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Climate Change [Binder] [2]

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- Is global warming a problem?

There is now fairly wide scientific consensus that anthropogenic warming is happening. The speed, and the effects on crop yields, sea levels, disease patterns, storm frequency, and ocean currents still seem to be uncertain. Nevertheless, one cannot view the prospect of such changes with equanimity. The risks to the planet do make this a problem.

- The U.S. is currently engaged in international negotiations concerning limits on greenhouse gas emissions with the goal of signing an agreement in Kyoto, Japan in December 1997? What will be the economic impact of such a treaty if it is signed?

Studies of global CO<sub>2</sub> abatement costs relative to the baseline projection range from a 0.1% loss of GNP for a 14% reduction of emissions to a 5.7% loss of GNP for an 88% reduction of emissions. Studies of U.S. CO<sub>2</sub> abatement costs relative to the baseline projection range from a -1.2% loss of GNP for a 21% reduction in emissions to a 10.9% loss of GNP for a 96% reduction in emissions. These estimates vary considerably due to the choice of methodologies, underlying assumptions (i.e. population growth, energy intensity, etc.), emission scenarios, policy instruments, reporting year, and others. Manne and Richels (1994) polled a group of experts on their beliefs about the key parameters to which abatement costs are especially sensitive. A probability distribution was constructed for the costs of stabilizing global carbon emissions at 1990 levels using their Global 2100 model. The distribution expresses costs ranging from 0.2% to 6.8% of gross world product, with the median cost of emissions stabilization equal to 1.0% of GWP and the mean approximately 1.5% of GWP. Note that these models assume that no revenues are raised by auctioning off tradable emission permits. CEA prepared a review of published literature, indicating that the median price of carbon in the studies was \$82 per ton and the median impact on GDP by 2020 was -0.6% of GDP.

- What will be the effect on the U.S. if we adhere to an emissions reduction treaty by reducing our level of CO<sub>2</sub> emissions, but none of the other non-Annex I countries do their part?

Evidence demonstrates that no single country is sufficiently important or powerful enough to control global carbon emissions in the short term or in the long run. If non-Annex I nations do not alter their emissions path, global emissions levels will continue to increase even if all Annex I nations completely eliminated all emissions. This situation is exacerbated by the fact that, if controls of some sort were adopted only in the industrialized countries, “dirty” industries would migrate to the non-member countries. This makes it clear that the U.S. would bear the costs of eliminating CO<sub>2</sub> emissions but global emissions would continue to rise without cooperation from non-Annex I countries.

- What would be a cost effective approach to lowering emissions in the U.S.? Should we be supportive of tradable permits or carbon taxes?

U.S. experience with emissions trading includes the SO<sub>2</sub> Allowance Trading program which has dramatically reduced the cost of the SO<sub>2</sub> abatement program. Emissions in 1995 were 40% below legally required levels for the year. The lead trading program was also a success, providing a savings of approximately \$200 million annually while it was in effect. There are numerous other examples. One problem to address in implementing a CO<sub>2</sub> emissions tradable permit system is in how to deal with non-point source polluters. Direct emitters of CO<sub>2</sub> number in the hundreds of millions since they include sources such as automobiles. A tradable permit system is capable of creating the appropriate market incentives to lower emission levels below targeted levels.

## Questions for Hearings

7/11/97; QS.DOC

1. **Is climate change a problem we should do something about now?**
  - a) What are the impacts of doing nothing -- how hard/on who/when?
  - b) How do economists think about the risks?
  - c) Scientists say nothing we do now will significantly slow global warming, is there an economic justification for action?
2. **What should policies be?**
  - a) What should our broad near-term goals be? -- what should guide us in choosing an emissions level/target?
  - b) We heard about a \$5 tax proposal by Jorgensen, what do you think?
  - c) What is the value of international cooperation -- emissions trading & JI
3. **What are the impacts of the administration's proposed policies?**
  - a) Why is there such a broad range of economic modeling results?
  - b) On international competitiveness if only developed countries take part?
    - i) Agriculture -- arkansas rice production vs. china
    - ii) Industry
  - c) What assumptions are made about domestic & international implementation?
  - d) In past economists have over-estimated costs, why different this time?
4. **What role can/should government play in developing technologies for the future?**

CCAP - not total funding, energy prices, 70% of goal at 60%  
economy grew fast of funding

### Issues from past Senate Hearings:

- ✓ Leakage/International Competitiveness *Why should we care?*
- Will current proposals hurt competitiveness of US firms? *JI - Export*
  - Will emissions simply re-locate to LDC's in current proposal?

#### Administration's Analysis & Cooperation

Administration is "hiding the ball", how would any of this work -- domestically and internationally.

Why did we commit to a certain structure for treaty w/out complete analysis?

What is the justification for action

What are the costs of action

*Leaked report -*

### Senate Foreign Relations Hearing -- (6/19)

Wirth was questioned about the administration's economic analysis, and lack of public disclosure of the numbers. He basically ducked the questions and discounted the value of the modeling as being very uncertain, subject to many assumptions. Senators were somewhat hostile at the administration's lack of cooperation and expressed a firm desire to see the administrations numbers.

AFL-CIO representatives presented their own calculations showing major impacts on employment, and questioned why the administration's numbers have gotten rosier with time. Most questions centered around the loss to US competitiveness if restrictions are focused on developed nations.

### Senate Environment/Public Works (7/10)

- Q: What is the "driving force" for doing something about climate change?  
Jorgensen: We are sure that climate change will have a negative impact, but we are unsure about the magnitude and timing of those impacts, which could be severe. This uncertainty is a call for action as an insurance mechanism.
- Q: Will the administration's proposals do the trick and solve climate change?  
Jorgensen: NO. The policy is not justified by the economics. Should begin by eliminating energy subsidies, and then impose a very mild carbon tax -- \$5 now, growing to \$10 by 2025.
- Q: Why are should we reduce emissions in developed nations if world emissions will continue to grow?  
Jorg.: This is an equity issue, and the question is what do we need to do something now to ensure that developing nations will participate in the future.

### **Jorgensen Testimony**

"The economics of climate change is well understood. The optimal policy, involves a modest reduction in the growth in greenhouse gas emissions."

1. This is a problem, and we should start doing something (economists statement).
2. Current proposals are worse than doing nothing.
3. A practical begining -- eliminate energy subsidies, start substituting energy taxes for income taxes.

7/10/97

TO: David Sandalow  
David Gardiner  
David Doniger  
Alicia Munnell  
Steve Seidel

FROM: Jim Simon

Based on our discussion this morning and later discussions with all of you except David S., I think that there is a consensus about the story that we want to tell and the framework for releasing the economic analysis. I told you that I would put my perception of the consensus on a piece of paper and fax it back.

1. As he said at the U.N., the President believes there should be public discussion about the problem of global warming. We have been assembling the best sources of information as a basis for this discussion.

2.
  - a. It is clear that the globe is warming.
  - b. The best judgment of scientists is that mankind has had a hand in the warming.

[release version of paper on science]

3.
  - a. Global warming will have serious effects.
  - b. Quick action by the world is necessary if we are to have any hope of avoiding the most draconian effects that would occur from uncontrolled continued release of GHGs.

[release version of paper on effects]

4.
  - a. We have done an economic analysis, based on existing models and a review of the literature. We have subjected the analysis to peer review. We have incorporated comments and diverging views.
  - b. The clear answer from all the models run by us or anyone else is that, for targets of the type that so

far have been discussed by the international community; there need not be a negative effect on the GDP if we accomplish reductions in sensible ways, including:

- ▶ accelerating technology diffusion
- ▶ using market mechanisms
- ▶ reinvesting any revenue wisely
- ▶ [others]

[release economic analysis including Reppetto]

5. We are planning regional and national meetings to discuss how the country can contribute to a world-wide solution to this problem.

[release any information about meeting plans?]

\* \* \*

We would thus accomplish several goals:

- get the economic analysis out, in the context of information about the problem
- get out the range of possible economic results, but put forward reasons to hope that the low-cost scenarios can be achieved
- focus debate on the problem and the policy solutions that appear promising for reducing cost
- at the request of the economic agencies, not suggest a position at this time on which international target we adopt.

I hope this is helpful.



## U.S. Department of Justice

## Environment and Natural Resources Division

Office of the Assistant Attorney General

Washington, D.C. 20530

CONFIRMATION NUMBER: (202) 514-2701

FAX NUMBER: (202) 514-0557

NO. OF PAGES: 3 (INCLUDING COVER PAGE)DATE: 7/10/97TO: D. Sandalow, D. Gardiner, D. Doniger,TELEPHONE NO.: A. Munnell, S. Seidel

FAX NO.:

FROM: Jim Simon

MESSAGE:

PLEASE NOTIFY SENDER IMMEDIATELY IF YOU HAVE ANY PROBLEMS  
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cc: JAV  
JS  
TJR

THE WHITE HOUSE  
WASHINGTON

July 14, 1997

MEMORANDUM FOR DISTRIBUTION

FROM: MARK MAZUR  
DAVID SANDALOW

SUBJECT: Climate Change

Per our discussion today, our next meeting will be tomorrow, Tuesday, July 15 from 2:00-4:00 in OEOB Rm. 231. The agenda is:

1. Domestic emissions trading (one hour)
2. Technology programs (one hour)

The meeting will start promptly at 2:00. Everyone on the attached list has been cleared into the building. For questions concerning clearance, please call Adam Cox (456-5145).

# Economic Policy Institute

1660 L STREET, NW • SUITE 1200 • WASHINGTON, DC 20036 • 202/775-8810 • FAX 202/775-0819

June 2, 1997

Everett M. Ehrlich  
Under Secretary for Economic Affairs  
U.S. Department of Commerce  
14<sup>th</sup> and Constitution Avenue, N.W.  
Washington, D.C. 20030

Scott

Dear Dr. Ehrlich:

These are my first reactions to the draft report on the "Economic Effects of Global Climate Change Policies." Since I just received the draft last week, please treat these as preliminary thoughts. I will send additional comments later, if time allows.

At the outset I want to make clear that I support the overall goals of the Climate Change Negotiations. Scientific evidence on the need to restrain global carbon emissions is accumulating rapidly and the potential damage to the world economy is likely to grow if we delay action until some later date. Your task force has also examined a wide range of impacts, under a number of different assumptions, and your final report will no doubt be of great assistance to our negotiators in Kyoto.

I do, however, believe that the analysis of the costs of emission controls could be improved. First, most of the policy analysis in the report assume that revenues "will be recycled into the economy through deficit reduction." This implicitly assumes that Congress will agree to impose a huge tax on the economy of \$170 billion in 2010, and \$180 billion in 2020, along with the restriction on emissions. As you know, in the DRI model a tax increase has the effect of raising national savings and stimulating investment. While this may be a desirable policy to pursue, it is distinct from the decision to limit emissions.

For this reason, the best estimate of the effects of the most likely policies is provided in the "auction, 100% returned to consumers" case shown in Figure 13. In this case, which reveals the pure effect of the cost of emission permits, GDP falls by approximately 1% in 2010, and losses continue to grow after 2015, as limits on energy supplies restrict economic growth. This scenario is most consistent with economic intuition regarding the effects of limiting emissions, *ceteris paribus*. Therefore, this case deserves much more prominent treatment in the report. All the important implications of this case should also be illustrated, including the effects on trade, employment and different regions of the country. I understand that this may require further model

Dr. Everett M. Ehrlich  
May 30, 1997  
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runs, and encourage you to order these runs, if necessary.

The impact of deficit reduction, *ceteris paribus*, is clearly illustrated in Figure 16 on p. 30. However, the text at that point fails to make clear that the deficit reduction effect (the personal income tax case) must be subtracted from the 1990 level case in order to isolate the effects of the permit system alone. Note that the peak adjustment cost, in terms of lost GDP in 2005, is somewhat lower in the "auction, 100% consumers" case (Figure 13) than in the 1990 level case, as a result of the recycling of revenues to consumer disposable income, rather than deficit (or more accurately, debt) reduction.

My second concern has to do with the effects of the policies on trade and investment. These may be quite large, since, if only Annex I countries are included in the Kyoto agreements, U.S. firms will have increased incentives to out-source production and move plants to developing countries. As a result, the share of our imports coming from these countries could escalate even more rapidly in the future than it did in the past. Between 1978 and 1990, imports from developing countries increased for 29.1% to 36.4% of all U.S. imports.<sup>1</sup> Thus the price assumptions in your model (60% of imports from Annex I countries) will be too low by 2010--the developing country share could easily rise to 50%, or more. In addition, effects on the motor vehicle industry alone, could be much larger than is implied in this model. A shift to more energy efficient models could dramatically increase imports in this sector, where the U.S. had a \$55 billion trade deficit in 1996, if demand shifts away from energy inefficient trucks, which are the base of the domestic producer's recovery in the 1980s and 1990s.

