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United States Department of State

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

Washington, D.C. 20520

cc: 3 pages, total

May 27, 1997

TO: Distribution

FROM: OES - Rafe Pomerance, Acting

SUBJECT: Assistant Secretaries Group: Climate Change Meeting

The next Assistant Secretaries group meeting is scheduled for tomorrow, Wednesday, May 28, from 10:30 a.m. to 12:00 p.m., in Main State Room 7835. Attached please find new draft language for Annex C. On the basis of our decisions, additional simplified papers with proposed changes to our draft Protocol text will be prepared. These will be cleared through a paper process, and submitted to the Convention Secretariat in time to meet the June 1, 1997, deadline. Please call Lilly Roots-Wiggins (647-1554) to confirm your attendance at this meeting.

Attachment:
As Stated

Additional U.S. Proposals
(references are to the original U.S. submission)

Article 1 (Definitions)

- Replace definition 3 ("Greenhouse gas") with the following:

  "Greenhouse gas" means any greenhouse gas covered in Annex C of this Protocol."

- Replace definition 4 ("Tonne of carbon equivalent") with the following:

  "Tonne of carbon equivalent" means one metric tonne of carbon, or a quantity of one or more other greenhouse gases equivalent to one metric tonne based on the global warming potentials decided by the Parties in accordance with Annex C of this Protocol.

Article 2 (Emissions Budgets)

- Delete paragraph 7

Article 3 (Measurement and Reporting)

- Replace paragraph 2 with the following:

  For the purposes of implementing paragraph 1 and promoting comparability, consistency, and transparency, the Parties shall, not later than their first Meeting, decide on agreed best available methods for the measurement by Parties of anthropogenic emissions by sources, and removals by sinks, of greenhouse gases, taking into account the best available methods determined by the IPCC. They shall also decide on appropriate adjustments to measurements of emissions and removals where agreed best available methods have not been used. The Parties shall periodically update agreed best available methods based on evolving scientific knowledge, including advice from the Subsidiary Body for Scientific and Technological Advice referred to in Article 12.

Annex C

- Replace descriptive language with the following:

  All greenhouse gases, their sources and sinks, with global warming potentials as decided by the Parties at their first meeting (taking into account the IPCC's global warming potentials for 100-year time horizons) and as subsequently updated by the Parties to reflect evolving scientific knowledge.

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United States Department of State

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

Washington, D.C. 20520

cc: DW
JAP
SS

May 22, 1997

TO: Distribution

FROM: OES - Eileen B. Claussen

SUBJECT: Assistant Secretaries Group: Climate Change Meeting

The next Assistant Secretaries group meeting is scheduled for Thursday, May 22, from 10:00 to 11:30 a.m., in Main State Room 7835. It is my intention to use this meeting to take decisions on a series of issues related to joint implementation, Annex C (which gases/sectors should be included in the Kyoto agreement), and early banking (whether there should be any credit for early action prior to the beginning of the first budget period). On the basis of our decisions, simplified papers with proposed changes to our draft Protocol text will be prepared. These will be cleared through a paper process, and submitted to the Convention Secretariat in time to meet the June 1, 1997, deadline. Please call Lilly Roots-Wiggins (647-1554) to confirm your attendance at this meeting.

Attachment:
As Stated

PROPOSED AGENDA

May 22 Assistant Secretaries Meeting

- Annex C gases/sectors - Decision on comprehensive approach (with discounting) versus limited list.

- Early Banking - Decision on whether the international agreement should include provisions ensuring that early reduction efforts be credited against a future obligation; if so, what options should be developed.

- Joint Implementation -
  - are JI projects restricted to non-Annex A/B hosts?
  - when do credits from projects begin?
  - must guidelines for JI be adopted by Kyoto – if not, by when?
  - should final agreement in Kyoto on targets be contingent on inclusion of JI ?
  - how should additionality be addressed in the agreement?
  - what should be in included in the JI review process?

- Emissions Trading - Distribution of paper; NOTE: This paper is an explanation and elaboration of existing U.S. proposals only.

Joint Implementation Issue Paper
(D R A F T 5/20/97)

Joint Implementation (JI) is one of the highest U.S. priorities in the negotiations. Along with emissions trading, it is a key flexibility element, providing an option for Parties to use reductions achieved through projects in other countries to offset domestic emissions. It also establishes a new form of currency for developing countries, allowing them to generate credits for sale or for future banking. However, a number of critical unresolved questions have been identified in the interagency process, and decisions must be taken on these in order to allow JI to proceed. These are detailed below.

1. **Can JI projects be hosted in non-Annex A/B Parties only, or may projects be developed in Annex A and B Parties as well?**

The existing text does not (legally) preclude any Party from hosting JI projects, although many in the Administration and in other countries have interpreted the U.S proposal as allowing JI only in the territory of a non-Annex A/B Party. A number of advantages have been identified for allowing JI projects to be undertaken globally: if a country does not have the capacity to develop a national emissions monitoring program, or is not willing or able to adhere to an emissions budget, it could still participate in a JI regime (something that may apply specifically to the EIT countries); prior to the budget period, it may be desirable to allow reductions to be undertaken (see question #2 below); and, if emissions trading does not become part of the Kyoto agreement, we may want to preserve the option of JI between all Parties (noting in particular the EU proposal, in which there is no emissions trading, and JI is only allowed between Annex A/B Parties) Conversely, if JI is open to all Parties (and particularly if it is comparatively easy to develop, review and agree on the transfer of credits for reductions), there may be a lesser incentive for Parties to take on a budget obligations and join Annex A. As one of the "carrots" in the U.S. proposal is the ability to participate in low cost trading, this situation may set up a perverse incentive. Finally, if JI is to be allowed between Annex A/B countries, some modification of the existing text may be required to allow for debiting JI TCEs from the participating Annex A/B Party.

2. **When may JI projects begin to generate TCEs (following the start of the first budget period, at any time, including prior to the beginning of the first budget period, only once guidelines have been approved by the MOP)?**

The current text of the U.S. proposal does not stipulate when TCEs may be generated from JI projects. Allowing projects to generate TCEs immediately may ensure that project development proceeds without interruption, while removing the credit option until the first budget period may significantly reduce the number of projects undertaken. Inasmuch as projects are supposed to be credited only for "additional" actions, this would mean a loss in global emissions reductions. It should be noted that a proposal has been submitted to the AGBM (by Norway) that would allow JI to begin after the pilot phase ends, and once modalities have been agreed.

Allowing JI projects to generate TCEs prior to the first budget period may create some difficult compliance issues – particularly if they are allowed prior to the development of review guidelines. There is the further specific question of whether projects should be "grandfathered" from the present, and whether these would need to be reviewed and approved again at the start of the budget period. Some of these questions may not be answerable until decisions have been taken on issues related to the review and approval process discussed later in this paper.

3. Should guidelines, criteria and other modalities for JI be included in the Kyoto agreement or be agreed upon later? If later, when?

- Option 1. Provide for an "Annex "D" in the agreement which would contain (1) an a priori list of acceptable JI project types, as well as (2) general language on guidelines, criteria and other modalities for projects not included in the list. While possibly desirable, it is looking increasingly less likely that we can agree on the elements of such an Annex within the USG – or negotiate one internationally within the Kyoto timeframe.

- Option 2. Set a date no later than the end of the Activities Implemented Jointly (AIJ) pilot phase (i.e., not later than December 31, 1999), or one year later, for adoption of the guidelines. This option acknowledges a connection between the Berlin decision on Activities Implemented Jointly (AIJ) and ultimate progress on JI. However, it presumes a successful conclusion to the AIJ pilot phase, and that JI projects will be developed even if there is no clear incentive from the Kyoto language in the form of agreed procedures. It also presumes the Kyoto agreement has entered into force – since guidelines could only be adopted by the Meeting of the Parties.

- Option 3. Call for adoption of guidelines no later than one year after entry-into-force of the agreement. This sets a different date certain for guidelines, and does not tie itself to the AIJ program – which is a no-crediting effort and may bog down allowing TCEs to be generated or traded. However, entry into force may be a much delayed event – and will be independent of issues related to the adequacy of JI guidelines or criteria. Of course, if entry into force were delayed, there would be no need for any "credits" against the targets either.

- Option 4. Allow JI to proceed without guidelines specified in the agreement, presumably on the basis of MOP decisions. This option assumes that we do not need to specify guidelines at this time. Implicit in this choice is that guidelines would likely be developed at a later date, and that Parties have until the first budget period (if "early action" is disallowed) before guidelines would need to be developed. However, it presumes that project developers would be willing to move forward with projects to allow the testing of various guidelines – even in the absence of international agreement. It also presumes that no projects would proceed without guidelines; if projects did get initiated, there would be no way to weed out bogus efforts.

4. Is it necessary to make our acceptance of the final agreement contingent on the successful negotiation of such guidelines? If the guidelines are held up, is the U.S. willing to allow JI to proceed without them?

JI is one of the critical flexibility issues proposed in the U.S. draft protocol. The economic analysis suggests that significant additional cost-savings are possible from JI over those available from emissions trading (presuming the latter is allowed in Annex A or B countries only, and the former in developing countries). If JI is not included in the agreement, such cost-saving opportunities will be lost. In such a case, the United States might choose to negotiate a lower target – although our ability to do this may be constrained by the form of the "package" deal negotiated in Kyoto.

The U.S. could also insert language into the agreement calling for conditions on entry into force pending resolution of any questions on JI guidelines, or we could not sign the agreement until such issues were resolved. If conditions were imposed, they could create some interesting problems. For example, in the absence of a new set of Parties, agreement on the guidelines would be undertaken by all FCCC Parties, not just those to the protocol, allowing countries not likely to join the new agreement to block the guidelines and delay the protocol's entry into force.

However, there is a strong concern that JI not be allowed to proceed without guidelines – and that setting entry into force contingent on agreement of guidelines will inappropriately delay global action on climate change. In this case, there would be no link between setting guidelines and agreement on a binding target in Kyoto.

5. How should "additionality" be treated in the agreement?

In the existing text, we stipulated that "projects must provide a reduction in emissions that is additional to any that would otherwise occur." There is general agreement that some form of additionality must be present to ensure that "bogus" emissions are not counted. However, additionality is not easily measured. Even the use of the word "additionality" has its supporters and detractors. The additionality issue has been among the most complex in the USIJI panel deliberations; it has not been satisfactorily resolved for many projects, and both agencies and project developers disagree over the application of this criterion. Any decision is likely to have political opponents, either from the environmental community or the private sector, and it is recognized that each would need to periodically be reviewed. Several approaches have been advanced; these need not be mutually exclusive:

- Do not attempt to resolve the additionality issue by Kyoto, but agree that the guidelines must more fully address the questions prior to allowing project derived TCEs to be exchanged between Parties.

- Develop a list of a priori acceptable project types (an "Annex D"). It seems unlikely that such an Annex could be negotiated prior to Kyoto; if this option were chosen, a placeholder may need to be inserted into the text.

- Redefine additionality as "an enhanced Greenhouse Gas Benefits", and require that net GHG emissions with the project be less than the GHG emissions associated with the reference case for that activity within a particular country and year. For example, a power plant retrofit will be 10% more efficient than some existing standard, and the GHG reduction associated with the 10% difference could be claimed in its entirety

- Develop guidelines for determining additionality through a more stringent standard in which a determination would be made as to whether a project would have happened anyway (e.g., whether the utility planned to upgrade the power plant in its normal course of business), and that the project is over and above "no regrets" actions. Only those projects meeting this criteria would be allowed. While likely to generate more environmental benefit, there are concerns that such standards could not be readily defined, and could lead to a circumstance in which no projects would be undertaken.

6. Review Process

A number of issues have been raised on the form and structure required for an adequate review process. The fundamental conflict is between the extent of the review necessary to ensure verifiability and credibility versus the risk that excessive transaction costs will stifle JI activity.

- Extent of the Review. Upon submission of projects that have generated TCEs, should the FCCC Secretariat conduct only a "checklist" review (to determine whether all the requested information plus appropriate back-up materials have been provided) or conduct a more comprehensive review in which individual project reports are checked for accuracy and validity? The former allows for significantly more rapid turn-around, and does not require the Secretariat to call into question Parties' reports. However, because of its cursory nature, it will likely not cull out projects which do not meet all criteria, particularly in cases where issues of "additionality" are ambiguous. The latter alternative could impose a significant (and potentially costly) burden for project review on the Secretariat, and could delay allowing project TCEs to be recorded, likely increasing project transaction costs and limiting the number of projects. It is possible that multiple stages of a review process could be agreed, in which the initial review could be more comprehensive, and subsequent reviews adhering to a simplified checklist – unless a Party objected to the allowing of TCEs.

- Frequency and Timing of Reviews. The nature and frequency of reviews will have a direct impact on transaction costs and the required Secretariat budget, as well as on the credibility of those projects with acceptable TCEs. In addition to the concept of random audits, and the existing provisions requiring annual reporting on emissions reductions generated or exchanged through JI, proposals have been made for the following (not necessarily mutually exclusive) options:

  – annual review of each project through the Party's required annual report on JI (to insure that TCEs claimed during any given year are legitimate);

  – review in the course of a National Communication review (presumably on a three-year cycle) of Annex A/B Parties, which would included any JI projects undertaken; and for

  – review only if requested by a Party (noting that any Party might, at any time, challenge the TCEs generated from a project – leading to an automatic review, and possible action by an implementation committee).

- Who conducts the review – the Secretariat? Annex A/B review teams? Independent auditors? With adequate financial support, the Secretariat could develop the expertise necessary to fully review projects. Using the existing procedures for review of Annex A/B communications may be viable in that teams include both Secretariat representatives and representatives of Parties; however, to date, review teams have not had much expertise in matters specifically related to JI activities, and might overlook problems in projects. While it is generally agreed that independent auditors(conducting reviews of all projects on a random basis) would be desirable, there is a question of who supervises them; it may be undesirable to have it done by the Secretariat, but difficult if not impossible to have direct oversight by the MOP or the SBSTA. Some do not believe that independent auditors would need supervision, but rather that the market would ensure high quality auditors (i.e., we can depend on the private sector's need to have accurate information for the validity of JI credits). Finally, it was generally agreed that the Secretariat would have the role of preparing a synthesis report at regular intervals to be considerd by the MOP in assessing progress under JI.

- Approval of the Review. Once the review has been completed, other questions have been raised about approval of projects. One alternative is to make approval automatic if no concerns are raised, and allow it to be blocked if any objectionable practices are uncovered. However, this raises a question of whether the Secretariat should be allowed to reject non-complying projects, potentially opening the system to accusations of too much centralized authority being vested in a UN body – and out of the control of Parties. Conversely, if the review must be approved by Parties (or a subset of Parties), considerable time may pass between project submission and review – significantly increasing transaction costs. Finally, it is clear that in some cases, there will be contested reviews; in this context, a number of agencies have proposed using an "Implementation Committee" to address unresolved issues. However, agreement on the establishment of such a committee would not be consistent with the earlier decisions adopted in the separate decision paper on compliance issues; this earlier decision may need to be reconsidered.

Annex C: Which Gases/Sectors to Include in the Kyoto Agreement?

(D R A F T 5/20/97)

The January 17, 1997 draft U.S. protocol text defines "greenhouse gases" to be those gases for which a global warming potential is set forth in Annex C; Annex C is to "list greenhouse gases not covered by the Montreal Protocol, with the exception of gases, or particular sources and sinks, for which there is insufficient knowledge of the GWP or inability to accurately measures emissions or removals. GWPs would be developed by the IPCC." This paper seeks to identify two possible options to complete Annex C: (1) a comprehensive approach (with some discounting), and (2) a limited list.

Option 1. Comprehensive Approach with Some Discounting

- All sources and sinks of greenhouse gases not included in the Montreal Protocol.
- Annex I Parties to use most detailed available agreed inventory methods (e.g., detailed IPCC method); if estimates are made using less rigorous methods (e.g., default IPCC), an uncertainty factor would be added to emissions estimates for budget years.
  - Uncertainty factors would be determined by IPCC or OECD/Annex I Experts Group and adopted by the Meeting of the parties (MOP); factors will be specific to gas/sector/source and estimation method.
- The base level is established using existing 1990 inventories; it is not modified as methods improve, except to recalculate based on new GWPs (as agreed by MOP).

Key Points

- Allows maximum flexibility across gases to comply with budget; U.S. already uses best method and could count all control efforts.
- Maximizes environmental protection through comprehensive coverage of GHGs, ensuring tracking and control even of gases with "uncertain" emissions.
- Provides incentive to use best methods for reporting (uncertainty factors are only a backstop if less rigorous methods are used).
- Accommodates GHG emissions trading and JI (does not require separate provisions to allow project-based JI in non-Annex C gases).
- No problem of adding gases/sectors; everything is already in.

Potential problems:

- Uncertainty of estimate for some gases may lead to offset of certain emissions with reductions from less certain sources (likely a relatively small component of most national totals, although for some, may be up to 30%); even with the best methods, some sources/sinks are only known to ±50% or ±100%.

- Requires development/agreement of uncertainty factors (although a similar problem exists unless a blanket acceptance of gases is allowed).

- Generic (in contrast with Party-specific) uncertainty factors may reduce incentive for data improvement in some cases.

- May be opposed by Parties using less rigorous methods, who may have to improve or inflate inventory (particularly developing countries).

Option 2. Limited List

- Include only sources, removals and sectors that can be accurately estimated or measured in Annex C; others are omitted, and controlled only through general existing FCCC obligation.

  - Propose a threshold of ±20% for inclusion in Annex C (would include about 95% of the total US 1990 inventory; some excluded gases/sectors are now included in U.S. Climate Change Action Plan, including N2O from fertilizer use and CH4 from ruminants).

  - The following list includes those GHGs estimated by US agencies to be accurate to within ±20% now in the United States, or projected to attain that accuracy within 5 years:

    - All energy-related carbon dioxide ($C0_2$) emissions and above-ground forest sinks
    - All emissions of high GWP gases (HFCs, PFCs, and sulfur hexafluoride (SF_6),
    - Most methane (CH_4) emissions (e.g., about 76% of US 1990 CH_4 emissions)
    - Some nitrous oxide (N_20) emissions (e.g., about 14% of US 1990 N_20 emissions)

- Review and update contents of Annex C every five years with input from SBSTA and/or IPCC, allowing for additions or deletions as methodologies are improved.

- Parties set goal of achieving accurate estimation and measurement of all GHGs by 2020.

- Baseline established on basis of included gases only.

Key Points

- Emphasizes verifiability, but is still (at least for U.S.) quite comprehensive and flexible.
- Simplifies and protects the rigor of compliance by restricting trading and offsets to the GHG sources/sectors that can be accurately measured/estimated.
- Avoids substitution of less certain reductions (about 3% of US 1990 inventory is not known to better than ±100%) for more certain emissions.
- Provides incentive for improving sink and emissions methodologies in cases where actions in non-included gases/sectors are less expensive than Annex C actions.

Potential problems:

- Could require adoption of policies and measures to address non-included gases/sectors or leave those gases/sectors uncrontrolled.
- May require special -- and potentially complex -- provisions for amending Annex C.
- Could establish disincentive to develop/improve non-Annex C gases/sector methods.
- Could set a bias against developing countries -- where a larger proportion of emissions will be in non-Annex C gases.

Conclusions

Both options leave some key decisions up to subsequent expert group agreement. This paper does not seek to identify what would happen in the case of a failed effort to gain agreement -- for example, in option 1 of ther is no agreement on "ucertainty" factors, or in option 2, if there is no agreement on what sources are measurable within ±20%.

Annex C Analysis

Business as Usual Emissions for the United States: 1990-2020 (MMTCE)

	1990	2000	2010	2020
INCLUDED (under Option 2)	1508.7	1662.8	1822.0	1972.1
SINKS	125.0	-109.0	-108.0	-92.0
EXCLUDED (under Option 2)	73.4	75.1	79.4	82.8
TOTAL All Gases/Sources	1457.1	1628.9	1795.4	1962.9

Environmental Impact for U.S. under Annex C Options (MMTCE)

Scenario	1990	2010	2020
Business as Usual	1457	1795	1963
Option 1 - Comprehensive			
Annex C-Capped	1457	1457	1457
Uncontrolled	0	0	0
Total	1457	1457	1457
Option 2 - Including Sinks			
Annex C-Capped	1384	1384	1384
Uncontrolled	73	79	83
Total	1457	1463	1467
Option 2 - Excluding Sinks			
Annex C - Capped	1509	1509	1509
Uncontrolled	-52	-27	-9
Total	1457	1482	1500

EARLY BANKING: CREDITS FOR EARLY REDUCTION
(D R A F T 5/20/97)

Background

"Early banking" is the term used to describe actions that are taken prior to the beginning of the first budget period for credit against obligations in that period. The rationale for early banking is based on a presumption that it eases compliance costs; however, inasmuch as the costs of complying will be a function of the timing and level of the first budget period (as well as the domestic distribution of the obligations), it is unlikely that the true value of early banking can be conclusively resolved without knowing these constraints.

Advantages of early banking include creating an incentive for emission reductions prior to the start of carbon budget periods; potentially creating a fund of extra emission rights from early action that eases requirements in, and effectively lengthens the first control period; and encouraging early experience that may reduce resistance to complying with later binding obligations. Disadvantages include difficulty in negotiating (given that most other countries will perceive this effort as a ruse to allow U.S. emissions to continue to grow during the budget period); difficulty in compliance (there will be no budget against which reductions will be measured), and a perception that the entire issue can be accommodated through domestic allocation systems – in which early efforts can be credited by allowing extra emissions to those early reducers in out-years.

This paper suggests several options for treating the early banking issue: (1) rewarding early reductions by adding allowances in the budget period; (2) recognizing that countries may credit early actions domestically, but do not provide for an additional "pool" of international credits; (3) providing for early banking only in JI projects, and (4) rejecting early banking.

Several issues are raised in this paper that may warrant additional consideration. While each of these are addressed briefly here, they are also raised in other documents being considered in the interagency process – the first in discussions of the budget level and timing, and the second in the paper on JI.

(1) The U.S. has specifically rejected a budget period which begins in 2005 or before. Some concern has consequently been expressed that there may only be weak incentives, if any, to reduce carbon emissions prior to the first control period – a concern that is exacerbated if the first period does not begin until 2010. Early banking has been proposed to address this late start. Furthermore, with a considerable delay prior to the initiation of the first budget period, some transition economies with "excess" reductions may be forced to forego the benefits from monetizing their reductions; early banking may to a certain extent also alleviate their concerns.

(2) We have not yet taken a decision on the timing for allowing JI credits to be counted. If

tons can be generated prior to the first budget period, they may be banked for use in that first period.

Constituency Views

Domestic industries that have opportunities for early carbon reduction clearly favor early banking. This group includes both industries that have already claimed reductions and those who could make initial or further reductions prior to the first control period. These groups want assurance that their early reductions: will be rewarded; will not be the basis for tighter limits in the future; and will be compensated commensurate with costs incurred. However, most industry groups are significantly more concerned that early banking provisions would be interpreted as an early target – which they have flatly rejected.

Some environmental groups would like to see early banking provisions to create an incentive for early actions, but only if credits would not result in increases in cumulative emissions. However, most environmental constituencies would strongly prefer a 2005 target to any provisions on early banking.

Transition-economies' actual emissions are anticipated to lie well below the likely obligations set in the first budget period. These countries may favor early banking as a way monetize the "underages". Environmental interests (and many in the OECD) believe that such reductions exist solely as a result of economic downturns, and trading them could result in a redistribution of wealth internationally but lead to no net environmental gain. While the transition economies' concerns could be met with an early target, they are likely to oppose a later target with no banking.

Option 1: Reward Early Reductions with Net Added Credits

In this option, the Kyoto agreement would provide for extra allowances to be granted to Parties in the first budget period equal to the number of early reductions taken prior to the beginning of the period. Essentially, this would compensate Parties which incur costs to achieve early reductions. A key concern is how to measure the extent of an early reduction. While a baseline is needed, neither the 1990 baseline nor the first control budget is necessarily the proper test; the right interim baseline could be some interpolation between the two. Imprecision in the benchmark for quantifying early reductions could open the door to later emissions that were not offset by real early reductions, and environmental loss. Of course, choosing any year will implicitly "reward" some for taking early action – although the domestic allocation of the reward is a matter that will still need to be determined through internal distributions of initial permits.

Pro:

- Added allowances maximize incentives for early action.
- Early reductions that reduce cumulative emissions can be given additional allowances without environmental loss.

- May contribute to a useful technology jump start.
- May reduce opposition/political barriers to adoption of more stringent target.

