Room 231. We will start promptly at 1:00.

The agenda is:

1. Next Steps on Economic Analysis

2. Next Steps on Domestic Policy Development

3. Hill Modeling Briefing

* 4. Concentrations/Emissions Paper

Everyone on the attached list has been cleared into the building. If you have questions concerning clearance, please call Wendy Philleo (456-6224).

From Jay S.

* Attached is the paper for #4 (ROBINA's paper). ROBINA, Steve Siedel, and I had a meeting where I asked for and wrote up points that summarized the key ideas in the paper. The idea was to put the key points on page 1 for the deputies. I thought we understood each other but that is not how it turned out

THE LONGER-TERM VIEW: THE RELATIONSHIP OF EMISSIONS TO ATMOSPHERIC CONCENTRATIONS

Most discussions have focused on what steps might be taken in the medium term (2010-2020) to reduce emissions of greenhouse gases. Such actions represent only an initial step and, by themselves, would fall far short of significantly reducing the risks of climate change. Much more long-term planning will be necessary to achieve the goal of the Framework Convention on Climate Change:

> *"stabilization of greenhouse gas concentrations . . . at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should . . . allow ecosystems to adapt naturally to climate change; ensure that food production is not threatened; and enable economic development to proceed in a sustainable matter."*

This paper describes emissions paths that would be necessary to achieve various longer-term goals of stabilizing atmospheric concentrations of greenhouse gases. It also explores the implications ~~that a~~ of a longer term goal ~~has~~ for shaping near-term policy decisions.

Several aspects of the climate change issue underscore its long-term nature, but also suggest a need for beginning action now:

- -- Once emitted, carbon dioxide will remain in the atmosphere for 150-200 years.
- -- Lags in the climate system result in temperatures increasing for several decades and sea levels rising for centuries after greenhouse emissions have ceased to increase.
- -- Uncertainties in scientific understanding of climate change and its relationship to long-term costs and benefits make selecting any specific ultimate concentration goal somewhat speculative at this time.
- -- It has taken decades for the infrastructure of fossil-fuel based technologies to develop. A transition to alternative sources of energy will also require many decades, but will only begin in earnest if research and development is begun now and if proper incentives are provided.

I. GLOBAL EMISSIONS AND ATMOSPHERIC CONCENTRATIONS

In the absence of any actions specifically to limit carbon dioxide emissions, the Intergovernmental Panel on Climate Change ~~(IPCC), as shown in Figure 1,~~ estimated that current emissions (as shown by the 2 upper lines labeled Business as Usual [BAU]) of 6 billion tons of carbon per year could grow to between 15-25 billion tons of carbon by 2050 and continue to increase through the end of the next century.

Global CO_2 Emissions & Concentrations

Emissions

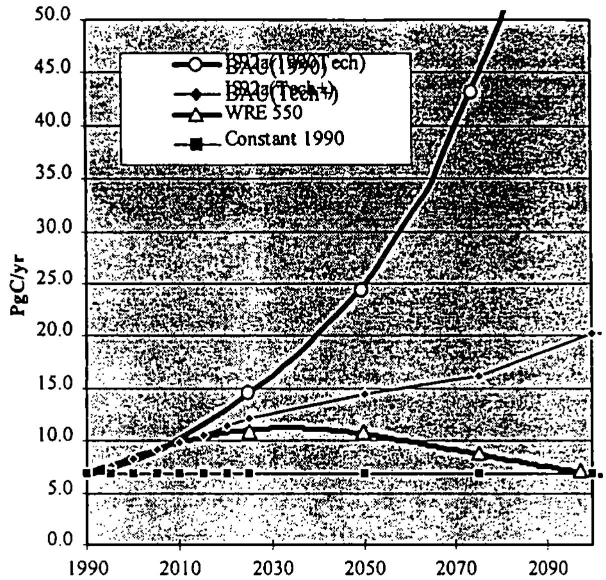


Figure 1

Concentrations

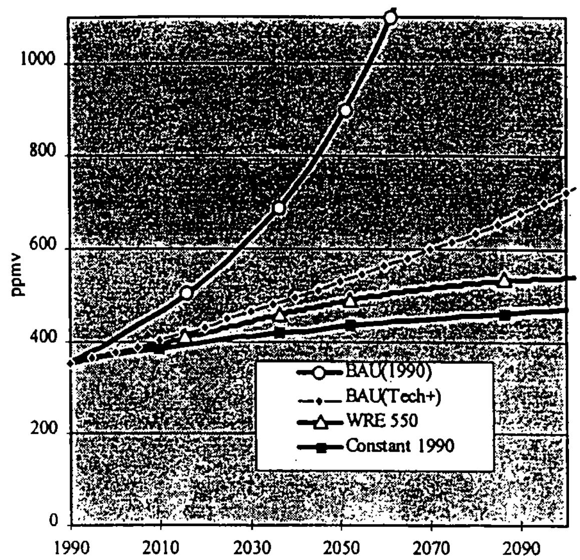


Figure 2

Figure 2 shows the impact of these emissions scenarios on atmospheric concentrations. For context, preindustrial levels of carbon dioxide were about 280 ppm, and have increased to today's levels of about 360 ppm. The BAU "1990 tech" scenario assumes technology remains constant at 1990 levels in the future. The BAU "tech+" scenario assumes technology improves substantially and results in lower costs for alternative fuels and enhanced energy efficiency; this latter scenario represents the "central case" developed by the IPCC and is sometimes referred to as "IS92a". In both of these scenarios, emissions grow substantially over time and concentrations far exceed a doubling of preindustrial levels before the end of the next century.

If it were possible to cap global emissions in both developed and developing countries at 1990 levels, figure 2 (line labeled "constant 1990") shows that concentrations would nonetheless continue to rise throughout the next century and beyond, eventually exceeding a doubling of preindustrial levels. (Note that the other greenhouse gases make the effective concentration about 20% higher than indicated by CO_2 alone.)

Figure 3 shows the projected long-term atmospheric concentrations if emissions were stabilized at different levels. The figure shows that if emissions were stabilized at current levels (6 PgC/yr), atmospheric concentrations would grow to almost 500 ppm by 2100 and continue increasing thereafter. It also shows that if worldwide emissions are frozen at 10 PgC/yr, roughly 33 percent higher than today's level, then atmospheric concentrations would more than double from pre-industrial levels by 2100, and continue to increase thereafter.