A second, and related, concern is that the report does not refer to the investment diversion that may result. This suggests that investment diversion hasn't been considered in the model. If U.S. firms move (or build new) factories in Mexico, rather than the U.S., this will reduce investment spending in the U.S. As a result, there will be less demand for investment goods and a smaller manufacturing sector, overall. This effect needs to be examined carefully in your analysis.

Even with these errors, the model suggests large trade effects. Figure 18 shows that the trade balance will become more negative by \$50 billion in 2020, which is remarkable since energy imports must also decline significantly, relative to the base case. The addition of \$50 billion to the U.S. deficit would increase the U.S. 1996 trade deficit by 44%. It would also have eliminated approximately 700,000 U.S. jobs, and the gross job dislocation in manufacturing would be even higher than this figure, because goods trade losses were offset by improvements in energy trade. These are not insignificant job losses. The amount of trade-related job displacement could be even larger under the "auction, 100% returned to consumers case," because of higher consumption spending.

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<sup>1</sup>Sachs, Jeffrey, and Howard Shatz, "Trade and Jobs in U.S. Manufacturing", *Brookings Papers on Economic Activity*, 1:1994, p. 12.

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In order to reduce the effects of climate change policies on trade, and manufacturing employment, I strongly encourage you to run an alternative set of scenarios which evaluate the effects of a border equalization tax. Such a tax would reduce or eliminate the effects of the emissions permit system on trade and investment flows. It is important to examine the other economic implications of this policy alternative, and incorporate this information into the policy debate, as suggested above.

These are my major concerns. In summary, I believe that the most likely case for policies is an emissions permit system in which revenues are recycled to consumers. I also think that labor displacement will be minimized if policies are adopted to adjust direct and indirect energy costs of imports and exports at the border, to minimize the effects of these policies on trade and investment. This suggests the need for two new or expanded policy scenarios.

I have a number of other, more technical concerns that I will briefly mention here. I have also requested further detail on the DRI model runs from Tracy Terry at EPA. I will provide further comments on these issues and materials next week, if they are still of use to you in the review process.

The following are technical issues for future discussion:

1. How reliable are the model's estimates of the responsiveness of investment to a change in national savings?
2. Is the base case too optimistic in its assumptions regarding the assumed annual rate of decline in the energy intensity of the economy?
3. The CGE models do not "bracket" the effects of the policy; they ask different questions and ignore adjustment costs.
4. What are the costs of backstop technologies in the Markal and SGM?
5. Are the labor force growth forecasts low?
6. The report needs to consider employment effects and the distribution of income and wages for each major scenario. The loss of manufacturing jobs, and implied growth of services employment (under full employment) will reduce wages, especially for non-college educated workers.
7. The report should report transfers and BOP effects under emissions trading, with and without corresponding reductions. Does the U.S. gain or lose on services trade?
8. What are the costs of operating the emissions trading system? These should be treated as a dead-weight loss associated with the policy.

In conclusion, the draft report underestimates the costs of the proposed policies, in a number of ways suggested above. In addition, it fails to consider a policy option (the border adjustment tax) that could significantly reduce the impacts of emissions policies on trade and employment. The report is an excellent first draft, but can and should be significantly improved

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along the lines suggested above.

Thank you for the opportunity to provide comments. I look forward to working with you as the project proceeds. Please let me know if additional comments would be relevant, along the lines suggested above.

Sincerely yours,



Robert E. Scott  
Economist

cc: Mark Mazur, National Economic Council

## UNIVERSITY OF CALIFORNIA, SANTA BARBARA

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DEPARTMENT OF ECONOMICS  
SANTA BARBARA, CALIFORNIA 93106-9218PHONE: (805) 893-3678  
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May 30, 1997

## MEMORANDUM TO:

Everett M. Ehrlich  
United States Department of Commerce  
Office of the Secretary  
Washington, DC 20230

## FROM:

Stephen J. DeCanio  
Professor of Economics  
University of California  
Santa Barbara, CA 93106  
e-mail: decanio@econ.ucsb.edu*Stephen J. DeCanio*

## SUBJECT:

Review of "Economic Effects of Global Climate Change  
Policies"

Thank you for inviting my comments on "Economic Effects of Global Climate Change Policies: Results of the Research Efforts of the Interagency Analytical Team." The work of the IAT is an important part of the Administration's preparation for the Kyoto meeting, and I commend all members of the team for their efforts. Although I see the need to carry out some of these model runs, it is still my strong impression that the work done to date provides only a one-sided evaluation of the economic impact of greenhouse gas emissions reductions policies. The assessment of those policies cannot be complete unless the benefits of mitigating the risks of climate change are taken into account. With that said, let me discuss several specific issues raised by the paper.

## 1. Problems of documentation and transparency.

Most of the reported runs are based on the DRI model. The reviewers received inadequate documentation of all three models in the initial packet mailed to us on April 8, but the materials pertaining to the DRI model were the sketchiest of all. Essentially, DRI's "documentation" consisted of a set of six presentation-type overheads, with no text and no description of any of the key features of the model (such as the "Federal Reserve reaction function" and the savings and investment equations) that drive the results. The inner workings of the model have to be inferred from the results, which is unsatisfactory if the goal is to obtain the best possible external peer review.

## 2. "Revenue neutrality" and the savings/investment implications of the DRI model

The basic pattern in all the DRI runs is that output falls at first because of the increased carbon price associated with the emissions permits, then recovers and actually rises to higher level than the baseline because of the "recycling" of the permit revenues to reduce the deficit (or increase the surplus). Output rises in the later years because of increased private investment induced by reduction of the deficit. The claim is that deficit reduction pushes down interest rates and drives up investment. At one point, this is referred to as "forced saving" (p. 25). One of the simulations shows that an even greater economic "rebound" effect could be achieved by an increase in personal taxes (Figure 16).

There are a number of problems with this approach. It is not generally accepted within the economics profession that it is possible to tax ourselves into prosperity. The idea that higher taxes (with no change in the pattern of government spending) can lead to increased GNP over the long run is simply implausible. Taxes carry with them deadweight losses and distort the allocations of capital and labor. There is a large literature on the "double dividend hypothesis" (the notion that substitution of pollution taxes for taxes on labor and capital can create economic benefits independent of the environmental benefits of the pollution taxes), with the balance of evidence suggesting that although recycling of pollution tax revenues through reducing other taxes is better than simply imposing the pollution taxes, the pollution taxes are justified only if they do in fact produce an environmental benefit. These sophisticated arguments turn on the relative magnitudes of the deadweight losses of the different kinds of taxes, not on the old-fashioned "vulgar Keynesian" notion that increases in government spending per se can stimulate output over the long run.

Furthermore, the deficit and the total amount of government spending are quite distinct. Holding government spending constant, it is not likely to be very important whether the spending is financed by borrowing or current taxes. For a fixed level of government expenditures, deficit financing of current spending means increased taxes in the future, and individuals contemplating their earnings and consumption over the life cycle are likely to realize this. Strong Ricardian equivalence holds that the mix of taxes and deficit finance doesn't matter at all. Even if the strong Ricardian equivalence hypothesis is not accepted, it is possible to make the argument that financing by deficit vs. taxes has only second-order effects, or even that increased deficits will *increase* current savings as people prepare for the higher taxes they are certain to face in the future. The extent to which deficits are financed by foreign borrowing adds another layer of complication. In short, the entire issue of the effect of deficits on saving is controversial, to say the least, and there is no agreement among economists that the way these issues are handled in the DRI model is correct. (And we as reviewers are not privy to the exact specification of the DRI model, because there is no documentation.)

The extent to which the DRI model is skewed by its disequilibrium structure is indicated by the sectoral results. Because of the boost to investment (and output in the

later years), the DRI results list the energy-intensive Hydraulic Cement and Primary Aluminum industries among those that will *benefit most* from the 1990 emissions stabilization case. This will certainly raise eyebrows, and is likely to reduce the credibility of the entire analysis process.

### 3. The role of technology and the modeling of technology.

The IAT modeling exercise falls short in its treatment of technological change. To some extent, this is an inevitable consequence of the difficulty of modeling technological progress; there are few areas of economics and social science in which the underlying processes are less well understood. Nevertheless, the modeling effort does not deal with these issues in a persuasive way.

As I stated in my earlier memo of May 19, none of the models is well suited to take account of the more rapid diffusion of existing technologies that would accompany a clear and unambiguous price-like signal in favor of energy efficiency. The models' parameters necessarily embody historical patterns of response, but these parameters are estimated over a limited set of experiences (including the oil price shocks of the '70s, when policies were remarkably suboptimal). The recent experiences with CFC and SO<sub>2</sub> reductions suggests that more rapid and less costly substitution responses are possible, if good policies are in place to encourage them. The IAT paper repeatedly talks about an "announcement effect" on the rate of technology innovation and diffusion, but it does not seem to recognize that the strongest historical responses to policy have occurred when the policy signal was tangible and could not be ignored (such as the requirement of specific reductions in CFC consumption or SO<sub>2</sub> emissions). The industrial response was triggered not by the "announcement" of a goal, but by the business necessity of responding to real regulatory requirements. The IAT paper (and the entire modeling exercise) largely ignores the extensive literature that substantial energy-saving investments could be made at a profit even given current energy price levels, if organizational inertia and institutional barriers could be overcome.

As an example of its technological conservatism, the IAT paper appears to hold implicitly that both the current *level* and the current *allocation* of R&D expenditures is in equilibrium. In speaking of the potential gains from an increased rate of technological advance in energy efficiency (such as the 1.75% annual AEEI case), the paper states,

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 (p. 32).

There are several problems with this view. First, the literature shows that both the private and social rates of return to R&D are very high, so that both firms and society as a whole are underinvesting in R&D. (The social rate of return on R&D is higher than the private return because part of the product of R&D is non-excludable. This market failure is the justification for government support of R&D.) The following table summarizes some of the leading studies in this literature:

| Source                                      | Private Rate of Return (%) | Social Rate of Return (%) |
|---------------------------------------------|----------------------------|---------------------------|
| <i>Agriculture</i>                          |                            |                           |
| Griliches (1958) <sup>1</sup>               |                            | 20.0 - 40.0               |
| Peterson (1967) <sup>1</sup>                |                            | 21.0 - 25.0               |
| Schmitz-Seckler (1970) <sup>1</sup>         |                            | 37.0 - 46.0               |
| Griliches (1964) <sup>1</sup>               |                            | 35.0 - 40.0               |
| Evenson (1968) <sup>1</sup>                 |                            | 41.0 - 50.0               |
| Evenson <i>et al.</i> (1979) <sup>2</sup>   | 14.4 - 87.1                | 45.0 - 130.0              |
| Knutson-Tweeten (1979) <sup>1</sup>         |                            | 28.0 - 47.0               |
| Huffman-Evenson (1991) <sup>1</sup>         |                            | 11.0 - 83.0               |
| <i>Industry</i>                             |                            |                           |
| Terleckyj (1974) <sup>3</sup>               | 28.0 - 29.0                | 76.0 - 107.0              |
| Mansfield <i>et al.</i> (1977) <sup>3</sup> | 25.0                       | 81.0                      |
| Sveikanskas (1981) <sup>3</sup>             | 10.0 - 23.0                | 60.0 - 73.0               |
| Scherer (1982)                              |                            | 70.0 - 104.0              |
| Mohnen-Lepine (1988) <sup>3</sup>           | 56.0                       | 84.0                      |
| Bernstein-Nadiri (1988)                     | 8.5 - 26.7                 | 10.5 - 161.5              |
| Bernstein (1989)                            | 24.0 - 47.0                | 29.0 - 93.6               |
| Goto-Suzuki (1989)                          | 25.5                       | 105.5                     |
| Bernstein-Nadiri (1991) <sup>3</sup>        | 14.0 - 28.0                | 70.0 - 84.0               |
| Mansfield (1991)                            |                            | 10.0 - 200.0              |
| Suzuki (1993)                               | 15.4 - 20.2                | 15.4 - 23.8               |
| Nadiri-Mamuneas (1994) <sup>4</sup>         |                            | 6.0 - 17.1                |
| Coe-Helpman (1995)                          | 123.0                      | 155.0                     |
| Bernstein (1996)                            | 12.0 - 19.1                | 31.7 - 183.1              |

Full references available upon request.

<sup>1</sup>Returns from Griliches (1992), citing Huffman-Evenson (1991).

<sup>2</sup>In this reference, private returns are returns on R&D within the state in which the R&D originated.

<sup>3</sup>Returns from Griliches (1992).

<sup>4</sup>Public R&D.

