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Remarks by Vice President Al Gore
The United Nations Committee on Climate Change Conference of the Parties
December 8, 1997
Kyoto, Japan

Thank you. Prime Minister Hashimoto and President Figueres, President Kinza Clodumar, other distinguished heads of state, distinguished delegates, ladies and gentlemen.

It is an honor to be here at this historic gathering, in this ancient capital of such beauty and grace. On behalf of President Clinton and the American people, and our U.S. negotiator, Ambassador Stu Eizenstat, I salute our Japanese hosts for their gracious hospitality, and offer a special thank you to Prime Minister Hashimoto, and to our chairs, Minister Ohki, and Ambassador Estrada, for their hard work and leadership.

Since we gathered at the Rio Conference in 1992, both scientific consensus and political will have come a long way. If we pause for a moment and look around us, we can see how extraordinary this gathering really is.

We have reached a fundamentally new stage in the development of human civilization, in which it is necessary to take responsibility for a recent but profound alteration in the relationship between our species and our planet. Because of new technological power and our growing numbers, we now must pay careful attention to the consequences of what we are doing to the Earth - especially to the atmosphere.

There are other parts of the Earth's ecological system that are also threatened by the increasingly harsh impact of thoughtless behavior:

The poisoning of too many places where people -- especially poor people -- live, and the deaths of too many children -- especially poor children -- from polluted water and dirty air.

The dangerous and unsustainable depletion of ocean fisheries. And

The rapid destruction of critical habitats -- rain forests, temperate forests, boreal forests, wetlands, coral reefs, and other precious wellsprings of genetic variety upon which the future of humankind depends.

But the most vulnerable part of the Earth"s environment is the very thin layer of air clinging near to the surface of the planet. that we are now so carelessly filling with gaseous wastes that we are actually altering the relationship between the Earth and the Sun -- by trapping more solar radiation under this growing blanket of pollution that envelops the entire world.

The extra heat which cannot escape is beginning to change the global patterns of climate to which we are accustomed, and to which we have adapted over the last 10,000 years.

Last week we learned from scientists that this year, 1997, with only three weeks remaining, will be the hottest year since records have been kept. Indeed, nine of the ten hottest years since the measurements began have come in the last ten years. The trend is clear. The human consequences -- and the economic costs -- of failing to act are unthinkable. More record floods and droughts. Diseases and pests spreading to new areas. Crop failures and famines. Melting glaciers, stronger storms, and rising seas.

Our fundamental challenge now is to find out whether and how we can change the behaviors that are causing the problem.

To do so requires humility, because the spiritual roots of our crisis are pridefulness and a failure to understand and respect our connections to God's Earth and to each other.

Each of the 160 nations here has brought unique perspectives to the table, but we all understand that our work in Kyoto is only a beginning. Non of the proposals being debated here will solve the problem completely by itself. But if we get off to the right start here, we can quickly build momentum as we learn together how to meet this challenge. Our first step should be to set realistic and achievable, binding emissions limits, which will create new markets for new technologies and new ideas that will, in turn, expand the boundaries of the possible and create new hope. Other steps will then follow. And then, ultimately, we will achieve a safe overall concentration level for greenhouse gases in the Earth's atmosphere.

This is the step-by-step approach we took in Montreal ten years ago to address the problem of ozone depletion. And it is working.

This time, success will require first and foremost that we heal the divisions among us.

The first and most important task for developed countries is to hear the immediate needs of the developing world. And let me say, the United States has listened and we have learned.

We understand that your first priority is to lift your citizens from the poverty so many endure and build strong economies that will assure a better future. This is your right: it will not be denied.

And let me be clear in our answer to you: we do not want to founder on a false divide. Reducing poverty and protecting the Earth's environment are both crucial components of truly sustainable development. We want to forge a lasting partnership to achieve a better future. One key is mobilizing new investment in your countries to ensure that you have higher standards of living, with modern, clean and efficient technologies.

That is what our proposals for emissions trading and joint implementation strive to do.

To our partners in the developed world, let me say we have listened and learned from you as well. We understand that while we share a common goal, each of us faces unique challenges.

You have shown leadership here, and for that we are grateful. We came to Kyoto to find new ways to bridge our differences. In doing so, however, we must not waiver in our resolve. For our part, the United States remains firmly committed to a strong, binding target that will reduce our own emissions by nearly 30 percent from what they would otherwise be -- a commitment as strong, or stronger, than any we have heard here from any country. The imperative here is to do what we promise, rather than to promise what we cannot do.

All of us, must reject the advice of those who ask us to believe there really is no problem at all. We know their arguments: we have heard others like them throughout history. For example, in my country, we remember the tobacco company spokesman who insisted for so long that smoking did no harm. To those who seek to obfuscate and obstruct, we say: we will not allow you to put narrow special interests above the interests of all humankind.

So what does the United States propose we do?

The first measure of any proposal must be its environmental merit, and ours is environmentally solid and sound.

It is strong and comprehensive, covering all six significant greenhouse gases. It recognizes the link between the air and the land, including both sources and sinks. It provides the tools to ensure that targets can be met -- offering emissions trading, joint implementation and research as powerful engines of technology development and transfer. It further reduces emissions -- below 1990 levels -- in the years 2012 and beyond. It provides the means to ensure that all nations can join us on their own terms in meeting this common challenge.

It is also economically sound. And, with strict monitoring and accountability, it ensures that we will keep our bond with one another.

Whether or not agreement is reached here, we will take concrete steps to help meet this challenge. President Clinton and I understand that out first obligations is to address this issue at home. I commit to you today that the United States is prepared to act -- and will act.

For my part, I have come here to Kyoto because I am both determined and optimistic that we can succeed. I believe that by our coming together in Kyoto we have already achieved a major victory, one both of substance and of spirit. I have no doubt that the process we have started here inevitably will lead to a solution in the days or years ahead.

Some of you have, perhaps, heard from your home capitals that President Clinton and I have been burning up the phone lines, consulting and sharing new ideas. Today let me add this. After talking with our negotiators this morning and after speaking on the telephone from here a short time ago with President Clinton, I am instructing our delegation right now to show increased negotiating flexibility if a comprehensive plan can be put in place, one with realistic targets and timetables, market mechanisms, and the meaningful participation of key developing countries.

Earlier this century, the Scottish mountain climber, W.H. Murray, wrote:

"Until one is committed there is hesitancy, the chance to draw back, always ineffectiveness. Concerning all acts of initiative. . .there is one elementary truth, the ignorance of which kills countless ideas and splendid plans: that the moment one definitely commits oneself, providence moves, too."

So let us press forward. Let us resolve to conduct ourselves in such a way that our children's children will read about the "Spirit of Kyoto," and remember well the place and the time where humankind first chose to embark together on a long-term sustainable relationship between our civilization and the Earth's environment.

In that spirit, let us transcend our differences and commit to secure our common destiny: a planet whole and healthy, whose nations are at peace, prosperous and free; and whose people everywhere are able to reach for their God-given potential.

Thank you.

DISCUSSION PAPER

This paper considers several ways of adjusting our position in the climate negotiations, to help shape a deal at Kyoto.

The paper does not assume that it would be desirable to adjust our position in the climate negotiations. Instead, the paper explores different ways in which we might do so, examining pros and cons. Furthermore, the paper does not attempt to package the discrete elements considered into a larger whole. Based on feedback from principals, larger packages and broader strategies will be developed.

I. TARGETS AND TIMETABLES

Our proposal -- 1990 levels by 2008-2012 and reductions in the five-year period that follows -- has attracted no international support. The prospects that such a target will be sufficient to convince key negotiating partners to accept other parts of our framework (i.e., flexibility and developing country participation) are very slim.

Following are possible compromise approaches on targets and timetables:

A. Accept "differentiated" targets

This is the term used to describe different targets for different Annex I countries. The idea has considerable support from some of our natural allies in the negotiating process (including Japan, Norway and Australia). During the past several months, Climate Convention Chairman Estrada has increasingly been saying that some form of differentiation will be required for an agreement at Kyoto. To date, the EU has opposed "differentiation" labeled as such, although their "bubble" is (in fact) a differentiation scheme.

1. Japanese proposal

The Japanese propose that all Annex I countries reduce emissions 0-5% from 1990 levels by 2008-2012. The precise amount each country must reduce would be determined based on rates of change in population growth, energy intensity and/or per capita emissions. Under the Japanese formula, both the U.S. and Japan would need to reduce emissions roughly 2.5%.

Pros

- Forging common ground with the Japanese could offer strategic advantage within the negotiations.

- Japanese reduction targets are not significantly different than our own. Japanese may have flexibility to move toward us.

- The Japanese proposal constrains the differentiation within a very narrow range, avoiding widely disparate targets for Annex I countries in this round of negotiations.

Cons

- Reductions from 1990 levels in 2008-2012 would be very difficult domestically.

- EU opposes differentiation-by-formula component of Japanese position.

- By accepting the principle of differentiation-by-formula, we could open a Pandora's box of proposals for different targets based on different national circumstances.

2. Differentiation by baseline year

Another approach is to have common reduction targets for all Annex I countries, but allow countries some discretion in choosing a baseline year. For example, Annex I countries could agree to reduce emissions by 7.5%, with countries free to pick any baseline year between 1987 and 1995.

Pros

- Could thread the needle between EU and US positions, meeting the EU's domestic political need to claim "significant reductions" while allowing U.S. to stay at target level we have already proposed.

- Providing some pre-1990 baseline flexibility would be helpful in gaining the support of the Economies in Transition.

Cons

- The 1990 baseline is one of the few points of agreement in the international negotiations.

- Could be attacked as a gimmick by the environmental community, while Congress and industry would need assurance that we were not in fact proposing anything more stringent.

3. Pledge and Negotiate

Another possibility is for each Annex I country to propose its own target, to be included in the agreement. Country A could insist on more from Country B before signing, but the negotiations would focus on individual country commitments, not commitments for Annex I as a whole.

Pros

- May be only feasible approach, in light of wide range in willingness of Annex I countries to commit to reductions.

Cons

- Would lead to fractured Convention, difficult to explain to public.
- If some Annex I countries pledge significantly less than the U.S., could make domestic implementation and consensus-building more difficult.

"Pledge and negotiate" could be combined with "differentiation by baseline year." Under such an approach, each country could express its pledge in terms of a baseline year and reduction target of its choosing.

B. Support Specific Reductions in 2013-2017

In his speech, the President proposed reductions from 1990 levels in 2013-2017, without specifying a number. We could propose a specific number for this period.

Pros

- Would be seen abroad as an indication of U.S. seriousness, especially if number were greater than 5%.
- Could put counter-pressure on the EU, whose long-term projections apparently raise concerns about their ability to meet a tough target in this timeframe (because of anticipated growth in eastern Germany and the possibility of future more Warsaw Pact countries joining the Union).
- Would be well-received by the domestic environmental community.

Cons

- Lose an important piece of leverage for any future round of negotiations with developing countries.

- Congressional and business reaction would likely be negative. Some supporters of the Byrd Resolution would oppose our signing up for second budget period before getting a commitment out of developing countries for a first.

C. Exclude Certain Gases from U.S. Proposal

The United States has proposed to include six major greenhouse gases (carbon dioxide, methane, nitrous oxide, HFCs, PFCs and SF-6) in our target. The EU and Japanese proposals do not include HFCs, PFCs and SF-6. These three gases have very high Global Warming Potentials. (SF-6 is roughly 25,000 times more potent than carbon dioxide.)

We could propose to drop HFCs, PFCs and SF-6 from our target. [According to some estimates, this would allow us to accept a 2-3 percent reduction below 1990 levels in the same 2008-2012 period at equivalent economic cost.]

Pros

- This could help provide the leeway to propose the reduction target we have been under pressure to produce internationally.

- By counting the same sources as the EU and Japan, it would allow for a fairer and more accurate comparative assessment of our proposal.

Cons

- U.S. manufacturers of HFCs, PFCs and SF-6 want these gases *included* in the agreement. (These manufacturers want to establish a regime in which required reductions in these three gases can be traded for reductions in carbon dioxide. They want to avoid a regime which leads to phase-outs targeted narrowly to these gases.)

- Getting other countries to *include* all six gases appears to be an area where we actually made some progress in Bonn. A "comprehensive" approach is a long-standing element of the U.S. position.

- Allowing unregulated growth in these gases would be bad for the environment.

Note: If we choose to maintain our current position, we may want to get more mileage out of doing so, both diplomatically and in the realm of public opinion. It seems that our "comprehensive approach" could be earning us some credit, particularly if it can be argued that this makes our proposal stronger than Japan's.

D. Support an Aspirational Target

We could accept a legally-binding target at roughly the level we have proposed and a more stringent, non-binding target.

Pros

- Could provide a way for EU politicians to claim that "significant reductions" were agreed at Kyoto.
- While ensuring a minimum standard of achievement across Annex I, would provide a vehicle for "greener" countries and environmental groups to continue to prod for steeper cuts.

Cons

- Internationally, this approach is unlikely to be viewed as credible, insofar as one of the defining features of these negotiations is "legally-binding targets."
- Domestically, could make everyone mad. Congress and much of the business community could be concerned that the non-binding target would translate into additional regulations and possible economic costs down the road. Many environmental groups could be concerned that non-binding targets would have limited meaning.

E. Adjust Methodologies for Sinks

White House and agency staff are intensively examining different opportunities related to the treatment of sinks. Although further work is needed, two options may be promising. They are:

1. Excluding "soil carbon" from the agreement. According to projections, U.S. soils will absorb roughly 30 MMT less carbon in 2010 than they did in 1990. However, methodologies for these calculations are highly uncertain. If "soil carbon" were excluded from the agreement, the U.S. reduction target would shrink by 30 MMT (approximately 7% of the emissions growth from 1990 to 2010).

2. **Modified New Zealand Proposal**. Under a proposal currently under discussion internationally, 1990 baselines for Annex I countries would be adjusted so as not to penalize countries (like the US) that were engaged in unusually high levels of forestation in that year. This requires further analysis, but could be helpful.

F. Strengthen our Existing Target

Flexibility: Agree to strengthen our existing target either by accepting reductions below the 1990 baseline in the 2008-2012 period or by moving up our timetable for stabilization (i.e. 2005-2012 or even 2005-2015).

Pros

Strengthening our target would help bridge the gap with the EU and gain support from the G-77 for other elements of our proposal. We would get more credit for accepting reductions below the 1990 baseline than for moving the timetable.

Cons

Given that the President has already announced our target and given the economic and political realities associated with it, it is unlikely that we could move far enough to make much of a difference.

Any agreement to reductions below the 1990 level seems improbable in the absence of new and compelling economic analysis that such reductions could be achieved without higher costs.

Opting for a 2005-2012 time frame seems almost equally hard. It might be possible to argue for the 2007-2013 or 2005-2015 possibility by playing both ends of the timetable (i.e. emphasizing the earlier start for environmentalists and the later end for industry).

II. FLEXIBILITY PROVISIONS

Our emissions trading proposals are winning only limited support abroad. Although there are reasonable prospects that Annex I emissions trading will be accepted by the Parties, significant restrictions on such trading are possible. These include (1) provisions requiring domestic emissions reductions to be the "main" means of meeting Party's commitments, (2) provisions limiting to trading to "Parties," and (3) restrictions that may emerge as methodologies for emissions trading are developed after Kyoto. In addition, support for joint implementation for credit is very limited. It appears very unlikely that Parties will agree at Kyoto to joint implementation for credit, except among Annex I countries and with those developing countries who "volunteer" for binding limits.

Note: The SGM model suggests that over 50 percent of U.S. reductions are likely to come from abroad.

- According to the SGM model, 55 percent of our reductions to reach 1990 levels by 2010 are likely to come from Annex I trading and 83 percent from Annex I trading plus non-Annex I reductions. (Two notes: First, the figures are lower if paper tons are not allocated to the former Soviet Union. Second, the model assumes worldwide trading -- not "JI.")

A very rough rule of thumb from the economic models is that every 10 percentage point increase in the share of reductions that must be done domestically (above those that would occur at home without any restriction) raises the domestic permit price by perhaps $10 to $20 per ton.

Restricting the share of reductions from international trading and/or JI would raise costs domestically, but would reduce concerns associated with capital transfers abroad.

III. PARTICIPATION OF DEVELOPING COUNTRIES

Our "evolution" proposal -- that developing countries agree to negotiate binding limits as part of a Kyoto protocol -- has no support from other countries and is dead. A weaker version -- under which Parties would decide at Kyoto to begin such negotiations under a document other than a protocol -- has some modest prospects for success. However, the terms for any such agreement are unlikely to be favorable. At this writing, it appears that the strongest possible mandate would be an agreement to aim to negotiate limits of some kind (i.e., not necessarily binding limits) by 2002 or 2003 at the earliest. Even this is far from certain.

In recent weeks, staff for Senator Byrd has been stressing that an "agreement to negotiate" is not satisfactory to the Senator and would not in the Senator's view address the concerns expressed in his resolution.

Other parts of the original U.S. proposal for developing country participation are meeting with somewhat greater success. There is now a reasonable chance that a protocol could include a "volunteers category" -- that is a section providing for non-Annex I countries to volunteer for commitments individually. Such action could give countries the right to participate in the global trading regime.

The current state of play raises two questions:

A. Which would be preferable: an "evolution" provision with a 2002/2003 end-date and soft "aim to negotiate" language, or no "evolution" provision at all?

- An evolution provision, however soft, could generate momentum internationally toward the participation of developing countries and help keep this issue on the agenda. It could be part of our explanation at home of the steps we are taking to engage developing countries.

- On the other hand, the terms of the mandate could become a constraint -- e.g., no *sooner* than 2002/2003. They could also underscore the unwillingness of developing countries to participate, while providing no benefit with Senator Byrd and his allies. Even getting a soft mandate would require a fair amount of diplomatic effort and perhaps concessions.

B. Is the U.S. prepared to return from Kyoto without any form of evolution provision but -- instead -- with an agreement on a "volunteers category" and plans to persuade key developing countries to "volunteer" before any protocol became binding in the U.S.?

- Bilateral discussions with key developing countries may bear more fruit than talks in the highly-politicized atmosphere of the Climate Convention. Success with a few key countries could help significantly both to address the environmental need and to respond to domestic political concerns.

- However, this approach could be viewed as inadequate by many at home and bad faith by many abroad. Could be especially difficult if no major developing countries indicate an interest in volunteering at Kyoto. The sequencing could be awkward, if we are asking key developing countries to sign onto commitments (e.g., in 1998 and 1999) before we decide to make our Kyoto commitments binding on ourselves.

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Office of Economic Policy

Department of the Treasury
Washington, D.C. 20220

FAX

Date: 10/22/97
Number of pages including cover sheet: 26

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To:	Joe Aldy	395-6809	395-1455
From:	Jon Gruber	202-622-2633	622-0563

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

DEPARTMENT OF THE TREASURY
WASHINGTON, D.C. 20220

October 22, 1997

MEMORANDUM TO: DEPUTY SECRETARY SUMMERS

FROM: JONATHAN GRUBER

RE: **Responses to Your Questions on Climate Change**

You had asked nine questions related to the economic analysis of the administration's climate change proposal:

Variation in Gas and Energy Prices Over Time

Depending on the ultimate rise in carbon permit prices, the increase in gasoline prices expected from the President's plan may be no larger than the normal month-to-month and year-to-year variation in these prices.

Retail gasoline prices vary considerably from one month to the next. For example, in November 1995, new rules requiring oxygenated fuels in the winter months went into effect in Washington and several other metropolitan areas. This caused the price of gasoline at the pump in the Washington area jumped by 10 cents per gallon overnight -- an increase equivalent to a $40 per ton carbon tax, yet few consumers noticed. In the same way, the seasonal increase in summertime demand raises gasoline prices by several cents per gallon for several months each year.

Year-to-year changes have often been greater than the price change expected to result from the President's plan. We attach to this memo (**TAB A**) a graph of gas and energy prices since 1970, as well as a printout of the underlying data points.

- The table shows: real gas prices; the year to year change; the energy price index; and the year to year percentage change in that index.
- The average of the absolute value of year to year changes since 1970 for gas prices is 11 cents; this is equivalent to the gas price increase from a $42/ton price of carbon. There are five years over this period in which price changes exceeded 26 cents, or the equivalent of $100/ton
- The average from 1983 to 1997 is 8 cents, equivalent to a $31/ton price of carbon; there is only one large change overthis period.
- The changes in overall energy prices is much less pronounced year to year, and does not seem to make the point as well.

Moreover, the effects of the President's plan would not all be felt in one year, further dampening the effect on prices.

We should note, however, that this argument *appears to contradict the comparison you have drawn with the OPEC oil shocks throughout the internal Administration debate.*

Historical Perspective on Energy and Resource Utilization

After both oil shocks, we heard predictions of the catastrophes that lay ahead -- oil prices would continue to climb, and the economy would crash. For example:

- On March 31, 1979, President Carter said, "There is a dwindling supply of energy sources. Prices are going to rise in the future no matter which party occupies the administration in Washington, no matter what we do." Actually, prices then fell for five straight years, from 1981 through 1986. In 1982, the economy launched its longest postwar expansion, which continues today, 15 years later. The Clinton Administration's climate policy is not expected to have nearly the effect on energy prices than the oil shocks.

- The 1972 bestseller, *The Limits to Growth,* contained dire predictions of impending resource depletion: the world would run out of gold by 1981, mercury by 1985, tin by 1987, zinc by 1990, **petroleum by 1992,** and copper, lead, and natural gas by 1993. None of these predictions came true; indeed the real prices of natural resources have been steadily dropping.

We attach (**TAB B**) a list of other recent resource forecasts that turned out to be very wide of the mark.

Detailed Evaluation of the Emissions Implications of Electricity Restructuring

We attach to this memo (**TAB C**) a draft memo from the Energy Department on carbon emissions implications of restructuring, including the administration add-ons of the RPS, the Public Benefits Fund, and green marketing. Under pressure from EPA, the Energy Department has presented a broad estimate, ranging from an emissions increase of 20 MMT to an emissions reduction of 84 MMT. This consists of a narrower range of effects of retail restructuring itself (-25 to +33 MMT), along with modest impacts of administration add-ons (-36 to -13 MMT). The consensus among economics experts such as Paul Joskow is that the *best guess for the long run is a small emissions reduction* (on the order of 20-40 MMT).

Relative to trend emissions in this sector, *this consensus is plausible.* Current emissions in the electric sector are 506 MMT, projected to rise to 626 MMT in 2010. So the consensus estimate of a 20-40 MMT reduction represents a reduction in emissions growth of one-sixth to one-third; even the upper bound estimate would have emissions growing by almost 10% above today's level.

The Potential for Worldwide Trading

We attach to this memo (**TAB D**) a qualitative analysis describing the great potential of international cooperation for reducing carbon abatement costs. In particular, the attachment discusses how the energy inefficiency and greater expected growth of non-OECD countries make joint implementation (JI) and permit trading important avenues for reducing costs. We note in particular that a World Bank study suggests that emissions reductions in China before 2020 could save roughly as much in carbon emission as the U.S. would have to reduce to achieve 1990 levels by 2010. Anecdotal evidence describes the untapped potential for efficiency gains in developing and transitional economies and also highlights the success of JI pilot projects.

How do we Distinguish Our "Phase I" Plan from the Climate Change Action Plan?

Phase I of the president's plan calls for new technology spending of roughly $1 billion per year, but no explicit price of carbon. The question is whether this represents a real step beyond the Climate Change Action Plan, which has been regarded by some as a failure. The White House has produced a good set of talking points on this issue, which we draw on and expand here:

- The President's plan includes substantially ***more funding***: $5 billion over 5 years--about 6 times as much funding as for the Climate Change Action Plan (Note on funding: the President's plan has about 3 times more funding than CCAP plus the Partnership for a New Generation of Vehicles).

- The President's proposal now includes ***binding*** targets. In expectation of these binding targets, firms and households will begin to adjust their behavior today -- a factor not present in the Climate Change Action Plan.

- To provide further incentives for firms to take action now, the President has indicated his strong support for developing an ***early credit*** program of appropriate rewards for those who take prompt early action.

- The President has indicated his support for environmentally-friendly ***electricity restructuring***, which has the potential to reduce emissions significantly.

- The President has announced that the US will provide $1 billion over the next 5 years to ***help developing nations*** and countries in transition to reduce the threat of climate change.

What are the Assumptions of the Models that Generate Small Economic Effects?

The White House talking points cite model results that suggest that with worldwide permit trading, the United States could reach 1990 emissions levels by 2010 with a permit price of $25 in 2010, and a loss of only 0.1% of GDP.

These results come from Battelle's Second Generation Model (SGM), used in the IAT's work earlier this year. SGM is a 12-region model that includes 10 supply sectors (of which 8 are energy-related), with capital modeled as "putty-clay". SGM includes 2 end-use sectors, households and government, which consume final products, provide labor, land, and capital to the markets, and determine the savings rate. The model allows regions to trade goods. SGM models energy as a depletable, graded resource for both fossil and non-fossil fuels.