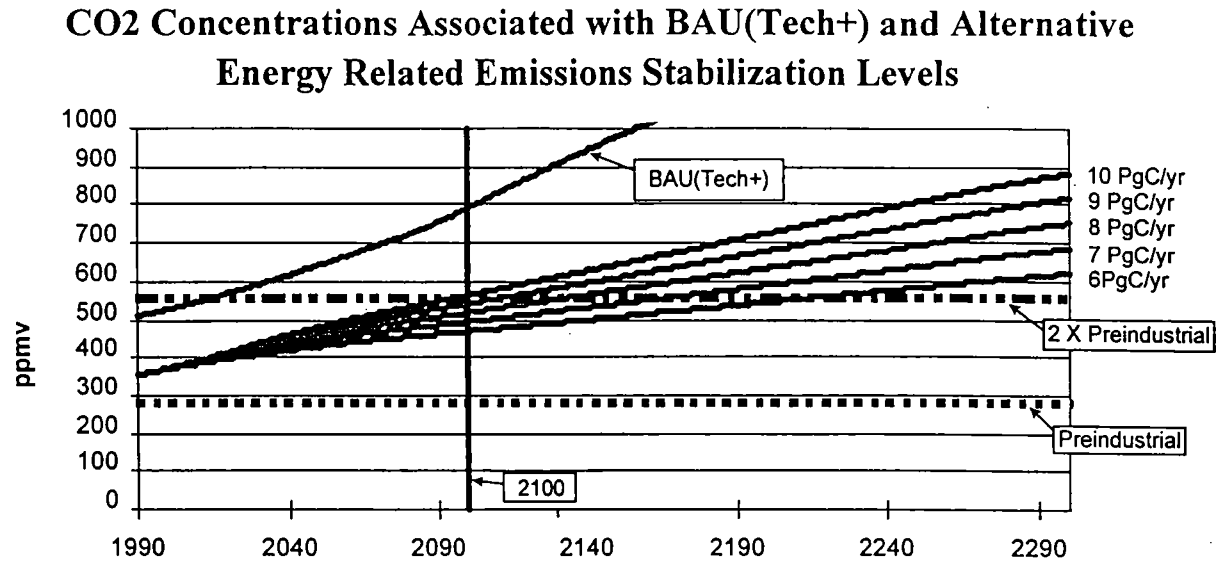


Figure 3

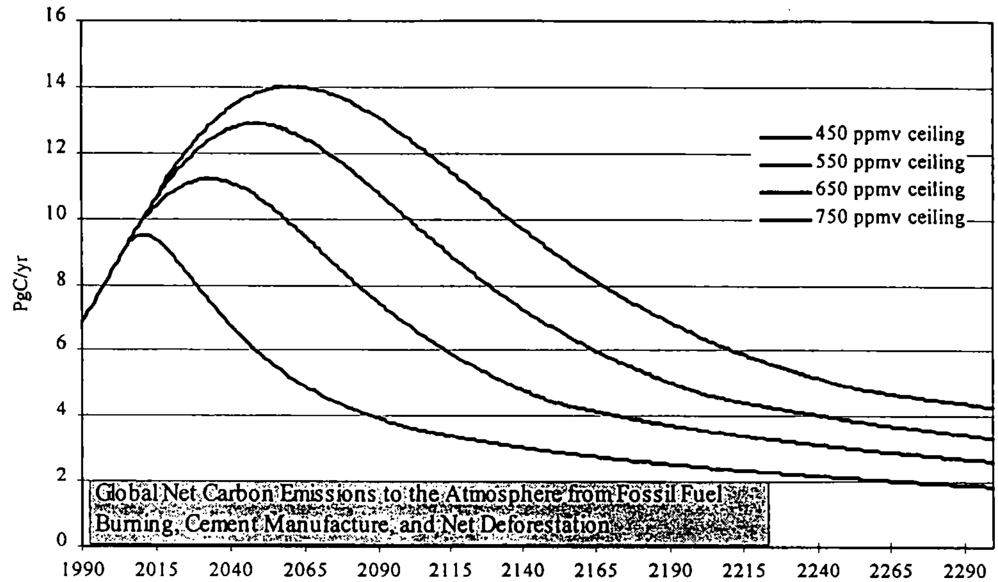
Table 1 shows how various concentration targets relate to emissions pathways. For example, to meet a 550 ppmv concentration goal, global emissions must begin to deflect from the business-as-usual curve by 2013. In this scenario, emissions would peak at 9.7 PgC/yr in 2033 and drop rapidly thereafter.

Researchers have examined in some detail the annual emissions paths required to meet atmospheric carbon concentration targets of 450 to 750 ppm. These targets require significant reductions in cumulative projected global carbon emissions; and as shown in Figure 3, all of them require dramatic reductions in annual emissions rates sometime during the next century. To achieve 450 ppm target – which still represents a two-thirds increase in atmospheric concentrations over preindustrial levels – annual emissions must begin declining steeply within the next quarter-century and must fall to less than half the current rate by 2100. To achieve a 550 ppm concentration target – which represents about a doubling in atmospheric concentrations – annual emissions must begin declining steeply during the second quarter of the century. Furthermore, these budgets must be distributed both across countries and across time.

The relationship between CO2 concentrations and emissions pathways (energy emissions only)*				
Steady-State Concentration⇒	450 ppmv	550 ppmv	650 ppmv	750 ppmv
Deflection Date BAU (Tech+)[a]	2007	2013	2018	2023
Maximum Emission Date	2011	2033	2049	2062
Maximum Emission[b]	8.0	9.7	11.4	12.5

[a] The deflection date is the year in which emissions first fall below BAU emissions.

[B] Maximum PgC/yr fossil fuel carbon emissions. If other greenhouse gases were included, emissions would be effectively 20% higher; thus, reductions would have to occur sooner than the deflection date noted to achieve a given concentration.



* - note: the curves in the graph represent slightly different values than those in the table because the graph takes cement manufacture and deforestation into account in addition to energy emissions.

Figure 4

II. DEVELOPED AND DEVELOPING COUNTRY EMISSION TRENDS

Figure 5 presents current and projected emissions of carbon dioxide for developed and developing countries. Of the current emissions of roughly 6 billion tons, approximately two-thirds are from developed and one-third from developing countries. The U.S. is currently the largest emitter of carbon dioxide, with China the second largest source. However, on a per capita basis, the U.S. emits about 5 tons of carbon per capita, compared to an average of approximately 4 tons per capita in Japan and Western Europe, and 0.4 tons per capita for developing countries. Figure 6 shows per capita emissions for the BAU case out to 2100. While per capita differences remain large over time, by the middle of the next century, developing countries would become a source for more than half of total global emissions.

Annex I and Non-Annex I Fossil Fuel Carbon Emissions: BAU(Tech+)

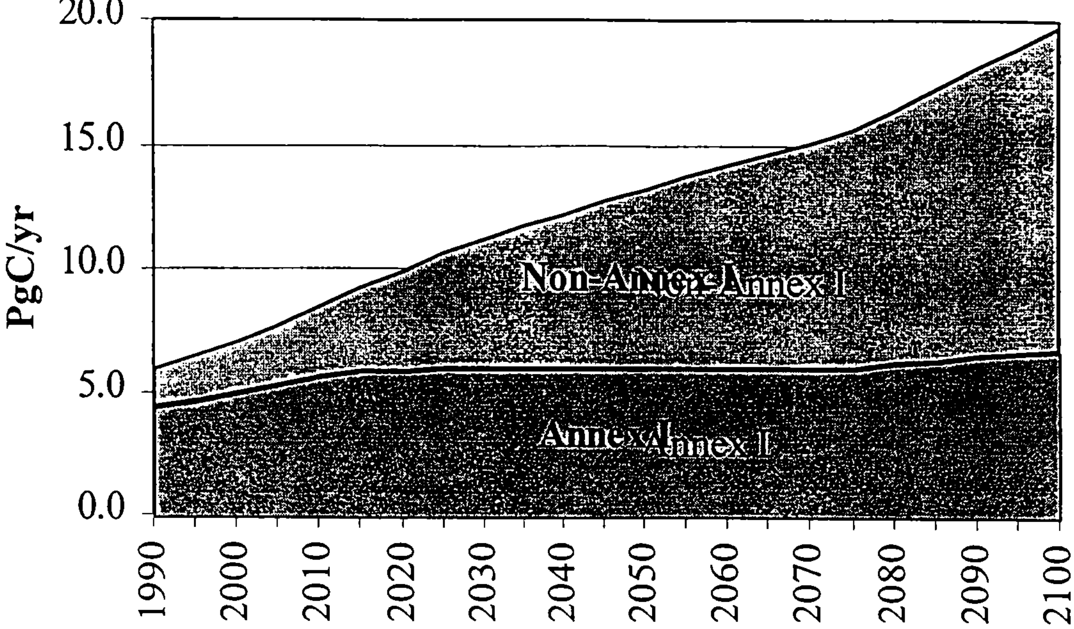


Figure 5

Per Capita Carbon Emissions By Region: BAU(Tech+)