Con:

- Request for international approval for early banking invites a counter-demand for earlier adoption of binding targets.
- Proving real reductions requires an emissions benchmark. If additionality is not proven, then added allowances may increase net carbon emissions.
- Early reductions permit Parties to do less in the first control period by using early credits; this could make second period compliance more difficult.
- Would require a Party-by-Party interpolation of appropriate baselines.

Option 2: Domestic Implementation

Recognizing the advantages of early compliance, countries (including the United States) might choose to credit early action against future allowances. Providing such credit would, however, reduce the pool available for allocation during the budget period. Domestic decisions would determine how many future allowances would be so allotted, and how many would remain available for normal distribution. Of course, countries would need to consider how many credits to carve out, recognizing that some constituencies will not be willing to take early action, and will object to the effective increase in price attached to a reduction in the number of permits allocated later. No legal text would be required to allow this alternative. However, to provide some textual grounds in the agreement for countries to take such steps, hortatory language might be inserted urging early compliance; such an option might also address the desire for a near-term target. If this option were chosen, considerable thought would be needed in the development of any language.

Pro:

- Early reductions, if real, reduce cumulative carbon and reduce the entry emissions level at the start of the first period. Early actions may also stimulate technologies that reduce long term compliance costs.
- Successful early reduction experience could make full implementation easier by reducing uncertainty.
- Some problems of an interim emission baseline are avoided; the control period baseline still applies.
- Allowing this type of early banking extends the interval for the first control period compliance.
- This option would be entirely within our domestic purview; no treaty language would be required.

Con:

- Including this option will likely incite others to recommend an earlier start date for the budget period -- a outcome we have already rejected.

- The national incentive to make early reductions is limited because there is no added emission right to offset either the cost of early reduction (compared to later implementation) or the real reduction in cumulative emissions resulting from reduction prior to the control period.
- Those who do not take early reductions will complain at the reduction in the size of the pool later; the more early actions that occur, the more the pool would have to be reduced.
- There is no guarantee Congress will follow Executive Branch proposals in developing carve-outs.

Option 3: Early Credits for JI Projects only

JI projects that meet established criteria for atmospheric carbon reduction and satisfy tests of additionality could be granted early reduction credits even if early banking for reduction of overall national emissions were not approved. This issue is particularly relevant with respect to economies in transition, which anticipate significant financial benefits from the sale of reductions in the pre-2010 period. It is clear that issues related to monitoring, measurement and additionality (all discussed in the separate JI paper) would need to be resolved prior to moving forward with this option.

Pro:
- Early JI captures environmental benefits that would be lost without credits for early action.
- Private financing for early JI will not appear without bankable credits.
- Successful JI early experience could reduce anxiety over adoption of the first period emissions budgets.

Con:
- Not all early reduction opportunities can meet the JI project definitions. For example, some valuable early reductions are domestic process modifications that could not be credited without early banking provisions.
- If early JI is allowed without agreement on criteria to ensure real reductions, adoption of this option may lead to granting of bogus credits.

Option 4: Reject Early Banking

Of course, a fourth alternative is always available – to reject early banking for inclusion in the U.S. draft Protocol. There is a clear concern that proposing any of the options listed above, particularly in light of our inability to also announce a stringent target, will be met with enormous skepticism. Such an announcement would likely be perceived as an effort to defer any action rather than as an effort to lower costs. Furthermore, while some flexibility advantages may accrue to adopting one of these alternatives, rejecting an explicit textual change to support early banking would not preclude allowing the United States to develop an early banking proposal at a domestic level.

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United States Department of State

Bureau of Oceans and International Environmental and Scientific Affairs

Washington, D.C. 20520

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MESSAGE: ASSISTANT SECRETARIES CLIMATE CHANGE MEETING WEDNESDAY, MAY 28 from 10:30-12:00, Rm. 7835. Please RSVP to Lilly Wiggins at 647-1554 by COB: Tuesday, May 27. Thank you.

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White House Climate Change Task Force

734 Jackson Place • Washington, DC • 20503
(202) 343-1060 • (202) 343-1162 fax

May 20, 1997

FAX TO: Addressees

FROM: Dirk Forrister, Director
White House Climate Change Task Force

SUBJECT: Assistant Secretaries' Meeting -- Proposed June Public Climate Meeting

Please join me **tomorrow, May 21, 2-3 pm at 734 Jackson Place** for a discussion of the logistics and substantive details on the proposed June meeting. Drafts of the papers that are being prepared for the meeting will be handed out for your comments. **Authors of the papers are requested to bring 25 copies of their drafts to the meeting.** In addition, other details surrounding the meeting and a timeline of tasks/deliverables will be finalized. Below is the proposed agenda for tomorrow:

- Overview and Status of June Meeting
- Status of Documents and Concurrence Process
- Agenda for June Meeting
- Options for Date/Location for June Meeting
- Next Steps/Timeline

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Date: Tuesday, May 20, 1997 **Time:** 2:39:01 PM 3 **Pages**

To: Jeff Frankel
CEA

Fax: 3956958
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From: White House Climate Change Task Force

Fax: 202 343 1163
Voice: 202 343 1060

Comments:

cc · JAF
SS

May 15, 1997

MEMORANDUM FOR DISTRIBUTION

FROM: ROBERT S. KAPLA
COUNCIL ON ENVIRONMENTAL QUALITY

SUBJECT: CLIMATE CHANGE DEPUTIES MEETING

Katie McGinty and Dan Tarullo will chair a climate change deputies meeting **Monday, May 19 from 2:30 - 4:00pm in room 231 of the OEOB.**

Materials for the deputies meeting will be available for pickup at 11:00am Friday, May 16 at 722 Jackson Place (the CEQ townhouse). No clearance information is needed to enter the townhouse.

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For 5/19/97 Climate Change Deputies mtg

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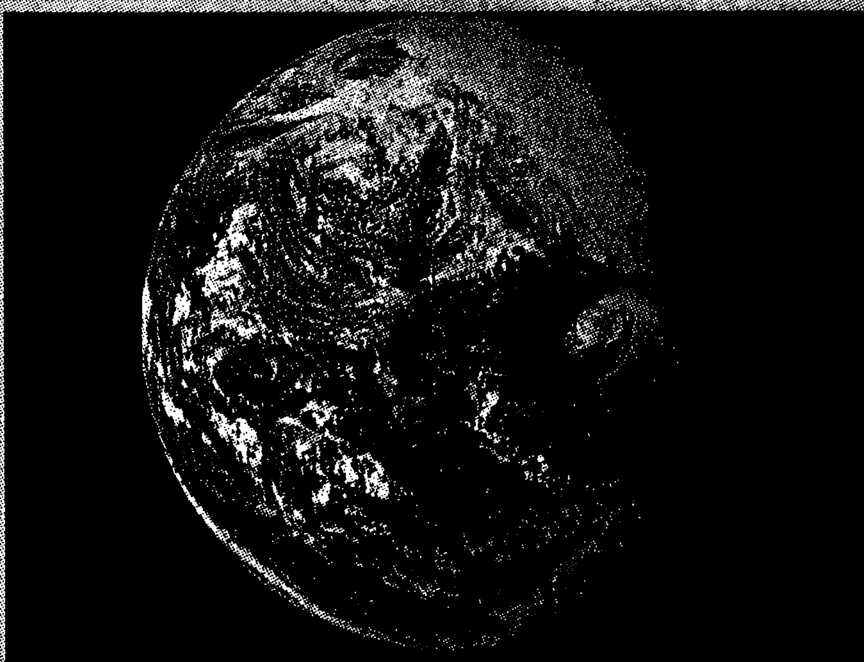
Climate Change Deputies

Decision Memorandum



May 19, 1997

International climate change negotiations are scheduled to conclude in December 1997. This memorandum describes the background of those negotiations and sets forth key issues for decision.

ISSUES FOR DECISION

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

2. What domestic policies should the administration support to implement our obligations under the climate treaty?

NEED FOR DECISION

1. Emissions Budgets. Decisions are needed by June, in connection with the G-7 Summit (June 20-22) and UN General Assembly Special Session on Environment and Development (June 23-27). In addition, U.S. negotiators need guidance to allow them to generate support for our position in the months prior to the December meeting in Kyoto. Other countries and domestic constituencies are calling on the U.S. to state its views.

2. Domestic Policies. There is no immediate need for decision. However, the administration may wish to announce a set of domestic policies (and/or a process for developing them) in connection with a decision on emissions budgets.

TABLE OF CONTENTS

I. BACKGROUND

Climate change is an issue of vast scale. The problem and costs of addressing it are each, potentially, enormous.

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. During the next century, for example, the ideal range of forests is expected to move several hundred miles north, exceeding the ability of many forests to migrate. Sea-level rise is expected to inundate more than 9000 square miles in the United States, with the Atlantic and Gulf Coasts especially vulnerable. An additional 50-80 million cases of malaria are projected worldwide. 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 weather 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 ppm, 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 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 US 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 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.

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.

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." A similar letter is expected from the scientific community soon.

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 just beginning to pay attention -- although the European industry and U.S. reinsurers have voiced concern about climate change during the past several years.

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.

II. ISSUES FOR DECISION

This memorandum poses two issues for decision:

A. What emissions budgets should the US support in international climate change negotiations?

B. What domestic policies should the administration support to implement our obligations under the climate treaty?

Several agencies believe that the first issue is by far the most important. In their view, the first issue raises broad questions of direction for the U.S. and its economy, while the second focuses more on programmatic details.

A. What emissions budgets should the US support in international climate change negotiations?

Decisions on this question are needed by June, in connection with the G-7 Summit (June 20-22) and UN General Assembly Special Session on Environment and Development (June 23-27). In addition, U.S. negotiators need guidance on this issue to allow them to generate support for our position in the months prior to the December meeting in Kyoto. Other countries and domestic constituencies are calling on the U.S. to state its views.

1. Background

In climate change negotiations, the term "emissions budget" refers to the amount of greenhouse gases that may be emitted over a certain period of time. The term is roughly synonymous with "target and timetable" (though an "emissions budget" connotes a longer time period than a "target").

To date, the United States has not supported any specific emissions budget for the post-2000 period. Our statements with respect to emissions budgets have been limited to the following: (1) emissions budgets should be binding; (2) this round of negotiations should address emissions in the medium-term, e.g. 2006-2020; (3) the base year for emissions budgets should be 1990; and (4) emissions budgets should consist of multi-year periods (i.e., the target should not be a single year).

A threshold question is whether the United States should try to delay agreement on an emissions budget beyond the December 1997 meeting in Kyoto. That question is not addressed in detail in this memorandum. Although no agency has voiced support for such an approach, some agencies believe this question should be identified to principals in light of the large potential costs of even the least stringent emissions control options. The advantage of delaying an agreement would presumably include delaying or even avoiding such costs; disadvantages would include the large potential health, environmental and economic costs of failing to make progress on climate change and criticism from those who would charge the administration with backtracking or changing position on this issue.

2. Options

This memorandum considers three options for emissions budgets. Each option is defined in terms of a broad directional statement the U.S. might offer in June, followed by an example of a budget consistent with that statement.

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

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

OPTION 3 - Gradually stabilize emissions in the medium term. For example, reduce greenhouse gas emissions to 1990 levels by a multi-year period around 2020.

A variation on any of the foregoing could include an "early emissions budget," in the period around 2005, less stringent than the levels described above. A budget covering years earlier than 2006 would require a change in the U.S. position, but could possibly be structured to win support from domestic constituencies and other countries in the negotiations. Several agencies support such an approach.

The availability of various flexibilities (international emissions trading, joint implementation, banking and borrowing) fundamentally affects the emissions budgets the US would be willing to support. The more such provisions are included in the agreement, the less costly it will be for the US to meet any given emissions budget. However, if the bulk of the US obligation could be satisfied by purchasing low-cost emissions reductions from abroad, the agreement might not provide large incentives for US industry to develop the technologies needed to address the climate change problem over the long-term.

3. Analysis of different options

The discussion below analyzes the three options based on environmental impacts, economic impacts, domestic political implications, and implications for the international negotiations.

a. Environmental impacts.

1. Climate change impacts

In terms of additional loadings of greenhouse gases into the atmosphere, the difference between the three options in the short-term is small.

However, the options may produce very different environmental impacts, when considered as part of a longer, multi-decade path of reduced greenhouse gas emissions. For example, 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.

Institutional and political factors also lead to important differences between these options. Some agencies believe that few businesses will take Option 3 seriously, because the budget period is too distant. Some agencies believe that few businesses will take Option 1 seriously, since the economic costs would be too great, and that most businesses would simply work to block implementation rather than restructure activities to comply. All agencies agree that developing countries, who will represent the bulk of emissions growth in the decades ahead, will only take serious actions to address emissions after the developed world has done so. This tends to argue for early, serious action, to leverage reductions in the developing world.

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.

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 any of the options discussed here would total tens of billions of dollars per year. These environmental benefits would likely be greatest with Option 1 and smallest with Option 3.

b. Economic impacts

1. Introduction. An Interagency Analytical Team has analyzed the economic impact of various emissions scenarios, 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.
- The Federal Reserve undertakes relatively favorable monetary policy to offset 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.

Three 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 significantly. With international emissions trading, the United States is estimated to pay almost $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 emissions fall below a "no-policy" baseline). All figures are presented relative to a "no-policy" baseline, in 1995 dollars.

The obvious effect of the international emissions constraints and the domestic emissions trading program is to raise energy prices. Stabilizing greenhouse gas emissions at 1990 levels in 2010 with international trading is estimated to raise gasoline and heating oil prices by 10-15 cents per gallon and retail electricity prices by about 1 cent per kilowatt hour (about 8-13 and 10-12 percent, respectively) in the base case.

The losses in aggregate economic activity are noticeable, but largely transitory. Table 1 shows GDP loss with international trading peaking at a couple of 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 and 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. With international trading, overall energy consumption drops by about 10 percent and coal consumption falls by about 15 percent. This reflects the fact that 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.

As noted above, any market-based program that imposes constraints on greenhouse gases will increase energy costs. Stabilizing greenhouse gas emissions at 1990 levels by 2010 without international trading is estimated to raise gasoline and home heating oil costs by 20-40 cents per gallon and electricity prices by 1.5-3.0 cents per kilowatt hour (both about 17-35 percent).

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).

Coal bears even more of the burden of emissions reduction in the case without international emission trading. Overall energy consumption in 2010 is estimated to be 10-16 percent lower than in the "no-policy" baseline, but coal production drops 25-30 percent relative to the baseline.

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 any of the options discussed here would total tens of billions of dollars per year.

Economic impacts are summarized on the charts below.

Table 1 -- Base Case with Annex I Emissions Permit Trading*

Variable of Interest	Option 1 -- 10% below 1990 levels	Option 2 -- 1990 levels by 2010	Option 3 -- 10% above 1990 levels
GDP in 2005	-1.0% to -0.1%	-0.5% to 0.0%	-0.2% to 0.0%
GDP in 2010	about -0.3%	-0.4% to -0.1%	-0.2% to -0.1%
GDP in 2020	-0.3% to +0.2%	about -0.1%	-0.1~~% to 0.0~~%
Implied price increase per ton of carbon in 2010	about $85	about $50	about $20
Implied price increase per gallon of gasoline in 2010	about 20-25 cents	about 10-15 cents	about 5 cents
Implied price increase per ton of coal in 2010	about $50	about $30	about $10-15
Implied average price increase for residential electricity in 2010	about 1.5 cents per kwh	about 1 cent per kwh	about 0.5 cents per kwh
Decline in total employment in 2010 (national)	about 200,000	about 50,000-250,000	about 50,000-150,000
Decline in overall energy use in 2010			
Increase in renewables (2010)			
Annual value of domestic emission permits (2010)	about $110 billion	about $60-70 billion	about $25-30 billion

* Analysis of Joint Implementation (worldwide emissions trading) would show lower implied price increases, smaller reductions in economic activity, and greater purchases by the U.S. of emissions reductions abroad.

Table 2 -- Base Case without Emissions Permit Annex I Trading

Variable of Interest	Option 1 -- 10% below 1990 levels	Option 2 -- 1990 levels by 2010	Option 3 -- 10% above 1990 levels
GDP in 2005	-2.0% to -0.1%	-1.0% to -0.1%	-0.5% to 0.0%
GDP in 2010	-0.7% to -0.3%	-0.6% to -0.2%	-0.4% to -0.1%
GDP in 2020	-0.3% to +1.0%	-0.6% to +0.2%	about -0.1%
Implied price increase per ton of carbon in 2010	$130-200	$80-140	$35-50
Implied price increase per gallon of gasoline in 2010	35-50 cents	20-40 cents	10-15 cents
Implied price increase per ton of coal in 2010	$80-120	$50-85	$20-30
Implied average price increase for residential electricity in 2010	about 4 cents per kwh	about 1.5-3.0 cents per kwh	about 1 cent per kwh
Decline in total employment in 2010 (national)	about 200,000-500,000	about 150,000-400,000	about 50,000-250,000
Decline in overall energy use relative to 2010 baseline		10% to 17%	
Increase in renewables (2010)		about 15%	
Annual value of domestic emission permits (2010)	about $270 billion	about $110-190 billion	about $60-70 billion

c. Domestic political implications

None of the options above are stringent enough for most environmental groups. All are too stringent for some in the business and labor communities. Opposition to any agreement from coal interests will be intense. The reaction of many constituencies will ultimately depend on the domestic implementation regime.

That said, it is reasonable to speculate that Option 1 would be considered a reasonably strong position by many in the environmental community. Sierra Club might oppose, but many groups would likely be pleased. Most in industry -- including utilities, coal, oil, autos, chemicals, transport and agriculture -- would strongly oppose. Efficiency and renewables businesses would support, but even natural gas interests would probably be unhappy. Labor would strongly oppose.

Option 2 would likely split key constituencies, including environmental groups and business. Though many environmentalists would consider this option weak, some (such as the Environmental Defense Fund) would likely defend an agreement at this level. Business groups would be split as well, with support possible from some utilities, chemical companies, natural gas interests and others. Opposition from labor might be softened, with support possible from Steelworkers and the Oil, Chemical and Atomic Workers. Most farm groups would be opposed. In all cases, support would depend on the details of domestic program design.

Option 3 would be opposed by all environmental groups. Much of industry might be willing to support, although coal and oil would remain opposed. Most labor groups would likely be relieved and not actively oppose, with the exception of the mineworkers.

d. International negotiating implications

Our ability to negotiate a successful agreement in Kyoto is dependent on the emissions budget we select. To date, the US has won limited support abroad for its proposals on flexibility and developing country participation. Our ability to garner international support for these proposals will require us to select an emissions budget that is viewed as credible.

To date, proposals on emissions budgets include: (1) a 20% cut from 1990 levels by 2005 (small island states), and (2) a 10-15% cut from 1990 levels by 2010 (the EU). There is an expectation that this round of negotiations will produce reductions from 1990 levels in the next several decades.

An emissions budget that does not include a reduction below 1990 levels by 2020 would not be taken seriously abroad. Most other countries in the negotiating process would view this as extremely weak. Accordingly, it is unlikely that Option 3 could be achieved in this round of negotiations. In the unlikely event that Option 3 could be achieved, it would be at the expense of other aspects of the U.S. position, including the developing country and flexibility provisions.

Of the three options, Option 1 would give us the greatest opportunity to negotiate both the flexibility and developing country provisions. Option 2, with stabilization in 2010 and a reduction around 2020, would also give us a good chance of success.

B. **<u>What domestic policies should the administration support to implement our obligations under the climate treaty?</u>**

There is no immediate need for a decision on this question. However, we may wish to announce a set of domestic policies (and/or a process for developing them) in connection with any announcement on emissions budgets.

The "Assistant Secretaries group" believes that emissions trading, technology and transition programs should be central parts of our climate change policy. Members of the group see support for these policies as a consequence of support for any of the emissions budgets discussed above.

Pursuant to direction, the "Assistant Secretaries group" did not consider tax shifts as a policy for addressing climate change.

1. <u>Should domestic emissions trading be a central part of our climate change policy</u>?

A. <u>Background</u>. Under a domestic emissions trading program, 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 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 auctioned, substantial revenues would be raised. (Reflow options include tax cuts, deficit reduction and support for transitional or technology programs). If given away, recipients would potentially receive a windfall.

--Comprehensiveness. Controls could apply to some greenhouse gases or only a subset (e.g., CO2). If a "sectoral" approach is used, the program could apply to a single sector, several sectors or all sectors of concern.

B. Recommendation. Participants in the "Assistant Secretaries group" agree that domestic emissions trading should be a central part of our climate change policy. Participants agree that important program design issues should be addressed in consultation with key constituencies. Such consultations could begin soon and continue through the summer and fall.

Option 1: Accept the recommendation.

Option 2: Do not accept the recommendation. Provide working groups with alternative direction.

2. Should technology programs be a central part of our climate change policy?

A. Background. 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. Some 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.). For a variety of market and institutional reasons, businesses and consumers may either be unaware of the full range of available alternatives or unable to make use of them. The current Climate Change Action Plan follows in the tradition of agricultural and manufacturing extension services by working to overcome these barriers. However, Congress has significantly reduced administration budget requests for these programs.

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, government support for basic and applied research in energy technologies has been declining sharply since the early 1980's, and is now less than half of levels from the late 1970's (in constant dollars).

Possible policies and actions include:

--a strong Presidential statement on the importance of clean energy technologies, including a series of goals for those technologies for the decades ahead;

--asking the President's science advisory panel to report back by October 1997 on ways to accelerate rates of technological change in energy and other sectors;

--emphasizing to Congress the importance of the President's FY98 request for renewable energy and energy efficiency ($1.08 billion, a 21% increase over FY97 enacted levels), possibly with a veto threat;

-committing to increased budget requests for renewable energy and energy efficiency over the next five years; and

--promoting technology innovation in connection with the design of an emissions trading program.

B. Recommendation. Although agencies have different views about the efficacy of government technology programs, all agencies agree that, when combined with market-based measures such as an emissions trading program, technology programs can reduce costs of meeting greenhouse gas limits. Participants agree that policies and actions such as those described above should be further analyzed and explored in consultation with key constituencies. Such consultations could begin soon and continue through the summer and fall.

Option 1: Accept the recommendation.

Option 2: Do not accept the recommendation. Provide working groups with alternative direction.

3. Should transition assistance be a central part of our climate change policy?

A. Background.

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 may provide a revenue source while technology enhancement may change the extent and perhaps even who is affected by climate change policy.

--- Defining the eligible population of workers and communities will affect the costs of the program. Other aspects of climate change policy like emissions budgeting will affect the timing of when benefits can start to be received and when eligibility will expire.

B. Recommendation. Participants in the "Assistant Secretaries group" agree that transition programs should be a central part of our climate change policy. Participants agree that important program design issues should be addressed in consultation with key constituencies. Such consultations could begin soon and continue through the summer and fall.

Option 1: Accept the recommendation.

Option 2: Do not accept the recommendation. Provide working groups with alternative direction.

DRAFT--May 19, 1997

Economic Effects of
Global Climate Change Policies

Results of the Research Efforts of the

Interagency Analytical Team

June 1997

Introduction

In June 1996, the Department of Energy (DOE) and the Environmental Protection Agency (EPA) sponsored a joint workshop where more than 50 experts from inside and outside the government made presentations on technical issues associated with our emissions trends and capability to reduce emissions trends in the next century. As a part of that workshop, the Interagency Analytical Team (IAT) released what were then preliminary results on the economic effects of emissions reduction proposals.

Since that June 1996 workshop, the IAT has reviewed its work, selected new modeling instruments, improved its approach to old ones, and developed a new set of modeling runs that lead to a better understanding of the economic dimensions of the climate change policy problem. This paper describes those efforts. It first summarizes the IAT model selection process. Second, it discusses the (pre-policy) base case used to measure the effects of various policy options. Third, it discusses the IAT's core emissions reduction scenario. Finally, the bulk of this paper discusses the results of the IAT's analysis.

The modeling work performed for this analysis was done by economists at DOE and EPA. The IAT also included members from the Departments of Commerce, Treasury, Labor, and State, as well as members of the White House staff. The majority of the IAT members are still primarily from DOE and EPA --the agencies that have the primary responsibility for the Administration's energy and environmental policies.

Model Selection

The first task that the IAT confronted was to review the analytic "toolbox" to assure that it had all the tools necessary to specify the economic effects of a broad range of climate change proposals. At the time, the IAT relied primarily on the Data Resources, Inc. (DRI) macro model to measure economic effects. After this reevaluation of our modeling needs, it was apparent that the complexity of the analysis would require a broader range of analytical tools.