The average social rate of return to R&D from this table is 63.8%. (Both endpoints of ranges were included in computing the average.) Mansfield (1991) states, "[d]ozens of economists working independently with quite different sorts of models and entirely different kinds of data have found that the social rate of return from industrial innovations and R&D has been very high, frequently 40 percent or more. This is a remarkable fact,

and one that policy-makers should recognize." This evidence clearly indicates the potential to improve welfare by increasing aggregate R&D, including R&D in energy efficiency technologies. The risks of increased energy-efficiency R&D suggested by the IAT paper would be significant only if (1) the total R&D budget for the economy were fixed, and (2) the allocation between energy-efficiency R&D and other R&D were already optimal. There is no basis for either assumption. Indeed, we know that it is possible to increase aggregate R&D substantially; this is a policy decision having mainly to do with the funding of graduate education for scientists and engineers, and with the availability of jobs and equipment for those researchers upon completion of their degrees. The time lag for beginning to see the effects of such an effort would be three years at the most. We have the historical experience of the post-Sputnik push that demonstrates the feasibility (and benefits) of an increase in society-wide R&D.

Second, there is no evidence that the present allocation of R&D monies is optimal. Government research dollars are not apportioned to projects on the basis of their social rate of return. Private R&D decisions are also influenced by the wedge between private and social returns. Other things equal, companies will tend to invest in R&D having the highest private return, and will avoid projects having larger social returns but whose returns are non-excludable. A large fraction of the technical resources of the country are still devoted to military R&D. While this R&D may be important for national defense, the resources given to it are not being allocated according to criteria of economic productivity.

Even if it were known that the social rate of return to energy-efficiency R&D were lower than the return to some other kinds of R&D, it would still be justified to increase energy-efficiency R&D if (1) the environmental benefits augment the other economic benefits sufficiently, or (2) it is not possible (perhaps for political reasons) to increase R&D in the other sectors. A social rate of return of 40% is still quite attractive, even if some other (unobtainable) opportunity offers 50%. The ideal should not be the enemy of the good; if society has the opportunity to make high-yielding investments in energy efficiency, there is no reason not to do so, especially if these investments can be made by increasing the total R&D budget.

#### 4. Overview.

It is worthwhile to step back from the details of the IAT analysis and consider the wider policy implications of the decision to act or not to act to reduce GHG emissions. To attain perspective, it is necessary to weigh the potential costs and potential benefits of action. The IAT cost estimates are quite likely to be upper bounds, because of the nature of the models selected and because of the conservatism of their assumptions about technology. Yet even their worst-case scenarios (no international trading of permits, no Joint Implementation) show maximum GDP losses on the order of 1% for a few years, with the average GDP loss over the analysis period much lower than that. For example, the average GDP loss for the DRI 1990 level case is approximately 0.3% over the entire 21-year analysis period (based on eyeball estimation from the graphs). It is a

commonplace that given continued economic growth, even a permanent GDP loss of this magnitude, amounting to no more than about 2 months' worth of normal economic growth (at the IAT baseline average rate of 1.9% per year over the 1990-2020 period), is hardly noticeable in the noise. The GDP dip from the baseline as shown by the DRI model would not show up in any year as an absolute decline in GDP, given continuing economic growth at the average historical rate.

On the other side of the benefit/cost ratio, the risks of climate change are very large. In my May 19 memo, I strongly urged that *EPA coordinate a full-scale risk assessment to provide a comprehensive background on the potential damages from climate change*, and I reiterate that recommendation. The major risks include danger to human health from disease, heat waves, and extreme weather events; damage to property from storms, floods, and droughts; sea-level rise that could inundate coastal properties and wetlands and require expensive mitigations; disruptions to ecosystems (including agriculture and silviculture); loss of biodiversity from changes in temperature and precipitation that overstress natural systems; infrastructure costs including water supply problems; and the low-probability but truly catastrophic possibilities such as alteration of the ocean currents that regulate regional weather patterns and the potential positive-feedback releases of CO<sub>2</sub> and methane from land and oceanic sinks that might be triggered by some future level of warming. These risks might be acceptable if we understood the earth/climate system perfectly, but we do not. In effect, we are conducting a single trial of a global experiment with large downside risks, and it is our children and grandchildren who will have to bear the irreversible consequences.

In addition to averting these inherently disagreeable risks, the successful negotiation of a climate protocol in Kyoto would carry with it considerable diplomatic and political benefits for the United States. We have an opportunity to exercise international diplomatic leadership on the largest scale. Our working to bring about a good treaty would enhance our credibility and global perception of the United States's magnanimity. Our leadership in reconciling differences between developed and developing countries would strengthen our national security, because tensions between the rich and poor nations pose a continuing threat to peace. Environmental protection has very high support among all strata of the population, both at home and abroad. It is difficult to imagine a foreign policy initiative that could bring greater advantages to the United States at such a minimal cost, even under the most pessimistic assumptions of the IAT models.

Once again, I appreciate the opportunity to comment on the important work of the IAT. Please do not hesitate to contact me at 805-893-3130 (office) or 805-965-2211 (home) if you would like to discuss any of these points further. My fax number is 805-893-8830. In order that you may have all my comments in a convenient form, I am appending a copy of my previous memorandum of May 19. Hard copies will follow by regular mail. I am available to travel to Washington for additional discussions if that would be helpful.

THE FOLLOWING IS MY PREVIOUS MEMORANDUM OF MAY 19, 1997.

## UNIVERSITY OF CALIFORNIA, SANTA BARBARA

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DEPARTMENT OF ECONOMICS  
SANTA BARBARA, CALIFORNIA 93106-9210

May 19, 1997

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MEMORANDUM TO: Everett M. Ehrlich  
United States Department of Commerce  
Office of the Secretary  
Washington, DC 20230

FROM: Stephen J. DeCanio  
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SUBJECT: Interagency Task Force on analyzing the effects of possible  
policies to reduce greenhouse gas emissions

Thank you for inviting my comments on the work of the Interagency Task Force. To date I have received only the materials included in your original mailing of April 8, 1997. Some observations can be made on the basis of these materials, but I hope you will send all reviewers the additional results, analyses, and documentation that have been developed in the course of the interagency team's work. My preliminary comments are as follows:

(1) The greatest problem with the outline of the analysis as presented in the mailing of April 8 is that it does not in any way incorporate the *benefits* of reducing greenhouse gas emissions. GHG reduction strategies will have numerous benefits, some of which are easier to quantify than others, but all need to be considered in the decision-making process. For example, some of the predictable effects of climate change such as the damages caused by sea-level rise and the increased demand for air conditioning services in the summer have been estimated by a number of scholars. Much more important are the *risks* of climate change, which include health risks, possible increased frequency and severity of extreme weather events, loss of biodiversity from changes in ecosystems, and potential large-scale nonlinear systemic changes such as disruptions of the ocean currents that regulate weather on a continental scale. Inclusion of such risks using probabilistic decision analysis is within the capability of modern economic analysis, and such calculations are crucial to assessing the full magnitude of the climate problem. I understand that some consideration is being given to the local air quality benefits of GHG reductions, but the calculation of benefits of emissions reductions should go far beyond this to incorporate the entire range of climate-related effects.

The focus of the interagency team's efforts so far have been concentrated only on estimating the costs of various mitigation strategies, but ultimately the case for action to reduce GHG emissions will have to be made in terms of the risks and damages avoided by such reductions versus the costs incurred. Therefore, *my first and strongest recommendation is that the EPA coordinate a full-scale risk assessment of climate change.* The initial step would be to compile and review all the relevant studies that have already been prepared by EPA and the IPCC. It should be possible to do this in the relevant time frame (the interval between now and ratification of the prospective Kyoto Protocol by the Senate), provided the necessary staff and resources are mobilized.

(2) The scope of the interagency group's work seems to have been limited in several key ways that are certain to bias the results towards inaction. For example, the time frame of the analysis is unnecessarily short. The adverse effects of increasing atmospheric concentrations of greenhouse gases occur primarily in the long run, so ending the analysis in the year 2020 necessarily cannot capture these effects. A second example of unnecessarily limiting the scope of the analysis is that revenue-generating policy options do not seem to have been examined, at least in the materials I have received. Policies that would bring about substantial reductions in GHG emissions from baseline projections would almost certainly have revenue implications for the government. All standard models indicate that the economic effects of GHG reduction policies would be strongly influenced by what is done with these revenues. A system that "grandfathers" permit allocations to existing GHG emitters or producers would have very different macroeconomic consequences from one in which the revenues from permit auctions were used to reduce the deficit or cut other taxes. Such policy options need to be included in the analysis to avoid biased estimates of the economic costs of GHG mitigation measures.

(3) A great deal of attention has been directed towards the range of values that will be assumed for the "autonomous energy efficiency improvement" (AEEI) parameter. It is stated in the Note on Technology Assumptions that "the 1.25 and 1.75 values can also be seen as place-holders for the effects of possible policies aimed at spurring innovation and diffusion." It is reasonable to simulate the models under this range of values for the AEEI, but it should always be kept in mind that economists do not have a very good understanding of the complex processes that determine the AEEI (or other measures of technological change). Good data is hard to come by and consensus is lacking. Therefore, it is important not to try to ask too much of models or modeling exercises. Historically, rates of technological improvement (in energy and in other fields) have proven to be quite susceptible to policy changes, but the magnitude of the response depends on the policy.

The exact nature of the policy signal required to elicit a faster rate of AEEI is not known. An unambiguous price or price-like signal (such as a meaningful quantitative restriction on emissions that would translate into a price increase) is likely to do the trick, but economists cannot say just how large this price signal would need to be. The rate of AEEI has increased in the past (the 1970s) under the influence of price increases, yet the

oil shock episodes are not good predictors of how large a price increase would be required to increase the AEEI under a rational policy regime. The price shocks of the '70s were unexpected and sudden (as opposed to being predictable and gradually phased in), and the policies of the '70s—price controls, scattershot standards, and political scapegoating—were about as inefficient as they could possibly be. Alternatively, infusions of funds for R&D could potentially increase the AEEI, but it is not known how much money would be needed. Redirection of R&D to energy efficiency might reduce technological progress in other sectors; but the relative magnitudes of the changes are not known. Over the time span of decades relevant for climate policy, it ought to be possible to increase society-wide R&D effectively, and the literature suggests that this would have a positive macroeconomic effect.

(4) "Environment-saving" technological change can be more rapid and more profitable than expected before the fact. The happy experience with the CFC phaseout was not just "good luck"; policies to implement CFC reductions were well designed to get the most effective technological progress at the lowest cost. These policies included: a clear and unambiguous signal that significant CFC reductions were going to have to be made; facilitation of networking and communications among innovators and users of technologies; government's providing good information and serving as a reliable clearinghouse; encouraging private sector creativity to flourish; and removing regulatory obstacles to innovation (such as in toxicity testing and military specifications). The "autonomous CFC reduction rate" was very much accelerated by the Montreal Protocol and its domestic implementation. None of the models used by the interagency task force is well designed to capture this type of effect.

(5) If there is society-wide underinvestment in R&D (because the benefits cannot fully be captured by private-sector firms), then policy measures to increase R&D will have positive feedbacks to the economy as a whole. The government does not have to be able to pick the R&D areas with the highest social rates of return to achieve these benefits. Investing in R&D with a 40% social rate of return would be desirable even if some other area would yield a 50% return. There is a substantial empirical literature suggesting that the social returns to R&D are quite high, indicating that the market failure resulting from the non-excludability of the benefits of R&D is real and important. There are also empirical results suggesting the existence of the other spillover effects of the type associated with the "new growth theory." This entire class of potential benefits to GHG reduction policies needs to be taken into account in a way that the current models fail to do.

(6) It is important to recognize that it will not be as difficult to move the AEEI as it would be to change the rate of technological progress for the economy as a whole. Energy is considerably less than 10% of the economy, so some improvement in the AEEI could be achieved simply by shifting R&D resources. This would have a net cost (ignoring environmental benefits) only if it were known that the existing allocation of R&D resources is optimal. But there is no reason to believe that to be the case, especially given the still-large fraction of military R&D (which may be important for military

reasons, but which is not optimal from a productivity-enhancement standpoint). Allocations of government research funds are not currently made on the basis of their social rate of return.

(7) I support the conclusion of the Jorgenson/Nordhaus memorandum of April 24 that the DRI model is ill-suited for the task of longer-term forecasting of the type required by the interagency group's charge. Short-term macro forecasting models such as the DRI model simply are not suitable or appropriate for this exercise. The results will be misleading and are likely to overestimate the costs of GHG reduction policies. The mere fact that the DRI model contains a great deal of sectoral detail does not alleviate its shortcomings for the purpose of long-term forecasting.

(8) The nature of the permit policy that eventually will be implemented will have a strong influence on the economic effects. Internationally traded permits would reduce global costs, but could involve wealth transfers from the United States to developing countries. Such wealth transfers are justifiable on both economic grounds (because of the risks of climate change and the gains to the U.S. that would follow from more rapid economic growth in developing regions) and on political grounds (because the climate agreement could be a cornerstone of international cooperation and stability). At the same time, allocation of the permits could be used to cushion the displacement of coal miners and other fossil fuel industry employees (and shareholders). The economic consequences of the permit policy will vary with the details of the permit allocation process, and alternative scenarios should be tested in model simulations. More detail and debate about potential permit policy options would be helpful in tracing through the economic effects of the GHG reductions and in allaying political fears.

