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GCC [Global Climate Change] March 1997

Stack:	Row:	Section:	Shelf:	Position:
S	20	4	11	1

Dan T

~~7827 5754~~

1. Modeling exercise

sectoral effects

macro not no distrut

2010

price 20 ¢/gal

recycling

Needs to be validated by mainstream economists

What would reactn would be

2. Off the record

G7

Coal

who doing testing

MacAvoy, Kruger, Clio, Kon

Krugman, Nordhaus, Jorg

Wilcoxen... Goulder

chk our validatn. names

Nobels

Jaysen

Solow, Sargent, Royik, Shavell

Spence, Gramli, Hanz, Shearer

AM LS VF DT

validate use of model.

Who should present.

Some techn. expert

EV E.

dc: AM JHF JS

United States Department of State

Assistant Secretary of State for Oceans and International Environmental and Scientific Affairs

Washington, D.C. 20520

March 12, 1997

TO: DISTRIBUTION

FROM: EILEEN CLAUSSEN

Climate Change Meeting on Tuesday, March 18 from 9:30 to 11:00 in Room 3524, Department of State, Principal plus one. Topics for discussion are (1) review of papers and (2) next steps.

Please contact Lilly Wiggins by 4:00 pm on Monday March 17 to confirm your attendance. Lilly can be reached at 647-1554.

TABLE A1-1
UNCERTAINTIES DUE TO EMISSION FACTORS AND ACTIVITY DATA

1	2	3	4	5
Gas	**Source category**	**Emission factor** U_E	**Activity data** U_A	**Overall uncertainty** U_T
CO_2	Energy	7%	7%	10%
CO_2	Industrial Processes	7%	7%	10%
CO_2	Land Use Change and Forestry	33%	50%	60%
CH_4,	Biomass Burning	50%	50%	100%
CH_4	Oil and Nat. Gas Activities	55%	20%	60%
CH_4	Coal Mining and Handling Activities	55%	20%	60%
CH_4	Rice Cultivation	3/4	1/4	1
CH_4	Waste	2/3	1/3	1
CH_4	Animals	25%	10%	25%
CH_4	Animal waste	20%	10%	20%
N_2O	Industrial Processes	35%	35%	50%
N_2O	Agricultural Soils			2 orders of magnitude
N_2O	Biomass Burning			100%

Note: Individual uncertainties that appear to be greater than ± 60% are not shown. Instead judgement as to the relative importance of emission factor and activity data uncertainties are shown as fractions which sum to one.

A1.2 Procedures for Quantifying Uncertainty

Estimating Uncertainty of Components

To estimate uncertainty by source category and gas for a national inventory, it is necessary to develop information like that shown in Table A1-1, but specific to the individual country, methodology and data sources used. In scientific and process control literature the 95 per cent (± 2) confidence limit is often regarded as appropriate for range definition. Where there is sufficient information to define the underlying probability distribution for conventional statistical analysis, a 95 per cent confidence interval should be calculated as a definition of the range. Uncertainty ranges can be estimated using classical analysis (see Robinson) or the Monte Carlo technique (in Eggleston, 1993). Otherwise the range will have to be assessed by national experts.

Current and Potential Reliability of Emissions and Reductions Estimates by Source
E=(±5 percent), G=(±20 percent), OK=(±50), P=(±100), WAG=(order of magnitude)

Ratings Annex	Source	Reliability of Emissions Now	Reliability of Emissions With Effort	Reliability of Reductions	US Emissions Share (percent)	Cheap Reductions Available?	US Emissions Trend
	Carbon Dioxide						
1	Energy Consumption	E	E	E	85.5	N	up
1	Flare Gas	G	E	E	0.2	?	--
2	Natural Gas CO2	WAG	P-G	G-E	0.4	?	--
1	Non-Fuel Use/Seq**	OK	G	G	5.1	N	up
1	US Military Abroad	G	E	E	0.2	N	down
1	Cement	E	E	E	0.5	N	up
1	Other process	G	E	E	0.5	N	--
2/3	Forestry**	P	OK	OK	7.1	Y	--
2/3	Other Land Use	WAG	P	P	0.1?	?	?
	Methane						
2	Coal Mines-abandoned	WAG	P	G-E	0.1	Y	?
2	Coal Mine-Surface	P	OK	P-OK	0.2	N*	--
1	Coal Mine-Underground	OK	G	G	1.1	Y*	down
2	Gas Venting	P	E	E	0.3	Y*	--
2	Gas Pipelines	P	OK	OK	1.2	Y*	--
2	Oil & Gas Production	P	OK	OK	0.8	Y*	--
2	Landfills	P	OK	E	3.5	Y	down
2	Waste Disposal	WAG	P-OK	E	1.1	Y	up
2/3	Livestock	P	P	P	1.9	?	up
2/3	Rice Cultivation	WAG	P	P	0.2	N	--
2/3	Crop Burning	WAG	P	P	0.1	?	?
2	Industrial Methane	WAG	OK	OK	0.04	?	up
3	Mobile Combustion	P	OK	P	0.1	N*	down
3	Stationary Combustion	WAG	P	P-E	0.1	N*	down
	Nitrous Oxide						
1	Industrial nitrous oxide	WAG	G	E	0.5	?	--
3	Fertilizer N2O	WAG	P	WAG	0.9	N	up
3	Mobile Combustion	P	OK	P	0.7	N*	--
3	Stationary Combustion	P	OK	P	0.2	N*	--
	Halocarbons/HI GWPs						
2	SF6-all sources	WAG	G-E	E	0.3	Y	?
2	PFC/exotic solvents	WAG	E	E	0.05?	Y	?
2	HFC mobile use	OK	G	E	0.2	?*	up
2	HFC stationary	P	G	E	0.05?	?*	up
2	PFC aluminum	P	OK-G	OK-G	0.2	?*	--
2	HFC-23 Industrial	P	OK-G	OK-G	0.8	Y	down

Source: calculated from: Energy Information Administration, *Emissions of Greenhouse Gases in the United States 1995* (Washington, October 1996).
*Emissions correlated with energy consumption, hence possible multiplier effect if energy consumption declines.
**Produces negative net emissions

1 recommend priority
2 harder
3 hardest

Add them all together in one budget?
Tradeoff between moral hazard (if uncertainty)
+ Efficiency gains from subsidies vs Conservation

RECALL The Conditions for a Successful Permit Market ARE:

1. *A Sufficient Degree of Compliance should be achieved*

   The protocol envisions that the "tonne of carbon equivalent emissions allowed" (TCEEA) would be the unit to track emission budget obligations. But monitoring will be less costly if the permit scheme was based on **carbon-content trading** rather than **carbon-emissions trading**. Why? Much easier to monitor the inputs than the outputs.

2. *Transaction costs must be low enough not to prevent efficient permit exchanges from taking place*

   The permit system must keep transaction costs low: including the costs of finding prospective buyers and sellers, costs of obtaining any necessary approval for trading. Brokers would likely emerge in the presence of high transaction costs.

   Regulatory constraints could lead to high transaction costs if each and every trade has to be approved by an international body.

3. *The Market for permits must be competitive*

   If a nation or firm that buys and sells a significant fraction of the total number of permits traded might be able to influence price, e.g., Russia. This would imply that greenhouse gas reductions would not be achieved at minimum cost.

4. *The policy must be seen as one that will remain in place for a significant period of time.*

   Firms and nations cannot be expected to trade if they think that policy is likely to change. If policy is stable for a reasonable time period, and there is little uncertainty about regarding the legitimacy of transactions. Who is liable if a seller sells and then ignores its obligations--the buyer or seller?

3/18

Suggested Schedule for Climate Work: Preparation for April 1 Submission
(3/18/97)

March 18	Assistant Secretaries Meeting
March 18-25	Meetings with stakeholders (Hill, and environmental and private sector NGOs)
March 21	Revised papers circulated to Assistant Secretaries for clearance
March 25	Final papers distributed to Deputies
March 27	Deputies Committee Meets/adopts U.S. position
April 1	Public meeting to announce U.S. position; U.S text sent to Bonn

FAX TRANSMISSION

U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF POLICY, PLANNING AND EVALUATION

401 M STREET SW
WASHINGTON, DC 20460
202-260-4332
FAX: 202-260-0275

To:	Assistant Secretaries Group	**Date:**	March 17, 1997
Fax #:	See attached list.	**Pages:**	1, including this cover sheet.
From:	William N. White		
Subject:	Correction to meeting time		

COMMENTS:

URGENT

THE TWO PAPERS I PREVIOUSLY SENT (ON EMISSIONS TRADING AND STANDARDS AND REGULATION) ARE FOR THE DOMESTIC CLIMATE CHANGE GROUP MEETING SCHEDULED FOR WEDNESDAY, MARCH 19 FROM 1:30-3:00 PM IN OEOB ROOM 472; NOT FOR THE ASSISTANT SECRETARIES' MEETING TOMORROW WITH EILEEN CLAUSSEN,AS PREVIOUSLY INDICATED. THOSE PAPERS HAVE BEEN SENT SEPARATELY BY THE STATE DEPARTMENT. SORRY FOR THE CONFUSION.

TALKING POINTS
KEY OUTCOMES FROM BONN CLIMATE CHANGE TALKS
MARCH 3 - 7, 1997

1. The real negotiations have yet to begin. But for this session, the U.S. achieved our #1 priority of keeping all of our ideas on the table -- in fact, all of our protocol provisions are contained in the negotiating text.

   -- In addition, we have the opportunity before April 1, 1997 to submit further legal language for inclusion in the negotiating text. This language could replace "place-holder" provisions in our current draft. We're considering whether to submit language now.

2. Regarding emissions levels and timing of reductions, the U.S. is confident that the extreme range on the table -- including the Australian proposal that encompasses the European Union range of between 40% growth and a 30% reduction from 1990 levels -- will fully bound any final outcome.

   -- We will base our final decision on thorough economic and environmental analysis that is currently underway. We are committed to supporting reasonable and achievable levels and time frames.

3. For the first time in Bonn, the U.S. had the opportunity to fully explain our protocol proposal in an international forum. While there were numerous clarifying questions, our proposal got favorable reviews from many negotiators for being the most well-developed; it is the most comprehensive text on the table, combining reasonable commitments, flexibility and strong compliance provisions.

4. The U.S. pursued enhanced performance from developing nations in four ways: involvement in joint implementation projects; specific commitments on "no regrets" policies; a "graduation" provision for more advanced developing countries to voluntarily "opt in" to a binding commitment at a different level/time frame; and a negotiating mandate for all nations to have legally binding commitments by 2005.

   -- We are serious about taking the lead in addressing emissions -- but we are equally serious that all nations must be part of the solution.

5. The U.S. continued to push hard for maximum flexibility in national implementation -- including fighting for our provisions for emissions trading, joint implementation, budgeting (with banking and limited borrowing). We opposed infeasible early deadlines such as 2005, and we opposed legally binding internationally harmonized policies and measures .

6. A series of intercessional meetings, as well as two more AGBM negotiating sessions (August and October) are scheduled prior to Kyoto (December). The U.S. is actively seeking agreement on our proposals in these and other bilateral meetings.

March 19, 1997
White House Climate Change Task Force

United States Department of State

Bureau of Oceans and International Environmental and Scientific Affairs

Washington, D.C. 20520

March 18, 1997

TO: Distribution

FROM: OES - Eileen B. Claussen *for*

SUBJECT: Climate Change Papers

During the course of our climate discussions today, the following points of consensus emerged:

- We may only need a few (if any) pieces of additional text to supplement our draft protocol language by the April 1, 1997 deadline. It was recognized that the option of adding material was preserved by the inclusion of the italicized text in the January 15 submission, and also that some additional language might be added prior to June 1, 1997, or prior to the July 1997 AGBM session. If agreed in the interagency process, additional text could include:
  - language on compliance issues – where the group seemed to be the closest to reaching agreement; and possibly,
  - text on joint implementation.
- Any submissions made should be kept to the barest minimum possible; we have already overloaded the international system with proposals, and simplicity must be the watchword if we hope to see our ideas accepted in the Kyoto agreement;

In light of agreement on these points, it is proposed that we seek to revise some of the existing papers to facilitate the decision-making process. Revised papers must be circulated to the Assistant Secretaries Group by Friday, March 21.

- A revised paper on compliance. To reach consensus, a session to hammer out an interagency agreement will be convened by L/OES (Sue Biniaz) and OES/EGC (Dan Reifsnyder) on Wednesday from 3:30-5:00p.m. All interested agencies should send an individual empowered to speak to the agency position to the meeting. L/OES will take the lead on drafting the revision.

- In an effort to keep the JI language as simple as possible, and noting that the simplest approach (proposed by DOE) is to put off any decision until the first meeting of the Parties to the agreement, it is proposed that DOE take the lead (with input from EPA and other interested agencies) in providing an abbreviated text for consideration. A revised text (if agreed) should be circulated to the Assistant Secretaries through OES as soon as it is completed (if possible by COB Wednesday March 19).

To insure that any language that is to be submitted has full interagency review, we must stick to the time-frames suggested above; the April 1 deadline provided by the AGBM is firm – and both the Assistant Secretaries Group and the Deputies Committee must have time to review and approve any submissions.

The remaining papers (on Annex B, Annex C, Emissions Trading and Borrowing) do not, in light of the discussion today, seem to have elements that must be submitted by the April 1 deadline. However, there are aspects to each of these issues that will need further consideration in the course of the negotiations. Thus, additional iterations of papers on these topics should be reviewed and revised at the staff level, working through the IWG. Using the revised papers, additional proposals to elaborate these issues may be developed to meet a June 1 deadline, or in time for circulation prior to the July session of the AGBM.

CLIMATE CHANGE DISTRIBUTION LIST

OSTP	Rosina Bierbaum	456-6202	FAX: 456-6025
CEA	Alicia Munnell	395-5036	FAX: 395-6958
NEC	Elgie Holstein	456-5370	FAX: 456-2223
OMB	T.J. Glauthier	395-4561	FAX:395-4639
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Commerce	Jeffrey Hunker	482-6055	FAX:482-4636
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CEQ	Steve Seidel	395-3706	FAX:456-6546
AID	David Hales	875-4205	FAX:(703)875-4639

Table 1 - Base Case without International Trade

Variable of Interest	Option 1 -- 10% below 1990 levels	Option 2 -- 1990 levels by 2010	Option 3 -- 10% above 1990 levels
GDP in 2005	≈ -2.0%	-0.1 to -1.0 %	≈ -0.5%
GDP in 2010	≈ -0.7 %	-0.2 to -0.6 %	≈ -0.4 %
GDP in 2020	≈ +1.0 %	-0.6 to +0.2 %	≈ -0.1 %
Implied price increase per ton of carbon in 2010	$135-$200	$82-145	$35-$50
Implied price increase per gallon of gasoline in 2010	35-52¢	21¢-38¢	9¢-13¢
Implied price increase per ton of coal in 2010	$80-120	≈$50-$85	$20-30
Implied average price increase for residential electricity in 2010	≈ 4¢/kwh	1.6-2.9 ¢/kwh	≈ 1¢/kwh
Implied increase in average household energy costs in 2010			
Decline in overall energy use in 2010		10%-17%	
Increase in renewables (2010)		≈ 16%	
Annual revenue raised by permit auction (2010)	≈ 270B	$110B-$190B	≈ 67B

* The upper bounds of losses for these variables will increase in final version as Market-Macro results get fully incorporated

Source: Ev's paper and 5/12/97 Market Macro and SGM runs

Base Case with International Trading

Table 7 – 7

Variable of Interest	Option 1 -- 10% below 1990 levels	Option 2 -- 1990 levels by 2010	Option 3 -- 10% above 1990 levels
GDP in 2005	≈ -1.0 % to -0.1 %	-0.5% to 0.0%	≈ -0.2% to 0.0 %
GDP in 2010	≈ -0.3 %	-0.4 % to -0.1 %	≈ -0.2 % to -0.1 %
GDP in 2020	≈ -0.3% to +0.2%	≈ -0.1 %	≈ -0.1 % to 0.0 %
Implied price increase per ton of carbon in 2010	≈ $85	≈ $50	≈ $20
Implied price increase per gallon of gasoline in 2010	≈ 22¢	≈ 13¢	≈ 5¢
Implied price increase per ton of coal in 2010	≈ $50	≈ $30	≈ $12
Implied average price increase for residential electricity in 2010	≈ 1.7¢/kwh	≈ 1¢/kwh	≈ 0.4¢/kwh
Implied increase in average household energy costs in 2010			
Decline in overall energy use in 2010			
Increase in renewables (2010)			
Annual revenue raised by permit auction (2010)	≈ $114 B	≈ $67 B	≈ $27 B

Assistant Secretaries' Meeting
19 March 97 1:30pm

REVIEW OF CLIMATE CHANGE PAPERS FROM THE EPA

1. Trading paper

Issue: sign off? **Yes**, this paper is in good shape.

2. Technology diffusion paper

Issue: sign off? **No,**

A. Ask that the quote by the 2001 economists be removed. The quote is out of context and subject to wide interpretation.

B. Ask the authors to justify why they continue to blur **market failure** and **non-market barriers** (e.g., high discount rates, risk aversion, incomplete information). The reasons for slow diffusion differ, and policies should reflect this difference.

The EPA claims that this "text-book" distinction has no added value to actual policy analysis. This is untenable. For example, tradable pollution permits were "textbook" economics a few years ago but have gone on the save the economy billions of dollars. **Does the EPA have evidence to suggest that no additional benefits are gain when a policy accounts for the distinction between market failure and non-market barriers?**

C. Effectiveness rates of programs are debatable. I calculated that the implied rate of return to a $200 m/yr CCAP program with their 1.25 E/GDP goal was **about 2000 percent.**

3. Regulation and Standards

Issue: sign off? **No**, this paper needs a good edit. I will send my comments over directly.

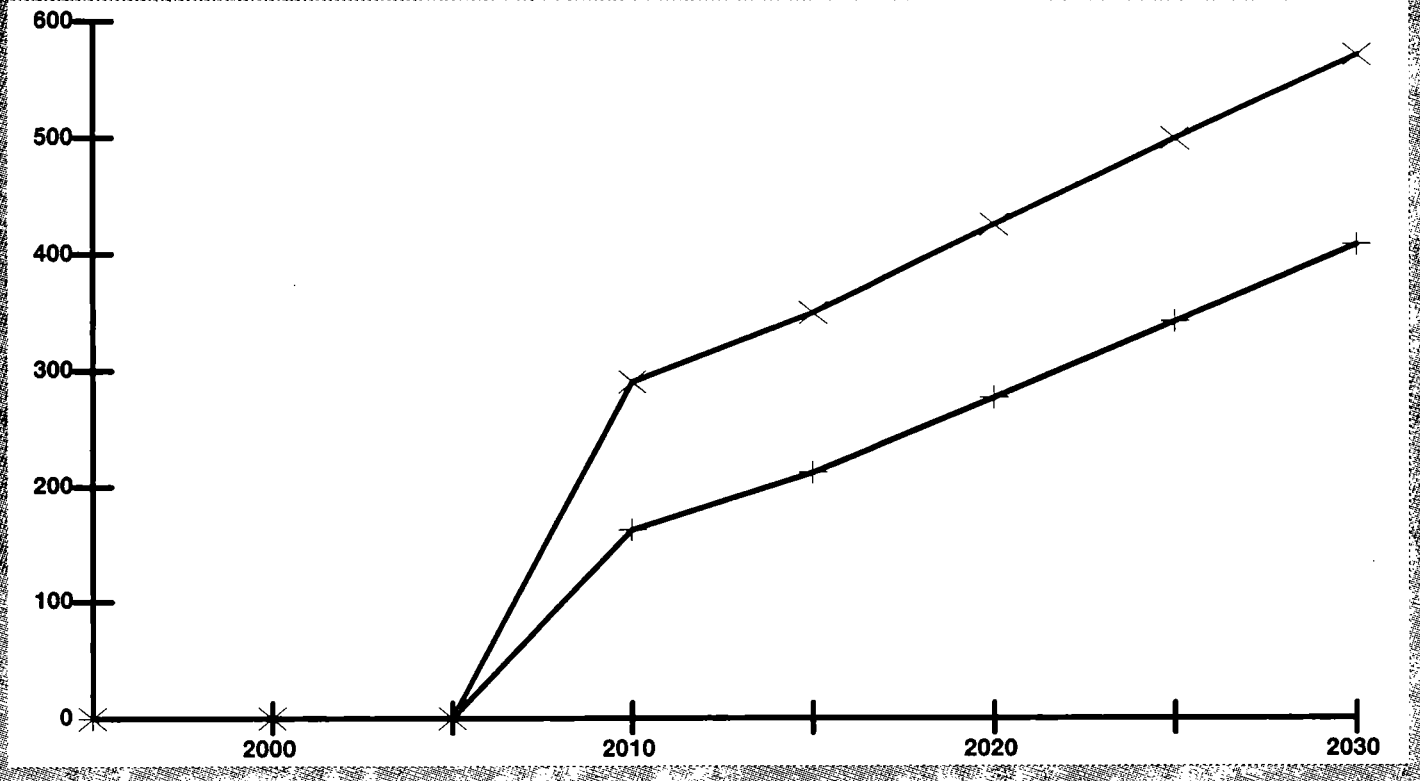
II. IAT UPDATE

1. **Rates of technological change remain an issue.** The implied **2000%** rate of return for CCAP seems high to me. We need to ask for rates of return on tax payer dollars and ask whether these rates are reasonable.

2. **Tax reform with and without carbon policy**. We asked for but have yet to receive the baselines with tax reform and no carbon policy?

year	gdp	%energy	%improve	gdp gain	disc factor	disc gdp	disc prog co
			0.25%		5%		2E+08
1	7E+12	0.04	0.0025	700000000	1.05	666666667	171428571
2			0.005	1.40E+09	1.1025	1.27E+09	163265306
3			0.0075	2.10E+09	1.157625	1.81E+09	155490768
4			0.01	2.80E+09	1.2155062	2.30E+09	148086445
5			0.0125	3.50E+09	1.2762816	2.74E+09	141034710
6			0.015	4.20E+09	1.3400956	3.13E+09	134318771
7			0.0175	4.90E+09	1.4071004	3.48E+09	127922639
8			0.02	5.60E+09	1.4774554	3.79E+09	121831085
9			0.0225	6.30E+09	1.5513282	4.06E+09	116029605
10			0.025	7.00E+09	1.6288946	4.30E+09	110504386
	totals					2.76E+10	1.39E+09
	rate of return						1982.98%

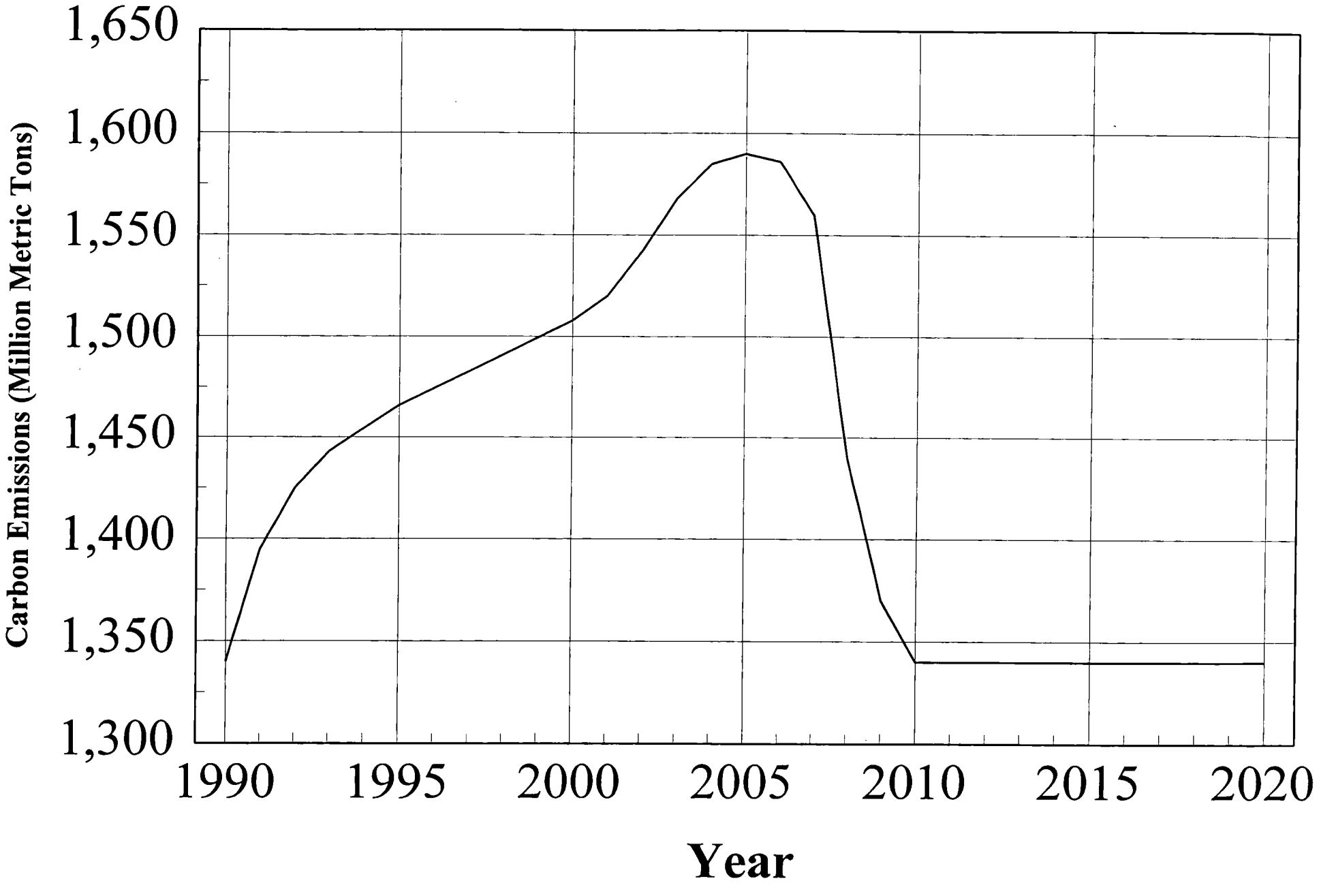
Carbon Tax



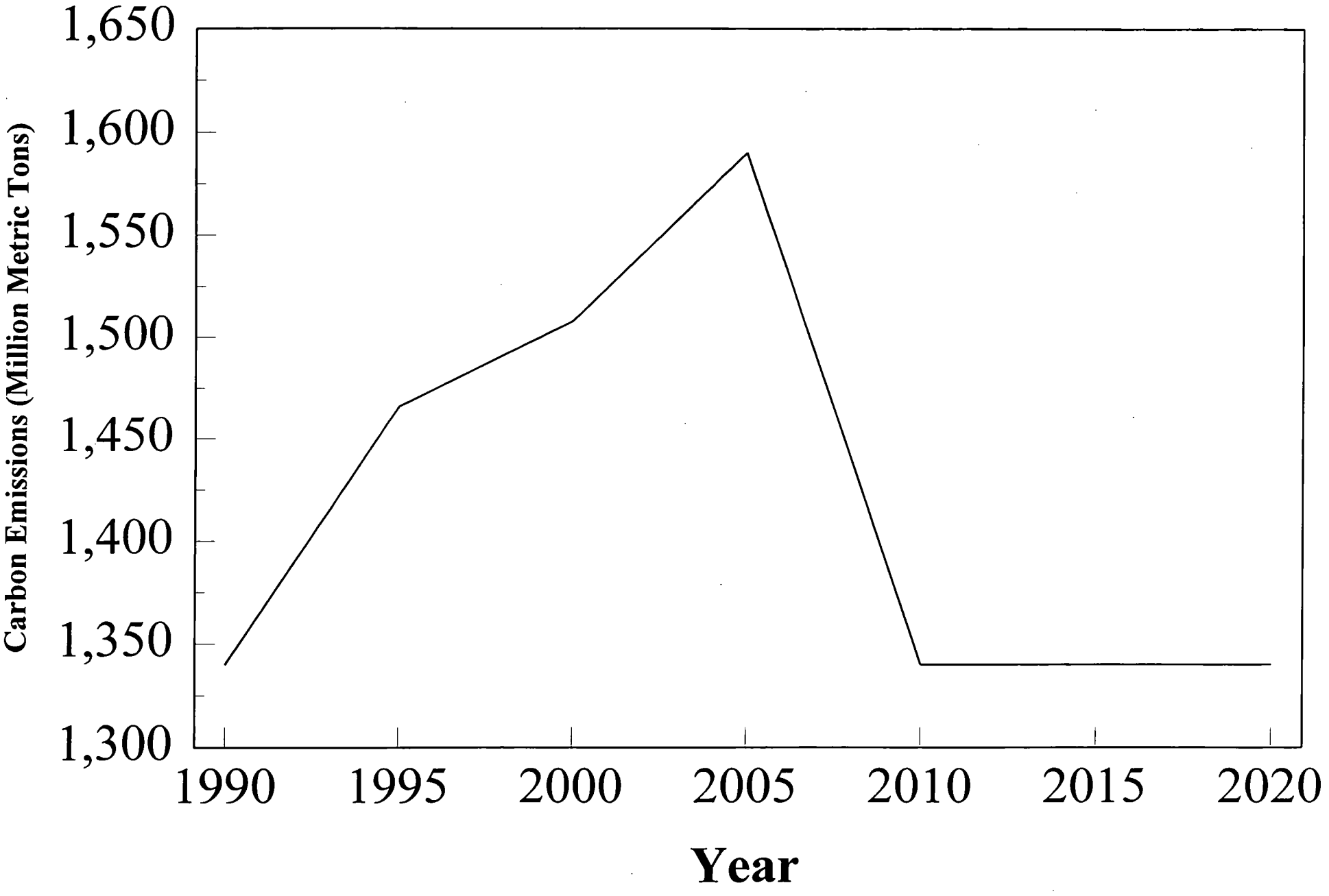
ID	Country	Policy	Oil Response	Import Subt	Backstop	Ref Scene
111	United States	US1	L	M	H	IS92A
112	United States	US2	L	M	H	IS92A

For further information, contact: Dr. W. David Montgomery (202) 662-3840 wdm@crai.com

1.2ɔ Extrapolated Stabilization Path



1.2ɔ Stabilization Path



The Role of Technology Policies in Limiting Greenhouse Gas Emissions

"Economics studies have found that there are many potential policies to reduce greenhouse gas emissions for which the total benefits outweigh the total costs. For the United States in particular, sound economic analysis shows that there are policy options that would slow climate change without harming American living standards, and these measures may in fact improve U.S. productivity in the long run."
-- The Economists' Statement on Climate Change, Feb. 13, 1997 (signed by more than 2,000 economists, including six Nobel Laureates)

A strategy to accelerate the diffusion of existing technologies and the research, development and deployment of more advanced technologies is a critical component of any U.S. policy to stabilize greenhouse gas emissions. A cap and trade system alone — without such a technology strategy — would result in higher prices for carbon allowances than would otherwise be the case. Analysis suggests than an accelerated technology effort has a large potential for bringing down this price, and thus the cost to the economy. In addition to major studies in the early 1990s, forthcoming analysis by five leading National Laboratories finds that a large potential remains for reducing U.S. energy consumption and greenhouse gas emissions while meeting the full energy needs of U.S. businesses and families. In the long term, stabilizing concentrations at even twice pre-industrial levels, which will likely still have severe national and global environmental impact, poses an unprecedented challenge that can only be met with superior technology brought about by aggressive diffusion and significantly higher levels of R&D.