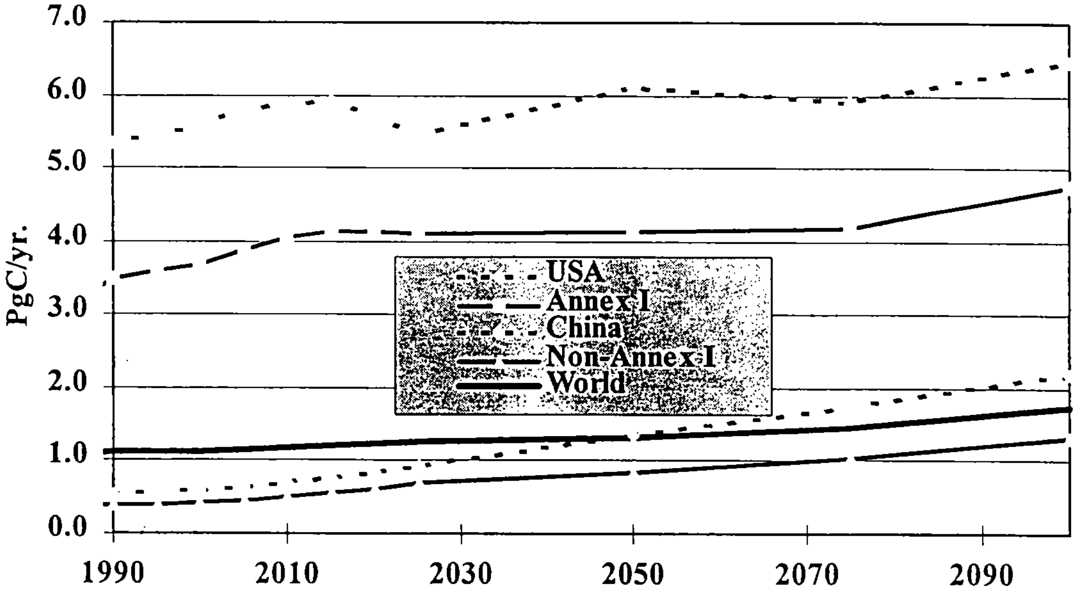


Figure 6

III. ILLUSTRATIVE EMISSION REDUCTION SCENARIOS

Limited mid-term actions to reduce emissions by developed countries alone have little impact on shifting the atmospheric concentrations curve. The top line in Figure 7 shows the small change in concentrations if Annex I (developed countries) freeze emissions at 1990 levels in the year 2010. Successive lines show what a coal ban in various parts of the world (beginning in 2020) might do to emissions and concentrations. Without the participation of developing countries, concentrations will not stabilize.

Annex I coal ban 100% pretty good

Global Paths for BAU(Tech+), Annex I Emissions Stabilization, Coal Bans

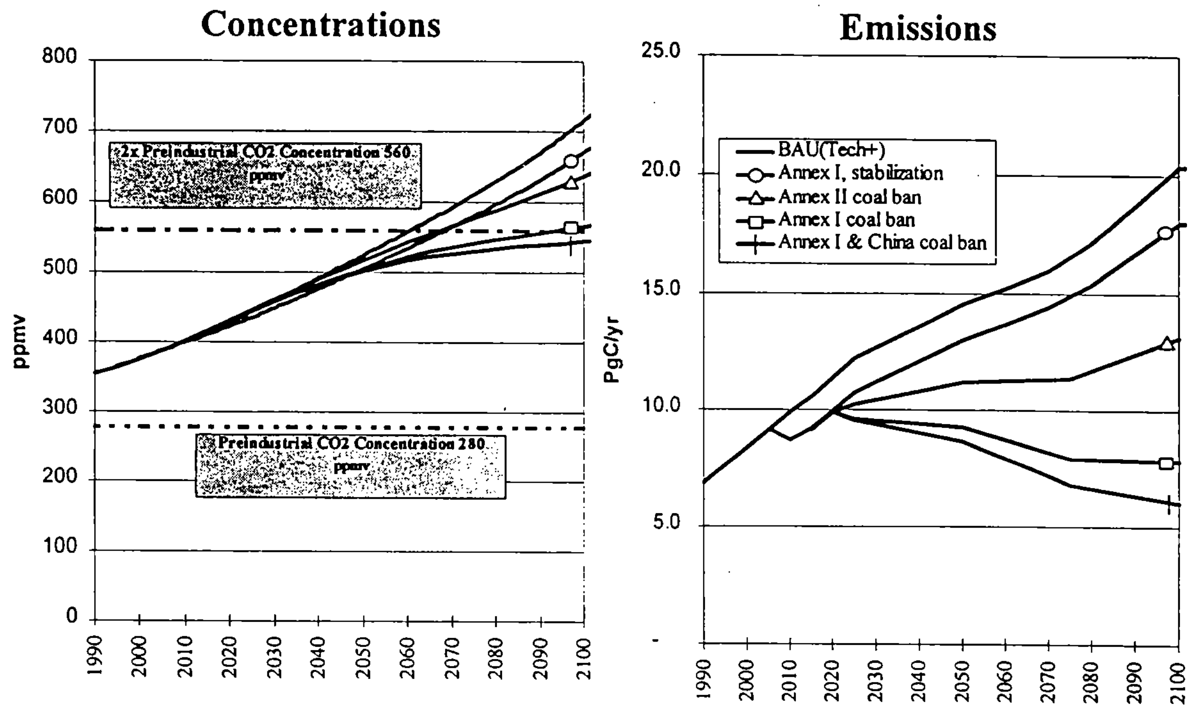
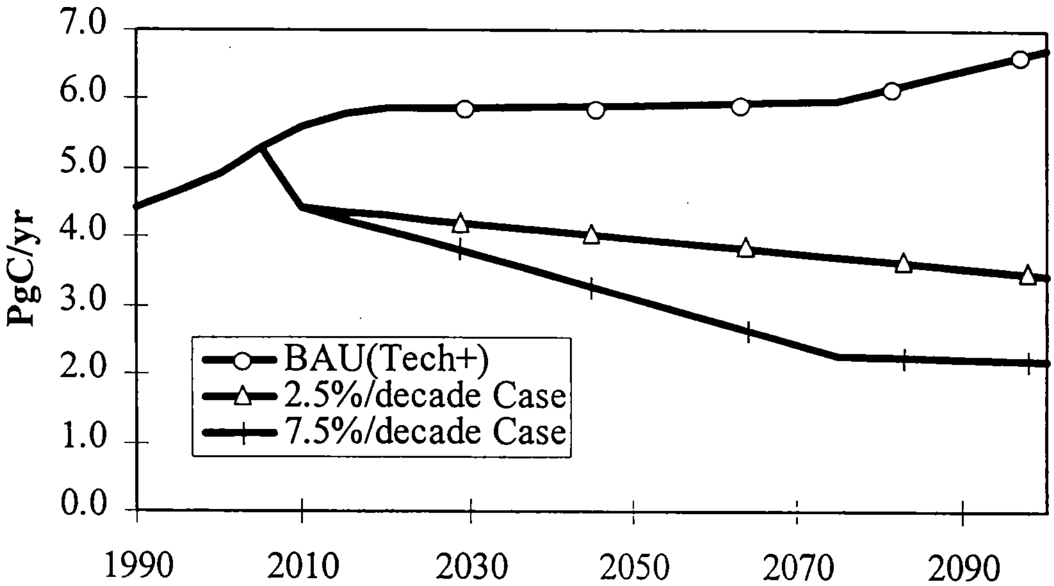


Figure 7

Annex I Fossil Fuel Carbon Emissions: BAU(Tech+), and 2.5%/Decade, & 7.5%/Decade Reductions



2.5%/Decade Case assumes that Annex I nations stabilize emissions at 1990 levels in 2010 and then reduce emissions at 2.5%/decade through the year 2100.

7.5%/Decade Case assumes that Annex I nations stabilize emissions at 1990 levels in 2010 and then reduce emissions at 7.5%/decade until they are 50% of 1990 levels after which time they are held constant.

Figure 8

Figure 8 illustrates two possible emissions profiles for developed (Annex I) countries. Both scenarios assume a freeze in emissions at 1990 levels in 2010. On the hatched line, emissions are then reduced by 2.5% per decade and in the lower line they are reduced at 7.5% per decade. The highest line is the business-as-usual (TECH+) scenario from the IPCC.

Figure 9 is based on the Annex I pathways described in Figure 6. They show the pathway developing countries would need to follow to stabilize concentrations at 450 ppm, 550 ppm and 650 ppm. These figures show that to achieve stabilization at 550, developing countries would be able to emit on their currently projected path until about 2020 before significant reductions would be required.