Can Other Examples be Used to Demonstrate that our Assumptions are Overly Pessimistic?

As you know, a recent article in the American Prospect highlighted a number of other environmental control programs where the initial cost estimates turned out to be overly pessimistic. Unfortunately, most of their examples have fundamental flaws in one way or another. There are three examples that do bear scrutiny:

- *Cotton dust*. Actual costs were below estimated costs in part because estimates were based on models that did not include the effects of technical change in the industry, which was accelerated by the new standards.
- *Strip mining*. Early costs estimates referred to reclamation at mines in operation at the time. In response to the law, however, producers expanded operations at sites where reclamation costs were lower, often on flatter terrain.
- *Vinyl chloride*. Early estimates were based on static cost models, and did turn out to be too high.

A number of examples are not relevant, as discussed in the attached memo. In particular, you asked about CFCs. EPA's estimates for the cost of reducing CFC production fell from $3.55 per kg (1988) to $2.45 per kg (1996), with the latter price for a more stringent standard. But the well-publicized problem of CFC smuggling indicates that control costs at the margin, which is what counts, are much higher than these estimates. CFC-12, the most common form, now has a street value of about $50/kg. By one estimate, 10 thousand tons of CFCs are now smuggled into the US every year; by comparison, legal production is 100 thousand tons this year.

We attach (TAB E) a memo that describes this conclusion in more detail, as well as the American Prospect article itself.

What Assumptions Underlie the Estimates of Massive Job Loss from the President's Plan?

The widely publized recent job loss estimates come from the EPI, a labor union think-tank, which projects job losses of 1.7 million by 2010. These estimates are implausible, for a number of reasons:

- Many IAT reviewers, including Nordhaus and Jorgenson, note that short-term macro models, such as the EPI-GRI model, are not appropriate for long-term predictions.
- The DRI model used in this study is very sensitive to changes in assumptions. In this study, DRI ran a short-term macro model with assumptions that would provide a worst-case result: a $200 permit price, increased emissions baseline, and decreased rate of efficiency

improvements.

- The study also ignores Annex I trading, JI, or worldwide trading; worldwide trading has been estimated to lower costs by 50-75% in other models.

- A key contributor to the large unemployment effects appears to be large trade effects, which are inconsistent with other models and probably reflects weak trade modelling.

- It is worth noting that this is not the first time that EPI has staked out this position on job loss; their estimates of the effects of NAFTA have been proven to be wildly pessimistic.

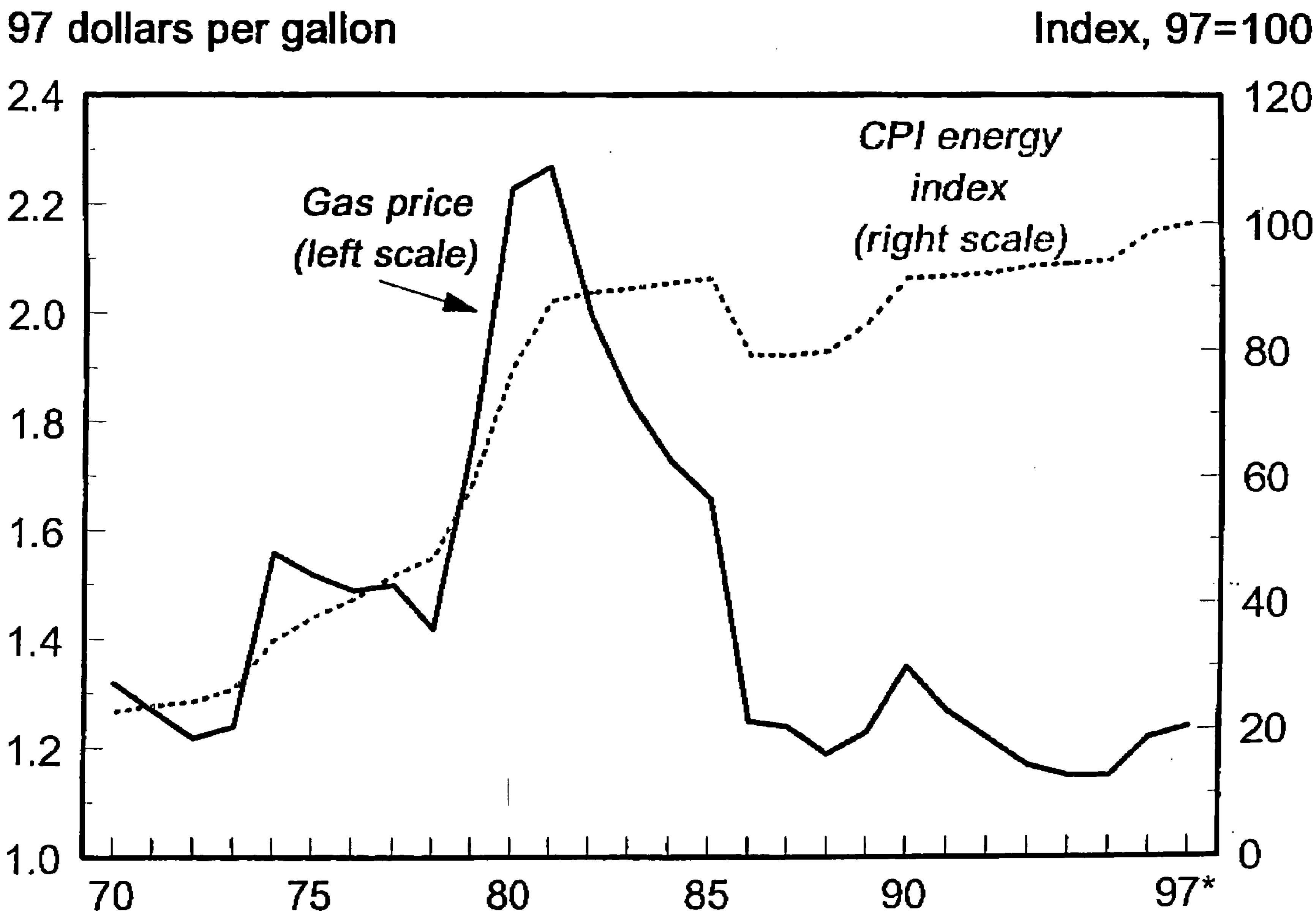
We attach a detailed critique of the EPI-DRI study as **TAB F.**

To What Extent can the Cost Savings from Electricity Deregulation Offset Price Increases Due to our Climate Change Plan?

- Electricity restructuring would reduce electricity prices by 0.5 to 1.1 cents per kw-hour; a carbon tax of $30 to $70 per ton would raise electricity prices by the same amount. This comparison is misleading, however, since the price reduction from electricity restructuring falls only on the electricity sector, while the price increase from a carbon tax would increase prices for other carbon-based fuels as well.

- Electricity restructuring is expected to save the average 4-person family about $232-$488 per year; a carbon tax of roughly $15 to $35 per ton would cost the average family about the same amount.

RETAIL ENERGY PRICES



* 1997 based on 7-month average

RETAIL PRICES OF GASOLINE AND TOTAL ENERGY

	Gasoline (1997 price per gallon)	Year-to-year change	Consumer energy price index (1997=100)	Percent Change
1970	1.32		22.911	
1971	1.27	-0.04	23.824	1.0
1972	1.22	-0.06	24.483	1.0
1973	1.24	0.02	26.453	1.1
1974	1.56	0.32	34.179	1.3
1975	1.52	-0.04	37.803	1.1
1976	1.49	-0.02	40.544	1.1
1977	1.50	0.01	44.385	1.1
1978	1.42	-0.08	47.207	1.1
1979	1.77	0.35	59.097	1.3
1980	2.23	0.46	77.321	1.3
1981	2.27	0.03	87.781	1.1
1982	2.00	-0.26	89.091	1.0
1983	1.84	-0.16	89.727	1.0
1984	1.73	-0.11	90.618	1.0
1985	1.66	-0.07	91.240	1.0
1986	1.25	-0.41	79.283	0.9
1987	1.24	-0.01	79.298	1.0
1988	1.19	-0.05	79.889	1.0
1989	1.23	0.04	84.419	1.1
190	1.35	0.11	91.375	1.1
.991	1.27	-0.08	91.742	1.0
1992	1.22	-0.05	92.206	1.0
1993	1.17	-0.05	93.299	1.0
1994	1.15	-0.02	93.688	1.0
1995	1.15	0.01	94.227	1.0
1996	1.22	0.06	98.637	1.0
1997 (7-mo	1.24	0.02	100.000	1.0

	Standard Deviation	Average of Absol. Value of Yr/Yr Change	Standard Deviation	Average of Absol. Value of Yr/Yr Change
1970-97	0.32	0.11	26.80	1.06
1983-97	0.22	0.08	6.28	1.01
1985-97	0.13	0.08	6.74	1.01

DIRE PREDICTIONS THAT WERE PROVED WRONG

1. In 1972, The Club of Rome published in *The Limits of Growth* dire predictions that the world would run out of gold in 1981, mercury in 1985, tin by 1987, zinc by 1990, **petroleum by 1992**, and copper, lead, and natural gas by 1993. None of these predictions came true. Indeed the real prices of natural resources have been steadily dropping. For example, the price of crude petroleum in 1992 dollars, as measured by the composite of domestic and imported crude oil refiners acquisition costs, was $10.69 per barrel in 1972, rose with the oil price shock in 1974 to $23.56, and reached a high of $53.47 in 1981 before more or less steadily declining to $18.82 in 1996. (See reference A.)

2. On March 31, 1979, President Jimmy Carter predicted " There is a dwindling supply of energy sources. The prices are going to rise in the future no matter which party occupies the administration in Washington, no matter what we do." Subsequently, prices fell for 5 straight years from 1981 through 1986. (See reference B.)

3. Secretary of Energy Schlesinger was quoted by the *U.S. News and World Report* on July 10, 1978: "What we face I the middle 1980s is a notional worldwide shortage of about 5 million barrels of oil a day." Instead, there was a crude petroleum glut and price collapse. (See reference B.)

4. Kenneth Arrow, quoted in *Forbes* magazine on February 4, 1980, predicted that "We're heading into a world of considerably higher prices. There will be a major impact on housing by 1983, and I'd be surprised if gasoline is less than $2 per gallon plus whatever inflation adds." Housing prices actually dropped in the late 1980s and during the 1990s. The actual price of a gallon gasoline was about $1.16 in 1983 and has not reached $2 plus inflation since. (See reference B.)

5. In 1979, the Annual Report to Congress (ARC) forecast for oil prices per barrel for 1990 ranged from $39.47 to $64.32 (in 1987 dollars). All were substantially above the actual oil price in 1990. 1980 projections by the Energy Information Administration (AEI) were also badly off the mark: their 1985 projection was 70.9 percent too high; their 1990 projection was 194 percent too high; and their 1995 projection was an astounding 385 percent too high. Its 1985 projections for 1990 and 1995 were a little better, 71.7 percent and 239 percent too high, respectively.

A.) Joseph Blast, Peter Hill, and Richard Rue, *Eco-Sanity,* 19xx.

B.) Malcom Shealy of decision Focus Inc., *A Review of Energy Forecasts: What Have We Learned?* February 16, 1989.

Version That was "almost" agreed to last night

DRAFT**DRAFT**DRAFT**DRAFT

The Impact of Retail Restructuring and Federal Legislation on Carbon Emissions in 2010

An ad hoc agency staff group from DOE, EPA, and CEA considered the carbon reductions that are likely to occur in 2010 if DOE's proposed restructuring bill becomes law. Per discussion at the principals level, we attempt to separate the emissions effect of the explicit carbon friendly provisions of the DOE proposal from the effects of retail restructuring itself, which would be accelerated by, but is not entirely dependent on, Federal restructuring legislation. This memo reflects a quick-turnaround effort. Analyses are continuing at both agencies.

a. The Emissions Impact of Explicit "Carbon Friendly" Provisions of the DOE Proposal

There is agreement between DOE and EPA staff that the explicit "carbon friendly" provisions of the bill (Renewable Portfolio Standard, Public Benefits Fund, and Information Disclosure, the latter of which supports marketing of "green" power from renewable resources to interested customers. The estimated impact of these provisions is a carbon reduction of 13 to 36 million metric tons (MMT) of carbon in 2010 -- see summary table for components.

b. The Emissions Impact of Retail Restructuring Itself

Both DOE and EPA staff agree that substantial retail restructuring is likely to occur with or without Federal legislation. Indeed, major states such as California and Pennsylvania have already implemented retail competition, and other states are in various stages of developing such plans. The effect of retail competition on carbon emissions outside of the explicit "carbon friendly" provisions noted above is subject to considerable dispute, in part because the evolution of service offerings under incentives in the future competitive market are not presently known.

On the emissions-increasing side, retail competition should lower electricity prices, which will increase demand, and increase incentives for economically efficient dispatch, which could result in more use of existing coal plants in cases where capacity is available. Restructuring could also increase pressures for early retirements of nuclear power plants.

On the emissions-reducing side, retail competition will provide a financial incentive for generating plant owners to improve their heat rate, reducing the amount of fuel burned to generate each kilowatt-hour of electricity. In addition, competing retailers will likely increase value of their product to buyers by creating packages of electricity and efficiency services that take advantage of cost-effective efficiency opportunities (such as those identified in the recent "five lab" study), or by selling "green power" derived from renewable sources to environmentally-conscious consumers. Finally, some of the increased demand for electricity will reduce end-use consumption of primary fuels, reducing emissions outside the electric sector.

Given the number of factors involved, the ad hoc agency staff group settled on a range of estimates from an emissions reduction of 48 MMT to an emissions increase of 33 MMT in 2010 for all of the components discussed in the previous two paragraphs and included under headings "b1" and "b2" of the summary table. If, as EPA staff believes, no increase in efficiency services can be expected from differentiated product competition among competitive suppliers under any plausible circumstances (i.e. both the high and low estimate of this component are zero) then the range of estimates for emissions impacts due to restructuring are an emissions reduction of 25 MMT to an emissions increase of 33 MMT, as presented under heading "b1" of the summary table. In both cases, these emissions changes are "over and above" the reductions presented

"almost" agreed
p #2

above in section a of the memo and the summary table.

c. Caveats

There is considerable two-sided uncertainty regarding many of these estimates. For example, green power may be more attractive, heat rate improvements may be lower or greater than projected, and efficiency oriented marketing of electricity services may be greater or less than the range presented above. Notwithstanding these uncertainties, the ranges presented above reflect the best estimates of reasonable ranges of emissions impacts based on available information.

In addition, the distinction of "carbon friendly" provisions of the DOE bill and restructuring itself is somewhat fuzzy, given that the DOE bill is expected to speed the transition to retail competition. An indeterminate portion of the emissions impacts identified in Section (b) of this note are probably attributable to the DOE bill.

Summary Impacts of Restructuring and the DOE Bill on Carbon Emissions in 2010

Factor	Change in Carbon Emissions in 2010 (MMT)
a. Explicit "Carbon Friendly" Provisions, *including:*	**-36 to -13**
Renewable Portfolio Standard	-12 to -6
Public Benefits Fund	-11 to -4
Information Disclosure (supports "green marketing" -- reflects ½ of total green power estimate)	-13 to -3
b1. Retail Restructuring, *including:*	**-25 to +33**
Electricity Demand Increase / Fuel Mix Change	+25 to +32
Nuclear Unit Retirement due to Retail Competition	+3 to 10
Green Pricing (½ of total "green power" estimate)	- 13 to -3
Generation Efficiency (heat rate) improvements	-15 to -5
Demand Reduction for Direct Use of Primary Fuels	-2 to -1
b2. Efficiency Marketing by Energy Service Companies	**-23 to 0**
SUM OF COMPONENTS (a +b1 +b2)	**-84 to +20**

V

The Potential Benefit from Worldwide Trading

Lesser-Developed Countries (LDCs) and Economies in Transition (EITs) offer low-cost opportunities for reducing carbon emissions. Joint implementation and international trading mechanisms can help the world mitigate global warming in the most efficient manner.

Great Potential Benefits

There are three fundamental reasons why non-OECD countries offer the world such great opportunities for reducing carbon emissions:

Energy Efficiency. LDCs and particularly EITs are much less energy efficient than OECD countries. In many cases, these relative inefficiencies provide *negative cost* opportunities to reduce carbon emissions. For example:

- Chinese coal-fired boilers are only 2/3 as efficient as US boilers. Retro-fitting Chinese plants with US boilers saves more money than it costs.

- Retrofitting Khrushchev-era Russian apartments saves 30% of heat use and saves more money than it costs. Many other negative cost efficiency improvements have been identified for Russian industry, including the use of quality insulation around steam piping, improved energy control systems, and more efficient motors.

Overall, the possibilities from energy efficiency improvements provide large opportunities for carbon reduction. For example, a $2 million study conducted by the World Bank and Chinese officials found that China could reduce its carbon emissions nearly 15% from its projected 2020 levels through zero and negative cost energy efficiency improvements.

- That is, we *could reduce total emissions by roughly 333 MMT through these low or no cost improvements; this amounts to roughly the reduction required by the U.S. to reach 1990 levels in 2010.* Approximately 2/3 to 3/4 of these improvements would come as a result of market oriented restructuring, while the remainder would come from specific, technical projects.

New Capacity. Due to their high growth rates, developing countries have an advantage over the OECD in their ability to meet their reduction targets by installing new, carbon-efficient plants rather than by retrofitting existing plants.

- Loosely speaking, OECD countries will have to balance the costs of building new, natural gas plants against simply continuing to operate existing coal plants -- large coal price adjustments will clearly be required to make building the new natural gas plant the preferable option. Developing countries, however, will balance the costs of installing new natural gas plants against the costs of installing new coal capacity. For these countries, little if any coal price adjustment would be required to make natural gas the economic choice.

Energy Subsidies. Recent World Bank estimates indicate that developing countries could reduce carbon emissions by 7 - 9% by eliminating energy subsidies.

For all of these reasons, the cost of carbon reductions is much lower in developing and transitional economies. For example, if the US, instead of reducing its own emissions to 1990 levels by 2010, transferred its reduction burden in entirety to China, China could accomplish these reductions at only 35% of the costs (this result comes from the mainstream SGM model).

Tapping the Potential: Current Success in JI Pilot Projects

Since its foundation in 1993, the US Initiative on Joint Implementation (USIJI) has accepted 25 project proposals which help US firms tap the potential outside the OECD for low-cost carbon reduction. Some of these projects have already begun to reduce carbon concentrations by implementing new, carbon-efficient power plants, improving energy efficiency, or through other methods such as planting new forests. For example:

- A project in the Czech Republic converted a district heating plant from coal to natural gas and built a cogeneration plant to provide both steam and electricity. This project is projected to reduce carbon emissions by 165,000 tons over 25 years.
- A project in Costa Rica has replaced fossil-fuel burning power sources with a 20 MW wind farm which is expected to reduce carbon emissions by 72,000 tons over 15 years.
- A project in Russia planted 506 hectares of trees and is expected to reduce carbon concentrations by 35,000 tons over 60 years.

Other projects, in various stages of implementation, include:

- A large forest management project in progress in Bolivia combines forest regeneration and protection with the promotion of sustainable forest-product enterprises to reduce atmospheric carbon by an estimated 14.5 million tons over 30 years.
- A project in Russia will improve heating efficiency in Zelenograd simply by installing new heat exchangers, pumps, and control equipment. This project can reduce carbon emissions by 440,000 tons over 30 years.

Joint Implementation, while very valuable in helping to efficiently reduce carbon emissions, can serve other useful purposes including: the opening of overseas markets, the wider dissemination of advanced technologies, and the creation of local health and environmental benefits.

Tapping the Potential: The Future

The success of JI pilot projects shows that they can work. Once countries face binding emissions limits -- and are allowed to acquire offsets from other countries -- JI and more general mechanisms for international cooperation will become essential in meeting common goals at the least cost. Many analysts believe that international permit trading and JI can reduce costs by 50% or more.

If LDCs and EITs sign on to binding agreements, international permit trading will allow the world to focus its carbon reduction efforts in the most efficient places. A portion of the easy reductions possible in developing and transitional economies stem from possible market oriented reforms and the elimination of energy subsidies. Reductions through these means will be of great benefit to other countries in an international permit trading regime, but will be difficult to tap in a project-oriented joint implementation setting. Insofar as developing countries and others choose to remain outside an international agreement -- so that they could not take part in a permit trading program -- JI will be relied on to play an important role.

The World Bank is exploring the possibility of a carbon investment fund to act as a market intermediary for JI projects. The fund, on behalf of its investors, would undertake JI type projects and sell the resulting carbon offsets to make a profit. Such a fund would improve on the efficiency of today's bilateral JI pilot projects by reducing transaction and search costs, providing efficient administration, and pooling risk. The Bank is continuing to investigate this and other mechanisms to help in international carbon offset trading.

E

October 21, 1997

MEMORANDUM FOR DEPUTY SECRETARY SUMMERS

FROM: Jonathan Gruber
Deputy Assistant Secretary (Economic Policy)

SUBJECT: **Do we always overestimate environmental control costs?**

In "Polluted Data: Overestimating Environmental Costs," *(The American Prospect*, Nov/Dec 97), Eban Goodstein and Hart Hodges argue that most pollution control programs turn out to be far less costly than had been estimated beforehand. They claim that "reducing pollution emissions at the source ... is almost certain to be (substantially) cheaper than we think it will be." But why, one might ask, are the experts always wrong -- and always in the same direction? "The reason, of course, is technology forcing," answer the authors. "When industry is required to lower pollution output, it usually doesn't just slap a new filter on an existing process; it often invents new technology."

The authors give a list of environmental programs in which, they claim, technical innovation came to the rescue and dramatically reduced costs, compared to initial estimates. Some of these examples lend credence to the authors' thesis, but many do not.

Convincing Examples:

Cotton dust. Actual costs were below estimated costs in part because estimates were based on models that did not include the effects of technical change in the industry. As the standards were introduced, the textile industry was about to replace its older capital stock with new machines that, among other things, markedly reduced the amount of cotton dust in the air. The standard accelerated this change.

Strip mining. The authors quote compliance cost estimates in the range of $6 to $12 per ton of coal, as against actual costs of 50 cents to $1 per ton. Early costs estimates referred to reclamation at mines in operation at the time. In response to the law, however, producers expanded operations at sites where reclamation costs were lower, often on flatter terrain. Thus, these early "static" estimates overstated costs.

Vinyl chloride. The authors say that control cost estimates fell from about $100 million per year to $20 million per year. John Morrall of OIRA reports that the earlier estimates, which were based on static cost models, did turn out to be too high. We should note, however, that the authors also claim that the 1 ppm standard was met with a price increase of only about 6 percent. The US vinyl chloride market today is about $1 billion, so 6 percent implies $60 million annually

Prepared by Ray Squitieri

in direct control costs, undercutting their $20 million estimate.

Problematic Examples

Asbestos. The paper says that one study by a consulting firm in the early 1970s estimated control costs that turned out to be too high by a factor of two. This refers only to the earliest estimates, done in support of OSHA's proposal in the early 1970s. Two later OSHA cost estimates, in the late 1980s and early 1990s, did not substantially overestimate control costs, according to John Morrall, now a branch chief at OIRA, who was responsible for reviewing all three sets of estimates.

Benzene. The paper cites a process that substituted other chemicals for benzene, "and virtually eliminated control costs." Benzene is one of the most widely used organic chemicals, with over $2 billion in sales last year. The new process alluded to (using maleic anhydride) replaced benzene in only a small portion of its uses.

CFCs. The paper correctly quotes EPA's price estimates for reducing CFC production, which fell from $3.55 per kg (1988) to $2.45 per kg (1996); the latter price was for a more stringent standard. On the other hand, the well-publicized problem of CFC smuggling indicates that control costs at the margin, which is what counts, are much higher than these estimates. When the US ceased CFC production in January 1996, a CFC smuggling industry was already in place. CFC-12, the most common form, now has a street value of about $50/kg. By one estimate, 10 thousand tons of CFCs are now smuggled into the US every year.

Coke ovens. The paper quotes a 1974 study that gave a range of $200 million to more than $1 billion, and says that a later study by the Council on Wage and Price Stability (COWPS) estimated the actual cost of the standard at $160 million. The author of the COWPS estimate, John Morrall of OIRA, says that he did not make an independent estimate, but simply took the low end of the industry estimate that OSHA was using, on the grounds that industry had an incentive to overstate control costs. He also says that the authors' range ($200 million to more than $1 billion) appears to be the range in the industry study he used, with $160 million rounded upward to $200 million. Moreover, the OSHA standard was never met.

More General Critique

The authors are correct in their general claim that many cost estimates come from models that do not factor in technical innovation. But their argument is incomplete, and sometimes wrong.