At a public meeting last November, the IAT announced the selection of three models for its analysis. It decided to continue to use the DRI model, but also included two additional models: the Second Generation Model (SGM) and the Markal-Macro model. Each of these three models met the criteria of being available in the public sphere; being well documented; having a track record of analysis in the climate change area; being widely understood within the energy-environment community; and bringing a unique capability to the IAT's work. Used separately, but in concert with each other, they provide the broad analytical capability needed to examine the many complex economic effects of potential global climate change policies.

The DRI model is a large disequilibrium model of the domestic economy that is particularly well suited to identify transition issues based on short-run behavior embedded into a long-run model. The DRI macroeconomic model is linked to energy, regional, and industry sub-models so that macroeconomic effects of policies are translated into the effects on specific industries and regions of the country. The link to energy sub-models provides specific detailed information about the interaction of the energy sector with the rest of the economy. The DRI model also includes the interaction of the financial markets with markets for goods and services and enables the analysis of the interaction of fiscal and monetary policy with the rest of the economy.

The SGM model is a computable general equilibrium good at identifying an economy's long-term trends in response to climate policies. As such, it is particularly good at describing the economy's long-term path while not as good at describing short-term transition issues. In this sense, its strengths and weaknesses are counterpoised to those of DRI. International in scope, SGM also provides detail for 12 global regions that allows us to examine the effects of permit trading and joint implementation. The SGM model assesses the impacts of greenhouse gas emissions policies on economic growth, consumption, and energy.

The DRI and SGM models can be thought of as lying at opposite ends of an axis that measures time horizons. A second dimension of the climate change problem concerns the role of technology. Both DRI and SGM allow technological progress to move forward in response to the parameters of their models. But given the unpredictable character of innovation, the IAT concluded that a second approach would be helpful. The Markal-Macro model consists of an integrated energy supply and demand modeling system (Markal) and a macroeconomic model (Macro) useful for translating technological assumptions into economic outcomes. Thus, the Markal-Macro model is particularly useful in answering the question, "How do we get there from here?" Markal-Macro allows the user to control technology innovation and diffusion and its cost to the user in order to determine the levels of energy efficiencies that might be expected from a long-term policy announcement. This model also allows us to understand the implications of technology and its interaction with the economy, and helps us determine whether expected energy-efficient technologies hold the key to continued economic growth.

The DRI model and the SGM model in some sense provide notional brackets for estimates of the economic effects of carbon-limiting policies. The DRI model is focused on short-term transitions and measures the economy in quarters. In some sectors, the DRI model has forward-looking behavior, but it is structured to examine the effects of short-term changes in the economy, and is often held to overstate the transitions created by broad, secular changes in the economy (and, as will be discussed below, might overstates subsequent economic improvements as well). The SGM model focuses on long-term transitions and measures the economy in five-year intervals. Thus, it risks racing past short-term transition issues, while identifying the economy's ultimate destination.

The Base Case

The domestic energy and emissions baseline forecasts were taken from the Energy Information Administration's 1997 Annual Energy Outlook (AEO97). The international baseline forecast was taken from the International Energy Agency's World Energy Outlook, except for the baseline forecast of the Former Soviet Union (FSU), which came from World Bank projections. The IAT then imposed, as best possible, consistency across the models with regard to projections of baseline GDP, total energy consumption, and carbon emissions. Once these were calibrated into the 3 models, the models solved for energy prices by fuel type. Thus, the baselines of the three models are consistent, but not identical.

Tables 1 and 2 summarize the IAT baseline. In the baseline, U.S. economic growth is projected to slow over the next several decades, as the retirement of "baby boom" workers slows labor force growth and reduces the economy's potential growth rate. Energy demand therefore grows somewhat more slowly than it now does. Energy intensity, measured as energy use per dollar of GDP (the E/GDP ratio), is a key ingredient in the AEO97 forecast, because it measures the growing efficiency with which the economy uses energy. In the 1970s and 1980s, the E/GDP rate of decline averaged almost 2 percent annually--1.5 percent due to price effects and 0.5 percent due to non-price effects. Moderate price increases and the growth of more energy-intensive industries in the late 1980s lead to a stable of energy intensity. The baseline projection used for this study incorporates a 1.0 percent annual reduction in energy consumption per unit of real output, which is taken from the EIA's Annual Energy Outlook. With these improvements included, energy demand grows at an annual rate of about 0.8 percent over the period from 1995 to 2020, tailing off at the end of the period as does economic growth.

Carbon emissions in the baseline are projected to increase by about 1.2 percent a year through 2010, and by 0.6 percent annually from 2010 to 2020, reaching 1805 million metric tons in 2020. In 1990, the year most frequently used in the international negotiating process as the reference level of carbon, carbon emissions were 1,340 million metric tons, 22 percent below EIA's projection for 2010 and 36 percent below DRI's projection for 2020.

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Table 1: IAT Domestic Baseline

	Year							Average Annual Growth Rate (percent) [1]					
	1990	1995	2000	2005	2010	2015	2020	90-95	95-00	00-05	05-10	10-15	15-20
Population													
DRI-DRI Energy	250	263	276	287	299	311	323	1.0	0.9	0.8	0.8	0.8	0.7
AEO97 (NEMS) [2]	250	264	276	287	299	311	n/a	1.0	0.9	0.8	0.8	0.8	n/a
SGM	250	263	276	287	299	311	323	1.0	0.9	0.8	0.8	0.8	0.7
Markal-Macro	250	263	276	287	299	311	323	1.0	1.0	0.8	0.8	0.8	0.8
GDP ($Billion 1992)													
DRI-DRI Energy	$6,139	$6,743	$7,515	$8,320	$9,163	$9,996	$10,670	1.9	2.2	2.1	1.9	1.8	1.3
AEO97 (NEMS)	$6,139	$6,739	$7,544	$8,390	$9,185	$9,880	n/a	1.9	2.3	2.1	1.8	1.5	n/a
SGM	$6,139	$6,739	$7,544	$8,390	$9,185	$9,880	$10,591	1.9	2.3	2.1	1.8	1.5	1.4
Markal-Macro	$6,139	$6,739	$7,549	$8,384	$9,198	$9,880	$10,498	1.9	2.3	2.1	1.9	1.4	1.2
OMB [3]	$6,142	$6,721	$7,470	$8,343	$9,225	$9,929	$10,581	1.8	2.1	2.2	2.0	1.5	[illegible]
Total Energy Consumption (Quads) [4]													
DRI-DRI Energy	82.6	88.9	95.9	101.0	105.3	107.4	108.9	1.5	1.5	1.0	0.8	0.4	0.3
AEO97 (NEMS)	83.7	90.0	97.9	103.4	107.9	110.9	n/a	1.5	1.7	1.1	0.9	0.5	n/a
SGM	81.2	90.6	96.0	102.0	107.0	110.3	113.0	2.2	1.2	1.2	1.0	0.6	0.5
Markal-Macro	83.7	90.9	98.0	103.7	107.8	110.7	115.3	1.7	1.5	1.1	0.8	0.5	0.8
Energy Intensity (TBtu/$92GDP)													
DRI-DRI Energy	13.5	13.2	12.8	12.1	11.5	10.7	10.2	-0.4	-0.7	-1.0	-1.1	-1.3	-1.0
AEO97 (NEMS)	13.6	13.4	13.0	12.3	11.7	11.2	n/a	-0.4	-0.6	-1.0	-1.0	-0.9	n/a
SGM	13.2	13.5	12.8	12.2	11.6	11.2	10.7	0.4	-1.0	-1.0	-1.0	-0.9	-0.9
Markal-Macro	13.6	13.5	13.0	12.4	11.7	11.2	11.0	-0.2	-0.8	-1.0	-1.1	-0.9	-0.4
Minemouth Coal Price ($95/ton)													
DRI-DRI Energy	$23.92	$18.45	$15.28	$14.41	$13.76	$13.16	$12.70	-5.1	-3.7	-1.2	-0.9	-0.9	-0.7
AEO97 (NEMS)	$19.88	$18.83	$18.38	$17.47	$16.92	$15.46	n/a	-1.1	-0.5	-1.0	-0.6	-1.8	n/a
SGM	$19.88	$19.45	$18.48	$17.30	$16.47	$15.73	$14.96	-0.4	-1.0	-1.3	-1.0	-0.9	-1.0
Markal-Macro	$19.88	$18.83	$17.37	$16.39	$15.90	$16.39	$16.14	-1.1	-1.6	-1.2	-0.6	0.6	-0.3
World Oil Price ($95/Barrel)													
DRI-DRI Energy	$25.23	$17.14	$16.18	$18.93	$21.24	$22.86	$23.95	-7.4	-1.1	3.2	2.3	1.5	0.9
AEO97 (NEMS)	$24.87	$17.26	$18.20	$19.72	$20.41	$20.98	n/a	-7.0	1.1	1.6	0.7	0.6	n/a
SGM	$24.87	$17.26	$18.20	$19.72	$20.41	$20.98	$21.57	-7.0	1.1	1.6	0.7	0.6	0.6
Markal-Macro	$24.87	$17.26	$18.59	$19.75	$20.29	$21.05	$22.20	-7.0	1.5	1.2	0.5	0.7	1.1
Natural Gas Price (wellhead $95/Mcf)													
DRI-DRI Energy	$1.81	$1.46	$1.87	$2.15	$2.42	$2.54	$2.65	-4.2	5.1	2.8	2.4	1.0	0.9
AEO97 (NEMS)	$1.97	$1.61	$1.82	$1.94	$2.01	$2.13	n/a	-4.0	2.5	1.3	0.7	1.2	n/a
SGM	$1.97	$1.99	$2.07	$2.10	$2.16	$2.11	$1.97	0.2	0.9	0.2	0.6	-0.5	-1.4
Markal-Macro	$1.71	$1.55	$2.22	$2.28	$2.46	$2.77	$2.97	-1.9	7.4	0.5	1.6	2.4	1.4
Gasoline Prices ($95/Gal) [5]													
DRI-DRI Energy	$1.40	$1.21	$1.20	$1.26	$1.31	$1.37	$1.40	-2.9	-0.1	1.0	0.8	0.8	0.4
AEO97 (NEMS)	$1.34	$1.15	$1.19	$1.21	$1.22	$1.17	n/a	-3.1	0.8	0.3	0.1	-0.7	n/a
SGM	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Markal-Macro	$1.34	$1.15	$1.34	$1.39	$1.40	$1.41	$1.44	-3.0	3.1	0.7	0.1	0.1	0.4
Carbon Emissions (MMTC) -- Total													
DRI-DRI Energy	1338	1413	1516	1612	1693	1767	1805	1.1	1.4	1.2	1.0	0.9	0.4
AEO97 (NEMS)	1339	1424	1543	1639	1722	1799	n/a	1.2	1.6	1.2	1.0	0.9	n/a
SGM	1350	1480	1550	1637	1729	1808	1871	1.9	0.9	1.1	1.1	0.9	0.7
Markal-Macro	1338	1459	1574	1674	1741	1806	1914	1.7	1.5	1.2	0.8	0.7	1.2

1 Growth rates are calculated from non-rounded levels. 2 AEO97 projections extend only to 2015. 3 Office of Management and Budget fiscal year 1998 assumptions. 4 SGM projections do not include geothermal, wind, biomass waste, and other municipal waste. 5 The SGM model does not include gasoline.

Table 2: IAT International Baseline

Average Annual Growth Rates (percent)

	Real Economic Growth (GDP)			Energy Growth (Quads)			Emissions Growth (MMTC)		
	1990-00	2000-10	2010-20	1990-00	2000-10	2010-20	1990-00	2000-10	2010-20
Australia	2.8	2.8	2.6	2.1	1.5	0.9	2.0	1.5	0.9
Canada	2.6	2.5	1.2	1.7	1.0	0.4	2.2	1.4	0.7
China	8.4	7.5	5.8	3.9	2.8	2.1	3.8	2.8	2.2
Former Soviet Union	-3.5	4.6	4.2	-3.5	1.8	1.2	-4.0	1.8	1.2
Eastern Europe	-4.5	4.2	4.3	-3.0	1.3	1.2	-3.5	1.3	1.2
India	4.1	4.5	3.9	3.9	1.3	3.1	4.1	2.1	3.3
Japan	2.1	1.7	0.9	2.2	0.9	0.1	2.1	0.9	0.1
Korea	5.0	5.9	4.4	4.0	3.1	2.4	2.6	3.3	2.9
Mexico	4.0	4.0	3.2	4.2	2.9	2.3	4.2	2.9	2.4
Western Europe	2.3	2.5	2.4	1.5	1.4	0.6	1.2	1.4	0.6
United States	2.1	2.2	1.4	1.7	1.1	0.6	1.4	1.1	0.8
Rest-Of-World	3.6	3.4	3.0	3.0	2.0	2.0	3.0	2.2	2.2

The Analytical "Starting Point"

The IAT began its analysis of emissions reductions policies by examining one core emissions reduction scenario. Then we explored the economic effect of changes to this scenario. The central policy modeled -- the "starting point" scenario -- is aimed at reducing carbon and other greenhouse gas emissions by stabilizing them at 1990 levels. The "starting point" scenario pursues those reductions by issuing tradable emission permits at the earliest point of energy production or when imported into the United States. The policy is announced in 2000 and its restrictions are phased-in over a ten year period, so that the policy would take full effect in 2010. The permits are initially auctioned in a way that is revenue neutral; i.e., all revenues generated through permits would be recycled through the economy through deficit reduction. The "starting point" scenario assumes no international cooperation, although this option is discussed later in the paper along with other alternatives and sensitivities.

Estimates in reductions of non-carbon emissions, such as methane and forest carbon sinks, are obtained from engineering estimates outside the models. Early in the process, the IAT estimated a strike-price for these sources of $70 per ton (which turned out to be low). Appendix Table A shows baselines for, and the quantities of emissions obtained from, these non-carbon sources at this price. These carbon tons were subtracted from the emissions targets being modeled. But the cost of obtaining them was not factored back into the models and, is therefore missing. While the engineering estimates are uncertain, the cost of abating non-carbon sources could increase the estimates of economic effects by as much as 25 percent.

The "starting point"scenario was employed as an analytical starting point for this analysis primarily because it has already been the subject of much attention within the analytical literature. Most analysts of climate change policies have used an emissions freeze in the year 2010 at 1990 levels as their framework. The IAT, therefore, used this scenario as a starting point in order to facilitate comparisons of its work to that of other researchers.

Industry and regional effects, as presented here, show only the effects of the climate change policy on the industry's output (shipments plus inventory change). We considered this our first step in understanding the likely sectoral consequences of emissions reductions. As the year goes on, the IAT hopes to provide further detail to the industry analysis by examining jobs, international trade, industries comparisons between countries, and the possibility that domestic industries might relocate overseas due to increased domestic costs.

The "starting point" scenario incorporates a slight improvement in energy intensity (E/GDP) over the EIA/AEO baseline, which declines by 1.0 percent per year. This improvement comes about because of "announcement effects" -- that is, the actions that take place because the climate change policy undertaken generates foreseeable increases in the future price of energy. The "announcement effect," therefore, is what allows the model to distinguish between a change in future policy regarding carbon emissions and an exogenous shock, such as the two oil price increases in the 1970s. This leads to somewhat faster rate of diffusion of energy efficient technologies and a higher rate of innovation through R&D in anticipation of future higher energy prices. The IAT assumes an improvement in energy intensity of 0.25 percent so that the total annual change in the ratio of energy to GDP is 1.25 percent per year. A faster technology alternative is also investigated. (More detail on energy-efficient technology improvement is provided later in this paper.)

Unless otherwise stated, the tables and figures that follow were derived using the DRI model and using the "starting point" scenario, which disallows international emissions trading. These estimates, therefore, will be at the high end of the likely range.

"Starting Point" Results

Estimates of permit prices are around $100 in 2010 and rising slightly thereafter, and are consistent across models. While the three models used for this analysis vary in structure and often in terms of macroeconomic outcomes, they generate fairly consistent results as to the implicit price of carbon in the economy. Table 3 presents the results obtained by the three models for the value of any permit to emit carbon. Figure 1 shows the path for the value of carbon in these models. All of these estimates pertain to the "starting point" option in which emissions are frozen at their 1990 level in 2010 and thereafter.

Table 3: The Implicit Price of Carbon (1995$) in 2010 and 2020

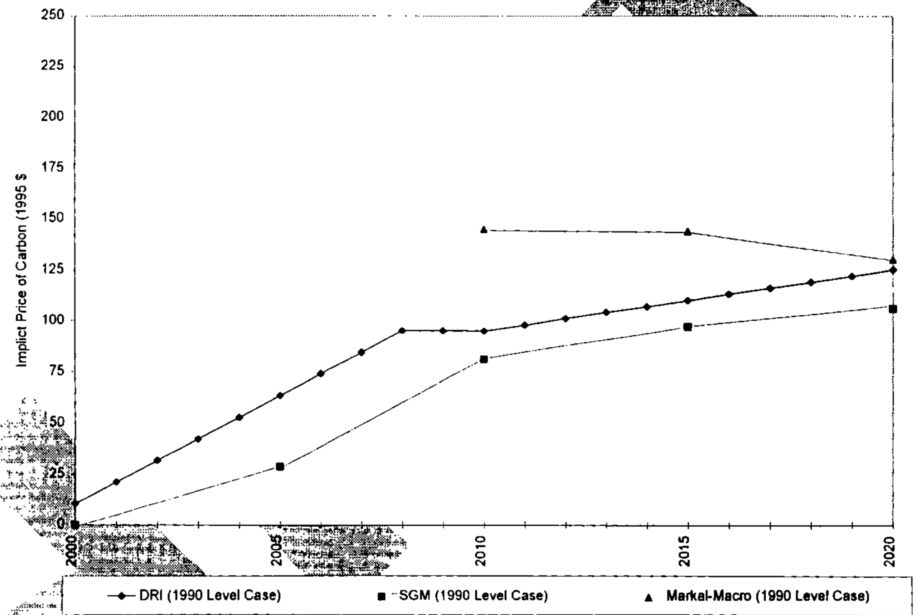
1990 Level Case, No International Trading

	2010	2020
DRI-DRI Energy	95	125
SGM	81	106
Markal-Macro	145	130

Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues recycled into the economy through deficit reduction and assuming a 1.25 percent annual decrease in E/GDP. SGM permit prices are calculated using the rate of change in Carbon to GDP (C/GDP), which incorporate emission rates by the different fuel types.

Figure 1 : Price Path of the Implicit Price of Carbon (1995$)

2010 to 2020, No International Trading



Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues recycled into the economy through deficit reduction and assuming a 1.25 percent annual decrease in E/GDP. SGM and Markal-Macro permit prices are calculated using the rate of change in C/GDP. SGM and Markal-Macro models use data and generate results in five year intervals.

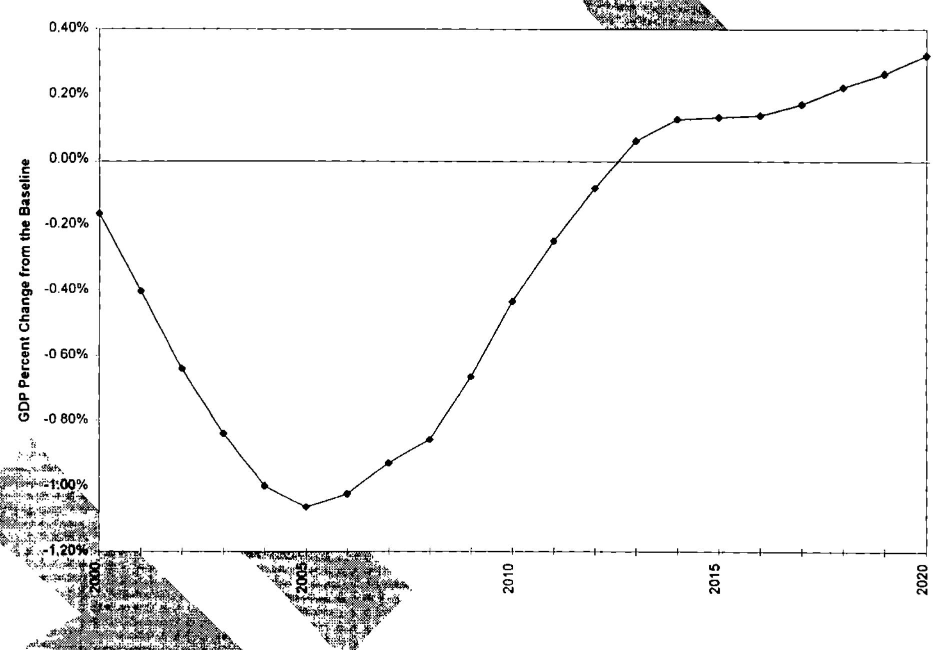
The DRI model concludes that an implicit price of $95 (1995$) per ton of carbon in 2010 would result in stabilization. The Markal-Macro model estimated $145 (1995$) while the SGM model predicted about $81 (1995$), in 2010.[1] A carbon tax of $100 per ton is the equivalent of a price increase of 26 cents per gallon of refined petroleum product, $1.49 per thousand cubic feet of natural gas, $52.52 per ton of coal, and 2 cents per kilowatt hour of electricity produced.

[1] The higher permit price from the Markal-Macro model reflects, in part, differences in model structure, but results mostly from differences in the calibration of the baseline emissions.

The models also agree that this implicit price of carbon grows somewhat over time. This reflects the fact that the 1990 emission ceiling becomes a progressively more binding constraint over time given projected growth in base case emissions. By the year 2020, the implicit price of carbon rises, in 1995 dollars, to $125, $106 and $130 per ton in the DRI, SGM, and Markal-Macro models, respectively.

Emissions reductions lead to small reductions in short-term economic growth (GDP), but growth later appears to recover The burden of reducing carbon and other greenhouse gas emissions leads to short-term reductions in economic growth as measured by GDP. These reductions, however, are not large and, in many instances, are recovered in later years.

Figure 2: DRI 1990 Level Case, No International Trading--Gross Domestic Product



Results from the DRI model are presented in Figure 2. The results indicate that there is an initial GDP loss as the emission-limiting policy begins to be phased in. These losses cumulate to a peak loss of about 1.0 percent of total economic output in the year 2005 -- that is, the economy's growth slows until the size of the economy is, at worst, about 1.0 percent smaller in that year when compared to the base case. After 2005, the economy actually grows faster than it would have absent climate change policy and starts to make up the lost ground. By the year 2013, the economy is back to the point at which it would have been had no policy been enacted. In subsequent years, the economy improves slightly compared to the "no policy" base case-- this differential reaches 0.3 percent by 2020, the last year of the model run.Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues recycled into the economy through deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

This improvement occurs in the DRI model because the emissions reduction policies modeled have some effects that favor savings and investment at the expense of consumption. If the government auctions off emissions permits, it acquires the wherewithal to reduce the deficit (or retire debt) and, in effect, increase the nation's savings. This allows the cost of capital to fall and favors investment. The marginal profitability of investment also rises under these policies because new investment allows firms to neutralize higher energy costs. In effect, capital is a long-term substitute for energy and is favored after a transition period. Thus, the cost of investment falls and the incentive to invest is strengthened. This faster rate of investment (discussed in greater detail below) gives the economy a newer and larger capital stock: as a result the economy's ability to grow improves until it actually reaches a modestly higher growth path in the years following the transition.

Figure 3 shows comparable results for the SGM and Markal-Macro models. In contrast to the DRI model, which focuses on short-term transition issues and may, therefore, tend to produce larger estimates of GDP losses, the SGM and Markal-Macro models move quickly through these issues and focus on longer-term prospects. The SGM model estimates peak losses for the economy of 0.17 percent of GDP in 2015, but the economy then stabilizes through 2020. The Markal-Macro model estimates losses around 0.60 percent in 2010, 0.80 percent in 2015, and 0.60 percent in 2020.

The Markal-Macro simulation results show a reduction in GDP of 0.60 percent from baseline in 2010 in the stabilization case. GDP remains below baseline levels throughout the forecast horizon. The GDP impact profile reflects the model structure, which represents the base case solution as a set of optimal energy use and technology choices given fuel prices, technology characteristics, and discount rates. Since a carbon constraint limits the use of fuels and technologies that would otherwise be chosen, projected GDP must fall. Moreover, since the balance between investment and consumption is optimized within each case considered, economic welfare cannot be increased by an investment-oriented revenue recycling scheme. Consequently, although investment will adjust, the maximization of economic welfare under a carbon constraint does not lead to higher GDP in the future years.