Figures 10 and 11 show the **per capita** emissions for both developed and developing countries that result from the scenarios described in the previous two figures. They show that under these scenarios, developed country emissions stay substantially greater than those in developing countries (which rise to 1 TC/person only in the 650 ppm case).

Allowable Non-Annex I Emissions if Annex I Countries Stabilize then Reduce Emissions: 450 ppmv, 550 ppmv & 650 ppmv CO2 Ceilings

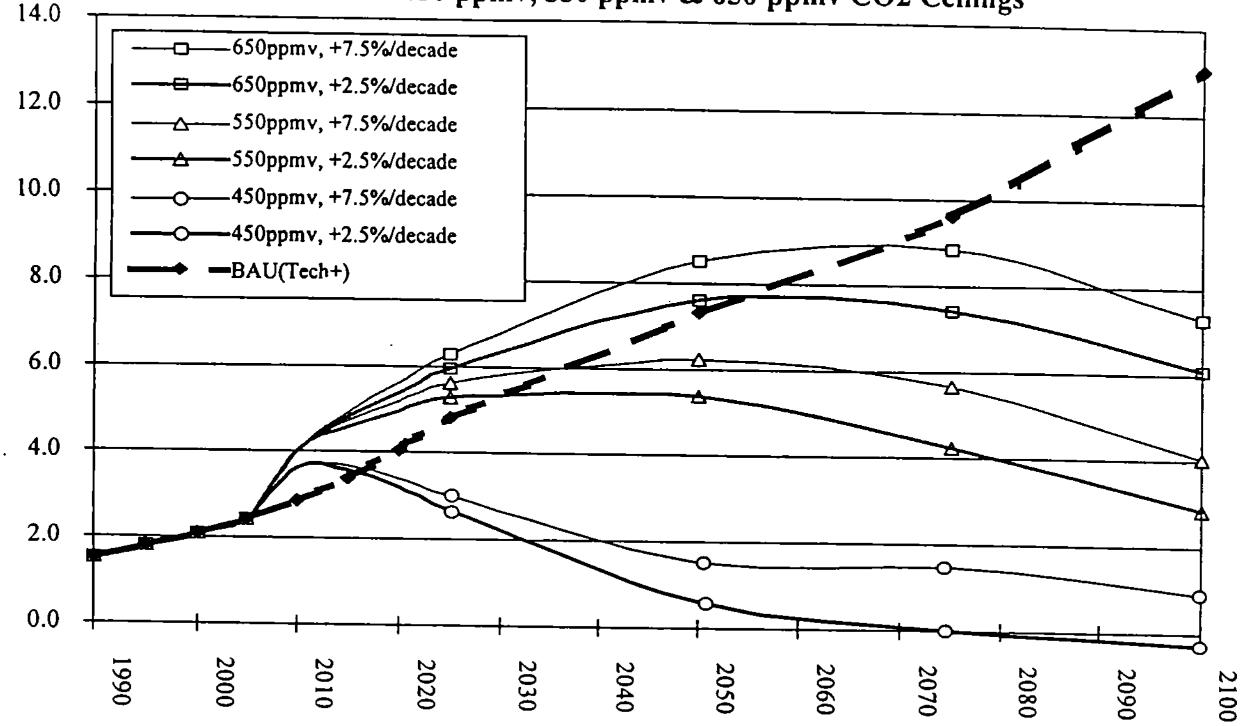


Figure 9

Per Capita Emissions
Various CO2 Concentration Ceilings--Annex I 2.5%/Decade Emissions Reductions

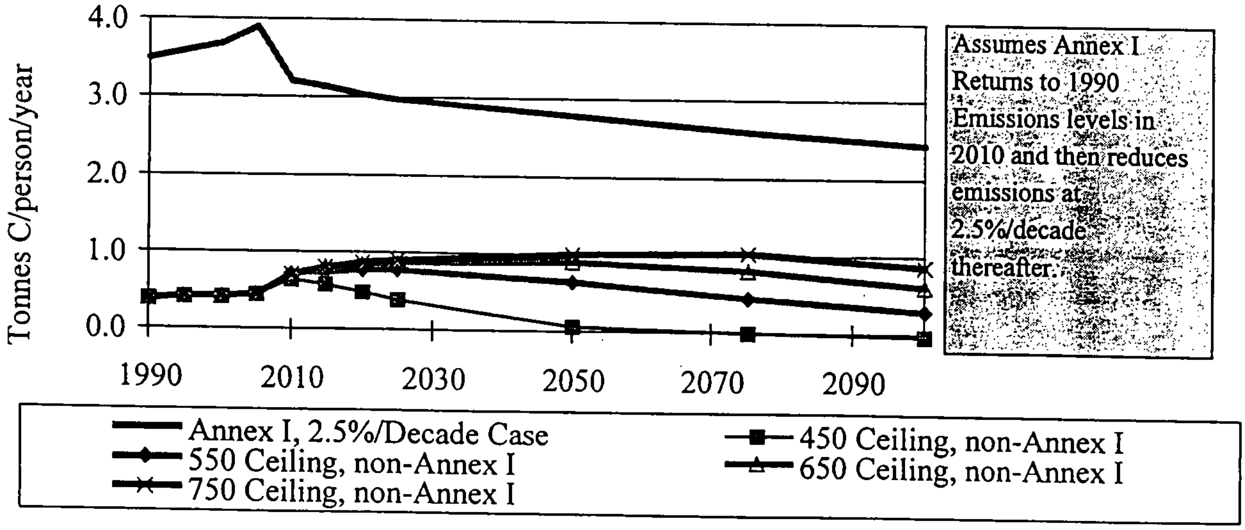


Figure 10

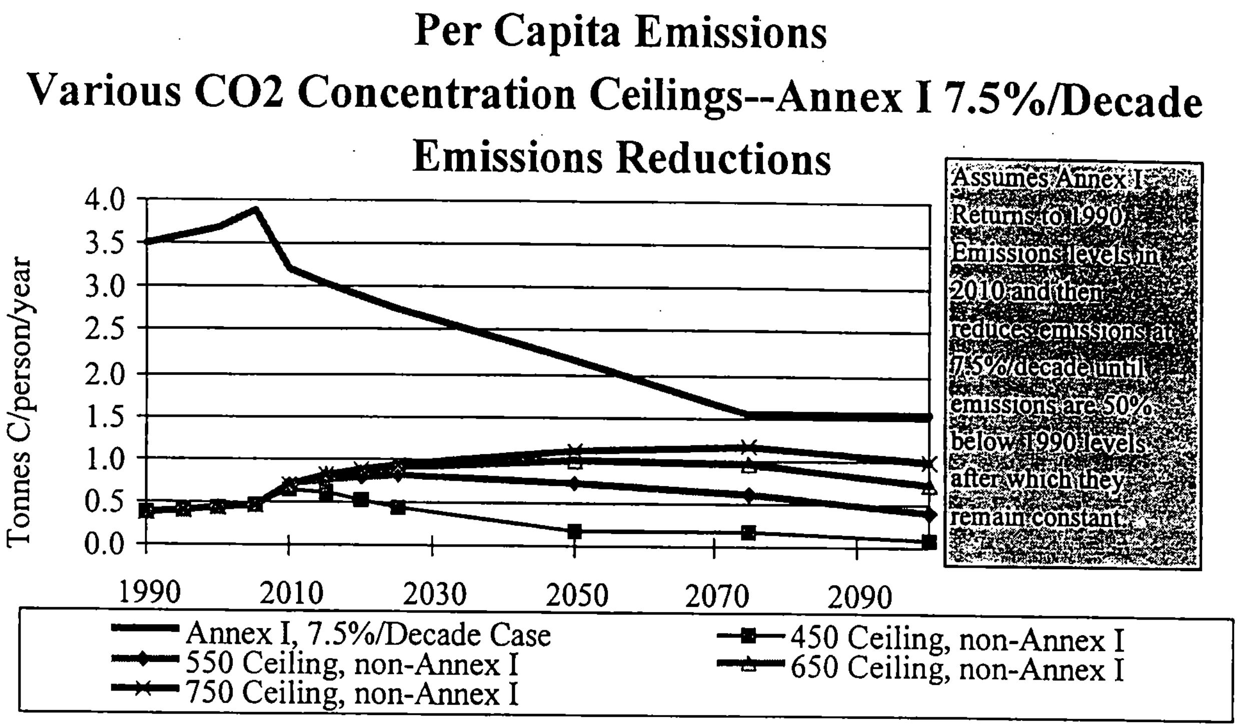


Figure 11

IV. THE ROLE OF TECHNOLOGY AND IMPACTS ON COSTS

As suggested in Figure 1, the rate of technological change can play a very important role in determining the level at which atmospheric concentrations can be stabilized. Figure 11 looks specifically at the costs associated with different technology cases. It looks at three specific cases:

-- 1990 tech: assumes no technological change from 1990

Do you really mean this?