Two types of technology provide significant opportunities to reduce greenhouse gas emissions while providing our full energy needs. First, energy-efficient technologies are currently underutilized in all sectors of the economy. These technologies allow us to do more while consuming less energy and reducing pollution. Through increased energy efficiency, we can maintain GDP growth while cutting energy usage and associated greenhouse gas and other air pollution. Second, technologies using a variety of energy sources, such as solar, wind, and biomass, are becoming increasingly competitive. These technologies can supply energy with little or no carbon emissions, allowing us to sever the link between GDP and greenhouse gas emissions and other air pollution. Working together, energy efficiency and low-pollution technologies provide the means of sustaining economic growth while meeting medium- and long-term limits on greenhouse gas emissions.

In addition to reducing greenhouse gas emissions, these technologies provide other benefits to the nation that have long been the basis of national policy, including: achieving major reductions in criteria air pollutants, decreasing dependence on foreign oil, increasing productivity of domestic industries, and promoting U.S. leadership in the large and growing international market for advanced technologies.

By the year 2010, existing energy-efficient technologies comprise the bulk of the potential to substantially reduce greenhouse gas emissions in the U.S. The development of some additional key technologies, particularly in the transportation and energy supply sectors, can provide additional opportunities for economically beneficial reductions. Studies by the National Academy of Sciences, the Office of Technology Assessment, and the American Council for an Energy-Efficient Economy (jointly with the Union of Concerned Scientists and others) have all demonstrated that the technological potential exists to cut energy consumption and greenhouse gas emissions in the medium-term by 20% or more at a net economic benefit. (Significant

reductions before 2010 are more difficult to achieve cost-effectively because sufficient time must be allowed for the natural turnover of energy consuming equipment.)

A clear policy on limiting U.S. greenhouse gas emissions will help to focus attention on energy consumption and will provide important incentives for the diffusion of existing technologies and the development of even more advanced technologies. The technological response to past environmental policies, such as acid rain controls and the ban on CFCs, has been dramatic. In both cases, the actual cost of control has been dramatically less than early projections. Unfortunately, even with a clearer market signal, the technology response to a greenhouse gas policy will continue to be restrained. A host of ~~market~~ barriers contribute to today's large energy efficiency gap — the significant underutilization of existing, cost-effective energy-efficient technologies.

Federal policies that can unleash more of the technology potential are important because they allow a smoother and less costly transition to meeting a carbon constraint. Several federal programs, many of which were launched in the President's Climate Change Action Plan, are successfully overcoming market barriers to key energy-efficient technologies through partnerships with the private sector. These programs need to be fully supported, and additional initiatives need to be put in place to target the remaining barriers to energy efficiency.

To achieve a sustainable emissions pathway beyond the year 2010, there is an unavoidable need for advances in low-pollution energy supply technologies as well as continued improvements in the efficiency of energy using technologies. As global population and affluence continue to rise, technological advances provide the key to stabilizing global concentrations of greenhouse gases at safe levels without jeopardizing our quality of life. In order to stabilize greenhouse gas concentrations at safe levels, new technologies will have to reduce emissions by more than a factor of ten during the next few decades and be competitive enough to achieve deployment throughout the world. This need for major and continual advancements can only be met through a strong commitment to Federal RD&D.

THE ROLE OF TECHNOLOGY THROUGH 2010

The key to cost-effective greenhouse gas reductions by 2010 is the large potential of today's underutilized energy-efficient technologies. Greater penetration of these technologies can enhance economic productivity through more efficient use of our energy resources. Paying energy bills is a relatively less productive use of consumer and business resources than the many other investments and spending choices that consumers and businesses have available to them. Shifting capital from energy expenditures to new investments elsewhere in the economy will help drive economic growth, employment and consumer income. Several major studies support the economic value of improved energy efficiency. For example, an Energy Information Administration report based on the *Annual Energy Outlook 1996* suggests that a reduction in U.S. energy consumption of 12 percent (by the year 2015) would increase GDP by 0.5 percent.

However, there is clear evidence that this potential is not being realized in the current market system because of a number of institutional, organizational, and other barriers that work against the diffusion of existing, energy-efficient technologies and the development of advanced technologies. The existence or availability of a financially attractive technology does not by itself

mean the technology will be purchased and used in sizable quantities. For high rates of market penetration, a number of other key factors must be in place:

- Potential buyers of products need to know of the technology;
- Potential buyers of products need clear, reliable information on the performance and economic benefits of the technology;
- Potential buyers must be the ones to see the benefits of lower energy bills;
- Service providers and users of the technologies must have expertise to appropriately design for, install, and operate the technology; and
- Sources of capital must understand the low-risk nature of these investments.

In many cases, these factors are not in place due to a wide variety of market barriers. For example, the attached table provides a list of market barriers in the buildings sector.

These barriers result in consumers and businesses ignoring otherwise cost-effective investments in energy-efficient technologies. Consequently, many of these energy-efficient technologies have relatively small market shares and low rates of technology diffusion. There is a sizable remaining potential, or "efficiency gap." For example, fluorescent lighting ballasts were found in almost every commercial building in 1989. Energy-efficient ballasts had been on the market for many years, were based on well-known, proven technology, delivered equivalent performance to its inefficient counterpart, and had a longer lifetime. Although purchases of efficient magnetic ballasts in 1989 represented investments with IRRs of 60% or greater, only about 12 percent of the market had found the technology and about 24 percent of the market was purchasing the technology due to state standards. The remaining 64 percent of the market was purchasing less efficient technologies and committing themselves to much higher operating expenses over the life of the ballast. This remaining 64% represented a large efficiency gap for building lighting.

A number of federal, voluntary programs are currently enhancing markets by overcoming the barriers to energy efficiency. The Administration's Climate Change Action Plan (CCAP) launched over 40 initiatives in 1993. Building on other DOE and EPA programs, the CCAP's goal was to return U.S. greenhouse gas emissions to 1990 levels by the year 2000. Despite large funding cuts, the CCAP programs are successfully overcoming market barriers and are currently expected to deliver approximately 3/4 of the emissions reductions originally projected. With continued support beyond the year 2000, these programs will significantly restrain growth in U.S. greenhouse gases through 2010 and beyond. Even at current funding levels, Administration projections indicate that these programs will eliminate 1/4 of total emissions growth through the year 2010, resulting in annual energy bill savings of approximately $30 billion (in 1995 dollars). A sustained commitment to these programs beyond the year 2000 is needed to achieve these results, and restored full funding of CCAP programs will further cut the growth in greenhouse gas emissions. Total expenditures on CCAP programs in 1997 is $183 million, $120 million below the President's requested budget of $305 million.

CCAP 1.25

A successful strategy to reduce greenhouse gas emissions by 2010 while improving the economy would include:

(1) Restored full funding of CCAP programs, with a sustained commitment to these programs beyond the year 2000.

(2) New initiatives to overcome additional market barriers and aggressively develop and deploy key technologies.

Following is a discussion of the role of federal programs for accelerated technology diffusion and near-term RD&D in some key energy sectors. Because the CCAP's focus on the year 2000 limited the options that were implemented, a longer term goal provides significant new opportunities to overcome remaining market barriers and develop key technologies. Some of these areas of opportunity are also discussed below. An interagency effort is underway to assess potential initiatives to address these opportunities and to develop a national market transformation plan that effectively narrows the efficiency gap by 2010 and beyond. Example approaches mentioned below are illustrative of the types of initiatives that may be included in a final plan.

BUILDINGS

The largest untapped potential is our daily energy use in homes and commercial buildings, which consume one-third of the nation's energy and two-thirds of its electricity. Deploying existing, cost-effective technologies could return greenhouse gas emissions to below 1990 levels by 2010. These technologies include improved lighting, heating, cooling, windows, insulation, office equipment, energy management systems, and geothermal heat pumps. Many of these technologies improve the quality of service delivery (for example, improved comfort and lighting quality) and have been documented in a number of cases to improve productivity.

DOE's Rebuild America program and EPA's Green Lights and ENERGY STAR Buildings programs are demonstrating that many of the barriers to energy efficiency in the commercial buildings sector can be overcome. These programs have formed over 2500 partnerships to improve energy efficiency in buildings by up to 40% through technology investments with annual rates of return of 20-50%. Program partners saved over $250 million on their energy bills in 1996. Because the rates of return on energy efficiency investments in commercial buildings are so high, they offer increased yields to businesses over typical investment opportunities, spurring new investment, economic growth, increased federal tax revenues, and new jobs.

EPA and DOE's ENERGY STAR Consumer Labeling program is removing barriers that consumers have faced in purchasing energy-efficient home products, such as heating and cooling equipment and appliances. The program has already transformed a number of markets, including cutting the energy used by computers, monitors, and printers by 50% at virtually no incremental cost. Manufacturers of home products are now partnering with the federal government and labeling their more efficient products as consumers are provided with information on these products' environmental and economic benefits. Through 1996, this program has seen thousands of products labeled and billions of dollars invested in ENERGY STAR products. Consumers saved approximately $500 million on their energy bills in 1996.

Additional opportunities for new initiatives include:

Overcoming Split Incentives — In landlord-tenant arrangements, the building owner often makes long-range investment decisions but does not pay the energy bills for the property. In these situations, the owner will often not invest in energy efficiency opportunities in spite

of excellent, low-risk financial returns because the returns go to someone else. The same problem occurs with building designers and builders, because they choose the technologies for new buildings but do not pay the energy bills. EPA and DOE could develop a means of providing reliable and impartial energy performance information for commercial buildings. This would allow building purchasers to make informed decisions and demand good energy performance. CCAP programs in this sector have built the reputations and developed the technical expertise that would be needed to address these barrier.

Energy Information — Empowering consumers and businesses to save money and preserve the environment requires that they be properly informed about energy choices. One available vehicle for better information is their monthly energy bills. Better information could include benchmarking comparisons showing how their bill measures up to model, cost-effective efficiency and to other customers. It could also include information on the overall efficiency and renewable components of the customer's power provider.

RD&D of Fuel Cells — An aggressive 5-year R&D effort aimed at fuel cells (running on hydrogen converted from natural gas), such as proton-exchange membrane (PEM) fuel cells, which could become the most cost-competitive energy provider for buildings (and light industry). If successful, a new or retrofit building in 2010 using efficient technologies with electricity and hot water provided by an 80% to 90% efficient fuel cell could have no first-cost penalty with well under half the energy bill of a typical 1990 building and one-quarter the greenhouse gas emissions.

Reflective Surfaces — Recent research has shown that a city can be cooled by five or six degrees Fahrenheit by planting shade trees and replacing roads, roofs and parking lots with lighter surfaces during the course of normal maintenance. This nominal additional cost could, by the year 2010, save the country up to $5 billion a year in energy and environmental costs. In Los Angeles alone, this would lower annual air conditioning bills by $170 million and reduce the creation of ozone smog by 10%. An aggressive diffusion and targeted reflective materials R&D effort could yield substantial greenhouse gas reductions.

INDUSTRY

The industrial sector consumes about one-third of the nation's energy. Since 1985, the energy intensity of the industrial sector has not improved significantly. Yet major energy-saving technological advances have continued steadily in cross-cutting areas (such as motors, which consume 70% of industrial electricity) and in industry-specific areas (such as impulse-drying in paper manufacturing, vacuum pressure swing adsorption in glass making, and electrochemical dezincing of steel scrap). Many industrial efficiency improvements also offer important productivity benefits. As an example, the average total annual savings from many energy efficiency projects undertaken at the Louisiana Division of Dow Chemicals were 3 to 13 times as large as the energy savings alone.

Several CCAP programs are achieving near-term efficiency improvements. DOE's Motor Challenge program, for example, is providing technical support to over 1,600 industry partners. Rather than focusing on a particular technology, DOE and EPA's Climate Wise program is working with over 250 companies to develop company-specific plans to reduce greenhouse gas emissions.

The seven most energy-intensive industries—steel, aluminum, petroleum refining, chemicals, pulp and paper products, glass, and metal casting—account for about 80% of the energy consumed in U.S. manufacturing. They represent the largest opportunity for reducing industrial greenhouse gas emissions. DOE has formed long-term partnerships with each of these industries to develop "Visions" of energy-efficient, low-polluting, highly competitive "Industries of the Future," as well as roadmaps to identify an RD&D pathway to achieving the vision.

The announcement of a new climate policy would create a large opportunity to work more aggressively with major industries such as these to achieve significant reductions by 2010. The industry Visions developed with DOE typically foresee between a 1% to 1.5% per year improvement in efficiency for two decades. Achieving the high-end of that range, or even higher (by accelerating the rate of implementation) is possible, but would require a significantly greater government-industry effort. Because industry has already identified niches for each technology pursued, the diffusion of newly developed technologies can occur relatively quickly. For example, we have already seen in the metal casting area a leap from idea to actual prototype in 18 months.

Not only can we reduce the energy intensity of industry, an aggressive RD&D program could begin to reduce the carbon intensity of industrial energy consumption. Accelerating our current R&D effort in advanced gas turbine cogeneration (coupled with regulatory streamlining for accelerated diffusion) could allow significant market penetration by 2010 of distributed power plants with efficiencies in excess of 85%. Industries such as pulp and paper could power these turbines with low-cost biomass feedstocks.

TRANSPORTATION

Fuel economy has been flat for over a decade due in part to the absence of increased fuel-efficiency standards, but also because consumers haven't themselves demanded increased fuel economy. The attributes of cars most desirable to consumers change over time. During the 1970s, when oil prices were high, fuel economy was one of the top features consumers looked for when shopping for cars. Lately, fuel economy has fallen while speed, acceleration, four wheel drive and amenities are more more in demand. Since 1982, the average horsepower ratings of the new light vehicle fleet has increased by 60 percent while the average fuel economy of the same fleet has remained unchanged. From an engineering point of view, manufacturers have increased the efficiency of new cars, but that efficiency has been devoted to delivering what consumers want today. Had the new cars sold in 1996 retained the same average acceleration performance and average weight as the new cars sold in 1982, the improved technologies actually incorporated into the fleet during this period could have increased new car fuel economy by about 6 miles per gallon, or about 20 percent. If fuel prices and/or consumer preferences were to change again, and there were increased demand for better fuel economy in new cars, manufacturers could redirect both past and future technology improvements to deliver better fuel economy.

With the focus on the year 2000, CCAP programs are focusing on reducing fuel consumption through increased telecommuting and reduced traffic congestion. The Partnership for a New Generation of Vehicles (PNGV), on the other hand, is a longer-term effort to develop more efficient technologies for new vehicles. PNGV is a joint automotive research and development effort between the federal government and the U.S.-based automakers. The goal is to develop new automotive technology that can more than double the fuel efficiency of a typical family sedan while

meeting stringent emission and safety standards and maintaining affordability, performance, and utility. The timeline is for basic component research through 1997-1998, the design, buildup, and evaluation of concept vehicles through 2001, and the development of production prototypes by 2003-2004. Increasing the fuel economy of a midsize vehicle from 27 to 80 miles per gallon would reduce the carbon dioxide emissions of that vehicle by two-thirds. The full impact of the PNGV program and its effect on fuel efficiency won't be realized until beyond 2010. However, some of the technology elements that are developed will also provide an important near-term opportunity for improving fuel efficiency in vehicles prior to 2010.

One technology that offers the chance for dramatic gains in efficiency that could be realized by 2010 is the diesel engine. The diesel has a number of advantages from the perspective of stabilizing in 2010. Diesels are already more than 40% efficient, and a 55% efficient diesel is a plausible outcome of near-term research, an efficiency that no other engine can surpass or even match before 2010. Also, both the fuel and manufacturing infrastructures already exist for diesel, unlike several other proposed advanced engines, making rapid penetration more feasible. Advanced diesels not only afford potential savings in a hybrid for cars, but also for sport utility vehicles and light duty trucks (the segment of fastest growth in fuel use), and in heavy duty trucks, with their low fuel economy (7 to 8 mpg). The key problem is the unacceptably high level of particulate and NOx emissions. A "clean" diesel would be a major achievement, and is now viewed as plausible by many even in the near term through a combination of a cleaner fuel (such as dimethyl ether which can be made from natural gas or ethanol), an advanced engine, and after-treatment (including advanced catalysts). DOE is pursuing all of these areas, but successful penetration by 2010 will require additional funding.

Ethanol is another prime candidate for an intense RD&D effort. Federal R&D has brought the cost of ethanol from $3.60 per gallon in 1980 to $1.20 per gallon. With continued R&D in bio-engineered organisms and fast-growing crops, the biofuels program is expected to produce ethanol for under 70 cents a gallon by 2005, competitive with oil at its current price (ethanol has lower energy content). The ethanol would be derived not from the starchy (i.e., edible) part of corn, as it is now, but from cellulosic waste (such as waste paper or crop waste) and dedicated crops, either herbaceous (as from switchgrass) or woody (as from hybrid poplar trees). A 1996 Argonne analysis of total fuel cycle shows a greater than 90% reduction in greenhouse gases from woody-biomass-derived E85 (85% ethanol) compared to reformulated gasoline.

ADDITIONAL, CROSS-CUTTING OPPORTUNITIES FOR NEW INITIATIVES

A number of additional opportunities exist across all sectors of the economy. For example:

> *Financing for Energy Efficiency Investments* — Large companies often rely on their own capital for new investments and yet are reluctant, due to organizational barriers, to use that same capital for investments in efficiency (even though they offer impressive rates of return). Small to mid-size businesses and consumers have little access to capital to begin with, and they have a difficult time obtaining reasonable financing. Consequently, in all sectors of the economy, there are significant opportunities for efficiency improvements that could be made if financing designed specifically for energy efficiency investments were widely available. Previous opportunities to achieve a public good through organizing financial markets have been addressed by creating a secondary financing market through "government sponsored enterprises" (GSEs), like Fannie Mae, Freddie Mac or Sallie Mae.

These GSEs purchase particular types of loans (e.g. home mortgages, student loans) from primary lenders, such as commercial banks and mortgage companies, and bundle these loans for sale in the secondary security market to investors. After more than three years of effort, much of it aimed at developing a broadly accepted North American Monitoring and Verification Protocol for efficiency retrofits, DOE has laid the foundation for jump-starting a billion dollar a year secondary market for energy efficiency loans.

Incentives Through a Domestic Greenhouse Gas Policy — A new U.S. climate change policy would provide unique opportunities to provide further incentives to improve the penetration and innovation of energy efficiency and renewable technologies. This could work in a number of ways. For example, under a domestic trading system with a cap on greenhouse gas emissions, a reserve of allowances or a portion of auction revenues could be set aside to reward new R&D investment and production of efficient and renewable technologies.

Business Accounting Practices — Currently, companies ignore future energy liability and undervalue the benefits of investments in energy efficiency. When a firm invests in energy efficiency, the accounting shows only a liability, and there is no recognition of the reduction in future energy expenditures. With the longer term focus beyond 2000 and a clear policy signal on energy, it may be possible to work with businesses to develop new practices that more accurately reflect energy liabilities. Strategic improvements to tracking demand and use of energy resources would allow firms to identify and capitalize on profitable improvements that are currently hidden in the noise of corporate financial data.

Government Procurement — In addition to providing a strong energy signal to businesses, a new climate policy will create additional opportunities for coordinated government action in promoting efficient technologies. Programs like ENERGY STAR Computers have benefited significantly from federal procurement policy in the past, but innovative initiatives are often difficult because of decentralized and sometimes restrictive procurement policies. The federal, state, and local governments together purchase a sizable portion of energy-consuming technologies. Harnessing the combined purchasing power of all levels of government could be an important opportunity to provide large markets for efficient and renewable technologies. This would provide a strong incentive for increased R&D; reduce the cost of production of these technologies (due to the effects of "learning by doing"); demonstrate the successful performance of new technologies; and make all participating governments more energy efficient.

ELECTRICITY PRODUCTION

The efficiency improvements described above could slow electricity demand growth substantially, and much of the growth that did occur could be provided locally by distributed cogeneration, such as advanced turbines in industry (running mainly on natural gas, with some biomass) or fuel cells in buildings (running on natural gas). The very low central station power demand growth means that the replacement of dirtier plants with cleaner ones that is expected to occur would also be slowed. However, a clear and consistent price signal from a cap and trade system at even a low level could have a substantial effect, most likely causing some of the dirtiest and oldest coal plants to be repowered with natural gas.

Such a price signal for carbon would almost certainly lead to increased utilization of natural gas, through a combination of increased gas use at dual-fuel power plants and repowering of selected older, inefficient plants. An estimated 10% of existing coal capacity is nominally dual-fuel. While some of this capacity would require some investments to use gas, the infrastructure is already there and costs would be minimal — likely well under $100/kW. Repowering of older coal plants with gas would cost an estimated $400/kW. This increased use of gas could be expected to increase prices. That suggests the need for expanded R&D into lowering the cost of natural gas production and increasing the domestic resource base, though efforts such as improved drilling and advanced computational modeling. Such R&D could have a large impact on the cost of climate mitigation.

In addition, much technological progress has been made in co-firing biomass fuels with coal. This technology exists, but economic incentives for widespread use are currently lacking. Incremental capital investments would be required, but up to an estimated 40% co-firing biomass with coal would be possible at costs of $150-250/kW — making biomass co-firing an attractive option under a cap and trade policy.

THE ROLE OF TECHNOLOGY BEYOND 2010

A strategy of continued diffusion of efficient energy using and energy supply technologies and accelerated development of key new low-carbon technologies during the next decade sets the stage for accelerated development and diffusion of a number of very-low and zero carbon technologies that may begin to see limited penetration by 2010, but will have substantial impacts after 2010. The need for major technology advances can be seen from the following equation:

Emissions = *Population* x *Affluence* (GDP/capita) x *Technology* (Emissions/GDP)

From 1990 to 2050, we may well see global population double and affluence increase by a factor of four. At the same time, just to stabilize concentrations at pre-industrial levels (which would still have severe national and global impact), the world may ultimately need to *lower* emissions from 1990 levels, requiring the average emissions-related technology to improve by more than a factor of ten during the next few decades and then be rapidly deployed throughout the world.

This section examines the most promising R&D for mitigating CO_2 , focusing on four strategic thrusts: (1) clean power generation, (2) energy efficiency, (3) carbon sequestration accompanying a transition to a hydrogen-based economy, and (4) basic and very advanced research. Responding to the climate problem may require breakthroughs in all of these areas, and in any case the high-risk nature of R&D requires the pursuit of multiple pathways.

Increasing the probability of achieving these desirable outcomes will require expanding the government's current R&D spending in these areas, which is roughly $1.3 billion per year. Also, the policies described in the previous section, including partnerships with industry, "market pull" deployment initiatives, and improved regulations, will be required to ensure technological success and accelerated market penetration. The benefits could be enormous, including the avoidance of the costs associated with the other approaches to CO_2 mitigation such as higher taxes and regulation. A 1997 study by Pacific Northwest Laboratory found that developing and deploying advanced technologies over the next 15 to 30 years could substantially lower the cost to the global economy of achieving major reductions in emissions of greenhouse gases.

CLEAN POWER GENERATION

Natural gas technologies now set the benchmark for low cost, cleaner power generation. Moreover, advances in natural gas turbines will yield overall energy conversion efficiencies of 60% or more in the next decade, doubling the efficiency of traditional coal-fired plants. High temperature fuel-cells, such as molten carbonate and solid oxide, may have significant application in power generation with further R&D, promising high efficiency and low emissions. Molten carbonate fuel cells are expected to reach 50-60% efficiency by 2000, and perhaps 70% by 2005. As a result, fuel cells can cut greenhouse gas emissions by as much as 50%.

High efficiency coal-fueled power plants, such as integrated gasification combined cycle (IGCC) are now being demonstrated at efficiencies (40 to 43%) that are competitive with more traditional coal-fired power plants but with much lower emissions, including 35-45% lower CO_2 emissions. The efficiency of the next generation IGCC plant could exceed 55%, and, in combination with a fuel cell, achieve 60% by 2015. While lowering CO_2 emissions, these technologies also dramatically reduce traditional pollutants, such as particulate matter, nitrogen dioxide, and sulfur dioxide, while allowing the continued use of low-cost fossil fuels. Hence, advances in technology from federal R&D in this area will ensure the supply of low cost, clean electricity, while helping the U.S. realize domestic and global market opportunities for these superior technologies.

While electricity from fossil fuels continue to become cleaner and cheaper, expanded R&D and deployment could make a number of renewable technologies competitive on purely economic grounds in the next two decades: wind power, PV, biomass power, solar thermal, and geothermal. In a greenhouse-gas constrained world, these zero-carbon emitting sources of power would be even more competitive. Royal/Dutch Shell projects these technologies to be the dominant global source of energy by the middle of the next century.

Renewable technologies are becoming more economically competitive over time. Both wind and PV are experiencing a 20% cost reduction for every doubling of cumulative production. Photovoltaic (PV) cells, which convert sunlight into electricity, have dropped from 90 cents per kilowatt-hour in 1980 to under 20 cents today while wind power has dropped from 25 cents per kWh to 5 cents. These cost reductions will continue to occur not just because of R&D, such as advances in thin film PV, but also through economies of scale and improvements in manufacturing that come with increased production. A number of different PV technologies are being pursued, providing multiple opportunities for breakthroughs. Accelerated RD&D for wind could potentially have an impact on CO_2 emissions in 2010.

Nuclear power provides 22% of our electricity emits no CO_2 and its contribution to reducing CO_2 emissions is expected to increase as plants become increasingly efficient over the next decade. However, these plants are due to begin retiring by 2010, with virtually all capacity due to be retired by 2030. To keep nuclear power a viable option for future electricity production, DOE has developed advanced nuclear reactor designs soon to be certified by the Nuclear Regulatory Commission. A plant similar to these advanced designs was recently completed in Japan at under half the time and about half the cost to complete the most recently finished U.S. nuclear plants. In addition, the Department is conducting R&D on life extension of existing nuclear power plants so continued operation of these zero carbon technologies is an option in the future.

Opportunities for new initiatives include:

Increasing market penetration of technologies such as PV and fuel cells — Government investments in R&D cannot be limited by the old notion of the linear model of R&D where basic research is fed into a technology pipeline and out pops a commercialized product. Today's complex technologies do not begin with basic research and then proceed in a simple fashion through the different stages until marketing begins. Successful innovation relies heavily on communication and feedback between engineers and scientists throughout the innovation process, including the later stages of development. Rapid penetration of clean technologies requires a concerted effort of activities across the technology innovation spectrum. The CCAP contains a number of measures to reduce costs through accelerated domestic deployment for wind, PVs, geothermal, and fuel cells, but these efforts are severely under-funded.

Increasing international diffusion of advanced supply technologies — A U.S. strategy to accelerate market penetration of these technologies requires an international component. Many renewables are most cost-effective today in developing countries without an electricity grid. Advanced coal technologies will be critical in developing nations with large coal reserves, such as China. Besides lowering costs, many of these efforts give vendors and utilities experience using these new technologies in niche markets, helping to remove barriers to more expanded use in the future as the technology improves.

A new government partnership with utilities — The power industry is reducing R&D and deployment of renewables, fuel cells and other technologies in the face of increased competitive pressures — which in turn drives short-term cost-cutting efforts. Congressional legislation to restructure the utility industry may well be enacted in the next two years — providing a crucial opportunity to find alternative means to support R&D and deployment of low-carbon power generation technologies.