The two types of models used by the IAT offer a similar picture in some regards -- both show initial losses in aggregate economic output that are not very large (even the DRI peak loss is spread over five years). But they also differ in predictable ways, given their structure. Disequilibrium macro models, such as DRI, tend to identify deeper transitional losses and steeper transitional rebounds. Computable general equilibrium models, such as SGM, see more sanguine short-term effects and see the economy stabilizing after a more frictionless adjustment. However, the SGM model is less flexible than some computable general equilibrium model because it does not allow instantaneous shifts in capital. The SGM model maintains vintaged capital stock in the energy sector and retires old capital only when it cannot cover operating expenses or reaches its fixed lifetime. This feature allows the analysis to incorporate the costs of reallocating capital stock. A recent analysis by Dr. Robert Repetto and Dr. Dunkin Austin of the World Resources Institute examined 162 analyses of climate change policy and found that model structure can account for two-thirds of the difference in results, if environmental benefits are ignored.[2]

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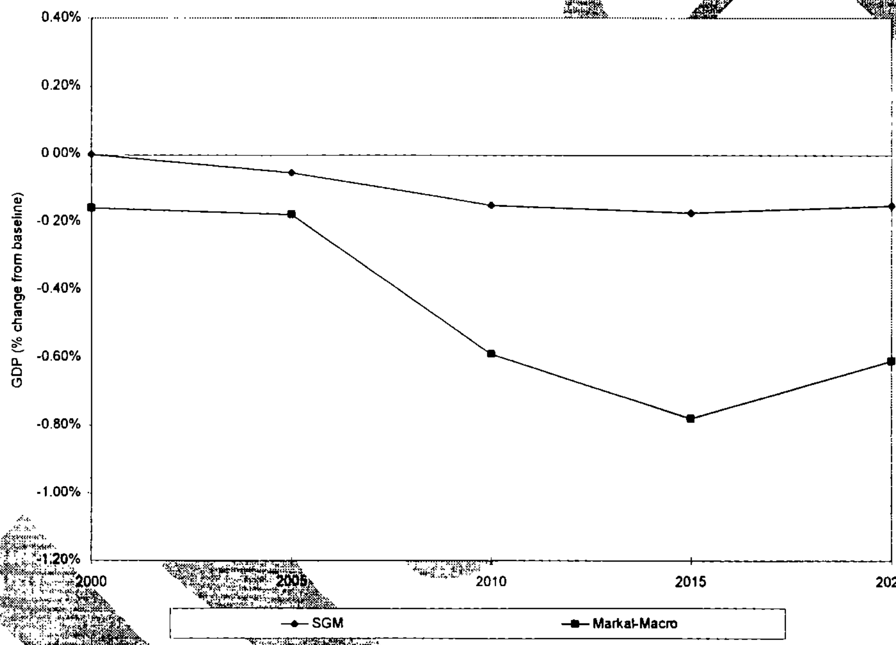
[2] Repetto, Robert and Dunkin Austin. "The Cost of Controlling CO2 Emissions: A Guide for the Perplexed." *World Resources Institute* (Forthcoming).

Which, then, is right? The answer is likely bracketed by the model results. DRI's transitional losses may be overstated, but so would be the rebound and the shift to a higher growth path it estimates for later years. SGM probably understates the transitional problem, but also avoids the later-year growth surge that DRI sees as driven by higher levels of investment. The models probably serve as brackets for the range of reasonable estimates of the economic effects of an emissions freeze at 1990 levels in 2010 and thereafter.

Figure 3: SGM and Markal Macro 1990 Level Case, No International Trading

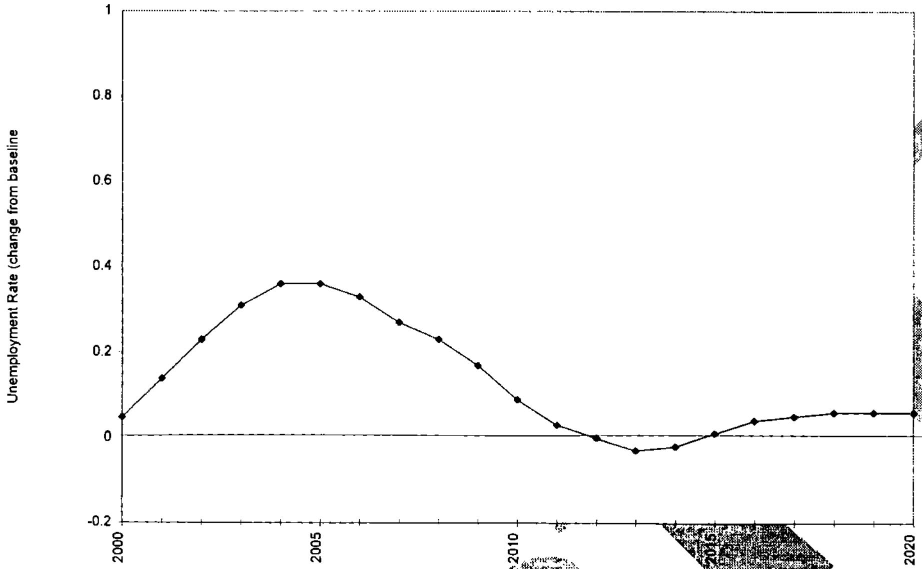
Gross Domestic Product



Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues recycled into the economy through deficit reduction and assuming a 1.25 percent annual decrease in C/GDP.

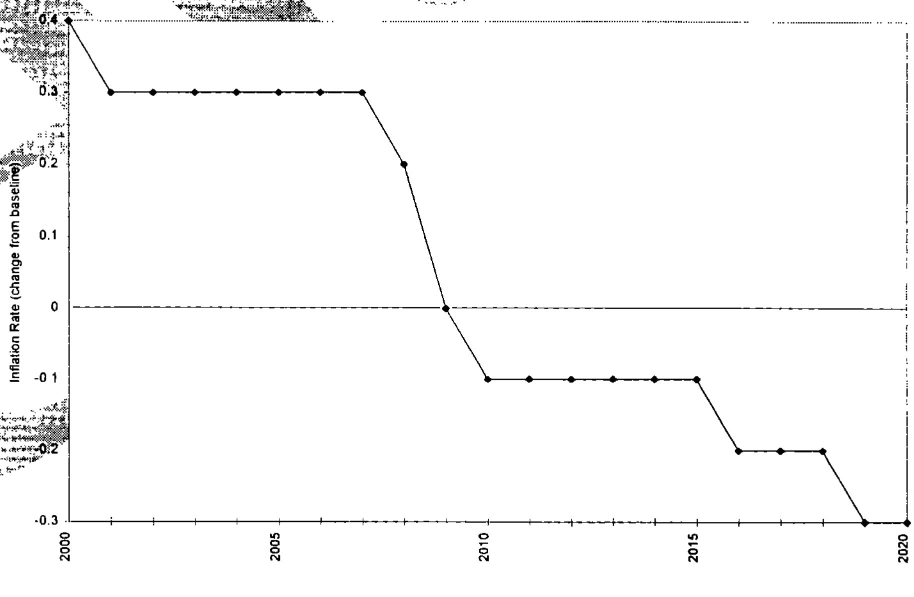
Unemployment and Inflation. The effect of the emissions stabilization policy results in approximately a 0.2 percentage point increase in the unemployment rate from 2001 through 2011, with a peak increase of about 0.4 percentage points in 2015, as estimated using the DRI model. The unemployment rate first rises as GDP falls, but then returns to its pre-policy level by 2012, as shown in Figure 4. The inflation rate increases by about 0.3 percentage points until 2009, measured by the annual rate of change in the Consumer Price Index (CPI). The annual rate of change in the CPI declines by about 0.1 to 0.2 percentage points per year for 2010 through 2020, as shown in Figure 5.

Figure 4: DRI 1990 Level Case -- Unemployment Rate



Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues recycled into the economy through deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

Figure 5: DRI 1990 Level Case, No International Trading -- Inflation Rate

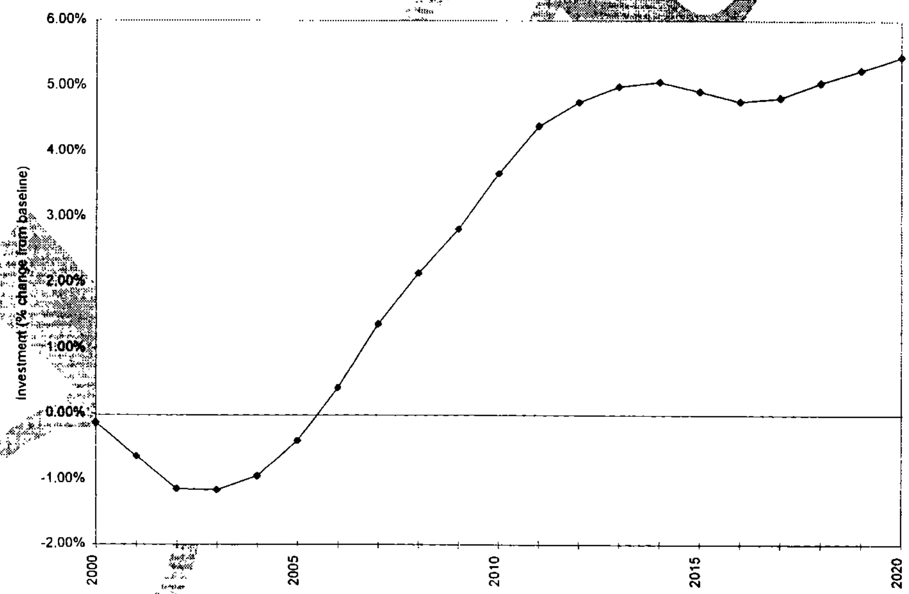


Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues recycled into the economy through deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

Investment policies are key to getting the economy back on track. In the baseline forecast, slow labor force growth of 0.8% per year leads to slow potential GDP growth, which results in slow capital stock turnover. The slower rate at which the capital stock is renewed is of direct consequence to mitigating carbon and other related emissions, since improvements in energy-efficiency or carbon-abating technologies generally must be embodied in the capital stock in order to be effective. Thus, any global climate change policy, to be effective, must focus on investment at the expense of consumption. The deficit reduction policy option, one of the several revenue recycling options examined, promotes savings, which boosts this investment.

The DRI model suggests that investment under a climate change policy scenario begins to exceed investment in the baseline by 2006, as seen in Figure 6. By the time the policy is fully implemented in 2010, investment exceeds the baseline by about $50 billion (1992$), with this difference rising to about $100 billion in 2020. Personal Consumption Expenditures (PCE), on the other hand, remain below the baseline level throughout the forecast period, so that PCE drops by about $80 billion in 2008, as seen in Figure 7. After the trough in 2008, PCE gradually moves toward baseline by 2020.

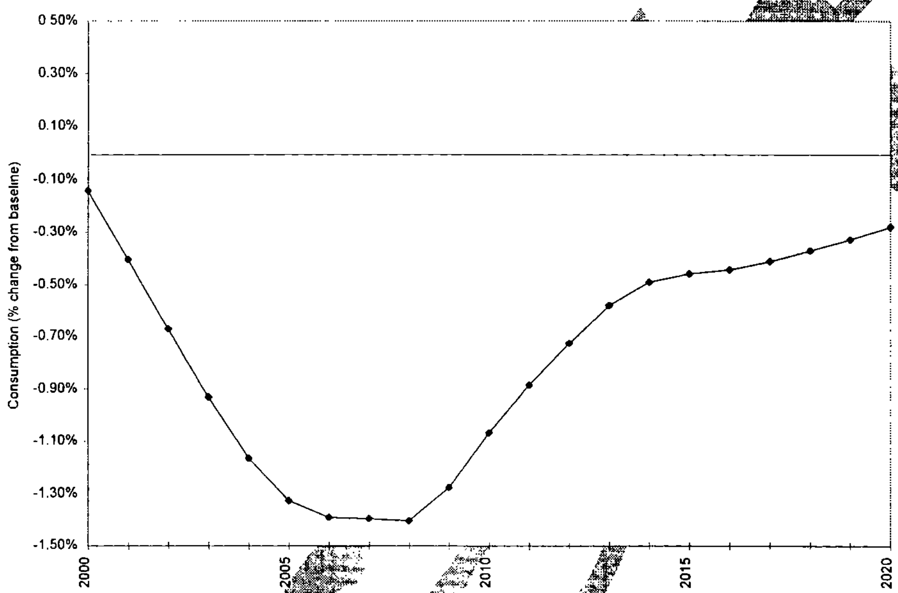
Figure 6: DRI 1990 Level Case, No International Trading--Investment



Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues recycled into the economy through deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

The faster rate of investment drives the rebounding of real economic growth in the later years of the model simulation. But it should be noted that consumption does not rebound in the same manner, although it does recover from its peak losses, as seen in Figure 7. But consumption can be taken as the measure of economic activity that is closer to consumer "welfare" than total GDP, which includes investment, because consumption includes all activities that are of direct consequence to households. Thus, while increases in investment drive the economy's growth path back to and perhaps even above its original trend, it does so by diverting resources away from uses that allow consumers to enjoy them directly in the short term.

Figure 7: DRI 1990 Level Case, No International Trading--Consumption



Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues recycled into the economy through deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

The paths of consumption and investment following the imposition of a climate change policy depend critically on assumptions regarding the manner in which revenue flows related to the allocation of emissions permits are managed and the conduct of monetary policy by the Federal Reserve. These sensitivities are discussed in a later section.

Among fuels, demand for coal bears the brunt of greenhouse gas stabilization Table 4 presents the effects of carbon-limiting policies on the economy's energy consumption and fuel mix. Using the DRI model, total energy consumption falls from 105 quadrillion Btus (quads) in the base case in 2010 to a level of 88 quads under the policy, a reduction of 16 percent in that year. By 2020, energy consumption in the economy has declined by 20 percent, from 109 quads to 87 quads, when compared to the base case for that year. The table also shows comparable results using the Markal model, when the 1990-level emissions freeze produces a decline in projected energy consumption of 14 percent in 2010 and 16 percent in 2020. SGM model results are similar to both the DRI and Markal-Macro results; energy consumption drops by 15 percent in 2010, and 20 percent in 2020.

Table 4: Effects of Carbon Stabilization on Energy Consumption and Fuel Mix (quadrillion Btus)

	2010		2020	
	Base case	1990 Level Case, No International Trading	Base case	1990 Level Case, No International Trading
DRI-DRI Energy				
Total U.S. Energy Consumption	105.3	88.2	108.9	86.7
Natural Gas	27.4	22.9	29.8	24.9
Oil	41.1	35.6	44.1	37.4
Coal	24.3	17.2	25.8	15.2
SGM				
Total U.S. Energy Consumption	107.0	91.4	113.0	90.0
Natural Gas	33.2	33.1	37.7	36.7
Oil	36.5	33.1	39.0	34.0
Coal	23.9	11.3	25.8	8.5
Markal-Macro				
Total U.S. Energy Consumption	107.8	92.6	115.6	96.7
Natural Gas	29.0	30.7	35.1	36.7
Oil	43.4	37.9	45.0	40.1
Coal	22.5	9.4	24.6	4.7
DRI-NEMS				
Total U.S. Energy Consumption	n/a	n/a	n/a	n/a
Natural Gas	n/a	n/a	n/a	n/a
Oil	n/a	n/a	n/a	n/a
Coal	n/a	n/a	n/a	n/a

Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues recycled into the economy through deficit reduction and assuming a 1.25 percent annual decrease in E/GDP. SGM permit prices are calculated using the rate of change in C/GDP. DRI-NEMS data are forthcoming.

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DRI, Markal-Macro, and SGM demonstrate that dampened energy consumption and reduced carbon emissions are concentrated in coal use. As seen in Table 5, DRI results show that about 57 percent of the total emissions reductions in 2010 result from reduced demand for coal, 30 percent from oil, and 13 percent from natural gas. By 2020, 65 percent of emission reductions are generated from reductions in demand for coal. This translates to a 25 percent total emission reduction for coal in 2010 and a 36 percent reduction in 2020. Markal-Macro produces somewhat similar results: it shows that about 57 percent of total emissions reductions in 2010 occur due to reduced coal use; and 16 percent due to reduced oil use; while natural gas consumption is 5 percent above the base case. By 2020, coal accounts for about 80 percent of emissions reductions. The SGM model results are also similar; i.e., coal is responsible for 80 percent of emissions reductions in 2010 and 2020.

The different spread of percent of total emissions reductions by fuel occurs because renewable energy sources and increases in the consumption of natural gas play important roles in the Markal-Macro and SGM models. It is also true because DRI's model sees strong transportation demands and more limited technological prospects for serving it, while transportation choices do not take into account price expectations. This is in contrast to DRI's treatment of the utility sector, which is relatively forward looking when examining fuel choices.

Table 5: 1990 Level Case, No International Trading -- Percent of Total Emissions Reduction by Fuel

	2010	2020
DRI-DRI Energy		
Natural Gas	13	8
Oil	30	28
Coal	57	65
SGM		
Natural Gas	0	3
Oil	18	18
Coal	82	79
Markal-Macro		
Natural Gas	-5	-4
Oil	16	15
Coal	57	80
DRI-NEMS		
Natural Gas	n/a	n/a
Oil	n/a	n/a
Coal	n/a	n/a

Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues recycled into the economy through deficit reduction and assuming a 1.25 percent annual decrease in E/GDP. DRI-NEMS data are forthcoming.

On the demand side, according to DRI, about 46 percent of total emission reductions in 2010 come from the electric sector due to fuel switching and decreases in demand for electricity, 26 percent come from reduced demand for transportation and 19 percent come from reduced demand by the industrial sector, as shown in Table 6. The commercial and residential sectors contribute a combined 8 percent to the total of emissions reductions. The corresponding estimates obtained from the Markal model show that electricity uses account for 40 percent of total reduction in emissions, and transportation, industrial, and residential and commercial uses for 16 percent, 17 percent, and 15 percent, respectively.

Table 6: 1990 Level Case, No International Trading -- Percent of Total Emissions Reduction by Demand Sector

	2010	2020
DRI-DRI Energy		
Residential	5	4
Commercial	3	2
Industrial	19	21
Transportation	27	25
Electricity	46	47
SGM		
Residential	n/a	n/a
Commercial	n/a	n/a
Industrial	n/a	n/a
Transportation	n/a	n/a
Electricity	n/a	n/a
Markal-Macro		
Residential and Commercial	15	15
Industrial	17	22
Transportation	16	17
Electricity	40	53
DRI-NEMS		
Residential	n/a	n/a
Commercial	n/a	n/a
Industrial	n/a	n/a
Transportation	n/a	n/a
Electricity	n/a	n/a

Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues recycled into the economy through deficit reduction and assuming a 1.25 percent annual decrease in E/GDP. The SGM model does not generate data by demand sector. DRI-NEMS data are forthcoming.

Thus, across models and when viewed from different perspectives, the center of the reductions in emissions obtained under the broadest strategies moves toward reducing utility consumption of coal. Reducing coal use under utility boilers is generally the largest, cheapest option to reduce carbon emissions in the economy. This is accomplished through better operating rates and through the substitution of gas-fired combined-cycle units for coal-fired units. The implicit price of carbon obtained in most model runs is usually the one that accomplishes this transition in electricity baseload. The range of carbon values -- generally about $100 per ton -- is as high as it is because most coal-fired units are fairly old and already fully amortized. Thus, their product costs mainly consist of fuel and operating and maintenance expenses but not capital costs. The price of coal, therefore, must rise considerably to make coal-fired electricity more expensive on the margin than electricity generated by a new gas-fired plant that entails new capital costs.

International trading of carbon permits among the Annex I countries leads to sizable reductions in costs needed to stabilize emissions. The discussion so far has centered on the how the U.S. economy reacts when the United States independently reduces emissions, however establishing an international market to trade emissions permits is an alternative to unilateral action. The purpose of such a market would be to increase the efficiency and reduce the cost of reducing global emissions by giving all emitters the incentive to search for least-cost solutions across national boundaries.

In brief, under a system of tradable permits, a country could either reduce emissions or purchase additional emissions "rights" (i.e., permits) from other countries. Countries with opportunities to reduce emissions that cost less than the going permit price would have an incentive to reduce emissions and sell their "right to emit" for cash. Countries that had only high cost options to reduce emissions (that is, reduction options that cost more than the permit prices) could purchase emission permits. The forces of supply and demand would set the permit price and the market incentives would push the trading group, as a whole, to institute the least cost emissions reductions first. As a result, it costs less for the trading group, as a whole, to reach the target emissions levels, than it would for each country to reduce unilaterally its emissions to the target levels. Such a policy, of course, raises a variety of legal and institutional questions regarding how it would be implemented with certainty. These issues are not addressed here: instead, the simple assumption is made that the policy works as intended and least-cost approaches to abating carbon are identified and traded.

Using the SGM model, the IAT modeled two international trading scenarios. In the first, it examined the affects of establishing a permit market among the United States, Canada, Western Europe, Eastern Europe, Japan, the Former Soviet Union (FSU), and Australia (collectively known as Annex I countries). In the second scenario, it examined the effects of Joint Implementation, that is, establishing a wider permit market that includes the rest of the world. These scenarios are compared to a scenario in which each of the Annex I countries independently implemented our "starting point" scenario for stabilizing carbon emissions; that is, stabilizing emissions at 1990 levels in 2010 with a ten year phase in, where revenues are used to reduce the deficit, and under the assumption of moderate technological change (i.e., a .25 percent increase over the baseline in the annual increase in energy or carbon efficiency).

International emissions trading calls into question one of the basic assumptions regarding international compliance when performing the estimates. This concerns the case of the FSU. The "starting point" case assumes that all countries are restricted to their 1990 emissions level before they trade. The FSU nations, however, will have emissions below their 1990 levels for years to come. Thus, under this rule, they would be able to sell to other nations their "right to emit" up to their 1990 levels, but would not have to perform any actual emissions reductions. Thus, emissions trades would not have "corresponding reductions" in annual emissions.

The IAT performed its analysis both with and without "corresponding reductions." The case without "corresponding reductions" allows the FSU to sell emissions rights up to its 1990 base. The case with "corresponding reductions" does not allow these trades. Instead the IAT specified that if a nation's emissions were below their 1990 level in the base case, its baseline was shifted down from the 1990 level to whatever the nation's actual emissions would be. For example, the FSU had carbon emissions of 1050 million metric tons (MMT) in 1990, and is projected to have emissions of 836 MMT in 2010. Their baseline in 2010, therefore, is 836 MMT, even though it is lower than the 1990 level. Thus, any tons "sold" from the FSU in these simulations represent actual emissions reductions. The results obtained using the SGM model appear in Tables 7a and 7b.

Under the Annex I trading scenario, the United States, Canada, Western Europe, Japan, and Australia each bear real costs for emissions reduction. The losses experienced by the different nations reflect the economic assumptions made for them (which are presented earlier in this report, in Table 2) and their energy policies to date. Japan, for example, is projected to have relatively slow economic growth and already has relatively high energy prices and an extensive nuclear program. Thus, it is not projected to have strong growth in emissions over the next few decades. Japan has a high implicit price of carbon ($268 per ton) as shown in Table 8. The reason is that Japan does not have many cheap emissions to reduce because they rely extensively on nuclear power. Western Europe fares somewhat worse, since its economic growth is projected to be stronger, and its energy policies have been biased towards coal.

Table 7a: GDP Impacts to Annex I Countries, No Trading v. Annex I Trading, SGM 1990 Level Case

	No Trading					Annex I Trading (With Corresponding Reductions)				
	2000	2005	2010	2015	2020	2000	2005	2010	2015	2020
Australia	0.00%	-0.17%	-0.49%	-0.37%	-0.21%	0.00%	-0.10%	-0.27%	-0.22%	-0.14%
Canada	0.00%	-0.42%	-1.06%	-1.08%	-1.10%	0.00%	-0.14%	-0.36%	-0.31%	-0.24%
Eastern Europe	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.04%	0.33%	0.33%	0.30%
Former Soviet Union	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.11%	0.54%	0.60%	0.49%
Japan	0.00%	-0.23%	-0.63%	-0.43%	-0.29%	0.00%	-0.07%	-0.16%	-0.11%	-0.05%
Western Europe	0.00%	-0.19%	-0.67%	-0.44%	-0.18%	0.00%	-0.10%	-0.34%	-0.20%	-0.07%
United States	0.00%	-0.06%	-0.15%	-0.17%	-0.15%	0.00%	-0.05%	-0.13%	-0.13%	-0.10%

Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues recycled into the economy through deficit reduction and assuming a 1.25 percent annual decrease in C/GDP.