First, analysts are often mistaken about the costs of environmental controls, but not just on the high side; this article has clearly selected its examples to illustrate its point, downplaying examples which cut the other way. For example:

- The National Ambient Air Quality Standards (NAAQS), set by the original Clean Air Act (CAA) of 1970, were estimated to be achievable in 7 years. Twenty-seven years later, we still do not know how, when, or even if the original goals will ever be met. At the time EPA tightened the ozone NAAQs earlier this year, 75 areas did not even meet the standard then in place, which is looser than the original standard set a quarter century ago. These non-attainment areas contain 75 million people, and include most of the country's major cities: Los Angeles, Houston, Dallas, St. Louis, Chicago, Pittsburgh, Cleveland, Boston, New York, Philadelphia, Baltimore, Washington, and Atlanta.

- The Clean Air Act Amendments of 1990 established a program for "clean-fuel vehicles" in California, with a target of 150,000 vehicles to be purchased annually in model years 1996, 1997, and 1998, and 300,000 vehicles (about 25% of sales) in model years 1999 and after. The writers of this technology-forcing law seriously underestimated the cost of producing this vehicle. As of now, there appears to be no way to produce this car at a price consumers will accept, and EPA has, in effect, allowed the program to lapse.

- The authors make a false distinction between controlling pollution and the source, and treating soil and water after it has been contaminated. They concede that some programs, such as Superfund and the Clean Water Act, have been far more costly than anticipated. But they assert that this occurred because cleaning up existing contamination is not subject to the same forces of innovation as preventing pollution at the source. The authors offer no support for this claim.

Second, most ex-post cost estimates, including all those cited by the authors, include only direct compliance costs. Indirect costs, which are borne elsewhere in the economy, are harder to measure, but no less real. An often-cited 1990 study by Kopp and Hazilla of Resources for the Future estimates that indirect costs of environmental rules are roughly equal to direct compliance costs. In a 1993 study of the paper, oil refining, and steel industries, Gray and Shadbegian estimate that for every $1 in compliance costs, total factor productivity is reduced by $3 to $4. In a series of papers this decade, Jorgenson and Wilcoxen calculated that environmental regulations have reduced the US capital stock by 4.3 percent, increased the cost of capital by 5.5 percent, and reduced real GDP by more than 3 percent annually, with indirect costs accounting for most of this burden.

Third, the authors do not support their claims about technology forcing. They quote Michael Porter, who has written that environmental regulations often yield "innovation offsets." But they try to prove their case with anecdotes. Anecdotes alone do not prove an assertion, because we have no guarantee that the speaker has not selected only those that support his position. Moreover, we have survey evidence that runs the other way. When the BEA conducted its surveys of environmental compliance costs, it asked about "product offsets," resulting from compliance with the regulation in question. In contrast to Porter's claims, only two percent of respondents identified any "product offsets."

Fifth, the same market forces that drive down compliance costs also drive down benefits. For example, several years ago OSHA estimated very large benefits for its new rules intended to control the spread of tuberculosis. But at the same time that OSHA's program was being put in place, tuberculosis rates were falling, as the Centers for Disease Control (CDC) increased its focus on tuberculosis. This slowed the spread of the disease and reduced the benefits of OSHA's program. Similarly, OSHA's recent rules on blood-borne pathogens aimed to limit transmission of AIDS and, especially, hepatitis-B. The recent vaccine for hepatitis-B has considerably lowered the value of OSHA's rule.

More fundamentally, program costs can get wildly out of control when EPA takes a program with modest goals, and sweeps into it activities that were not intended to fall into its purview. Superfund is an example of this driftnet approach. Superfund began life as a program to clean up a few big sites on the order of Love Canal, but metamorphosed into "a behemoth, towering over American environmental policy, gobbling vast quantities of public and private cash and management time." [Francis Cairncross, environment editor of *The Economist*, in her book *Costing the Earth*]. On a smaller scale, EPA's rule on toxicity characteristics provided a way that a waste stream could be designated as hazardous. The agency estimated its cost in the low hundreds of millions of dollars per year. These estimates failed to anticipate that EPA would then insist on regulating many items posing low or negligible risk, including fluorescent light bulbs and telephone poles; as a result, the rule has been far more expensive than anticipated in these initial estimates.

ƷAN GOODSTEIN AND HART HODGES

Polluted Data: Overestimating Environmental Costs

In July, Carol Browner, chief of the Environmental Protection Agency, issued new regulations reducing permissible levels of smog and particulate (fine soot) pollution. The political battle leading up to the decision was fierce, even within the administration. One staff member on the Council of Economic Advisers maintained that the regulations would cost a whopping $60 billion—a figure quickly seized upon by industry opposition. The EPA's own cost estimate was much more modest, between $6 billion and $8 billion. In making her case for the new r 'ations, however, Browner 'y disavowed even her own a ey's cost estimates. She argued that industry would find a way to do it cheaper.

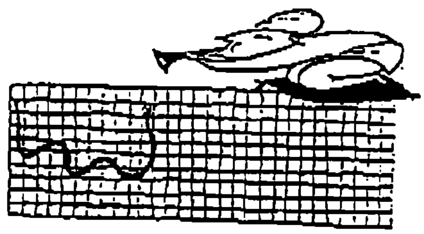
Whom to believe? Confronted with conflicting estimates, most lay people either throw up their hands or choose sides ideologically. But history provides a basis for evaluating these estimates. Not only do industry lobbyists wildly overestimate the costs of proposed environmental regulations. More surprisingly, academic and government economists consistently do too—and for an equally surprising reason. When forecasting the costs of new environmental regulations, economic analysts routinely ignore a primary economic lesson: Markets cut costs through innovation. And innovation can be promoted through regulation. This history is worth bearing in mind as we approach the most important environmental controversy to date—how to deal with the crisis of global warming.

THE ABCs OF OVERESTIMATION

In every case we have found where researchers have calculated actual regulatory costs and then compared them to *ex ante* estimates, the estimate exceeded the actual cost. We have uncovered a dozen such efforts, ranging from A (asbestos) to V (vinyl chloride). In all cases but one, the initial estimates were at least double the actual costs.

Asbestos. When the Occupational Safety and Health Administration (OSHA) instituted regulations covering exposure to asbestos in the early 1970s, they hired a consulting firm to estimate the cost of compliance. Two later studies found that the original prediction for the cost of compliance was more than double the actual cost, because of overly static assumptions.

Benzene. In the late 1970s, the chemical industry predicted that controlling benzene emissions would cost $350,000 per plant. Shortly after these predic-



tions were made, however, the plants developed a process that substituted other chemicals for benzene and virtually eliminated control costs.

Chlorofluorocarbons (CFCs). In 1988, reducing CFC production by 50 percent within 10 years was estimated by the EPA to cost $3.55 per kilogram. By 1993, the goal had become much more ambitious: complete elimination of CFC production, with the deadline moved up two years, to 1996. Nevertheless, the estimated cost of compliance fell more than 30 percent, to $2.45 per kilogram. And where substitutes for certain CFCs had not been expected to be available for eight or nine years, industry was able to identify and adopt substitutes in as little as two years.

CFCs in automobile air conditioners. In 1993 car manufacturers estimated that the price of a new car would increase by $650 to $1,200 due to new regulations limiting the use of CFCs. In 1997 the actual cost was estimated to be $40 to $400 per car.

Coke ovens. The original OSHA estimate for the cost of complying with the 1976 coke oven standard was more than five times higher than estimates of actual costs. OSHA's contractor suggested that complying with the standard would cost from $200 million to more than $1 billion. However, a Council on Wage-Price Stability study later estimated the actual cost of the standard to be $160 million.

The OSHA consultant estimated that three steel firms in their sample would spend $93 million on capital equipment and $34 million in annual operating costs to comply with the regulations. A later study by Arthur Andersen determined that the three firms actually spent between $5 million and $7 million in 1977 to comply with the standard, and only $1 million to $2 million on capital expenditures. Ultimately, firms were able to meet the standard without incurring all of the capital costs in the first year, and actual compliance costs were dramatically lower than originally predicted.

In the late 1980s, coke production again came under regulatory scrutiny, this time by the EPA. In 1987, the agency estimated that the cost of controlling hazardous air pollution from coke ovens would be roughly $4 billion. By 1991 that estimate fell to between $250 million and $400 million.

Cotton dust. In 1976, OSHA proposed a maximum permissible exposure limit of 0.2 milligrams per cubic meter for cotton dust, and its consultant estimated that compliance costs would be approximately $700 million per year. The standard promulgated in 1978 actually allowed for higher exposure levels in some sectors of the textile industry, but the small changes in the standard do not fully explain the decrease in estimated compliance costs; in 1978 the estimate fell to $205 million per year. Moreover, a new study conducted in 1982, after the Reagan administration called for a review of the standard, concluded that compliance costs were $83 million per year.

Halons. In 1989 members of the United Nations Environment Program's Halons Technical Options Committee disagreed on whether direct halon replacements could be found and whether a phase-out was possible. However, in 1993 the committee concluded that a phase-out of halons, a substance found in fire extinguishers that destroys the ozone layer faster than chlorofluorocarbons, would be both technologically and economically feasible by 1994.

Strip mining. Prior to the passage of the 1978 Surface Mining Control and Reclamation Act, estimates for compliance costs ranged from $6 to $12 per ton of coal. Actual costs for eastern coal operations have been in the range of 50 cents to $1 per ton. After the regulations were adopted, the market switched away from coal deposits with high reclamation costs. Ready substitutes included surface-minable coal in flatter areas (with lower reclamation costs), and underground deposits.

Vinyl chloride. OSHA's vinyl chloride standard, set in 1974, provides a final example of wildly excessive cost projections. The agency's consultant estimated that it would cost $22 million per year to meet the permissible exposure limit of 2 to 5 parts per million (ppm) in the vinyl chloride monomer sector, and $87 million per year to meet the 10 to 15 ppm exposure limit in the polyvinyl chloride sector. In addition, the consultant argued that the 1 ppm permissible exposure limit simply could not be attained. The president of Firestone's plastics division said that a standard of 1 ppm "puts the vinyl plastics industry on a collision course with economic disaster."

In spite of these protests, OSHA did adopt the strict permissible exposure limit of 1 ppm. A study conducted several years later by researchers from the Wharton School of Business estimated that the total cost of compliance for *both* sectors had been about $20 million per year. A 1976 congressional research paper also indicated that the actual cost of compliance was dramatically less than the original prediction. The early claims that the 1 ppm standard could not be met evaporated; instead, the regulatory action led to about a 6 percent rise in polyvinyl chloride prices.

While costs have been consistently overestimated for emission reduction, they have been underestimated for environmental cleanup. For example, when the Clean Water Act was enacted in 1972, the EPA estimated that $12.6 billion was needed to provide secondary sewage treatment systems. According to the American Enterprise Institute, actual spending for sewage treatment between 1972 and 1981 exceeded $160 billion.

Costs for the Superfund program have also mushroomed. When first launched, people expected the mandated cleanups to apply to a small handful of Love Canals. However, the program has expanded dramatically, now covering far more than a thousand sites. In addition, cleanup has proved far more costly than predicted: The average cost overrun on cleanup expenditures at Superfund sites has been 44 percent.

The message from these cases is clear. On the one hand, treating already polluted water, cleaning dirty soil, and scrubbing oily rocks costs a lot of money, (much) more than expected. On the other, when it comes to reducing pollution emissions at the source, it is almost certain to be (substantially) cheaper than we think it will be. Updating *Poor Richard's Almanack*, an ounce of prevention is clearly worth a pound of cleanup.

Why were the estimated costs of reducing emissions at the source so inflated? The reason, of course, is "technology-forcing." When industry is required to lower pollution output, it usually doesn't just slap a new filter on an existing process; it often invents new technology. Frequently the new technology turns out to have higher productivity benefits, which help to offset the cost of the regulation. To see this, it is worth looking in detail at two high-profile cases where markets have responded to regulation by cutting costs.

Coke Break

Robert Hahn, a well-known environmental economist, is currently a resident scholar at the American Enterprise Institute and an adjunct research fellow at Harvard's Kennedy School of Government, and is a former senior staff member of Bush's Council of Economic Advisers. In 1990 he and a co-author wrote a report for the U.S. Business Roundtable predicting the impact of the proposed Clean Air Act amendments on employment. These amendments had the dual purpose of cleaning up both acid rain and so-called "air toxics" from industrial plants.

The executive summary of Hahn's report leaves "no doubt that, across the Clean Air Act Amendments studied, there are a minimum of several hundred thousand jobs at various levels of severity of risk—even with the more moderate [Bush] Administration proposals." Hahn's absolute minimum prediction was 20,000 jobs directly lost, mostly from the closing of coke ovens in the steel industry. Hahn and his co-author viewed this as "truly a limiting, rock-bottom estimate" for several reasons. Important among them was that it considered only job losses arising from one portion of the bill—control of air toxics.

The amendments did pass later in 1990. The bill was in most respects more restrictive on air toxics than the one on which Hahn's study based its minimum job loss estimates. The legislation also authorized retraining funds of $50 million per year for displaced workers, which gives a nice way to track job impacts.

In the almost seven years since passage of the legislation, fewer than 7,000 workers have received aid because their jobs were affected by the Clean Air Act amendments. And the vast majority of these have been eastern, high-sulfur-coal miners, who have been laid off due not to the air toxics provision, but to the acid rain amendment. (The same legislation has in fact led to a boom in the western, low-sulfur-coal industry.) No workers from shutdown coke oven plants have received adjustment assistance. And between 1992 and 1995, production in the coke and (closely related) blast furnace industries actually increased, from $1.74 billion to $1.95 billion.

Hahn was consulting for industry here, so it is not surprising that his numbers were a bit on the high side. Corporate America, when faced with new regulations, has never been shy about claiming that the sky is falling. But Hahn is not a hired gun; he has very solid academic credentials. How could he have gotten it so wrong?

It turns out that Hahn's overestimation of regulatory impacts, while extreme, is not unusual. In fact, as we have seen in every case for which we have been able to track down data, academic and government economists have routinely overestimated the costs of reducing pollution emissions—by at least 30 percent, and generally by more than 100 percent.

The Acid Test

The EPA's acid rain program is another dramatic case in point. Since 1995, electrical utilities have been required to hold permits for each ton of sulfur dioxide they emit. These permits, in limited supply, are distributed to firms each year by the government. The innovative feature of the program is that the permits can then be bought and sold. Given this, permit prices roughly reflect per ton pollution control costs. This is true because a firm generally wouldn't buy an extra ermit if the cost of doing so exceeded the cost of reducing sulfur emissions by a ton.

When the tradable permits market was being designed in the early 1990s, credible industry estimates of permit prices (and thus control costs) were $1,500 per ton; the EPA was predicting $750. In 1997, permits were in fact selling for around $100 a piece.

Part of the current low permit price is due to a higher than expected initial supply of permits, but real compliance costs have in fact been two to four times lower than the EPA expected, and four to eight times below industry estimates.

The Virtue of Markets

When environmental economists figure their cost estimates, one particular lapse is quite startling. Economists have tended to grossly underestimate a virtue of markets they readily preach elsewhere: flexibility. When pollution regulation makes a certain type of production more expensive, markets adjust—in fairly rapid order, uncovering substitute methods of production, and developing cheaper cleanup technologies. This fact, while not completely ignored by economists, is seldom factored into their cost estimates. Instead analysts tend to predict future costs statically, as if firms would continue to use existing practices and technologies.

So, for example, the much lower than expected costs for the acid rain program can be explained in retrospect by the increased flexibility that firms were given to achieve their mandated reductions in sulfur dioxide emissions. Rather than install expensive scrubbers (or buy extra permits), many more firms than expected have met their sulfur dioxide targets by switching to low-sulfur coal, or developing new fuel-blending techniques. Railroad deregulation, along with economies of scale, led to an unexpected decline in low-sulfur-coal prices. And with the increased competition from coal, scrubber prices fell by half from 1990 to 1995.

All this is easy to see after the fact, but would have been very hard to predict. Hahn got his 20,000 lost jobs from air toxics regulation following this same practice—ignoring innovative market responses. While parenthetically noting that "technological improvements could reduce the direct economic impacts," the study explicitly ignores the possibility "because of the difficulties in predicting how technology will evolve." Because in the mid- to late 1980s, available control technologies for coke ovens seemed to be quite expensive, Hahn assumed that regulating air toxics would simply shut down much of the industry.

However, as we saw above, the EPA's own estimates of control costs for coke ovens were plummeting even as Hahn was writing his report. By 1991, they were down by a factor of ten or more from the 1987 forecasts. Hahn may not have been aware of the EPA's work; instead he cites an industry source to justify his claim that "there is widespread agreement that coke ovens will be required to close down, with an estimated loss of 15,000 jobs."

A secondary reason for the overestimates is that in implementation, legislation is never as draconian as it appears on paper. In practice, timetables get stretched out, compliance dates get extended, and waivers are granted. Eventually the regulations begin to bite, but industry is usually given a fair amount of time to adjust. Most cost estimates assume high degrees of near-term compliance.

Peering into the future is hard work. It is, in fact, close to impossible for economists to predict the specifics of how technology will evolve. This is especially true since much of the information about potential innovations consists of closely held trade secrets, which industry has little incentive to reveal. But basing cost predictions on scenarios that assume no technical evolution is guaranteed to produce gross overestimates. Innovation is indeed something at which markets are very good. When given a narrowly defined task—to produce commodity *x* emitting less of pollutant *y*—short-term substitutions and long-term shifts in technology guarantee large cost reductions over current practice.

Inflating Costs, Ignoring Benefits

In the late 1980s, when the international phase-out of ozone-destroying CFCs got underway, a company called Nortel began looking for substitutes. The company, which had used the chemicals as a cleaning agent, invested $1 million to purchase and employ new hardware. Once the redesigned system was in place, however, Nortel found that it actually saved $4 million in chemical waste-disposal costs and CFC purchases.

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The CFC regulatory compliance costs for Nortel clearly were \$1 million. But how do we figure in the \$4 million savings? Economists have long recognized that a dollar spent on environmental pollution control is not the "true" cost to society. Some have argued that the cost is in fact much higher, because environmental spending "diverts" capital investment from more productive uses.

In recent years, by contrast, Michael Porter of the Harvard Business School has been pointing to examples like Nortel to argue that environmental regulations, by forcing firms to rethink their production processes, can often lead to lower production costs and lend a competitive advantage.

More generally, much of the reported costs of environmental regulation occurs when firms invest in new capital equipment, thoroughly redesigned to be both cleaner and more productive. Many of these investments would have happened sooner or later anyway. So a primary effect of regulation is to speed up the investment process. This is costly to firms, since they must scrap old machinery that is not necessarily worn out. When this happens, however, much of measured compliance cost is in fact just early capital investments. This in turn implies that the compliance figures are much higher than the real costs.

Researchers at Resources for the Future recently conducted a study asking how much \$1 spent on environmental protection really costs an industry. For some industries, specifically steel, the answer was little more than \$1, due to the diversion effect. For others, notably plastics, the industry actually saved money as productivity was boosted. On average, the study concluded, \$1 spent on environmental pollution control reflected a real expense of 13 cents. In general then, even when cost estimates are "correct," this new research suggests that the reported values often overstate the true costs to the firm, on average by a factor of seven.

The Road to Kyoto

The debate over compliance costs is now heating up for the mother of all pollution issues—global warming. International negotiators are at work on what are supposed to be binding carbon emission reduction requirements, to be announced in Kyoto in December. The European Union is pushing for a 15 percent cut below 1990 levels to be achieved by 2010; the members of the Alliance of Small Island States—whose very existence is at stake due to anticipated flooding—want a 20 percent cutback by 2005.

The United States, by far the world's biggest greenhouse polluter, is dragging its heels. President Clinton, when pressed to commit the U.S. to specifics, has promised only to convene a conference in the fall to try to achieve a consensus among American industry, labor, and other groups on the need for action. And Clinton will clearly face a tough sales job for ratification in the Republican-controlled Senate.

Academic economists have lined up behind a strong U.S. leadership role in Kyoto. Greenhouse "moderates" like Yale's William Nordhaus and Harvard's Dale Jorgenson headed up a list of more than 2,000 economists who signed a letter arguing that a first round of carbon emission reductions could be achieved at relatively low cost. And in late July, to the dismay of U.S. industry, the Clinton economic team published its official cost estimates, confirming this general view.

There is a minority opinion among economists that reducing greenhouse gas emissions will be very, very cheap, and in the long run, even profitable. The reasons? Already existing energy efficiency technologies can help the United States break its addiction to cheap oil without too much pain. And within a decade or two, renewable fuel sources—coupled with efficiently redesigned technologies—will be cheaper than oil or coal are today. In this view, the sooner we redirect the market into a serious search for alternatives to fossil fuels, the richer we will be in the future.

There are, however, likely to be transitional costs, both for workers, particularly in fossil fuel industries, and for Third World countries. In the past, government has not done a very good job in equitably sharing the burdens of such transitions. This is no reason to reject a global warming accord, but it is a strong reason to be alert to the allocation of costs and benefits.

In the global warming debate, as when past environmental regulations have been proposed, there are the three compliance cost scenarios: apocalyptic (industry), doable but costly (academic and government), and profitable (a few visionaries). Our guess, based on the record of previous academic and government cost forecasts, is somewhere between doable and profitable.❑

EPI Review of DRI study of the Economic and Employment Impact of Climate Change Policies

On September 17, EPI released the results of its review of a study conducted by DRI on the economic and employment effects of climate change policy on the US economy. The results present a doom and gloom scenario largely because the model used by DRI is not appropriate for long term forecasting and because many of the assumptions tend to exacerbate the negative impacts.

WEFA has announced a study estimating the impacts of climate change polices. The only copy of their report that we have for review is methodologically bankrupt. However, the estimated permit price is similar to the EPI-DRI price and many of the results are of a similar magnitude. This attachment will focus on the EPI-DRI report because there is a detailed explanation of their methodology.

The model used in the DRI/McGraw-Hill study is a short-run forecasting model with an fixed coefficient, input-output-based structure. The shortcomings of this model for forecasting the impact of potential climate change policies are:

- Long-term climate polices are likely to alter significantly the structure of the economy and encourage fuel switching and capital-energy substitution. The model used by EPI-DRI fails to capture any of these changes because it relies on fixed, historical estimates and cannot adequately predict future production, investment, and labor supply/consumption decisions.

- This type of model tends to distort the adjustment behavior of the economy. As a result, errors due to the rigidity of the model are magnified as the time horizon of the forecast is lengthened. In other words, the forecasts for 2020 are less reliable than those for 2010, and the model is really only built to be able to produce reliable forecasts for two or three years in the future, in the present case the year 2000.

    - "[The DRI model] is highly inappropriate [for long-term predictions] and has some important limitations that are well-known to the community of economic forecasters. For example, the DRI long-term predictions are extremely sensitive to assumptions about energy prices." Jorgenson and Nordhaus from a memo to the IAT, April 24,1997.

    - The DRI model used fixed proportions of inputs to outputs which fails to capture any energy conservation of carbon emissions reductions. Therefore, "it is clearly unrealistic for periods of a decade or more." Jorgenson and Nordhaus.

As noted above, this type of model is very sensitive to changes in the assumptions such as energy prices. In many cases, the EPI-DRI modelers choose assumptions that would exacerbate any negative economic and employment effects resulting from climate change policies. For example, the EPI-DRI review:

- Assumes that the permit prices will be between $180 - $190 per mmtC (1995 dollars) in 2010. This permit price is approximately twice as high as found by the Interagency Analytic Team on the Economic Effects of Global Climate Change Policies (IAT) which estimated permit prices between $80 - $100 for the same scenario. As a result, energy price increases are much greater in the EPI-DRI review. These higher prices are a result of two modeling decisions:
  - The EPI-DRI model assumes slightly lower baseline improvements in energy efficiency (1% versus 1.25%). This also has an effect on baseline carbon emissions growth.
  - The EPI-DRI model assumes smaller price and substitution elasticities than used by the IAT; again, this is a result of the limitations of the model which does not handle substitution and fuel switching well.
- Overstates the amount of carbon emission in 2010 and 2020. Baseline carbon emissions estimates are greater for 2010 and 2020 in the EPI-DRI scenario than in either the Energy Department's AEO97 baseline or the IAT report.
  - For example, in 2010 the EPI-DRI report baseline case predicts 1,746 million metric tons (mmt). The Energy Department predicts 1,722 mmt, and DRI in the IAT report predicts 1,693 mmt in the reference case.
  - In 2020, EPI-DRI predicts 1,894 mmt while DRI predicts only 1,805 in the IAT.
- Ignores international emissions trading and the role of JI or worldwide trading, which other models predict can lower permit prices by 50% of more.
- Exaggerates impact of climate change policies on international trade and the trade deficit, multiplying the unemployment figures.
  - The EPI-DRI model predicts substantial increases in the trade deficit from our climate change policy. This largely reflects poor modelling of the trade sector in the DRI model, which is not built to handle international trade. In fact, other models (such as the SGM model) which more appropriately reflect international trading suggest only minimal impacts on the trade deficit.
    - Two-thirds of all carbon emissions are from "non-tradable"sectors: residential and transportation.
    - On average, energy costs account for only about 2% of input costs for the industrial sector. In other words, 98% of production costs are non-energy related.
    - A recent CEA analysis states that the bottom line is that the evidence is

against the view that the exclusion of LDCs would have a substantial adverse effect on the overall US trade position.