Given the uncertain nature of R&D, the level of funding necessary to achieve such a world cannot be known, but is likely to be considerably higher than today's investment levels, especially if the Nation seeks to maintain world leadership in these technologies. In PVs, deep R&D cuts in the 1980's have left us with only 40% of the world market. The Japanese outspend our $60 million R&D effort in PVs by more than two to one. The relatively high price for electricity in other developed nations, and the far greater financial incentives they offer industry, means alternative energy will be cost-effective in foreign countries before it is here. Our primary competitive advantage can come only from technological leadership. Innovative partnerships aimed at domestic deployment are essential because there aren't many instances of a nation achieving global market leadership in a technology for which there was not a robust domestic market.

END-USE ENERGY EFFICIENCY

Technology R&D in transportation is essential because the sector uses very little electricity, so advances in clean power generation offer little hope of lowering its CO_2 emissions in the near term. Also, two other major national problems — urban air pollution and dependence on foreign oil — stem largely from the transportation sector. The current federal strategy is to develop cars and trucks that are highly fuel-efficient as well as ones that run on fuels other than petroleum, including natural gas, electricity, and biofuels (ethanol). We could see significant penetration of biofuels in the next two decades with the RD&D strategy discussed in the first section.

As mentioned previously, the Partnership for a New Generation of Vehicle (PNGV) is pursuing multiple pathways for both advanced engines (hybrid electric, Stirling engine, gas turbine and clean diesel) and energy storage (such as a batteries, flywheel or ultra capacitor). Supporting R&D includes lightweight, super-strong materials such as composites; high-temperature ceramics; regenerative breaking; and advanced power electronics. PNGV vehicles, available just prior to 2010, will be 2.5 times more efficient than today's conventional vehicles, providing large potential to reduce greenhouse gas emissions.

Proton Exchange Membrane (PEM) fuel cells have perhaps the greatest long-term potential for reducing transportation CO_2. Recently PNGV developed an on-board reformer for converting gasoline into hydrogen to run a PEM fuel cell, which would have a 50% increase in fuel efficiency over an internal combustion engine, half the CO_2, and a 90% reduction in conventional pollutants below ultra-low emission vehicle standards. A PEM fuel cell running on ethanol would have virtually no net CO_2 emission. A decade of R&D may be needed to bring costs down and integrate fuel cells into a commercial vehicle, which Chrysler has committed to do in partnership with the government. Maximum efficiency and emissions reductions would come from running the car on hydrogen directly, which will require even more research with automakers.

The ultimate low-CO_2 vehicles and the fuels they would use cannot be known today. To ensure that the R&D leads to commercially viable vehicles, a number of programs are needed to guarantee that the infrastructure is available to support vehicles that run on non-traditional fuels.

The Industries of the Future visions and technology roadmaps identify the best R&D opportunities for increasing energy efficiency and reducing emissions in the industrial sector while increasing productivity. These include advanced materials development, such as ceramic composites; separation technology, such as advanced membranes; catalysis; bioprocessing, biocatalysis, and renewable feedstocks; sensors and controls; and industrial cogeneration. All of these industries would like to dramatically improve their environmental performance. The pulp and paper industry, for example, sees the possibility of becoming a no-net-CO_2 industry, through a combination of efficient use of energy and biomass cogeneration.

These industries (except chemicals) significantly under-invest in R&D compared to the industry average. What R&D they have devoted to the environment has traditionally been focused on compliance — end-of-pipe treatment and control, as opposed to prevention — since that is how our regulatory system is designed. While increased R&D is needed, the Administration's regulatory reinvention revolution must succeed.

Federal RD&D into buildings technologies has been remarkably successful. Consider just five technologies developed or advanced by the national laboratories in the past two decades at a cost of roughly $40 million — building design software and advanced lighting, windows, oil burners, and refrigerator compressors. These have provided cumulative net savings of more than $25 billion to consumers and businesses, exceeding the $8 billion spent on all energy efficiency R&D since 1978. They now provide 18 million metric tons of annual CO_2 savings.

Continued RD&D in the buildings sector is likely to prove just as cost-effective. Key near-term technologies include improvements in lighting, superwindows, advanced design software, high-efficiency clothes washing, heat-pump water heaters, gas heat pumps, improved insulation and duct systems, more efficient cooling including gas cooling, solar heating and cooling, and day

lighting, and urban heat island mitigation R&D (such as more reflective roofing and road materials). Longer term R&D needs include electrochromic glazings for windows, building-integrated PV systems, and PEM fuel cells, all of which could begin to see market share before 2010 and make a very large impact in the following decade.

Opportunities for new initiatives include:

> *Increasing federal investments in technology RD&D with industry* — Most of the technology pathways that will result in sizable reductions in CO_2 emissions in the 2010-2020 time frame are being pursued today, but at funding levels substantially below what is required to maintain greenhouse gas stabilization beyond 2010 at relatively low economic costs to our nation. Examination of these pathways and increased funding in some key areas is of critical importance.

CARBON CAPTURE AND SEQUESTRATION

In addition to the portfolio of R&D options related to less CO_2 intensive technologies for energy supply and use, capture and disposal of CO_2 offers an additional alternative for reducing atmospheric concentrations of CO_2. If major reductions in CO_2 emissions are necessary, and global reliance on fossil fuels continues beyond the middle of the next century, then some form of CO_2 sequestration will almost certainly be needed.

Moreover, a successful program to develop safe, low cost greenhouse gas sequestration options should garner bipartisan support for progress on climate change issues by allowing for continued use of fossil fuels while minimizing the direct costs of mitigation programs. If these disposal techniques are sufficiently low in cost, they could also be a means to induce developing country participation in a climate change mitigation program, thereby overcoming another institutional barrier to implementing an effective mitigation program.

A long-term R&D strategy would include demonstration of a number of sequestration options and research into their possible environmental impacts; converting CO_2 into an industrial chemical feedstocks; other novel sequestration options, such as CO_2 fixation by micro-algae; selectively permeable membranes for CO_2 capture; processes for converting fossil fuels and biomass into CO_2 and hydrogen; development of hydrogen infrastructure technology, including transportation and storage; and PEM fuel cells.

Technology R&D into clean power generation and energy efficiency support many long-standing national goals and have been pursued for years. Carbon dioxide capture and sequestration, however, makes sense on a massive scale only in a greenhouse-gas constrained world. So, at least in this country, this area has been relatively under funded; since 1990 Japan has spent more than 30 times what we have on CO_2 capture and sequestration.

BASIC AND ADVANCED RESEARCH

A number of areas of basic research could prove crucial to responding to climate change, including biotechnology, fermentation microbiology, combustion research, polymer and ceramic science, process engineering, supercritical CO2, new materials synthesis, and nanotechnology. We need to better understand the underlying biochemistry of the bioconversion of carbon dioxide to

methane or to other potential fuels and feedstocks. This new research includes the ability to sequence the genetic material of microorganisms and plants, to develop new molecular genetic engineering techniques, and to understand biophysical and biochemical pathways of photosynthesis.

One essential area for expanded R&D is superconductivity. Superconductors offer the possibility of storing and transmitting electricity with virtually zero loss, with potential savings of 5% to 10% of all electricity presently generated by utilities. Highly efficient superconducting motors could have an even larger impact since motors currently consume 60% of all electricity. While U.S. and German funding is roughly $40 million annually, Japan spends nearly $70 million, not including their superconducting MagLev train program, with some $3.5 billion being spent over five years. Significant increases in both basic and applied research in superconductivity should be an essential part of a low-CO_2 R&D strategy.

Historical Forces ~~Leading to Market Barriers~~ to Energy Efficiency in the Buildings Market

Type of Barrier	Nature of Barrier	Examples of Barrier
Imperfect Competition		
Natural Monopoly	Economies of scale	Electric utilities
Market Power (Monopoly and Oligopoly)	Bargaining power; Interdependent conduct	Uniqueness of building location; few development firms in one area
Anti-Competitive Conduct	Collusion; predation	Manipulation of permit process to the detriment of competitors
Information Availability		
Information Costs	Transaction costs	High cost of customized audit (cheaper if done en masse); collecting product info; finding credible information sources
Asymmetric Information	Unequal bargaining	Developer's superior knowledge of building
Misinformation	Misinformed exchange	Belief: "no efficiency increase is possible"
Lack of Information	Uninformed exchange	No knowledge of efficient technologies
Economic Non-Rationality		
Bounded Rationality, Satisficing	Using rules of thumb to reduce transaction costs; not maximizing profits	Ignore costs that are < 5% of rent; use a two year payback; seek acceptable profits
Other Non-Rationality	Cultural reasons for taking actions that affect business practice	Preferring energy production to cost-cutting because it is more congruent with management culture
Risk Aversion	Resistance to change	Avoid changes in suppliers and technologies; avoid new technologies
Side Effects	Negative externalities from power production	Pollution from power generation; dependence on imported oil; risks of nuclear energ
Split Incentives	Utility costs not paid by purchaser and user of equipment	Landlord-tenant problem; builder-buyer problem
Public Goods		
R&D	Non-excludability, zero marginal costs	Too little R&D performed
Expertise and Training	Non-excludability, zero marginal costs	Too little training on efficient design, installation and maintenance; too little informati dissemination
Cash Flow Constraints	Lack of access to capital	Small business tenants on the edge; developer's reluctance to take on more debt
Regulatory Distortions		
Regulatory Bias	More profits for energy production than for efficient use	Utility reluctance to install conservation even when cheaper than new supply
Average Cost Pricing	Price signals do not reflect cost, leading to inefficient usage	Utility regulation in the US
Building Codes	Obsolete codes and poor code enforcement inhibit innovation and efficiency; # of inconsistent codes inhibits achieving economies of scale	Local US building codes contain requirements that interfere with efficient constructio thousands of building codes in the US

Assistant Secretaries' Meeting at State
18 March 97 9:30pm

REVIEW OF CLIMATE CHANGE PAPERS FROM THE STATE DEPARTMENT

1. Compliance

Issue: What to do about the trading, borrowing, and JI of non-compliant nations?

Why should non-complaint nations be denied the means to get back into compliance--banned from trading or JI?

Why should borrowing incur a penalty in the next period?

By restricting flexibility, some nations might find it in their self-interest to drop out of the market.

2. Joint Implementation

Issue: How to structure the Joint implementation agreements?

The paper submits a JI plan complicated enough to drive away all but the most determined nations. Nations are asked to clear many hurdles to get approval that many potentially beneficial projects could get dropped.

In addition, it is all rather vague as to whether if one country gets a "credit" for JI does the second country get a "debit"? The G-77 countries have not appreciated the vagueness behind the current version of JI.

3. Annex C Gases

Issue: What to do about other non-carbon gases?

The proposal seems to suggest two separate markets for carbon and non-carbon gases.
But do we need two parallel trading systems? Can we just say that a plan for Annex C gases is forthcoming?

More flexibility and thus more cost-effectiveness could be achieved if we allowed trading across gases. Additional administrative complexities could arise, but so would brokers to handle the conversion problems.

4. Borrowing

Issue: Should we remove borrowing from the US protocol?

The paper says that "the option to borrow should be left to the discretion of the Parties." What exactly does this mean?

Also why make borrowing so onerous? Are penalties really necessary?

Why restrict borrowing to just 10 years into the future?

Again the LEAST-COST PATH, based on the IPCC, allows emissions to rise then fall.

5. Annex B

Issue: What nations, and what obligations should be included in Annex B?

Criteria have been proposed such as including those nations that have at least the level of per capita income or emissions as existing Annex I countries. It is unclear as to why a country would want to be on the Annex B list--what do they gain?

6. Four International Emission Trading Papers

Issue #1: Is there a need for a new international oversight group?

It depends---The more each trade is "handled", the greater the transaction costs of participation and the less likely a potential trader will want to participate in this market. **Keep transaction costs down to a minimum.**

Issue #2: In what units should the trades occur?

The proposal is to trade units of carbon equivalent emissions. However, trading on the **carbon-content** of energy inputs might be a viable alternative given the difficulties in measuring emissions in many countries. Why? Much easier to monitor inputs than the emission levels.

Issue #3: How should "problem" countries be addressed?

STATE recommends that the Secretariat has authority to require annual review and rating of each Party's emission and budget reports and each Parties performance in meeting its budget commitments.

The plan is to have a three tier classification of permits--"GREEN/YELLOW/RED"

GREEN	nations in compliance
YELLOW	nations in non-compliance with procedural requirements or cumulative emission budgets--all YELLOW permits still are valid but buyers are put on notice.
RED	nations that fail to cure their non-compliance within a given time frame--all RED permits are voided

Does this scheme trigger too much uncertainty into the trading scheme? If so, potential traders might just drop out of the market, and thus increase the costs of compliance.

Non-Issue #1: Steps to operationalize trading?

No comments

RECALL The Conditions for a Successful Permit Market ARE:

1. *A Sufficient Degree of Compliance should be achieved*

   The protocol envisions that the "tonne of carbon equivalent emissions allowed" (TCEEA) would be the unit to track emission budget obligations. But monitoring will be less costly if the permit scheme was based on **carbon-content trading** rather than **carbon-emissions trading**. Why? Much easier to monitor the inputs than the outputs.

2. *Transaction costs must be low enough not to prevent efficient permit exchanges from taking place*

   The permit system must keep transaction costs low: including the costs of finding prospective buyers and sellers, costs of obtaining any necessary approval for trading. Brokers would likely emerge in the presence of high transaction costs.

   Regulatory constraints could lead to high transaction costs if each and every trade has to be approved by an international body.

3. *The Market for permits must be competitive*

   If a nation or firm that buys and sells a significant fraction of the total number of permits traded might be able to influence price, e.g., Russia. This would imply that greenhouse gas reductions would not be achieved at minimum cost.

4. *The policy must be seen as one that will remain in place for a significant period of time.*

   Firms and nations cannot be expected to trade if they think that policy is likely to change. If policy is stable for a reasonable time period, and there is little uncertainty about regarding the legitimacy of transactions. Who is liable if a seller sells and then ignores its obligations--the buyer or seller?

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Tues. 3/18/97 9:30 am

cc: AW JH JS

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International Emissions Trading: Issue Papers

Issue		Page Number
1.	Is there a need for a new international oversight group?	1
2.	In what units should trades occur?	3
3.	How should "problem" countries be addressed?	4

[note that the text provided is for clarity on the substantive suggestions for additions to the protocol; the text may need editing from State Department to ensure proper "legal" wording and placement for the Protocol]

Emissions Trading Issue #1: Enhancing the Role of the FCCC Secretariat in the Protocol

Issue: Is there a need for a new international oversight group to implement trading?

Background: No, the U.S. Protocol can be implemented through a clear division of responsibility assigned to the Parties, the FCCC Secretariat, and the in-depth expert review teams (and the multilateral consultative process discussed at length in another paper). The Protocol can be enhanced by clarifying the role of the FCCC Secretariat as the official tracker of the budget information for all Parties, using the mechanism of the compilation and synthesis report which is already required. The Protocol is already clear on each Party's required responsibilities for the individual tracking and reporting required for emissions and budget calculations. However, it is important to ensure that the Secretariat can verify it has received an official authorization from a Party before it records an emissions trade, similar to the requirement for the authorization from a "designated representative" from the utility company under the Acid Rain Program. Finally, although the Protocol implicitly requires (in Article 3.5) that the Party report its remaining budget after emissions are deducted, it may be appropriate to modify the Protocol explicitly in Article 2.2 to clarify the Party's requirement to adjust its budget annually by deducting the number of "tonnes allowed" which would be needed to pay for its annual emissions.

Options: See recommendations.

Recommendations:
- Add text that specifies the role of the Secretariat as the official tracking mechanism for budget accounting information.
- Add the concept that a Party must give official approval before the FCCC Secretariat is authorized to record an emissions trade (similar to required "designated representative under the Acid Rain Program. This is envisioned as a multi-part form by which both buyer and seller must identify the quantity of tonnes traded and provide authentication to the Secretariat as recorder of trades)
- Add text for the annual deduction for emissions as a responsibility for each Party to determine its own remaining multi-year budget balance.

Draft Text:

1. *insert new language in measurement and reporting section, at end of paragraph 3.5:*

3.5 With respect to any tonnes of carbon equivalent emissions allowed that are acquired or transferred under Articles 6 or 7, the Party shall specify the quantity, Party of origin or destination, and the relevant budget period, **and include evidence of official approval for the transaction, on the prescribed form from both Parties to the transaction.**

2. *insert new paragraph(s) in measurement and reporting section, or in Secretariat section*

11.? The Secretariat shall track tonnes of carbon equivalent emissions allowed for each Party which are allocated, saved, borrowed, transferred among Parties, and retired. The Secretariat shall impose annually any automatic consequences recommended based on each Party's status and compliance progress. The Secretariat shall record and publish each Party's annual

emissions and emissions budget levels, including any adjustments in the annual synthesis and compilation report.

3. *insert new language in emissions trading section, paragraphs 6.1 and 6.2:*

6.1 An Annex A or Annex B Party that is in compliance with its obligations under Article 3 (Measurement and reporting) and that has in place a national mechanism for certification and verification, **may direct/authorize the Secretariat to record transfers to or receipts from** any Annex A or Annex B Party any of its tonnes of carbon equivalent emissions allowed for a budget period, for the purpose of meeting its obligations under Article 2.

6.2 A Party may authorize any domestic entity (e.g. government agencies, private firms, non-governmental organizations, individuals) to participate in actions leading to transfer and receipt under paragraph 1 of tonnes of carbon equivalent emissions allowed, **provided that before the tonnes of carbon equivalent emissions allowed may be used for the purpose adjusting its budget under Article 2, a Party must authorize/direct the Secretariat to implement any such transfers or receipts.**

4. insert new paragraph in emissions budget section, directly following budget adjustment paragraph which is currently numbered 2.2:

the number of tonnes of carbon equivalent emissions equal to the Party's prior year actual emissions.

5. We recommend reordering Article 2 so that the paragraphs of the budget section are in correct time sequence:

I. Initial Budget Allocation (current Articles 2.3 and 2.4 become 2.1 and 2.2)
II. Budget Adjustments (current Article 2.2 becomes 2.3)
III. Annual Budget Balance (new language listed above in item#4 becomes Article 2.4)
IV. Emissions shall not exceed budget. (Current Article 2.1 becomes Article 2.5; however, because this is the most important directive in the budget section, another logical reordering of the budget section would be I. Emissions shall not Exceed Budget, II. Initial Budget Allocation, III. Budget Adjustments, IV. Budget Balance, V. End-of Budget Reconciliation. VI. Other paragraphs on non-annex C and ratification)
V/End of Budget Reconciliation (current Articles 2.5 & 2.6 become Article 2.6 & 2.7)
VI. Other paragraphs on non-annex C and ratification follow.

Emissions Trading Issue #2: Clarifying the Budget Unit of Measure

Issue: What units of measure should be used to implement emissions trading?

Background: The protocol envisions that the "tonne of carbon equivalent emissions allowed" or "TCEEA" would be the unit used to track emissions budget obligations. The TCEEA (or allowance) should also be the unit of measure used by the FCCC Secretariat for recording transfers from one Party to another. Individual Party's are also responsible for tracking and reporting their emissions budgets, including any purchases or sales, using the TCEEA as the unit of measure. However, the Party may wish to verify the appropriateness of the quantity of TCEEAs it is willing to transfer by identifying the particular emission reduction which will provide the basis of the transfer, calculating the quantity of the particular greenhouse gas, and multiplying that quantity by the approved GWP contained in the Protocol (recommended in another paper as the 100 year GWPs identified by the IPCC). Thus, no change is needed to the protocol text to address this issue because the tonne of carbon equivalent emissions allowed is the appropriate unit of measure to implement emissions trading.

Nevertheless, there is one practical consideration for the unit of measure which may be important to flag as a definition in the Protocol language (but which perhaps could wait instead to be defined in more detailed guidelines later). Specifically, the practical implications of the sheer number of tonnes of carbon equivalent emissions allowed which must be tracked by the FCCC Secretariat.

Options: See recommendations.

Recommendations for future guidelines to be developed:
- Add the concept for a Tradeable Budget Unit (TBU) which is defined as some multiple [e.g., 1,000] number of tonnes of carbon equivalent emissions allowed

NOTE: although this concept is important enough to include in the protocol for practical considerations, there may be some concern about introducing a new concept to the protocol negotiations now when others may already perceive the U.S. proposal as "too complicated". Therefore, it may be appropriate not to add this to the protocol text, but to include in the implementation guidelines to be developed later.

Draft Text:

> **"Tradeable Budget Unit (TBU)" means the authorization under the GHG Protocol to emit up to [e.g., 1000] tonnes of carbon equivalent during or after a specified budget period.**

Emissions Trading Issue #3: Trading Mechanism to Encourage Party Compliance

Issue: How should problem countries be addressed?

Background: Any international trading system should have a mechanism which provides an automatic incentive to comply with both reporting requirements and the budget commitments. The mechanism could be a definitive determination on the status, defined below using a "green/yellow/red" signal, of each Party's progress in meeting both its reporting and budget commitments. The concept is that the FCCC Secretariat (or the in-depth review team) will follow predetermined criteria to be developed (on an annual or other periodic basis) to assign a status showing a "satisfactory/caution/unsatisfactory" (corresponding to the green/yellow/red signal developed for this paper) rating of each Party's progress in meeting both its reporting and budget commitments. A Party would have to initially earn its green status before it could engage in trading, based on an initial review of its monitoring and reporting system to ensure the system meets required minimum standards established in guidelines, and then would need to maintain that status on the basis of its annual reports to continue to trade. Then, for a Party assigned a yellow or red status, automatic trading consequences would be implemented in addition to a referral to the Multilateral Consultative Process (described in another paper). For a more detailed description of the green/yellow/red signal system, see the attachment. The automatic trading consequence for the status for a yellow signal would be that although "allowances" could be sold, they would be marked by the Secretariat such that they could not be used for compliance with any Party's budget commitments until "green" status was restored to the issuer. The automatic trading consequences for a red signal would include 1) suspension of the right to sell allowances, 2) the automatic deduction excess tonnes emitted plus at least the interest rate required for borrowing, and 3) the automatic devaluation of any allowances sold after the yellow signal was assigned.

[[The yellow signal could be raised for determinations made during the budget period, including a determination based on interim emissions benchmarks, that a Party may fail to meet its budget obligations at the end of the budget period. If interim compliance benchmarks are unacceptable, then shorter budget periods (e.g. 3 years) might be considered.]]

Options:

1. Ensure the FCCC Secretariat has the administrative authority to implement automatic consequences which provide incentives for Parties to meet their reporting requirements [[, to meet interim emissions benchmarks,]] and to comply by the end of each budget period .
2. If the FCCC Secretariat does not have such administrative authority, then the U.S. should reserve the right to unilaterally deny "bad" tonnes of carbon equivalent emissions allowed, and this right should be shielded from the World Trade Organization.
3. Consider that the appropriate monitoring, reporting, and enforcement mechanisms may not be sufficient at this time to justify a full emissions trading system at this time, and construct the "trading" allowed by the Protocol to require case-by-case review and approval of specific emission reduction projects which could generate budget transfers (i.e., a "joint implementation" structure even for Annex I country trading).

Recommendation: Option 1

- Define the administrative and non-discretionary authority for the FCCC Secretariat (or the in-depth review teams) to appropriately oversee the emissions trading program. Specifically, require annual review and rating of each Party's emission and budget reports and each Party's

performance in meeting its budget commitments. [note that this does increase the FCCC's workload, and consequent need for funding.]

- One critical feature of this authority is that the signal and thus the automatic consequences would be implemented upon the finding of the deficiency, so that it would not be necessary to wait to implement any consequences until the MCP process came out with a recommended resolution

Note that the consequence for the yellow signal is defined so that the Party which received the yellow signal would be allowed to sell "tonnes allowed", but the tonnes would be tracked as "yellow" and could not be used by the buyer for compliance (those tonnes allowed could not be deducted to cover the buyer's emissions) until the Secretariat made a new determination that the seller had rectified its deficiencies and returned to green status. If the seller did not rectify its deficiencies after a specific time period, then the Secretariat would automatically downgrade the seller to red status, meaning that no further tonnes allowed could be sold, and any "yellow" tonnes sitting in any buyer's accounts would be downgraded to red, where the red tonnes are valueless for compliance and would be retired.

This scenario for green/yellow/red determinations envisions that **any** deficiency in an annual communication (mathematical error, failure to follow approved IPCC guidelines for some of the emission calculations, or complete failure to follow approved guidelines such that the entire emissions report is in question) would trigger a "yellow" status, which would provide the Party with some defined period of time to rectify the deficiencies before the "red" status (and consequently the prohibition against sale of tonnes allowed) is imposed. However, as the guidelines are developed, there may be some deficiencies which are so severe that it would be appropriate to trigger the "red" status immediately.

Draft Text:

insert into international emissions trading section:

Each Annex A or Annex B Party must adopt a monitoring and reporting system which satisfactorily meets the promulgated minimum standards before it may engage in international emissions trading. In addition, each Annex A or Annex B Party's annual report shall be reviewed to determine if the Party's emissions and budget calculations are satisfactory, cautionary, or unsatisfactory, and the FCCC Secretariat will ensure any automatic trading limitations are followed.

ATTACHMENT for Trading Mechanism to Encourage Party Compliance

Meaning of Color Designations: (green, yellow, red)

Green Status: Upon compliance with procedural requirements, a Party will be assigned Green status. With green status, a party may trade TBUs whose tender value will not be questioned by the FCCC. Green status must be affirmatively reestablished after any period of yellow or red status.

Yellow Status: Upon failure to comply with the procedural requirements or cumulative emissions budgets, a Party will be assigned Yellow status. With Yellow status, a party may continue to sell TBUs, but buyers are on notice that there are deficiencies in the performance of the issuing Party, and that the current tender value of the TBUs units sold by a Party under Yellow Status is suspended. Prices would presumably reflect the severity of market-perceived impairment.

Parties under Yellow status would have a specified period during which it would be expected to cure the identified deficiencies to the satisfaction of the FCCC Secretariat, and such Parties would concurrently be referred into the Multilateral Consultative Process. If the deficiency is timely cured, TBUs issued during the Yellow period will have their tender value restored, and the Party may be assigned Green status for future periods. If left uncured at the end of the period provided, a red status results.

[[Maintaining a plausible path toward budget period compliance should be a requirement of overall compliance, especially if the emission budget period is lengthy (e.g., more than 5 years). The plausibility of compliance would be tested during a multiyear budget period by comparing cumulative emissions during the budget period to date to a formula allowance. The formula allowance could be: (1) the budget period allowance pro-rated over the elapsed time since the start of the most recent budget period, (2) net adjustments from completed trades (including JI or other credits) and banked TBUs, plus (3) 10% of the current multiyear budget. Parties which exceeded the formula allowance at any time during the budget period would receive Yellow status. Green status could be restored by TBUs unit purchases or by reducing emissions, but failure to reach formula compliance could result in Red status after a specified interval.]]

Red Status: Upon failure to cure any Yellow deficiencies during the period provided, non-discretionary Red status must be assigned. With Red status, Yellow period TBUs issuances are invalidated and retired, clearing them from the books. Holders of such TBUs receive no value (or possibly reduced value under pro-ration of a deficiency).

Out of compliance
can't sell rights to pollute
either (1) failed to cure penalty
or (2) still pending & failed to
cure as would be said initially.

Recommended Annex C Criteria

Issues

Which gases/sources/sectors belong in Annex C (i.e., subject to the binding overall budget set forth in the Protocol) and which should be excluded from Annex C (i.e., outside of the overall budget)? How should the distinction between Annex C and non-Annex C be made to ensure that the protocol optimizes comprehensiveness, cost-effectiveness, and compliance requirements?

The determination of whether or not a gas/source/sink belongs in Annex C should be made based on objective criteria. These criteria should be applied to the FCCC guidelines for national greenhouse gas inventories, perhaps with consideration of the potential for the methods to be improved in the near term. The gases/sources/sinks that meet the criteria should be included in Annex C and those that fail should be excluded from Annex C. As methods and data improve, those sectors excluded from Annex C should be reviewed, and additional gases/sources/sink could be moved into Annex C. Graduation of a gas/source/sink into Annex C should occur systematically, with the agreement of all Parties. No Party can unilaterally move a gas/source/sink into Annex C.

Recommended Criteria

There are at least five key criteria that gases, sources and sinks should satisfy in order to be included in Annex C. The effect of applying these criteria is to limit membership to only those gases and sources that meet general criteria and can be measured accurately or precisely.

The following list proposes criteria for inclusion in Annex C:

1. Internationally approved or accepted methods (i.e., guidelines adopted by the FCCC) for estimating emissions of this gas from this sector/source category must be available;

2. The national emission estimation methods must be sufficiently accurate and/or precise to ensure that compliance (or non-compliance) could be established. [Note that objective thresholds of accuracy and/or precision should be determined once the scope of Annex C is established. (e.g. +/-10%)]

3. The ability to measure emissions reductions must be systematically captured in the methodologies.

4. Methods must be sufficient to prevent game-playing or manipulation of estimates to falsely demonstrate compliance.

5. The methods must allow progress to be tracked and performance to be evaluated. This will require that data be reported on an annual basis.

6. The methods must be able to be consistently applied by all Annex A and B Parties.

Proposal

Apply the criteria to the current (or expected?) IPCC guidelines and develop a list of gases and sources that satisfy them. Given the timeframe, the technical analyst could not compile a list of gases, sources, and sinks that meet these criteria. We will develop this list for submission to the Secretariat by April 1.

Separate language should be developed to ensure that gases, sources, and sinks not included in Annex C are treated (see Issue Paper on Control of Non-Annex C Gases/Sources/Sinks).