-- 1990 tech +: assumes significant improvements in reducing the costs of alternative fuels and in improving efficiency;

-- Advanced tech: assumes even further advances and cost savings.

A description of key assumptions for the latter two cases is included as Appendix 1.

Figure 11 shows for each of these technology cases, the total costs associated with achieving three different levels of atmospheric concentrations: 550, 650 and 750 ppm. The estimated costs under the assumption that no technological progress is possible were found to be about \$12 trillion or 1.2% of total world GDP, compared to \$1 trillion or 0.12% of GDP assuming substantial progress in reduction technologies. In the advanced technology case, which assumes very substantial non-fossil alternatives will be available by 2020, the costs are greatly reduced. However, the assumed cost and performance of the alternative technologies would only become achievable with significant increases in research and development investments. For example, funding in conservation and renewables is about half of what it was 15 years ago, despite substantial proposed increases each year of the Clinton Administration.

The Relationship Between Technology and Minimum Cost of Stabilizing the Atmosphere Below Various Ceilings

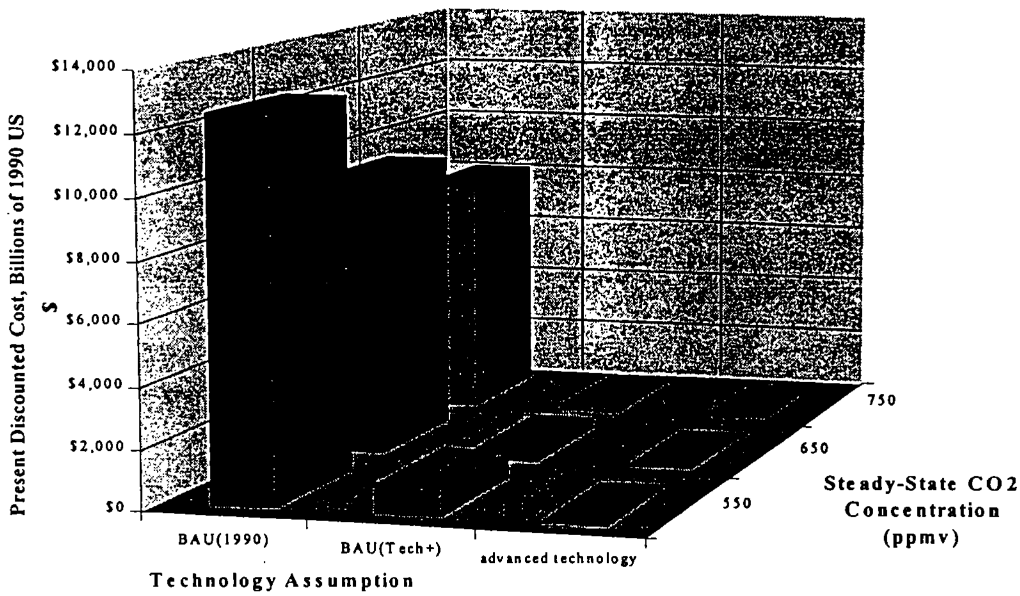


Figure 12

Substantial technological progress aimed at reducing the costs of emission reductions is critical for several reasons. It would result in lower costs to the U.S. economy, both in terms of reductions made domestically and in the costs of a reductions obtained abroad through any emissions trading regime. Reducing the costs of alternatives is also critical to limiting future emissions from developing countries, particularly those with large fossil fuel reserves. Finally, expanding the technological frontier offers U.S. industry significant potential opportunities for expanding our industrial base both at home and abroad.

APPENDIX

Key Assumptions about Technology Scenarios:

IS92a (Tech+)

- End-use (AEEI) Improves at 1%/yr.
- Conventional Fossil Fuel Power Generation Improves at 1%/yr.
- Non-Fossil Power Sources Improves at 4.5%/yr, 1990 to 2025, 1.25%/yr thereafter.
- Biomass Energy Improves at 1%/yr.

Advanced Energy Technology

- Advanced solar/wind/fusion
  - The cost of solar/wind power reaches a busbar cost of $0.04/kWh by 2020 and
  - the cost decreases at 0.5 %/year thereafter.
- Low cost biomass
  - By the year 2020, 20% of the biomass resource is available at $1.40/GJ and
  - 80% is available at $2.40
- Advanced liquefied hydrogen fuel cells for transport

cc: JAF
JS

FAX TRANSMISSION

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To:	Assistant Secretaries Climate Change Group Group (see attached list)	**Date:**	February 20, 1997
Fax #:	See attached list	**Pages:**	10, including this cover sheet.
From:	William N. White Special Assistant to David Gardiner		
Subject:	Emissions, Concentrations and Consequences paper		

COMMENTS:

Please find attached the latest draft of the paper entitled "Emissions, Concentrations and Consequences" . **This is the first part of a two part fax. The second part will be sent by Rosina Bierbaum of OSTP later today.** Please review this paper to prepare for a discussion at tomorrow's meeting of the Assistant Secretaries' Climate Change Group. Please call me or Diane Anderson at 260-4332 if you do not recive a complete transmission.

Emissions, Concentrations, and Their Consequences

Concerns about the potential effects of human induced climate change lead to the signing of the Framework Convention on Climate Change (FCCC), whose ultimate objective is to achieve "... stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." Concentrations of greenhouse gases have already risen significantly above those of the preindustrial era as a result of past emissions: concentrations of carbon dioxide, methane, and nitrous oxide have risen by about 30%, 145% and 15% respectively. Concurrently, global mean surface temperatures have increased 0.6 to 1.2°F since the late 19th century. In the absence of emissions control policies, concentrations are projected to rise further yet. For example, by 2100 the concentration of carbon dioxide is projected to be 30 to 150% higher than today's level. The projected increases in concentrations of carbon dioxide and other greenhouse gases are estimated to further warm the surface of the earth by an average of 1.6 to 6.3°F by 2100. This rate of warming is probably greater than any sustained rate of warming of the last 10,000 years, or since the innovation of agriculture (IPCC, WG I Summary for Policy Makers, 1995).

Most estimates of the effects of climate change are those associated with a doubling of the preindustrial concentration of carbon dioxide to approximately 550 parts per million (ppm), or an increase in all greenhouse gas concentrations that together would have an equivalent capacity to trap heat. Little information is available on the effects associated with other concentration levels.

The climatic changes that would result from an equivalent doubling of greenhouse gases would have pervasive effects, some of them irreversible, on the environment and human societies. Unfortunately, the tools and information available to predict specific impacts and convert them into monetized damages are limited at this time, hampering the ability to undertake a more comprehensive cost-benefit assessment of climate change policies. Nevertheless, some impact analyses have indicated substantial possible costs associated with inaction, providing an important context for considering the economic costs associated with policies to reduce greenhouse gas emissions.

Health Effects

Climate change will affect the health of human populations in diverse ways and adverse effects are likely to outweigh beneficial effects substantially (WHO, 1996). One source of adverse effects is illness and death from summertime heat stress. In 44 US cities, summer heat related deaths are estimated to increase 70-150% by 2050, even if people adjust physiologically and behaviorally to changing climate conditions and make some adjustments to urban infrastrure (Figure 1, Kalkstein and Greene, 1997). The elderly are at greatest risk in the US and urban populations in developing countries are also especially vulnerable to heat stress.