- These increases in the trade deficit contribute substantially to the high unemployment numbers, since the DRI model simply multiplies the deficit to get trade-related unemployment.

- In 1992, EPI conducted a similar review of potential economic and employment estimates of the proposed NAFTA treaty. EPI stated that the available models were flawed and job losses would result from a NAFTA.

    - EPI highlighted the results of a1991 Economic Strategies Institute study found that, as a result of increased Mexican imports to the US, there would be a net job loss of 900,000 by 1999.

    - EPI continues to assert that NAFTA has cost the US jobs. In two recent issue briefs, EPI states that NAFTA has resulted in a net loss of 394,835 jobs in the US in its first three years.

    - In fact, after taking in account storing US economic performance, Mexico's balance-of-payments crisis and 1995 recession, and US implementation of MFN tariff cuts mandated by the Uruguay Round, several studies, including ones from DRI and the Federal Resereve Bank of Dallas, generally conclude that NAFTA in isolation has had a modest positive effect on the US economy. The Adminitration has recently announced an **increase** of 311,000 jobs supported by exports to Canada (189,000) and Mexico (122,000) since 1993.

Preliminary Draft

MEMORANDUM

DATE: October 15, 1997

RE: An assessment of the economic effects and emissions reductions under 1990 in 2015 and 2020, with and without a safety valve

An analysis of a proposal to stabilize emissions at the 1990 level in either 2015 or 2020 with a low price safety valve indicates that the price schedule under consideration is incompatible with these targets and timetables. According to SGM, employing safety valve prices between $10 and $30 results in minor economic effects (measured in terms of lost GDP relative to business as usual). However, these permit price ceilings also result in carbon emissions reductions that are roughly a quarter of what is necessary to achieve the specified targets and timetables. Even a safety valve price of $50/ton gets less than half of the necessary reductions to meet either goal. Further, the safety valve price needs to increase with time to maintain percentage cuts relative to the business as usual. A flat safety valve price for the time beyond the target year merely delays increases in emissions relative to business as usual -- it does not eliminate emissions growth.

Proposal

Target and Timetable	**Domestic Implementation**	**Safety Valve (ramp up between start and target years)**
1990 by 2015 *or* 1990 by 2020	tradeable carbon permit system starting in 2005	Prices -- 2005: $10/ton 2015 *or* 2020: $30/ton *or* $50/ton

Assessment

To assess the effects of these targets and timetables on the economy and on carbon emissions, we had the following scenarios modeled with SGM.

Scenario	T&T	Domestic Implementation	Safety Valve
2015, no SV	1990 by 2015	2005: permit system	none
2015, SV(30)	1990 by 2015	2005: permit system	2005: $10; 2015: $30; >2015: $30
2015, SV(>30)	1990 by 2015	2005: permit system	2005: $10; 2015: $30; >2015: ↑$2/year
2015, SV(50)	1990 by 2015	2005: permit system	2005: $10; 2015: $50; >2015: $50
2015, SV(>50)	1990 by 2015	2005: permit system	2005: $10; 2015: $50; >2015: ↑$4/year
2020, no SV	1990 by 2020	2005: permit system	none
2020, SV(30)	1990 by 2020	2005: permit system	2005: $10; 2020: $30; >2020: $30
2020, SV(>30)	1990 by 2020	2005: permit system	2005: $10; 2020: $30; >2020: ↑$1.3/year
2020, SV(50)	1990 by 2020	2005: permit system	2005: $10; 2020: $50; >2020: $50
2020, SV(>50)	1990 by 2020	2005: permit system	2005: $10; 2020: $50; >2020: ↑$2.6/year

Results

The following chart indicates that safety valve prices set at low levels (e.g., $10-$50) result in carbon emissions reductions of much smaller magnitudes than would be expected under the same targets and timetables without safety valves. The safety valve scenarios do result in much smaller losses in GDP, but the trade-off is clear: substantially fewer emissions reductions are the cost of less economic pain.

Scenarios	Emissions[1]			Permit Price			GDP Loss[2]		
	2010	2015	2020	2010	2015	2020	2010	2015	2020
2015, no SV	1416 (-18%)	1350 (-25%)	1350 (-28%)	$83	$145	$172	$16 billion	$29 billion	$34 billion
2015, SV(30)	1639 (-5%)	1687 (-7%)	1756 (-6%)	$20	$31	$31	$3 billion	$3 billion	$2 billion
2015, SV(>30)	1639 (-5%)	1687 (-7%)	1717 (-8%)	$20	$31	$40	$3 billion	$3 billion	$4 billion
2015, SV(50)	1594 (-8%)	1610 (-11%)	1675 (-10%)	$31	$50	$50	$5 billion	$7 billion	$6 billion
2015, SV(>50)	1594 (-8%)	1610 (-11%)	1604 (-14%)	$31	$50	$70	$5 billion	$7 billion	$10 billion
2020, no SV	1450 (-16%)	1400 (-23%)	1350 (-28%)	$71	$122	$173	$13 billion	$23 billion	$34 billion
2020, SV(30)	1657 (-4%)	1722 (-5%)	1757 (-6%)	$17	$23	$31	$2 billion	$1 billion	$1 billion
2020, SV(>30)	1657 (-4%)	1722 (-5%)	1757 (-6%)	$17	$23	$31	$2 billion	$1 billion	$1 billion
2020, SV(50)	1627 (-6%)	1660 (-8%)	1677 (-10%)	$23	$37	$50	$3 billion	$4 billion	$6 billion
2020, SV(>50)	1627 (-6%)	1660 (-8%)	1677 (-10%)	$23	$37	$50	$3 billion	$4 billion	$6 billion

model: SGM

Scenario	Emissions			GDP		
	2010	2015	2020	2010	2015	2020
BAU	1729	1808	1871	$9.185 trillion	$9.880 trillion	$10.591 trillion

model: SGM

[1] The percent changes are relative to business as usual in that year.

[2] The GDP losses are calculated relative to business as usual GDP in that year.

Preliminary Draft

MEMORANDUM

DATE: October 9, 1997

RE: An assessment of the economic effects and emissions reductions under 1990 in 2015 and 2020, with and without a safety valve

An analysis of a proposal to stabilize emissions at the 1990 level in either 2015 or 2020 with a low price safety valve indicates that the price schedule under consideration is incompatible with these targets and timetables. According to SGM, employing safety valve prices between $10 and $30 results in minor economic effects (measured in terms of lost GDP relative to business as usual). However, these permit price ceilings also result in carbon emissions reductions that are roughly a quarter of what is necessary to achieve the specified targets and timetables.

Proposal

Target and Timetable	**Domestic Implementation**	**Safety Valve (ramp up between start and target years)**
1990 by 2015 *or* 1990 by 2020	tradeable carbon permit system starting in 2005	Prices -- 2005: $10/ton 2015 *or* 2020: $30/ton

Assessment

To assess the effects of these targets and timetables on the economy and on carbon emissions, we had the following scenarios modeled with SGM.

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2015, SV(>30)	1990 by 2015	2005: permit system	2005: $10; 2015: $30; >2015: ↑$2/year
2020, no SV	1990 by 2020	2005: permit system	none
2020, SV(30)	1990 by 2020	2005: permit system	2005: $10; 2020: $30; >2020: $30
2020, SV(>30)	1990 by 2020	2005: permit system	2005: $10; 2020: $30; >2020: ↑$1.3/year

Results

The following chart indicates that safety valve prices set at low levels (e.g., $10-$30) results in carbon emissions reductions of much smaller magnitudes than would be expected under the same targets and timetables without safety valves. The safety valve scenarios do result in much smaller losses in GDP, but the trade-off is clear: substantially fewer emissions reductions are the cost of less economic pain.

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2020, SV(>30)	1722 (-5%)	1757 (-6%)	$23	$31	$1 billion	$1 billion

model: SGM

Scenario	2015 Emissions	2020 Emissions	2015 GDP	2020 GDP
BAU	1808	1871	$9.880 trillion	$10.591 trillion

model: SGM

[1] The percent changes are relative to business as usual in that year.

[2] The GDP losses are calculated relative to business as usual GDP in that year.

Results

The following chart indicates that safety valve prices set at low levels (e.g., $10-$30) result in carbon emissions reductions of much smaller magnitudes than would be expected under the same targets and timetables without safety valves. The safety valve scenarios do result in much smaller losses in GDP, but the trade-off is clear: substantially fewer emissions reductions are the cost of less economic pain.

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model: SGM

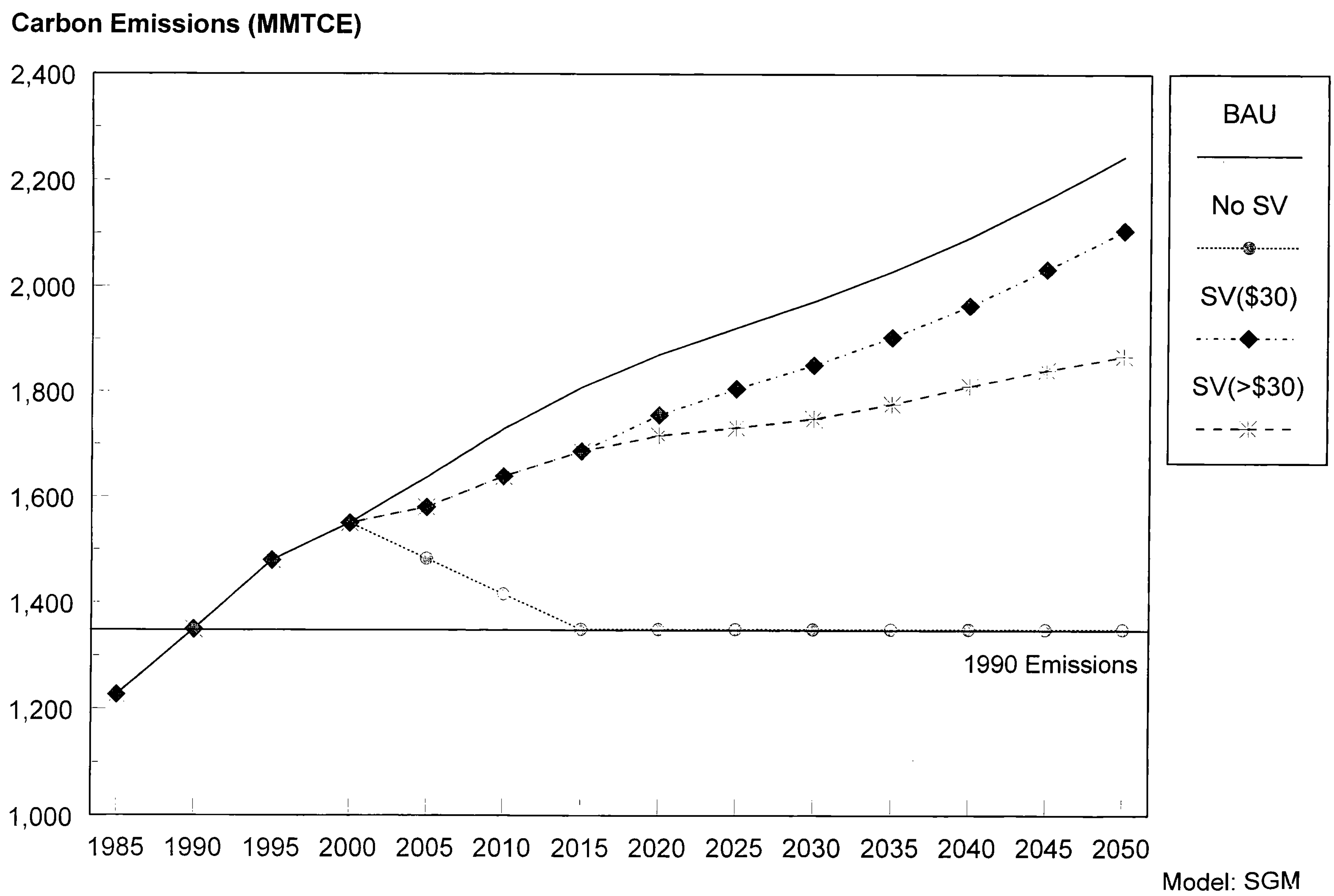
Scenario	**Emissions**			**GDP**		
	2010	**2015**	**2020**	**2010**	**2015**	**2020**
BAU	1729	1808	1871	$9.185 trillion	$9.880 trillion	$10.591 trillion

model: SGM

[1] The percent changes are relative to business as usual in that year.

[2] The GDP losses are calculated relative to business as usual GDP in that year.

Emissions Paths for 1990 in 2015 Case, with and without Safety Valve



MEMORANDUM

To: Janet Yellen
From: Joe Aldy and Randy Lutter
Date: 10/8/97
Subject: Sensitivity of permit prices to alternative economic assumptions

How sensitive are estimated carbon permit prices to alternative assumptions about GDP growth, autonomous energy efficiency improvement, and the opportunities for substitution across technologies and fuels? A preliminary assessment of the effects of varying these assumptions indicates that permit prices are unlikely to fall significantly. Since fuel switching is sensitive to elasticities embedded in models, we conducted our analysis with energy and carbon outputs from the Markal Macro and SGM models.

We find that for the permit price to be $30/ton in the SGM model, AEEI would have to equal GDP growth. (This implies zero growth in energy use over the decade.) For the permit price to be $30 in the Markal Macro model, AEEI would have to exceed GDP growth, implying that energy use would have to fall over this period. The only recent decade when energy consumption did not grow was from 1972 to 1982.

Methodology

We assume that the price of carbon varies linearly with the emissions reduction required under a 1990 in 2010 stabilization case relative to a no policy baseline.

$$P_s = P_m \frac{\hat{C}_s}{\hat{C}_m},$$

where P_s is the forecast price under stabilization under our approach, P_m is the model output forecast price under stabilization, C_s is the change in carbon emissions required to achieve 1990 level in 2010 from a business as usual level (specified below), and C_m is the reduction in carbon relative to the models' estimated business as usual.

Emissions reductions can be written as

$$\hat{C}_s = \frac{\hat{C}_m}{\hat{E}_m} \hat{E}_s,$$

the product of a fuel switching factor, which is defined as the change in carbon under a stabilization policy divided by the change in energy under this policy (both relative to a business as usual projection for 2010) from a model, multiplied by the percentage change in energy consumption. (Note that since the fuel switching parameter is driven by the price of carbon, we cannot vary it exogenously.) The change in total energy use between the stabilization case and business as usual in 2010 is determined by GDP growth and autonomous energy efficiency improvement inputs.

As a starting point, we use the results from SGM and Markal Macro with the IAT assumptions (AEEI = 1.25%, GDP growth of 2.06% and 1.91%) and permit prices of $81/ton and $145/ton in 2010. We use these to calibrate our spreadsheet. Note that our calibrations result in price estimates that differ from the model results by 5.8% and 2.6% -- this likely is a function of using rounded averages for GDP and AEEI.[1] SGM generates a fuel switching factor of 1.5, while Markal Macro assumes more fuel switching, so its factor is 1.64. We then calculated a set of permit prices by varying GDP and AEEI over the 1995-2010 period. We varied annual GDP growth by about 1.3% and 3% and AEEI by 0.7% and 1.75%. Note that the most recent GDP growth rate projection is about 2.4%, and a survey of energy economists indicates that AEEI likely falls between 0.5% and 0.7% (EIA employs a 0.9% energy efficiency improvement).

Results

The assessment of the permit prices with varying input assumptions indicates that permit prices can vary significantly with the inputs. However, given that the IAT employed very optimistic AEEI (1.25%) and moderate economic growth (~2%), the variations of inputs imply that permit prices could easily be above the IAT forecast results. For example, assuming an AEEI of 0.9% (consistent with the Energy Information Administration) and the present projected GDP growth rate of 2.4%, the computed permit price with the SGM derived measure would be about $130/ton while the Markal Macro derived measure would be about $250/ton. The chart on the next page presents the estimated permit prices given the ranges of GDP growth and AEEI considered.

Low permit prices would require very slow growth and very optimistic AEEI. For example, assume that over the next 13 years, the economy experiences 8 years of zero growth (e.g., a prolonged recession) and five years of moderate growth (e.g., 2% per year). During this period, assume that autonomous energy efficiency improvements occur at an annual rate of 0.9%. Under this scenario, 2010 energy consumption would be roughly equal to 1995 energy consumption. The price of a carbon permit in 2010 would still be about $30/ton with the SGM derived measure, and nearly $60/ton with the Markal Macro measure.

Our sensitivity analysis indicates that prices can vary, but are more likely to vary upward relative to the IAT results. Note however that we only varied GDP growth and AEEI. The nature of the supply curve for emissions reductions also can affect the permit price. Modifying other assumptions may generate different results.

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[1] As a check on our proportionality assumption, we did a second calibration of SGM using an AEEI of 1.0%, GDP growth of 2.0%, a fuel switching factor of 1.39, and a permit price of $108. This results in a predicted price of $121, or 12% from the actual model result. Our assumption does not appear to be far off, but with higher emissions reductions, our approach generates permit prices slightly larger than the model estimates. With smaller emissions reductions, the error appears to be small. Note the attached chart that illustrates the marginal abatement cost curve for emissions reductions in 2010.

Estimated Permit Prices Under Various GDP Growth and AEEI Assumptions

Derived from:	**GDP Growth Rate**	**AEEI**	**Permit Price ($/ton)**
SGM*	2.06%	1.25%	$86
SGM, Best Estimate	2.4%[1]	0.9%[1]	$128
SGM	1.25%[2]	0.7%	$69
SGM	1.25%[2]	0.9%	$55
SGM	1.25%[2]	1.25%	$31[3]
SGM	1.25%[2]	1.75%	$0[3]
Markal Macro*	1.91%	1.25%	$149
Markal Macro, Best Estimate	2.4%[1]	0.9%[1]	$250
Markal Macro	1.25%[2]	0.7%	$135
Markal Macro	1.25%[2]	0.9%	$108
Markal Macro	1.25%[2]	1.25%	$60[3]
Markal Macro	1.25%[2]	1.45%	$31[3]
Markal Macro	1.25%[2]	1.75%	$0[3]

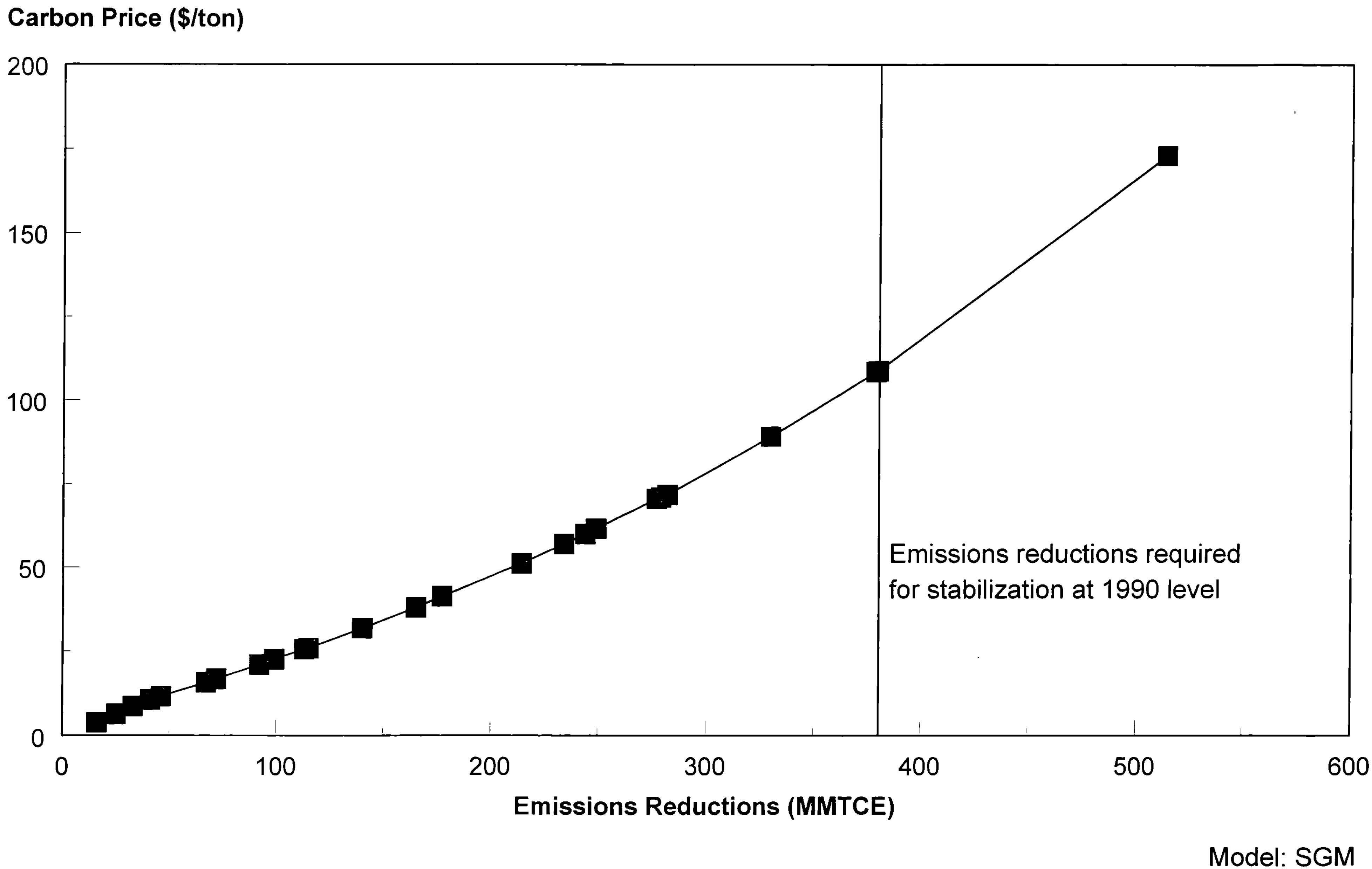
* Calibration estimates: SGM model result is $81/ton, Markal Macro model result is $145/ton.

1: The 2.4% GDP growth rate corresponds to the Administration's most recent projection of GDP growth. The 0.9% AEEI corresponds to the Energy Information Administration's projection of AEEI over the next 20 years.

2: A growth rate average of 1.25% between now and 2010 would imply that during six of the next thirteen years, the nation would experience a GDP growth rate of zero (e.g., a prolonged recession) and annual GDP growth would average, during the remaining seven years, about 2%.

3: These estimates of permit prices assume that energy use remains flat or falls between now and 2010. An energy trend of this nature, over a period as long as a decade, has only occurred during the 1970s and early 1980s as a result of the OPEC oil shocks.

Carbon Emissions Reductions Marginal Abatement Cost Curve, 2010



Preliminary Draft

MEMORANDUM

DATE: 10/7/97

RE: Safety Valves, Carbon Prices, and Emissions

A "safety valve" implemented with tradeable permits would result in a hybrid permit-tax system. The safety valve would serve as a ceiling on the price of a carbon permit. While this provides increased certainty to those who must acquire permits to operate their firms, it also could result in domestic emissions in excess of a specified target, depending on the price of the safety valve. Based on an analysis of available modeling results, safety valves set at low prices (e.g., $10-$30) could result in emissions well above a 1990 target in 2010 and subsequent years. For example, a safety valve set at $25/ton could result in emissions 12% - 20% above 1990 levels in 2010.

Economic Analysis

For this overview of safety valves, we considered economic outputs from the SGM model (Edmonds) and the DOE 5 Labs Study. The SGM model suggests that permit prices would need to be about $110/ton to achieve the 1990 emissions level in 2010.[1] This permit price is consistent with the range of estimates from other economic models, and actually lies near the low end of the carbon price estimates from these models. Safety valve prices set higher than this would not be triggered, under this model's assumptions. However, prices set less than $110/ton could be reached as industry trades carbon permits under a climate policy. Safety valve prices set lower than the unconstrained permit price for meeting 1990 in 2010 would result in purchases of additional permits. The magnitude of these additional purchases depends on the safety valve price. The chart below and the attached figure illustrate the emissions associated with a range of safety valve prices.