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Table 7b: GDP Impacts to Annex I Countries, No Trading v. Annex I Trading --SGM 1990 Level Case

	No Trading					Annex I Trading (With out Corresponding Reductions)				
	2000	2005	2010	2015	2020	2000	2005	2010	2015	2020
Australia	0.00%	-0.17%	-0.49%	-0.37%	-0.21%	0.00%	0.00%	-0.14%	-0.15%	-0.14%
Canada	0.00%	-0.42%	-1.06%	-1.08%	-1.10%	0.00%	0.00%	-0.16%	-0.20%	-0.19%
Eastern Europe	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.72%	0.68%	0.49%
Former Soviet Union	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.39%	0.50%	0.46%
Japan	0.00%	-0.23%	-0.63%	-0.43%	-0.29%	0.00%	0.00%	-0.08%	-0.08%	-0.06%
Western Europe	0.00%	-0.19%	-0.67%	-0.43%	-0.17%	0.00%	0.00%	-0.16%	-0.15%	-0.09%
United States	0.00%	-0.06%	-0.15%	-0.17%	-0.15%	0.00%	0.00%	-0.08%	-0.10%	-0.10%

Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues recycled back into the economy through deficit reduction and assuming a 1.25 percent annual decrease in C/GDP.

In addition to a high permit price, near term GDP losses in Canada are the most severe in Annex I. This occurs because Canada is already less carbon intensive, but not as energy efficient as the United States. The carbon to population ratios in Canada are about 17 percent below that of the U.S. levels throughout the baseline projection period, while its energy to GDP ratio is about 46 percent higher. Canada relies more heavily on non-carbon sources of energy, such as hydroelectrical generation.

Table 8 shows the implicit price of carbon by country without trading, trading with Annex I countries, and with Joint implementation with the developing countries.

Table 8: Implicit Price of Carbon (1995$) Under Annex I Trading and Joint Implementation--SGM 1990 Level Case

	2010					2020				
	No Trading	Annex I Trading		Joint Implementation		No Trading	Annex I Trading		Joint Implementation	
		with CR	without CR	with CR	without CR		with CR	without CR	with CR	without CR
Australia	132	56	23	20	9	126	50	35	16	12
Canada	222	56	23	20	9	252	50	35	16	12
China	*	n/a	n/a	20	9	*	n/a	n/a	16	12
Former Soviet Union	0	56	23	20	9	0	50	35	16	12
Eastern Europe	0	56	23	20	9	0	50	35	16	12
India	*	n/a	n/a	20	9	*	n/a	n/a	16	12
Japan	268	56	23	20	9	257	50	35	16	12
Korea	*	n/a	n/a	20	9	*	n/a	n/a	16	12
Mexico	*	n/a	n/a	20	9	*	n/a	n/a	16	12
Western Europe	130	56	23	20	9	139	50	35	16	12
United States	82	56	23	20	9	107	50	35	16	12
Rest of World	*	n/a	n/a	20	9	*	n/a	n/a	16	12

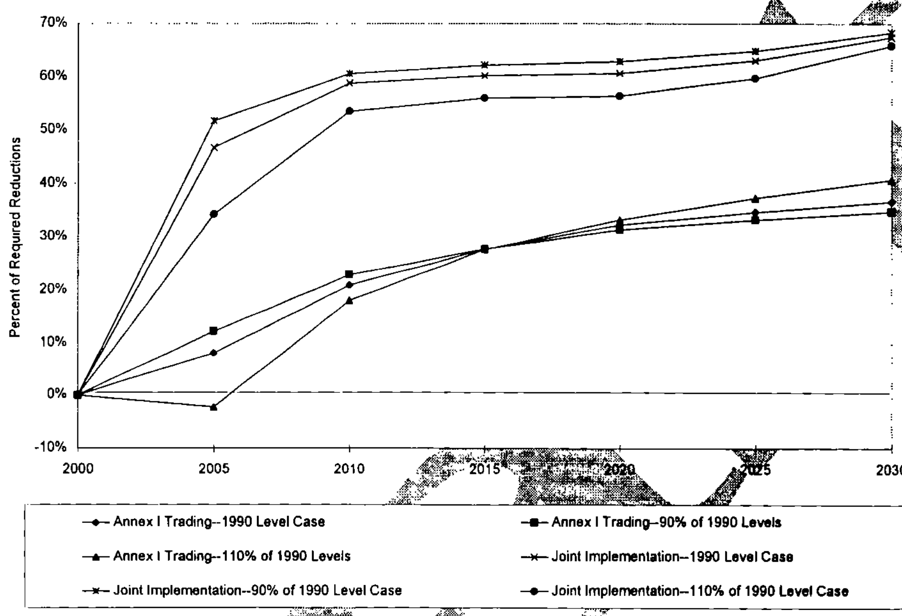
Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues recycled into the economy through deficit reduction and assuming a 1.25 percent annual decrease in C/GDP. * indicates the cell is blank because the country is a non-Annex I country
CR=corresponding reductions.

The United States shows smaller output losses than Japan or Western Europe predominantly because it has more "cheap" carbon-abating opportunities. Its energy prices are lower than these regions' and its has yet to take a variety of steps to promote energy conservation and reduced fossil fuels use that are more commonplace elsewhere. Thus, it is somewhat easier for the United States to reach emission targets than other regions, which have already "picked the low fruit."

Under Annex I trading with "corresponding reductions," the implicit price of carbon falls dramatically--to $56 in 2010 and $50 in 2020. All countries gain through these lower permit prices, because as a whole they achieve stabilization at 1990 levels more cheaply. The source of these cheap emissions is the FSU and the Eastern European nations. The implicit price of carbon falls because it is cheaper for all of the industrialized nations to pay for carbon abatements in those nations (due to lax environmental standards and slow economic growth) than to pursue domestic options only. These nations gain as they become emissions permit sellers under Annex I trading. If "corresponding reductions" are not required, the FSU would be allowed to sell permits up to its 1990 level further depressing the price to $23 per ton in 2010 and $35 in 2020.

Under Annex I trading with corresponding reductions, the U.S. purchases 72 million metric tons of permits from the FSU and Eastern Europe in 2010 at a cost of $4 billion ($95), which offsets $5 billion of abatement expenditures. U.S. purchases of permits abroad increases to 157 million metric tons of permits in 2020 at a cost of $7.8 billion, which offsets $12.2 billion of cost increases that would have occurred domestically if the U.S. did not participate in international trading.

Figure 8 : U.S. Imports of Carbon Permits under Alternate Mitigation Targets for Annex I Trading and Joint Implementation



Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues recycled into the economy through deficit reduction and assuming a 1.25 percent annual decrease in C/GDP.

Joint Implementation with developing countries reduce the costs of permit prices even further. Joint implementation -- emissions trading on a global scale -- reduces the permit price further, to $20 in 2010 and $16 in 2020 (with corresponding reductions). If corresponding reductions are not required the implicit price of carbon falls to $9 in 2010 and $12 in 2020. Under this broader market for tradeable emissions permits, however, the FSU and Eastern Europe lose their monopoly on permit sales. Specifically, Joint Implementation encourages China and India to reduce their use of coal and enter the market as emissions permit sellers.

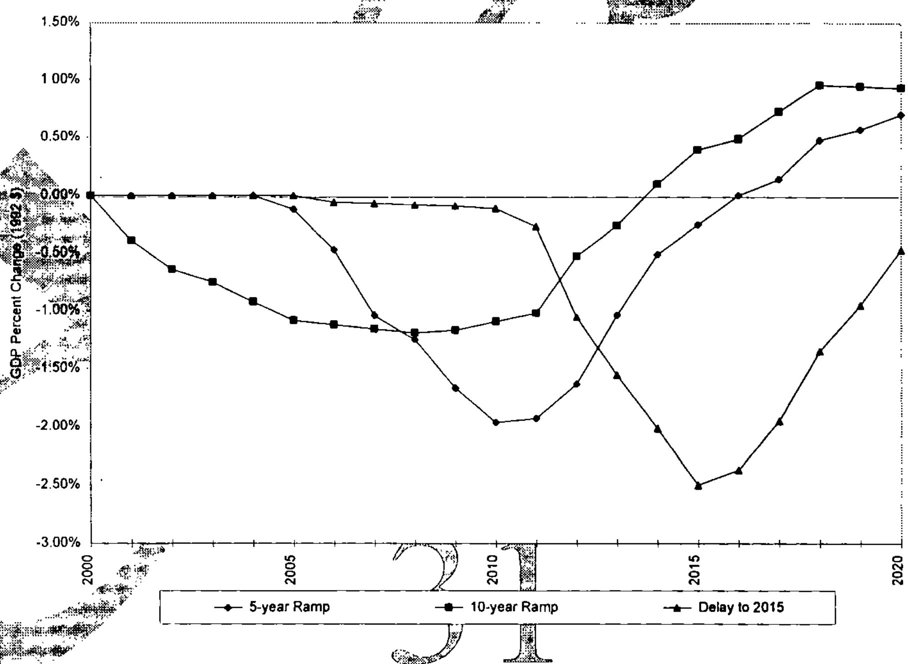
NOTE TO READERS: IAT is still in the process of taking the lower implicit carbon prices calculated by SGM and using them as input to simulate macroeconomic conditions under DRI. Note, however, that the implicit price involved are less than those of the "110 percent case" above, and the economic losses, therefore, should be anticipated to be smaller.

Important Sensitivities

The following represents a number of variations from the "starting point" scenario that the IAT analysts examined to address a number of factors that negotiators are likely to face in the global climate change policy process. These include the effects of: (1) timing, including different transition periods to full implementation and delaying implementation; (2) lower or higher emission level targets; (3) revenue recycling options, including comparing the deficit reduction case with scenarios where revenues are distributed to consumers, distributed to business, and a combination of both consumers and business; (4) policy announcement on the rate if technological innovation and diffusion as well as the steps needed to achieve a higher level of innovation and diffusion; (5) other collateral environmental benefits; and (6) effects on international trade; and (7) Federal Reserve reaction assumptions in the DRI model,

A longer period for implementation, from 5 to 10 years in the 1990 level stabilization case in 2010, dampens negative effects on GDP while delaying implementation does little to improve GDP effects. The IAT examined differing effects on GDP of a 5-year and a 10-year implementation period for the stabilization "starting point" scenario. These results are shown in Figure 9. A 10-year implementation or "ramp-up" period between 2000 and 2010 results in a maximum GDP loss of 1.19 percent in 2008 and a return to the baseline in 2014. On the other hand, a 5-year ramp-up between 2005 and 2010 results in a maximum of a 1.96 percent loss in 2010 and a return to the baseline in 2016. Thus, shorter transition periods result in a more pronounced economic cycle in response to policy--a sharper downturn and deferred recovery.

Figure 9 : 1990 Level Case, No International Trading--Sensitivity to the Length of the Implementation Period and to Implementation Timing



Note: These simulations were conducted using DRI and the NEMS Energy Model and they do not conform in detail to those conducted using DRI and the DRI Energy Model. 5-Year and 10-Year Ramp to 1990 Levels in 2010; 1990 Levels in 2015 using a 5-Year ramp-up.

Figure 9 also shows the result of delaying the implementation by 5 years, to 2015 combined with the shorter 5-year ramp-up period. GDP effects for the delayed case are less severe in the initial period, but become greater than either the 5-year or 10-year ramp-up to stabilization in 2010 reaching a maximum of 2.5 percent in 2015 and never regaining the baseline GDP throughout the period.

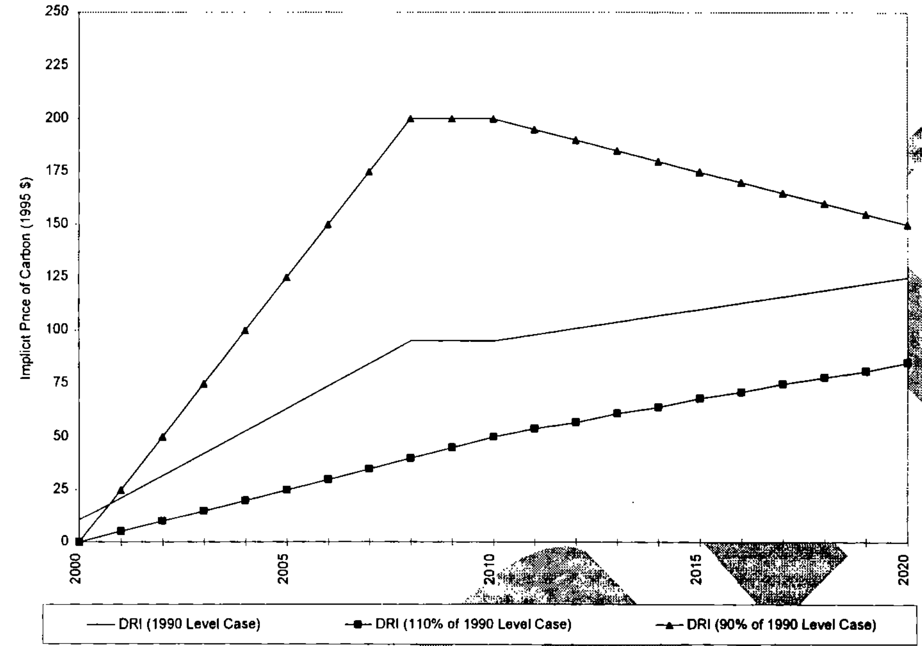
Raising or lowering emission targets lead to obvious results --more stringent emission targets lead to greater economic losses while less stringent ones have less severe impacts The three models were used to analyze how changes in the level of emissions affect the implicit price of carbon. If the emission target for the year 2010 and beyond is raised (made less severe) to a level equal to 110 percent of the 1990 emissions level (that is, to a target of 1,472 million tons as opposed to 1,338 million tons), then the DRI model estimated that permit prices drop almost by half -- to about $50 per ton of carbon, while the SGM model dropped from $81 to $37. The very large decline in the implicit price of carbon reflects the fact that additional emissions reductions are progressively harder to find. On the other hand, a more stringent target, one that freezes emissions at 90 percent of their 1990 level in the year 2010 and beyond, leads to an implicit price of carbon of $200 per ton in 2010 and $150 per ton in 2020, according to the DRI model. The SGM model estimated that permit prices would be $145 and $183 in 2010 and 2020, respectively. Table 9 and Figures 10 and 11 describe the sensitivity of these results using DRI, SGM, and Markal-Macro.

Table 9: Sensitivity of the Implicit Price of Carbon to the Stringency of the Emissions Target

	2010	2020
DRI-DRI Energy		
Carbon Emissions 90% of 1990 Level Case, No International Trading	200	150
Carbon Emissions 110% of 1990 Level Case, No International Trading	50	85
SGM		
Carbon Emissions 90% of 1990 Level Case, No International Trading	145	183
Carbon Emissions 110% of 1990 Level Case, No International Trading	37	56
Markal-Macro		
Carbon Emissions 90% of 1990 Level Case, No International Trading	187	207
Carbon Emissions 110% of 1990 Level Case, No International Trading	101	93

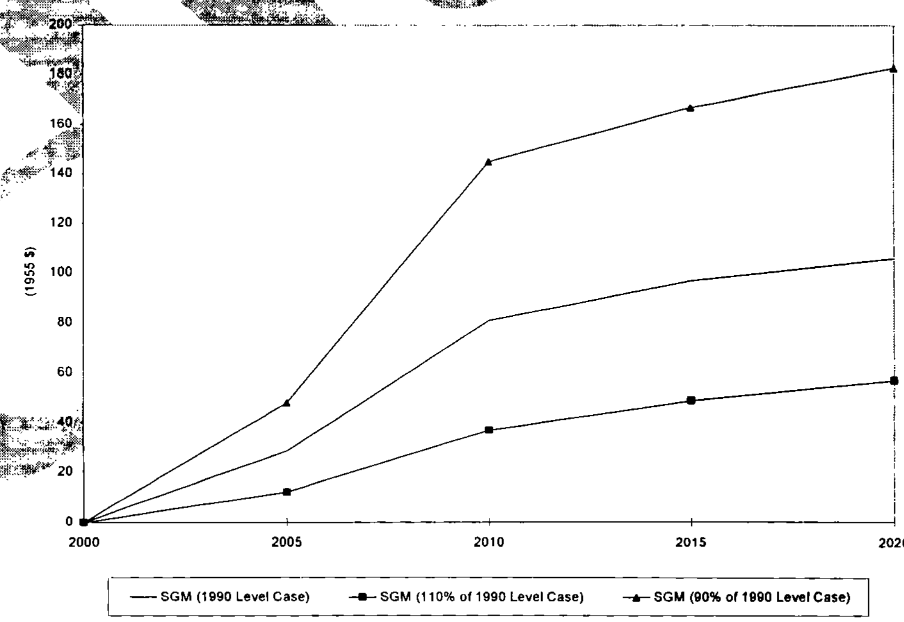
Note: 10 year phase-in with revenues recycled into the economy through deficit reduction and assuming a 1.25 percent annual decrease in E/GDP. SGM permit prices are calculated using the rate of change in C/GDP.

Figure 10 : Sensitivity of the DRI Implicit Price of Carbon to the Stringency of the Emissions Target --2010 to 2020



Note: 10 year phase-in with revenues recycled into the economy through deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

Figure 11: Sensitivity of the SGM Implicit Price of Carbon to the Stringency of the Emissions Target --2010 to 2020



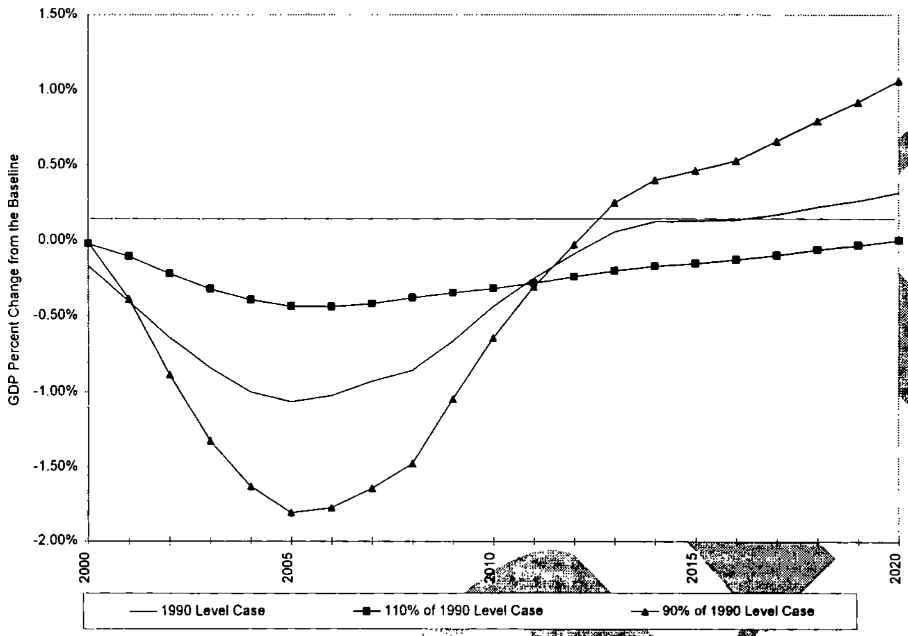
Note: 10 year phase-in with revenues recycled into the economy through deficit reduction and assuming a 1.25 percent annual decrease in C/GDP.

The implicit carbon prices in 2010 of the 110 percent of 1990 Level Case, No International Trading in 2010 are $50, or approximately half the "starting point" stabilization permit price. In 2020, permit prices rise to about $85 compared with the $125 permit price under stabilization. Alternatively, an emissions target of 90 percent of 1990 level results in an implicit price of carbon of $200 per ton in 2010 and $150 in 2020. Unlike in the other cases, the implicit price of carbon falls after 2010. This is because the initial price increase is large enough to set in motion a series of capital stock improvements, particularly in utilities, that reduce the ongoing level of emissions by enough to allow the implicit price to fall in the future. Thus, this result is predicated on the idea that future price expectations could be wrong. In fact, if decision makers had perfect price expectations, the implicit price of carbon would lie somewhere between these two values over the period.

It is no surprise that the 90 percent of 1990 emissions case results in a more severe decline of GDP in the transition period. But what is surprising, and questionable, is that this scenario also has a greater long-term potential for economic recovery. As shown in Figure 12, GDP declines to a peak loss of 1.9 percent below the base case in 2005. It recovers to the base case level in 2013 and increases to 1.0 percent above the base case in 2020. The long-term rebound effect results from a greater amount of revenue recycled to deficit reduction (or debt retirement), which pushes interest rates down substantially and drives up investment.

This result is questionable. The DRI model, as discussed, is prone to depicting large effects of interest rates on investment. Thus, when confronted with a very large implicit price of carbon and, in turn, large amounts of forced saving, either through deficit reduction or by grandfathering these new property rights to firms, it produces much higher levels of investment and a higher long-term growth path. The reality is probably more moderate at both ends. In essence, this case appears to tax the ability of the model to manage these revenue flows.

Figure 12: Sensitivity of GDP to the Stringency of the Emissions Target



Note: 10 year phase-in with revenues recycled into the economy through deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

The portion of total emission reductions from coal and oil in both the 90 percent and 110 percent of 1990 Level Case, No International Trading, increases only slightly--about 5 percentage points--while total emission reductions from natural gas change significantly. In 2010, under stabilization, about 13 percent of total emission reductions are from natural gas. Under a 10 percent increase in the target (that is, a target of 90 percent of 1990 emissions), about 24 percent of total emission reductions are from natural gas. This occurs because the substitution of gas for coal in electric utilities is not enough to achieve the bulk of the 90 percent (more stringent) target. Additional emissions reductions must be found, which forces the burden to be spread more evenly among fuel types and sectors.

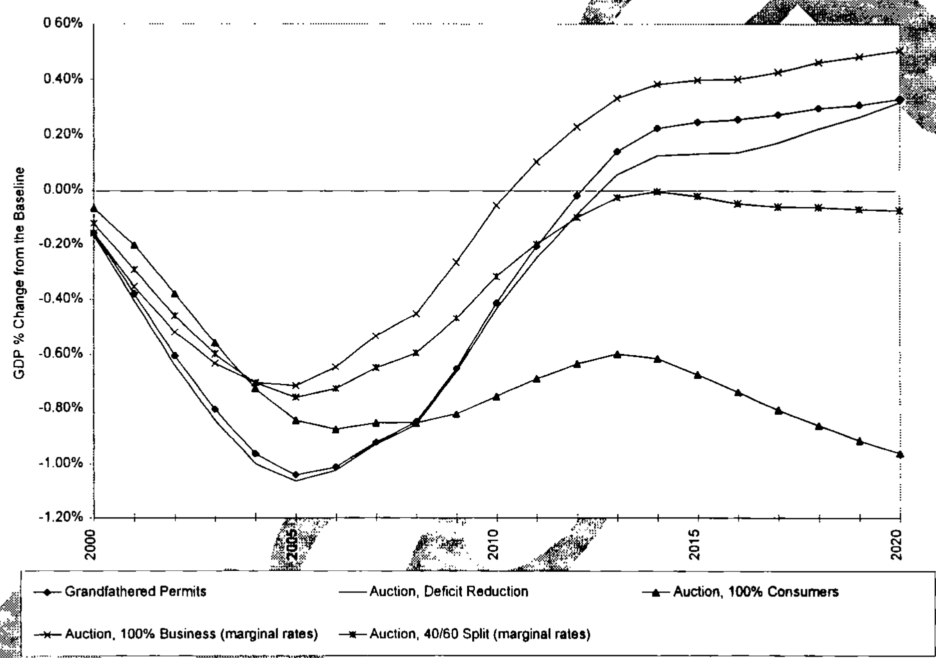
Adopting a revenue recycling option that leads to investment in energy efficient capital leads to less impact on the economy during the transition and greater returns to the economy in the long term. The IAT looked at a number of revenue recycling policies in addition to the deficit reduction case. These options are depicted in Figure 13. These include:

- "grandfathering" permits to producers, meaning that every carbon-emitter would be given sufficient permits to allow them to emit at their 1990 level. The permits allowing them to do so would then be traded freely, allowing a least-cost response to the problem to emerge;

- a 100 percent recycling of any revenues from permit auctions to consumers through a reduction in the personal income tax;
- a 100 percent return to business through a reduction in the marginal rates of the corporate income tax or through lump-sum rebates; or
- a 40/60 split to consumers and businesses, in proportion to their shares of energy use, either through tax rate reductions or a lump-sum return.

Figure 13: DRI 1990 Level Case, No International Trading--

GDP Sensitivity to Revenue Recycling Options



Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Assuming a 1.25 percent annual decrease in E/GDP.

According to the IAT analysis, the revenues generated from the implementation of this policy have the most positive effect when returned through either the deficit reduction plan, grandfathered permits, or to business through lower taxes. Revenue recycled to consumers, in either case, result in a greater and longer-term reductions in GDP, when measured against the baseline.