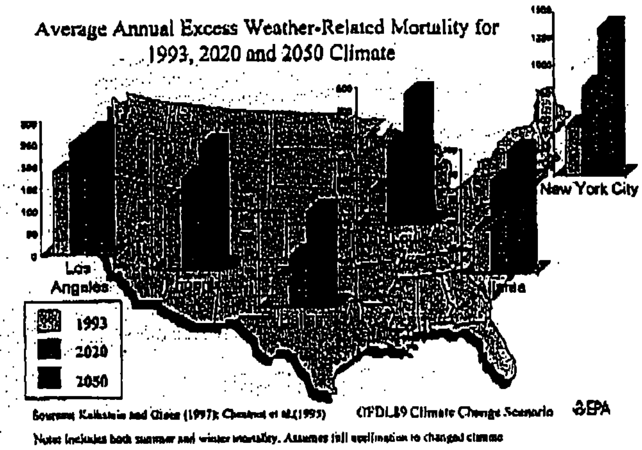


Figure 1

The incidence of infectious diseases, which are still the world's leading cause of fatalities, may increase as a result of climate change. Climate change may extend the geographic ranges of disease-carrying vectors such as mosquitos, which can increase the populations exposed to diseases such as malaria, dengue and yellow fever. In North America, the area of potential malaria transmission may expand as a result of 2xCO2 climate change (Figure 2). Globally, the population potentially exposed to malaria could increase by one-third, with a possibility of 50-80 million additional malaria cases per year relative to a baseline of 500 million cases (IPCC, WG II Report, 1995). The incidence of water borne infectious diseases such as cholera and diarrheal diseases may also increase due to the effects of climate change on water supply, water quality, and sanitation (WHO, 1996).

Climate change can reduce air quality and increase levels of air borne pollen and spores which exacerbate respiratory disease, asthma, and allergic disorders. In addition, controls to reduce greenhouse gas emissions would simultaneously reduce atmospheric concentrations of air pollutants such as fine particles, NOx, ozone, and heavy metals including mercury. For example, capping CO2 emissions at 1990 levels has been estimated to yield co-control reductions of up to 2.3 million tons of NOx emissions and 0.9 million tons of SO2

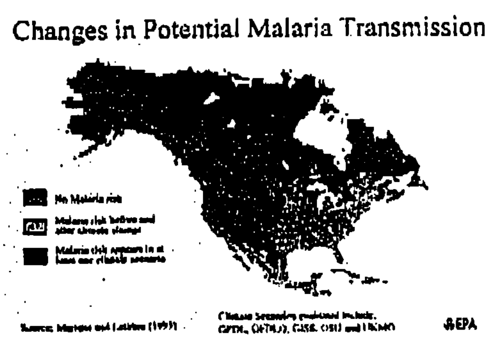


Figure 2

emissions in 2010. Co-control reductions in these pollutants would bring local air quality and health benefits that would add to and be more immediate than the climate related health benefits of greenhouse gas emission reductions.

Water Resources

Human welfare is also placed at risk by changes in the availability of fresh water that may result from climate change. Changes in precipitation and increased evapotranspiration due to higher temperatures from 2xCO2 climate change can be expected to cause large changes in water runoff in some regions, affecting the quantity and quality of water supplies for domestic and industrial uses, irrigation, hydropower generation, navigation, stream ecosystems and water based recreation. Increased variability in the hydrologic cycle is expected to result in more severe droughts and/or floods in some places but less severe in others (IPCC, WG I Report, 1995).

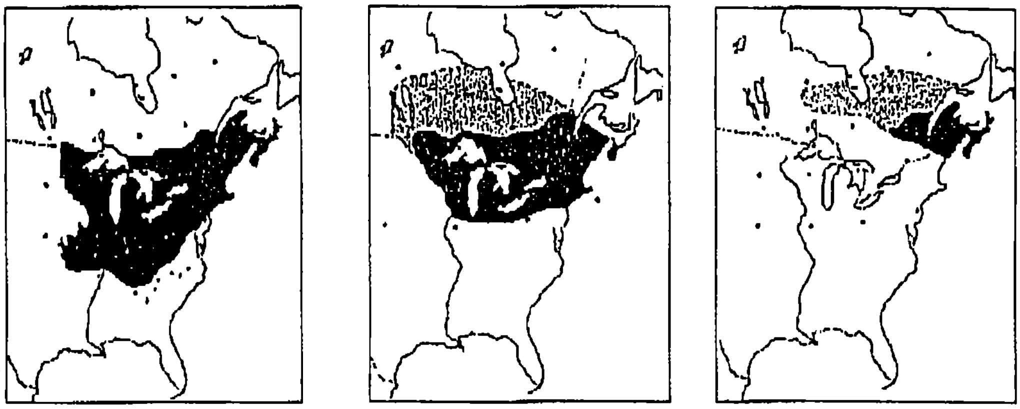
Areas of greatest vulnerability are those where water supplies and quality are already problems, such as arid and semi-arid regions of the world and some low lying coastal areas, deltas and small islands. In some cases these areas coincide with conflict prone areas which are highly dependent on water originating in areas outside their borders such as Cambodia, Syria, Sudan, Egypt and Iraq (IPCC, WG II Report, 1995).

In the United States, the Colorado River Basin would suffer decreased summer runoff, coinciding with peak demand for irrigation, unless precipitation also increases substantially. Reductions in runoff of up to 25 percent in the basin are projected under some scenarios of 2xCO2 climate change. Runoff losses of this magnitude in water short regions such as the Colorado River basin are likely to adversely affect water deliveries, exacerbate salinity problems, reduce hydropower generation, and reduce water storage in reservoirs (Nash and Gleick, 1993).

Forests and Natural Areas

Climate change can dramatically alter the geographic distributions of individual tree species and of forest and vegetation types (see Figure 3). One-third of the Earth's forests would undergo a major change in the type of vegetation that could be supported as a result of CO2 doubling. In boreal forests, which are the forests most vulnerable to climate change, two-thirds of the currently forested area may undergo a change in vegetation type. In some instances, a change in vegetation type will result in a loss of forest area as the land converts to grassland or shrubland. Globally, forested areas may decline 10 percent after forests reach a new equilibrium under a new climate (IPCC, WG

II Report, 1995).



A B C

Present and future geographical range for sugar maple. A: Present range (from Fowells, 1965). B: 2XCO2 climate-space in 2090 A.D. under the GISS scenario. Black area is the predicted species range; stippled area is potential range. C: 2XCO2 climate-space in 2090 A.D. under the GFDL scenario. Black area is the predicted species range, stippled area is potential range.

Source: USEPA, 1989

Figure 3

In the United States, western conifer forests could decrease in area and be replaced by broadleaf forests; eastern deciduous forests may be replaced by grasslands along their western boundary. Total forested area in the United States could either increase or decrease after forests reach a new equilibrium with a 2xCO2 climate. Projections of decreases are as high as 15 percent (VEMAP, 1995).

Loss of Habitat for Brown Trout from a Doubling of CO_2

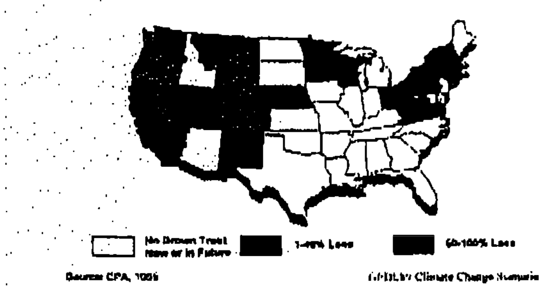


Figure 4

Wildlife habitat could be altered substantially with repercussions for wildlife abundance, local species survival, and global species survival. For example, a potential change from boreal forest to northern hardwood in the Boundary Waters Canoe Area would result in an area currently suitable for moose changing to one more suitable for white-tailed deer (Botkin, 1989). As another example, increases in water temperatures of rivers and streams would change the types of fish that could be supported and potentially result in losses of habitat for cold water fish species such as Brook, Brown, Rainbow and Cutthroat trout (Figure 4).