Approximate Emissions in 2010 Under Various Safety Valve Prices

Carbon Price	Emissions in 2010	Percent above 1990
$10	1690	25%
$30	1600	19%
$50	1520	13%
$75	1440	7%
$100	1370	2%

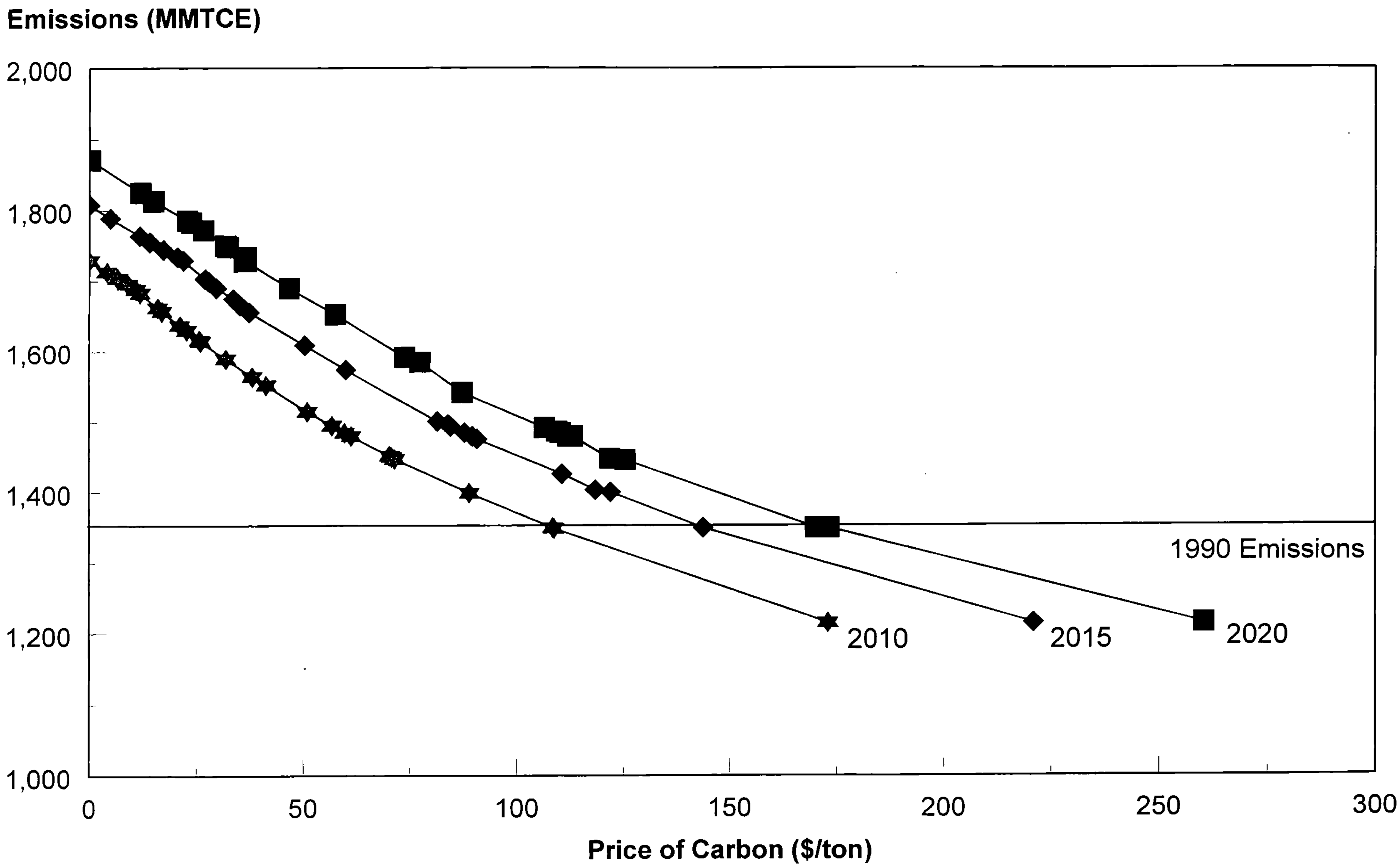
Model: SGM

[1] This price is higher than the SGM result in the IAT report because of a 1% AEEI assumption.

The DOE 5 Labs Study, although much less transparent than the model outputs of SGM, provides estimates of the effects of two permit prices: \$25/ton and \$50/ton. At \$25/ton, the study estimates that emissions would be about 1500 MMTCE in 2010, or 12% above 1990 levels. Under the assumptions of unspecified government programs and a \$50/ton permit system, U.S. emissions could return to the 1990 level in 2010. Given many of the methodological assumptions in the study that do not conform with actual consumer and firm behavior and the unspecified government policies, this \$50/ton could be considered the lower bound of the range of permit prices to achieve 1990 levels.

Regardless of study, safety valve prices less than \$50/ton would likely result in emissions in excess of 1990 levels in 2010. Note also that most models indicate that to maintain emissions at the 1990 level beyond 2010 requires even higher carbon prices. This implies that the safety valve approach may need to have prices rise over time.

Safety Valves: Prices and Emissions of Carbon, 2010 - 2020



Model: SGM

5655

Proposal on QELROs
by the Government of Japan
September 29, 1997

1. As the president-designate of the COP3, the Government of Japan proposes 5% as a base reduction rate for deciding a reduction target for each country on the premise that the following conditions from (1) to (3) are accepted. The base year of this reduction is 1990. The target period for the reduction is five years from 2008 to 2012 (the first budget period).

(1) Green house gasses covered by this proposal include carbon dioxide, methane and nitrous oxide.

(2) As the quantified target includes a portion prescribed by future technological development and changes of energy situation and industrial structure, etc. which are uncertain factors not foreseen at present, compliance clauses in regard to this portion should have certain flexibility. Formulation of this flexibility has to be stipulated in a protocol or another legal instrument. In any case, the emissions of any country shall not exceed its emissions in 1990.

(3) The target for an individual country is differentiated by emission per GDP, emission per capita and population growth:

Countries with the following conditions may apply any one of the following Alternative Reduction Rates:

(a) For a country of which emissions per GDP in 1990 (A) are less than the emission per GDP of all Annex I countries in 1990 (B):
Alternative Reduction Rate (%) = 5% × (A/B)

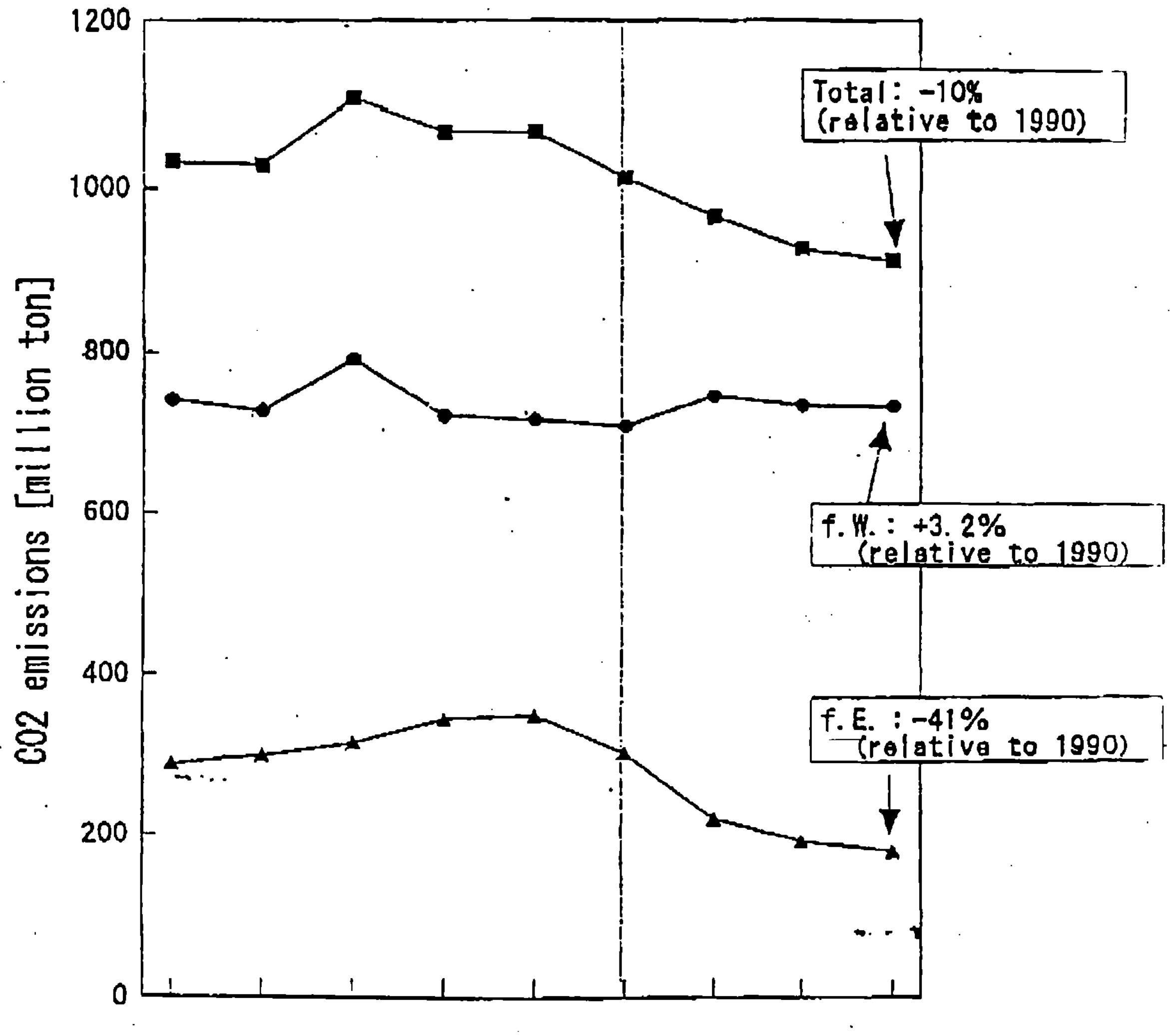
(b) For a country of which emissions per capita in 1990 (C) are less than the emission per capita of all Annex I countries in 1990 (D):
Alternative Reduction Rate (%)= 5% × (C/D)

(c) For a country of which population growth from 1990 to 1995 exceeds the population growth of all Annex I countries for the same period, the higher growth of population should be considered in deciding the target of the country. Concrete formulation of this alternative reduction rate is to be developed.

2. Banking, borrowing, emissions trading and joint implementation should be adopted under certain conditions.

3. Emissions for the second budget period shall not exceed those for the first budget period. More sophisticated method of differentiation should be applied for the second budget period.

Change for CO2 emissions in Germany



	1970	1975	1980	1985	1987	1990	1991	1992	1993
●f.W.	741	728	792	723	718	709	745	734	732
▲f.E.	291	301	316	345	350	303	220	192	179
■Total	1032	1029	1108	1068	1068	1012	965	926	911

Forcast of Future Greenhouse Gas Emissions Levels of Developed Countries

	1995 CO2 Emissions <Rate of increase relative to 1990>	Forecast of CO2 emissions in 2010 according to N.C. <Rate of increase relative to 1990>	QERLOs proposal	GHG emissions per Capita (1990) <ratio of Japan's 2.6t as 1>
Australia	(+5)	+20～+6	Not proposed	2.55
U.S.	(+3)	+23	Not proposed	2.34
New Zealand	+7	+43	Not proposed	2.35
Canada	+8	+19	Not proposed	2.08
Iceland	+6	Not yielded	Not proposed	1.13
Norway	+7	+33	Not proposed	1.20
Switzerland	▲2	▲3	Not proposed	0.82
Luxembourg	Not yielded	Not yielded	(▲30)	3.28
Germany	▲12	▲1.6	(▲25)	1.57
Denmark	(+21)	Not yielded	(▲25)	1.29
Austria	Not yielded	Not yielded	(▲25)	0.98
Netherlands	+9	▲2	(▲10)	1.43
Belgium	(+6)	Not yielded	(▲10)	1.42
U.K.	(▲5)	+3	(▲10)	1.28
Italy	+8	Not yielded	(▲7)	1.00
Finland	+4	+4～+31	(0)	1.34
France	+2	Not yielded	(0)	0.91
Sweden	+5	+12	(+5)	0.79
Ireland	+10	+33	(+15)	1.68
Spain	Not yielded	Not yielded	(+17)	0.80
Greece	Not yielded	Not yielded	(+30)	0.95
Portugal	(+10)	Not yielded	(+40)	0.53
EU		Not yielded	(▲15)	1.16
Japan	+8.3	Not yielded	Not proposed	1.00

[Note] EU's position in the negotiations is that the 2010 targets for each EU nation are based on the premise that each non-EU nation's target is −15%

cc: JY, JAF, JA

Office of Economic Policy

Department of the Treasury
Washington, D.C. 20220

FAX

Date: 10/1/97
Number of pages including cover sheet: 4

	Name	Fax Number	Phone Number
To:	Jeff Frankel	395-6958	
From:	Jon Gruber	202-622-2633	

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

The Economics of Reducing Emissions

It will not be possible to stabilize -- let alone reduce -- carbon emissions in the United States without substantial and continuous increases in the price of carbon fuels.

The Facts

- Carbon efficiency: Rising by 0.9 percent per year
- GDP growth: 2.4 percent per year
- Carbon Emissions: Rising by the difference - 1.5 percent per year, or 16 percent over a decade
- Reducing emissions by 1 percent requires a $4-$8 per ton increase in the price of carbon

The Implications

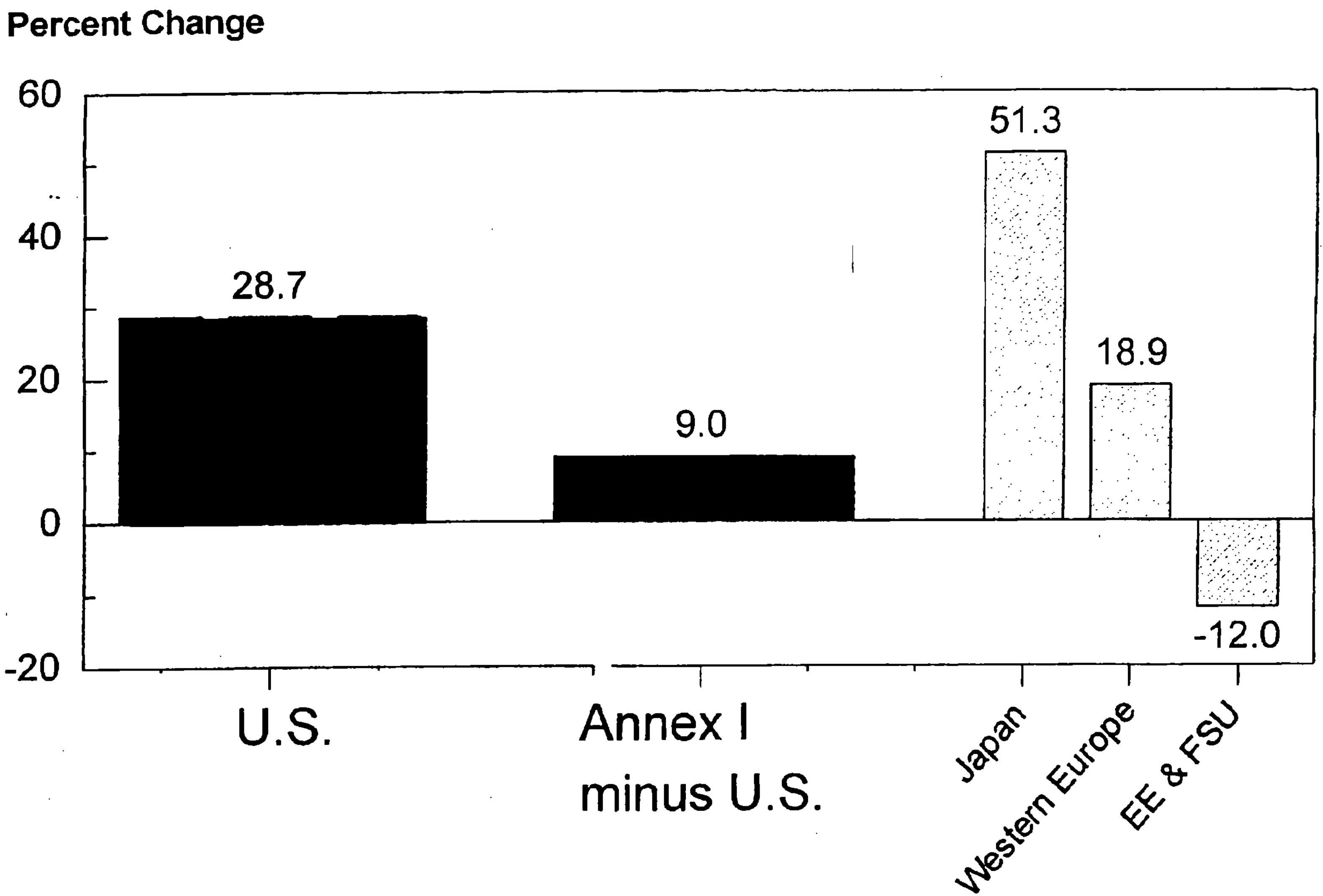
- Holding emissions steady for a decade would require the price of carbon to rise by $64-$128 per ton
- Reducing emissions to their 1990 level from their year 2000 level would require price increases of an additional $60-$120 per ton.
- So **achieving 1990 levels of emissions by 2010 requires a carbon price of $120-$248 per ton**
- These costs rise substantially as we move beyond 2010, since we must continue to hold emissions constant at 1990 levels.

Some Relevant Comparisons

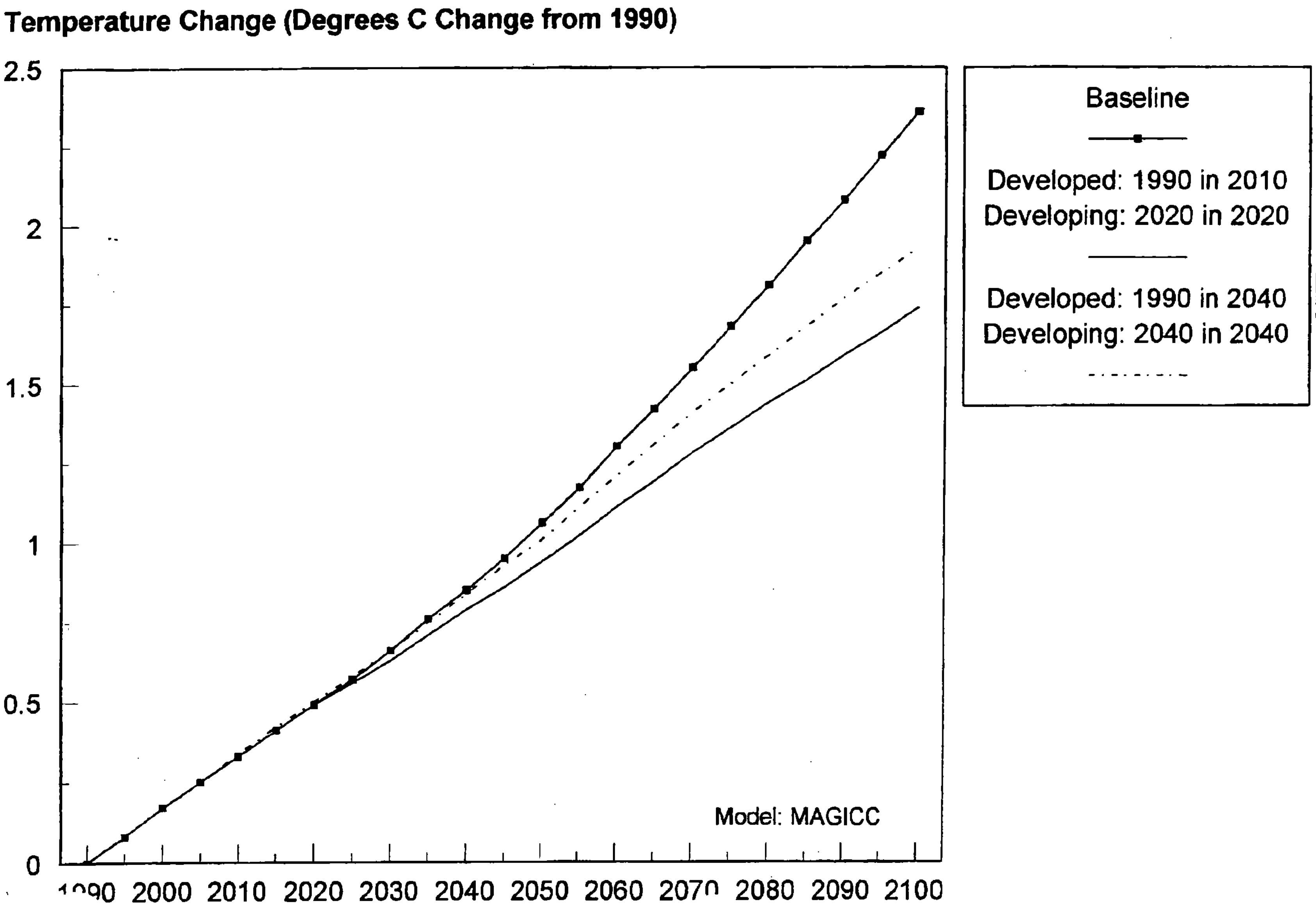
- The 1993 BTU tax was the equivalent of only a $20-per-ton carbon tax, so that this would amount to *at least 6 BTU taxes.*
- Even a $50-per-ton carbon tax would reduce the standard of living of the average family by about $550; this is roughly equivalent to more than one week's take-home pay. An increase in the price of carbon would also be *highly regressive* in its impact.
- Each $1 per ton increase in the price of carbon raises $1 billion in revenues, so that achieving 1990 levels by 2010 implies a tax increase of $120 to $248 billion.

1990 by 2010 Unfair to U.S.

Change in Carbon Emissions (1990 to 2010)



An Aggressive Policy Achieves Modest Additional Environmental Benefit



cc: Yellen
Aldy
Morris
Candelario
from JF

THE WHITE HOUSE
WASHINGTON

FAX COVER SHEET

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TO: Jeff Frankel

FAX NUMBER:

ORGANIZATION:

DATE:

NUMBER OF PAGES (including cover sheet):

COMMENTS:

Japanese proposal. (do not circulate) It's too complicated. But factoring in past emissions and GDP and pop. is what I have been thinking about re long-term formula (for LDCs).
JF

5655

Proposal on QELROs
by the Government of Japan
September 29, 1997

1. As the president-designate of the COP3, the Government of Japan proposes 5% as a base reduction rate for deciding a reduction target for each country on the premise that the following conditions from (1) to (3) are accepted. The base year of this reduction is 1990. The target period for the reduction is five years from 2008 to 2012 (the first budget period).

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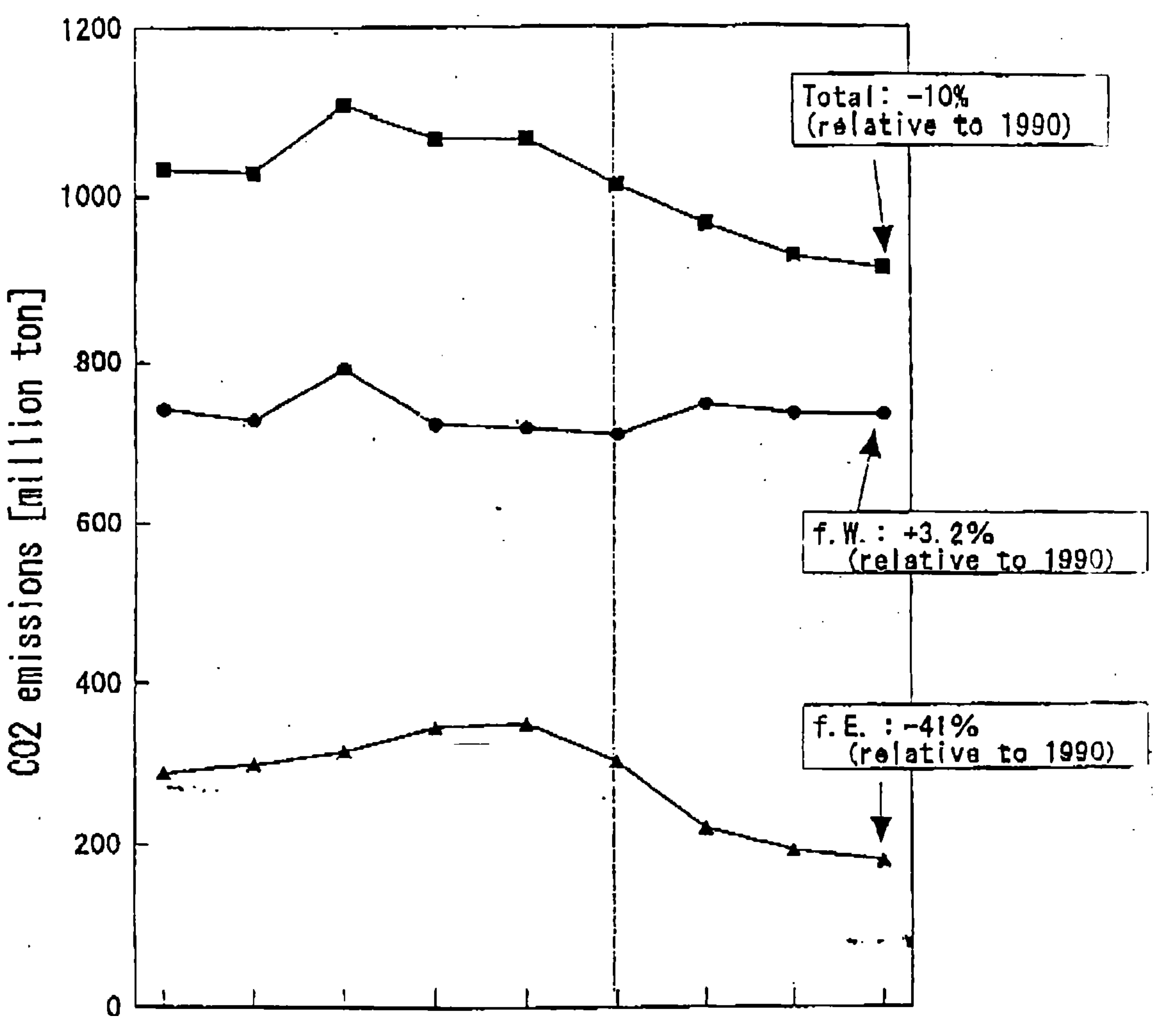

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▲ f.E.	291	301	316	345	350	303	220	192	179
■ Total	1032	1029	1108	1068	1068	1012	965	926	911

ISSUE FOR DECISION

What emissions levels should the U.S. support in international climate change negotiations?