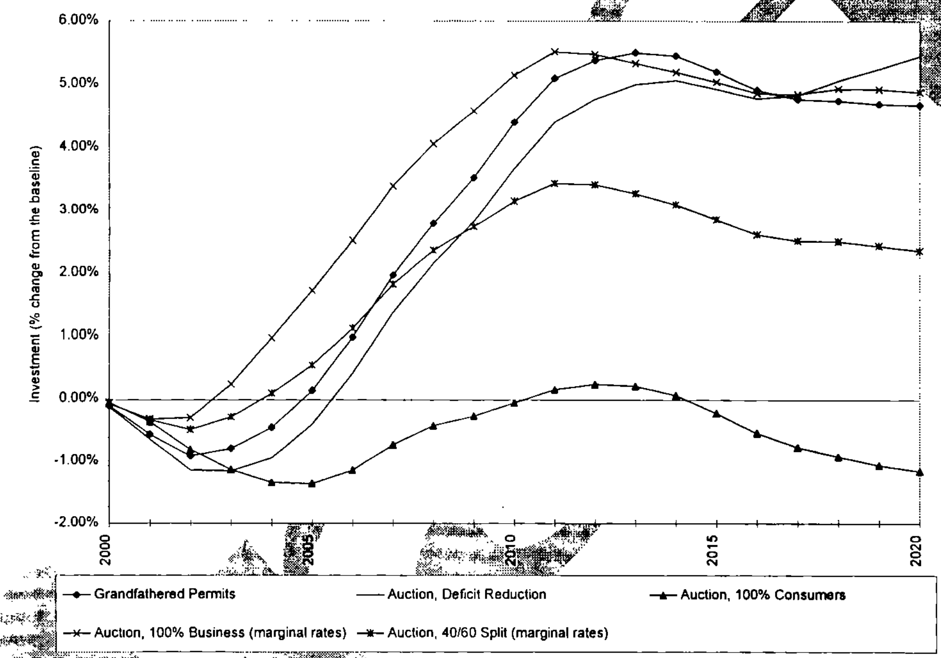
The revenue recycling options that lead to better economic outcomes are all those associated with greater investment and capital formation. Deficit reduction leads to lower interest rates, which lowers the cost of capital and facilitates investment. Recycling revenues to companies has the effect of increasing savings through apparent profits and provides the wherewithal for greater investment spending. Similarly, grandfathering permits to producers allows them to "assetize" their right to produce emissions. This allows firms to realize gains on this "right" and again provides the wherewithal to invest.

Peak GDP losses during the transition period are less severe for the 100 percent to business and 40/60 split when accomplished through reductions in the marginal tax rates, (about 0.7 percent in 2005), compared with the other recycling options, (between 0.8 and 1.0 percent in that year).

Figures 14 and 15 demonstrate the effects of revenue recycling on investment and consumption, in relation to the effect on GDP, as shown in the previous figure. As these figures show, the key to economic recovery among the revenue recycling options is to improve investment in the economy.

Figure 14 : DRI 1990 Level Case, No International Trading

Investment Sensitivity to Revenue Recycling Options



Note: Emissions stabilized at 1990 levels in 2010 with a 10-year phase-in. Assuming a 1.25 percent annual decrease in E/GDP.

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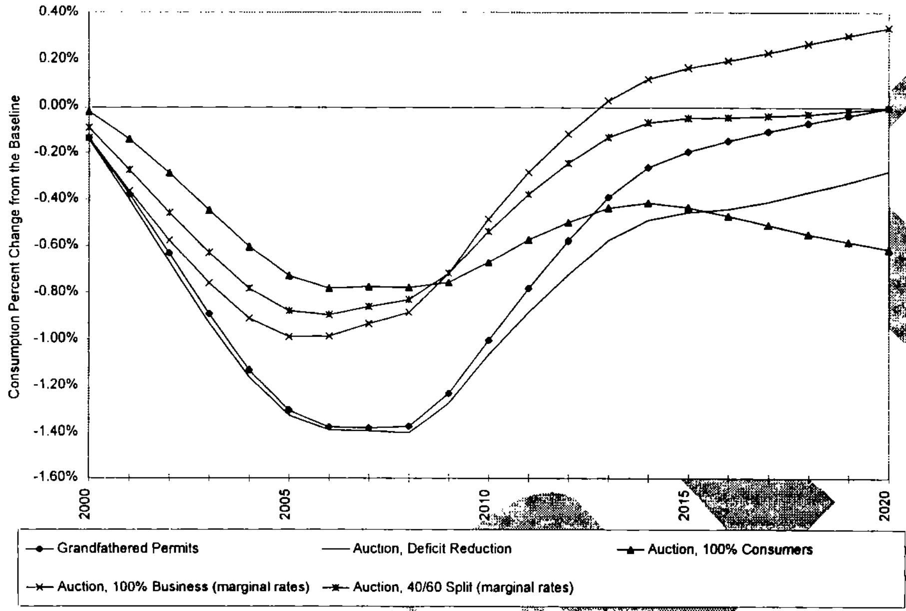
Figure 15: DRI 1990 Level Case

Consumption Sensitivity to Revenue Recycling Options



Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Assuming a 1.25 percent annual decrease in E/GDP.

But the economic effects of these recycling options must be separated from the economic effects of carbon limitations *per se*. That is, economic analysis can make the case -- and models are often structured to demonstrate -- that capital-favoring taxes could improve long-term economic performance. In order to separate these effects, the 1990 emissions freeze accompanied by the use of any permit auction revenues to reduce the deficit was compared to a conventional increase in the personal income tax to achieve a comparable level of deficit reduction.

An increase in the personal income tax results in smaller economic losses and a more prompt economic rebound than a "deficit-equivalent" carbon reduction policy, as shown in Figure 16. Thus, while revenue recycling options can affect significantly the outcome of a carbon-reduction policy, the gains they create are unrelated to carbon reduction itself.

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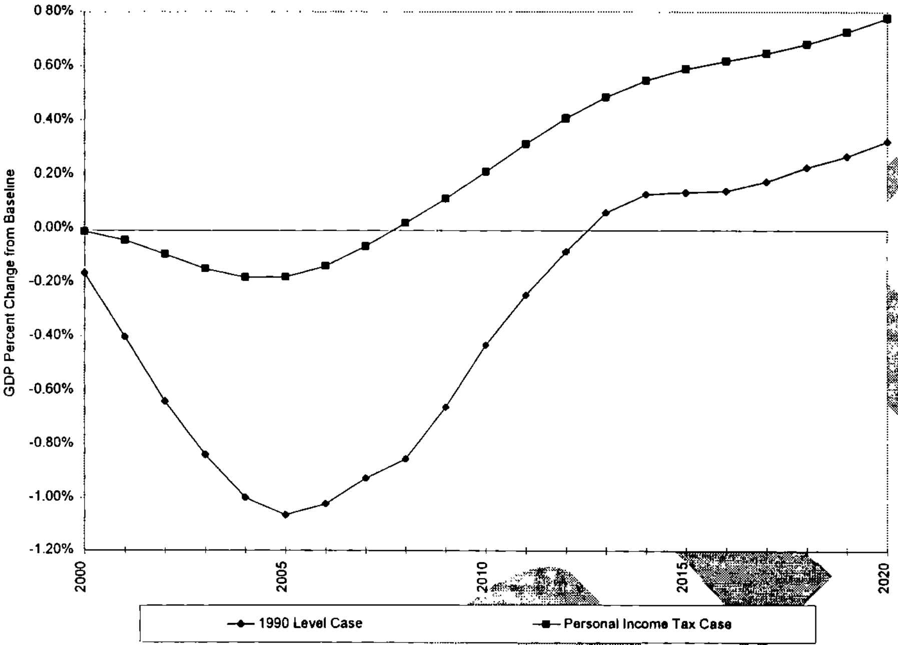
Figure 16: Comparison of Deficit Reduction to Personal Tax Increase: Effects to GDP



Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Assuming a 1.25 percent annual decrease in E/GDP.

Technological progress can be very helpful, but in the long term. In its analysis of technology, the Markal-Macro model was used to determine whether higher levels of energy to GDP (E/GDP) savings are realistic. This analysis assumed two benchmarks for technological progress. In the first, the annual steady-state improvement in the economy's efficient use of energy was increased from the level of 1.0 percent found in the EIA/AEO projections (found in the "no policy" base case) to a level of 1.25 percent. In the second case, this improvement in energy efficiency was increased to 1.75 percent. These two benchmark levels were obtained by examining the historical record and engineering estimates of potential technical progress. The point of the analysis was then to determine not only what effect technical progress might have on the economic effects of climate change policy, but also whether these rates were themselves technically feasible.

According to results from the Markal-Macro model, an improvement in the energy intensity of 0.25 percent annually, or a total annual decline of 1.25 in energy per unit of real output, can be achieved without great difficulty using both off the shelf technologies as well as new technologies that are near commercial viability. For example, such an improvement can be produced if the "hurdle rates" -- that is, the premium that households and firms appear to place in their discount rate when considering energy-efficiency investments -- declines by 21 percent. (For example, the discount rate households use when considering installing better insulation would have to fall from [FORTHCOMING] percent to [FORTHCOMING] percent). Thus, this improvement can be achieved through diffusion practices even without assuming a higher rate of innovation and technological progress.

In fact, some analysts believe that the enactment of the Climate Change Action Plan (CCAP) gets us to the 1.25 annual reduction. DRI achieved a 1.25 percent annual rate of improvement in E/GDP using the latest estimates of energy savings from CCAP. The model then takes these savings and computes carbon emission reductions based on the energy savings profile, assuming that there is no overlap between CCAP emissions and energy reduction estimates and the DRI Energy model baseline.

The Markal model demonstrates that the higher technological case -- an increase in the annual rate of improvement in energy-efficiency of 1.75 percent -- is more difficult to achieve. Specifically, this higher level of energy savings cannot be achieved through better diffusion of best technical practices alone. Thus, new innovation must occur if we are to move beyond the 1.25 case. To achieve the 1.75 case, a new set of advanced energy efficiency technologies was added to the pool of technologies. These are part of the DOE research portfolio. Some of these technologies are aggressive in their scope: For example, the average fuel efficiency of new cars entering the vehicle fleet in the year 2020 is 33 miles per gallon in the 1.25 case, but rises to 55 miles per gallon for new cars entering the vehicle fleet in the 1.75 case. They were all deemed viable in an outside peer-review of the DOE program. The IAT will be circulating the technological assumptions necessary to achieve this 1.75 benchmark in a separate paper.

Rather than use the specific technological assumptions developed in Markal, the IAT represented technological progress in the DRI model by targeting a 1.75 percent annual rate of energy improvement in the economy for supply and end-use technologies in all sectors. For residential and commercial sector space heating/cooling and water heating, DRI assumed improved performance and cost characteristics for various heating and cooling equipment types and allowed the model to choose the optimal technologies. The model selects equipment based on life-cycle cost estimates, which include a "first-cost bias" that weights up-front capital costs more heavily than future fuel costs. This is comparable to the higher discount rates used in Markal.

For all other residential and commercial sector energy end-uses, the DRI model uses estimates of the average efficiency of all new and retrofit equipment purchases to determine fuel use requirements. These average efficiencies were increased to reflect improvements to technology performance and higher rates of diffusion for more efficient technologies. No changes were made to the rates of capital stock turnover and replacement.

Finally, when possible, the rate of improvement in energy-efficiency that IAT assumed was applied to the economy's carbon-efficiency for purposes of modeling. That is because carbon is the appropriate target. But not all models can be managed to this parameter. Nevertheless, the differences in the results of the two specifications is not large.

Table 10 summarizes the effects of higher technological progress (that is, the 1.75 percent annual rate versus the 1.25 annual rate) on the economic effects of carbon-limiting policies. As seen, higher rates of technological progress can cut dramatically the implicit price of carbon and the associated transitional GDP losses. For example, in the IAT "starting point" case (assuming 1.25 percent annual efficiency improvements), the implicit price of carbon in the two models is $95 and $145 per ton in 2010 and $125 and $130 per ton in 2020, for DRI and Markal-Macro respectively. In the more advanced technology case, the implicit price of carbon is $88 per ton and $77 in 2010 and $30 and $35 per ton in 2020, for DRI and Markal-Macro respectively.

Table 10: Sensitivity of Implicit Price of Carbon (1995$)

to Rate of Technological Change --1990 Level Case, No International Trading

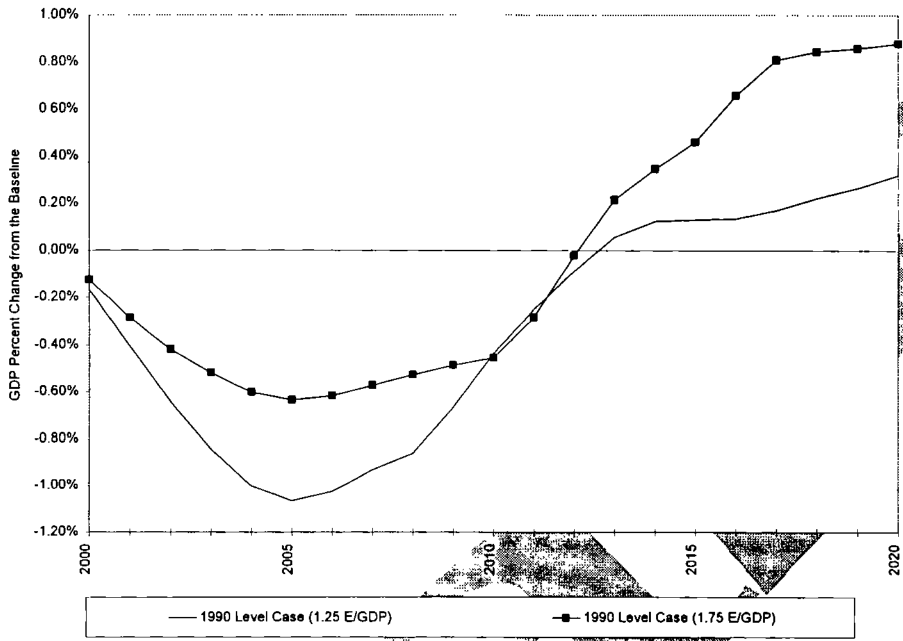
	2010		2020	
	1.25 Case	1.75 Case	1.25 Case	1.75 Case
DRI-DRI Energy	95	88	125	30
SGM	81	n/a	106	n/a
Markal-Macro	145	77	130	35

Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues recycled into the economy through deficit reduction. DRI permit prices are generated using the annual rate of change in E/GDP. Markal-Macro permit prices are calculated using the rate of change in C/GDP. The SGM 1.75 case is forthcoming.

The peak GDP losses change accordingly, as shown in Figure 17. Using the DRI model, the peak output loss of -0.6 percent occurs in 2005, and the economy reaches its pre-policy growth path by 2012. The economy's shift to a higher growth path is also more pronounced, but here the result is more believable, because it is achieved through technological progress rather than revenue recycling that raises savings and fosters investment (in fact, the level of revenue recycling falls dramatically as does the implicit price of carbon). The risk, however, is that these output gains may be somewhat overstated, because they do not account for the cost of the investments needed to reach the higher rate of technological progress. For example, firms will have to perform R&D that might distract them from other R&D tasks. If other R&D in the economy fell as energy- and carbon-related R&D was performed, overall productivity could drop and offset the economy's potential growth elsewhere. Alternatively, firms might increase total R&D effort, but leave the economy with fewer resources to do other things. While it is likely that these effects are second-order when compared to the effects of the improvement in carbon-related efficiency, they are still absent from the analysis.

Figure 17 : Sensitivity of GDP to the Rate of Technological Progress

DRI 1990 Level Case, No International Trading



Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues recycled into the economy through deficit reduction.

These results indicate how important technological progress is in the long term. A substantially higher rate of technological progress affects short-term results only modestly. But it is capable of moving the analysis significantly once its effects are allowed to accumulate.

Reducing carbon emissions would also lead to reductions in other pollutants of direct economic benefit.

NOTE TO READERS: The IAT is still in the process of estimating collateral environmental benefits.

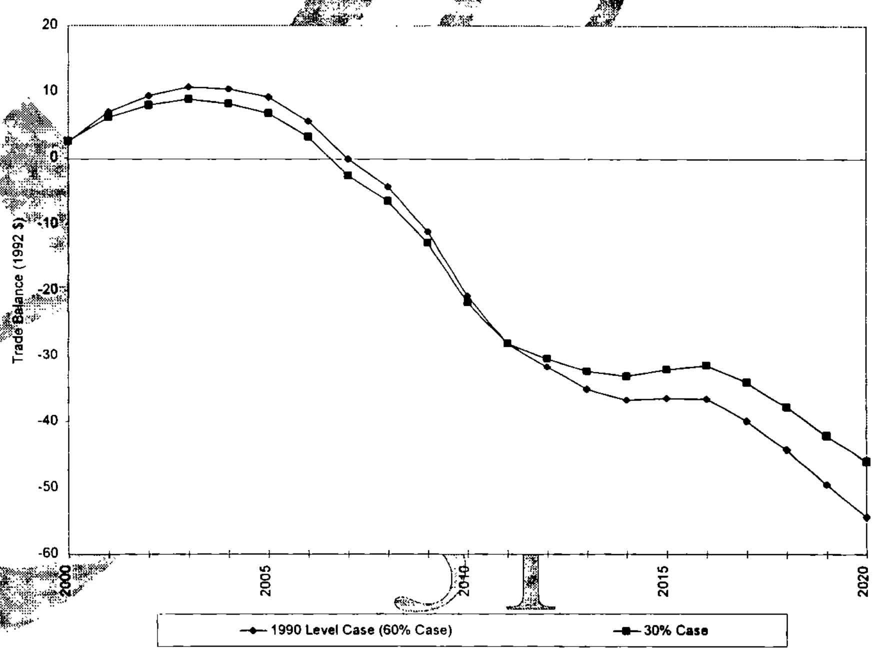
The losses experienced by the United States by handicapping energy-intensive industries in international trade need not be large. There is widespread and legitimate concern that forcing an implicit energy price increase on U.S. producers will disadvantage them substantially through trade, particularly with those countries outside of "Annex I" that might not be subject to the same emissions limits. While the IAT is still examining these questions on an industry-by-industry basis, it used the DRI model to examine the overall trade implications of such a possible energy price differential.

The DRI model examines overall trade effects by assuming a rate at which producers who export to the U.S. experience cost increases. In the aggregate, about 60 percent of imports of manufactured goods come from Annex I countries that will also experience higher implicit carbon prices (and, therefore, energy prices). The DRI model, therefore, assumes that manufactured imports, in general rise by an average of 60 percent of the full cost increase experienced by U.S. manufacturers.

This assumption, however, can be criticized as being too favorable to U.S. producers. If exporters from non-Annex I countries do not experience the cost increase that Annex I producers do, then they will no doubt substitute their production for Annex I production. Given this likely switching of export sources, the DRI model was also run with the assumption that foreign producers experience a cost increase equal to, on average, a 30 percent as opposed to 60 percent of the U.S. cost increase.

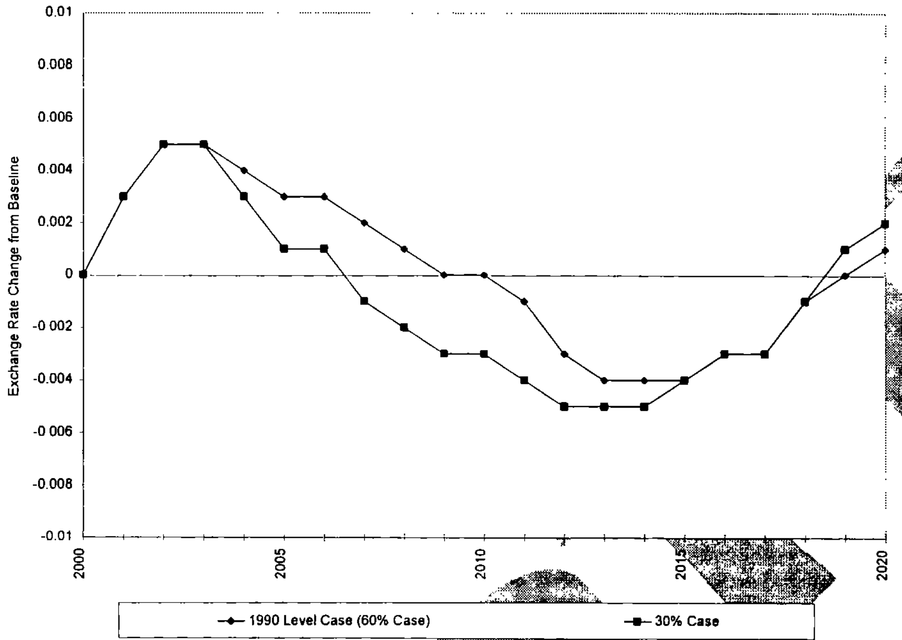
Figure 18 presents the results under these two cases. The effect of the carbon-limiting policy on trade is depicted in these runs as surprisingly small. Some of the change in trade flows is reconciled in the DRI model by allowing the exchange rate to move, but as seen in Figure 19, the anticipated changes in the exchange rate themselves are not large and do not vary between the two assumptions. The small differences are not necessarily counterintuitive. There are already substantial energy price differences and differing environmental restrictions among trading nations that are larger than the price increase that results from the policies considered here.

Figure 18: Sensitivity of the Trade Balance to International Price Ratio Assumptions



Note: Emissions stabilized at 1990 levels in 2010. Revenues recycled into the economy through deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

Figure 19:Sensitivity of the Exchange Rate to International Price Ratio Assumptions



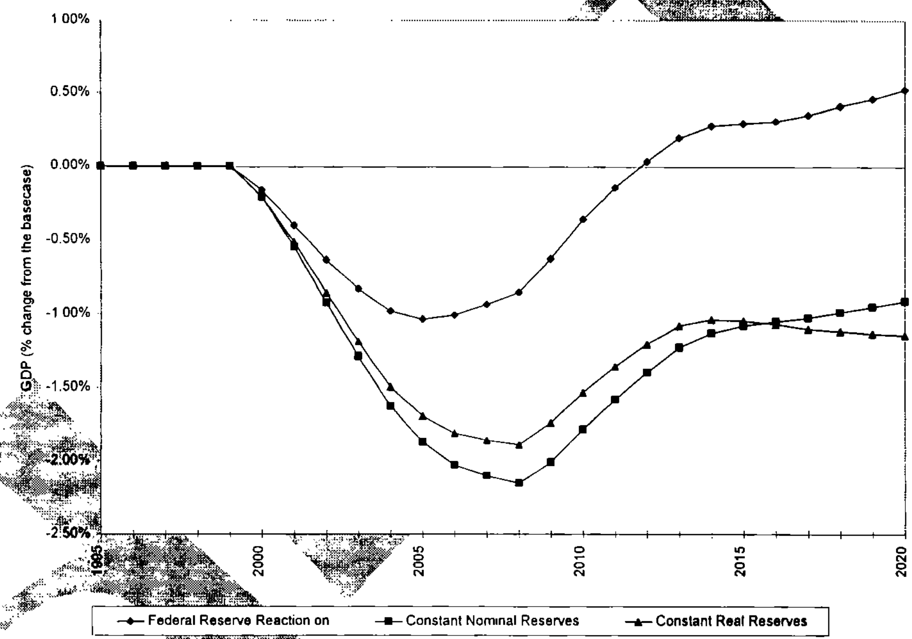
Note: Emissions stabilized at 1990 levels in 2010. Revenues recycled into the economy through deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

The IAT decided to maintain the DRI assumptions about the reaction of the Federal Reserve (Fed) to price inflation and changes in unemployment in the economy. However, alternative views about Federal Reserve policy can yield significantly different resultsU.S. The Federal Reserve reaction function in the DRI model is an empirically derived estimation of likely Federal Reserve policy responses to changes in price inflation and the unemployment rate, among other variables. It is seen by DRI as the best proxy for Fed decisions in the model simulations. In essence, the reaction function will abate unemployment unless doing so would lead to high rates of inflation. This reaction function was used in the analysis as the default setting for the assessment of the alternative target profiles and implementation strategies. This section reports on a set of sensitivity analyses which consider different Federal Reserve actions: maintaining *nominal* non-borrowed reserves at baseline levels, and a case where *real* non-borrowed reserves are held at baseline. As can be seen from Figure 20, the effects of the alternative policy assumptions are substantial.