Wetlands represent another critical set of ecological systems at risk from climate change. For example, the IPCC found that precipitation changes and salt water intrusion from sea level rise could adversely affect the ecological communities of the Florida Everglades and degrade the habitat for many species of wading birds. The wetlands of the prairie pothole region of North America, which supports half the waterfowl population of this continent, could diminish in area and change dramatically in character in response to climate change according to the IPCC. Although not specifically assessed by the IPCC, such changes could be devastating to migratory bird populations and species survival.

Coastal Areas

With a doubling of CO2, sea level would continue to rise for several centuries, with the best estimate of the equilibrium rise being at least seven feet. In the next century, sea level is projected to rise about 20 inches, which is over three times the 6 inch rise experienced over the last century. Along most of the U.S. Atlantic and Gulf Coasts, sea level is projected to rise one foot in the next fifty years and two feet in the next century. The IPCC estimates that a 50 cm rise in sea level would increase the population at risk from storm surges from roughly 45 million at present to over 90 million world wide.

Rising sea level erodes beaches and coastal wetlands, causes the gradual inundation of low lying areas and increases the vulnerability in coastal areas to flooding from storm surges and intense rainfall. A one foot rise could erode ocean beaches 100-150 feet over the next fifty years, which would threaten the first few rows of houses along many barrier islands and other resorts. A two foot rise would inundate 3000 to 7000 square miles of coastal lowlands and 20-45 percent of U.S. coastal wetlands. Rising sea level and lower river flows will increase salinity levels in aquifers and estuaries, tentially harming drinking water supplies in California's Central Valley, Philadelphia, New York, and Miami. Rising sea level could also change the character of coastal areas. For example, along the Chesapeake Bay and other estuaries, the small sandy beaches and wetland shores could gradually be replaced with walls of steel, rock, wood, and concrete.

Blackwater National Wildlife Refuge (Maryland)
Surface Classification: 1938 and 1980

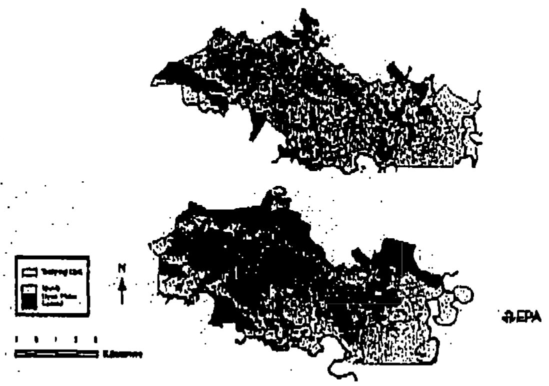


Figure 5

Agriculture and Food Supply

Climate strongly affects crop yields and projected changes under a CO2 doubling can exceed 30 or 40 percent for some crops and locations (Figure 6). But despite the potentially large changes in yields, global food production is not expected to change substantially. This is because farming practices are considered to be highly adaptable to different climates, because production of important food crops can shift to new locations in response to changes in climate, and because CO2 has beneficial effects for plant photosynthesis and water use efficiency that can offset deleterious effects of changes in climate. Regional food production, however, may be substantially affected. Agricultural production could decline significantly in developing countries while being only slightly affected in developed countries. Production decreases in developing countries have been estimated to increase the population at risk from hunger by 5 to 50 percent, or 40 million to 300 million persons (Rosenzweig, Parry and Fischer, 1995).

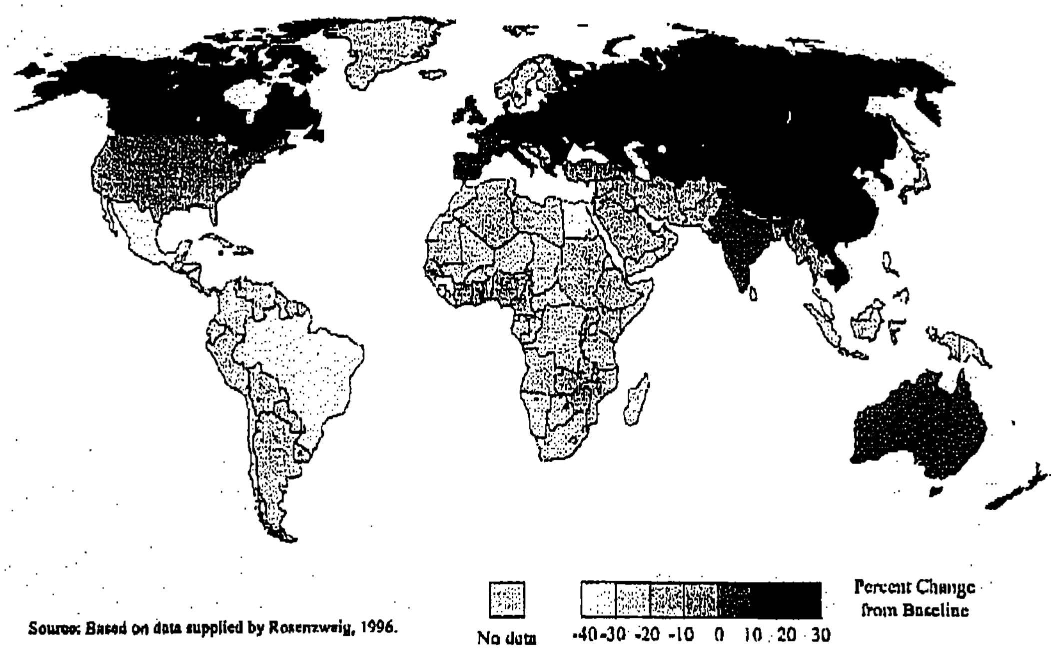


Figure 6 Estimated change in average wheat yield for GISS 2xCO2 scenario.

In the United States, total agricultural production and income generated in agriculture would most likely change only slightly under a doubling of CO2. The aggregate effects, however, mask regional differences in the impacts of climate change on agriculture. For example, eastern and southern areas of the United States are projected to experience losses in agriculture under a number of scenarios, while northern and western areas are projected to benefit (Adams et al., 1995).

Catastrophic Events, Surprises and Rates of Change

There are various feedback effects between the atmosphere, oceans, and terrestrial systems that amplify or dampen changes in climate that are projected to result from human emissions of greenhouse gases. Uncertainties about these effects are largely responsible for differences in the warming projected by different models for a doubling of carbon dioxide. But because of the complexity and non-linearity of the processes and interactions, abrupt, large and unpredicted changes in climate and/or sea level are possible.

There are also potentially significant feedbacks not accounted for in climate and sea level rise projections. For example, the rates of warming projected to result if no further actions are take to control greenhouse gas emissions would cause suitable climates for many tree species to move polewards at rates that are an order of magnitude greater than the species can migrate (IPCC, WG II Report, 1995). This could cause significant losses of forest productivity and dieback of forests. As a result, enormous quantities of carbon could be released to the atmosphere and significantly amplify the warming. Though the probabilities of such events are considered to be low, they are expected to grow the more rapid is the rate of warming (IPCC, WG I Report, 1995).

Emissions

While little can be said about the effects associated with concentrations other than 550 ppm CO2 equivalent, it is likely that uncontrolled emissions will result in higher concentrations. While 550 ppm is approximately the concentration of CO2 that would result if current global emissions were permanently capped at the current emission level of 6 billion tons, the mid-range estimate of the IPCC projects growth of CO2 emissions to 13 billion tons by 2050 and 20 billion tons by 2100.

Greenhouse gases include carbon dioxide, methane, nitrous oxides, hydrofluorocarbons (HFCs), poly-perfluorocarbons (PFCs), and sulfur hexafluoride (SF6). Gases differ both in their atmospheric lifetimes and in their ability to trap heat in the atmosphere. In addition, carbon is not only emitted through the combustion of fossil fuels, but is also absorbed by "sinks" such as trees and soils.