NEED FOR DECISION

Decisions are needed in connection with trips by the President to the Denver Summit of the Eight (June 20-22) and UN General Assembly Special Session on Environment and Development (June 26). In addition, U.S. negotiators need guidance to allow them to generate support for our position prior to a meeting in Kyoto this December where participants hope to sign a treaty. Other countries and domestic constituencies are calling on the U.S. to state its views.

I. BACKGROUND

Climate change is an issue of vast scale. Decisions on the issue posed in this memorandum could have significant environmental, economic and political consequences.

The build-up of greenhouse gases in the atmosphere threatens fundamentally to alter the Earth's climate. Currently, greenhouse gas concentrations are at their highest level in more than 200,000 years. (See Appendix A). Absent policy interventions, concentrations by the end of the next century will reach the highest level in more than *50 million* years. Impacts are predicted to include sea level rise, the spread of infectious disease, more frequent and severe droughts and floods, loss of forest cover and shifts in agriculturally-productive regions. Absent policy interventions, global average temperatures by the end of the next century will increase 2-6.5 degrees F., sea-level rise will inundate more than 9000 square miles in the United States (with Florida and Louisiana most vulnerable) and an additional 50-80 ~~million people~~ will contract malaria worldwide. US? According to a NOAA study, average July temperatures in Washington, D.C. by the end of the next century are expected to increase by 5-15 degrees F. (with greater humidity).

The cost of reducing greenhouse gas emissions is potentially substantial. The principal source of such emissions is the burning of fossil fuels, which powers the global economy. Meeting the emissions targets proposed by the European Union, for example, is predicted to reduce U.S. GDP in 2005 by 0.1-1.0%, increase gasoline prices in 2010 by 20-25 cents per gallon and increase coal prices in 2010 by almost 180%. Without a well-functioning system of international emissions trading, these figures would roughly double. Private capital outflows associated with an international emissions trading regime are predicted to be roughly $5 billion per year. Significantly, modeling indicates that economic losses from some policies are transitory: after an initial loss, the economy rebounds and catches up to its original growth path. Costs depend significantly on rates of technological innovation.

The Clinton administration has been active on this issue since Earth Day 1993, at which time the President pledged to return U.S. greenhouse gas emissions to 1990 levels by the year 2000, and then to continue the trend of reduced emissions. In October 1993, the Administration issued the Climate Change Action Plan, made up of several dozen mostly voluntary programs, designed to meet that goal. (Due to Congressional budget cuts and other factors, the goal will be missed by a wide margin). U.S. negotiators have shaped the international climate change negotiations by calling for binding emissions targets, "flexibility" provisions (such as international emissions trading and joint implementation) that would significantly lower costs of meeting those targets, and the participation of developing countries. The President has spoken to this issue several times in the past year, including in the 1997 State of the Union, where he called for "reduc[ing] the greenhouse gases that challenge our health even as they change our climate."

For many environmental groups, strong action on climate change is a litmus test for the administration's environmental policy. Although there is some difference of views in the business community, most in heavy industry and energy extraction are strongly opposed to action on this issue. Labor is increasingly opposed to measures to address climate change, largely in deference to the concerns of the United Mine Workers.

II. OPTIONS

This memorandum identifies four options concerning the U.S. position on emissions levels in the international climate change negotiations. Each option is defined in terms of a broad directional statement the President might offer in June.

Option 1: Significantly reduce emissions in the medium term. For example, reduce greenhouse gas emissions to 90 percent of 1990 levels by a multi-year period around 2010 and to lower levels thereafter.

> *Comment:* This is similar to the E.U. proposal. With this option, there is a reasonable chance of obtaining international agreement to key elements of our proposals on "flexibility" and "developing country participation."

Senate issue

> The option could impose very large costs on the U.S. economy. Environmental benefits could also be large, especially when non-climate benefits (such as reducing fine particles and ozone) are considered. Many environmental groups would be pleased, but business and labor would be very strongly opposed. Without significant changes in the political landscape, the prospects for ratification by the Senate in the next several years would be close to zero.

Option 2: Stabilize emissions in the medium term and reduce thereafter. For example, stabilize greenhouse gas emissions at 1990 levels by a multi-year period around 2010 and reduce to lower levels thereafter.

> *Comment:* With this option, there is some chance of obtaining international agreement to key elements of our proposals on "flexibility" and "developing country participation." Overall economic impacts could be significant (but mostly transitory); dislocation in some sectors could be large. Environmental benefits (both climate and non-climate) could be significant. Some environmental groups would be pleased; others would complain of lack of U.S. leadership. Most business and labor groups would be opposed, although some might support if the policy were coupled with other features they find attractive. Without significant changes in the political landscape, the prospects for ratification by the Senate in the next several years would be poor.

Option 3: Begin to reduce projected emissions growth in the medium term. For example, limit greenhouse gas emissions to 115-120% of 1990 levels by 2010. (Absent new policies, emissions levels are projected to reach 120-125% of 1990 levels by 2010). This position has been referred to as a "growth target."

Comment: With this option, there is no chance of obtaining international agreement on our "flexibility" or "developing country participation" proposals. Other countries and domestic environmental groups would be extremely critical. Economic costs would be mild, as would opposition in the business and labor communities. Environmental benefits (both climate and non-climate) would be modest. There is a chance this would be ratified by the U.S. Senate in the next several years without major political changes.

Option 4: Reject quantitative emissions limits under the climate treaty. For example, the U.S. could announce a new policy of supporting a worldwide end to fossil fuel subsidies and increased investment in technologies as the preferred alternative to emissions constraints. The U.S. could make clear that any internationally-imposed climate change policies that led to increased domestic energy prices would be unacceptable.

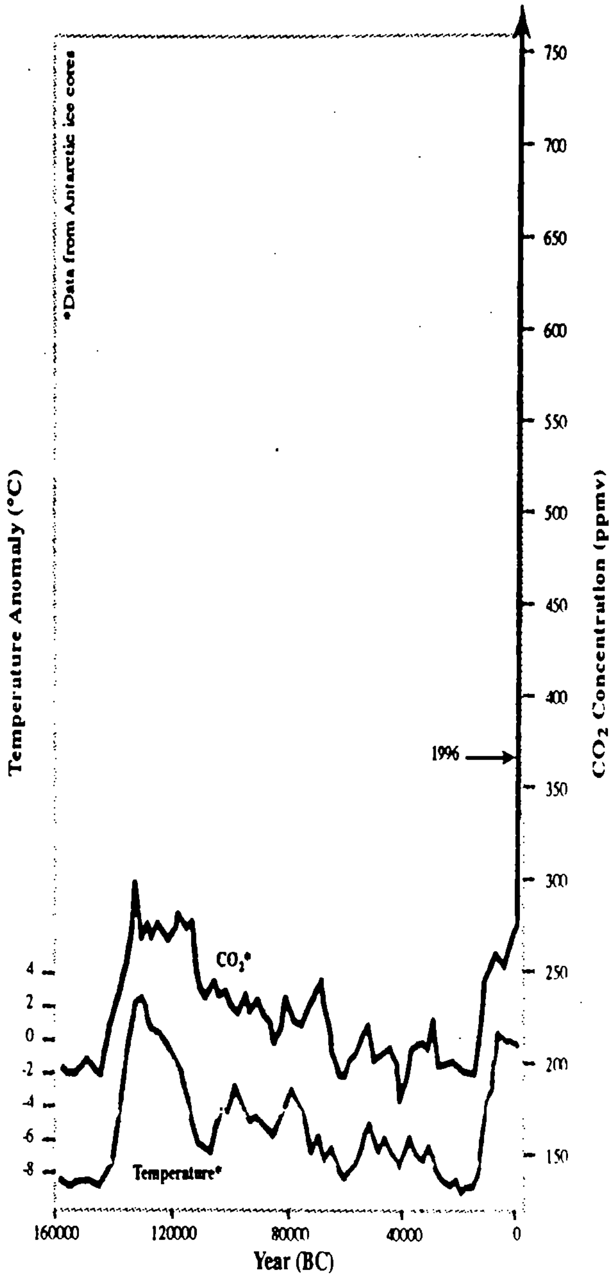
Comment: Criticism from other countries and U.S. environmental groups would be scathing. Environmental benefits (climate and non-climate) would be small. Heavy manufacturing, energy extraction and coal unions might support. Generating Congressional support for large new expenditures on technology programs would be difficult.

Material analyzing the environmental impacts of these options is attached as Appendix B. Material summarizing the projected economic impacts of Options 1, 2 and 3 is presented in Appendix C. Additional background material on climate change (including a discussion of domestic policy options) is attached as Appendix D.

A related issue is how best to formulate the U.S. position concerning "flexibility" and "developing country participation." As noted above, in the international negotiations the U.S. has proposed a series of flexibility provisions that would significantly lower costs of complying with a target (international emissions trading, joint implementation, etc.). The United States has also proposed that developing countries participate more fully in efforts to address climate change. Neither proposal has won much support abroad.

As part of any U.S. announcement on emissions budgets, the President could make a strong statement concerning the importance of these "flexibility" and "developing country" provisions. This could include a statement that the U.S. would not sign an agreement in Kyoto without such provisions.

Appendix A


*Data from Antarctic ice cores
Temperature Anomaly (°C)
CO2 Concentration (ppmv)
750
700
650
600
550
500
450
400
1996
350
300
250
200
150
4
2
0
-2
-4
-6
-8
CO2*
Temperature*
160000
120000
80000
40000
0
Year (BC)

APPENDIX B
ENVIRONMENTAL IMPACTS OF OPTIONS

1. Climate Change Impacts

Absent policy interventions, atmospheric greenhouse gas concentrations will increase during the next century to levels unknown on this planet for 50 million years. To avoid such extraordinary increases, *global* greenhouse gas emissions must begin to decline from projected levels early in the next century. For *global* emissions to begin to decline in this time frame, developed countries must move quickly to reduce their emissions, setting the stage for future rounds of negotiations.

In the short-term, the difference between the options presented in terms of additional greenhouse gas concentrations in the atmosphere is small. However, institutional and political factors will lead to important differences between these options. Options 3 and 4, for example, are unlikely to lead developing countries to participate meaningfully in the negotiating process. Option 1, on the other hand, may be so stringent that many businesses would simply work to block implementation rather than restructure activities to comply.

For the world realistically to avoid a doubling of pre-industrial greenhouse gas concentrations (to 550 ppm) in the next century, *global* emissions must deflect from a "business-as-usual" path by about 2010. For the world realistically to avoid a near-tripling of greenhouse gas concentrations (750 ppm), *global* emissions must deflect from this "business-as-usual" path by 2020. Even assuming steep reductions in greenhouse gas emissions in distant decades (which our children and grandchildren may or may not be able to achieve), reductions must begin soon to avoid serious environmental damage.

2. Other Environmental Impacts

Any of the options discussed here could have considerable environmental benefits unrelated to climate change. Measures to reduce greenhouse gas emissions would also reduce emissions of SOX, NOX and toxic pollutants such as mercury. Such measures would contribute significantly to meeting potential Clean Air Act standards for particulate matter and ozone. According to EPA estimates, monetizable benefits of reducing fine particles and ozone in connection with Option 1 or Option 2 could total tens of billions of dollars per year by 2010.

APPENDIX C
ECONOMIC ANALYSIS

1. Introduction. An Interagency Analytical Team (IAT) has analyzed the economic impact of various emissions constraints, using three different models. The results are broadly consistent with the considerable literature on this subject.

Economic models are by nature imprecise, especially when projecting over several decades. The models' limitations are exacerbated by the complex and far-reaching effects of any policy aimed at reducing greenhouse gas emissions. Some agencies believe it is important to stress that similar modeling in the past with respect to SO2 controls under the Clean Air Act dramatically overstated costs, due to unforeseen factors. Nevertheless, models can provide insight into the economic costs and benefits of various policy alternatives.

The "base case" modeling results presented here make the following key assumptions:

- Policy options are implemented by 2010, with a ten-year phase-in period.
- Domestic emissions reductions are achieved by an emissions trading system, where certain entities responsible for greenhouse gas emissions must have a permit, a limited number of permits are sold at auction, and permits may then be traded.
- All revenues raised through the auction process go to reduce the Federal budget deficit.
- There are no transaction costs nor compliance problems with the domestic emissions trading system.
- Monetary policy offsets the effects of reduced economic activity through lower interest rates.
- The path of technological progress over the forecast period has energy use per unit of GDP decreasing more rapidly than observed in most historical periods, consistent with increased emphasis on greenhouse gas emissions and energy efficiency.
- The rest of the economy remains unchanged, which will not occur over the long forecast period used. Unexpected shocks to the economy are likely to have very large effects on the estimates presented.

Results are presented for Options 1 through 3, but the figures associated with Option 3 should be viewed as very tentative. These figures were not derived from specific IAT modeling of the Option 3 emissions constraints (reduce emissions to 115 percent of 1990 levels by 2010), but rather were estimated by reference to other constraints that were modeled.

Three additional caveats should be noted. First, the base case masks disagreements among agencies over likely rates of technological innovation and diffusion. A faster rate of progress in energy-efficiency and carbon-reducing technologies could reduce estimated economic costs by as much as one-third relative to the base case estimates. However, a slower rate of technological progress than assumed in the base case would increase economic costs noticeably. Second, to the extent that domestic greenhouse gas constraints are not implemented through an emissions trading regime, but instead through less flexible regulatory programs, economic costs will be greater than those shown. Third, to the extent that the distribution of emission permits does not support increased levels of capital investment compared to the baseline, the long-term economic results will be less favorable than estimated by the models.

2. Results. As noted above, the United States has strongly supported international trading of greenhouse gases. With trading, countries with high abatement costs (e.g., the United States and Western Europe) could purchase emissions reductions in countries with lower abatement costs (e.g., in the former Soviet Union). Incorporating a well-functioning international market in emissions permits in the modeling reduces estimated energy price increases significantly. With international emissions trading, the United States is estimated to pay about $5 billion per year to other developed countries (including those in the former Soviet Union) to purchase permits, avoiding greater expenditures in compliance costs.

Results with international trading

Table 1 presents results from the base case with trading of emissions permits among Annex I nations. The trading takes place among all Annex I nations. (In countries where emissions have fallen below 1990 levels, such as in some parts of the former Soviet Union, trading is assumed to be allowed only to the extent there are corresponding emissions reductions from a "no-policy" baseline). All figures are presented relative to a "no-policy" baseline, in 1995 dollars.

The losses in aggregate economic activity are noticeable, but largely transitory. Table 1 shows GDP loss with international trading peaking at a few tenths of a percentage point in 2005-2010. After this initial loss, the economy begins to rebound as the proceeds from permit auctions reduce the Federal budget deficit, leading to lower interest rates. Businesses respond by making capital investments to offset higher energy costs. After a while, the economy catches up to its original growth path, indicating that the emissions reduction program modeled is implicitly pro-investment and that the economy is robust enough to withstand modest shocks.

Coal bears the brunt of the emissions reduction policies, because coal is the most greenhouse gas intensive fuel. In general, the least costly way to garner significant emissions reductions is to replace coal in electricity generation and industrial uses.

Results without international trading

If an effective regime for trading international emissions permits is not established, then the estimated energy price increases are nearly doubled, with parallel economic losses. This situation is depicted for the base case in Table 2.

The losses in aggregate economic activity are significant, though again, largely transitory. Table 2 shows GDP loss without international trading peaking around 1 percent in 2005, for stabilizing emissions at 1990 levels in 2010. After this initial loss, the economy begins to rebound as revenue from the domestic permit auctions reduces the Federal budget deficit and lowers interest rates. Businesses respond by making additional capital investments, setting off a mini- "investment boom". By 2015, the economy is estimated (in some models) to regain and even surpass its original growth path. This result indicates that the emissions reduction program as modeled is pro-investment (because reduced personal consumption allows businesses the wherewithal to expand the capital stock).

Technology assumptions

Another possibility for mitigating economic costs is focusing attention and resources on programs that promise to decrease the rate at which the economy produces greenhouse gas emissions. Examples here might include an increased research and development effort or an initiative to more rapidly diffuse the most efficient energy practices through industry. The "hi-tech" set of assumptions added to the base case modeling shows that energy price increases could be reduced by 10-30 percent, by 2010, with larger reductions possible further in the future. Estimated economic costs of the base case policies would be correspondingly reduced.

Environmental benefits

The figures presented here do not reflect the environmental benefits associated with avoiding climate change, nor do they reflect collateral environmental benefits that may result from reduced emissions of greenhouse gases. Policies to reduce greenhouse gas emissions, for example, are likely to reduce emissions of other pollutants, including SOX, NOX, particulate matter and toxic pollutants (e.g., mercury). According to EPA estimates, the monetizable benefits of reducing fine particles and ozone in connection with either Option 1 or Option 2 could total tens of billions of dollars per year.

Economic effects are summarized on the charts below.

Table 1 -- Base Case with OECD Emissions Trading*

Variable of Interest	Option 1 -- 10% below 1990 levels by 2010	Option 2 -- 1990 levels by 2010	Option 3 -- 15-20% above 1990 levels by 2010**
GDP in 2005	-1.0% to -0.1%	-0.5% to 0.0%	-0.1% to 0.0%**
GDP in 2010	about -0.3%	-0.4% to -0.1%	about -0.1%**
GDP in 2020	-0.3% to +0.2%	about -0.1%	about 0.0%**
Implied price increase per ton of carbon in 2010	about $85	about $50	about $10**
Implied price increase per gallon of gasoline in 2010	about 20-25 cents	about 10-15 cents	about 2-3 cents**
Implied price increase per ton of coal in 2010***	about $50	about $30	about $6**
Implied average price increase for residential electricity in 2010****	about 1.5 cents per kwh	about 1 cent per kwh	about 0.3 cents per kwh**
Decline in total employment in 2010 (national)	about 200,000	about 50,000-250,000	less than 50,000**
Annual value of domestic emission permits (2010)	about $110 billion	about $60-70 billion	about $10-15 billion**

* Analysis of Joint Implementation (worldwide emissions trading) would show lower costs and imply greater purchases by the U.S. of emissions reductions abroad.

** *Although figures are presented, obtaining agreement under the climate treaty to an international emissions trading regime would not be possible with a target in this range.*

*** Current national average appr. $28/ton

**** Current national average appr. 8 cents/kilowatt hour

Table 2 -- Base Case without OECD Emissions Trading

Variable of Interest	Option 1 -- 10% below 1990 levels by 2010	Option 2 -- 1990 levels by 2010	Option 3 -- 15-20% above 1990 levels by 2010
GDP in 2005	-2.0% to -0.1%	-1.0% to -0.1%	-0.3% to 0.0%
GDP in 2010	-0.7% to -0.3%	-0.6% to -0.2%	-0.2% to -0.1%
GDP in 2020	-0.3% to +1.0%	-0.6% to +0.2%	about 0.0%
Implied price increase per ton of carbon in 2010	$130-200	$80-140	$15-25
Implied price increase per gallon of gasoline in 2010	35-50 cents	20-40 cents	5-10 cents
Implied price increase per ton of coal in 2010*	$80-120	$50-85	about $10-15
Implied average price increase for residential electricity in 2010**	about 4 cents per kwh	about 1.5-3.0 cents per kwh	about 0.5 cent per kwh
Decline in total employment in 2010 (national)	about 200,000-500,000	about 150,000-400,000	about 50,000-100,000
Annual value of domestic emission permits (2010)	about $270 billion	about $110-190 billion	about $20-35 billion

* Current national average appr. $28/ton
**Current national average appr. 8 cents/kilowatt hour.

control costs.

Domestic emissions trading programs are an attractive policy tool. Compared to traditional "command-and-control" regulatory approaches, they offer greater flexibility and lower costs. Such programs are being used successfully in several areas under the U.S. Clean Air Act.

Among the important issues to be addressed in designing a domestic emissions trading program are:

--Where the constraint is imposed. A "primary fuel" trading program would limit the production or import of fossil fuels. A "sectoral" trading program would limit emissions from one or more key sectors (e.g., utilities, transport and heavy manufacturing).

--How permits are distributed. Permits could be given to existing emitters, given to others (who could then sell them back to current emitters), auctioned, or some combination of the foregoing. If permits are auctioned, substantial revenues would be raised. (Options for using these revenues include tax cuts, deficit reduction and support for transitional or technology programs). If permits are given away, recipients would potentially receive a windfall.

ii. Technology Programs. The cost of reducing greenhouse gas emissions between now and 2020 depends greatly on the ability to accelerate use of existing energy-efficient technologies. Over the longer-term, the solution to the climate change problem depends on developing and deploying new technologies that are even more efficient and/or based on non-carbon energy sources.

A range of government programs might help accelerate technological change. Information dissemination programs assist businesses and consumers in identifying opportunities to reduce the energy intensity of their products or services (e.g., using more energy efficient light bulbs, insulation, appliances, etc.). In addition, research and development programs generally aim to improve technologies by lowering production and operating costs. Large opportunities for cost-lowering research and development exist in buildings, transportation, combustion, renewables and sequestration (e.g., fuel cells, advanced industrial turbines, advanced diesel engines, and transportation biofuels). However, generating significant increases in budget support for technology programs will be challenging.

iii. Transition Assistance Programs. Under any of the policy options being considered, some workers and communities may be adversely affected. Workers in energy-intensive industries and those in energy extraction may be most likely to be hurt. Given the geographic isolation of some of these industries, the surrounding communities may also be adversely affected.

A transition program would reduce costs to individuals and communities. Transition assistance can help facilitate community and worker adjustments via retraining, job search assistance, and infrastructure development for new business in the community. As previous experience with acid rain, military base closures, and the federal government's own work force restructuring has demonstrated, the early development of such programs can be vital to building public support for a policy.

Among the important issues to address in designing a transition program are:

---Whether a new, categorical program should be designed or existing programs expanded. A new, categorical program would limit benefits to targeted workers and communities but allow for flexibility in benefit levels. Expansion of current programs to allow for increased usage is consistent with Administration program consolidation efforts but constrains program design flexibility.

---How the program will interact with the other components of climate change policy. Permit auctions could provide an important revenue source for these programs. Permit allocations could be used to "fund" transition assistance.

APPENDIX D
ADDITIONAL BACKGROUND

A. Basis for Concern

The build-up of greenhouse gases in the atmosphere threatens fundamentally to alter the Earth's climate. The most recent international scientific assessment concluded that global average temperatures will increase by 2-6.5 degrees F. by 2100, unless actions are taken to slow the build-up of greenhouse gases. This is the fastest increase in more than 10,000 years.

Potential impacts from climate change include sea level rise, the spread of infectious disease, extreme weather events (such as droughts and floods), loss of forest cover and shifts in agriculturally-productive regions. Absent policy interventions, global average temperatures by the end of the next century will increase 2-6.5 degrees F., sea-level rise will inundate more than 9000 square miles in the United States (with Florida and Louisiana most vulnerable), and an additional 50-80 million people will contract malaria worldwide. According to a NOAA study, average July temperatures in Washington, D.C. by the end of the next century are expected to increase by 5-15 degrees F. (with greater humidity). The international scientific assessment states that "climate change is likely to have wide-ranging and mostly adverse impacts on human health, with significant loss of life."

Nevertheless, significant uncertainties remain concerning the magnitude, timing and regional distribution of impacts. Currently, scientists are unable to predict changes in short-termweather patterns in particular regions.

Atmospheric concentrations of carbon dioxide (the most important greenhouse gas) are well above historic levels and climbing sharply. Concentrations are currently 360 parts per million (ppm), about 30% above pre-industrial levels and the highest in at least 200,000 years. Absent policy interventions, concentrations in 2100 are predicted to reach roughly 750 p.m., the highest in more than 50 million years.

B. Human Sources of Greenhouse Gases

The principal cause of the buildup in greenhouse gases is the burning of fossil fuels. Other human activities, including deforestation and mining, also play a role. The international scientific assessment concluded that "the balance of evidence suggests there is a discernible human influence on the global climate."