Control of Non-Annex C Gases/Sources/Sinks

Issue

The binding target outlined in the protocol will apply to only the gases/sources/sinks listed in Annex C. Other provisions (unspecified in the draft protocol) will be developed for those gases/sources/sinks which are not listed in Annex C. This paper identifies the options for addressing these gases/sources/sinks.

Options

Essentially, there are four ways to control non-Annex C gases/sources/sectors, as described below:

1. Binding Target:

Description: Either together or individually, specific emission/removal targets could be set for Non-Annex C gases/sources/sectors.

Pros: Maximum environmental gains could be assured by setting a binding target for non-Annex C.

Cons: Difficult to implement and manage separate budgets for Annex C and non-Annex C. Likely to be unworkable since many of the non-Annex C gases are highly uncertain.

2. Binding Policies & Measures:

Description: Each Party could be required to impose select policies and measures on Non-Annex C

Pros: Greater assurance that environmental objectives would be met, while recognizing that weaknesses in estimation methods would make a binding target unworkable.

Cons: Imposition of harmonized, binding policies and measures does not reflect differing national circumstances among Parties.

3. Voluntary Policies & Measures:

Description: Each Party could voluntarily adopt policies and measures to reduce emissions from non Annex C.

Pros: Some environmental gains will be made, in a manner consistent with national priorities and circumstances.

Cons: Maximum environmental gains will likely not be made.

4. No Provisions:

Description: Parties could assume no obligations (binding or voluntary) with respect to Non Annex C.

Pros: Eases burden on Parties; no additional compliance requirements.

Cons: No environmental progress made for non-Annex C gases.

Borrowing Against Future Targets

Issue: Should Parties be allowed to borrow against future targets, and should language to this effect be removed from or maintained in the U.S. proposal?

Background: The concept of borrowing is currently included in the U.S. draft protocol proposal. It is mentioned in two places: Article 2.2(c) on emissions budgets which states that the budget includes: "up to [__ percent] of the tonnes of carbon equivalent emissions allowed ....such as may be borrowed from the subsequent budget period....", and Article 2.6 which states "At the end of a budget period applicable to a Party, any amount of tonnes of carbon equivalent emissions allowed that is borrowed from the subsequent budget period shall be subtracted at a rate of [1.2:1] from the subsequent budget period." Thus, the language incorporates both a restriction on the amount allowed and a penalty for borrowing.

At the most recent session of the AGBM, the concept of borrowing came under significant attack, with delegates arguing that it allowed Parties to indefinitely exceed their commitments, and made any assessment of compliance impossible. This paper discusses the concept of borrowing, and suggests some approaches and clarifications that might address some of these concerns.

While borrowing has raised concerns, there are also several issues to be considered with respect to excluding the option. For example, without borrowing, a Party that exceeds its first budget by a modest margin would either start the next period with a clean slate, or be subject to a non-compliance provision that requires them to make up the shortfall, possibly with a penalty. The first alternative perversely rewards non-compliance, while the second is virtually identical to borrowing, except that only "non-compliers" may use it. By providing all Parties with access to borrowing, Parties in compliance are not penalized relative to Parties not in compliance. The extra degree of timing flexibility allows more Parties to remain in compliance. Moreover, borrowing does not endanger the environmental objective of the Protocol – in fact successful borrowing transactions would reduce atmospheric concentrations below the level that would have prevailed in their absence due to the requirement to pay back 20 percent more tons than are borrowed.

The concept of borrowing is familiar to all who are involved in financial transactions -- it involves taking a loan against future resources in order to pay current obligations. In the case of the climate, current obligations would equate to current levels of allowable emissions (or emissions in a given budget period); future resources would equate to allowable emissions in a future period.

A financial world without borrowing would be difficult to imagine. It is rare that a firm has internal capital resources adequate to fully finance its future growth. Similarly, responding to any significant climate change mitigation strategy without a parallel option for borrowing can also be expected to impose costly economic constraints on the system: it clearly reduces flexibility in terms of planning; and it may require the premature retirement of capital stock in order to meet strict deadlines. Borrowing also allow for a appropriate planning and introduction of new technologies – on a timeframe that may lead to greater emissions reductions than without such a system. In planning a borrowing regime, we must remain aware that the climate and mitigation responses are not fully analogous to financial markets.

Also in a manner similar to financial transactions, costs could be associated with emissions borrowing. These include risks of the borrower defaulting on the loan; opportunity costs to the lender of not making a more profitable investment elsewhere; and the adequacy of institutional mechanisms. Unlike most financial transactions, some additional risk may be associated with an emissions borrowing regime, including impacts to the environment from delayed reductions. However, the environmental risk posed by greenhouse gas emissions is a function of atmospheric concentrations rather than annual emissions. While borrowing tends to increase near term emissions, the environmental risks could be reduced if borrowing and repayment schedules were managed in such a way as to preclude concentrations rising above long-term target levels.

Notwithstanding the differences between financial borrowing and emissions borrowing, some of the solutions applied in the financial arena are applicable in both cases. For example:

- Loans are usually offered at some cost in the form of interest paid by the borrower; the analogous situation could call for the borrower to pay more in the way of future reductions for any emissions used in the current period. The U.S. proposal contains such provisions, with the penalty assessed at 20 percent of the amount borrowed. Several options might be considered if the exemplary number were changed:
  - A fixed rate for the budget period could be assigned on a political basis;
  - An annual rate could be developed; or
  - A rate based on market lending rates could be assigned (to insure that emissions borrowing was not less expensive than financial transactions)

- Financial transactions are also often accompanied by requirements that the borrower put up collateral; in the case of emissions borrowing, a bond might be posted to ensure that funds would be available to "buy" emissions should the borrower default on the loan, or another entity might guarantee the shortfall. We may also consider the potential "riskiness" of a borrower, and require more stringent safeguards for borrowers with questionable reduction strategies. The U.S. proposal does not currently contain such provisions. These might be added, and could take several forms including requiring the borrower to provide an indication of how repayment would be made, and only allowing borrowing for the amount that could be reasonably expected to be repaid.

- Financial transactions are also often limited in terms of the amount that can be borrowed -- either as a fixed total, or as a percentage of future earnings; emissions borrowing might have a similar limit (for example, a country or firm might be prohibited from borrowing more than [2][5][10] percent of its total emission reduction obligation). The U.S. proposal contains such provisions, although the number is unspecified. These provisions insure that Parties cannot use borrowing to indefinitely exceed their commitments. For example, a Party that "borrowed" the maximum amount in the first period would be unable to borrow more in the second period. A Party that borrowed would overcomply substantially relative to its second budget period if it paid back its borrowings fully. In fact, it would overcomply even in the extreme case in which it "rolled over" its initial borrowing, since to stay within the total borrowing limit it would have to overcomply at least to the extent of the borrowing penalty.

- Finally, defaulting borrowers are usually assessed a penalty; a similar penalty might be applied toward a defaulting emissions borrower -- either in the form of a monetized fine, or in the form of an additional reduction obligation. This concept is embedded in the non-

compliance provisions that are already included in the U.S. proposal – although additional penalties might be assessed on amounts borrowed in one budget period that are not repaid by the end of the subsequent budget period

Recommendation

Noting both the concerns which many countries have expressed regarding borrowing – but also the significant advantages that accrue in terms of cost-effectiveness from allowing borrowing – the option to borrow should be left to the discretion of the Parties. However, in discussing the concept, the restriction placed on borrowing should be noted. In particular, the U.S. proposal restricts the extent to which borrowed emissions are to be used in a country's emissions budget (for the April 1 deadline, we could suggest that no more than [2][5][10][20] percent of a Party's total budget may be borrowed from a subsequent period), and also includes a penalty for borrowing – in the form of a 20 percent penalty on borrowed emissions. Our system also defines multiple budget periods (two are included in the U.S. proposal), and only allows borrowing from defined budget periods. In conjunction with the U.S. proposals for a stringent compliance and monitoring system, we believe that we have safeguarded borrowing from potential abuse.

To further address concerns about the concept, it is proposed that language be added to restrict borrowing to emissions for which a Party has provided detailed plans regarding repayment (and possibly require that guidelines for such proposals to be developed and adopted by the Parties at their first meeting). This addition would obligate a Party to develop, make public, have reviewed and have agreed specific proposals on how it would make up the additional obligations in the subsequent budget period. It would prohibit borrowing by Parties not having such plans. Language to this effect could be inserted into Article 2.6 of the U.S. proposal.

H:/FCCC/borrowing.doc

cc: AW
JAF
JS

THE WHITE HOUSE
WASHINGTON

March 14, 1997

MEMORANDUM FOR DISTRIBUTION

FROM: ELGIE HOLSTEIN
DAVID SANDALOW

SUBJECT: Climate Change

There will be a meeting Wednesday, March 19 from 1:30-3:00 in OEOB Room 472. The agenda will be:

1. Domestic Policies - recommendations for deputies

2. Emissions Budgets - recommendations for deputies

Attendance is principals only. Everyone on the attached list has been cleared into the building. For questions concerning clearance, please call Wendy Philleo (456-6224).

Can you have a 1:30 mtg at State w/ E Clearance when can we talk upon attend?

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To:	Assistant Secretaries Group	**Date:**	March 14, 1997
Fax #:	See attached list	**Pages:**	1, including this cover sheet.
From:	William N. White Special Assistant to David Gardiner		10
Subject:	Papers on Trading and Regulation		

COMMENTS:

Please find attached two papers for discussion at the Assistant Secretaries Climate Change Group meeting on Tuesday. The first is *Domestic Greenhouse Gas Emissions Trading*, the second is *Using Standards and Regulations to Reduce Greenhouse Gas Emissions*. Please contact me at 260-1345 if you have questions or do not receive a complete transmission.

second paper transmitted separately!

Domestic Greenhouse Gas Emissions Trading

Introduction

This paper describes options for a domestic emissions trading program to meet an international agreement on an emissions target for greenhouse gases. Emissions trading involves allocating or auctioning emissions allowances, and allowing the trading of allowances in a market with sufficient mechanisms to ensure compliance with targeted levels. Emission trading creates new, marketable assets that can have substantial value, so distributional issues will be an important component of program design. Allocation designs or auction revenues can be used to address these distributional issues.

Emissions trading offers two advantages over a system of emission taxes. First, by setting overall quantity targets, emissions trading programs offer greater certainty that national emission targets will be achieved. Under a tax system, the quantity of total emissions is the result of individual polluters' decisions in response to the incentive provided by the tax. In principle, if the entire cost structure is known, any quantity target attained by a tradable permit system could also be attained by an appropriately calculated tax. In so far as forecasting in practice is difficult, however, the resulting level of emissions can be greater or less than the level targeted when the tax rate is set. Second, under an allowance system, the government has greater flexibility in deciding whether to collect revenues. It can auction permits, allocate them based on historical emissions, or undertake some combination of the two. This flexibility can affect the public acceptance of the mitigation program. Emission tax systems always involve revenues accruing to the government (although they can be rebated).

Emission Trading of Greenhouse Gases

An emissions trading program, like any program designed to limit greenhouse gases, must contain certain elements. First, an agreed upon emissions budget, and any rules governing provision for the project-specific crediting of reductions made in activities not explicitly covered by the budget, must be established. A central authority must be given the domestic responsibility for verifying compliance and must be provided sufficient information to do so. Finally, noncompliance with allowance limitations or reporting requirements must generate real consequences, such as penalties or subtraction of allowances.

A program would have to establish permit lifetimes, monitoring and enforcement provisions, as well as rules for permit banking, borrowing, and trading. Consideration should also be given to transaction costs, which should be kept as low as possible. However, particularly difficult issues involve determining what types of activities require a permit and how permits should be allocated.

What types of Activities Should Require a Permit

Sources of greenhouse gases include not only those emitting carbon dioxide, but other gases such as methane, nitrous oxides, hydrofluorocarbons (HFCs), 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.

The decision for determining permit holders should consider the following:

- *Coverage:* While it may not be necessary to ensure that every ton of greenhouse gas is accounted for within an emission trading regime, the scope of coverage of the trading program should be sufficient to ensure compliance with targets set in accordance with an international agreement.
- *Administrative and compliance feasibility:* The number of sources involved in the trading program should be small enough to be administratively feasible and large enough to ensure market competition. In addition, monitoring and verification of permit compliance must be possible for those included in the program.
- *Potential to Diffuse Low Greenhouse Gas Technologies:* Alternative points of intervention should be evaluated for their ability to provide incentives for research, development, adoption and diffusion of low greenhouse gas technologies.
- *Market Impacts:* Any program that limits emissions will affect the bottom line of firms. The permit program will have economic impacts that vary depending on program design. For example, exempting certain sizes or categories of sources from permit requirements because of administrative or equity concerns (e.g., small boilers or home heating oil) has competitive implications within the energy market.
- *Public Acceptance:* The program must consider the ease or difficulty with which various allocation approaches would be accepted by the public.
- *Consistency with the international trading system:* The domestic program should be consistent with any international prescriptions concerning the coverage of sources and gases.

Carbon Sources

Carbon dioxide currently accounts for about 85% of U.S. greenhouse gas emissions and number in the hundreds of millions since they include sources such as automobiles and residential gas water heaters. However, since virtually all of the carbon contained in fossil fuel extracted from the ground (with the possible exception of certain feedstocks) is eventually released to the atmosphere, a trading program need not focus

uniquely on direct emitters, but can be implemented through other points in the energy market. These include fuel imports, fuel extraction, processing, refining, distribution, and secondary conversion (e.g., coal to electricity). In addition, these points could vary by sector. For example, an emission trading program could focus on the point of final combustion for coal, but on refining for oil, or distribution for natural gas. Given the wide variety of options available for including energy sources in a trading program, a few alternative programs are described below for illustration:

A Program Targeting Primary Fuel Producers

The primary fuel producing sector – extraction, processing, refining, and distribution – has many levels where a permit program could be implemented. One option would be to require permits at the point of first sale (a permit is surrendered with the first inter- or intra- company transaction). Such a system would include transactions between a coal company and an electric utility, between a natural gas producer and its marketing arm, between a natural gas producer and a broker, or between an oil extraction company and its refinery operations. Fuel importers would also require permits to import fuel. This would capture the carbon from fuel consumed in the refining process. The number of market actors under this program design would be under 5000 and virtually all carbon in the energy sector would be included in the program.

A Program of Emission Trading at the Sectoral Level

An emissions trading program could also be applied at the point of combustion, allowing trading among affected sources. This system would be most comparable to the current SO_2 emission allowance trading system.

Targeting the six largest industrial CO_2 emitting sectors (electric utilities, cement, primary metals, pulp and paper, petroleum refining and chemicals) in a sectoral trading program could encompass as many as 20,000 market participants and 90 percent of industrial CO_2 emissions. Mobile source emissions could either be indirectly included in the system by allocating transportation equipment manufacturers permits for emissions associated with their automobile fleets or by including refiners in the program. Residential and commercial emissions could be similarly addressed by focusing upstream in the energy system.

Other Greenhouse Gases and Sinks

Other gases account for the remaining 15% of greenhouse gas emissions (on a carbon-equivalent basis). Most important among these is methane, which accounts for 11% of national emissions. Since gases differ in their lifetimes and in their potential to trap heat in the atmosphere, an "exchange rate" or trading ratio must be established to convert all gases into common units for inclusion in a trading program. Such ratios have been developed by climate researchers and could be applied here. These should be consistent with the rules established in the international protocol.

Several, although not all, of the many sources of non-carbon greenhouse gases could likely be included in a trading system. For example, methane emitting coal mines, landfills, livestock manure management facilities and potentially natural gas distribution systems may meet the criteria described above for inclusion in a greenhouse gas trading program. These sources account for 7% of national greenhouse gas emissions. Similarly, emissions of some sources of other gases could potentially be included (e.g., magnesium production).

Forests in the United States currently remove an amount of carbon equal to 8% of national emissions from the atmosphere. Their inclusion in the trading program would theoretically enhance the system's flexibility. However, translating the potential of sinks into monitorable, verifiable, and cost effective emission reductions would require the development of a national accounting system for sinks. Such a system is needed to ensure that the planting of trees and preservation of forests in a given area would not result in offsetting losses elsewhere. The decision on whether to include sinks in the trading system will be influenced by the outcome of the international negotiations.

Allocating Permits

In an emission trading system, some mechanism must be provided for allocating permits to sources. This could be done on the basis of baseline/historical emissions (where permits are given to those currently emitting) or through an auction (where revenues accrue to the government). These two mechanisms might also be combined: a portion of permits could be allocated on the basis of historical emissions while the rest are auctioned. In any case, the value of these assets could be large depending on the permit price, which is determined by the emissions target and the costs of substitutes. Given that an auction could produce substantial revenues, some decision would have to be made with respect to what to do with the proceeds. These could be used to redress inequities in the distribution of control costs, fund R&D for less carbon intensive energy sources and end uses, or to reduce taxes or the deficit.

For example, a reserve of allowances or a portion of auction revenues could be set aside to encourage more rapid development and diffusion of low greenhouse gas emitting technologies. Manufacturers of energy consuming equipment could compete for the set aside based on the degree to which they produce equipment more efficient than the average in use or than required by current mandatory efficiency standards. Such a program could yield reductions in energy demand and help buffer the consumer from the impact of higher energy costs.

Alternatively, permit allocation formulae could take into account the market impacts of the mitigation program. "Set asides" could be made available to those industries, workers, or consumers who experience a grossly disproportional share of the costs of control. A set aside could also be auctioned, with the revenues used to redress gross inequities in the distribution of control costs.

Allocation Based On Baseline/Historical Emissions

Under this approach, sources are given a number of permits based on baseline fuel production or emissions and an allocation formula. Various allocation formulae can be devised, weighted to greater or lesser degrees in favor of sources with high historical emissions. Emissions allowances are endowed to facility operators for no cost and would be transferable. Those receiving permits thus obtain assets of potentially large value from the government at no cost.

Such an allocation mechanism could create entry barriers. In a capital intensive sector like primary fuel production, where entry barriers are already substantial, new entrants would be further disadvantaged if they had to purchase permits – especially if existing holders hoard permits. This problem could be mitigated by withholding a number of permits for purchase by new entrants or by auctioning a portion on the open market. Such an auction would also facilitate price discovery in a new market. Although new firms will still be disadvantaged (as they will pay for all of their permits), they would be able to enter the market. The pool of permits would need to be withheld from existing sources to ensure compliance with budgeted national emission levels – unless there are specific international provisions for early banking.

It may be desirable to design an allocation that would allow credit for early emissions reductions (those achieved prior to the start of the program, but after the baseline period) -- in particular for those that reduced greenhouse gas emissions as part of government sponsored voluntary programs. If credits for past actions are given, the total credits allowed would need to be deducted from the overall permit allocation in order not to exceed national greenhouse gas emissions target.

Auction

Alternatively, an auction could be used to allocate permits. In this case, permit holders would pay the market clearing price for every unit of greenhouse gas released. Auctions ensure that permits are available for trade, and would serve to inform potential traders about current price levels. All participants have equal access to permits, placing new entrants on the same footing as existing emitters. As discussed earlier, since an auction could produce substantial revenues, some decision would have to be made with respect to what to do with the proceeds.

Relationship to an International Trading System

Because control costs differ substantially among countries, international trading offers the potential of large, global efficiency gains. The current U.S. position calls for the international agreement on greenhouse gases to incorporate the trading of reduction obligations. While such obligations are the responsibility of governments, the creation of a domestic trading program reduces transaction costs and increases the likelihood that the theoretical gains of international trading will be realized.

Without a domestic trading system, some mechanism for effecting an international transaction between governments would need to be created. That is, once governments trade international obligations, some means to allocate the change in national "allowable" emission levels to sources within the country must be created. Without a domestic trading program, this is likely to require government intervention. With a program, sources of greenhouse gases could themselves become agents in the international market and undertake this function, thereby lowering transactions costs.

Consistency among the rules of domestic and international trading is therefore important. The International Agreement will specify the time dimension of national obligations, the coverage of gases, as well as the rules for banking and borrowing. If the domestic specifications for emissions trading are consistent with those for the trading of obligations among countries, the potential efficiency gains of international trading are more likely to be realized.

Attachment: US Experience with Emissions Trading

The US has had more experience with emissions trading than any other country in the world. Specific programs include:

- *Sulfur Dioxide (SO_2) Allowance Trading:* The Clean Air Act Amendments of 1990 required a 50% reduction in SO_2 emissions from electric utility boilers. To accomplish this goal, a fixed number of emission allowances were allocated to electric utilities based on a formula reflecting historical emissions. In addition, a small portion of allowances are auctioned every year to facilitate price discovery and new entrants. Allowances are specifically excluded from being defined as rights to pollute, may be traded to any party anywhere within the continental U.S., and may be "banked" for use in future years. Participants need to conduct regular monitoring of emissions and make an annual accounting of their emissions. Penalties are imposed if emissions exceed the number of allowances held by a source.

  A functioning market in SO_2 allowances now exists, involving both bilateral exchanges between companies, and brokered exchanges through third parties. This market, along with other factors,[1] has helped to dramatically reduce the cost of the abatement program. Initially, forecasters claimed that a 50% reduction (10 million tons) in SO2 would correspond to allowance prices in the range of $400 to $1000.[2] However, prices for allowances that would be needed in the next decade to achieve this level of emission reduction currently range between $90 to $100. In addition, 1995 emissions were actually 40% below the legally required levels for that year.

- *Water Effluent Trading:* The US generally has regulated surface water quality through a system of discharge limits for large sources of water pollution. In addition, states have standards for ambient water quality which are often not attained even after large dischargers apply "best technology." The reason is that small ("nonpoint") sources (such as runoff from farms) contribute significantly to water pollution. A number of state and local governments are employing trading systems for watersheds that either permit trading among large dischargers, or allow large dischargers to fulfill their requirements by controlling nonpoint sources. These include the Fox River in Wisconsin, the Dillon Reservoir in Colorado, and the Tar-Pamlico River in North Carolina. The latter two programs are designed to manage future economic growth. Thus, the quantity of effluent allowances allocated exceeds current discharge levels. Once growth consumes this excess, trading is expected to reduce compliance costs.

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[1] These include the fact that the bill that was actually adpted was not as onerous as many in industry had feared, the low price and widespread availability of low sulfur coal, the awarding of "bonus allowances," the postponement of capital investments, and lower than expected transportation costs.

[2] Hahn, Robert W., and Carol May, "The Behavior of the Allowance Market: Theory and Evidence," The Electricity Journal, March, 1994.

- *Inter-refinery Lead Trading:* EPA operated a lead trading program from 1983 to 1987 as it phased out lead from gasoline. Lead trading allowed refiners and importers to trade lead reduction credits in order to meet limits for the lead content of gasoline. The quantity of allowances to which a firm was entitled was determined by the amount of leaded fuel produced by the firm and the contemporaneous EPA standard. Those who bettered the standard could sell their credits to others. Some 10 billion grams of lead were traded during the course of the program at prices ranging from 0.75 to 5 cents per gram. Allowing the trading of lead credits reduced the costs of the program by approximately 20 percent.

- *Criteria Air Pollutant Trading:* EPA first began incorporating aspects of emissions trading in its air program in 1974, when it allowed a modified source to use "credits" earned by another source within the same plant to avoid additional regulatory requirements. Since then, emission trading has substantially expanded. Trades have numbered in the thousands and have been estimated by Hahn and Hester (1986) to have achieved savings between $525 million and $12 billion.

- *Market Mechanisms for Chlorofluorocarbon (CFC) Phaseout:* Under the 1987 Montreal Protocol to limit stratospheric ozone depletion, the U.S. required the phase out of the production of CFCs by 1996. As part of its program, the U.S. adopted a tradeable permit regime covering CFC manufacturers and importers. These allowances were allocated based on each firm's 1986 market share. As the market for CFCs declined, the system allowed firms to allocate production among different facilities according to the least-cost pattern of supply. It also gave CFC users the flexibility to switch between different CFC compounds, within the overall limit on allowances. This program helped reduce the costs of the phaseout. In 1988, EPA estimated that the cost to *halve* CFC use would be $3.55 per kilogram. By 1993, it became clear that all uses could be *eliminated* by 1996 at a cost of $2.45 per kilogram.

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United States Department of State

Bureau of Oceans and International Environmental and Scientific Affairs

Washington, D.C. 20520

March 17, 1997

TO: Distribution

FROM: OES - Eileen B. Claussen

SUBJECT: Climate Change Papers

Attached is a set of six papers setting forth ideas and proposals for possible inclusion as part of a U.S. submission to the Climate Convention Secretariat. We will consider these at the meeting of the Assistant Secretaries scheduled for 9:30 a.m. on Tuesday, March 18 in Main State Room 3524. Papers to be discussed include:

- Annex B countries and commitments
- Annex C gases and treatments
- Compliance
- Emissions Trading
- Joint Implementation
- Borrowing

These documents have been prepared to meet a very tight timetable; the Ad Hoc Group on the Berlin Mandate (AGBM) agreed that it would allow Parties to submit any new materials only until April 1, 1997 – and that all documents submitted following that date would not be included in the compilation being prepared for circulation to all Parties by June 1. However, in my view, while decisions on each of these issues will need to be taken over the next several months, not all need be decided – nor language submitted – by the April 1 deadline. I recommend that we focus our discussion tomorrow on Annex C gas/sector issues, compliance and joint implementation, and that time permitting, we then proceed with a discussion on Annex B, borrowing and emissions trading. We anticipate an additional round of review before submitting any materials to the Deputies, recognizing that any text must be completed and approved prior to the April 1, 1997, deadline. I would also like to use the session as an opportunity to discuss other aspects of the work program, with particular emphasis on briefings for the business and NGO communities, and the Hill. I look forward to seeing you tomorrow.

Attachments

As Stated

"Compliance" Elements

- Attached is the proposed text for additional "compliance" elements to be sent to the Secretariat for inclusion in the compilation document.

- These new elements (which are underlined below), combined with the existing U.S. proposal, would add up to a compliance regime along the following lines for Annex A and B Parties:

  -- a requirement to have in place a national system for the accurate measurement of emissions;

  -- a requirement to have national compliance and enforcement programs relevant to implementation;

  -- detailed reporting requirements, including on the current status of a Party's emissions budget;

  -- an automatic review process involving "review teams" (as currently used under the Convention) empowered to conduct on-site fact-finding and to prepare reports assessing implementation of commitments, including any potential problems in achieving such commitments;

  -- automatic referral by the Secretariat of reports indicating questions of implementation to a "friendly" multilateral consultative process for further handling; such process would, as under the Montreal Protocol, take the form of an implementation committee composed of a subset of Parties;

  -- in addition, at the request of a Party (about itself or other Parties) or the Secretariat, referral of implementation questions to the multilateral consultative process;

  -- multilateral consultative process empowered to make recommendations to a meeting of the Parties, which would be authorized generally to take appropriate action; indicative list of possible actions would be included in the agreement;

  -- explicit consequences in the agreement itself for certain violations:

     - a Party that borrows (although not technically a violation) loses a certain percentage of its budget from the subsequent period;

- a Party that exceeds its emissions budget is required to borrow from its subsequent budget period, at a higher rate than that applicable to legal borrowing;

- a Party may not sell [issue: also not acquire?] tons under emissions trading if it is not in compliance with its measurement/reporting obligations; does not have a national mechanism for certification and verification of trades; exceeds its emissions budget; or [the Parties so decide with respect to a Party unlikely to meet its budget] [a quantitative formula automatically indicates that a Party is unlikely to meet its budget];

  [Note that, with respect to all of these cases of non-compliance, there is an indicted vs. convicted issue, namely whether a Party is deemed to be in compliance for trading purposes until: a question is raised about its compliance (and, if so, by another Party? the Secretariat? the MCP? a meeting of the Parties?) or it has been found to be in non-compliance (by the MCP? a meeting of the Parties?) Text will need to be added on this point.]

- a Party not in compliance with measurement/reporting obligations may not acquire tons through joint implementation;

-- without prejudice to the multilateral process, the ability to invoke traditional bilateral dispute settlement leading to a recommendatory decision (as in the Convention);

-- various Secretariat functions related to the above.

o For non-Annex A and B Parties:

-- reporting requirements (e.g., on inventories, measures taken);

-- process for automatic review of individual communications;

-- multilateral consultative process (potentially leading to action by meeting of Parties), as referred to above;

-- traditional dispute settlement referred to above.

Text to Be Submitted
(note that Article #s will need to correspond to the new compilation text)

In Article 2 of the U.S. proposal (Emissions Budgets), add a new paragraph 6.bis. as follows:

6.bis. At the end of a budget period applicable to a Party, any amount of tonnes of carbon equivalent emissions over its emissions budget shall be subtracted at a rate of [rate substantially above that for limited legal borrowing] from the subsequent budget period.

In Article 4 of the U.S. proposal (Review and Compliance Process), substitute for paragraphs 4 to 6 the following text:

4.4 Review teams will review all aspects of a Party's implementation of this Protocol, including the likelihood that a Party will achieve its emissions budgets obligations. They will be authorized, inter alia, to conduct on-site fact-finding, review pertinent information, and consult with the Party in question and others as necessary. They will prepare a report assessing a Party's implementation of its obligations, identifying any areas of apparent non-compliance, as well as potential problems in achieving obligations.

4.5 Such reports will be circulated by the Secretariat to all Parties. In addition, the Secretariat will forward to the Multilateral Consultative Process referred to in Article 14 any report raising a question of implementation.

In Article 6 of the U.S. proposal (International Emissions Trading), substitute the following text:

6.1. Except as otherwise provided below, any Annex A or Annex B Party may transfer to, or receive from, any Annex A or Annex B Party, any of its tonnes of carbon equivalent emissions allowed for a budget period, for the purpose of meeting its obligations under Article 2.