Once again, I appreciate the opportunity to comment on the important work of the interagency task force. I am looking forward to reviewing additional materials as they are produced. Please do not hesitate to contact me at 805-893-3130 (office) or 805-965-2211 (home) if you would like to discuss these points further. My fax number is 805-893-8830. I am available to come to Washington for additional discussions if that would be useful.

cc/by fax, 202-482-0432

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**Organization/Location:** CEA

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**Fax Number:** 395-6853

**Subject:** Assumptions on Vehicle Efficiency

**No. of Pages (with cover):** 3

**From:** Phillip Tseng

**Phone Number:** 586-3892

## Light Duty Vehicle Fleet Efficiency

### Fuel Efficiency, On Road

#### Cars (Total Fleet)

| (MPG of Gasoline equivalent)                            | 1995 | 2000 | 2005 | 2010 | 2015 | 2020 |
|---------------------------------------------------------|------|------|------|------|------|------|
| Base Case                                               | 23.1 | 23.7 | 23.8 | 24.4 | 25.0 | 25.8 |
| Case 1.25 Stab. In 2010 at 1990 levels                  | 23.1 | 23.7 | 25.3 | 27.3 | 29.4 | 30.6 |
| Technology Investment Case Stab. In 2010 at 1990 levels | 22.0 | 24.2 | 26.6 | 33.1 | 36.0 | 38.1 |

#### Light Trucks

| (MPG of Gasoline equivalent)                            | 1995 | 2000 | 2005 | 2010 | 2015 | 2020 |
|---------------------------------------------------------|------|------|------|------|------|------|
| Base Case                                               | 15.1 | 15.2 | 15.0 | 16.6 | 16.4 | 17.1 |
| Case 1.25 Stab. In 2010 at 1990 levels                  | 15.1 | 15.3 | 15.2 | 16.6 | 16.5 | 17.1 |
| Technology Investment Case Stab. In 2010 at 1990 levels | 15.2 | 16.8 | 19.6 | 19.8 | 19.5 | 20.8 |

#### Total Light Duty Vehicles

| (MPG of Gasoline equivalent)                            | 1995 | 2000 | 2005 | 2010 | 2015 | 2020 |
|---------------------------------------------------------|------|------|------|------|------|------|
| Base Case                                               | 19.7 | 19.6 | 19.2 | 20.4 | 20.5 | 21.3 |
| Case 1.25 Stab. In 2010 at 1990 levels                  | 19.7 | 19.6 | 19.8 | 21.4 | 22.0 | 22.9 |
| Technology Investment Case Stab. In 2010 at 1990 levels | 19.8 | 20.7 | 23.2 | 25.8 | 26.9 | 27.5 |

### Fuel Efficiency, EPA

#### Cars (Total Fleet)

| (MPG of Gasoline equivalent)                             | 1995 | 2000 | 2005 | 2010 | 2015 | 2020 |
|----------------------------------------------------------|------|------|------|------|------|------|
| Base Case                                                | 26.7 | 29.9 | 30.7 | 30.8 | 30.7 | 31.8 |
| Case 1.25 Stab. In 2010 at 1990 levels*                  | 28.7 | 29.9 | 33.7 | 40.2 | 44.3 | 46.7 |
| Technology Investment Case Stab. In 2010 at 1990 levels* | 27.4 | 28.7 | 31.9 | 50.1 | 63.6 | 49.2 |
| Base Case, new cars only                                 | 28.2 | 28.2 | 28.2 | 30.7 | 30.7 | 32.7 |
| Case 1.25, new cars only**                               | 28.2 | 28.2 | 45.1 | 43.4 | 49.3 | 49.8 |
| Technology Investment Case, new cars only**              | 27.3 | 30.7 | 35.3 | 52.1 | 42.3 | 44.2 |

\* Includes electric vehicles in 2010, 2015 & 2020.

\*\* Electric vehicles are only purchased in 2010 for the Tech. Inv. Case. Case 1.25 has purchases in 2005, 2010, 2015 & 2020.

#### Light Trucks

| (MPG of Gasoline equivalent)                            | 1995 | 2000 | 2005 | 2010 | 2015 | 2020 |
|---------------------------------------------------------|------|------|------|------|------|------|
| Base Case                                               | 17.8 | 17.8 | 17.8 | 19.9 | 19.9 | 21.0 |
| Case 1.25 Stab. In 2010 at 1990 levels                  | 17.5 | 18.0 | 18.0 | 19.9 | 19.9 | 20.9 |
| Technology Investment Case Stab. In 2010 at 1990 levels | 17.7 | 19.7 | 23.3 | 23.7 | 23.6 | 25.3 |

#### Total Light Duty Vehicles

| (MPG of Gasoline equivalent)                            | 1995 | 2000 | 2005 | 2010 | 2015 | 2020 |
|---------------------------------------------------------|------|------|------|------|------|------|
| Base Case                                               | 22.8 | 22.8 | 22.7 | 24.4 | 24.8 | 26.0 |
| Case 1.25 Stab. In 2010 at 1990 levels                  | 22.8 | 23.0 | 23.5 | 25.7 | 26.8 | 28.0 |
| Technology Investment Case Stab. In 2010 at 1990 levels | 22.8 | 24.3 | 27.6 | 30.9 | 32.6 | 33.7 |

### Efficiency Improvements Relative to the Base Case

#### Car (Total Fleet)

|                                                         | 1995  | 2000 | 2005  | 2010  | 2015  | 2020  |
|---------------------------------------------------------|-------|------|-------|-------|-------|-------|
| Case 1.25 Stab. In 2010 at 1990 levels                  | -0.1% | 0.0% | 6.3%  | 11.8% | 17.4% | 18.3% |
| Technology Investment Case Stab. In 2010 at 1990 levels | -1.2% | 2.1% | 11.4% | 35.5% | 47.7% | 40.1% |

#### Light Trucks

|                                                         | 1995 | 2000  | 2005  | 2010  | 2015  | 2020  |
|---------------------------------------------------------|------|-------|-------|-------|-------|-------|
| Case 1.25 Stab. In 2010 at 1990 levels                  | 0.0% | 1.1%  | 1.0%  | 0.2%  | 0.2%  | 0.2%  |
| Technology Investment Case Stab. In 2010 at 1990 levels | 1.0% | 11.0% | 30.7% | 19.0% | 18.5% | 20.4% |

#### Total Light Duty Vehicles

|                                                         | 1995  | 2000 | 2005  | 2010  | 2015  | 2020  |
|---------------------------------------------------------|-------|------|-------|-------|-------|-------|
| Case 1.25 Stab. In 2010 at 1990 levels                  | -0.1% | 0.5% | 3.3%  | 5.2%  | 7.2%  | 7.5%  |
| Technology Investment Case Stab. In 2010 at 1990 levels | 0.2%  | 6.4% | 20.9% | 26.5% | 31.3% | 29.3% |

### Total Vehicle Miles Traveled

#### Car

| Bill. Vehicle Miles Traveled                            | 1995    | 2000    | 2005    | 2010    | 2015    | 2020    |
|---------------------------------------------------------|---------|---------|---------|---------|---------|---------|
| Base Case                                               | 1,476.1 | 1,461.6 | 1,523.2 | 1,614.6 | 1,707.3 | 1,786.6 |
| Case 1.25 Stab. In 2010 at 1990 levels                  | 1,483.0 | 1,467.8 | 1,607.3 | 1,607.8 | 1,879.5 | 1,872.3 |
| Technology Investment Case Stab. In 2010 at 1990 levels | 1,427.8 | 1,474.2 | 1,596.9 | 1,596.7 | 1,702.3 | 1,798.5 |

#### Light Trucks

| Bill. Vehicle Miles Traveled                            | 1995  | 2000  | 2005    | 2010    | 2015    | 2020    |
|---------------------------------------------------------|-------|-------|---------|---------|---------|---------|
| Base Case                                               | 725.0 | 829.4 | 1,066.0 | 1,189.7 | 1,236.8 | 1,295.8 |
| Case 1.25 Stab. In 2010 at 1990 levels                  | 718.9 | 930.7 | 1,066.2 | 1,119.2 | 1,186.7 | 1,247.6 |
| Technology Investment Case Stab. In 2010 at 1990 levels | 699.1 | 827.7 | 1,084.4 | 1,149.9 | 1,205.3 | 1,287.0 |

#### Total Light Duty Vehicles

| Bill. Vehicle Miles Traveled                            | 1995    | 2000    | 2005    | 2010    | 2015    | 2020    |
|---------------------------------------------------------|---------|---------|---------|---------|---------|---------|
| Base Case                                               | 2,201.1 | 2,387.9 | 2,589.2 | 2,783.3 | 2,946.1 | 3,082.4 |
| Case 1.25 Stab. In 2010 at 1990 levels                  | 2,168.9 | 2,398.2 | 2,673.5 | 2,627.0 | 2,766.2 | 2,919.9 |
| Technology Investment Case Stab. In 2010 at 1990 levels | 2,126.9 | 2,401.9 | 2,681.3 | 2,746.6 | 2,907.6 | 3,085.5 |

## Heavy Duty Vehicle Fleet Efficiency

### Fuel Efficiency, On Road

| <b>Heavy Trucks</b>                                    |      |      |      |      |      |      |
|--------------------------------------------------------|------|------|------|------|------|------|
| (MPG of Diesel equivalent)                             |      |      |      |      |      |      |
|                                                        | 1995 | 2000 | 2005 | 2010 | 2015 | 2020 |
| Base Case                                              | 7.9  | 8.1  | 8.2  | 7.8  | 8.3  | 8.3  |
| Case 1.25 Stab. in 2010 at 1990 levels                 | 7.9  | 8.1  | 8.2  | 8.2  | 8.9  | 8.8  |
| Technology Investment Case Stab. in 2010 at 1990 level | 8.0  | 8.3  | 8.6  | 8.6  | 9.1  | 8.9  |

| <b>Buses</b>                                           |      |      |      |      |      |      |
|--------------------------------------------------------|------|------|------|------|------|------|
| (MPG of Diesel equivalent)                             |      |      |      |      |      |      |
|                                                        | 1995 | 2000 | 2005 | 2010 | 2015 | 2020 |
| Base Case                                              | 6.7  | 6.7  | 6.7  | 6.7  | 6.7  | 6.7  |
| Case 1.25 Stab. in 2010 at 1990 levels                 | 6.7  | 6.7  | 6.7  | 6.7  | 6.7  | 6.7  |
| Technology Investment Case Stab. in 2010 at 1990 level | 6.7  | 6.7  | 6.7  | 6.7  | 6.7  | 6.7  |

| <b>Airplanes</b>                                       |      |      |      |      |      |      |
|--------------------------------------------------------|------|------|------|------|------|------|
| (Passenger MPG of Jet fuel)                            |      |      |      |      |      |      |
|                                                        | 1995 | 2000 | 2005 | 2010 | 2015 | 2020 |
| Base Case                                              | 22.3 | 23.4 | 24.5 | 25.6 | 26.6 | 26.8 |
| Case 1.25 Stab. in 2010 at 1990 levels                 | 22.3 | 23.4 | 24.5 | 25.6 | 26.6 | 26.6 |
| Technology Investment Case Stab. in 2010 at 1990 level | 22.3 | 23.8 | 24.5 | 27.3 | 28.6 | 30.9 |

| <b>Ships</b>                                           |      |      |      |      |      |      |
|--------------------------------------------------------|------|------|------|------|------|------|
| (Ton Freight MPG of Residual Fuel equivalent)          |      |      |      |      |      |      |
|                                                        | 1995 | 2000 | 2005 | 2010 | 2015 | 2020 |
| Base Case                                              | 19.7 | 21.2 | 22.0 | 22.0 | 22.7 | 22.7 |
| Case 1.25 Stab. in 2010 at 1990 levels                 | 19.7 | 21.2 | 22.0 | 22.0 | 22.7 | 22.7 |
| Technology Investment Case Stab. in 2010 at 1990 level | 19.7 | 19.7 | 22.0 | 22.3 | 22.7 | 24.8 |

| <b>Passenger Rail</b>                                  |      |      |      |      |      |      |
|--------------------------------------------------------|------|------|------|------|------|------|
| (Passenger MPG of Diesel equivalent)                   |      |      |      |      |      |      |
|                                                        | 1995 | 2000 | 2005 | 2010 | 2015 | 2020 |
| Base Case                                              | 48.1 | 53.3 | 55.9 | 58.5 | 57.7 | 57.1 |
| Case 1.25 Stab. in 2010 at 1990 levels                 | 48.1 | 53.3 | 55.4 | 55.3 | 55.1 | 54.1 |
| Technology Investment Case Stab. in 2010 at 1990 level | 48.1 | 53.3 | 56.8 | 66.1 | 71.1 | 76.4 |

| <b>Freight Rail</b>                                    |      |      |      |      |      |      |
|--------------------------------------------------------|------|------|------|------|------|------|
| (Freight Ton MPG of Diesel equivalent)                 |      |      |      |      |      |      |
|                                                        | 1995 | 2000 | 2005 | 2010 | 2015 | 2020 |
| Base Case                                              | 34.5 | 35.8 | 38.5 | 38.5 | 39.8 | 39.8 |
| Case 1.25 Stab. in 2010 at 1990 levels                 | 34.5 | 35.8 | 38.5 | 38.5 | 39.8 | 39.8 |
| Technology Investment Case Stab. in 2010 at 1990 level | 34.5 | 35.1 | 38.5 | 40.4 | 39.8 | 46.7 |