Developed countries are responsible for more than 75% of the increase in greenhouse gas concentrations since the beginning of the Industrial Revolution. In the decades ahead, however, emissions from developing countries are expected to grow sharply. By 2035, developing country emissions are expected to exceed those from the developed world.

The United States emits more greenhouse gases than any nation in the world (roughly 25% of the world's total). Our per capita emissions are among the world's highest -- roughly 50% greater than the OECD average and eight times that of China. In the United States, greenhouse gas emissions come mainly from industry (1/3), transport (1/3) and buildings (1/3). Since 1990, U.S. greenhouse gas emissions have grown 7-8%. Without policy interventions, U.S. emissions are projected to grow 20-25% over 1990 levels by 2010.

None of the actions contemplated during this round of negotiations will, by themselves, reverse the build-up of greenhouse gases in the atmosphere or even slow it significantly. However, this round will set the stage for future negotiations over steps by both developed and developing countries, and will send important signals to the private sector that could affect the rate at which beneficial technologies are developed and adopted.

C. Clinton Administration Policies To Date

The Clinton administration has been active on this issue since Earth Day 1993, at which time the President pledged to return U.S. greenhouse gas emissions to 1990 levels by the year 2000, and then to continue the trend of reduced emissions. In October 1993, the Administration issued the Climate Change Action Plan, designed to achieve that goal. Due to Congressional budget cuts, higher-than-expected economic growth and lower-than-expected energy prices, however, this goal will not be achieved.

The President has spoken to this issue on many occasions. In May 1997, in Costa Rica, he said "we must meet the challenge of climate change"; in April 1997, before departing for North Dakota, he discussed possible links between extreme weather events and greenhouse gas emissions; in his 1997 State of the Union, he called for "reduc[ing] the greenhouse gases that challenge our health even as they change our climate"; in December 1996, in Australia, he said "we must work to reduce harmful greenhouse gas emissions...If they continue unabated, the consequences will be nothing short of devastating the children here in this audience and their children."

The Administration has strongly supported research and development programs with significant climate change benefits. Examples include the Partnership for a New Generation of Vehicles (a $280 million program), the Global Change Research Program ($1.8 billion) and renewable energy and energy efficiency programs ($1 billion).

The United States has been an active participant in the international climate change negotiations, as described below.

D. International Negotiating Context

There is international agreement that the climate change problem is significant and requires action. There is also consensus that the existing UN Framework Convention on Climate Change, signed in Rio in 1992, is inadequate. Under the Convention, developed countries set a goal of reducing greenhouse gas emissions to 1990 levels by the year 2000, but few will do so. The Convention contains no goal beyond the year 2000.

In April 1995, in Berlin, the Parties to the Convention agreed to negotiate next steps for the post-2000 period. Under the terms of the "Berlin Mandate, " developed nations would agree to quantified emissions limits over specified time frames (e.g., 2005, 2010 and 2020) by December 1997. Developing nations (who typically have less stringent obligations than developed nations in environmental treaties) agreed to reaffirm their existing commitments, and continue to advance implementation of these commitments in this round of negotiations.

In July 1996, the U.S. called for an approach that would include three key elements: (1) a binding target (instead of the existing Convention's non-binding goal), (2) flexibility in implementation (for example, through emissions trading among developed nations and "joint implementation" with developing nations), and (3) the participation of developing countries. The U.S. proposal did not include any particular target or timetable.

Support for most aspects of the U.S. proposal has been quite limited. Some aspects have encountered stiff opposition. Few countries have supported the US call for more active developing country participation under the Convention. Developing countries, in particular, have argued heatedly that the developed world is responsible for the buildup of greenhouse gases in the atmosphere and must take the lead in addressing the problem. Support for "joint implementation" has also been limited. Such a mechanism could significantly reduce overall costs to the U.S., but involve substantial international payments or transfer of technology by the private sector.

Views of other countries vary considerably. The European Union has proposed that developed nations cut back emissions 10-15% from 1990 levels by 2010 (and an as-yet unspecified amount by 2005). Small island nations have proposed that developed nations reduce emissions by 20% from 1990 levels by 2005. Other nations, including Australia, Japan and Canada, have expressed concerns about moving too far too fast, but have not put forward any specific targets.

Absent policy interventions, atmospheric greenhouse gas concentrations will increase during the next century to levels unknown on this planet for hundreds of thousands (and possibly tens of millions) of years. To avoid such extraordinary increases, *global* greenhouse gas emissions must begin to decline from projected levels early in the next century. For *global* emissions to begin to decline in this time frame, developed countries must move quickly to reduce their emissions, setting the stage for future rounds of negotiations.

E. Constituency Views.

At present, public attention to climate change is low. Although polling data indicate that the public believes climate change is a serious problem, few rank it high on a list of concerns. Public and media attention to the issue will likely grow as the Kyoto Conference approaches.

For many environmental groups, strong action on climate change is a litmus test for the administration's environmental policy. They plan public relations campaigns on the issue in the year ahead. Many environmental groups are calling for sharp emissions cuts early in the next century (e.g., 20% below 1990 levels by 2005). On the issue of emissions trading and joint implementation, the environmental community is divided, with some groups (e.g., Environmental Defense Fund) strongly supportive and others (e.g., Sierra Club) strongly opposed. Most environmental groups will support flexibility provisions if coupled with emissions reductions below 1990 levels.

Business is composed of several camps. The largest -- made up of coal companies, coal-dependent utilities, fuel producers, heavy industry and transporters -- is strongly opposed to any action at Kyoto. This group is well-funded and poised for a significant public relations campaign. A second group -- made up of chemical companies, natural gas interests, some appliance manufacturers and others -- is cautiously supportive of action at Kyoto. A smaller third group -- composed of natural gas, renewable energy and energy efficiency companies -- strongly supports aggressive climate change policies. Many businesses point to international competitiveness as a primary concern. In a major speech recently, the CEO of BP broke ranks with other oil companies and said "it would be unwise and potentially dangerous" to ignore mounting evidence of climate change.

Earlier this year, more than 2000 economists (including six Nobel Laureates) signed a letter stating that "sound economic analysis shows that there are policy options that would slow climate change without harming American living standards, and these measures may in fact improve U.S. productivity in the longer-run." Recently, several dozen scientists sent the President a letter warning of the consequences of rapid climate change and urging us to limit change to the "lowest rate feasible."

Agriculture groups are only beginning to pay attention to this issue. They have been concerned about extreme weather, but also worried that climate change mitigation policies could lead to rising fuel costs and competitive disadvantage with developing countries. The U.S. insurance industry is also beginning to pay attention, especially the reinsurers (who have lobbied Congress for more money for climate change research).

Labor is increasingly opposed to action on climate change, largely in deference to the concerns of the United Mine Workers. An AFL-CIO resolution earlier this year was critical of the administration's climate change policy. Some unions -- including the UAW, the Steelworkers, the Oil, Chemical and Atomic Workers, the AFT and the NEA -- have taken more moderate views in the past.

Finally, the religious community is increasingly engaged on this issue. The National Council of Churches has collected more than 100,000 signatures in the past few months on a petition urging action on this issue.

F. Congressional Considerations

There is considerable skepticism about climate change on Capitol Hill. Most Republicans, and many Democrats, appear far more concerned about the costs of mitigation than the problem itself. Southern and western Republicans are, by and large, skeptical or hostile to action on climate change. Midwestern Democrats have expressed concern about the impacts of climate change policies on coal and heavy manufacturing (especially autos). Northeast and West Coast Members are perhaps the most likely to support action on this issue.

Many Members cite the unwillingness of developing countries to accept quantitative emissions limits as a major concern. Increasingly, Members are complaining about a lack of openness in our decision-making process. Many are urging the administration to make key aspects of our policy and analysis known in the very near future.

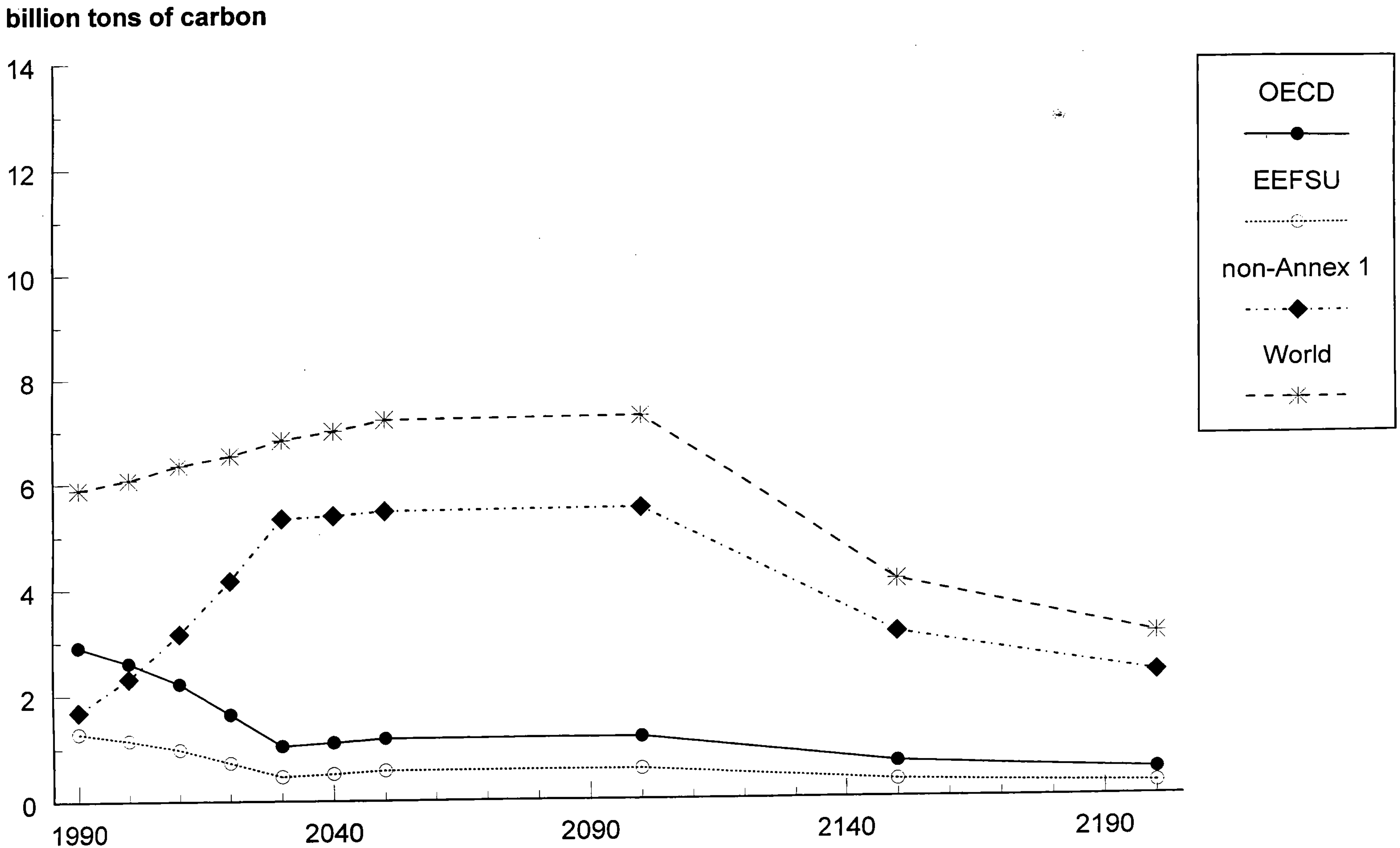
"Advice and consent" of the Senate will be required for any agreement reached in Kyoto. Implementing legislation will likely be needed as well. Favorable votes in the 105th Congress, or even the 106th, would be an enormous challenge. Ratification might need to await work on matters (e.g., joint implementation, developing country commitments) unlikely to be resolved in Kyoto.

G. Domestic Implementation

An Assistant Secretary-level working group has recommended a domestic climate change policy with three parts: domestic emissions trading programs, technology programs, and transition assistance programs. Details of these programs could be developed in consultation with consituencies in the months ahead.

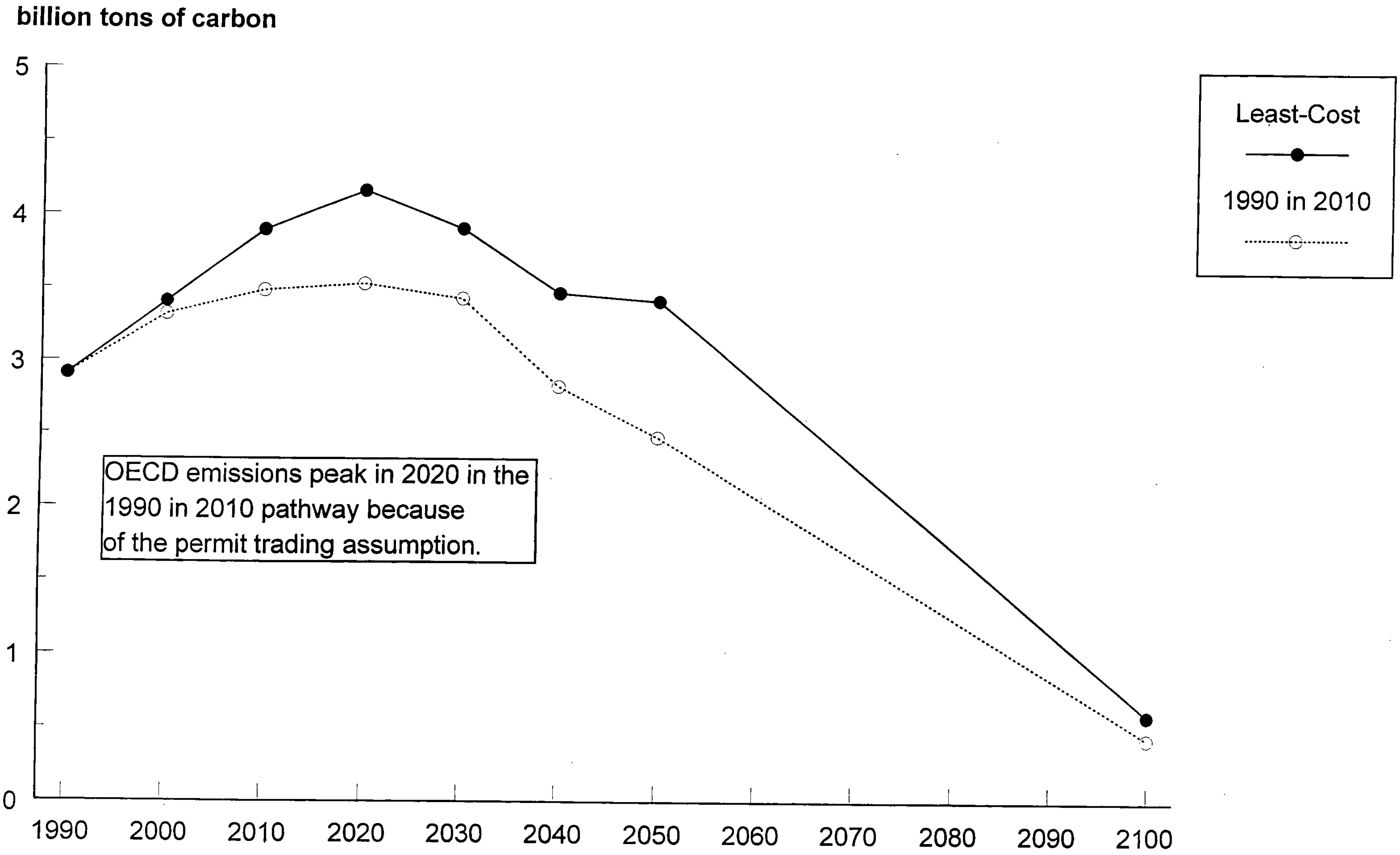
i. Emissions Trading Programs Under domestic emissions trading programs, permits representing rights to emit greenhouse gases in the United States would be distributed, either through an auction or allocation system. Permits would be tradeable. Firms would have an incentive to control emissions where costs are low and sell reductions to firms facing higher

WG1 Emissions Pathway to Stabilize Concentrations at 550 ppmv



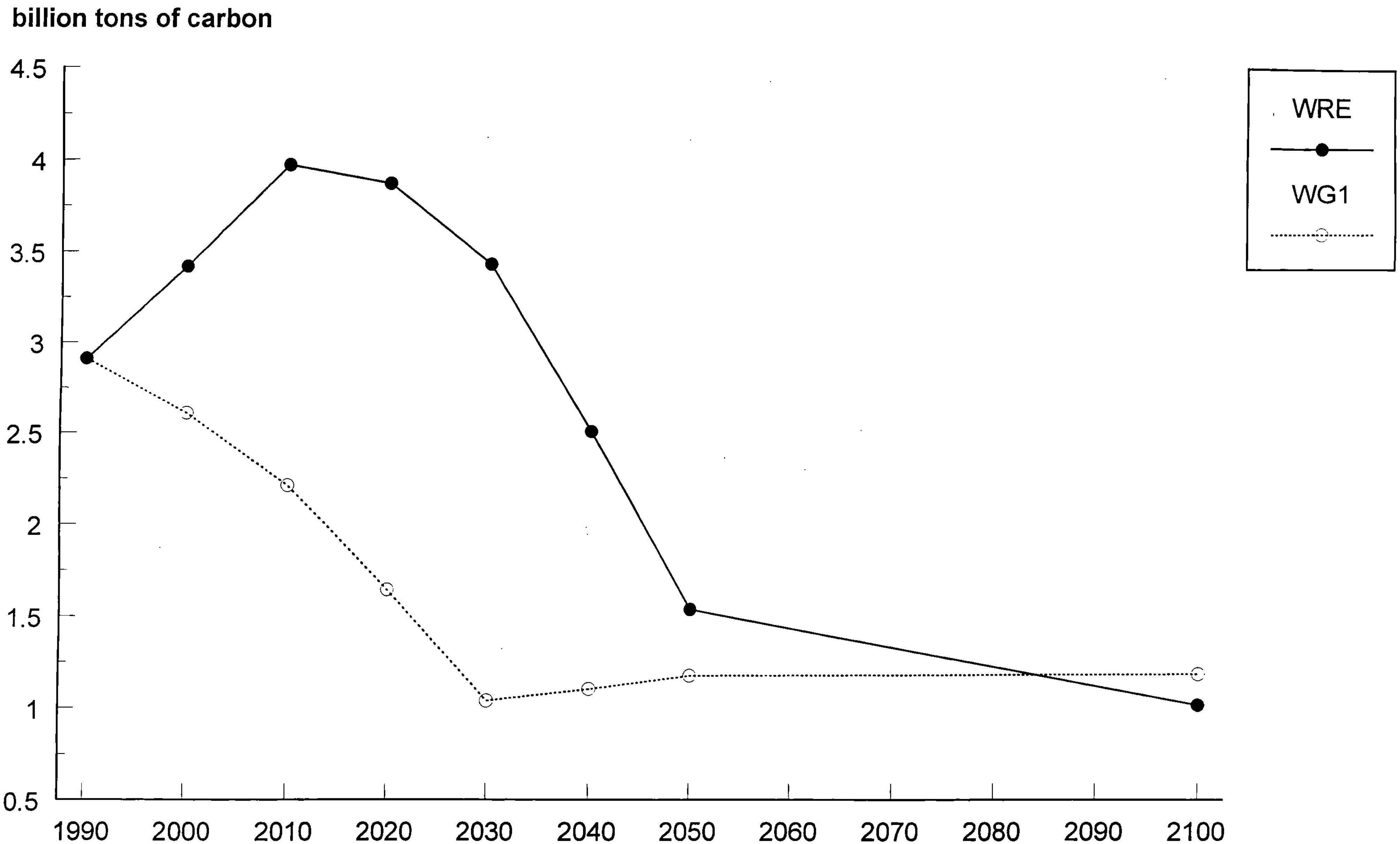
Source: Manne and Richels

Figure 4: Least-Cost and 1990 in 2010 Emissions Pathways for OECD to Stabilize Concentrations at 550 ppmv

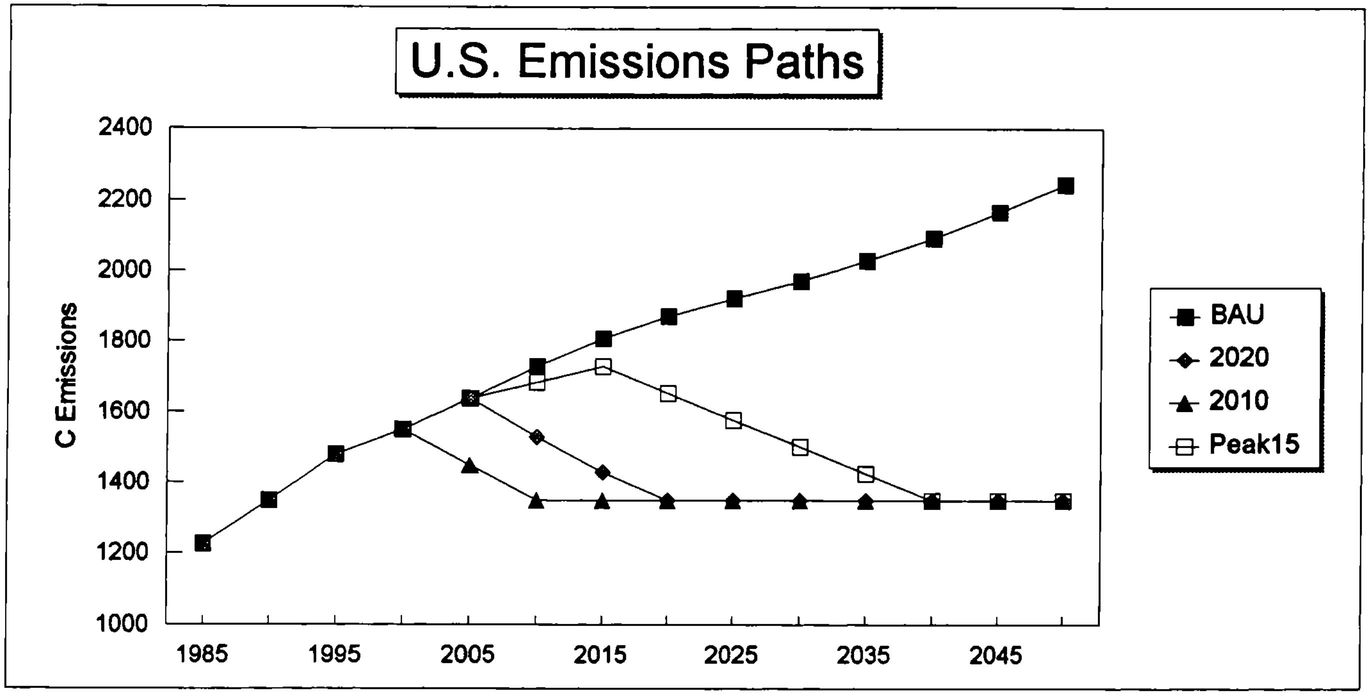


Source: Manne and Richels

Figure 3: WRE and WG1 Emissions Pathways for OECD to Stabilize Concentrations at 550 ppmv



Source: Manne and Richels



U.S. Emissions Paths
C Emissions
2400
2200
2000
1800
1600
1400
1200
1000
1985
1995
2005
2015
2025
2035
2045
BAU
2020
2010
Peak15

The Effects of International Permit Trading on Consumption Losses by OECD Countries, WRE Emissions Pathway to 550 ppmv Stabilization

Model	Trading	No Trading	Trading/No Trading
CETA	1.86	1.83	1.02
CPBRIVM	0.17	0.64	0.27
FUND	1.47	9.82	0.15
MERGE	0.60	0.85	0.71
MiniCAM	0.54	1.58	0.34
SGM	0.13	1.84	0.07
		Average:	0.43

The Effects of International Permit Trading on Consumption Losses by OECD Countries, WG1 Emissions Pathway to 550 ppmv Stabilization