6.2 An Annex A or Annex B Party may not transfer [issue: also not acquire?] any of its tonnes of carbon equivalent emissions allowed if:

(a) it is not in compliance with its obligations under Article 3 (Measurement and Reporting);

(b) it does not have in place a national mechanism for certification and verification or trades;

(c) it has exceeded its emissions budget for a given budget period; or

(d) [Option 1: the Parties, at a meeting, have so decided with respect to a Party that, based on its reporting and any reports of review processes under this Protocol, is unlikely to achieve its emissions budget.] [Option 2: a quantitative formula that automatically deems a Party unlikely to achieve its emissions budget].

6.3 A Party may authorize any domestic entity (e.g., government agencies, private firms, non-governmental organizations, individuals) to participate in actions leading to transfer and receipt under paragraph 1 of tonnes of carbon equivalent emissions allowed.

6.4 The Parties, at a meeting, may further elaborate guidelines to facilitate the reporting of emissions trading information.

In Article 10 of the U.S. proposal (Meetings of the Parties), for paragraph 4, substitute the following text:

10.4 The functions of the meetings of the Parties shall be to:

(a) periodically review the adequacy of this Protocol;

(b) review the implementation of this Protocol, including the information submitted in accordance with Articles 3 and 5, reports received from the review teams referred to in Article 4, and reports and recommendations received from the Multilateral Consultative Process referred to in Article 14;

(c) apply or decide on appropriate consequences in cases of non-compliance with obligations in this Protocol;

(d) in connection with subparagraph (c) above, develop an indicative list of appropriate consequences, taking into account the type, degree, and frequency of non-compliance; examples of consequences could include, e.g.,

-- issuance of recommendations from the meeting of the Parties to the Party in question;

-- requests for further information from the Party in question;

-- increased reporting requirements;

-- increased monitoring of a Party's compliance;

-- loss of voting rights and/or other opportunities to participate in processes under this Protocol;

-- devaluation or voiding of current and/or future transfers for purposes of International Emissions Trading;

-- ineligibility to engage in International Emissions Trading and/or Joint Implementation;

-- determination of ineligibility to receive technical or financial assistance;

-- imposition of monetary penalties;

-- mandatory purchasing of tons to clear an emissions budget debit;

-- trade measures.

In Article 11 of the U.S. proposal (Secretariat), for paragraph 2, substitute the following:

11.2 The functions of the secretariat shall be:

(a) to maintain and administer records relating to the accounting of the emissions budgets of Annex A and Annex B Parties, including initial budget allocations, adjustments to budgets consistent with Articles 2, 6, and 7, annual emissions, and remaining budgets in a given budget period;

(b) to facilitate the review of implementation of this Protocol through, inter alia, coordinating the review of Annex A and Annex B implementation; coordinating the reviews under Article 4; submitting to the Multilateral Consultative Process questions of implementation; and preparing an annual compilation and synthesis report that contains inventory and budget information, notes any discrepancies in accounting, and assesses whether individual reports are consistent with reporting criteria;

(c) [other].

In Article 14 of the U.S. proposal (Multilateral Consultative Process), for the bracketed text, substitute the following text:

14.1 At their first meeting after entry into force of this Protocol, the Parties shall establish a Multilateral Consultative Process, implemented through an Implementation Committee composed of a subset of the Parties, to review, at the request of a Party or Parties, the Secretariat, or a Party in respect of itself, implementation questions under this Protocol.

14.2 The Multilateral Consultative Process should, inter alia:

(a) provide for the Party whose implementation is in question to attend meetings of the Implementation Committee and take part in consultations with it;

(b) provide the Party whose implementation is in question a full opportunity to inform the Implementation Committee of its capacity to implement its obligations and of its needs relevant to that issue;

(c) provide for the Implementation Committee to consult, as it deems necessary, any subsidiary body under this Protocol or other expert bodies;

(d) promote, as appropriate, the enhancement of the capacity of the Party whose implementation of this Protocol is in question to implement fully its obligations;

(e) provide for the results of the work of the Implementation Committee, together with any recommendations, to be reported to the next meeting of the Parties;

(f) provide for the Implementation Committee to meet as frequently as necessary to carry out its mandate.

Annex B: An Options Paper

Issue: What countries, and what obligations should be included in Annex B?

Background: The language in the U.S. draft protocol to the Climate Convention suggests a variety of options for Annex B Parties, with the implicit assumption that Annex B commitments will differ from those of Annex A (developed countries and countries with economies in transition). The U.S. text includes the options of allowing budgets of Parties in Annex B to differ from those in Annex A with respect to the length of the budget periods, the baseyears, and/or the percentage reductions. This paper explores some of these options, proposes a criterion for denominating national emissions, and suggests a possible list of countries that might be persuaded to join Annex B.

Budget denomination. A commitment to a budget would allow free and full participation in international trading. One of the most fundamental elements of the US proposal is that Parties in either Annex A or Annex B would have binding budgets, backed up by full reporting, monitoring and verification obligations. Only with full compliance with such provisions would Parties be eligible to participate in international emissions trading regimes. However, in order to allow trading, it is critical that each Party have comparable budgets; in the U.S. proposal, such budgets would be denominated in terms of tonnes of carbon equivalents. Indicators such as energy consumption per unit of GDP, percentage of energy derived from renewables, or even greenhouse gas emissions per capita, while useful in their ability to point to areas for improvement in national emissions, do not independently provide adequate transparency for a full and open trading regime. Thus, to participate in Annex B Party commitments must be calibrated in terms of emissions; flexibility for them will lie in baseyears and/or percent emissions, not in the form of the commitment based on performance indicators.

NOTE: Discussion with Korea (and to a lesser extent, Mexico) have suggested that these countries may not be prepared to adopt binding emissions budgets. In this case, a different formulation may need to be found – one in which the Annex B obligation does not entitle participation in a trading regime. Such a structure, presumably of a voluntary nature, would still help differentiate between Annex B parties, and other developing country Parties.

Differentiation. It would be most desirable if a single set of parameters – or even a single percentage reduction – could be chosen to define the budgets for all Annex B Parties. However, recognizing the extremely wide variation in potential Annex B Party circumstances, and the substantial differences in their projected economic (and emissions) growth paths, it may be necessary to establish individual parameters for each Annex B Party. [NOTE: Establishing flexibility of this sort for Annex B Parties automatically raises the issue of why it is denied to Annex A Parties. Any approach which allows for such differentiation will need to address this issue.]

Budget Allocations. Given that setting a single, uniform target percentage may be inappropriate for all Annex B members, a different approach is needed to determine the initial allocation. It is suggested that Annex B countries be provided an initial budget allocation that would restrict emissions increases over the budget period to [10][20][30] percent less growth than that from the average of the equivalent previous period. It is also proposed that the allocation be reduced in subsequent budget periods, with the intent that Annex B Parties move from a growth path to stabilization within [15] years and ultimately a reduction path within [20] years. Provisions should be included in the instrument for a review of Annex B Party commitments at the conclusion of each budget period, and individual Party commitments should be modified to reflect changing circumstances.

Budget periods and base years. A number of options exist for selecting the base year (against which the future budget of a Party would be determined) for a Party. These could include:

- the year in which it signs the agreement (potentially leading to gaming of the numbers, or delay in signing);
- the base included in the Parties most recently included inventory following the entry into force of the instrument (faces some of the same problems, but may be less open to gaming); or
- a three year consecutive average surrounding the agreed Annex A base year (may not provide needed flexibility for the Annex B Parties).

The budget periods should be identical in length to those of Annex A Parties. If a Party accedes to the agreement during the middle of a budget period, its first period of obligation would be shortened, and its emissions budget pro-rated over the remainder of the period. In this way, budget periods will end at the same time for all Parties.

Annex B Candidates. Several alternative approaches may be taken in developing a list of possible Annex B members. It should be noted that the existing draft text already includes a clause allowing any Party to opt in—whether on the list or not. Two options are described below:

1. Select those countries that exceed levels of per capita income or emissions of existing Annex I countries (over a particular year, or average of several preceding years). A list of those countries with emissions per capita greater than 3.5 tons (Mexico is 3.7), and GDP per capita greater than $5,500/year (Poland's is $4900) not already in Annex I of the FCCC is contained in table 1. Political considerations may remove – or add – some additional Parties to this list. While not determining the level of the target, factors could be used to mark threshold levels beyond which a country would automatically become an Annex B member.
2. A second option for listing countries in Annex B is to include those countries that are currently not in Annex I but that have applied or are considering applying for OECD membership. Countries which have applied for observership in the OECD or its various individual work groups are listed in table 2.

POSSIBLE CANDIDATES FOR ANNEX B

TABLE 1

Countries with GDP/capita greater than $5,000 and CO2/capita greater than 3.5 tons

	Country/Region	CO2 Emissions (000 metric tons)	Per Capita CO2 Emissions (metric tons)	CO2 Emissions from Land Use (000 metric tons)	Total CO2 (000 metric tons)	GDP PPP (million Int$)	Per Capita GDP (PPP; Intl $)	Avg '83-'93 PPP Growth (%)	1990 Population (millions)	1990-1995 Pop Change (%)
1	Singapore	49,790	17.99	X	49,790	46,213	16,736	6.1	2,705	1.0
2	United Arab Emirates	70,616	42.28	X	70,616	25,381	15,784	0.5	1,671	2.6
3	Israel	41,605	8.1	X	41,605	64,245	12,783	4.2	4,660	3.8
4	Trinidad & Tobago	20,643	16.3	1,200	21,843	12,679	10,145	-1.6	1,236	1.1
5	Libya	39,520	8.1	76	39,596	36,531	9,649	X	4,545	3.5
6	Korea, Rep	289,833	6.56	1,500	291,333	415,320	9,565	9.6	42,869	1.0
7	Saudi Arabia	220,620	13.85	60	220,680	143,679	9,390	-1.6	16,048	2.2
8	Oman	10,036	6.12	X	10,036	13,975	8,650	2.6	1,751	4.2
9	Kuwait	15,971	8.1	X	15,971	17,557	8,561	-0.4	2,143	-6.5
10	Venezuela	116,424	5.75	170,000	286,424	172,419	8,449	2.9	19,502	2.3
11	Mexico	332,852	3.77	63,000	395,852	692,795	7,867	3.6	84,511	2.1
12	Malaysia	70,492	3.74	210,000	280,492	133,586	7,191	6.2	17,891	2.4
13	Argentina	117,003	3.52	85,000	202,003	191,699	5,921	-0.9	32,547	1.2

TABLE 2

Countries that have applied to the OECD for Observer Status in Some Areas

	Country/Region	CO2 Emissions (000 metric tons)	Per Capita CO2 Emissions (metric tons)	CO2 Emissions from Land Use (000 metric tons)	Total CO2 (000 metric tons)	GDP PPP (million Int$)	Per Capita GDP (PPP; Intl $)	Avg '83-'93 PPP Growth (%)	1990 Population (millions)	1990-1995 Pop Change (%)
1	Korea, Rep	289,833	6.56	1,500	291,333	415,320	9,565	9.6	42,869	1.0
2	Mexico	332,852	3.77	63,000	395,852	692,795	7,867	3.6	84,511	2.1
3	Argentina	117,003	3.52	85,000	202,003	191,699	5,921	-0.9	32,547	1.2
4	Slovenia, Rep	5,503	2.75	X	5,503	X	X	X	1,918	0.3
5	Chile	34,738	2.56	33,000	67,738	85,948	6,326	6.3	13,154	1.6
6	Israel	41,605	8.1	X	41,605	64,245	12,783	4.2	4,660	3.8

Data Taken from 1996-1997 WRI Data Tables. Some data computed from data provided

CO2 emissions data primarily from 1993

CO2 primarily from 1991 land use data

Total CO2 column derived by adding CO2 emissions and land use data

GDP data primarily from 1992

Article 7
Joint Implementation
March 14, 1997

General Issue: How should calculation, measurement, monitoring, verification, review and reporting for joint implementation projects be implemented?

Background: The current U.S. Protocol proposal contains much of the language that will be needed to negotiate, adopt, and implement a working JI regime. However, Article 7.3 calls for additional provisions to be added on calculation, measurement, monitoring, verification, review, and reporting. There is agreement within the U.S. government on two areas where new language is required. For each of these topics the paper briefly provides background and then presents proposed text. These areas include language on the:

- need for guidelines for the measurement and reporting of JI by Parties
- need for the FCCC Secretariat to synthesize and report information on JI submitted by Parties

There are three other areas where there is disagreement on the need for explicit language. For each of these topics the paper briefly provides background and presents options for proposed text. These areas include language on:

- the review and verification of "tonnes of carbon equivalent" created through JI
- the potential certification by the UNFCCC of independent auditors for JI projects
- additionality

Area 1: Need for guidelines for the measurement and reporting of JI by Parties

Background: The existing protocol language acknowledges the need to provide standards for the reporting and measurement by Parties of "tonnes of carbon equivalent allowed" created through JI. We suggest the following addition to the existing language of the US proposal.

Draft Text (new text is in italics):

Article 7

1. Any Party that is neither in Annex A nor B may generate tonnes of carbon equivalent emissions allowed through projects that meet the criteria set forth in paragraphs 2 *and 3.*

2. In addition to any criteria adopted by the Parties to this Protocol, the following criteria shall apply to projects:

(a) Projects must be compatible with and supportive of national environment and development priorities and strategies, as well as contribute to cost-effectiveness in achieving global benefits;

(b) Projects must provide a reduction in emissions that is additional to any that would otherwise occur.

3. ~~[Additional provisions to be added on calculation, measurement, monitoring, verification, review, reporting.]~~ *Parties shall adopt, no later than one year after entry into force:*

(a) guidelines for the measuring and reporting on emissions reductions and sequestration resulting from joint implementation projects

(I) The measurement guidelines shall be consistent with Article 3.2.

(ii) The reporting guidelines shall ensure consistency of the separate reporting paths for joint implementation: Article 3.5 for Annex A or B Parties and paragraph 7 of this Article for Parties which are neither Annex A nor B.

Area 2: Need for the FCCC Secretariat to synthesize and report information on JI submitted by Parties

Background: The existing protocol language recognizes the need for the synthesis and reporting of information submitted by Parties to the UNFCCC on JI. We suggest the following addition to the existing language of the US proposal.

Draft Text (new text is in italics):

Article 7

8. Submissions by Parties on joint implementation will be compiled into a synthesis report by the Secretariat at appropriate time intervals. The Synthesis report will be based on reports made under Article 3.5 and paragraph 7 of this Article.

Area 3: Review and verification of "tonnes of carbon equivalent" created through JI

Background: The U.S. draft protocol framework of January 17, 1997 says that Parties may generate "tonnes of carbon equivalent" allowed through JI. It recognizes the need for provisions for monitoring, verification, and review of proposed new "tonnes of carbon equivalent allowed." It does not address the process, however, for reviewing them according to the criteria or future guidelines, or to annul or otherwise deal with "tonnes of carbon equivalent" that do not meet the criteria or do not accrue GHG reductions as expected.

There are two options proposed below to deal with review. The first option is to elaborate on

a process for the review of "tonnes of carbon equivalent allowed" created through JI. The second is to provide a process by which reporting guidelines will be elaborated no later than one year after entry into force.

Option 1: Elaborate on a process for review

Draft Text (new text is in italics):

Article 7

5. An Annex A or Annex B Party *that is in compliance with its obligations under Article 3 (Measurement and Reporting)* may acquire tonnes of carbon equivalent emissions allowed under this Article for the purpose of meeting its obligations under Article 2. ~~provided it is in compliance with its obligations under Article 3 (Measurement and Reporting)~~ *Such tonnes of carbon equivalent emissions allowed may not be added to the emissions budget of any Party until the project from which such tonnes were derived and the quantity of emission reductions or sequestrations accrued have been reviewed and determined to meet the criteria of this Article and the guidelines adopted by the Parties. Reviews pursuant to this paragraph shall be reported to the Parties per paragraph 8 [see consensus text proposed under Area 2] and conducted by experts coordinated by the Secretariat and based on reports made under Article 3.5 and paragraph 7 of this Article as well as on other relevant information, including site visits, where appropriate.*

Option 2: Provide a process for establishing the review process

Draft Text (new text is in italics):

Article 7

3. *Parties shall adopt, no later than one year after entry into force:*

[insert at the end of consensus change to Article 3.(a) proposed under Area 1 above]

© *reporting guidelines for the baseline calculations and a review process for projects for which standard methodologies do not apply.*

4. no change

5. An Annex A or Annex B Party may acquired tonne of carbon equivalent emissions allowed under this Article for the purpose of meeting its obligations under Article 2, provided it is in compliance with its obligation under Article 3 (Measurement and Reporting). *No credits for emissions reduced or sequestered can accrue until generated.*

Area 4: Potential certification by the UNFCCC of independent auditors for JI projects

Background: It has been proposed by some in the United States that independent auditors might be employed by the UNFCCC Secretariat or project developers themselves to measure and certify the GHG emission reductions associated with JI projects. If the FCCC Secretariat is placed in the position of reviewing JI projects (see Area 3), it has been suggested by some that the benefit of such potential certification would be to privatize much of the necessary review and to lessen the workload of the FCCC Secretariat. At the same time, it provides project developers and Parties with an additional option for determining the validity of their JI projects and associated credits.

Option 1: Allow the potential certification by the UNFCCC of independent auditors for JI projects

Draft Text (new text is in italics):

Article 7

3.(a) [insert at the end of consensus change to Article 3.(a) proposed under Area 1 above]

The Parties may adopt additional guidelines as necessary, inter alia, for training and certification of independent auditors of JI projects.

Option 2: Do not broach the potential certification of independent auditors for JI projects

Article 7

3.(a) [insert at the end of consensus change to Article 3.(a) proposed under Area 1 above]

The Parties may adopt additional guidelines as necessary.

Area 5: Additionality

Background: "Additionality" has been a controversial issue both internationally and within the USIJI program because it is difficult to apply in practice. It is an important concept to ensure that "tonnes of carbon equivalent allowed" are not created for emission reductions (or avoidance of emission increases) that would occur anyway. This would expand the emissions budgets allowed under the agreement without an offset of that expansion through real GHG reductions elsewhere.

Option 1: Propose a two-tier process for decisions regarding additionality

This option would establish in the agreement a set of project types that would be considered additional *a priori*. This list would be reviewed by the Parties every 5 years. A set of 5 to 10 project categories could open a restricted window for projects that will push the diffusion of clean or efficient technologies. It would create certainty for project developers about what can qualify and reduce transaction costs almost to zero for the demonstration of additionality. For projects that do not fall into this set of project types, guidelines would be adopted governing how to determine additionality against baselines of 'what would otherwise occur,' over and above the "no regrets" actions required of developing countries in the U.S. proposal in Article 5. This second tier for review, similar to USIJI review if guidelines were available, would allow other types of projects to be considered, opening a wider window of opportunities. However, the process would be more data-intensive, more judgmental, less certain for project developers, and would entail much higher transaction costs.

Draft Text (new text is in italics):

Article 7

2.(b) Projects must provide a reduction in emissions that is additional to any that would otherwise occur. *Projects may demonstrate additionality in one of two ways:*

(I) Projects which fall into one of the following categories will a priori be considered additional. These project categories will be reviewed for potential modification every five years following the initiation of the first budget period of Article 2.3

(a) projects which replace existing or future energy production from fossil fuels with the production of energy by renewable energy technologies including PV or thermal solar, geothermal, sustainably-produced biomass, or wind energy;

(b) projects which demonstrably increase forest stock and which prevent shift of forest losses outside of the project area by reducing local and other pressure for extraction of forest products or conversion of forestry land to non-forestry uses such as agriculture, grazing, or human settlements

© projects which demonstrably reduce the loss of forest stock [by at least 20 %] through improved forest management practices and increase efficiency of the production of forest products where the majority of products produced are durable forest products with lifetimes of greater than [20] years

(d) projects at least [30%] more "carbon-equivalent" efficient than the average carbon-equivalent efficiency of projects in that category in that country in the previous [3] years.

(ii) Projects which fall outside of these categories may demonstrate the creation of proposed tonnes of carbon equivalent allowed from joint implementation through

the creation of a quantitative baseline of what would occur without JI, developed in accordance with guidelines under paragraph 3 of this Article. These guidelines shall take into account "no regrets" measures deemed to be required under Article 5, and give explicit consideration to how polices and measures would evolve over time to meet domestic environmental, economic, and social goals.

Option 2: Propose the future adoption of a process for the determination of additionality

This option would postpone the further elaboration of a method for the determination of additionality to the Parties post-Kyoto. It would instead propose a process for allowing Parties to adopt standardized methodologies for the determination of emissions additionality for narrow project types -- projects for which baseline calculations are certain. This would include many energy efficiency, forestry efficiency, renewable energy and fossil fuel projects. A likely example is a retrofit project where the baseline and changes to the baseline are clear. For projects which do not fall within the standardized methodologies, reporting guidelines for baseline calculations and a review process would be adopted (see Area 3, Option 2).

Draft Text (new text is in italics):

Article 7

3. Parties shall adopt, no later than one year after entry into force:

[insert at the end of consensus change to Article 3.(a) proposed under Area 1 above]

(b) standardized methodologies for the determination of emission additionality and criteria for its automatic application.

International Emissions Trading: Issue Papers

Issue		Page Number
1.	Is there a need for a new international oversight group?	1
2.	In what units should trades occur?	3
3.	How should "problem" countries be addressed?	4

[note that the text provided is for clarity on the substantive suggestions for additions to the protocol; the text may need editing from State Department to ensure proper "legal" wording and placement for the Protocol]

Emissions Trading Issue #1: Enhancing the Role of the FCCC Secretariat in the Protocol

Issue: Is there a need for a new international oversight group to implement trading?

Background: No, the U.S. Protocol can be implemented through a clear division of responsibility assigned to the Parties, the FCCC Secretariat, and the in-depth expert review teams (and the multilateral consultative process discussed at length in another paper). The Protocol can be enhanced by clarifying the role of the FCCC Secretariat as the official tracker of the budget information for all Parties, using the mechanism of the compilation and synthesis report which is already required. The Protocol is already clear on each Party's required responsibilities for the individual tracking and reporting required for emissions and budget calculations. However, it is important to ensure that the Secretariat can verify it has received an official authorization from a Party before it records an emissions trade, similar to the requirement for the authorization from a "designated representative" from the utility company under the Acid Rain Program. Finally, although the Protocol implicitly requires (in Article 3.5) that the Party report its remaining budget after emissions are deducted, it may be appropriate to modify the Protocol explicitly in Article 2.2 to clarify the Party's requirement to adjust its budget annually by deducting the number of "tonnes allowed" which would be needed to pay for its annual emissions.

Options: See recommendations.

Recommendations:
- Add text that specifies the role of the Secretariat as the official tracking mechanism for budget accounting information.
- Add the concept that a Party must give official approval before the FCCC Secretariat is authorized to record an emissions trade (similar to required "designated representative under the Acid Rain Program. This is envisioned as a multi-part form by which both buyer and seller must identify the quantity of tonnes traded and provide authentication to the Secretariat as recorder of trades)
- Add text for the annual deduction for emissions as a responsibility for each Party to determine its own remaining multi-year budget balance.

Draft Text:

1. *insert new language in measurement and reporting section, at end of paragraph 3.5:*

3.5 With respect to any tonnes of carbon equivalent emissions allowed that are acquired or transferred under Articles 6 or 7, the Party shall specify the quantity, Party of origin or destination, and the relevant budget period, **and include evidence of official approval for the transaction, on the prescribed form from both Parties to the transaction.**

2. *insert new paragraph(s) in measurement and reporting section, or in Secretariat section*

11.? The Secretariat shall track tonnes of carbon equivalent emissions allowed for each Party which are allocated, saved, borrowed, transferred among Parties, and retired. The Secretariat shall impose annually any automatic consequences recommended based on each Party's status and compliance progress. The Secretariat shall record and publish each Party's annual

emissions and emissions budget levels, including any adjustments in the annual synthesis and compilation report.

3. *insert new language in emissions trading section, paragraphs 6.1 and 6.2:*

6.1 An Annex A or Annex B Party that is in compliance with its obligations under Article 3 (Measurement and reporting) and that has in place a national mechanism for certification and verification, **may direct/authorize the Secretariat to record transfers to or receipts from** any Annex A or Annex B Party any of its tonnes of carbon equivalent emissions allowed for a budget period, for the purpose of meeting its obligations under Article 2.

6.2 A Party may authorize any domestic entity (e.g. government agencies, private firms, non-governmental organizations, individuals) to participate in actions leading to transfer and receipt under paragraph 1 of tonnes of carbon equivalent emissions allowed, **provided that before the tonnes of carbon equivalent emissions allowed may be used for the purpose adjusting its budget under Article 2, a Party must authorize/direct the Secretariat to implement any such transfers or receipts.**

4. insert new paragraph in emissions budget section, directly following budget adjustment paragraph which is currently numbered 2.2:

the number of tonnes of carbon equivalent emissions equal to the Party's prior year actual emissions.

5. We recommend reordering Article 2 so that the paragraphs of the budget section are in correct time sequence:

I. Initial Budget Allocation (current Articles 2.3 and 2.4 become 2.1 and 2.2)
II. Budget Adjustments (current Article 2.2 becomes 2.3)
III. Annual Budget Balance (new language listed above in item#4 becomes Article 2.4)
IV. Emissions shall not exceed budget. (Current Article 2.1 becomes Article 2.5; however, because this is the most important directive in the budget section, another logical reordering of the budget section would be I. Emissions shall not Exceed Budget, II. Initial Budget Allocation, III. Budget Adjustments, IV. Budget Balance, V. End-of Budget Reconciliation. VI. Other paragraphs on non-annex C and ratification)
V/End of Budget Reconciliation (current Articles 2.5 & 2.6 become Article 2.6 & 2.7)
VI. Other paragraphs on non-annex C and ratification follow.

Emissions Trading Issue #2: Clarifying the Budget Unit of Measure

Issue: What units of measure should be used to implement emissions trading?

Background: The protocol envisions that the "tonne of carbon equivalent emissions allowed" or "TCEEA" would be the unit used to track emissions budget obligations. The TCEEA (or allowance) should also be the unit of measure used by the FCCC Secretariat for recording transfers from one Party to another. Individual Party's are also responsible for tracking and reporting their emissions budgets, including any purchases or sales, using the TCEEA as the unit of measure. However, the Party may wish to verify the appropriateness of the quantity of TCEEAs it is willing to transfer by identifying the particular emission reduction which will provide the basis of the transfer, calculating the quantity of the particular greenhouse gas, and multiplying that quantity by the approved GWP contained in the Protocol (recommended in another paper as the 100 year GWPs identified by the IPCC). Thus, no change is needed to the protocol text to address this issue because the tonne of carbon equivalent emissions allowed is the appropriate unit of measure to implement emissions trading.

Nevertheless, there is one practical consideration for the unit of measure which may be important to flag as a definition in the Protocol language (but which perhaps could wait instead to be defined in more detailed guidelines later). Specifically, the practical implications of the sheer number of tonnes of carbon equivalent emissions allowed which must be tracked by the FCCC Secretariat.

Options: See recommendations.

Recommendations for future guidelines to be developed:
- Add the concept for a Tradeable Budget Unit (TBU) which is defined as some multiple [e.g., 1,000] number of tonnes of carbon equivalent emissions allowed

NOTE: although this concept is important enough to include in the protocol for practical considerations, there may be some concern about introducing a new concept to the protocol negotiations now when others may already perceive the U.S. proposal as "too complicated". Therefore, it may be appropriate not to add this to the protocol text, but to include in the implementation guidelines to be developed later.

Draft Text:

> **"Tradeable Budget Unit (TBU)" means the authorization under the GHG Protocol to emit up to [e.g., 1000] tonnes of carbon equivalent during or after a specified budget period.**

Emissions Trading Issue #3: Trading Mechanism to Encourage Party Compliance

Issue: How should problem countries be addressed?

Background: Any international trading system should have a mechanism which provides an automatic incentive to comply with both reporting requirements and the budget commitments. The mechanism could be a definitive determination on the status, defined below using a "green/yellow/red" signal, of each Party's progress in meeting both its reporting and budget commitments. The concept is that the FCCC Secretariat (or the in-depth review team) will follow predetermined criteria to be developed (on an annual or other periodic basis) to assign a status showing a "satisfactory/caution/unsatisfactory" (corresponding to the green/yellow/red signal developed for this paper) rating of each Party's progress in meeting both its reporting and budget commitments. A Party would have to initially earn its green status before it could engage in trading, based on an initial review of its monitoring and reporting system to ensure the system meets required minimum standards established in guidelines, and then would need to maintain that status on the basis of its annual reports to continue to trade. Then, for a Party assigned a yellow or red status, automatic trading consequences would be implemented in addition to a referral to the Multilateral Consultative Process (described in another paper). For a more detailed description of the green/yellow/red signal system, see the attachment. The automatic trading consequence for the status for a yellow signal would be that although "allowances" could be sold, they would be marked by the Secretariat such that they could not be used for compliance with any Party's budget commitments until "green" status was restored to the issuer. The automatic trading consequences for a red signal would include 1) suspension of the right to sell allowances, 2) the automatic deduction excess tonnes emitted plus at least the interest rate required for borrowing, and 3) the automatic devaluation of any allowances sold after the yellow signal was assigned.