### Service Demand

| <b>Heavy Trucks</b>                                    |       |       |       |       |       |       |
|--------------------------------------------------------|-------|-------|-------|-------|-------|-------|
| Bill. Vehicle Miles Traveled                           |       |       |       |       |       |       |
|                                                        | 1995  | 2000  | 2005  | 2010  | 2015  | 2020  |
| Base Case                                              | 158.0 | 184.9 | 208.6 | 241.3 | 238.2 | 250.1 |
| Case 1.25 Stab. in 2010 at 1990 levels                 | 158.5 | 185.1 | 208.6 | 228.6 | 221.7 | 232.2 |
| Technology Investment Case Stab. in 2010 at 1990 level | 155.1 | 184.8 | 209.8 | 229.6 | 229.9 | 245.6 |

| <b>Buses</b>                                           |      |      |      |      |      |      |
|--------------------------------------------------------|------|------|------|------|------|------|
| Bill. Vehicle Miles Traveled                           |      |      |      |      |      |      |
|                                                        | 1995 | 2000 | 2005 | 2010 | 2015 | 2020 |
| Base Case                                              | 7.8  | 8.2  | 8.0  | 9.0  | 9.3  | 9.7  |
| Case 1.25 Stab. in 2010 at 1990 levels                 | 7.7  | 8.2  | 8.6  | 8.6  | 8.9  | 9.1  |
| Technology Investment Case Stab. in 2010 at 1990 level | 7.7  | 8.2  | 8.7  | 8.7  | 9.1  | 9.1  |

| <b>Airplanes</b>                                       |       |       |       |         |         |         |
|--------------------------------------------------------|-------|-------|-------|---------|---------|---------|
| Bill. Passenger Miles Traveled                         |       |       |       |         |         |         |
|                                                        | 1995  | 2000  | 2005  | 2010    | 2015    | 2020    |
| Base Case                                              | 572.3 | 780.2 | 924.6 | 1,064.0 | 1,185.3 | 1,304.6 |
| Case 1.25 Stab. in 2010 at 1990 levels                 | 567.0 | 778.0 | 922.7 | 969.2   | 1,079.0 | 1,187.4 |
| Technology Investment Case Stab. in 2010 at 1990 level | 555.2 | 771.6 | 909.7 | 1,008.7 | 1,113.4 | 1,315.3 |

| <b>Ships</b>                                           |         |         |         |         |         |         |
|--------------------------------------------------------|---------|---------|---------|---------|---------|---------|
| Bill. Ton Miles Traveled                               |         |         |         |         |         |         |
|                                                        | 1995    | 2000    | 2005    | 2010    | 2015    | 2020    |
| Base Case                                              | 2,220.2 | 2,393.9 | 2,540.6 | 2,688.7 | 2,816.0 | 2,930.0 |
| Case 1.25 Stab. in 2010 at 1990 levels                 | 2,202.0 | 2,379.2 | 2,550.5 | 2,674.1 | 2,696.6 | 2,794.8 |
| Technology Investment Case Stab. in 2010 at 1990 level | 2,214.4 | 2,385.7 | 2,584.6 | 2,666.7 | 2,796.3 | 2,970.1 |

| <b>Passenger Rail</b>                                  |      |      |      |      |      |      |
|--------------------------------------------------------|------|------|------|------|------|------|
| Bill. Vehicle Miles Traveled                           |      |      |      |      |      |      |
|                                                        | 1995 | 2000 | 2005 | 2010 | 2015 | 2020 |
| Base Case                                              | 28.5 | 30.8 | 33.0 | 35.3 | 36.9 | 38.6 |
| Case 1.25 Stab. in 2010 at 1990 levels                 | 28.5 | 30.8 | 32.4 | 31.5 | 33.6 | 34.7 |
| Technology Investment Case Stab. in 2010 at 1990 level | 28.5 | 30.7 | 34.2 | 36.8 | 40.4 | 44.6 |

| <b>Freight Rail</b>                                    |         |         |         |         |         |         |
|--------------------------------------------------------|---------|---------|---------|---------|---------|---------|
| Bill. Ton Miles Traveled                               |         |         |         |         |         |         |
|                                                        | 1995    | 2000    | 2005    | 2010    | 2015    | 2020    |
| Base Case                                              | 1,178.4 | 1,275.1 | 1,365.0 | 1,451.7 | 1,528.0 | 1,589.1 |
| Case 1.25 Stab. in 2010 at 1990 levels                 | 1,157.1 | 1,271.8 | 1,355.6 | 1,280.1 | 1,350.5 | 1,386.2 |
| Technology Investment Case Stab. in 2010 at 1990 level | 1,163.8 | 1,257.7 | 1,376.6 | 1,385.2 | 1,427.2 | 1,642.9 |

## CEA Summary of Reviewer Comments on IAT Analysis

---rough draft---

18 June 97

### Summary

The most positive slant on the reviewers' comments is that the IAT analysis is salvageable provided the IAT considers reframing the question so that the level, form, and timing of the concentration target is examined, and the following are added: the benefits of policy options, a CGE model that captures trade, more sensitivity analysis on controversial assumptions, less focus on DRI, and others. The most negative slant on the comments is that the IAT used the wrong models to answer the wrong question the wrong way.

### 1. Asking a different question

#### *Concerns*

- The analysis does not address the overall goals of US policy in the international arena or evaluate the extent to which different policy options attain those goals. Current economic thinking does not support the idea of focusing on stabilizing emissions, particularly when stabilization is limited to the developed countries. Some analyses indicate that stabilizing emissions is worse than doing nothing. The current analysis has not fully experimented with alternative policy scenarios to answer these questions.
- The IAT needs to do more analysis to identify an optimal policy which could serve as a benchmark for comparing alternative policies. This will require an examination of both benefits and costs of policy options.

#### *Response to concerns*

- The analysis should identify integrated modeling systems such that the US can identify mitigation strategies that either maximize net benefits or minimize the sum of costs and damages. This implies exploring a target later than 2010 and the idea that it is better to abate later while enhancing technological knowledge now to lower the costs of future abatement.
- The IAT should use models that attempt to quantify the benefits of carbon abatement and to integrate these estimates into a framework that leads to the identification of the target and timetable as well as the cost. These benefits could

be characterized as reductions in the risks of climate change using probabilistic decision analysis.

## 2. The models I: general comments

### *General concerns*

The models used are inadequate because they cannot deal well with: current domestic policy options (e.g., a trading program), the effects of international flows on US trade balances and competitiveness, and the resource costs of technological progress.

- Models should focus on how economic agents respond to market and non-market signals, and measure the costs of adjustment. This requires a model of short and long term substitution in response to a different set of policy induced market and non-market signals.
- DRI is inadequate for the long-term economic forecasting being done (10 to 20 years); it is only appropriate for projecting the impacts of monetary and fiscal policy over a time frame of about 5 years or less.
- Markal Macro is a bottoms-up, energy-technology model, not an economic model; as such, it suffers from many weaknesses. IAT should consider using MERGE, which is a more rigorously tested model.
- SGM is a top-down model that is limited by its representation of the energy-economy interface. Its representation of abatement costs as flowing primarily through specific energy sector investments does not capture other costs from changes in the scale and composition of economic activity. It may also fail to adequately capture the opportunity costs of technical substitution, thus understating the costs of abatement policies. SGM is based on a characterization of potential technical options, but without a full recognition of the tradeoffs faced by real economic agents.

### *Responses to concerns*

- The IAT's analysis can be placed into a broader spectrum of other modeling efforts. Specifically, contact Stanford's Energy Modeling Forum (EMF) and ask them to do a set of modeling runs on our policy scenarios. **[This would require immediate action, as EMF is convening over the next weeks...]**
- Add **[a? -- is DRI a cge?]** another computable general equilibrium model. Besides EMF, candidates include **[G-cubed]**, and models constructed by Jorgenson and Wilcoxon, Goulder, and Harrison and Rutherford.
- **[moved this point to section on international aspects]** Add a non-CGE trade model that incorporates the effect of changing prices both within and across countries.

### 3. The models II: international aspects

#### *General concerns*

The analysis has not adequately addressed the international flows resulting from an international carbon trading system. These could have a substantial impact on the US current account, which would require currency and/or capital adjustments. This should be factored into the analysis and requires the use of another model.

- *World Trade.* The models have insufficiently detailed representation of world trade to study the issue of international implementation and its impacts. While SGM does model energy use in the regions included in the model, it does not incorporate trade in goods and services among the regions.
- *Carbon Leakage and Investment Diversion.* If only Annex 1 nations are included in an agreement, out-sourcing and carbon leakage may be a substantial problem. If US firms move or build new factories in Mexico, this reduces investment spending in the US, reducing demand for investment goods, and would result in a smaller manufacturing sector overall.
- *International Emissions Permit Trading.* Will international emission trading reduce the price of permits by as much as predicted by the SGM model? Even if permit-selling countries initially have much lower abatement costs, marginal abatement costs will rise for permit-selling countries as they abate more. What do the SGM abatement cost curves look like now -- are they linear or convex? Also, under global trading, what is assumed about non Annex-1 emissions constraints?

#### *Responses to concerns*

- **Add a non-computable general equilibrium (CGE) trade model that incorporates the effect of changing prices both within and across countries.**
- **Run an alternative set of scenarios to evaluate the effects of a border equalization tariff which could be used to reduce the effects of the cap system on trade and investment flows.**

### 4. The assumptions I: technology change

#### *Concerns*

Most reviewers (6 of 9) are skeptical of assumptions related to technological change, and generally about how technology and the "announcement effect" have been represented. While one reviewer argues these assumptions are too conservative, most reviewers think they are too high and are unsubstantiated in the historical evidence.

- *How is the announcement effect modeled?* Do people run an inter-temporal optimization with look ahead to see what people would do now if the cost of using carbon is substantially higher in 20 years? Although it is likely that the announcement of the policy will stimulate greater R&D and an associated increase in energy efficiency, such an improvement involves a resources cost. Additional resources must be devoted to R&D to generate this improvement and knowledge-generating resources are not unemployed resources that can be obtained at no cost. The baseline seems to assume that additional technological progress in energy efficient technologies does not involve any resource cost. Some empirical support is necessary to justify the values chosen for the announcement effect. Furthermore, the announcement effect should not lead to an immediate increase in the rate of improvement in energy intensity.
- *How is the specified E/GDP ratio implemented in each model?* How does it affect the definition of the base case in the 1.25 scenario? What is the impact on the base case carbon emissions? Is it uniform across models? The assumptions regarding energy efficiency trends seem unsubstantiated and to cover only the high end of the distribution. Work by a number of researchers suggests trends more like 0.5 to 0.7 [(baseline used is 0.1)].
- *Are full costs of technological adaptation included?* The models do not have behavioral equations that translate anticipated changes in energy prices to diffusion rates or rates of technological progress. Since none of this is explicitly represented in the models, it is sensitive to the assumptions made. For example, one reviewer suggested the analysis seems to hold implicitly that both the current level and the current allocation of R&D is optimal. There is little consensus among experts as to how technological change will affect the costs of emissions reduction policies, or how to model that process.

#### *Responses to concerns*

- Do some sensitivity analysis that uses 0.5 or 0.7 as the baseline change in energy/GDP and go 0.5 up and down for optimistic/pessimistic cases.
- Use Markal Macro to explore the technology assumptions required to produce energy intensity reductions of the magnitudes discussed.

### **5. The assumptions II: revenue recycling**

#### *Concerns*

- How is economic activity effected by a carbon-tax/revenue recycling scheme relative to a more generic consumption-tax/recycling scheme? The IAT should work to isolate the effect of the carbon policies rather than argue that there will

be an investment boom due to revenue recycling -- a carbon policy is not a necessary element of a policy to increase savings to spur more investment.