If the Federal Reserve maintains nominal reserves at baseline, the size of the GDP loss is approximately doubled, from a 1 percent peak loss when the reaction function is on to just over 2 percent peak loss when more restrictive policies are pursued. There is essentially no difference between holding nominal non-borrowed reserves constant and holding real non-borrowed reserves constant. (The level of non-borrowed reserves in the banking system is an important Federal Reserve policy. If the Fed chooses to hold nominal reserves constant, then the funds banks have to lend when inflation rises goes down. If real reserves are held constant, banks can lend more if prices go up.)

However, the sensitivity cases presented here focus only on using the collected funds to reduce the federal deficit. The lower deficit (or greater surplus) makes it easier for the Fed to ease credit conditions without making inflation worse (indeed, as shown in Figure 5 inflation subsides by 2009 and inflation thereafter is lower than in the base case).The Federal Reserve can therefore do much to ease the economic transition in such an environment. But, the impact of the Federal Reserve reaction function fundamentally depends on how revenue recycling policy affects price inflation and the unemployment rate. In cases where price inflation remains high and unemployment losses are lower, the reaction function would ease credit conditions at a slower rate, and the divergence between the reaction function results and the nominal reserves at base case may be much smaller.

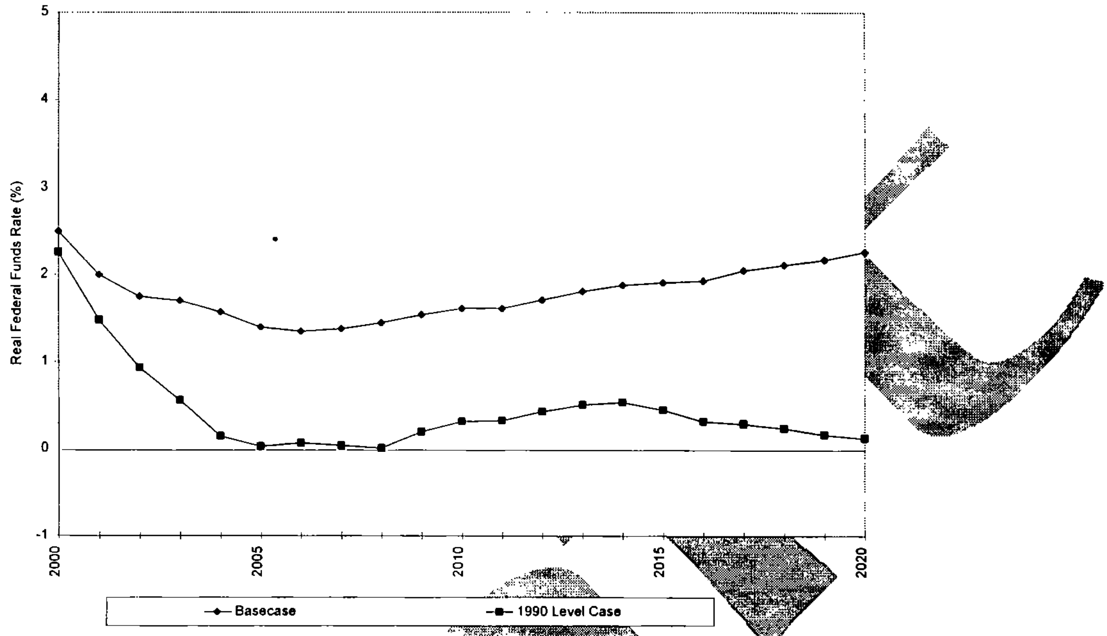
Figure 20 : DRI 1990 Level Case, No International Trading--
Sensitivity to Assumptions about Federal Reserve Policy



Note: Emissions stabilized at 1990 levels in 2010. Revenues recycled into the economy through deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

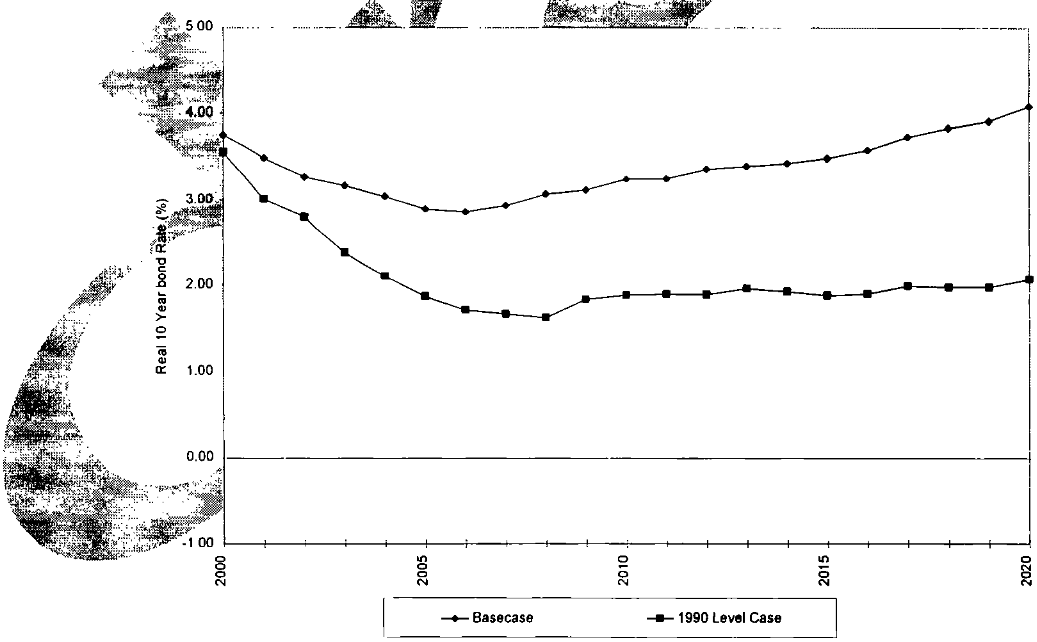
Figures 21, 22 and 23 show projections of the Federal Funds Rate, the 10-year Long Term Bond Rate, and the Federal Deficit/Surplus, respectively, from the DRI model while both the Federal Reaction Function and the Price Expectation equations are used in the analysis of the 1990 Level Case, No International Trading ("starting point"). These results show how important the treatment of revenue flows is in the DRI model. Substantial declines in the deficit (these runs were produced before the agreement to balance the budget in 2002 was achieved in May) allow interest rates to fall, which is the key to the economy's investment response.

Figure 21: DRI 1990 Level Case, No International Trading--Real Federal Funds Rate



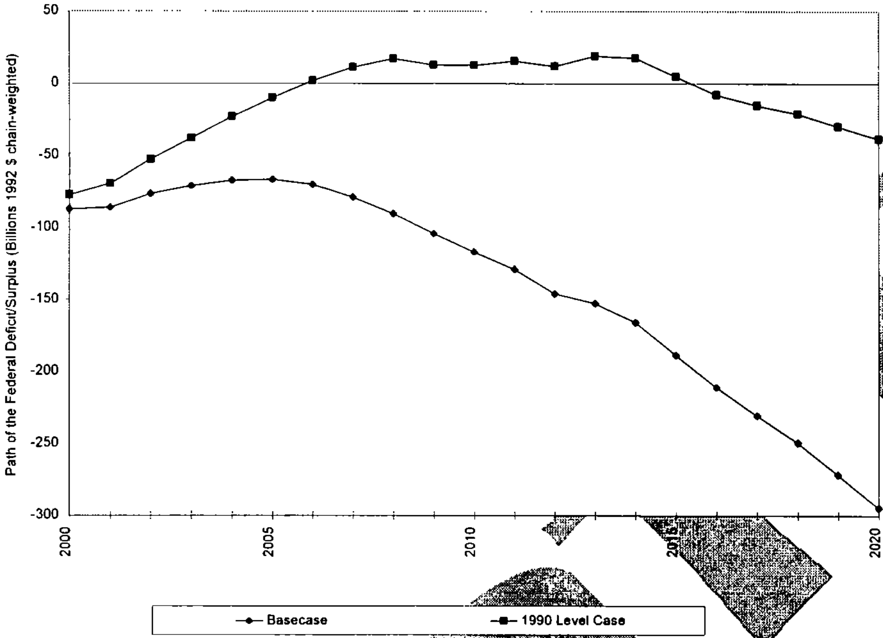
Note: Emissions stabilized at 1990 levels in 2010. Revenues recycled into the economy through deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

Figure 22: DRI 1990 Level Case, No International Trading--Real 10-Year Long-Term Bond Rate



Note: Emissions stabilized at 1990 levels in 2010. Revenues recycled into the economy through deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

Figure 23: DRI 1990 Level Case, No International Trading--Path of the Federal Deficit/Surplus



Note: Emissions stabilized at 1990 levels in 2010. Revenues recycled into the economy through deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

Regional and Sectoral Detail

Using the DRI model, the IAT examined issues regarding regional and industry detail associated with carbon-limiting policies. A summary of this detail for industry effects in given in Table 11.

Reduction in energy-related greenhouse emissions in the 2010 time frame will require a combination of three types of energy system changes: increased end-use efficiency, reduced end-use activity, or fuel-switching towards an increased market share of low- and no- carbon fuels. Increased end-use efficiency or reduced end-use activity tends to lower overall fuel demand, while fuel-switching favors low- and no-carbon fuels, such as natural gas and renewable energy, relative to high carbon fuels such as coal.

Different energy models place different emphasis on these three strategies, with corresponding differences in projected fossil fuel impacts. The DRI energy model results (reported in this paper) emphasize improved efficiency and reduced end-use activity. In this model, stabilization reduces the use of all fossil fuels (coal, oil, and natural gas) relative to baseline levels. The National Energy Modeling System (NEMS) results, run using DOE policy office assumptions, relies more heavily on fuel switching opportunities in the utility and transportation sectors, as well as efficiency improvements in cars. The NEMS stabilization runs (not reported in this paper) show greater reductions in coal than the DRI runs, but natural gas use actually increases relative to baseline due to fuel switching and a higher level of end-use energy demand.

Table 11: DRI 1990 Level Case, No International Trading--Impact on the Output of Energy Producing Industries and Energy Intensive Industries (Percent Change from Base Case)

	2010		2020	
	No trading	With International Trading	No trading	With International Trading
Energy Producers				
Electric Utilities	-11.6%	n/a	-17.7%	n/a
Petroleum Refining	-8.8%	n/a	-9.3%	n/a
Coal Mining	-25.9%	n/a	-39.3%	n/a
Natural Gas	-19.9%	n/a	-18.2%	n/a
Gas Utilities	-11.4%	n/a	-10.9%	n/a
Crude Petroleum	-11.8%	n/a	-12.4%	n/a
Fuel Oil	-13.6%	n/a	-16.7%	n/a
"Pipelines, ex. Natural Gas"	-7.8%	n/a	-8.0%	n/a
Energy Intensive Industries				
Food and Kindred Products	-1.0%	n/a	-0.6%	n/a
Chemical and Allied Products	-0.8%	n/a	-0.3%	n/a
Petroleum and Coal Products	-9.2%	n/a	-10.0%	n/a
Stone, Glass, and Clay Products	1.5%	n/a	2.9%	n/a
Paper and Allied Products	-0.4%	n/a	3.0%	n/a
Primary Metals	0.8%	n/a	1.5%	n/a

Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Assuming a 1.25 percent annual decrease in E/GDP. The data for the international trading scenario are forthcoming.

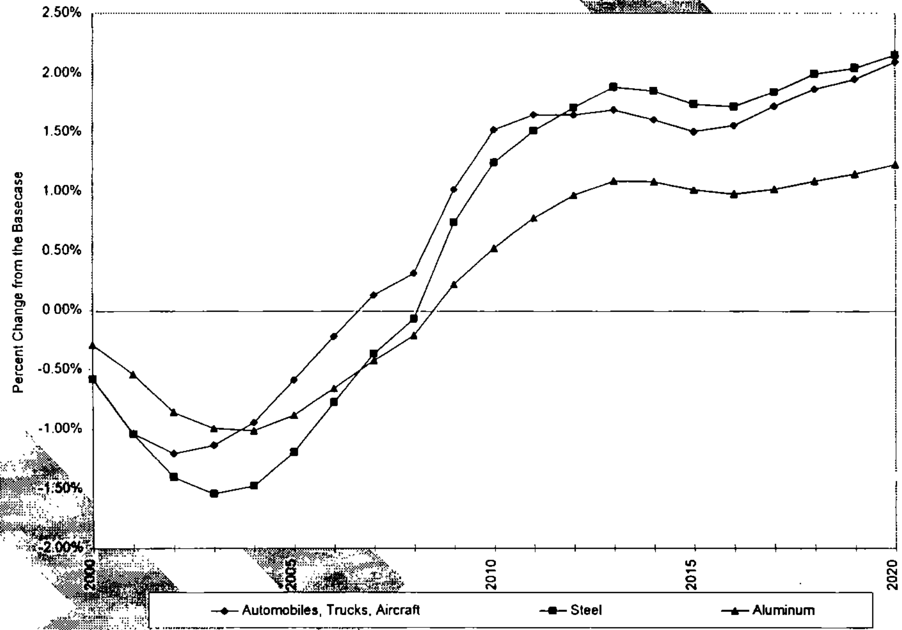
Energy-intensive industries are put at a disadvantage by higher implicit prices for fossil fuels following the imposition of policy. This occurs because they are displaced through trade -- an effect that DRI depicts as relatively minor -- or because the composition of the economy's output changes in favor of less energy-intensive goods and services. These composition shifts drive the industry results. For some industries, however, composition may shift in favor of energy intensive industries because the economy's composition shifts from consumption to investment, which calls up a different mix of goods itself.

For example, a number of energy intensive manufacturing and construction sectors benefit in the long-term by the stimulus to investment created by the reduction of the deficit. For example, output of the construction, steel, aluminum, lumber and wood products, and motor vehicles are 1.0 to 4.0 percent above the baseline in 2010. Figures 24 and 25 show the transitional output losses and the long-term output gains of a number of basic energy intensive industries that produce final or intermediate products for investment.

On the other hand, industries whose production is used primarily for consumption, particularly energy products such as petroleum and coal, but also including paper, chemicals, and food and kindred products, continue to show losses in annual output, from about 0.5 to 1.0 percent, even after the economy has recovered through 2010. In the longer-term, other than the energy producers, the consumption-oriented industries are expected to just about reach their output levels in the baseline.

This mix effect is particularly and obviously important for energy producers. The DRI model suggests output of petroleum products will decline by 8 percent in 2010 and by 9 percent in 2020, when compared to the base case. As seen in Table 12, coal production in the U.S. will be 26 percent lower in 2010 and 39 percent lower in 2020 when compared to its projected levels in the base case.

Figure 24: DRI 1990 Level Case, No International Trading--Output in Key Industries-- Automobiles, Trucks and Aircraft, Steel, and Aluminum



Note: Emissions stabilized at 1990 levels in 2010. Revenues recycled into the economy through deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

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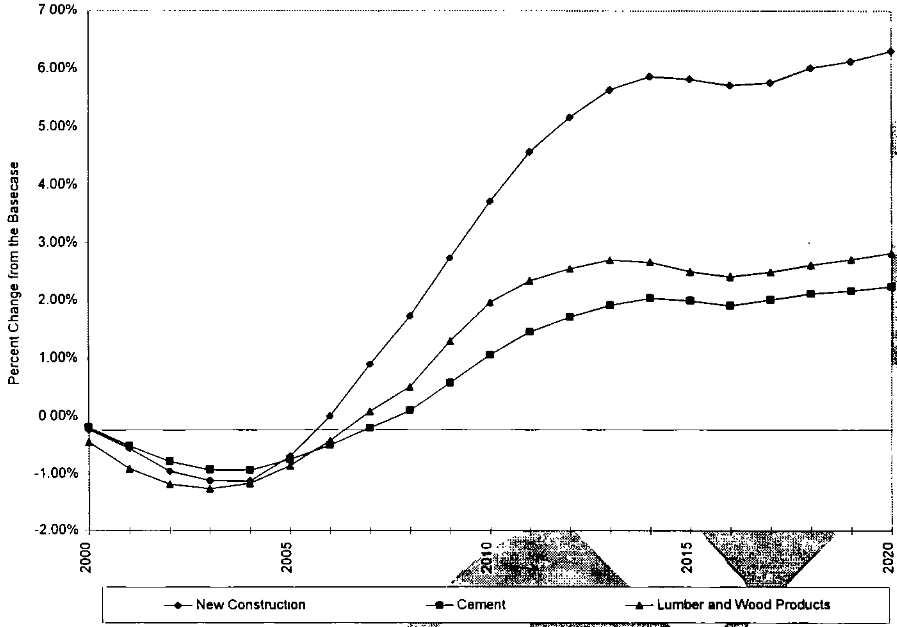
Figure 25: DRI 1990 Level Case, No International Trading--Output in Key Industries--New Construction, Cement, and Lumber and Wood Products



Note: Emissions stabilized at 1990 levels in 2010. Revenues recycled into the economy through deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

Mining (including coal, oil and natural gas extraction) employment would be 6 percent and 7 percent lower, respectively, in those years; these declines are lower than output losses because productivity in the industry is generally anticipated to improve and the nation's coal mix is projected to shift to more productive coal reserves. These employment losses are particularly severe in the east and west south central regions.

Electric utilities experience smaller percentage reductions in output, but their losses are larger in dollar terms. Utility output declines by about $30 billion in 2010 and $52 billion in 2020 when compared to the base case. Petroleum refining and coal mining also experience larger losses than other energy-related industries on a dollar basis.

As Tables 11 and 12 demonstrate, a number of industries are likely to benefit from the compositional change in the economy--the investment inducing policy of reducing the deficit. These include construction, cement, and lumber and wood products. Automobile production also benefits from a carbon policy that reduces the deficit and thus reduces interest rates.

Table 12: DRI 1990 Level Case, No International Trading--
Impacts on the Output of Selected Industries
(Percent Change from Base Case)

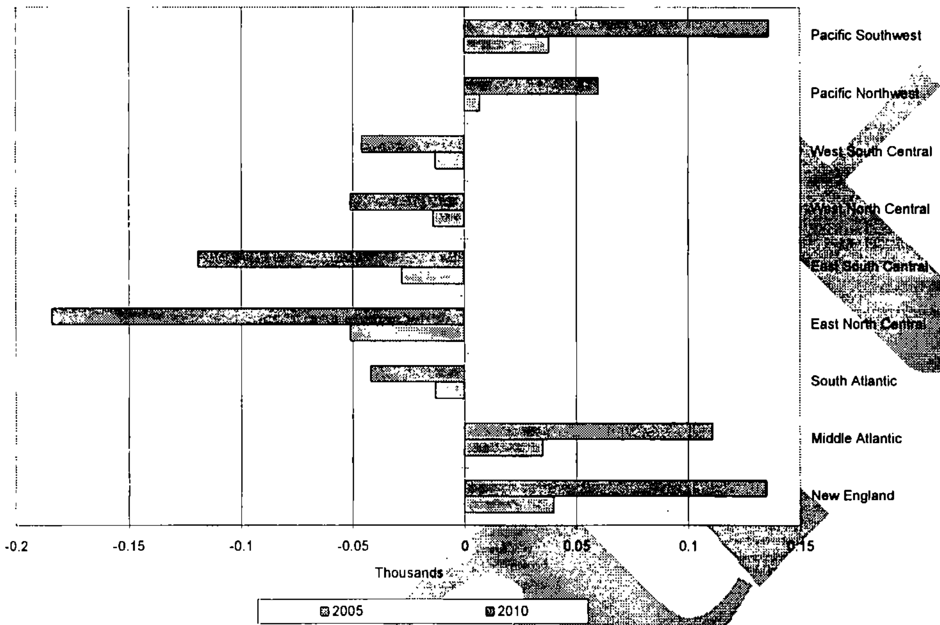
	2010	2020
Industries with the Largest Percent Increase in Output		
New Construction	3.7%	6.3%
Hydraulic Cement	1.1%	2.2%
Lumber and Wood Products	2.0%	2.8%
Motor Vehicles	2.2%	2.7%
Basic Steel and Mill Products	1.2%	2.2%
Primary Aluminum	0.5%	1.2%
Mining (excl. Fossil Fuel Extraction)	0.2%	0.7%
Textile and Apparel	0.4%	1.7%
Industries with the Largest Percent Decline in Output		
Railroads and Rail-Related Services	-1.7%	-1.8%
Pulp Mills	-1.1%	-0.2%
Paper and Paperboard Mills	-0.5%	0.2%
Paperboard Containers and Boxes	-0.3%	0.4%
Industrial Organic and Inorganic Chemicals	-0.8%	-0.3%
Agricultural Chemicals	-0.7%	-0.2%
Maintenance and Repair Construction	-2.0%	-1.6%
Printing and Publishing	-0.6%	-0.3%
Plastics Materials and Resins	-0.1%	0.7%
Agriculture Forestry and Fishing	-0.8%	-0.3%

Note: Emissions stabilized at 1990 levels in 2010. Revenues recycled into the economy through deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

Regional and Employment Effects. The effects of climate change policy on the various regions of the country are shown in Table 13. In general, states in the East North Central, East South Central, and West North Central regions will have proportionally greater losses in population, 150-, 125-, and 75-thousand, respectively, and employment, 210-, 165-, and 125-thousand, respectively, than the other regions of the country. See Figures 26 and 27. Total non-farm employment loss due to the climate change policy is about 900 thousand in 2005, but only 400 thousand in 2010 a the economy starts to recover. The New England, Middle Atlantic, and the Pacific Southwest are expected to show long-term gains in population of 125-, 110-, and 130 thousand, respectively, and in employment of 125-, 45-, and 65-thousand, respectively, because of climate change policy implementation.

Figure 26 : DRI 1990 Level Case, No International Trading-- Population

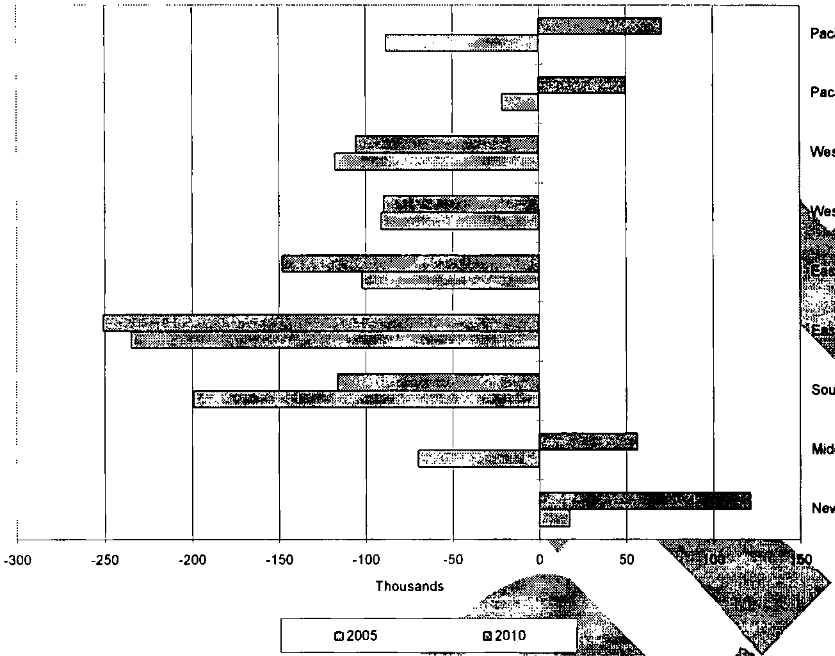
(change from the base case)



Note: Emissions stabilized at 1990 levels in 2010. Revenues recycled into the economy through deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

The key to the regional effects relies on how the revenue is recycled to the economy. In the policy reviewed for regional effects, revenues are used to reduce the deficit which supports savings, and, thus, increases investment. The climate change policy favors those states where production in industries support investment in structures and capital goods equipment, and of course, those areas of the country that are not as proportionally dependent on mining. The climate change policy's effects are mitigated in those regions whose mix of industries favor investment goods industries and where the levels of industry production are large and can absorb the losses in production in industries that produce consumer goods.

Figure 27: DRI 1990 Level Case, No International Trading--Total Non-Farm Employment change from the base case



Note: Emissions stabilized at 1990 levels in 2010. Revenues recycled into the economy through deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

As shown in Table 13, although the West South Central region is expected to have the greatest losses in mining employment, about 15 thousand in 2010, this represents only about 6 percent of its total mining employment in that year. On the other hand, the East South Central Region is expected to lose about 8 thousand in 2010, but this represents about 22 percent of its total mining employment in the same year.