[[The yellow signal could be raised for determinations made during the budget period, including a determination based on interim emissions benchmarks, that a Party may fail to meet its budget obligations at the end of the budget period. If interim compliance benchmarks are unacceptable, then shorter budget periods (e.g. 3 years) might be considered.]]

Options:

1. Ensure the FCCC Secretariat has the administrative authority to implement automatic consequences which provide incentives for Parties to meet their reporting requirements [[, to meet interim emissions benchmarks,]] and to comply by the end of each budget period .
2. If the FCCC Secretariat does not have such administrative authority, then the U.S. should reserve the right to unilaterally deny "bad" tonnes of carbon equivalent emissions allowed, and this right should be shielded from the World Trade Organization.
3. Consider that the appropriate monitoring, reporting, and enforcement mechanisms may not be sufficient at this time to justify a full emissions trading system at this time, and construct the "trading" allowed by the Protocol to require case-by-case review and approval of specific emission reduction projects which could generate budget transfers (i.e., a "joint implementation" structure even for Annex I country trading).

Recommendation: Option 1

- Define the administrative and non-discretionary authority for the FCCC Secretariat (or the in-depth review teams) to appropriately oversee the emissions trading program. Specifically, require annual review and rating of each Party's emission and budget reports and each Party's

performance in meeting its budget commitments. [note that this does increase the FCCC's workload, and consequent need for funding.]

- One critical feature of this authority is that the signal and thus the automatic consequences would be implemented upon the finding of the deficiency, so that it would not be necessary to wait to implement any consequences until the MCP process came out with a recommended resolution

Note that the consequence for the yellow signal is defined so that the Party which received the yellow signal would be allowed to sell "tonnes allowed", but the tonnes would be tracked as "yellow" and could not be used by the buyer for compliance (those tonnes allowed could not be deducted to cover the buyer's emissions) until the Secretariat made a new determination that the seller had rectified its deficiencies and returned to green status. If the seller did not rectify its deficiencies after a specific time period, then the Secretariat would automatically downgrade the seller to red status, meaning that no further tonnes allowed could be sold, and any "yellow" tonnes sitting in any buyer's accounts would be downgraded to red, where the red tonnes are valueless for compliance and would be retired.

This scenario for green/yellow/red determinations envisions that any deficiency in an annual communication (mathematical error, failure to follow approved IPCC guidelines for some of the emission calculations, or complete failure to follow approved guidelines such that the entire emissions report is in question) would trigger a "yellow" status, which would provide the Party with some defined period of time to rectify the deficiencies before the "red" status (and consequently the prohibition against sale of tonnes allowed) is imposed. However, as the guidelines are developed, there may be some deficiencies which are so severe that it would be appropriate to trigger the "red" status immediately.

Draft Text:

insert into international emissions trading section:

Each Annex A or Annex B Party must adopt a monitoring and reporting system which satisfactorily meets the promulgated minimum standards before it may engage in international emissions trading. In addition, each Annex A or Annex B Party's annual report shall be reviewed to determine if the Party's emissions and budget calculations are satisfactory, cautionary, or unsatisfactory, and the FCCC Secretariat will ensure any automatic trading limitations are followed.

ATTACHMENT for Trading Mechanism to Encourage Party Compliance

Meaning of Color Designations: (green, yellow, red)

Green Status: Upon compliance with procedural requirements, a Party will be assigned Green status. With green status, a party may trade TBUs whose tender value will not be questioned by the FCCC. Green status must be affirmatively reestablished after any period of yellow or red status.

Yellow Status: Upon failure to comply with the procedural requirements or cumulative emissions budgets, a Party will be assigned Yellow status. With Yellow status, a party may continue to sell TBUs, but buyers are on notice that there are deficiencies in the performance of the issuing Party, and that the current tender value of the TBUs units sold by a Party under Yellow Status is suspended. Prices would presumably reflect the severity of market-perceived impairment.

Parties under Yellow status would have a specified period during which it would be expected to cure the identified deficiencies to the satisfaction of the FCCC Secretariat, and such Parties would concurrently be referred into the Multilateral Consultative Process. If the deficiency is timely cured, TBUs issued during the Yellow period will have their tender value restored, and the Party may be assigned Green status for future periods. If left uncured at the end of the period provided, a red status results.

[[Maintaining a plausible path toward budget period compliance should be a requirement of overall compliance, especially if the emission budget period is lengthy (e.g., more than 5 years). The plausibility of compliance would be tested during a multiyear budget period by comparing cumulative emissions during the budget period to date to a formula allowance. The formula allowance could be: (1) the budget period allowance pro-rated over the elapsed time since the start of the most recent budget period, (2) net adjustments from completed trades (including JI or other credits) and banked TBUs, plus (3) 10% of the current multiyear budget. Parties which exceeded the formula allowance at any time during the budget period would receive Yellow status. Green status could be restored by TBUs unit purchases or by reducing emissions, but failure to reach formula compliance could result in Red status after a specified interval.]]

Red Status: Upon failure to cure any Yellow deficiencies during the period provided, non-discretionary Red status must be assigned. With Red status, Yellow period TBUs issuances are invalidated and retired, clearing them from the books. Holders of such TBUs receive no value (or possibly reduced value under pro-ration of a deficiency).

Recommended Annex C Criteria

Issues

Which gases/sources/sectors belong in Annex C (i.e., subject to the binding overall budget set forth in the Protocol) and which should be excluded from Annex C (i.e., outside of the overall budget)? How should the distinction between Annex C and non-Annex C be made to ensure that the protocol optimizes comprehensiveness, cost-effectiveness, and compliance requirements?

The determination of whether or not a gas/source/sink belongs in Annex C should be made based on objective criteria. These criteria should be applied to the FCCC guidelines for national greenhouse gas inventories, perhaps with consideration of the potential for the methods to be improved in the near term. The gases/sources/sinks that meet the criteria should be included in Annex C and those that fail should be excluded from Annex C. As methods and data improve, those sectors excluded from Annex C should be reviewed, and additional gases/sources/sink into Annex C should occur systematically, with the agreement of all Parties. No Party can unilaterally move a gas/source/sink into Annex C.

Recommended Criteria

There are at least five key criteria that gases, sources and sinks should satisfy in order to be included in Annex C. The effect of applying these criteria is to limit membership to only those gases and sources that meet general criteria and can be measured accurately or precisely.

The following list proposes criteria for inclusion in Annex C:

1. Internationally approved or accepted methods (i.e., guidelines adopted by the FCCC) for estimating emissions of this gas from this sector/source category must be available;

2. The national emission estimation methods must be sufficiently accurate and/or precise to ensure that compliance (or non-compliance) could be established. [Note that objective thresholds of accuracy and/or precision should be determined once the scope of Annex C is established. (e.g. +/-10%)]

3. The ability to measure emissions reductions must be systematically captured in the methodologies.

4. Methods must be sufficient to prevent game-playing or manipulation of estimates to falsely demonstrate compliance.

5. The methods must allow progress to be tracked and performance to be evaluated. This will require that data be reported on an annual basis.

6. The methods must be able to be consistently applied by all Annex A and B Parties.

Proposal

Apply the criteria to the current (or expected?) IPCC guidelines and develop a list of gases and sources that satisfy them. Given the timeframe, the technical analyst could not compile a list of gases, sources, and sinks that meet these criteria. We will develop this list for submission to the Secretariat by April 1.

Separate language should be developed to ensure that gases, sources, and sinks not included in Annex C are treated (see Issue Paper on Control of Non-Annex C Gases/Sources/Sinks).

Control of Non-Annex C Gases/Sources/Sinks

Issue

The binding target outlined in the protocol will apply to only the gases/sources/sinks listed in Annex C. Other provisions (unspecified in the draft protocol) will be developed for those gases/sources/sinks which are not listed in Annex C. This paper identifies the options for addressing these gases/sources/sinks.

Options

Essentially, there are four ways to control non-Annex C gases/ sources/sectors, as described below:

1. Binding Target:

Description: Either together or individually, specific emission/removal targets could be set for Non-Annex C gases/sources/sectors.

Pros: Maximum environmental gains could be assured by setting a binding target for non-Annex C.

Cons: Difficult to implement and manage separate budgets for Annex C and non-Annex C. Likely to be unworkable since many of the non-Annex C gases are highly uncertain.

2. Binding Policies & Measures:

Description: Each Party could be required to impose select policies and measures on Non-Annex C

Pros: Greater assurance that environmental objectives would be met, while recognizing that weaknesses in estimation methods would make a binding target unworkable.

Cons: Imposition of harmonized, binding policies and measures does not reflect differing national circumstances among Parties.

3. Voluntary Policies & Measures:

Description: Each Party could voluntarily adopt policies and measures to reduce emissions from non Annex C.

Pros: Some environmental gains will be made, in a manner consistent with national priorities and circumstances.

Cons: Maximum environmental gains will likely not be made.

4. No Provisions:

Description: Parties could assume no obligations (binding or voluntary) with respect to Non Annex C.

Pros: Eases burden on Parties; no additional compliance requirements.

Cons: No environmental progress made for non-Annex C gases.

Borrowing Against Future Targets

Issue: Should Parties be allowed to borrow against future targets, and should language to this effect be removed from or maintained in the U.S. proposal?

Background: The concept of borrowing is currently included in the U.S. draft protocol proposal. It is mentioned in two places: Article 2.2(c) on emissions budgets which states that the budget includes: "up to [__ percent] of the tonnes of carbon equivalent emissions allowed ....such as may be borrowed from the subsequent budget period....", and Article 2.6 which states "At the end of a budget period applicable to a Party, any amount of tonnes of carbon equivalent emissions allowed that is borrowed from the subsequent budget period shall be subtracted at a rate of [1.2:1] from the subsequent budget period." Thus, the language incorporates both a restriction on the amount allowed and a penalty for borrowing.

At the most recent session of the AGBM, the concept of borrowing came under significant attack, with delegates arguing that it allowed Parties to indefinitely exceed their commitments, and made any assessment of compliance impossible. This paper discusses the concept of borrowing, and suggests some approaches and clarifications that might address some of these concerns.

While borrowing has raised concerns, there are also several issues to be considered with respect to excluding the option. For example, without borrowing, a Party that exceeds its first budget by a modest margin would either start the next period with a clean slate, or be subject to a non-compliance provision that requires them to make up the shortfall, possibly with a penalty. The first alternative perversely rewards non-compliance, while the second is virtually identical to borrowing, except that only "non-compliers" may use it. By providing all Parties with access to borrowing, Parties in compliance are not penalized relative to Parties not in compliance. The extra degree of timing flexibility allows more Parties to remain in compliance. Moreover, borrowing does not endanger the environmental objective of the Protocol – in fact successful borrowing transactions would reduce atmospheric concentrations below the level that would have prevailed in their absence due to the requirement to pay back 20 percent more tons than are borrowed.

The concept of borrowing is familiar to all who are involved in financial transactions -- it involves taking a loan against future resources in order to pay current obligations. In the case of the climate, current obligations would equate to current levels of allowable emissions (or emissions in a given budget period); future resources would equate to allowable emissions in a future period.

A financial world without borrowing would be difficult to imagine. It is rare that a firm has internal capital resources adequate to fully finance its future growth. Similarly, responding to any significant climate change mitigation strategy without a parallel option for borrowing can also be expected to impose costly economic constraints on the system: it clearly reduces flexibility in terms of planning; and it may require the premature retirement of capital stock in order to meet strict deadlines. Borrowing also allow for a appropriate planning and introduction of new technologies – on a timeframe that may lead to greater emissions reductions than without such a system. In planning a borrowing regime, we must remain aware that the climate and mitigation responses are not fully analogous to financial markets.

Also in a manner similar to financial transactions, costs could be associated with emissions borrowing. These include risks of the borrower defaulting on the loan; opportunity costs to the lender of not making a more profitable investment elsewhere; and the adequacy of institutional mechanisms. Unlike most financial transactions, some additional risk may be associated with an emissions borrowing regime, including impacts to the environment from delayed reductions. However, the environmental risk posed by greenhouse gas emissions is a function of atmospheric concentrations rather than annual emissions. While borrowing tends to increase near term emissions, the environmental risks could be reduced if borrowing and repayment schedules were managed in such a way as to preclude concentrations rising above long-term target levels.

Notwithstanding the differences between financial borrowing and emissions borrowing, some of the solutions applied in the financial arena are applicable in both cases. For example:

- Loans are usually offered at some cost in the form of interest paid by the borrower; the analogous situation could call for the borrower to pay more in the way of future reductions for any emissions used in the current period. The U.S. proposal contains such provisions, with the penalty assessed at 20 percent of the amount borrowed. Several options might be considered if the exemplary number were changed:
  - A fixed rate for the budget period could be assigned on a political basis;
  - An annual rate could be developed; or
  - A rate based on market lending rates could be assigned (to insure that emissions borrowing was not less expensive than financial transactions)

- Financial transactions are also often accompanied by requirements that the borrower put up collateral; in the case of emissions borrowing, a bond might be posted to ensure that funds would be available to "buy" emissions should the borrower default on the loan, or another entity might guarantee the shortfall. We may also consider the potential "riskiness" of a borrower, and require more stringent safeguards for borrowers with questionable reduction strategies. The U.S. proposal does not currently contain such provisions. These might be added, and could take several forms including requiring the borrower to provide an indication of how repayment would be made, and only allowing borrowing for the amount that could be reasonably expected to be repaid.

- Financial transactions are also often limited in terms of the amount that can be borrowed -- either as a fixed total, or as a percentage of future earnings; emissions borrowing might have a similar limit (for example, a country or firm might be prohibited from borrowing more than [2][5][10] percent of its total emission reduction obligation). The U.S. proposal contains such provisions, although the number is unspecified. These provisions insure that Parties cannot use borrowing to indefinitely exceed their commitments. For example, a Party that "borrowed" the maximum amount in the first period would be unable to borrow more in the second period. A Party that borrowed would overcomply substantially relative to its second budget period if it paid back its borrowings fully. In fact, it would overcomply even in the extreme case in which it "rolled over" its initial borrowing, since to stay within the total borrowing limit it would have to overcomply at least to the extent of the borrowing penalty.

- Finally, defaulting borrowers are usually assessed a penalty; a similar penalty might be applied toward a defaulting emissions borrower -- either in the form of a monetized fine, or in the form of an additional reduction obligation. This concept is embedded in the non-

compliance provisions that are already included in the U.S. proposal – although additional penalties might be assessed on amounts borrowed in one budget period that are not repaid by the end of the subsequent budget period

Recommendation

Noting both the concerns which many countries have expressed regarding borrowing – but also the significant advantages that accrue in terms of cost-effectiveness from allowing borrowing – the option to borrow should be left to the discretion of the Parties. However, in discussing the concept, the restriction placed on borrowing should be noted. In particular, the U.S. proposal restricts the extent to which borrowed emissions are to be used in a country's emissions budget (for the April 1 deadline, we could suggest that no more than [2][5][10][20] percent of a Party's total budget may be borrowed from a subsequent period), and also includes a penalty for borrowing – in the form of a 20 percent penalty on borrowed emissions. Our system also defines multiple budget periods (two are included in the U.S. proposal), and only allows borrowing from defined budget periods. In conjunction with the U.S. proposals for a stringent compliance and monitoring system, we believe that we have safeguarded borrowing from potential abuse.

To further address concerns about the concept, it is proposed that language be added to restrict borrowing to emissions for which a Party has provided detailed plans regarding repayment (and possibly require that guidelines for such proposals to be developed and adopted by the Parties at their first meeting). This addition would obligate a Party to develop, make public, have reviewed and have agreed specific proposals on how it would make up the additional obligations in the subsequent budget period. It would prohibit borrowing by Parties not having such plans. Language to this effect could be inserted into Article 2.6 of the U.S. proposal.

H:/FCCC/borrowing.doc

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To:	Assistant Secretaries Group	**Date:**	March 17, 1997
Fax #:	See attached list.	**Pages:**	10, including this cover sheet.
From:	William N. White Special Assistant to David Gardiner		
Subject:	Regulation paper		

COMMENTS:
Please find attached the paper *Using Standards and Regulations to Reduce Greenhouse Gas Emissons*, to be discussed at tomorrow's Assistant Secretaries Climate Change Group meeting. Please contact me at 260-1345 if you have questions or do not receive a complete transmission.

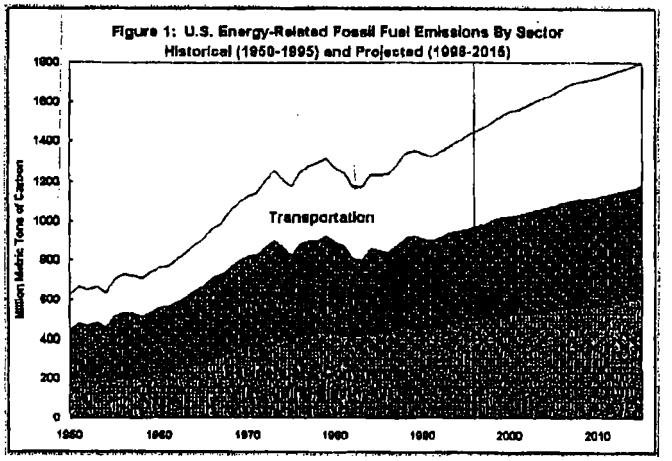
Using Standards and Regulations to Reduce Greenhouse Gas Emissions

Introduction

Limitations on greenhouse gas emissions could take the form of standards and regulations. This paper lays out the broad policy options available for limiting emissions using standards and other measures, but does not analyze the costs and benefits of particular options. Standards to limit greenhouse gas emissions could take the form of:

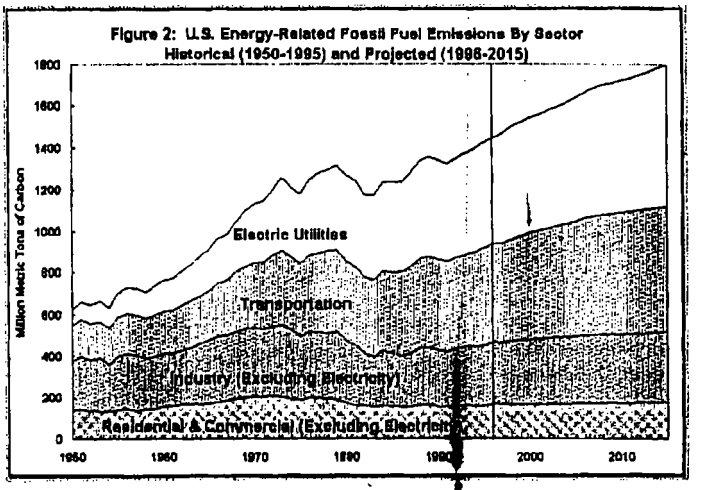
- *Minimum energy efficiency standards for energy consuming equipment:* Historically, these have targeted appliances and other residential and commercial equipment, as well as personal transportation (i.e., the Corporate Average Fuel Economy (CAFE) program).
- *Other measures:* These can take many forms and could include minimum purchase requirements for renewable sources of electricity, demand side management programs (which mandate electric utilities to undertake information and energy efficiency subsidy programs), federal spending rules for transportation infrastructure, and federal procurement policies.
- *Direct limits on greenhouse gases:* Standards could specify allowable greenhouse gas emission levels per unit of output (or some other factor). For example, a powerplant could face a limit on the amount of carbon dioxide emitted per kilowatt of electricity generated. Another example is methane from some landfills, which is already controlled due to limits on emissions of volatile organic compounds.

Within any program of standards, flexibility could be introduced by allowing those who perform better than the levels prescribed by the standards to trade their resulting "credits" with others, thereby reducing costs. Such a program could share many of the characteristics of an emissions trading program.



Figures 1 and 2 summarize sectoral CO_2 emissions (with and without emissions associated with electricity). As indicated, with respect to direct emissions, electric utilities account for about one-third of total CO_2 emissions, transportation for about one third, roughly one fifth for industry, seven percent for the residential sector, and about 4% for the

commercial sector. If electric utility emissions are attributed to final energy consumers, then industry's share rises to about one third and the residential and commercial sectors each account for 15-20% of the total.



Energy Efficiency Standards

1. Appliance Standards

Standards for energy consuming equipment can expand markets for such technologies, help to reduce information barriers and can lower consumer's decision costs. Standards can also provide incentives to private research and development by reducing uncertainty in the market. U.S. homeowners spend $110 billion each year to power home appliances. These uses account for about 70% of all the primary energy consumed in homes.

During its typical 10-15 year lifetime, an appliance's operating costs may exceed its initial purchase price several times over. Nevertheless, many consumers do not consider energy efficiency when making purchases. Manufacturers are often reluctant to invest in more efficient technology that may not be accepted in the highly competitive marketplace.

Recognizing the great potential for energy savings, many states began prescribing minimum energy efficiencies for appliances. Anticipating the burden of complying with differing state standards, manufacturers supported the development of federal standards that would preempt state standards. Federal standards provide a high degree of certainty for energy savings and achieve higher penetration rates for efficiency gains than voluntary, educational or incentive programs.

In 1975, the U.S. Congress established a program of test procedures, energy conservation standards, and labeling for certain major household appliances including refrigerators, freezers, air conditioners, water heaters, furnaces, dishwashers, clothes washers, clothes dryers and kitchen ranges and ovens. A 1987 amendment, the National Appliance Energy Conservation Act, set the first national efficiency standards for these appliances and established a schedule for regular updates by DOE to achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified.

The Energy Policy Act (EPACT) of 1992 expanded coverage to certain commercial and industrial equipment, including commercial heating and air-conditioning equipment, water heaters, certain incandescent and fluorescent lamps, distribution transformers, and electric motors. EPACT also established maximum water flow-rate requirements for certain plumbing products and provided for voluntary testing and consumer information programs for office equipment, luminaires, and windows.

Under DOE's first rulemaking in November 1989, updated standards were set for refrigerators and freezers that went into effect January 1993. The Final Rule for energy conservation standards for clothes washers, clothes dryers, and dishwashers issued in May 1991 became effective May 14, 1994.

The initial standards included in EPCA, and those already amended by DOE, are expected to save about 23 quadrillion Btus (24.3 exajoules) of source energy from 1993 to 2015. Current appliance standards have already saved consumers $1.9 billion and will ultimately save $58 billion in energy costs over the lifetimes of units installed between 1990 and 2015.

In addition, more efficient products are more competitive internationally and have environmental benefits from reduced atmospheric emissions. The total emission reductions of federal appliance standards implemented to date are estimated to be 14.2 MMTCE in the year 2000. Further development of standards could result in additional reductions.

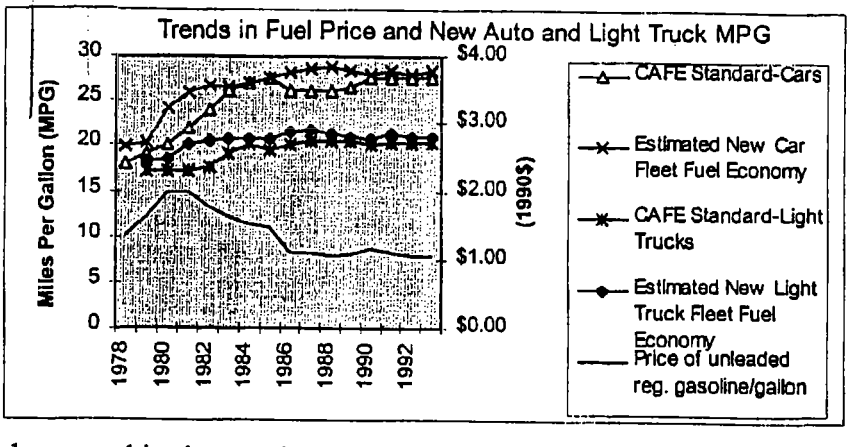
2. Personal Transportation

Consumers make choices about which type of vehicle to purchase and how much they drive their vehicles. There are many attributes that consumers may consider when purchasing a vehicle, such as: price, fuel economy, quality, safety, styling, performance, reliability, handling, comfort, options, size, etc. Fuel economy can conflict with a number of these attributes, and recent surveys confirm that fuel economy is very low on the list of attributes that consumers seek today. If the cost to society of greenhouse emissions is not reflected in the cost of owning and operating a vehicle, consumers will make inefficient choices, a classic case of market failure. One way to incorporate the external costs into the prices that consumers face is through regulation.

Such regulations already exist in the United States. The Energy Policy and Conservation Act of 1975 established mandatory average fuel economy standards for new cars and light trucks starting with the 1978 model year. The standard (currently, 27.5 mpg for cars and 20.7 mpg for light trucks) is calculated by each manufacturer's fleet (domestic or import) and model year. Each manufacturer's fleet average is equal to the sales-weighted fuel economy of all its new cars or light trucks of that vintage that are sold in the United States. Manufacturers that exceed the standard can carry forward credits for up to three years; manufacturers that fall short can carry backward projected future credits for up to three years. Failure to comply with CAFE requirements can result in a civil penalty. No major U.S manufacturer has ever paid a fine; only European manufacturers of luxury cars have opted to pay a fine rather than comply with the standards in a given year or take advantage of the credit system.

Emissions of greenhouse gases from the transportation sector account for about one-third of total U.S. GHG emissions. Transportation greenhouse gas emissions are expected to grow from about 430 million metric tons of carbon "equivalent" (MMTCe) in 1990 to 550 or more MMTCe in 2010. Passenger cars and light duty trucks (light vehicles) contribute the majority of transportation emissions. Emissions from light vehicles alone accounted for 20% of total U.S. greenhouse gas emissions in 1990, and in the absence of new policy measures are expected to rise from about 250 million metric tons of carbon equivalent (MMTCe) in 1990 to 350-400 MMTCe in 2010. All of this growth will likely be from light trucks, which are projected to account for a greater share of emissions than cars by the year 2000.

The major factors underlying the rapid growth in emissions from light vehicles are: growth in vehicle miles traveled; stagnant new fleet fuel economy levels; and growth in the relative proportion of light trucks sold, which have lower CAFE standards than cars.



Actual growth in vehicle miles traveled (VMT) since 1990 has averaged 2.4% per year. Growth in VMT is a function of a number of factors, including demographic changes (more women in the workforce; immigration), land use patterns (where people live in relation to where they work, shop, etc); the cost of driving each mile (now at an all-time low on an inflation-adjusted basis); and others.

Corporate average fuel economy of new car fleets increased steadily along with increasing CAFE standards throughout the late 1970s until the mid 1980s. Since then, new car and light truck fuel economy has been stagnant as new more efficient technologies have been applied to performance (which has increased by 60% for all light vehicles in the last 15 years) and utility rather than to fuel economy. Absent a driving force such as policy changes or fuel price increases, no significant increase in new fleet fuel economy is expected to occur. Further, because new vehicle fuel economy has been stagnant for several years, the in-use fleet of cars and light-trucks has also nearly reached a fuel economy equilibrium.

In fact, the overall in-use fuel economy of the combined new light vehicle fleet (i.e., cars and light trucks such as minivans, sport utility vehicles, and pickup trucks) has already begun to *decline*. Each year, about 15 million light vehicles are sold in the United States. In the past 15 years, sales of light trucks have skyrocketed. They have gone from under 25% of the market in 1982 to almost 45% today. A key reason that this shift is important in terms of GHG emissions is that light trucks face lower CAFE standards than cars (almost 7 mpg lower). Moreover, since light trucks tend to last longer than cars, they are likely to be driven more miles over their lifetime than cars.

In 1994, President Clinton convened a Federal Advisory Committee Policy Dialogue to assist in the development of measures to significantly reduce greenhouse gas emissions from personal motor vehicles ("CarTalk"). Although CarTalk ended without consensus among all members of the Committee, the process did result in a number of analyses and proposed policy options.

Other Mandates

Standards could also be used to limit greenhouse gas emissions in other sectors of the economy. Most prominent among these are:

Electricity Restructuring: There is currently a trend among states to adopt retail competition for the electricity industry. This trend could be accelerated with federal legislation. Retail competition is expected to lower the price of electricity by as much as 20-25% in certain regions and change the fuel mix of generation. Preliminary EPA and DOE analysis indicates that utility greenhouse gas emissions could rise by as much as 2-6% as a result. To mitigate the environmental impacts of competition and maintain the environmental benefits of current state level renewable and demand side management programs, a number of options have been adopted at the state level (for states that have already adopted competition) or are under consideration for the rest of the nation. These include:

- A "portfolio standard" for renewable energy or greenhouse gas emissions: This involves requiring that all generators meet a specified level of renewable generation

or greenhouse gas emission reduction either by undertaking such projects themselves or purchasing "credits" from others who have.

- A social benefit fund: Revenue is collected by placing a charge on transmission service. The funds are then used to subsidize energy efficiency projects or low income consumers. California has already adopted this approach.

- Information disclosure requirements: Generators could be required to disclose the emission profiles of their generation, facilitating the marketing of "green" electricity.

- Additional air pollutant requirements: Many states are hesitant to adopt retail competition because they perceive that differing regional environmental requirements both put their electric industry at a competitive disadvantage and will result in more pollution being transported into their states. Thus, additional environmental requirements to "level the playing field" – which could include greenhouse gas emission reductions – are currently being debated.

The Intermodal Surface Transportation Efficiency Act (ISTEA): This Act establishes the rules for federal transportation funding to the states. In 1991, ISTEA authorized $140 billion in transportation projects over a six year period. The Act expires in 1997 and Congress is now considering options for its reauthorization. These could include provisions that would indirectly reduce greenhouse gas emissions. Examples include the following:

- *Congestion Mitigation and Air Quality Improvement Program:* Additional funds could be targeted to transportation projects that reduce air emissions and energy consumption on a long-term sustainable basis.