- The primary case examined by the IAT assumes revenues will be used to reduce the deficit. Does this pass the laugh test? Will Congress agree to restrict emissions and impose a \$100b tax on the economy? Other recycling scenarios deserve more attention.
- If deficit reduction is considered, the report needs to provide more information on the way revenue recycling was modeled. The effect of the policy depends critically on which taxes are reduced in the future in the same way that the effect of a policy involving current tax reductions depends critically on which taxes are lowered today.
- Theoretical and empirical work indicates that grandfathered permit policies are considerably more costly to the economy than if revenues are returned through cuts in other taxes. The results in the analysis (figure 13) are contrary, and are not explained.

#### *Responses*

- **[The IAT report should focus on more likely policy scenarios and further explain the reasoning behind key assumptions and results.]**

### **6. Assumptions III: other**

#### *Concerns*

- *Baseline energy estimates.* While there is some faith in energy projections for most of the world, those for the Former Soviet Union are highly uncertain. Additionally, base case US carbon emissions growth seems to be on the low side, oil and gas prices are assumed to rise (in contrast with the history of declining real prices over the period 1990-95), and coal prices are assumed to fall more slowly than in recent history. What is the basis for assuming faster price increases or slower price reductions than in the past, and why the reliance on one set of energy projections?
- *Price elasticities for energy demand* in the DRI model might be too high.
- *Monetary Policy.* The results are sensitive to monetary policy assumptions. The IAT needs to address the plausibility of these assumptions, and ask whether the Fed is really going to act as suggested. Can monetary policy have the kinds of permanent effects on the growth rate modeled?
- *Nonconventional oil resources.* Richels is concerned about the availability of huge supplies of low-cost shale oil and tar sands at prices in the \$15 and \$20 per

barrel range. If this happens, baseline carbon emissions will be higher than projected, as will the cost of a carbon constraint.

- *Alternative metrics.* Consumption as a better measure of consumer welfare and the figures based on consumption look much less optimistic. There are also alternative metrics for measuring impacts, but their use is not facilitated by the models chosen. Presenting results in terms of discounted present value would give some indication of how large the benefits from a climate policy must be to outweigh the costs.
- *Models omit benefits from the reduction of conventional pollutants.* Some research suggests these collateral benefits could be significant.

#### *Responses to concerns*

- Considerably more sensitivity analysis is necessary to bound the range of costs.
- Use more than one set of baseline assumptions. The IAT can do a set of runs in which individual modelers use their own baseline assumptions for economic growth and energy use to describe a possible range of policy impacts. Energy predictions could be compared to the poll results of the 1997 International Energy Workshop published by the International Institute for Applied Systems Analysis.

aide to Chairman Bob Smith (R-Ore.) "a broad overview of the role of fire in federal land management."

Smith recently told *The Associated Press* that the federal government should scale back its efforts to burn off dead and dying timber and shrubs in national forests during the dry summer months.

Smith believes that during fire seasons, when the risk of naturally caused fires already is increased, "prescribed fire can be something of a gamble. Fire doesn't always do what you want it to," his aide said.

The chairman told AP he would rather see more salvage logging operations to remove the fuel load from national forests, adding that salvage logging would help increase employment at timber mills and is less dangerous than risking fires that could burn out of control.

The aide said a prescribed fire got out of hand in Oregon last year and burned vastly more acres than intended.

Smith's view is not shared by Interior Secretary Bruce Babbitt, who on Feb. 11 outlined his intentions to "fight fire with fire" in the national forests. In a speech in Boise, Idaho, Babbitt said the government must use "all the tools we have — carefully thinning excess young trees, igniting prescribed fires, managing land for fire, controlling invasive and exotic weed species" to reduce the buildup of fire fuels littering many national forests, Babbitt said.

Babbitt traced the history of wildland fires in the West, noting that those fires "have burned hotter, bigger, faster, growing ever more lethal, destructive and expensive to fight."

Babbitt called for a revised forest policy that would return forests to a state in which cooler fires would move rapidly through stands, doing little damage to mature trees. "We must prepare forests to absorb the impact of fire," he said.

Babbitt said the money requested in the Interior and Forest Service budgets for fuels management would pay for treatment of 1 million to 2 million acres of forest in fiscal 1998.

While thinning and prescribed burns cost money up front, that investment "is proving to be money in the bank," Babbitt said.

"Pre-treatment" can cost as little as \$25 an acre, compared to the \$1,000 to \$1,800 per acre spent on fighting the fires around Boise in 1996. The larger the area treated, the less it costs per acre; and fighting fires in treated areas is much less costly, Babbitt said.

Regarding thinning, Babbitt said that while loggers have historically gone after the big and valuable old growth trees, "timber companies are finding ways to retool and make use of the smaller trees for pulp, milling, even cogeneration. These sales will help pay for the fires needed to keep the forests healthy. ... Thinning can be both profitable and sustainable."

The administration proposed extra money in fiscal 1998 funding to reduce fire hazards, including the creation of a new Forest Ecosystem Restoration and Maintenance fund for forest health activities including removal of dead or diseased timber and prescribed fire.

House appropriators declined to approve the FERM fund, but the interior appropriations bill pending on the House floor (HR 2107, H. Rpt. 105-163) would give the Forest Service \$50 million to treat up to 1.5 million acres by reducing the buildup of fuels in federal forests.

**Witnesses:** A witness list was not available at press time; among those expected to testify are representatives of the Forest Service, state foresters, The Nature Conservancy, the timber industry and academicians.

**When:** The hearing will begin at 10 a.m. on Tuesday, July 15, in 1300 Longworth.

House Agriculture contacts: Dave Tenny, majority, 225-2342; Danelle Farmer, minority, 225-1494. — *Leslie Ann Duncan*

#### Global environment

## Senate panel to move climate resolution

Congressional debate on world climate change moves to a new stage in the Senate this week: The Foreign Relations Committee will act on a resolution call-

ing for strict terms for negotiations on a global accord to deal with the problem of so-called greenhouse gases.

The resolution (S. Res. 98), introduced by Sen. Robert Byrd (D-W.Va.), states that the United States should not sign any agreement limiting or reducing greenhouse gas emissions by developed nations unless developing nations also are required to meet similar specific commitments in the same time period.

It also says no agreement should be signed that "would result in serious harm to the United States."

The resolution, expressing the "sense of the Senate," is non-binding. But 65 senators have joined Byrd in co-sponsoring it, in a clear warning to the Clinton administration that the Senate will reject an agreement that does not meet its guidelines.

Greenhouse gases are carbon dioxide and other gases caused by the burning of fossil fuels, among other activities. The gases act like glass in a greenhouse, trapping heat near the earth's surface and driving up temperatures. Many experts warn that if greenhouse gases are allowed to build up unchecked, ecosystems could be changed and low-lying areas flooded.

Parties to the United Nations Framework Convention on Climate Change that went into force in 1994 are preparing for a conference in Kyoto, Japan, in December, aimed at achieving a new agreement to combat greenhouse gas. The United States has proposed developed country emissions targets. It is responsible for about one fifth of the world's greenhouse gas emissions.

The Byrd resolution, to be considered by the Senate Foreign Relations Committee Thursday, states that the "disparity of treatment" between developed and developing countries, could result "in serious harm to the United States economy."

It also states that "it is desirable" that Senate leaders name a bipartisan group of senators to monitor negotiations and report back to the Senate periodically.

Meanwhile, the climate issue is to be further examined this week in both the Senate and the House. The Senate Environment and Public Works Committee is to hold a hearing Thursday and the

House Commerce subcommittee on energy and power has a hearing scheduled for Tuesday.

The subcommittee is to hear from Undersecretary of State Timothy Wirth. The panel's chairman, Rep. Dan Schaefer (R-Colo.), released a letter Friday complaining that the administration had not provided a promised new analysis and assessment on appropriate new commitments on climate change.

The letter, addressed to the chairman of the White House Climate Change Task Force, Dirk Forrister, asked for copies of a peer review of a draft of the analysis and for witnesses to answer questions about the analysis at Schaefer's subcommittee hearing.

**When:** The Senate Foreign Relations Committee meets at 10 a.m. Thursday, July 17, in 419 Dirksen.

The Senate Environment and Public Works Committee's hearing is at 10 a.m. Thursday in 406 Dirksen.

The House Commerce subcommittee on energy and power meets at 1 p.m. Tuesday, July 15, in 2123 Rayburn.

**Witnesses:** Wirth will testify before the House Commerce subcommittee. No witness list was available for the Senate Environment hearing. — *William Scally*

### Appropriations

## Senate panel marks up farm funding bill

A Senate appropriations subcommittee Tuesday marks up a farm funding bill containing major environmental programs.

The agriculture subcommittee is due to consider the measure as the House prepares to debate its version of the bill later in the week. The House bill contains funding of \$13.1 billion, including supplemental funding, compared to the Clinton administration's request for \$14.1 billion and the current year's level of \$13.65 billion.

The bill contains money for a number of environmental programs under the control of the Natural Resources Con-

servation Service for which the administration has requested \$816 million.

The House measure's funding of the programs fell \$59 million short of this figure, prompting a letter from Office of Management and Budget Director Franklin Raines urging that more money be provided.

The environmental programs to be funded by the bill include conservation operations, watershed surveys and planning, flood prevention operations, resource conservation and development and incentive programs to restore forests on private lands.

**When:** The Appropriations agriculture subcommittee meets at 9 a.m. on Tuesday, July 15, in 138 Dirksen. — *William Scally*

### Energy security/renewables

## Energy security role for alternate fuels

The Senate Agriculture Committee will hear CIA testimony on energy security this week as it examines the role of alternative fuels and other issues.

Committee Chairman Richard Lugar (R-Ind.) is a proponent of tax incentives to encourage production of ethanol, a fuel additive made from grain, to supplement oil as an energy source. Critics have called the program an example of corporate welfare because it benefits big agribusinesses.

The Central Intelligence Agency will give a rare public briefing on the international energy security situation against a background of rising oil imports.

According to American Petroleum Institute figures, imports in April accounted for 55 percent of domestic petroleum deliveries, compared with 52.5 percent in April 1996. In contrast, imports accounted for less than 40 percent of demand in the early 1970s.

However, an API spokesman noted that a larger percentage of oil imports now come from areas other than the volatile Middle East, notably from Venezuela.

The CIA briefing will be followed by

testimony from officials of the Agriculture and Energy departments, the White House Office of Science and Technology and a Nebraska agriculture processing firm.

According to Lugar, the hearing will focus on "the importance of alternative fuels in addressing future national security concerns ... including agriculture's vulnerability to energy price volatility; the contribution of home-grown renewable alternative fuels; and the role of new technologies in making agriculture more energy efficient while increasing yields."

In a statement urging continuation of the ethanol tax credit last month, Lugar said that the fuel could advance U.S. vital energy security interests.

"A diverse, home-grown energy supply is necessary because of our dependence on oil from the unpredictable Persian Gulf region," he said.

Lugar quoted some analysts as asserting that the true cost of Persian Gulf oil is about four times the current price of around \$25 a barrel "calculating the cost of keeping shipping lanes open, rogue states in check and terrorists at bay."

He says that development of ethanol from biomass could supply 20 percent of U.S. motor fuels by the year 2010 at prices competitive with gasoline while at the same time bolstering farm incomes.

Ethanol tax breaks are set to continue in both House and Senate tax bills now in conference despite efforts to kill them.

The House bill would allow the subsidy to expire after 2000, but the Senate version would continue it at a lower rate after the turn of the century.

House Ways and Means Chairman Bill Archer (R-Texas) has called the subsidy "a wasteful use of tax dollars," saying it should be scrapped and the savings put into the highway trust fund.

**Witnesses:** Scheduled to testify are Central Intelligence Agency officials; Roger Conway, director of the office of energy and new uses at the Agriculture Department; Joseph Romm, acting assistant secretary for energy efficiency and renewables at the Energy Department; Henry Kelly, acting associate director for technology at the White House Office of Science and Technology Policy; and John Campbell, vice president for indus-

## Questions for Climate Change Hearings

### IAT Questions:

Under-Secretary of State Wirth stated at the June 19 hearing before the Senate Foreign Relations Committee: "These are the same models [IAT models] that were very wrong about what happened with the energy bump up in pricing after the Arab Oil Boycott of 1972. They were the same models that, for the most part, were very wrong about the cost of the Clean Air Act." Why should we base our policy models that have a track record of being "very wrong"?

What are the benefits of preventing climate change estimated by the IAT models? If there are no estimates of benefits, how do we know what we are getting with these expensive policies? If the state of the science and the economics is insufficient to generate estimates on benefits, doesn't that imply that we don't know enough about the problem to enact costly policy measures?

Some of the studies on this issue indicate that climate change policy might actually increase U.S. GDP. How can this be? If there are great win-win technologies already in existence, why hasn't the private sector already adopted them? Isn't the Administration's Climate Change Action Plan supposed to encourage voluntary adoption of these energy efficiency technologies?