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Table 13: DRI 1990 Level Case, No International Trading

Regional Impacts

Year	New England	Middle Atlantic	South Atlantic	East North Central	East South Central	West North Central	West South Central	Pacific North-west	Pacific Southwest
				Disposable Income, % change from base case					
2005	0.85%	0.38%	-0.08%	-0.44%	-0.45%	-0.73%	-0.15%	0.34%	0.27%
2010	1.89%	0.74%	-0.12%	-1.07%	-1.33%	-1.24%	-0.39%	1.10%	0.60%
2020	2.85%	0.91%	0.06%	-1.37%	-1.45%	-1.89%	-0.66%	1.35%	0.70%
				Total Non-farm employment, % change from base case					
2005	0.25%	-0.38%	-0.78%	-1.03%	-1.29%	-0.89%	-0.81%	-0.35%	-0.39%
2010	1.65%	0.30%	-0.42%	-1.06%	-1.80%	-0.84%	-0.68%	0.78%	0.29%
2020	2.66%	0.51%	-0.20%	-1.10%	-1.71%	-0.94%	-0.76%	1.12%	0.49%
				Mining,, Oil, and Gas Employment, % change from base case					
2005	0.43%	-8.52%	-8.33%	-5.92%	-10.87%	-0.75%	-1.43%	-2.11%	-0.89%
2010	4.40%	-10.85%	-11.62%	-7.78%	-20.54%	1.02%	-6.44%	-1.08%	0.79%
2020	9.03%	-14.04%	-15.57%	-6.22%	-27.84%	4.25%	-4.78%	-8.34%	0.56%
				Population, change from base case					
2005	0.04	0.04	-0.01	-0.05	-0.03	-0.01	-0.01	0.01	0.04
2010	0.14	0.11	-0.04	-0.18	-0.12	-0.05	-0.05	0.06	0.14
2020	0.25	0.18	-0.04	-0.30	-0.17	-0.11	-0.12	0.11	0.19
				Manufacturing Employment, change from base case					
2005	9.61	1.67	-32.48	-77.07	-24.65	-19.50	-21.51	-0.95	-0.56
2010	26.48	21.72	-28.41	-116.07	-32.47	-28.33	-28.50	6.74	17.34
2020	36.92	13.90	-33.80	-142.48	-32.69	-35.25	-41.78	7.28	23.91
				Transportation, Communication & Utilities, change from base case					
2005	1.74	-4.06	-12.10	-15.53	-4.90	-8.08	-8.70	-1.55	-6.49
2010	5.70	-2.94	-16.52	-25.93	-9.36	-13.46	-14.91	0.30	-5.52
2020	8.39	-4.83	-18.14	-31.18	-10.03	-16.07	-17.89	0.35	-5.35

Note: Emissions stabilized at 1990 levels in 2010. Revenues recycled into the economy through deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

Appendix Table A: Assumptions Regarding Non-Carbon Greenhouse Gases

(Million Metric Tons of Carbon Equivalent)

	1900	1995	2000	2005	2010	2015	2020
Baseline Emissions							
CH4	169	178	150	152	152	154	155
HFC PFC	24	n/a	42	69	91	115	133
N2O	37	34	31	32	34	36	37
Sinks	-136	-128	-121	-120	-119	-111	-103
Total	95	n/a	102	133	158	194	223
Cost Effective Reductions in Emissions (assuming an implicit price of carbon of $70 per ton)							
CH4					27	29	29
HFC PFC					51	75	110
N2O					4	4	4
Sinks				7	15	15	15
Total Reduction					97	123	159
Emissions with Cost Effective Reductions							
CH4	169	178	150	152	125	126	126
HFC PFC	24	n/a	42	69	40	41	23
N2O	37	34	31	32	30	31	33
Sinks	-136	-128	-121	-120	-134	-126	-118
Total Other Gas Emissions	95	n/a	102	133	61	71	64
Reductions Below 1990 Levels					34	23	31

Note: Million metric tonne of carbon Equivalent calculated using 100 year Global Warming Potentials (GWP) (IPCC, 1995). The $70 per ton implicit price of carbon was ballpark figure used by the IAT prior to generating implicit price of carbon using the IAT models.

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EXECUTIVE OFFICE OF THE PRESIDENT
COUNCIL OF ECONOMIC ADVISERS

May 15, 1997

TO: Dave Sandalow

This is a nice product; I have only minor comments. I still think the section on "investment of technology programs to help climate change" is too long.

Attached is a draft with my edits.

Alicia Munnell

MEMBER

MEMORANDUM FOR THE DEPUTIES

FROM:

SUBJECT: Climate Change

International climate change negotiations are scheduled to conclude in December 1997. This memorandum describes the background of those negotiations and sets forth key issues for decision.

ISSUES FOR DECISION

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

2. What domestic policies should the administration support to implement our obligations under the climate treaty?

NEED FOR DECISION

1. Emissions Budgets. Decisions are needed by June, in connection with the G-7 Summit (June 20-22) and UN General Assembly Special Session on Environment and Development (June 23-27). In addition, U.S. negotiators need guidance to allow them to generate support for our position in the months prior to the December meeting in Kyoto. Other countries and domestic constituencies are calling on the U.S. to state its views.

2. Domestic Policies. There is no immediate need for decision. However, the administration may wish to announce a set of domestic policies (and/or a process for developing them) in connection with a decision on emissions budgets.

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I. **BACKGROUND**

Climate change is an issue of vast scale. The problem and costs of addressing it are each, potentially, enormous.

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, more extreme weather events (such as droughts and floods), loss of forest cover and shifts in agriculturally-productive regions. During the next century, for example, the ideal range of forests is expected to move several hundred miles north, exceeding the ability of many forests to migrate. The international scientific assessment concluded 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, there is currently almost no ability to predict changes in weather 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 yea~~rs. Absent policy interventions, concentrations in 2100 are predicted to reach roughly 750 ppm, ~~the highest in more than 50 million years.~~ nearly a tripling of pre-industrial numbers

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, both in absolute terms (roughly 25% of the world's total) and per capita. Our per capita emissions are roughly 50% greater than the OECD average and eight times that of China. In the United States, greenhouse gas emissions come mainly from utilities (about 1/3), transport (about 1/3) and industrial and commercial sector (about 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. <u>Clinton Administration Policies To Date</u>

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 downward emissions. In 1994, 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.

what policies
do we require
need to.

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. <u>International Negotiating Context</u>

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 have done 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 US 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.

Views of other countries vary considerably. The European Union has proposed that developed nations cut back 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.

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.

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 renewable energy and energy efficiency companies -- strongly supports aggressive climate change policies. Many businesses point to international competitiveness as a primary concern.

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." A similar letter is expected from the scientific community soon.

Agriculture groups are only beginning to pay attention to this issue. They have been concerned about both extreme weather and the possibility that climate change mitigation policies could lead to rising fuel costs or new regulatory burdens. The U.S. insurance industry is also beginning to pay attention; ~~although~~ the European industry and U.S. reinsurers have voiced concern about climate change during the past several years.

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 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 most likely to support action on this issue.

"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) unlikely to be resolved in Kyoto.

II. ISSUES FOR DECISION

This memorandum poses two issues for decision:

A. What emissions budgets should the US support in international climate change negotiations?

B. What domestic policies should the administration support to implement our obligations under the climate treaty?

Several agencies believe that the first issue is by far the most important. In their view, the first issue raises broad questions of direction for the U.S. and its economy, while the second focuses more on narrow, programmatic details.

A. What emissions budgets should the US support in international climate change negotiations?

Decisions on this question are needed by June, in connection with the G-7 Summit (June 20-22) and UN General Assembly Special Session on Environment and Development (June 23-27). In addition, U.S. negotiators need guidance on this issue to allow them to generate support for our position in the months prior to the December meeting in Kyoto. Other countries and domestic constituencies are calling on the U.S. to state its views.

1. Background

In climate change negotiations, the term "emissions budget" refers to the amount of greenhouse gases that may be emitted over a certain period of time. The term is roughly synonymous with "target and timetable" (though an "emissions budget" connotes a longer time period than a "target").

To date, the United States has not supported any emissions budget for the post-2000 period. Our statements with respect to emissions budgets have been limited to the following: (1) this round of negotiations should address emissions in the medium-term, e.g. 2006-2020; (2) the base year for emissions budgets should be 1990, and (3) emissions budgets should consist of multi-year periods (i.e., the target should not be a single year).

A threshold question is whether the United States should try to delay agreement on an emissions budget beyond the December 1997 meeting in Kyoto. That question is not addressed in detail in this memorandum. Although no agency has voiced support for such an approach, some agencies believe this question should be identified to principals in light of the large potential costs of even the least stringent emissions control options. The advantage of avoiding an agreement would presumably include avoiding such costs; disadvantages would include the large potential costs of failing to make progress on climate change and criticism from those who would charge the administration with backtracking or changing position on this issue.

2. Options

This memorandum considers three options for emissions budgets. Each option is defined in terms of a broad directional statement the U.S. might offer in June, followed by an example of a budget consistent with that statement.

> **OPTION 1 - Take strong action to reduce emissions in the medium term.** For example, reduce greenhouse gas emissions to 90% of 1990 levels by a multi-year period around 2010 and to lower levels thereafter.
>
> **OPTION 2 - Stabilize emissions in the medium term and reduce thereafter.** For example, reduce greenhouse gas emissions to 1990 levels by a multi-year period around 2010 and to lower levels thereafter.
>
> **OPTION 3 - Gradually stabilize emissions in the medium term.** For example, reduce greenhouse gas emissions to 1990 levels by a multi-year period around 2020.

A variation on any of the foregoing would include an "early emissions budget," in the period around 2005, less stringent than the levels described above. This would require a change in the U.S. position, but could possibly be structured to win support from domestic constituencies and other countries in the negotiations. Several agencies support such an approach.

The availability of various flexibilities (international emissions trading, joint implementation, banking and borrowing) fundamentally affects the emissions budgets the US would be willing to support. The more such provisions are included in the agreement, the less costly it will be for the US to meet any given emissions budget. However, if the entire US obligation can be satisfied by purchasing low-cost emissions reductions from abroad, the agreement will not provide large incentives for US industry to develop the technologies needed to address the climate change problem over the long-term.

3. Analysis of different options

The discussion below analyzes the three options based on environmental impacts, economic impacts, domestic political implications, and implications for the international negotiations.

a. Environmental impacts.

1. Climate change impacts

In terms of additional loadings of greenhouse gases into the atmosphere, the difference between the three options in the short-term is small.

However, the options may produce very different environmental impacts, when considered as part of a longer, multi-decade path of reduced greenhouse gas emissions. For example, 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.

Institutional and political factors also lead to important differences between these options. Some agencies believe that few businesses will take Option 3 seriously, because the budget period is too distant. Some agencies believe that few businesses will take Option 1 seriously, since the economic costs would be too great, and that most businesses would simply work to block implementation rather than restructure activities to comply. All agencies agree that developing countries, who will represent the bulk of emissions growth in the decades ahead, will only take serious actions to address emissions after the developed world has done so. This tends to argue for early, serious action, to leverage reductions in the developing world.

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.

belongs in the intro.

2. Other environmental impacts

Any of these options 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 could total billions of dollars per year. These environmental benefits would likely be greatest with Option 1 and smallest with Option 3.

b. Economic impacts

To be revised

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

Economic models are by nature imprecise. Their 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~~ are based on the following key assumptions:

- Policy options are implemented by 2010, with a ten-year phase-in period.
- Domestic emissions reductions are achieved by a "cap and trade" system, where a limited number of greenhouse gas emissions permits are sold at auction and anyone who emits greenhouse gases must have a permit.
- 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.
- The Federal Reserve undertakes ~~relatively favorable~~ monetary policy to offset 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~~.
- Countries implement their policies in isolation, without an international trading regime that could permit countries with high-costs of emissions reduction to purchase emissions allowances from countries with lower abatement costs.
- The ~~rest of the economy remains~~ unchanged, which will not occur over the long forecast

Next carries?

period used. Unexpected shocks to the economy are likely to have very large effects on the estimates presented.

These "base case" assumptions are not ideal for informing policymakers, for several reasons. Perhaps most significantly, the assumption that there will be no international emissions trading is inconsistent with U.S. policy. Such trading can significantly reduce aggregate economic costs (on the order of 50%), by the U.S. buying relatively low-cost emissions reductions abroad. To ensure results are not misinterpreted, this fact is highlighted in the text below. In addition, the base case masks sharp disagreement among agencies over likely rates of technological innovation and diffusion. These differences can affect aggregate economic costs by as much as a third in either direction.

2. Results. Results are presented in tabular form in Appendix ____. Table 1 presents results from the base case; other tables present results for other sets of assumptions (such as a well-functioning international emissions trading regime, distributing domestic permits to current greenhouse gas emitters rather than auctioning, and a more optimistic path of technological progress). All figures are in 1995 dollars and are presented relative to a "no-policy" baseline.

The effect of the international emissions constraints and the domestic emissions trading program is to raise energy prices. Stabilizing greenhouse gas emissions at 1990 levels in 2010 *without international trading* is estimated to raise gasoline and heating oil prices by xx cents per gallon and retail electricity prices by yy cents per kilowatt hour (about aa and bb percent, respectively) in the base case.

The losses in aggregate economic activity are significant, but largely transitory. Table 1 shows GDP loss *in the absence of international trading* peaking around 1 percent in 20xx. After this initial loss, the economy begins to rebound as the proceeds from permit auctions reduce the Federal budget deficit and 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 and may even obtain real gains, indicating that the emissions reduction program modeled is implicitly pro-investment.

Coal bears the brunt of the emissions reduction policies, because coal is the most greenhouse gas intensive fuel. *Without international trading,* overall energy consumption drops by zz percent and coal consumption falls by qq percent. In essence, the least costly way to garner significant emissions reductions is to replace coal in electricity generation and industrial uses.

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). Adding a well-functioning international market to the base case model reduces the estimated energy price increases by as much as tt percent, with parallel economic savings. With international emissions trading, the United States is estimated to pay $XX billion per year to other developed countries (primarily the FSU) to purchase permits.

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 cc percent. Estimated economic costs of the base case policy would be correspondingly reduced.

The results presented here do not include environmental benefits associated with reduced energy use, such as improved health, less congestion, and reduced costs of meeting other environmental goals nor do they consider the benefits associated with an improved climate. These benefits could be substantial.

c. Domestic political implications

None of the options above are stringent enough for most environmental groups. All are too stringent for some in the business and labor communities. Opposition to any agreement from coal interests will be intense. The reaction of many constituencies will ultimately depend on the domestic implementation regime.

That said, it is reasonable to speculate that Option 1 would be considered a reasonably strong position by many in the environmental community. Sierra Club would oppose, but many groups would likely be pleased. Most in industry -- including utilities, coal, oil, autos, chemicals, transport and agriculture -- would strongly oppose. Efficiency and renewables businesses would support, but even natural gas interests would probably be unhappy. Labor would strongly oppose.

Option 2 would likely split key constituencies, including environmental groups, business and labor. Though many environmentalists would consider this option weak, some (such as the Environmental Defense Fund) would likely defend an agreement at this level. Business groups would be split as well, with support possible from some utilities, chemical companies, natural gas interests, farm groups and others. Labor would be split, with support possible from Steelwork~~ers and~~ the Oil, Chemical and Atomic Workers. In all cases, support would depend on the details of domestic program design.

Option 3 would be opposed by all environmental groups. Much of industry might be willing to support, although coal and oil would remain opposed. Most labor groups would likely be relieved and not actively oppose, with the exception of the mineworkers.

d. International negotiating implications

Our ability to negotiate a successful agreement in Kyoto is dependent on the emissions budget we select. To date, the US has won limited support abroad for its proposals on flexibility and developing country participation. Our ability to garner international support for these proposals will require us to select an emissions budget that is viewed as credible.

Already in the intro.

To date, proposals on emissions budgets include: ~~(1) a~~ 20% cut from ~~1990~~ levels by 2005 (small island states), and (2) ~~a 10-15%~~ cut from 1990 levels ~~by 2010~~ (the EU). ~~There is~~ an expectation that this ~~round~~ of negotiations will produce reductions from 1990 levels in the next ~~several~~ decades.

An emissions budget that does not include a reduction below 1990 levels by 2020 would not be taken seriously abroad. Most other countries in the negotiating process would view this as extremely weak. Accordingly, it is unlikely that Option 3 could be achieved in this round of negotiations. In the unlikely event that Option 3 could be achieved, it would be at the expense of other aspects of the U.S. position, including the developing country and flexibility provisions.

Of the three options, Option 1 would give us the greatest opportunity to negotiate both the flexibility and developing country provisions. Option 2, with stabilization in 2010 and a reduction around 2020, would also give us a good chance of success.

B. **What domestic policies should the administration support to implement our obligations under the climate treaty?**

There is no immediate need for a decision on this question. However, we may wish to announce a set of domestic policies (and/or a process for developing them) in connection with any announcement on emissions budgets.

~~The "Assistant Secretaries group" believes that emissions trading and transition programs should be central parts of our climate change policy. Most members of the "Assistant Secretaries group" believe that a technology program of some kind should be central to our climate change policy as well. Members of the group see support for these policies as a consequence of support for any of the emissions budgets discussed above.~~

Pursuant to direction, the "Assistant Secretaries group" did not consider tax ~~Shifts~~ increases on energy as a policy for addressing climate change.

1. Should domestic emissions trading be a central part of our climate change policy?

A. Background. Under a domestic emissions trading program, 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 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 auctioned, substantial revenues would be raised. (Reflow options include tax ~~cuts,~~ deficit reduction and support for transitional or technology programs). If given away, recipients would potentially receive a windfall.

--Comprehensiveness. Controls could apply to some greenhouse gases or only a subset (e.g., CO_2). If a "sectoral" approach is used, the program could apply to a single sector, several sectors or all sectors of concern.

More background on emissions trading programs is set forth in Exhibit ___.

B. Recommendation. Participants in the "Assistant Secretaries group" agree that domestic emissions trading should be a central part of our climate change policy. Participants agree that important program design issues should be addressed in consultation with key constituencies. Such consultations could begin soon and continue through the summer and fall.

Option 1: Accept the recommendation.

Option 2: Do not accept the recommendation. Provide working groups with alternative direction.

2. Should the administration increase its support of technology programs to help address climate change?

A. Background. 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. Some 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.). For a variety of market and institutional reasons, businesses and consumers may either be unaware of the full range of available alternatives or unable to make use of them. The current Climate Change Action Plan follows in the tradition of agricultural and manufacturing extension services by working to overcome these barriers.

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, government support for basic and applied research in energy technologies has been declining sharply since the early 1980's, and is now less than half of levels from the late 1970's (in constant dollars).

Although ~~there are different views among~~ the agencies have differing views about the effectiveness of ~~government~~ technology programs, all agencies agree that, when combined with market-based measures such as an emissions trading program, technology programs can reduce costs of meeting greenhouse gas limits.

B. Options

OPTION 1: Increase support for technology programs.

Possible policies under this option include:

-veto threat on President's FY98 request for renewable energy and energy efficiency ($1.08 billion, a 21% increase over FY97 enacted levels),

-ask President's science advisory panel to report back by October, 1997 on ways to accelerate rates of technological change in energy, other sector, and

-commit to steadily increasing budget requests for renewable energy and energy efficiency over the next five years.

OPTION 2: Maintain status quo level of support for technology programs.

3. Should transition assistance be a central part of our climate change policy?

A. Background.

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:

New program or old?
---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~~ interaction with the other components of climate change policy. Permit auctions may provide a revenue source while technology enhancement may change the extent and perhaps even who is affected by climate change policy.

---Eligibility. Defining the eligible population of workers and communities will affect the costs of the program. Other aspects of climate change policy like emissions budgeting will affect the timing of when benefits can start to be received and when eligibility will expire.

Additional background on transition assistance programs is set forth in Exhibit ___.

B. Recommendation. Participants in the "Assistant Secretaries group" agree that transition programs should be a central part of our climate change policy. Participants agree that important program design issues should be addressed in consultation with key constituencies. Such consultations could begin soon and continue through the summer and fall.

Option 1: Accept the recommendation.

Option 2: Do not accept the recommendation. Provide working groups with alternative direction.

Table 1

Variable of Interest	Option 1 -- 10% below 1990 levels	Option 2 -- 1990 levels by 2010	Option 3 -- 10% above 1990 levels
GDP in 2005			
GDP in 2010			
GDP in 2020			
Implied price increase per ton of carbon in 2010			
Implied price increase per gallon of gasoline in 2010			
Implied price increase per ton of coal in 2010			
Implied average price increase for residential electricity in 2010			
Implied increase in average household energy costs in 2010			
Decline in overall energy use in 2010			
Increase in renewables (2010)			
Annual revenue raised by permit auction (2010)			

[other tables follow]

Worried about case where permits are grandfathered

Table 1 -- Base Case with Annex I Emissions Permit Trading*

Variable of Interest	Option 1 -- 10% below 1990 levels	Option 2 -- 1990 levels by 2010	Option 3 -- 10% above 1990 levels
GDP in 2005	-1.0% to -0.1%	-0.5% to 0.0%	-0.2% to 0.0%
GDP in 2010	about -0.3%	-0.4% to -0.1%	-0.2% to -0.1%
GDP in 2020	-0.3% to +0.2%	about -0.1%	-0.1% to 0.0%
Implied price increase per ton of carbon in 2010	about $85	about $50	about $20
Implied price increase per gallon of gasoline in 2010	about 20-25 cents	about 10-15 cents	about 5 cents
Implied price increase per ton of coal in 2010	about $50	about $30	about $10-15
Implied average price increase for residential electricity in 2010	about 1.5 cents per kwh	about 1 cent per kwh	about 0.5 cents per kwh
Employment losses in 2010 (national)	about 200,000	about 50,000-250,000	about 50,000-150,000
Decline in overall energy use in 2010			
Increase in renewables (2010)			
Annual value of domestic emission permits (2010)	about $110 billion	about $60-70 billion	about $25-30 billion

* Analysis of Joint Implementation (worldwide emissions trading) would show lower implied price increases, smaller reductions in economic activity, and greater purchases by the U.S. of emissions reductions abroad.

Table 2 -- Base Case without Emissions Permit Annex I Trading

Variable of Interest	Option 1 -- 10% below 1990 levels	Option 2 -- 1990 levels by 2010	Option 3 -- 10% above 1990 levels
GDP in 2005	-2.0% to -0.1%	-1.0% to -0.1%	-0.5% to 0.0%
GDP in 2010	-0.7% to -0.3%	-0.6% to -0.2%	-0.4% to -0.1%
GDP in 2020	-0.3% to +1.0%	-0.6% to +0.2%	about -0.1%
Implied price increase per ton of carbon in 2010	$130-200	$80-140	$35-50
Implied price increase per gallon of gasoline in 2010	35-50 cents	20-40 cents	10-15 cents
Implied price increase per ton of coal in 2010	$80-120	$50-85	$20-30
Implied average price increase for residential electricity in 2010	about 4 cents per kwh	about 1.5-3.0 cents per kwh	about 1 cent per kwh
Employment losses in 2010 (national)	about 200,000-500,000	about 150,000-400,000	about 50,000-250,000
Decline in overall energy use relative to 2010 baseline		10% to 17%	
Increase in renewables (2010)		about 15%	
Annual value of domestic emission permits (2010)	about $270 billion	about $110-190 billion	about $60-70 billion

Table 3 -- Base Case with Rapidly Advancing Technology

Variable of Interest	Option 2-- 1990 levels by 2010
GDP in 2005	about -0.6%
GDP in 2010	about -0.5%
GDP in 2020	about +0.8%
Implied price increase per ton of carbon in 2010	about $90-100
Implied price increase per gallon of gasoline in 2010	20-25 cents
Implied price increase per ton of coal in 2010	$50-60
Implied average price increase for residential electricity in 2010	about 2.0 cents per kwh
Employment losses in 2010 (national)	about 300,000-400,000
Annual value of domestic emission permits (2010)	about $120-130 billion

Note: I am unsure if this table is helpful to the hi-tech fans because the SGM model has not completed its hi-tech runs and that is the model with the lowest GDP losses and permit prices.

THE WHITE HOUSE

WASHINGTON

May 9, 1997

MEMORANDUM FOR DISTRIBUTION

FROM: MARK MAZUR
DAVID SANDALOW

SUBJECT: Climate Change

Modeling runs will be available for pick-up at 2:00 pm Monday, May 12 in Ev Ehrlich's office (Commerce Dept. Rm. 4848).

We will meet with Ev to discuss the materials Wednesday, May 14 from 2:00-3:30 in the Eisenhower Room of the White House Conference Center. No clearance information is needed. Attendance is invitees only.

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