- *Brownfields Restoration:* Successful redevelopment of browfields can help revive inner city areas and reduce sprawl, thereby reducing vehicle miles traveled. By focusing job growth in inner city areas it encourages greater reliance on more energy efficient and environmentally sound transporation modes, including transit, walking, and bicycling. More funds could be made available for these projects.

- *Incentive Funds:* Climate actions through ISTEA can produce economic efficiency and reduce emissions, while increasing mobility choice and community livability. One option would be to create a $500 million Fuel Efficiency Incentive Fund that rewards the ten states that are able to reduce fuel consumption, on a per capita basis, the greatest over the next five years.

A Program of Standards on Direct Emissions

This system would establish a set of greenhouse gas performance standards for sources of emissions. Flexibility could be introduced by allowing the trading of emission

reduction "credits" when sources perform superior to specified levels. A source could thus comply with the performance standard either through its own control efforts, or by purchasing credits from other sources.

For such a system to work, a performance standard would be established for each sector covered under the program. For example, for coal fired electric boilers, a limit could be placed on the amount of carbon per Btu of energy combusted. Sources surpassing that limit would earn "credits" that would be tradable. The amount of tradable credit would be based on the source's past production rate.

The performance standards themselves would be "rate based." That is, they would establish allowable emissions per unit of production, but not set total output limits. The total amount of tradable credit available to a source would be the product of the amount by which the source is surpassing the rate-based standard and its historical production levels.

Likely candidates to include in such a program include:

- Manufacturers of energy-using equipment for which an efficiency standard can be set. For example, residential, commercial, and industrial equipment (refrigerators, furnaces, ranges, HVAC equipment, motors, and lighting) could be included.
- Transportation equipment manufacturers, including passenger vehicles, light and heavy duty trucks, commercial transport equipment (planes, trains), and off-road equipment (e.g., tractors, farm equipment) and small engines (e.g., mowers).
- The many sources of non-CO_2 emissions (such as coal mine methane, agricultural sources of emissions, and halogenated substances). A credit program is also well suited to "opt-in" smaller sources which are not included under the regulator requirements due to administrative and monitoring considerations, but have the potential to reduce emissions at low costs.
- Electric utilities and heavy industry
- Petroleum refiners

Under a program of this type, the set of performance standards for all sectors must be consistent with the national target. Since total CO_2 emissions are not directly limited, such compliance would have to be projected based on an analysis of the performance standards.

Trading Credits and Determining Compliance

Credits could be traded bilaterally between the source who creates the credit and the source whose performance (i.e., emissions) exceed the regulatory standard. Alternatively, brokers and central exchanges could also be a mechanism for trades.

The regulating authority at some point must approve the authenticity of the credit generating reductions. For some sectors, credits could be certified for one year only. For example, a utility emitting under its limit in a year would generate credits equal to the reductions in that year only. These may be sold in that year or banked for the utilities or use or future sale.

For other sectors, annual certification would not be feasible. For equipment manufacturers, credits would be granted for each piece of equipment sold with performance better than the standard. Credits would equal the emissions associated with this improvement for the life of the equipment. It would not be feasible to track each piece of equipment that is produced to ensure its continued operation and performance. Therefore, lifetimes, usage, and degradation assumptions would need to be stipulated.

Conclusion

There is a long history of government using standards and regulations to address market failures relating to environmental externalities, the provision of information, and energy security. In addition, the role of government in the provision of transportation infrastructure and the regulation of natural monopolies is large. Consequently, the number of actions could be taken to mitigate emissions of greenhouse gases is large. These range from direct limits on emissions, to changes in government policies that indirectly affect the demand for energy. Given this wide array, choices must be made that consider both the costs that such interventions may impose and the resulting reductions in greenhouse gas emissions.

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	David Doniger	260-5155
	David Gardiner	
DOT	Frank Kruesi	260-0275
OVP	Pete Jordan	366-7127
CEQ	Steve Seidel	456-9500
USAID	David Hales	456-6546
DOL	Andrew Samet	703-875-4639
		219-5980

MEMORANDUM

COUNCIL OF ECONOMIC ADVISERS

Date: 5 March 97

To: Jeff Frankel
Alicia Munnell

From: Jason Shogren

RE: Update on Climate Change

1. Status of Modeling

A. Base-case runs and lump-sum redistribution

The DRI/DOE model has run the lump-sum redistribution.

Ev is planning on runs that will separate out the effects of the carbon policy from the revenue recycling. They have not been run as of yet.

Ev also is asking the modelers to back out the implied social rate of return on R&D or the government subsidy needed to achieve the 1.75 AEEI runs. A quick estimate by the M-macro modelers suggests an implied social rate of return on R&D of over 125%. Empirical estimates based on historical data range from 20-50%.

B. Technology

Treasury and CEA had a meeting with Ev yesterday to express out concern about the 1.25 and 1.75 cases. Ev defended the 1.25 case again as plausible, and got testy later on when pushed on the potentially negative reaction by outside economists. A meeting next week on technology was tentatively set for Monday or Wednesday (preferable) to decide on this issue.

RFF has on meeting today and tomorrow on technology and carbon policy. Tom went this morning. Ray Squitieri is there now and will tell me what is going on.

C. Optimal Runs

Ev has yet to ask the modelers to run an optimal time path for emissions. The modelers have run a -10% case. What would be preferable is a set of runs such that we can calculate a set of MC curves by year and percent reduction from 1990 baseline. The MC curves could then be adjusted for permits and revenue recycling.

2. Coal Subsidies

3. Repetto's work on carbon prices

4. Bonn update

A. US's position

The clear question that is on everyone's mind but has not been answered is when will the US fill in the blanks on targets and timetables.

B. Budget periods and trading

EU is interested in budget periods but does not want to discuss the option until the US is more specific about intended level and timing of budgets. EU also expressed its doubt that trading could be negotiated by Kyoto.

China and G-77 clearly oppose trading and JI.

Many Parties were opposed to borrowing.

Canada, New Zealand, and Australian indicated support for multi-year targets.

1. Announcement
2 Δ Penny, lump sum
3. Recycling as cuts in income + corporate taxes

EXECUTIVE OFFICE OF THE PRESIDENT

04-Mar-1997 02:49pm

TO: Alicia H. Munnell

FROM: Jeffrey A. Frankel
Council of Economic Advisers

CC: Mark J. Mazur
CC: Jason F. Shogren
CC: Thomas A. Rhoads

SUBJECT: climate change issues

Perhaps 2:30 Thurs., would be a good time to discuss a few aspects of the climate change that I think we need to think about.
(1) Is Ev doing/reporting the "base case" policy runs, which were to have lump-sum redistribution of revenues (as decided clearly in Fall meetings at Commerce), in addition to the case where revenues are used to reduce taxes (or permits are grandfathered)? If the base case has fallen by the wayside, then Robert Gilingham's concerns are justified.
(2) Jay, what have you found out about coal subsidies in other countries? I really think that a ban on coal subsidies, eventually worldwide, would be a simpler and more practical/serious step then much of what is discussed; and it might be worth proposing a G-7 or G-8 version version of this for the Denver Summit. (But if most G-7 countries don't have coal subsidies, or if they are very asymmetrically distributed, then it would sound foolish.)
(3) Do we know if Repetto is taking up our suggestion of describing the results of the existing models in terms of impact on energy prices, rather than GDP?
(4) How close is Ev to the task, which he agreed on, of looking at the optimal time path of emissions from now to, say, 2020 (i.e., to meet a given emissions goal)? If we had this information in hand, I might propose that we propose to the Deputies group (who will soon have to give State instructions on filling in some of the blands in their treaty language) my earlier proposal: targets be phrased as seven three-year averages, where the seven numbers followed a smooth trajectory (rising at a diminishing rate, peaking ,and then coming down), and countries are told that they must hit 5 out of 7 targets.

Jay, I hope you can get info on as many of these four questions as possible.

Alicia, what items would you like to put on the agenda?

JF

Outside costs

E X E C U T I V E O F F I C E O F T H E P R E S I D E N T

04-Mar-1997 06:01pm

TO: Jason F. Shogren

FROM: Jeffrey A. Frankel
Council of Economic Advisers

SUBJECT: RE: climate change issues

The Germany info makes me want to pursue my idea. IF countries can't accept such policial and social difficulties, how can they expect to make the much larger adjustments that would follow from the plans under discussion?

On the other item (World Bank report), can you figure out their reasons? Might it just be that OECD coal use is a diminishing part of the problem, and LDC/NIS coal use an increasing part, in the future?

JF

04-Mar-1997 06:17pm

TO: Jeffrey A. Frankel

FROM: Jason F. Shogren
Council of Economic Advisers

SUBJECT: RE: climate change issues

the same world bank guys in the ipcc report are cited saying that removing all energy subsidies (worldwide, i assume although not explicitly stated) would reduce global carbon emissions by 4-6%. will get the details.

E X E C U T I V E O F F I C E O F T H E P R E S I D E N T

04-Mar-1997 06:25pm

TO: Jason F. Shogren

FROM: Jeffrey A. Frankel
Council of Economic Advisers

SUBJECT: RE: climate change issues

If we were to make a proposal on "Ban Coal Subsidies" for the G-7 Summit, it would be good to have information on the magnituded of coal use, coal subsidies, and effects on carbon emissions for each of the following:
(1) Each of the G-7
(2) OECD collectively
(3) Other Annex I countries (E.Eur. and NIS?) collectively
(4) Rest of World (perhaps with China broken out separately)

cc: Hall
STAF
JS
JR

THE WHITE HOUSE

WASHINGTON

March 3, 1997

MEMORANDUM FOR DISTRIBUTION

FROM: ELGIE HOLSTEIN
DAVID SANDALOW

SUBJECT: Climate Change

There will be a meeting Tuesday, March 11 from 9:30-11:00am in OEOB Room 472.

One of the items on our agenda will be clearance of a background paper on domestic emissions trading programs. Please review the attached draft, prepared by EPA, and provide any comments to David Gardiner (260-4332) no later than COB Thursday, March 6. EPA will distribute a revised draft prior to our meeting.

Complete agenda for our meeting to follow.

Everyone of the attached list has been cleared into the building. For questions concerning clearance, please contact Wendy Phillco (456-6224).

DISTRIBUTION:

Organization	Name
State	Eileen Claussen
	Rafe Pomerance
Commerce	Everett Erhlich
	Jeffrey Hunker
OSTP	Rosina Bierbaum
CEA	Alicia Munnell
	Jeff Frankel
	Mark Mazur
Treasury	Joshua Gotbaum
Justice	Lois Schiffer
Interior	Brooks Yeager
	Brooke Shearer
NOAA	Terry Garcia
OMB	T.J. Glauthier
USTR	Jennifer Haverkamp
Agric	Charlie Rawls
DOE	Mark Chupka
	Joe Romm
EPA	Mary Nichols
	David Doniger
	David Gardiner
DOT	Frank Kruesi
OVP	Pete Jordan
CEQ	Steve Seidel
USAID	David Hales
DOL	Ed Montogmery
TaskForce	Dirk Forrister

Overview of Domestic Greenhouse Gas Emissions Trading Programs

Introduction

This paper describes how a domestic emissions trading program could be used to comply with an emissions target designed to meet an international agreement on greenhouse gases. Emissions trading is a tool for meeting a total quantity limit on emissions. It involves allocating or auctioning emissions allowances, and allowing the trading of allowances in a market with sufficient mechanisms to ensure compliance with targeted levels. Since emission trading involves the creation of new, marketable assets that can have substantial value, addressing distributional issues will be an important component of program design. Allocation rules or auction revenues can be used to address these distributional issues.

Emission trading systems can offer both static and dynamic efficiency advantages over more traditional forms of regulation. The potential for static efficiency gains exists because emitters face different abatement costs. Emissions trading allows those with high abatement costs to purchase allowances from those whose costs are lower. Total costs would therefore be lower than through traditional regulations, which require all polluters to comply with a specific standard. However, it should be noted that such a program involves people and firms adjusting to higher energy prices.

Under traditional regulation, firms have little incentive to investigate ways of abating pollution by more than the minimum required to comply with regulatory requirements. Firms under-invest in pollution control R&D since they can capture neither the full market benefits from such spending (since others benefit from learning of their successes), nor the full value of any resulting environmental improvements. Trading offers dynamic efficiency gains because of the incentive to continuously improve pollution abatement technologies in order to create "surplus" allowances for sale. In addition, tradable permits can provide incentives for reduced total energy use.

These same efficiency benefits could be achieved through a system of emission taxes. However, a system based on emissions trading differs from a tax system in two important ways. First, under a tax system, the quantity of total emissions is the result of individual polluters' decisions in response to the incentive provided by the tax. In principle, if the entire cost structure is known, any quantity target attained by a tradable permit system could also be attained by an appropriately calculated tax. In so far as forecasting in practice is difficult, however, the resulting level of emissions can be greater or less than the level targeted when the tax rate is set. By setting overall quantity targets, emissions trading programs coupled with appropriate compliance procedures, offer greater certainty that national emission targets will be achieved. Second, emission tax systems always involve revenues accruing to the government (although they can be rebated). Under an allowance system, the government has greater flexibility in deciding

whether to collect revenues by auctioning permits or allocating them based on historical emissions or some combination of the two. This flexibility can affect the public acceptance of the mitigation program.

US Experience with Emissions Trading

The US has had more experience with emissions trading than any other country in the world. Specific programs include:

- *Sulfur Dioxide (SO2) Allowance Trading:* The Clean Air Act Amendments of 1990 imposed an overall 50% emission reduction requirement for SO2 emissions from electric utility boilers. The portion of the program concerning trading works by allocating emission allowances to electric utilities based on a formula reflecting historical emissions. In addition, a small portion of allowances are auctioned every year to facilitate price discovery and new entrants. Allowances are specifically excluded from being defined as property rights, may be traded to any party anywhere within the continental U.S., and may be "banked" for use in future years. Participants need to conduct regular monitoring of emissions and make an annual accounting of their emissions. Penalties are imposed if emissions exceed the number of allowances held by a source.

  There is now a functioning market in SO_2 allowances involving both bilateral exchanges between companies, and brokered exchanges through third parties. This market, along with other factors[1], has helped to dramatically reduce the cost of the abatement program. Initially, forecasters claimed that emissions allowances would sell in the range of $100 to $1000 per ton.[2] Current spot prices are in the range of $80 to $90. In addition, 1995 emissions were actually 40% below the legally required levels for that year.

- *Water Effluent Trading:* The US generally has regulated surface water quality through a system of discharge limits for large sources of water pollution. In addition, states have standards for ambient water quality which are often not attained even after large dischargers apply "best technology." The reason is that small ("nonpoint") sources (such as runoff from farms) contribute significantly to water pollution. A number of state and local governments are employing trading systems for watersheds that either permit trading among large dischargers, or allow large dischargers to fulfill their requirements by controlling nonpoint sources. These include the Fox River in Wisconsin, the Dillon Reservoir in Colorado, and the Tar-Pamlico River in North Carolina. The latter two programs are designed to manage future economic growth.

[1] These include the fact that the bill that was actually adpted was not as onerous as many in industry had feared, the low price and widespread availability of low sulfur coal, the awarding of "bonus allowances," the postponement of capital investments, and lower than expected transportation costs.
[2] Hahn, Robert W., and Carol May, "The Behavior of the Allowance Market: Theory and Evidence," The Electricity Journal, March, 1994.

Thus, the quantity of effluent allowances allocated exceeds current discharge levels. Once growth consumes this excess, trading is expected to reduce compliance costs.

- *Inter-refinery Lead Trading:* EPA operated a lead trading program from 1983 to 1987 as it phased out lead from gasoline. Lead trading allowed refiners and importers to trade lead reduction credits in order to meet limits for the lead content of gasoline. The quantity of allowances to which a firm was entitled was determined by the amount of leaded fuel produced by the firm and the contemporaneous EPA standard. Those who bettered the standard could sell their credits to others. Some 10 billion grams of lead were traded during the course of the program at prices ranging from 0.75 to 5 cents per gram. Allowing the trading of lead credits reduced the costs of the program by approximately 20 percent.

- *Criteria Air Pollutant Trading:* EPA first began incorporating aspects of emissions trading in its air program in 1974, when it allowed a modified source to use "credits" earned by another source within the same plant to avoid additional regulatory requirements. Since then, emission trading has substantially expanded. Trades have numbered in the thousands and have been estimated by Hahn and Hester (1986) to have achieved savings between $525 million and $12 billion.

- *Market Mechanisms for Chlorofluorocarbon (CFC) Phaseout:* Under the 1987 Montreal Protocol to limit stratospheric ozone depletion, the U.S. required the phase out of the production of CFCs by 1996. As part of its program, the U.S. adopted a tradeable permit regime covering CFC manufacturers and importers. These were allocated allowances based on each firm's 1986 market share. As the market for CFCs declined, the system allowed firms to allocate production between different production facilities according to the least-cost pattern of supply. It also gave CFC users the flexibility to switch between different CFC compounds, within the overall limit on allowances. This program helped reduce the costs of the phaseout. In 1988, EPA estimated that the cost to *halve* CFC use would be $3.55 per kilogram. By 1993, it became clear that all uses could be *eliminated* by 1996 at a cost of $2.45 per kilogram.

Emission Trading of Greenhouse Gases

These examples show that emission trading and banking have been used to meet established reduction requirements. Emissions trading, coupled with sufficient compliance mechanisms, may similarly be used to meet an established target for greenhouse gas emissions.

An emissions trading program, like any program designed to limit greenhouse gases, must contain certain elements. First, an agreed upon emissions budget must be established. A central authority must be given the domestic responsibility for verifying

compliance and must be provided sufficient information to do so. Finally, noncompliance with allowance limitations or reporting requirements must generate real consequences, such as penalties or subtraction of allowances.

A program would have to establish permit lifetimes, monitoring and enforcement provisions, as well as rules for permit banking, borrowing, and trading. Consideration should also be given to transaction costs, which should be kept as low as possible. However, particularly difficult issues involve determining what types of activities require a permit and how permits should be allocated.

What types of Activities Should Require a Permit

Sources of greenhouse gases include not only those emitting carbon dioxide, but other gases such as methane, nitrous oxides, hydrofluorocarbons (HFCs), 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.

The decision for determining who should be required to hold a permit should consider the following:

- *Coverage:* While it may not be necessary to ensure that every ton of greenhouse gas is accounted for within an emission trading regime, the scope of coverage of the trading program should be sufficient to ensure compliance with targets set in accordance with an international agreement.
- *Administrative and compliance feasibility:* The number of sources involved in the trading program should be small enough to be administratively feasible and large enough to ensure market competition. In addition, monitoring and verification of permit compliance must be possible for those included in the program.
- *Potential to Diffuse Low Greenhouse Gas Technologies:* Alternative points of intervention should be evaluated for their ability to provide incentives for research, development, adoption and diffusion of low greenhouse gas technologies.
- *Market Impacts:* Any program that limits emissions will affect the bottom line of firms. The permit program will have economic impacts that vary depending on program design. For example, exempting certain sizes or categories of sources from permit requirements because of administrative or equity concerns (e.g., small boilers or home heating oil) has competitive implications within the energy market..

Carbon Sources

Carbon dioxide currently accounts for about 85% of U.S. greenhouse gas emissions. The term "emission trading" implies the creation of a market of emission allowances (or permits) among *emitters* of greenhouse gases through a limitation on those

emissions. In the case of carbon dioxide, however, direct emitters number in the hundreds of millions since they include sources such as automobiles and residential gas water heaters.

However, since virtually all of the carbon contained in fossil fuel extracted from the ground (with the possible exception of certain feedstocks) is eventually released to the atmosphere, a trading program need not focus uniquely on direct emitters, but can be implemented through other points in the energy market. These include fuel imports, fuel extraction, processing, refining, distribution, and secondary conversion (e.g., coal to electricity). In addition, these points could vary by sector. For example, an emission trading program could focus on the point of final combustion for coal, but on refining for oil, or distribution for natural gas. Given the wide variety of options available for including energy sources in a trading program, a few alternative programs are described below for illustration:

A Program Targeting Primary Fuel Producers

There are various levels within the primary fuel producing sector – extraction, processing, refining, and distribution – where a permit program could be implemented. One option would be to require permits at the point of first sale (a permit is surrendered with the first inter- or intra- company transaction). Such a system would include transactions between a coal company and an electric utility, between a natural gas producer and its marketing arm, between a natural gas producer and a broker, or between an oil extraction company and its refinery operations. Fuel importers would also require permits to import fuel. This would capture the carbon from fuel consumed in the refining process. The number of market actors under this program design would be under 5000 and virtually all carbon in the energy sector would be included in the program.

A Program of Emission Trading at the Sectoral Level

An emissions trading program could also be applied at the point of combustion, allowing trading among affected sources. This system would be most comparable to the current SO_2 emission allowance trading system.

Targeting the six largest industrial CO_2 emitting sectors (electric utilities, cement, primary metals, pulp and paper, petroleum refining and chemicals) in a sectoral trading program could encompass as many as 20,000 market participants and 90 percent of industrial CO_2 emissions. Mobile source emissions could be indirectly included in the system by allocating transportation equipment manufacturers permits for emissions associated with their automobile fleets or by including refiners in the program. Residential and commercial emissions could be similarly addressed by focusing upstream in the energy system.

Other Greenhouse Gases and Sinks

The remaining 15% of greenhouse gas emissions (on a carbon-equivalent basis) are accounted for by other gases. Most important among these is methane, which by itself accounts for 11% of national emissions. Since gases differ in their lifetimes and in their potential to trap heat in the atmosphere, an "exchange rate" or trading ratio must be established to convert all gases into common units for inclusion in a trading program. Such ratios have been developed by climate researchers and could be applied here. These should be consistent with the rules established in the international protocol.

Several, although not all, of the many sources of non-carbon greenhouse gases could likely be included in a trading system. For example, methane emitting coal mines, landfills, livestock manure management facilities and potentially natural gas distribution systems may meet the criteria described above for inclusion in a greenhouse gas trading program. These sources account for 7% of national greenhouse gas emissions. Similarly, emissions of some sources of other gases could potentially be included (e.g., magnesium production).

Forests in the United States currently remove an amount of carbon equal to 8% of national emissions from the atmosphere. However, translating the potential of sinks into monitorable, verifiable, and cost effective emission reductions is hampered by the lack of a comprehensive national accounting system for sinks. Thus, while it may be possible to observe and monitor the planting of trees and preservation of forests in a given area, it is difficult to know how such actions affect national emissions. Preservation of one stand of forests may simply lead to destruction of another in a different location. Overcoming the difficulties associated with monitoring and verification is therefore especially important for the inclusion of sinks to be included in a trading program.

Allocating Permits

In an emission trading system, some mechanism must be provided for allocating permits to sources. This could be done on the basis of baseline/historical emissions (where permits are given to those currently emitting) or through an auction (where revenues accrue to the government). These two mechanisms might also be combined: some portion of permits could be allocated on the basis of historical emissions while the rest are auctioned. In any case, the value of these assets could be large depending on the permit price, which is determined by the emissions target and the costs of substitutes. Given that an auction could produce substantial revenues, some decision would have to be made with respect to what to do with the proceeds

A reserve of allowances or a portion of auction revenues could be set aside to encourage more rapid development and diffusion of low greenhouse gas emitting technologies. For example, manufacturers of energy consuming equipment could compete for the set aside based on the degree to which they produce equipment more efficient than the average in use or than required by current mandatory efficiency standards. Such a program could yield reductions in energy demand and help buffer the consumer from the impact of higher energy costs.

Allocation Based On Baseline/Historical Emissions

Under this approach, sources are given a number of permits based on baseline fuel production or emissions and an allocation formula. Various allocation formulae can be devised, weighted to greater or lesser degrees in favor of sources with high historical emissions. Emissions allowances are endowed to facility operators for no cost and would be transferable. Those receiving permits thus obtain assets of potentially large value from the government at no cost.

Such an allocation mechanism could create entry barriers. In a capital intensive sector like primary fuel production, where entry barriers are already substantial, new entrants would be further disadvantaged if they had to purchase permits. This problem could be mitigated by withholding a number of permits for purchase by new entrants or by auctioning a portion on the open market. Such an auction would also facilitate price discovery in a new market. Although new firms will still be disadvantaged (as they will pay for all of their permits), they would be able to enter the market. The pool of permits would need to be withheld from existing sources to ensure compliance with targeted national emission levels.

It may be desirable to design an allocation that would allow credit for early emissions reductions (those achieved prior to the start of the program, but after the baseline period) -- in particular for those that reduced greenhouse gas emissions as part of government sponsored voluntary programs. If credits for past actions are given, the total credits allowed would need to be deducted from the overall permit allocation in order not to exceed national greenhouse gas emissions target.

Permit allocation formulae could also take into account the market impacts of the mitigation program. For example, "set asides" could be made available to those industries or consumers who experience a grossly disproportional share of the costs of control. Alternatively, a set aside could be auctioned, with the revenues used to redress gross inequities in the distribution of control costs.

Auction

Alternatively, an auction could be used to allocate permits. In this case, permit holders would pay the market clearing price for every unit of greenhouse gas released. Auctions ensure that permits are available for trade, and would serve to inform potential traders about current price levels. All participants have equal access to permits, placing new entrants on the same footing as existing emitters. Given that an auction could produce substantial revenues, some decision would have to be made with respect to what to do with the proceeds. These include programs to redress inequities in the distribution of control costs (as discussed above), R&D for less carbon intensive energy sources and end uses, reductions in taxes, and/or deficit reduction.

Conclusion

Past experience with emission trading programs indicates that they can help significantly reduce the costs of meeting environmental objectives. This is due in part to the incentives they provide for developing and diffusing new environmental technologies. Thus, final compliance costs for the programs that have incorporated emissions trading have, in general, been dramatically lower than ex ante expectations. With careful attention to design, a system of emissions trading could be instituted for greenhouse gas emissions. Such a program would provide similar incentives to research, develop, and diffuse low greenhouse gas technologies and result in achieving targeted emission levels at the lowest possible cost.

Copy to OMB DS

February 26, 1997

MEMORANDUM FOR DISTRIBUTION

FROM: ROBERT S. KAPLA
COUNCIL ON ENVIRONMENTAL QUALITY

SUBJECT: CLIMATE CHANGE DEPUTIES MEETING

Attached is the agenda for the climate change deputies meeting scheduled for this **Thursday, February 27th at 4:00pm in room 472 OEOB**. Also attached is a paper on domestic policy options prepared by the Assistant Secretaries.

DISTRIBUTION:

Charles Curtis, DOE
Mort Downey, DOT
Everett Ehrlich, DOC
Leon Fuerth, OVP
John Garamendi, DOI
Jack Gibbons, OSTP
Jamie Gorelick, DOJ
David Hales, AID
Fred Hansen, EPA
Jeff Lang, USTR
Jack Lew, OMB
Ira Magaziner, DPC
Cynthia Metzler, DOL
Richard Rominger, USDA
Alicia Munnell, CEA
Jim Steinberg, NSC
Larry Summers, Treasury
Tim Wirth, DOS

CLIMATE CHANGE DEPUTIES MEETING

Thursday, February 27
4:00-6:00pm
OEOB Room 472

AGENDA

I. International Negotiations

-- current status
-- key upcoming decisions/dates

II. Economic Modeling Analysis

-- initial output from benchmark runs
-- next steps

III. Domestic Policy Options

-- Overview Paper
-- next steps

IV. Outreach Strategy

V. Relationship of Emissions, Concentrations and Impacts

Overview of Greenhouse Gas Mitigation Options

Introduction

Over the next century, important shifts in the global economy would be required to address climate change. (See attachments 1 and 2). While many mitigation options exist, these policies entail costs (e.g. increases in energy prices or additional federal spending). Taking no action also involves costs, since global warming can adversely affect both humans and ecosystems.

This paper lays out the broad policy options available for limiting emissions, but does not analyze the costs and benefits of particular options. The options fall into three general categories:

- Those that seek to increase the rate at which existing energy efficient technologies are deployed in the marketplace by overcoming information and other barriers to their use. The Administration's efforts in the Climate Change Action Plan were designed to use technology diffusion to reduce emissions to 1990 levels and may reduce as much as one-fourth of the amount of projected growth to the year 2010.

- Those that create new government requirements to internalize the costs of greenhouse gas emissions in the marketplace. These could take the form of additional standards and regulations, changes in other government policies that indirectly affect energy use, and/or an emissions trading program. Such programs typically involve government imposed limits on emissions that increase the costs of energy or restrict consumer choice.

- Research and Development (R&D). R&D can reduce costs in all periods. However, it is particularly important in the long term, since controlling warming ultimately requires adopting an energy system that does not rely primarily on fossil fuels. This would involve stepping up and refocusing the federal government's R&D program and reversing the long-term trend of declining government and private R&D expenditures.

Technology Diffusion Programs

As noted by the National Academy of Sciences (NAS) and the Office of Technology Assessment, many energy saving technologies already exist, but are not being implemented. The NAS, for example, stated that the total diffusion of existing energy efficiency technologies in "reasonable applications" could reduce current carbon emissions by almost one-fourth.

For an energy efficient technology to be more fully employed, however, potential buyers of products need to know of the technology, as well as its performance and

economic benefits. Service providers must have the expertise to appropriately design, install and operate the technology. Yet, given the transaction costs associated with obtaining reliable information, potential users may not fully appreciate the potential long-term net benefits of more energy-efficient technologies.