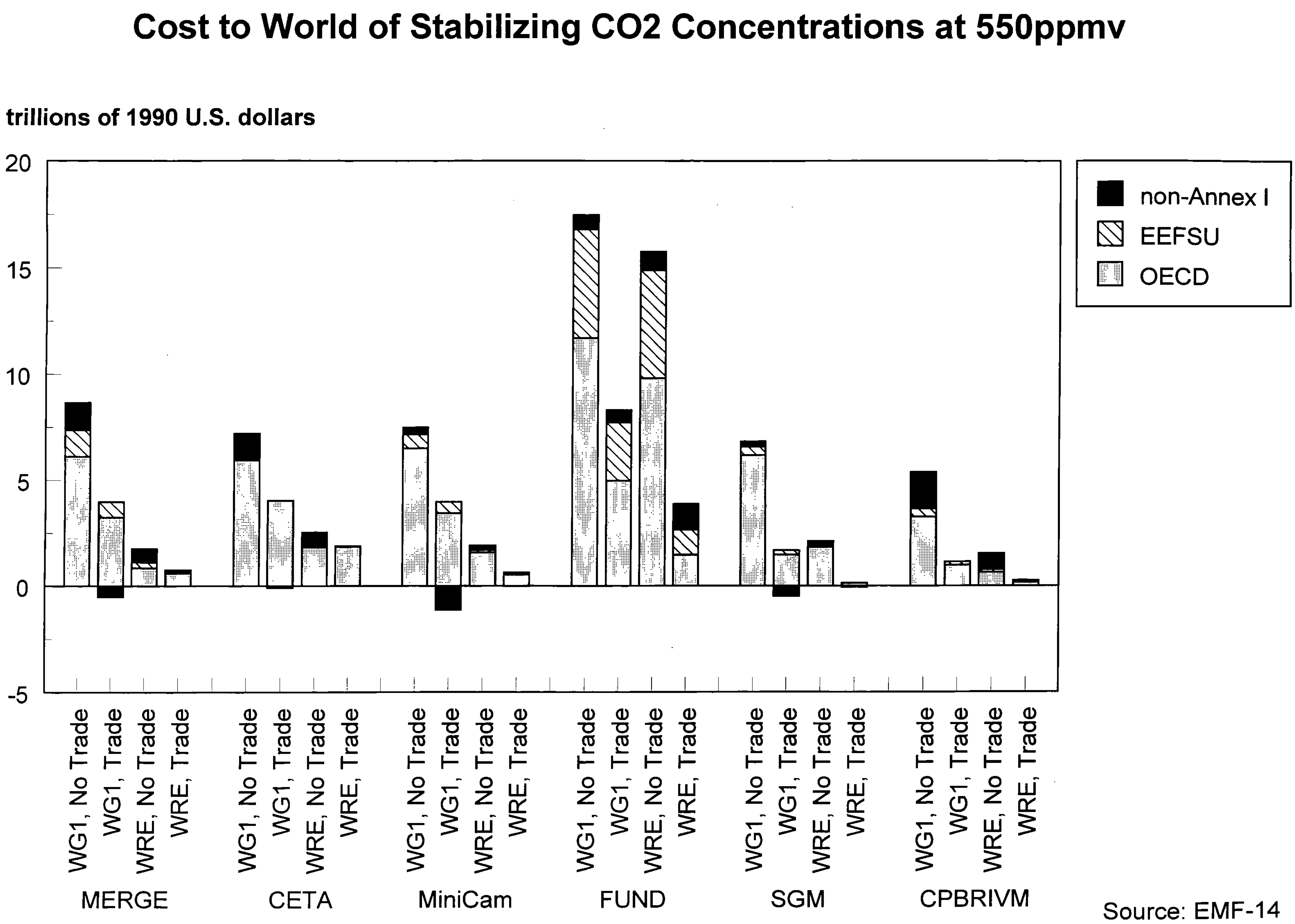
Model	Trading	No Trading	Trading/No Trading
CETA	4.03	5.94	0.68
CPBRIVM	0.99	3.25	0.30
FUND	4.97	11.71	0.42
MERGE	3.24	6.12	0.53
MiniCAM	3.44	6.51	0.53
SGM	1.48	6.17	0.24
		Average:	0.45
		Average (WRE + WG1):	0.44

The Effects of Emissions Pathway on Consumption Losses by OECD Countries, No International Permit Trading

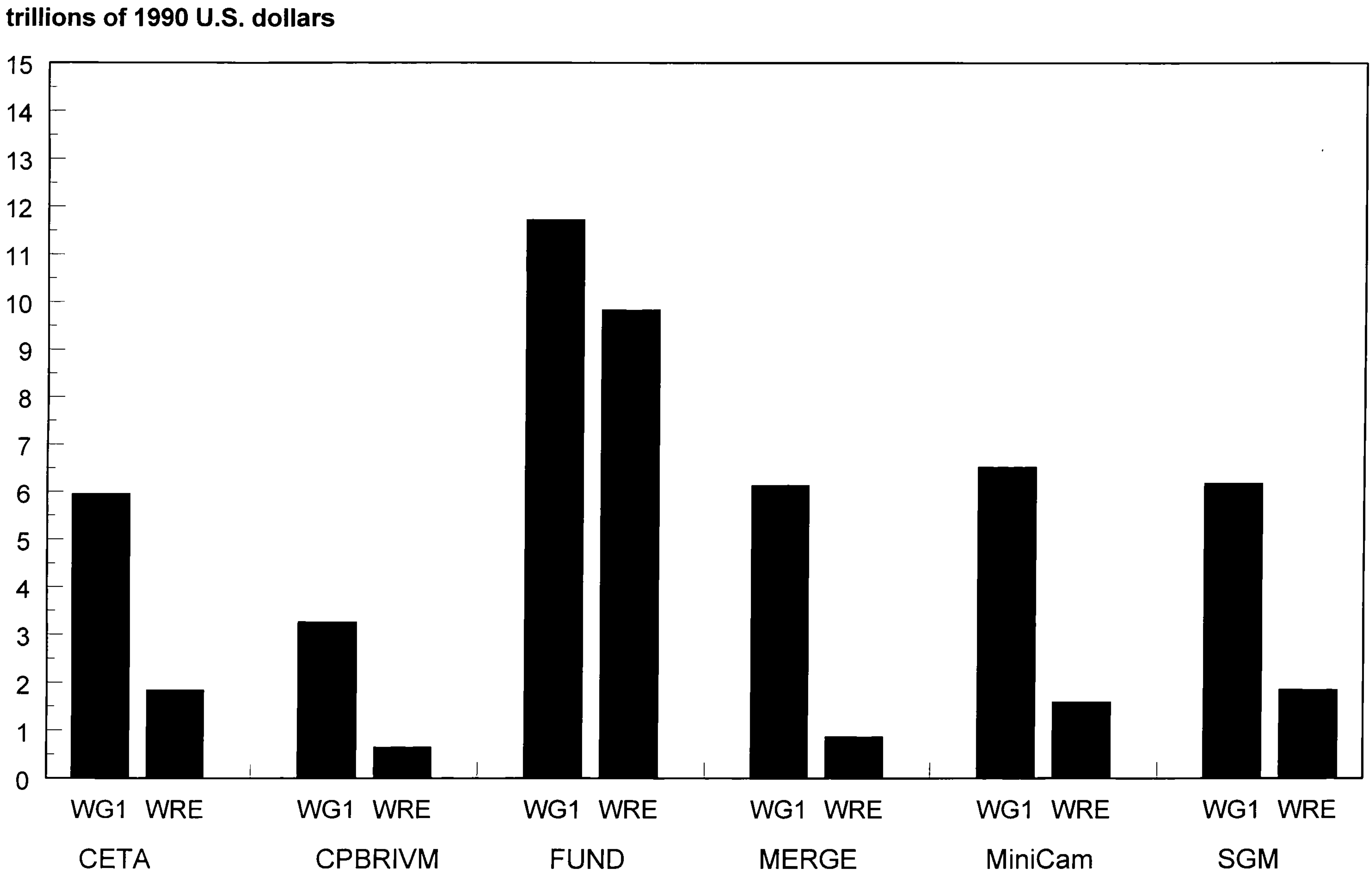
Model	WRE	WG1	WRE/WG1
CETA	1.83	5.94	0.31
CPBRIVM	0.64	3.25	0.20
FUND	9.82	11.71	0.84
MERGE	0.85	6.12	0.14
MiniCAM	1.58	6.51	0.24
SGM	1.84	6.17	0.30
		Average:	0.34

The Effects of Emissions Pathway on Consumption Losses by OECD Countries, International Permit Trading

Model	WRE	WG1	WRE/WG1
CETA	1.86	4.03	0.46
CPBRIVM	0.17	0.99	0.17
FUND	1.47	4.97	0.30
MERGE	0.60	3.24	0.19
MiniCAM	0.54	3.44	0.16
SGM	0.13	1.48	0.086
		Average:	0.23
		Average (Trading + No Trading):	0.28

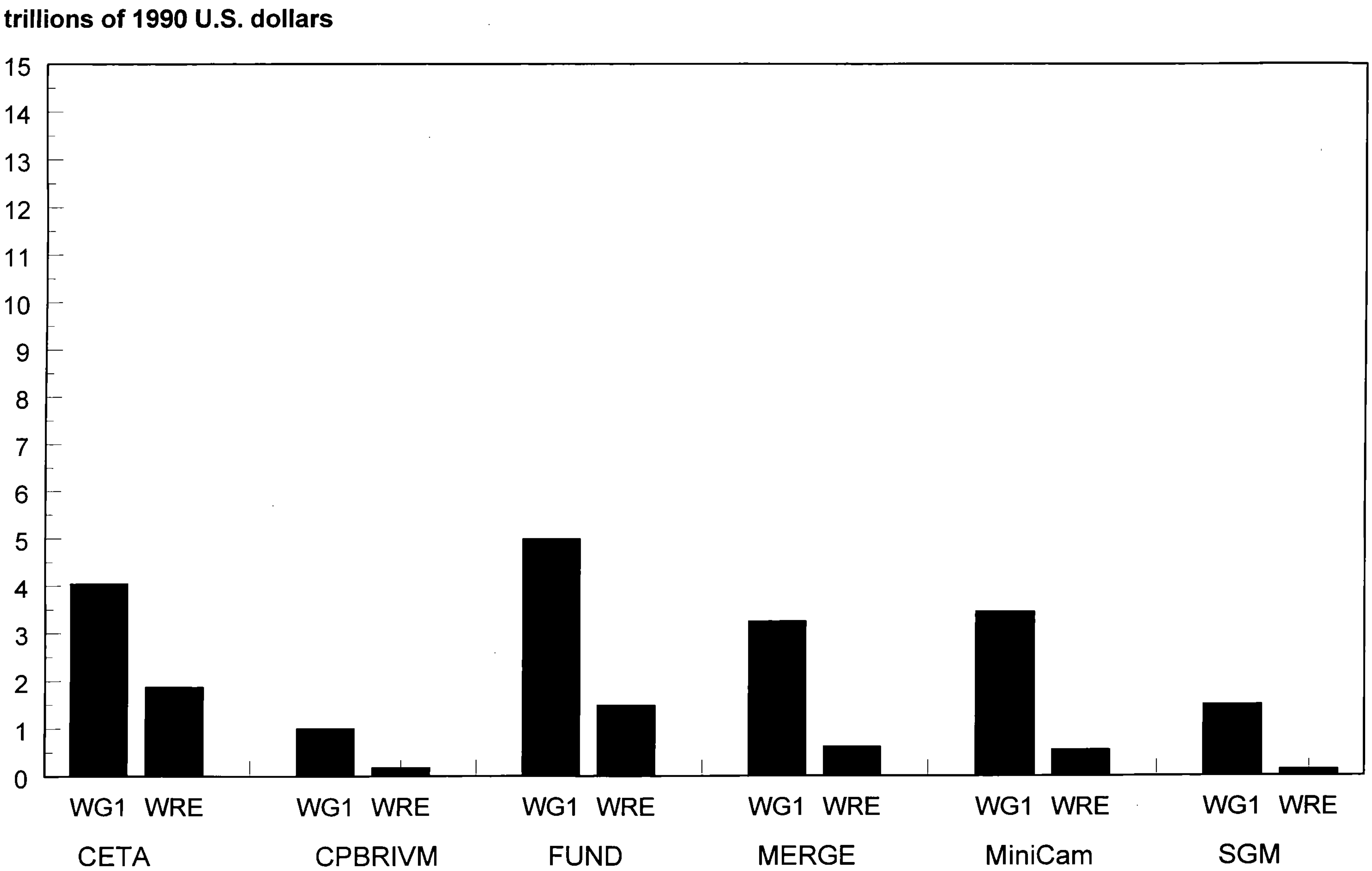

Cost to World of Stabilizing CO2 Concentrations at 550ppmv
trillions of 1990 U.S. dollars
20
15
10
5
0
-5
non-Annex I
EEFSU
OECD
WG1, No Trade
WG1, Trade
WRE, No Trade
WRE, Trade
MERGE
CETA
MiniCam
FUND
SGM
CPBRIVM
Source: EMF-14

Cost to OECD, of Stabilizing CO2 Concentrations at 550ppmv, without International Trading



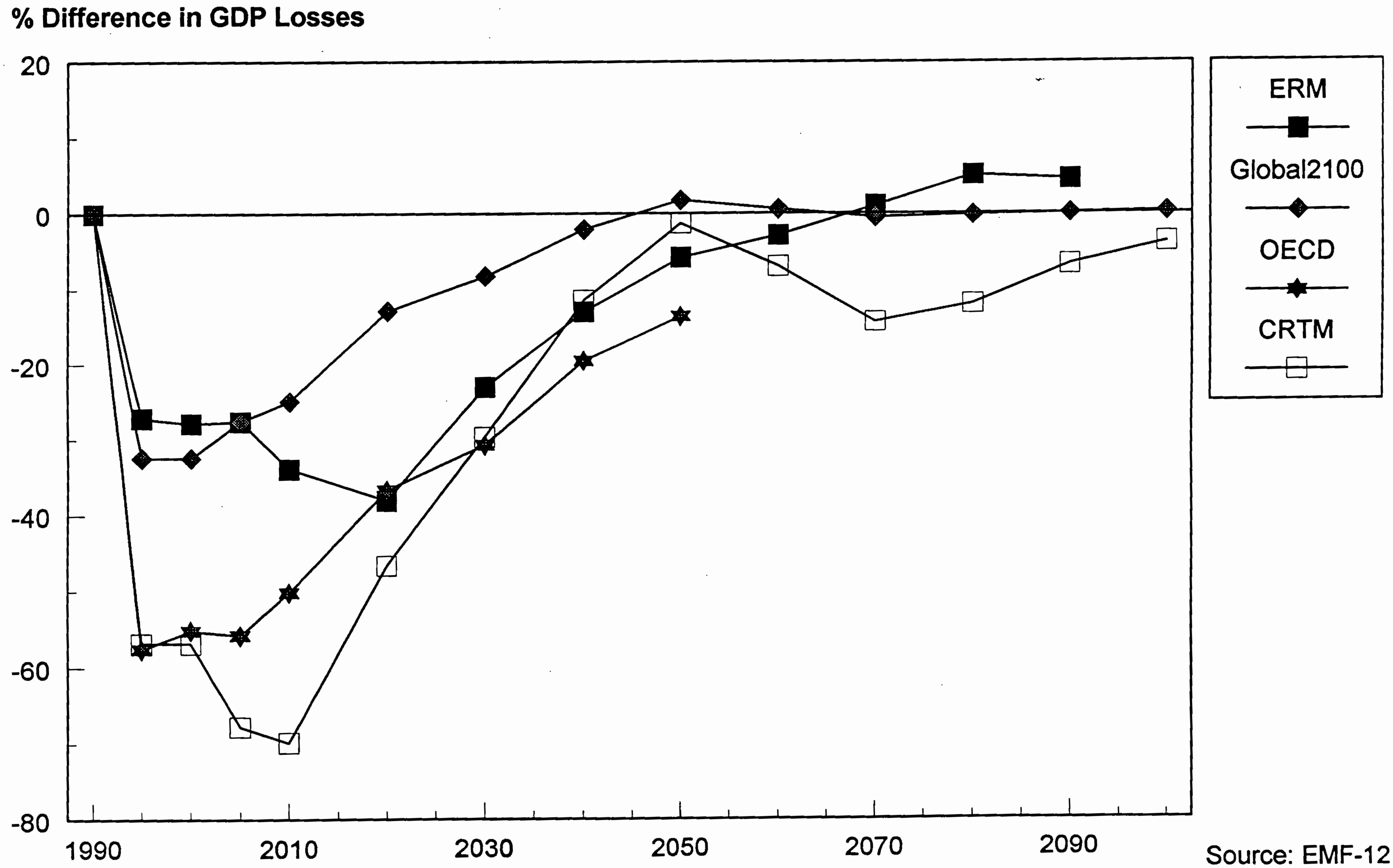
Source: EMF-14

Cost to OECD, of Stabilizing CO2 Concentrations at 550ppmv, with International Trading

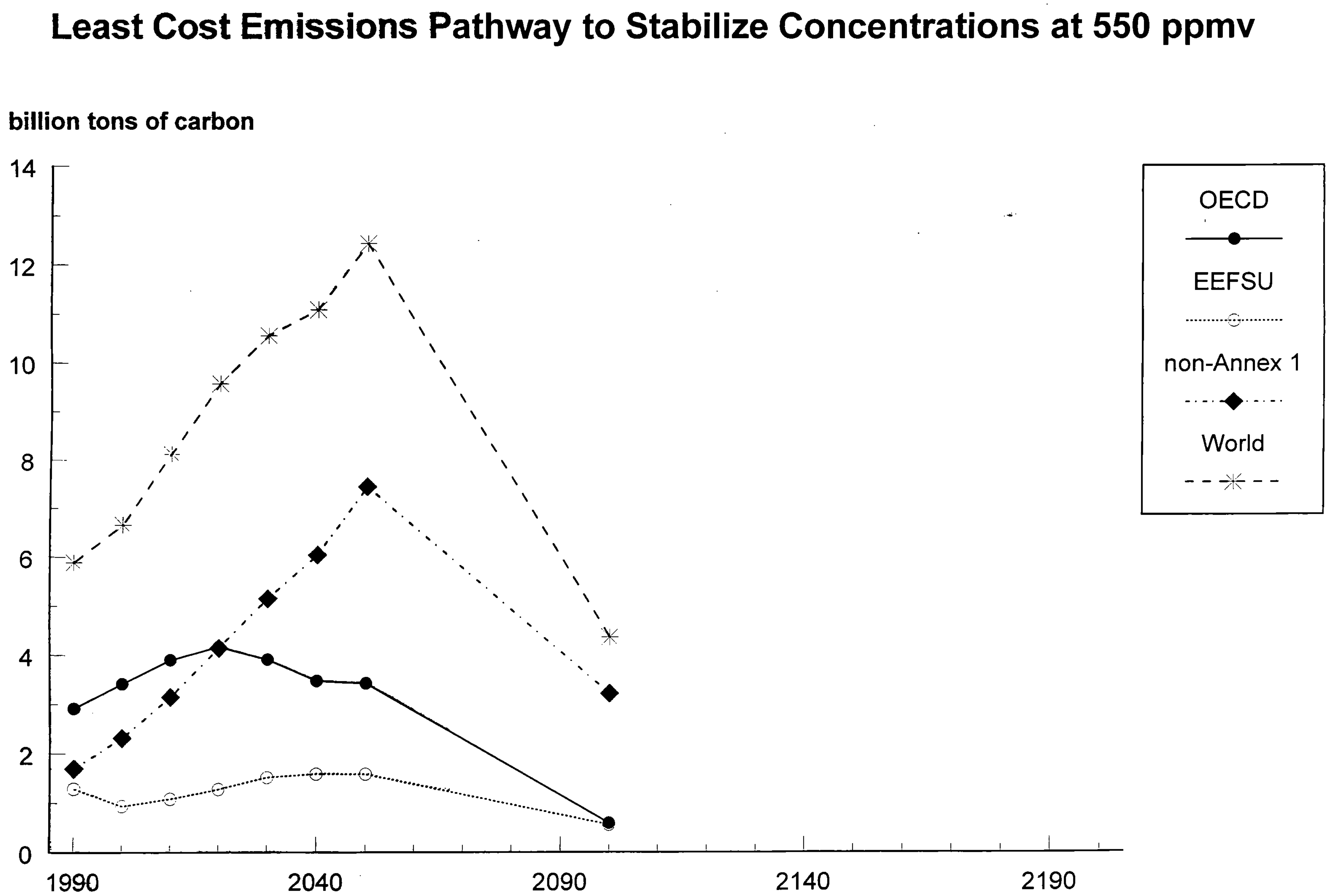


Source: EMF-14

Benefits of Emissions Trading to the World: 20% Reduction from 1990 Levels with Trading Relative to 20% Reduction from 1990 Levels without Trading



Source: EMF-12



Source: Manne and Richels

Least Cost Path Permit Prices
2010 $2
2020 $3
2030 $6
2040 $10
2050 $20
2100 $156

It is important to keep in mind that the permit price estimates cited above assume perfect global trading. Under this assumption, emission reductions occur where it is cheapest to do so regardless of geographic location (including in developing countries). What if there is no opportunity to buy emission reductions from lower-cost countries? The following table shows permit prices in 2010 when Annex I emissions are constrained to 1990 levels under alternative assumptions about where flexibility. If the U.S. must attain its target by domestic emission cuts entirely, because developing countries do not participate and there is not trading even among Annex I countries, then the cost rises steeply. These conditions triple the price of the "1990 by 2010" target, in terms of the marginal cost of abatement, from $67/ton to $204.

U.S. Permit Prices in 2010, 1990 Level in 2010 Scenario

Where Flexibility	Global Trading	Annex I Only Trading	Domestic Only Trading
Permit Price in 2010 ($/ton)	67	132	204

What if the developing countries do not agree to go along?

It is difficult to imagine that the industrialized countries will be able to extract commitments from developing countries much more serious than those assumed in the preceding section, the Manne-Richels burden-sharing schedule. (Or that U.S. taxpayers will agree to transfers to developing countries larger than those implicit in that schedule.) What if, as is more likely, the commitments extracted from developing countries are less strong than this, rather than more? On the one hand, as a matter of arithmetic, meeting the 550ppmv concentration constraint would require more aggressive targets and timetables on the part of the Annex I countries, if indeed it would be possible at all. On the other hand, as a matter of politics, the absence of the developing countries would probably lead the peoples of the Annex I countries to choose a less aggressive path, even though it would produce a higher terminal concentration level.[11] (An analytical balancing of costs and benefits would give the same answer -- a less aggressive path -- once the concentration constraint is relaxed.)

To consider the possibility that developing countries might decline to participate, or decide to participate only to a lesser degree than the Manne-Richels burden-sharing formula, we ask what would be the effects, both economic and environmental, if the Annex I countries were constrained to the WRE path, but developing countries do not participate (i.e., developing countries remain on their BAU path). The welfare losses (in terms of present discounted value) will depend upon whether there is trading in emission rights among Annex I countries. If Annex I trading occurs, then Annex I countries' losses increase from $0.62 trillion to $0.91 trillion, or 47%. If emission trading among Annex I countries does not occur, then losses rise to $1.00 trillion, or 61%. For the U.S., in

[11] Conversely, the developing countries are less likely to agree to participate if the Annex I countries have not already taken serious action.

the absence of developing country participation, welfare losses rise from $0.28 to $0.36 trillion, or 29%, assuming Annex I trading. Without Annex I trading, U.S. losses rise to $0.41 trillion or 46%.[12] Meanwhile, the non-participation of the developing countries means a clear failure to meet the goal of capping global emissions at 550 ppmv.

Even if the Annex I countries choose an aggressive path of reducing emissions 10% below 1990 levels by 2010 (and stay at that level thereafter), the effect is to reduce global concentrations only 7 % below BAU levels in the year 2100. This is less than a third of the reductions achieved when the developing countries participate [22%; conversation 8/28] This result illustrates the problem of free riding. Moreover, the estimate does not include an allowance for "leakage" of carbon savings from participating to non-participating countries (e.g., reduced oil demand in the former, via a lower world price of oil, raises oil consumption in the latter). Once leakage effects are added to the free-riding problem, the difficulty of accomplishing meaningful reductions without the help of developing countries are even greater. The savings is only 5 percent in this case. In other words, of the 22 percent reductions achieved when the developing countries participate, 15 percentage points are lost to free-riding, and another 2 points to carbon leakage. [conversation 8/29.] This estimate captures only some of the possible leakage channels; it omits, for example, the relocation of production in polluting industries to non-participating countries. Indeed, no model measures this effect with much precision or accuracy.

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4. What is the trade-off between the paths currently under discussion?

As we have seen, the Manne-Richels results suggest that the optimal path has Annex I emissions peaking in the decade 2020-2030 and returning to 1990 levels after 2050. The paths for emission reductions that have been discussed in the international negotiations are more aggressive.

What are the additional economic costs, and climatological benefits, of moving from the optimal path to "1990 levels by 2010"? Table 4, "Climate and Economic Variables under Alternative Emissions Paths,"which reports results from the SGM model, is designed to answer this question. The economic costs of the more aggressive path can be measured in several ways. The price of gasoline in 2010 would rise by 26 cents a gallon and coal prices by 273 percent, as compared to only 3 cents per gallon on the less ambitious path, and an increase in coal prices of only 53 per cent. The total economic loss, in the present discounted value of foregone consumption, $206 billion, as compared to only $95 billion on the less ambitious path. [These figures cumulate lost consumption out only to 2050, and thus are not comparable with the figures cited in the preceding section.] What is accomplished by the more aggressive strategy? The date at which concentrations are doubled is postponed by a mere 3 years (beyond the nine-year postponement achieved by the less aggressive path). The estimated warming in 2100 (2.45 degrees under the business as usual case)

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[12] For purposes of this comparison, we assume that if developing countries do participate, there will be full global trading.