Do some of these gains in GDP reflect revenue recycling? Is the argument for revenue recycling unique to climate change? Isn't it just a reflection of the more basic idea that the economy would improve if government removed more distorting taxes and replaced them with less distorting taxes?

Could you explain this "announcement effect" phenomenon described in the IAT Report? The reviewers of the report appeared to be skeptical of the impact and magnitude of this effect.

Why would an agreement in Kyoto increase the diffusion of technologies at a faster rate through the "announcement effect", but the President's Climate Change Action Plan, the primary purpose of which is to increase technology diffusion, apparently does not have this effect in the IAT modeling?

How sensitive are the results to the assumption on the improvements in energy efficiency and the "announcement effect"?

Couldn't an announcement result in higher emissions prior to implementing the announced climate policy than under a baseline scenario with no announcement?

Do the models account for the opportunity costs of investing in energy efficiency? The reviewers believe that the models do an inadequate job of representing these costs.

If one model cannot fully describe the effects of climate policy on the economy, then why 3? Why not 4 or 5, or 16 (as in the Repetto and Duncan analysis)?

Why do the models yield such different results? DRI estimates that in 2010 the price of carbon will be \$95 per ton while Markal-Macro estimates that the price will be \$145 per ton. Interestingly, DRI estimates the price of carbon will increase through 2020, while Markal-Macro estimates that the price will decrease through 2020.

The IAT analysis assumes that the revenues from a permit auction would go towards deficit reduction. How would the results change if the revenues financed a tax cut? Or additional government spending?

The IAT analysis estimates the price of carbon to be about \$100 per ton in 2010. The report notes that this will have the effect of raising gasoline prices by 26 cents per gallon, natural gas by \$1.50 per thousand cubic feet, and electricity by 2 cents per kilowatt hour. These are very substantial price hikes. How will they affect businesses? Consumers?

How will the higher energy prices affect lower income households? Won't these prices translate into higher heating costs and higher food bills, and make life tougher for households just trying to make ends meet?

The IAT analysis assumes that by using the revenues from an auction of carbon permits to reduce the deficit, the real interest rate will fall and thereby stimulate investment. How far will it fall?

Based on the three models used in the IAT analysis, it is difficult to determine if the hypothetical climate policy subsumed in the analysis will lead to an increase or a decrease in GDP over the baseline by 2020? The DRI model yields results that the economy under climate policy would be 0.3% larger in 2020, while the economy is about 0.2% smaller than baseline with the SGM model, and the Markal-Macro model generates estimates that the economy would be about 0.6% smaller under climate policy in 2020 than otherwise. The report notes that these values should serve as brackets about a reasonable range. However, this range is much smaller than the one provided in the Repetto and Duncan (WRI) analysis (about 2% gain to 2% loss in 2020). Why should an analysis of 3 models generate a more reliable range than an analysis of 16 models?

The DRI model indicates that the unemployment rate is higher under climate policy than under the baseline assumption of no-policy for all but 3 years between 2000 and 2020. How many jobs will be lost because of this policy?

If this "announcement effect" is supposed to increase the rate of diffusion of energy efficient technology, then shouldn't investment expenditures parallel this faster diffusion rate? If so, then why is investment under climate policy lower than baseline investment between 2000 and 2005?

The DRI model indicates that consumer expenditures fall below baseline and do not at anytime reach baseline. The report notes that consumer expenditures are "closer to consumer 'welfare' than total GDP". Doesn't this mean that individual consumers will be made worse off under climate policy, even if we do have a positive effect on GDP? Should the appropriate evaluation of policy then be based on GDP or consumer expenditures?

Why do two models (SGM and Markal-Macro) estimate that climate policy will increase natural gas consumption in 2010, while DRI has natural gas consumption falling more than 15%?

The panel of reviewers of the draft of the IAT report made several significant criticisms of this process. Regarding the selection of the models, do you share their concerns about them? Specifically, do the models insufficiently address international trade? If they cannot capture international trade well, then how can we estimate the effects of climate policy on competitiveness?

Based on the IAT analysis, how much of the reductions will be achieved by cutting coal emissions? How will this affect the coal-producing states? What kinds of job losses are predicted?

Based on the IAT analysis, how much of the reductions will be achieved by cutting car emissions? How will this affect the price of gasoline and the price of cars? What kinds of job dislocations does the IAT predict?

Some economic analyses indicate that attempting to stabilize U.S. emissions by 2010 without stabilization assurances by non-annex I countries is worse than doing nothing. Why should we then implement an expensive climate policy?

If we allocate permits to existing emitters of carbon dioxide instead of auctioning them, what will be the economic impacts? The IAT analysis indicates that the economy under climate policy will be larger by 2012 than it would have been under baseline conditions with this grandfathering of permits. The reviewers doubt that this is plausible. In fact, grandfathering of permits appears to outperform an auction with revenues used to reduce the deficit and any auction with revenues used to reduce personal income taxes. Should we grandfather permits?

Do you have faith in the assumptions used in creating the baseline projection? Should there be more than one baseline so that we have a range of possible predictions? Is the baseline sensitive to the assumptions that oil and gas prices will rise in the future (even though they have been declining thus far this decade)? What about new discoveries of fossil fuel reserves that can push down prices of these energy sources even more (and result in higher costs for a carbon constraint)?

What does the IAT analysis tell us about the value of emissions budgets?



## White House Climate Change Task Force

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# FAX

**To:** Tom Rhoads  
**Organization/Title:** CEA  
**Fax:** 395 6853 **Phone:** \_\_\_\_\_  
**Pages (including cover):** ~~4~~ 4 **Date:** July 14  
**From:** Judi Greenwald  
**Phone:** 343 1060

**Message:**

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JUL-14-97 01:21P Climate Change Task Force

P.O.

**ARGONNE REPORT Q'S AND A'S****Q1. WHAT WAS THE PURPOSE OF THIS STUDY?**

- A1.** The purpose of this study was to explore the possible effects of a set of hypothetical fuel price increases on six energy-intensive industries that are subject to significant foreign competition:

- basic chemicals;
- iron and steel;
- petroleum refining;
- paper and allied products;
- aluminum; and
- cement.

Panels of industry representatives and experts from academia, environmental groups, organized labor, the financial community, and government were asked to assume a projection of energy price increases that incorporated specific assumptions about the energy price effects of a postulated climate change agreement, and reflect on the possible industry responses. Panels for each of the industries met to discuss the possible impacts on industry output, employment, energy usage, technology, costs, prices, imports, and exports.

**Q2. WHAT DID THE PANELISTS FIND?**

- A2.** Overall, the participants reported negative impacts on the six industries under the assumed energy price increases. Panelists predicted that the industries would experience reductions in output and employment from the projected baseline levels.

Less-developed countries, which were assumed in the workshops not to adopt binding commitments to lower greenhouse gas emissions in the timeframe considered, would capture an increasing share of the respective markets. Some industries would locate new plants in the less developed countries, and some would increase the utilization of existing production facilities already located in these areas.

**Q3. WHAT IS THE DEPARTMENT'S RESPONSE TO THIS INPUT FROM INDUSTRIAL EXPERTS?**

- A3.** The workshops provided valuable information that reinforced the need to pursue sensible climate change policies. The negative conclusions expressed by the participants and summarized in this report are predicated on the specific energy price scenarios assumed in mid-1996, which do not reflect key policies advocated in international negotiations by the Clinton administration in the intervening year. For example, the assumed fuel price

scenarios do not take into account the impact of multi-year emissions budgets, international emission trading, and joint implementation. If adopted, these provisions would lower the costs of achieving emission reductions in the U.S. and other developed countries and would significantly lower the energy price increases assumed in the workshop scenarios. The Administration has also argued that the developing countries should assume additional obligations in the near future to reduce the projected rapid growth of greenhouse gas emissions. No such actions were reflected in the workshop scenarios.

The environmental and socio-economic issues surrounding the stabilization of greenhouse gas emissions have been the subject of considerable debate, but are especially sensitive now as participating nations are engaged in a new round of negotiations for further commitments within the Framework Convention on Climate Change that will conclude in December of 1997 in Kyoto, Japan. The U.S. position taken in these negotiations stresses that international agreements to combat the threat of climate change must be flexible, cost-effective, realistic, achievable, and ultimately global in scope.

By examining scenarios that do not reflect such policies, the workshops identified important economic risks in key industrial sectors that reaffirm the wisdom of the U.S. approach.

**Q4. HOW DOES THIS VERSION OF THE REPORT COMPARE TO THE EARLIER (DRAFT) PAPER BY SUTHERLAND?**

**A4.** A draft paper providing a personal interpretation of the workshops was circulated prior to completion of this report by an individual employee of Argonne National Laboratory. That paper was apparently prepared in advance of the participants' review of the workshop summaries and prior to the lead authors' completion of the revised focus papers based on comments received at the workshops. The Argonne report issued this week provides an accurate and complete summary of the workshop findings.

**Q5. DOESN'T THIS REPORT UNDERCUT THE ADMINISTRATION'S POSITION ON CLIMATE CHANGE?**

**A5.** No. Rather, it highlights the need for flexibility in implementing emissions reduction and the need to engage developing countries in the process of emissions reduction. Flexibility, including emissions trading, joint implementation, and multi-year emissions budgets and provisions to ensure the future participation of developing countries in binding emissions reductions are central elements of the Administration's climate change strategy.

**Q6. HOW DOES THIS STUDY RELATE TO DOE'S INITIATIVES TO INCREASE INDUSTRIAL ENERGY EFFICIENCY?**

A6. The study is unrelated to the activities of the Department's Office of Industrial Technologies, which is actively cooperating with many of these industries to achieve dramatically improved energy efficiency. Success of these efforts has the potential to improve the competitiveness of U.S. producers while reducing their energy use and greenhouse gas emissions. Increased energy efficiency also makes U.S. producers less sensitive to the adverse effects of any future energy price increases, regardless of their source.

**Q7. WHAT WAS THE BASIS FOR THE PRICE SCENARIOS ASSUMED, AND HOW DO THEY COMPARE TO THE PRICE SCENARIOS BEING USED FOR THE INTERAGENCY ANALYSIS TEAM WORK?**

A7. The hypothetical fuel price scenarios used in this project are within the range suggested by analyses presented at the inter-agency Climate Change Analysis Workshop held at Springfield, Virginia in June, 1996. These analyses were preliminary in nature and did not incorporate cost-saving features currently included in the U.S. negotiating position such as emissions trading, joint implementation, and multi-year emission budgets. The industry workshop participants did not assume any complementary technology-oriented policy measures, nor were they asked to consider price scenarios which included ameliorative policy measures that could offset the impact of energy price increases on industry.

**Q8. WHAT IS THE BASELINE STATUS OF THESE INDUSTRIES IN THE ABSENCE OF CLIMATE POLICY?**

A8. In many of these industries, recent U.S. investment has been in the form of refurbishing existing plants rather than building new "greenfield" plants. Even without the assumed fuel price increases, countries with lower costs for energy and other inputs or more rapidly growing demands may be more attractive than the U.S. as sites for new greenfield plants.

**Q9. HOW IMPORTANT ARE DEVELOPING COUNTRY COMMITMENTS TO THE LONG RUN RESULTS?**

A9. The Administration has argued that developing countries should assume additional obligations in the near future to reduce growth in their GHG emissions. While developed countries now account for the lion's share of emissions, developing country emissions are projected to grow rapidly. The potential for shifting production of energy-intensive products to developing countries identified in the Argonne report would exacerbate emissions growth. It will not be possible to achieve the long run objective of the Climate Convention without substantial

emissions reductions by developing countries. Their commitment to such reductions, which were not reflected in the workshop scenarios, would be likely to significantly reduce the potential for shifts in industry location identified at the workshops.

It is likely that energy-intensive industries in other developed countries would be subject to similar challenges as their U.S. counterparts under the energy price increase scenarios developed for this study. Energy-intensive industries in other Annex 1 would also benefit from the cost-reducing flexibility provisions included in the U.S. proposal, and from an approach that assures developing country participation in emissions reductions will occur in the near future.

**Q10. DOESN'T THIS REPORT PROVE SENATOR BYRD'S POINT THAT ENTERING INTO INTERNATIONAL AGREEMENTS WITHOUT THE FULL PARTICIPATION OF DEVELOPING COUNTRIES WOULD BE RUINOUS TO THE U.S. ECONOMY?**

A10. The panelists felt that if less-developed countries did not adopt binding commitments to lower greenhouse gas emissions, they would capture an increasing share of the markets. The current Administration position, which was not reflected in the energy price scenarios considered by the panelists in mid-1996, is that developing countries should assume additional obligations in the near future to reduce the projected rapid growth of greenhouse gas emissions.