A number of technology diffusion programs to address these problems are currently underway. The Administration's CCAP launched over 40 initiatives in 1993. Their goal was to return U.S. greenhouse gas emissions to 1990 levels by the year 2000. The Administration currently projects that if funding at current annual levels ($183 million) continues, these programs will eliminate as much as one-fourth of the total growth in emissions through the year 2010 and save over $35 billion in energy expenses in that year. The Administration proposed higher spending levels years ($305 million) for each of the past two years. However, Congress cut the requests by 40%.

The following illustrate the kinds of programs underway or that could be pursued in this category:

- Fully funding existing CCAP programs, adding initiatives to further reduce emissions beyond the year 2000.

- Establishing additional information and energy labeling programs for buildings (e.g., to redress the asymmetry of information between builders and occupants). This sector consumes one-third of the nation's energy.

- Should a domestic emissions trading system be created, setting aside a reserve of allowances or a portion of auction revenues to reward new R&D investment and the production of efficient and renewable technologies. Alternatively, a voluntary early banking program could be designed to encourage early action.

- Creating a secondary market for energy efficiency financing.

- Expanding sector-wide compacts in which entire industries could pledge improvements in emissions and benefit from shared information or R&D on technologies.

- Extending government procurement efforts for energy efficient technologies to state and local levels.

- Mandating through Executive Order the purchase of "green" power by federal facilities where available.

Standards and Regulations

Limitations on greenhouse gas emissions could also take the form of standards and regulations. These would have to be imposed on a wide array of consumer goods and energy consuming equipment, involving many government actions in which the tradeoffs among costs, emission reductions, and other product attributes would be contested. The resulting level of emissions would have to be consistent with the targets established by international agreement. Since total national greenhouse gas emissions would not be capped, such compliance would have to be projected based on an analysis of the impacts of the standards program. Such standards could include:

- *Direct limits on greenhouse gases:* Standards could specify allowable greenhouse gas emission levels per unit of output (or some other factor). For example, methane from some landfills is already controlled due to limits on emissions of volatile organic compounds.
- *Minimum energy efficiency standards for energy consuming equipment:* Historically, these have targeted appliances and other residential and commercial equipment, as well as personal transportation (i.e., the Corporate Average Fuel Economy (CAFE) program). DOE estimates that the federal appliance standards implemented to date will reduce carbon emissions by 14 million tons in the year 2000. Further development of standards could result in additional reductions, although recent bipartisan attacks on implementing new standards under the 1992 Energy Policy Act have stalled recent efforts to make progress in the appliance standards area.

  Emissions of greenhouse gases from the transportation sector account for about one-third of total U.S. GHG emissions and are expected to grow by about 25% by 2010. The overall in-use fuel economy of the combined new light vehicle fleet (i.e., cars and light trucks such as minivans, sport utility vehicles, and pickup trucks) has begun to *decline*. In 1994, President Clinton convened a Federal Advisory Committee Policy Dialogue to assist in the development of measures to significantly reduce greenhouse gas emissions from personal motor vehicles ("CarTalk"). Although CarTalk ended without consensus among members of the Committee, the process did result in a number of proposed policies that could be pursued.

Other Policies Relevant to Emissions

In addition to the standards it sets, government indirectly affects the levels of greenhouse gas emissions through its policies towards transportation and energy market regulation. These also offer opportunities to generate reductions in greenhouse gas emissions. Most prominent among these are:

Electricity Restructuring: States are currently adopting retail competition for the electricity industry. This trend could be accelerated with federal legislation. Retail

competition is expected to lower the price of electricity by as much as 20-25% in certain regions and change the fuel mix of generation. Preliminary EPA and DOE analysis indicates that utility greenhouse gas emissions could rise by as much as 2-6% as a result. To mitigate the environmental impacts of competition and maintain the environmental benefits of current state level renewable and demand side management programs, a number of options have been adopted at the state level (for states that have already adopted competition) or are under consideration for the rest of the nation. These include:

- A "portfolio standard" for renewable energy or greenhouse gas emissions: This would require that all generators meet a specified level of renewable generation or greenhouse gas emission reduction either by undertaking such projects themselves or purchasing "credits" from others who have.

- A social benefit fund: Revenues from a charge on transmission service are used to subsidize energy efficiency projects, renewables, R&D, or low income consumers. California has adopted this approach.

- Information disclosure requirements: Generators could be required to disclose the emission profiles of their generation, facilitating the marketing of "green" electricity.

- Additional air pollutant requirements: Many states are hesitant to adopt retail competition because they perceive that differing regional environmental requirements put their electric industry at a competitive disadvantage and will result in more pollution being transported into their states. Thus, additional environmental provisions to "level the playing field" – which could include greenhouse gas emission reductions – are currently being debated.

The Intermodal Surface Transportation Efficiency Act (ISTEA): This Act establishes the rules for federal transportation funding to the states. In 1991, ISTEA authorized $140 billion in transportation projects over six years. The Act expires in 1997 and Congress is now considering options for its reauthorization. These could include provisions that would indirectly reduce greenhouse gas emissions. Examples include the following:

- Congestion Mitigation and Air Quality Improvement Program: Additional funds could be targeted to transportation projects that reduce air emissions and energy consumption on a long-term sustainable basis.

- Brownfields Restoration: Successful redevelopment of brownfields can help revive inner city areas and reduce sprawl, thereby reducing vehicle miles traveled. More funds could be made available for these projects.

- Incentive Funds: A new $500 million Fuel Efficiency Incentive Fund could be established to reward the ten states that are able to reduce fuel consumption, on a per capita basis, by the greatest amount over the next five years.

Emissions Trading

Emissions trading is a tool for meeting a total quantity limit on emissions. It involves allocating or auctioning emissions allowances, and allowing the trading of allowances in a market with sufficient mechanisms to ensure compliance with targeted levels. Since emission trading involves the creation of new, marketable assets that can have substantial value, addressing distributional issues will be an important component of program design. Allocation rules or auction revenues can be used to address these distributional issues.

Emission trading systems can offer both static and dynamic efficiency advantages over more traditional forms of regulation. The potential for static efficiency gains exists because emitters face different abatement costs. Emissions trading allows those with high abatement costs to purchase allowances from those whose costs are lower. Total costs would therefore be lower than through traditional regulations, which require all polluters to comply with a specific standard. However, it should be noted that such a program involves people and firms adjusting to higher energy prices.

Under traditional regulation, firms have little incentive to investigate ways of abating pollution by more than the minimum required to comply with regulatory requirements. Firms under-invest in pollution control R&D since they can capture neither the full market benefits from such spending (since others benefit from learning of their successes), nor the full value of any resulting environmental improvements. Here, trading offers efficiency gains because of the incentive to continuously improve pollution abatement technologies in order to create "surplus" allowances for sale.

Experience in the United States has shown that final compliance costs for the programs that have incorporated emissions trading have, in general, been lower than predicted – often dramatically lower. While emissions trading is not the sole cause of this phenomenon, it has contributed to lower abatement costs in the acid rain program, the phase-out of Chlorofluorocarbons (CFCs), the "criteria" air pollution program, and the phase-out of lead in gasoline.

An emissions trading program, like any program designed to limit greenhouse gases, must contain certain elements. First, an agreed upon emissions budget must be established. A central authority must be given the domestic responsibility for verifying compliance and must be provided sufficient information to do so. Finally, noncompliance with allowance limitations or reporting requirements must generate real consequences, such as penalties or subtraction of allowances.

A program would have to establish permit lifetimes, monitoring and enforcement provisions, as well as rules for permit banking, borrowing, and trading. Consideration should also be given to transaction costs, which should be kept as low as possible.

However, particularly difficult issues involve determining what types of activities require a permit and how permits should be allocated. The decision for the former should consider the following:

- *Coverage:* While it may not be necessary to ensure that every ton of greenhouse gas is accounted for within an emission trading regime, the scope of coverage of the trading program should be sufficient to ensure compliance with targets set in accordance with an international agreement.
- *Administrative and compliance feasibility:* The number of sources involved in the trading program should be small enough to be administratively feasible and large enough to ensure market competition. In addition, monitoring and verification of permit compliance must be possible for those included in the program.
- *Potential to Diffuse Low Greenhouse Gas Technologies:* Alternative points of intervention should be evaluated for their ability to provide incentives for research, development, adoption and diffusion of low greenhouse gas technologies.
- *Market Impacts:* Any program that limits emissions will affect the bottom line of firms. The permit program will have economic impacts that vary depending on program design. For example, exempting certain sizes or categories of sources from permit requirements because of administrative or equity concerns (e.g., small boilers or home heating oil) has competitive implications within the energy market.

Since virtually all of the carbon contained in fossil fuel extracted from the ground (with the possible exception of certain feedstocks) is eventually released to the atmosphere, a trading program need not focus uniquely on direct emitters, but can be implemented through other points in the energy market. These include fuel imports, fuel extraction, processing, refining, distribution, and secondary conversion (e.g., coal to electricity). In addition, these points could vary by sector. For example, an emission trading program could focus on the point of final combustion for coal, but on refining for oil, or distribution for natural gas.

In an emission trading system, some mechanism must be provided for allocating permits to sources. This could be done on the basis of baseline/historical emissions (where permits are given to those currently emitting) or through an auction (where revenues accrue to the government). These two mechanisms might also be combined: some portion of permits could be allocated on the basis of historical emissions while the rest are auctioned. In any case, the value of these assets could be large depending on the permit price, which is determined by the emissions target and the costs of substitutes. Given that an auction could produce substantial revenues, some decision would have to be made with respect to what to do with the proceeds.

Research and Development (R&D)

One of the key issues in developing a domestic climate change policy will be the emphasis placed on potentially expanding the Federal R&D effort into technologies that reduce future greenhouse gas emissions and/or lower the cost of achieving a given greenhouse gas reduction target. Achieving greenhouse gas emission reductions that would stabilize atmospheric concentrations at "safe" levels will require major advances in technology in virtually every sector of the economy. These goals will be difficult to achieve during a time of constrained federal spending and sharp reductions in long-term private sector R&D. Since 1978, federal investment in energy R&D has declined 75%. Investment by industry fell 33% from 1983 to 1993.

The President's Fiscal Year 1998 budget requests an increase of $200 to $300 million in relevant R&D over the current level of approximately $1.3 billion. Such an increase was rejected by Congress last year, and achieving it may require raising the issue to a higher level in budget negotiations. In the Fiscal Year 1999 budget and beyond, further increases will be needed, as will a more coordinated effort to target the R&D on the biggest opportunities for CO2 mitigation.

Achieving greenhouse gas levels that are not harmful to humans or the environment will require major advances in technology as can be seen from the following equation:

Emissions = *Population* x *Affluence* (GDP/capita) x *Technology* (Emissions/GDP)

From 1990 to 2060, we may well see global population double and affluence increase by a factor of four. At the same time, the world may ultimately need to *lower* emissions from 1990 levels, requiring the average emissions-related technology to improve by more than a factor of ten during the next few decades and be rapidly deployed throughout the world. The benefits could be enormous, in part because of these technologies serve a number of other national goals, including reducing the emission of the criteria air pollutants and decreasing dependence on foreign oil.

Because of the high risk nature of R&D, a number of pathways could be pursued simultaneously:

Clean Power

- The next generation of natural gas technologies, including gas turbines and fuel cells, could achieve energy conversion efficiencies of 70% or more by 2005.

- The next generation of high efficiency coal-fueled power plants, such as integrated gasification combined cycle perhaps combined with a fuel cell, could achieve efficiency exceeding 55%, with half the CO2 emission of current plants.

- Renewable technologies—wind power, photovoltaics, biomass power, solar thermal, and geothermal—have seen sharp cost reductions in the past two decades, some by a factor of ten. Further R&D, coupled with expanded deployment to achieve economies of scale and improvements in manufacturing, would likely make one of more these technologies competitive with fossil fuels in a large number of areas in the next two decades.

- Nuclear fission and fusion remain options that could benefit from further R&D, though these raise significant environmental issues regarding waste handling and disposal.

Energy Efficiency

Transportation

The Partnership for a New Generation of Vehicles (PNGV) is a public-private partnership to design and build a triple-efficiency clean car by 2004. Multiple technology paths are being pursued to build a hybrid vehicle that has both an advanced engine (such as a clean diesel, Stirling or gas turbine) and an energy storage device (such as a battery, fly-wheel or ultracapacitor). Supporting R&D includes lightweight, super-strong materials such as composites; high-temperature ceramics; regenerative breaking; and advanced power electronics. Proton-exchange membane (PEM) fuel cells have perhaps the greatest long-term potential for reducing transportation CO2.

Biofuels also lower transportation CO2. Continued R&D in bio-engineered organisms and fast-growing crops is expected to produce ethanol from waste paper, crop waste, and dedicated crops for under 70 cents a gallon by 2005, competitive with oil at $25 a barrel.

Industry

The seven most energy-intensive industries—steel, aluminum, petroleum refining, chemicals, pulp and paper products, glass, and metal casting—account for about 80% of the energy consumed in U.S. manufacturing and more than 90% of the hazardous waste. They represent the largest opportunity for reducing industrial CO2 emissions, and the Energy Department is partnering with them because they significantly underinvest in R&D compared to the industry average. Key areas that would benefit from expanded R&D include advanced materials development; separation technology; catalysis; bioprocessing, biocatalysis, and renewable feedstocks; sensors and controls; and industrial cogeneration of electricity and heat, which can achieve overall efficiencies of more than 80% and ultimately utilize biomass.

Buildings

The buildings sector consumes one-third of the nation's energy and two-thirds of its electricity. Key near-term R&D opportunities include improvements in lighting, windows, design software, high-efficiency applicances, gas heat pumps, insulation and duct systems,

cooling including gas cooling, solar heating and cooling, daylighting, and urban heat island mitigation (reflective roofing and road materials). Longer term R&D needs include electrochromic glazings for windows, building-integrated PV systems, and PEM fuel cells.

Capture and Sequestration

If major reductions in CO2 emissions are necessary, and global reliance on fossil fuels continues beyond the middle of the next century, then some form of CO2 sequestration (i.e. capture and disposal) will be needed. A long-term R&D strategy would include demonstration of a number of sequestration options and research into their possible environmental impacts; converting CO2 into industrial chemical feedstocks; selectively permeable membranes for CO2 capture; processes for converting fossil fuels and biomass into CO2 and hydrogen; development of hydrogen infrastructure technology, including transportation and storage; and PEM fuel cells. Capture and sequestration has received only limited funding to date.

Advanced Research

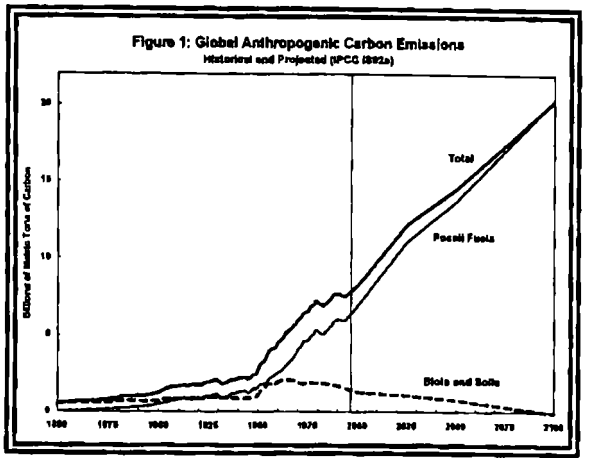
A number of areas of advanced research could prove crucial to responding to climate change, including photosynthetic mechanisms, biotechnology, fermentation microbiology, combustion research, polymer and ceramic science, process engineering, supercritical CO2, new materials synthesis, and nanotechnology. One essential area for expanded basic and applied R&D is superconductivity, which offers the possibility of nearly loss-less energy storage and transmission and of highly efficient superconducting motors.

Conclusion

A number of mitigation options exist for controlling greenhouse gas emissions. These can be organized in three general categories. First, greater efforts could be made to diffuse underutilized energy efficiency technologies. This could be accomplished through programs, such as those in the Climate Change Action Plan, to address lack of information and other market barriers. Second, new government interventions, either in the form of emissions trading and/or expanded regulatory programs, could be used to limit greenhouse gas emissions. Finally, additional incentives could be provided for (both government and private) research and development, since stabilization of atmospheric concentrations of greenhouse gases can only be accomplished if new non-fossil technologies are available and adopted.

Attachment 1: Global Trends in Emissions and Concentrations

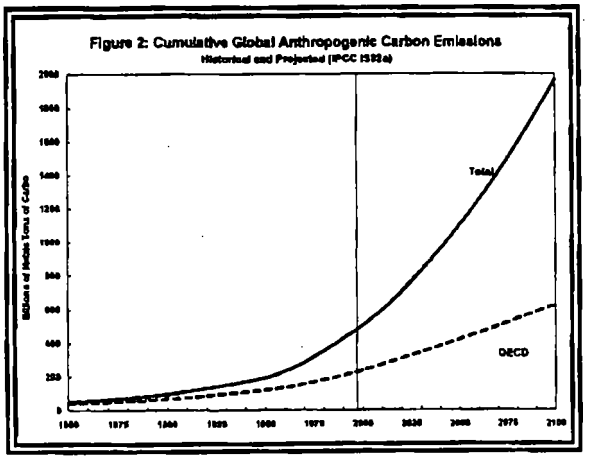
Growing emissions of greenhouse gases (GHGs) from industrial activity and land-use changes are rapidly raising the concentrations of these gases in the atmosphere, making some degree of climate change virtually certain. Although greenhouse gases come from many sources, carbon dioxide (CO_2) from fossil fuel use is the source of greatest concern because of its rapid historical and projected growth.[1] Atmospheric carbon concentrations are already over 30% higher than their pre-industrial levels and rising at about 4% per decade. The further potential for human activities to disrupt the natural balance is enormous because hundreds of years' worth of carbon (at current rates of use) are currently available in proved fossil fuel reserves that could be exploited under current economic and technological conditions – and even larger "ultimately recoverable" reserves. In the absence of controls, emissions are projected to grow quickly as the developing countries experience rapid population growth and industrial development. These trends are expected to lead to ongoing atmospheric accumulation and climate change into the indefinite future, with a doubling of atmospheric carbon concentrations sometime during the second half of the next century and a resulting long-run increase in average global temperatures by an estimated 1.5° to 4.5°C. Even stabilizing global emissions at 1990 levels *permanently* will lead to a near doubling of atmospheric carbon concentrations by the end of the next century.



Climate change is truly a global problem in the sense that emissions from anywhere will affect everyone everywhere. As a consequence, concerted international action will be needed to induce all countries to cooperate in reducing emissions. Nevertheless, cooperation will be hampered by the uneven distribution of past and future emissions. Simply put, the developed industrial nations have relatively high levels of per capita emissions and are largely responsible for past emissions, while the developing nations, whose per capita emissions are currently very low, will be responsible for the

[1] In total, 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. (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.) 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.

bulk of emissions in the future.[2] Since the developed countries have enjoyed high levels of emissions now and bear the greatest responsibility for current atmospheric concentrations, the developing countries have been reluctant to undertake any emissions reductions at all in the absence of significant emission controls on the part of the developed countries.



Yet, actions taken by the developed countries alone are likely to have little effect on cumulative global emissions or on atmospheric concentrations. Based on the projections shown in Figures 1 and 2, stabilization of Annex I country[3] emissions at 1990 levels from 2000 through 2100 would reduce cumulative carbon emissions by around 8%, and would reduce atmospheric CO_2 concentrations in 2100 by less than 5%. In other words, Annex I emissions stabilization will still lead to well more than a doubling of atmospheric CO_2 concentrations by 2100. Even stabilizing total global emissions – which, given anticipated population growth, would require dramatic reductions in global per capita emissions – will not lead to stabilized concentrations. *Stabilization of concentrations requires global emissions to fall well below current levels, and ultimately to decline to near zero.*

Table 1: Alternative Carbon Targets and Budgets		
Target	Carbon Budget 1991-2100 (GtC)	Reduction from 1500 GtC
450 ppm	630 - 650	-57% to -58%
550 ppm	870 - 990	-34% to -42%
650 ppm	1030 - 1190	-21% to -31%
750 ppm	1200 - 1300	-13% to -20%

Researchers have examined in some detail the annual emissions paths required to meet atmospheric carbon concentration targets of 450 to 750 ppm.[4] As shown in Table 1, all of these targets require significant reductions in cumulative

[2] 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. (Developing county emissions grew by 21% between 1990 and 1995, and 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. 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.

[3] The OECD nations plus the former Soviet Bloc.

[4] The lower target would limit the projected average global temperature increase to roughly between 0.6°C to 1.75°C; the higher target would limit the increase to between 1.4°C to 3.5°C.

projected global carbon emissions; and as shown in Figures 3 and 4, all of them require dramatic reductions in annual emissions rates sometime during the next century. To achieve a 450 ppm target – which still represents a two-thirds increase in atmospheric

Figure 3: Alternative Atmospheric Concentration Pathways

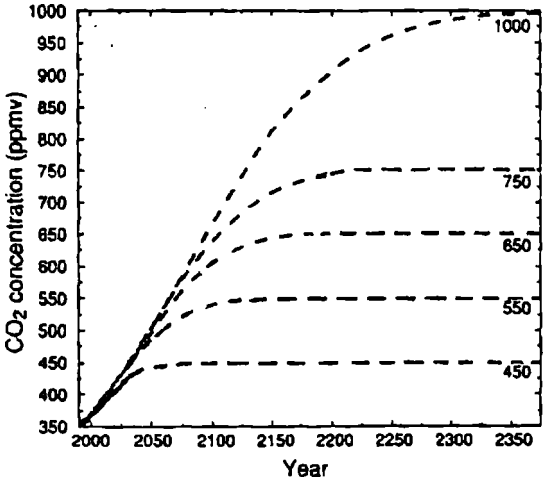
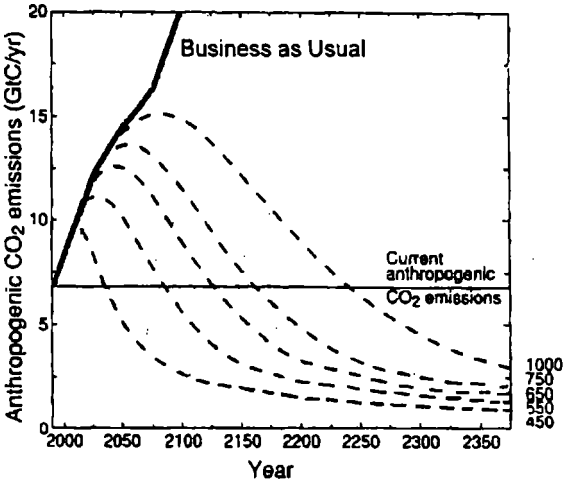


Figure 4: Emission Scenarios to Meet Alternative Atmospheric Concentrations



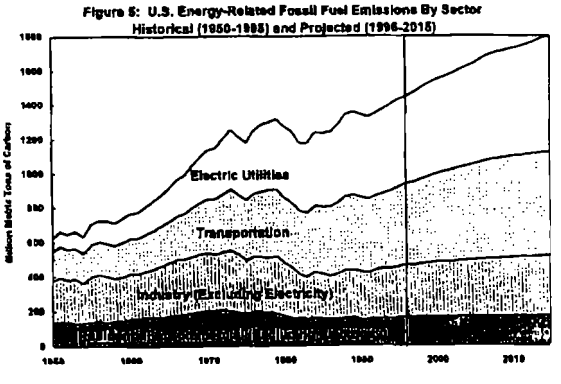
concentrations over preindustrial levels – annual emissions must begin declining steeply within the next quarter-century and must fall to less than half the current rate by 2100. To achieve a 550 ppm concentration target – which represents more than a doubling in atmospheric concentrations – annual emissions must begin declining steeply during the second quarter of the century. Furthermore, these budgets must be distributed both across countries and across time. And while emissions can increase in the near term, higher growth in emissions in the near term must be offset by increasingly dramatic reductions later on.

Attachment 2: U.S. Emission Trends

In 1995, gross greenhouse gas emissions in the U.S. were about 1,674 MMTCe (million metric tons of carbon equivalent), of which more than 85% were carbon emissions from fossil fuel combustion. Methane emissions (mainly from landfills and agricultural activities) accounted for 11%, nitrous oxides 2% and various halocarbons 2%. These emissions were offset by roughly 100 MMTCe of carbon sequestered by the nation's forests. U.S. greenhouse gas emissions have risen nearly 7% in the past five years.

Annual U.S. fossil-related carbon emissions have grown from around 620 MMTC (million metric tons of carbon) in 1950 to about 1430 MMTC in 1996, and are projected to rise to around 1800 MMTC over the next twenty years. Coal's share of the total has fallen from 50% in 1950 to 35% in 1996; while oil's share has risen from 36% to 42% and natural gas' share has risen from 14% to 23%. These shares are expected to remain fairly steady over the next quarter century.

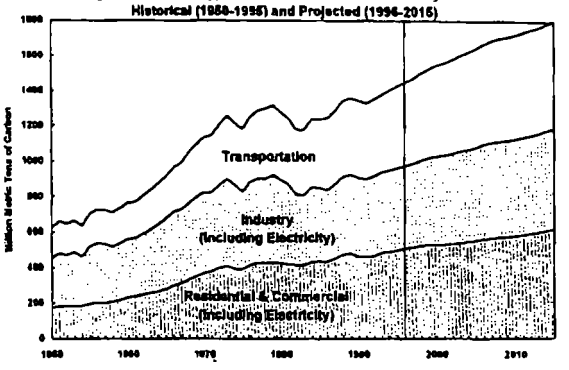
The electric utility sector's share has grown from 12% in 1950 to 35% in 1996 (500 MMTC), as the American economy has steadily increased its use of electricity. Over 85% of electric utility sector carbon emissions come from burning coal. Similarly, the transportation sector's share of fossil-related carbon emissions has grown from 28% in 1950 to 33% in 1996 (470 MMTC), with oil accounting for practically all of the fuel use in the transportation sector. Thus, the transportation and utility sectors together currently account for 68% of U.S. fossil-related carbon emissions.



In contrast, carbon emissions from the residential and commercial sectors' direct energy use have fallen from 22% of the total in 1950 to 12% in 1996; while emissions from industrial direct energy use have fallen from 38% to 20%. However, if electricity-related carbon emissions are attributed to the sectors that consume the electricity (rather than to the utility sector which produces it), the residential and commercial sectors' share has risen from 28% in 1950 to 35% in 1996. In contrast, the industrial sector's share has fallen from 44% in 1950 to 32% in 1996, as industry's share of economic activity has declined and services' share has risen.

Attributing electricity-related emissions to end-use sectors, then, 35% of carbon emissions are related to households and commercial businesses; 33% are related to transportation, and 32% are related to industry. These shares are projected to remain fairly constant over the next twenty to twenty-five years, although transportation's share of carbon emissions will increase slightly, while electricity generation will account for a slightly increasing share of primary energy consumption.

Figure 6: U.S. Energy-Related Fossil Fuel Emissions By Sector
Historical (1958-1995) and Projected (1996-2015)



Note: The numbers on this page are approximate welfare effects to show gains from participating in permit trading. [these are approximations and they will be improved in a later version]

Approximation of Cost (0.5 * tax * change in carbon)

Cost: Independent Stabilization Relative to Reference Case (millions of US$)

	Canada	FSU	Japan	USA	W. Europe	Australia
1985	0	0	0	0	0	0
1990	0	0	0	0	0	0
1995	0	0	0	0	0	0
2000	0	0	0	0	0	0
2005	0	0	0	0	0	0
2010	-3497	0	-7286	-9755	-69446	-634
2015	-3360	0	-4849	-9820	-91148	-424
2020	-2485	0	-2929	-6761	-138116	-187

Cost: Annex I Stabilization (millions of US$)

	Canada	FSU	Japan	USA	W. Europe	Australia
1985	0	0	0	0	0	0
1990	0	0	0	0	0	0
1995	0	0	0	0	0	0
2000	0	0	0	0	0	0
2005	0	0	0	0	0	0
2010	-505	-6771	-895	-7001	-4955	-311
2015	-290	-3236	-415	-3744	-3091	-179
2020	-224	-3226	-297	-3219	-2497	-140

Difference in Cost Between Independent Stabilization and Annex I Stabilization (excluding revenues from permit sales)

	Canada	FSU	Japan	USA	W. Europe	Australia
1985	0	0	0	0	0	0
1990	0	0	0	0	0	0
1995	0	0	0	0	0	0
2000	0	0	0	0	0	0
2005	0	0	0	0	0	0
2010	2992	-6771	6391	2754	64491	323
2015	3070	-3236	4434	6076	88057	245
2020	2262	-3226	2632	3543	135619	46

Revenue (+) or Expenditure (-) on Sale of Carbon Permits (millions of US$)

	Canada	FSU	Japan	USA	W. Europe	Australia
1985	0	0	0	0	0	0
1990	0	0	0	0	0	0
1995	0	0	0	0	0	0
2000	0	0	0	0	0	0
2005	0	0	0	0	0	0
2010	-1350	19411	-2558	-2334	-12971	-204
2015	-991	17060	-1600	-4347	-9972	-149
2020	-736	15553	-1048	-2993	-10766	-49

Net Gain (+) or Loss (-) on Carbon Trading Relative to Annex I Stabilization (millions of US$)

	Canada	FSU	Japan	USA	W. Europe	Australia
1985	0	0	0	0	0	0
1990	0	0	0	0	0	0
1995	0	0	0	0	0	0
2000	0	0	0	0	0	0
2005	0	0	0	0	0	0
2010	1642	12639	3833	419	51520	118

2015	2080	13824	2833	1729	78085	96
2020	1526	12327	1584	549	124853	-3