Although greenhouse gases come from many sources, carbon dioxide (CO_2) from fossil fuel use is the source of greatest concern because of its rapid historical and projected growth. Human activities have already resulted in roughly 250 billion tons of carbon (gigatons of carbon or GtC) emissions from fossil fuel combustion and perhaps 200 GtC from net deforestation since 1700. In terms of carbon equivalent, cumulative anthropogenic greenhouse gas emissions since the beginning of the Industrial Revolution have been roughly 570 billion metric tons of carbon equivalent (GtCe), of which about 450 GtC have been carbon.[1]

Historically, fossil carbon emissions have come mainly from the U.S. (27% of the postwar total), the rest of the OECD (22%), and the former Soviet Bloc (24%). The rest of the world, with nearly 80% of the population, is responsible for a mere 27% of cumulative emissions. On a per capita basis, U.S. emissions are over 5 tons per person per year; the industrial nations of Western Europe and Japan emit about 2 to 2.5 tons per person; and the nations of the former Soviet Bloc, whose per capita emissions used to be very high due to the inefficiencies of central planning, have fallen to about 2.5 tons per person. At the other end of the spectrum, the developing countries of the Americas, Africa and Asia have emissions on the order of 0.2 to 0.6 tons per person.

Despite their relatively low emission levels, developing countries' emissions are growing very rapidly -- 21% between 1990 and 1995. Global fossil fuel emissions have been roughly stable during this period only because of the 30% reduction in former Soviet Bloc emissions associated with the collapse of the centrally planned economies. Given current projections of population growth and economic activity, developing countries' share of annual global fossil emissions should surpass that of the developed countries during the second quarter of the next century (Figure 6). However, their share of *cumulative* fossil emissions will remain below that of the developed countries for many years to come, as will their per capita emissions.

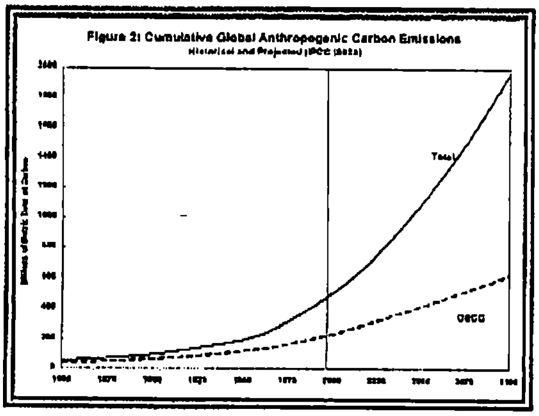


Figure 7

More than 75% of all fossil emissions in history have occurred since 1945, and 50% have occurred since 1970. About 40% of total carbon emissions have accumulated in the atmosphere, raising the stock of atmospheric carbon by nearly 30% from 280 ppm (parts per million) to over 360 ppm. Somewhat less than half of current emissions are accumulating in the atmosphere, while the rest is absorbed in natural sinks (the oceans and biosphere) through processes that are as yet only poorly understood. Although most of the increased carbon will ultimately be absorbed by the oceans, the increased atmospheric concentrations of carbon dioxide and other greenhouse gases will affect the climate for centuries to come. Once emitted, carbon dioxide will remain in the atmosphere for 150-200 years.

[1] Deforestation and other changes in land use have reduced the amount of carbon stored in biota and soils by perhaps 275 GtC, or around 10%, since the beginning of agriculture.

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M E M O

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Re: Senator Johnson and latest CBPP piece on the BBA and Social Security

Date: February 21, 1997

COMMENTS:

Here is the latest volley from us on the Social Security trust fund issue and the Republicans' response to the Center and the CRS. We finished this Wednesday night and gave it to Sen. Johnson for him to use it at his Thursday press conference.

If all pages are not received, please contact above person at number indicated.

CENTER ON BUDGET AND POLICY PRIORITIES

February 18, 1997

SOCIAL SECURITY, THE BALANCED BUDGET AMENDMENT, AND THE CONGRESSIONAL RESEARCH SERVICE

Last week, the Congressional Research Service issued two memoranda on the potential effects of the balanced budget amendment on Social Security finances during the baby boom generation's peak retirement years. The Center on Budget and Policy Priorities also issued an analysis of this issue.

Both of the CRS memos and the Center's analysis reached the same conclusion. Some proponents of the balanced budget amendment have claimed, however, that the first CRS memo and the Center's analysis were somehow in error and that the second CRS memo corrected them. This is not the case.

All three memos explain that under the Hatch and Schaefer-Stenholm versions of the balanced budget amendment, outlays in any year — including outlays for benefits paid from the Social Security trust fund — may not exceed receipts in that year. All three memos note that any funds drawn down from the accumulated Social Security surpluses to help pay for the Social Security benefits of retired baby boomers would *not* count as receipts in those years.

Thus, all three memos conclude that the only way the surpluses now accumulating in the trust fund could be tapped to help pay for the large costs of the baby boomers' retirement — and, similarly, the only way that interest earned on the surplus could be used to help pay for these benefits — would be if there were an offsetting surplus in the rest of the budget.

Some proponents of the balanced budget amendment have set up a "straw man," claiming incorrectly that the first CRS memo and the Center's analysis said no funds could be drawn down from the surplus in any case. These proponents have contended the second CRS memo shows that the first CRS memo and the Center's analysis were inaccurate on this score. But neither the first CRS memo nor the Center's analysis made such a claim.

This criticism of a claim neither of the first two memoranda made may draw attention away from what should be the key issues here. The realities that must be confronted are: 1) that it will be very difficult to run a sizable surplus in the rest of the budget during the baby boom generation's peak retirement years because the rest of the budget includes Medicare and Medicaid, which also will swell in cost when the

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retirement of the baby boom generation produces a demographic bulge of older people; and 2) either running a surplus in the rest of the budget to enable the Social Security surplus to be tapped in those years or raising payroll taxes so Social Security revenues equal Social Security benefits in those years would inequitably shift burdens to younger generations.

- Both the 1977 and 1983 changes in Social Security took important steps to move Social Security away from a pure "pay as you go" funding system to help ease the burdens on those who will be working when the baby boomers retire. The Social Security system is now accumulating large surpluses that will reach an estimated $2.9 trillion in 2019. After that, when the bulk of the baby boomers retire, the surpluses could be drawn down — or at a minimum, the interest on the surplus could be used — to help meet the costs of Social Security benefits in those years without placing too heavy a payroll tax burden on those working in those years.

- Under the balanced budget amendment, however, the Social Security surplus could not be tapped and interest earnings on the surplus could not be used unless there was an offsetting surplus in the rest of the budget. Achieving a sizable surplus in the rest of the budget would be unlikely in those years because Medicare and Medicaid costs will rise sharply when the baby boomers retire. (Two-thirds of Medicaid costs are for the elderly and disabled.) Although reforms in Medicare are necessary and inevitable, the combination of a large increase in the number of elderly people when the baby boomers retire and continued advances in medical technology that improve health but add significantly to health care costs make it inevitable that federal health care costs for the elderly will rise significantly when the baby boomers reach old age.

- Suppose that despite these demographic realities a sizable surplus could be run in the *non*-Social Security budget during the baby boomers' peak retirement years. What would it take to achieve such a surplus? The answer is that it would almost certainly require either substantial increases in income taxes or large cuts in funding for other government services. In either case, the generations working in those years would likely bear the lion's share of these sacrifices.

- This means that either raising Social Security payroll taxes in those years so Social Security benefits do not exceed Social Security payroll tax receipts or achieving a large enough surplus in the rest of the budget in those years to enable the Social Security reserves to be drawn down would likely entail shifting a larger share of the burden of paying for the baby boomers' Social Security costs to younger generations.

- The only other course would be to cut Social Security benefits sufficiently so the benefits paid when the baby boomers retire are shrunk to the level of the payroll taxes collected in those years. Given the numbers and anticipated political strength of the baby boomers, this course seems unlikely.

This is an important matter that Congress should debate as it considers the balanced budget amendment. Skirting the issue by arguing that several memos reaching the same conclusion somehow differ — and implying that the balanced budget amendment poses no serious issues on this front — denies the nation the debate it deserves on this matter.