**Q11. WHY DID IT TAKE THE DEPARTMENT SO LONG TO RELEASE THIS REPORT? WEREN'T THESE WORKSHOPS HELD OVER A YEAR AGO?**

A11. The participants at the workshops focused their discussions around an initial draft of an expert author's paper. The expert authors then revised and clarified their papers over the following months in response to the panelists suggestions. Summaries of both the papers and the workshop proceedings were then forwarded to all participants for their review and to confirm that the workshop summary provided an accurate characterization of the workshop discussions.

**Q12. THIS REPORT SHOWS HOW SOME INDUSTRIES WOULD BE HURT BY LARGE ENERGY PRICE INCREASES. WOULDN'T SOME INDUSTRIES, LIKE COMPACT FLUORESCENT BULB MANUFACTURERS, ACTUALLY BE HELPED? HOW COME THEY WERE NOT INCLUDED IN THE STUDY?**

A12. The study focused on energy-intensive industries in order to develop information that would help in assessing the validity of the existing approaches to modeling the impacts of regime changes on energy use in the industrial sector, which accounts for over 1/3 of total U.S. energy use. The industries considered in this study account for over 80 percent of energy use in manufacturing. An understanding of the forces driving production decisions in these sectors is critical to comprehending and projecting the implications of alternative policy scenarios for the national energy market, a primary function of the Policy Office. Identifying changes in the relative performance of different economic sectors is also important. A second phase of our effort, which is now ongoing, is examining those industries that might benefit from higher energy prices.

**White House Climate Change Task Force**

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## ARGONNE REPORT Q'S AND A'S

## Q1. WHAT WAS THE PURPOSE OF THIS STUDY?

A1. The purpose of this study was to explore the possible effects of a set of hypothetical fuel price increases on six energy-intensive industries that are subject to significant foreign competition:

- basic chemicals;
- iron and steel;
- petroleum refining;
- paper and allied products;
- aluminum; and
- cement.

Panels of industry representatives and experts from academia, environmental groups, organized labor, the financial community, and government were asked to assume a projection of energy price increases that incorporated specific assumptions about the energy price effects of a postulated climate change agreement, and reflect on the possible industry responses. Panels for each of the industries met to discuss the possible impacts on industry output, employment, energy usage, technology, costs, prices, imports, and exports.

## Q2. WHAT DID THE PANELISTS FIND?

A2. Overall, the participants reported negative impacts on the six industries under the assumed energy price increases. Panelists predicted that the industries would experience reductions in output and employment from the projected baseline levels.

Less-developed countries, which were assumed in the workshops not to adopt binding commitments to lower greenhouse gas emissions in the timeframe considered, would capture an increasing share of the respective markets. Some industries would locate new plants in the less developed countries, and some would increase the utilization of existing production facilities already located in these areas.

## Q3. WHAT IS THE DEPARTMENT'S RESPONSE TO THIS INPUT FROM INDUSTRIAL EXPERTS?

A3. The workshops provided valuable information that reinforced the need to pursue sensible climate change policies. The negative conclusions expressed by the participants and summarized in this report are predicated on the specific energy price scenarios assumed in mid-1996, which do not reflect key policies advocated in international negotiations by the Clinton administration in the intervening year. For example, the assumed fuel price

Q. The Administration is planning to implement a climate change agreement which would require developed countries to reduce emissions, but not require developing countries to do so. Won't this agreement negatively affect the international competitiveness of U.S. industry?

A. Work that the U.S. government has commissioned by DRI, a private consulting firm, suggests that the international competitiveness implications for U.S. economy will be slight. DRI estimates that only 1% of all U.S. industrial sector energy use (and emissions) will shift overseas as a result of the agreement. The degree to which particular industry is vulnerable to overseas competition will depend upon (1) its energy intensiveness (2) the degree to which it is in direct competition with imports from countries not likely to be subject to our binding targets for emissions and (3) whether the particular U.S. industry exports to countries not subject to the agreement.

For most industries, either (a) energy is not a large fraction of their costs, or (b) the industries do not have direct competitive pressure on their products. However, there may be particular industries that will be more adversely affected.

(Analysis attached)

## **U.S. Industry Competitiveness Under an Emissions Stabilization Policy**

The impact of binding greenhouse gas emissions targets on U.S. industrial competitiveness is an issue of central concern for policy makers. Currently 40% of U.S. trade is with non-Annex I countries. Annex I countries are the nations that initially agreed to voluntary greenhouse gas emission reduction targets under the 1992 Framework Convention on Climate Change. They include members of the OECD, Eastern Europe and countries formerly within the Soviet Union. Industries located in nations that are not currently part of Annex I may not be faced with binding emissions constraints under the current proposals. As a result, they could gain a competitive advantage over industries in the U.S. and other Annex I nations. Under a stabilization policy, international competitiveness and potential output declines in individual industries will depend on the following industry specific factors:

- The importance of imports from non-Annex I nations in the U.S. market, and the importance of exports to these same countries as share of U.S. production
- The importance of energy as a cost of production and the potential to reduce energy and/or carbon intensity of production
- The long term trends for these industries as a share of U.S. output and employment

### ***Current Trade Shares***

The potential impacts on U.S. industry from production shifting to non-Annex I partners is influenced by the relationship between three categories of commodities in each industry: U.S. production, imports from non-Annex I nations and imports from Annex I nations. The share of U.S. consumption<sup>1</sup> imported from non-Annex I countries can be defined as the quantity of non-Annex I imports in each sector divided by domestic production and net imports (imports minus exports) in each sector. The share of U.S. output exported to non-Annex I countries can be defined as the quantity of U.S. exports to non-Annex I countries divided by the total U.S. output in each sector. These shares give the best indication of how significant current trade with non-Annex I countries is for each U.S. industry. Table 1 shows the level of integration with non-Annex I trading partners for key energy intensive industries.

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<sup>1</sup> "Total Apparent Consumption" = Total Output + Imports - Exports for each sector.

**Table 1: Non-Annex I Shares of U.S. Imports and Exports**

|                                            | Imports from<br>non-Annex I<br>Countries as a<br>share of U.S.<br>Consumption | Exports to non-<br>Annex I<br>Countries as a<br>share of U.S.<br>Output |
|--------------------------------------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| <b><u>Energy Intensive Industries</u></b>  |                                                                               |                                                                         |
| Pulp Mills                                 | 4.2%                                                                          | 12.7%                                                                   |
| Paper and Paperboard Mills                 | 0.5%                                                                          | 4.4%                                                                    |
| Industrial Organic and Inorganic Chemicals | 6.7%                                                                          | 13.5%                                                                   |
| Fertilizers                                | 2.1%                                                                          | 0.4%                                                                    |
| Pesticides and Agricultural Chemicals      | 1.2%                                                                          | 4.6%                                                                    |
| Cement                                     | 2.7%                                                                          | 0.3%                                                                    |
| Glass                                      | 5.5%                                                                          | 4.5%                                                                    |
| Steel                                      | 6.3%                                                                          | 3.6%                                                                    |
| Aluminum                                   | 4.7%                                                                          | 3.9%                                                                    |
| <b><u>Other Key Industries</u></b>         |                                                                               |                                                                         |
| Lumber and Wood Products                   | 3.3%                                                                          | 1.5%                                                                    |
| Transportation Equipment                   | 3.4%                                                                          | 7.7%                                                                    |
| Fabricated Metal Products                  | 4.0%                                                                          | 3.5%                                                                    |
| Instruments and Related Equipment          | 6.7%                                                                          | 7.1%                                                                    |
| Electronic and Other Electrical Equipment  | 23.1%                                                                         | 19.5%                                                                   |
| Textile and Apparel Products               | 25.5%                                                                         | 5.4%                                                                    |
| Leather Goods and Products                 | 56.1%                                                                         | 9.9%                                                                    |

Source: DRI McGraw-Hill, Fall 1996 Forecast

### ***Increases in Costs of Production***

The carbon intensity of energy inputs and their share of the cost of production also indicate the potential for losses of competitiveness by U.S. industry under the policy. Table 2 shows the increases in the price of final products from specific energy intensive manufacturing sectors that would result from the direct as well as indirect impacts of emission constraints.<sup>2</sup> The permit value, which will affect the prices for fossil fuels, can be described within a certain range depending on several variables that are unknown at this point such as technology innovation and diffusion, the scope of international emissions trading, and the treatment of other greenhouse gases. Additionally, the price effects in Table 2 are based on current production methods and fuel mix. Any improvements in energy efficiency or switching to less carbon intensive fuels, that would almost certainly take place with a stabilization policy, are not captured in these calculations. Therefore, the following numbers may overstate the price increases.

**Table 2: Price Effects from Carbon Constraints**

| Percent Increase in<br>Product Prices | Percent Increase in<br>Product Prices |
|---------------------------------------|---------------------------------------|
|---------------------------------------|---------------------------------------|

<sup>2</sup> The calculation of the direct and indirect impact on prices of final products from each sector from a \$5\$/ton of carbon permit value and \$0\$/ton of carbon permit value was based on a standard inter-industry table of input coefficients and assumed an improvement of energy efficiency consistent with historic trends.

| <u>Energy Intensive Industries</u>         | from a High Permit Value <sup>1</sup> | from a Low Permit Value <sup>1</sup> |
|--------------------------------------------|---------------------------------------|--------------------------------------|
| Pulp Mills                                 | 3.9%                                  | 2.3%                                 |
| Paper and Paperboard Mills                 | 6.1%                                  | 3.8%                                 |
| Industrial Organic and Inorganic Chemicals | 8.1%                                  | 4.8%                                 |
| Fertilizers                                | 11.2%                                 | 6.6%                                 |
| Pesticides and Agricultural Chemicals      | 2.1%                                  | 1.2%                                 |
| Cement                                     | 20.0%                                 | 13.3%                                |
| Glass                                      | 3.2%                                  | 1.9%                                 |
| Steel                                      | 9.7%                                  | 6.3%                                 |
| Aluminum                                   | 6.2%                                  | 3.8%                                 |

### *Trends in Industry*

The projected levels of output and employment for industries most effected by energy price changes is another important factor to consider. Even in the absence of an emissions stabilization policy, the significance of energy intensive and fossil fuel producing sectors contributions to national employment and industrial output are projected to decline. These industries currently employ 4.2% of the U.S. workforce, by 2020, their share will drop to 3%, (Table 3). Additionally, energy intensive industries' share of both total industrial output and total manufacturing output are also declining.(Table 4)

Several factors are leading to smaller shares of U.S. output and less employment over time in these industries. Probably the most important cause of these changes is structural change in the U.S. economy. High-tech and service industries have been consistently growing as a share of both employment and will continue to gain importance in the future. Additionally, improvements in labor productivity have led to a decline in employment per dollar output in these industries. Finally, production in key U.S. industries will shift to non-Annex I countries even without greenhouse gas stabilization policies. For example, Table 5 shows the projections for increased global market share for the East Asian economies that are the most significant industrial producers among non-Annex I nations (China, Hong Kong, Indonesia, India, Malaysia, Singapore, South Korea, Taiwan and Thailand).

**Table 3: Extraction and Energy Intensive Employment in the U.S.**

| Sector                          | (thousands of employees) |                           |       |                           |       |                           |
|---------------------------------|--------------------------|---------------------------|-------|---------------------------|-------|---------------------------|
|                                 | 1996                     | Share of Total Employment | 2010  | Share of Total Employment | 2020  | Share of Total Employment |
| Mining & Fossil Fuel Extraction | 570                      | 0.5%                      | 510   | 0.3%                      | 470   | 0.3%                      |
| Food and Products               | 1,652                    | 1.3%                      | 1,577 | 1.1%                      | 1,496 | 1.0%                      |

<sup>1</sup> Estimates for permit values an independent stabilization of U.S. greenhouse gases at 1990 levels by 2010, without international emissions trading, are \$95/ton carbon

<sup>2</sup> Estimates for permit values under stabilization at 1990 levels with Annex I emissions trading are \$50/ton of carbon. Under targets that would permit Joint Implementation projects or assume more optimistic technology assumptions have been estimated at less than half this value.

|                        |         |      |         |      |         |      |
|------------------------|---------|------|---------|------|---------|------|
| Paper and Products     | 678     | 0.5% | 663     | 0.5% | 620     | 0.4% |
| Chemicals and Products | 1,021   | 0.8% | 1,005   | 0.7% | 997     | 0.6% |
| Petroleum Products     | 139     | 0.1% | 120     | 0.1% | 102     | 0.1% |
| Stone, Clay Glass      | 535     | 0.4% | 501     | 0.3% | 461     | 0.3% |
| Primary Metals         | 704     | 0.6% | 617     | 0.4% | 519     | 0.3% |
| Total                  | 5,299   | 4.2% | 4,993   | 3.4% | 4,665   | 3.0% |
| U.S. Total Employment  | 126,700 |      | 147,100 |      | 154,500 |      |

Source: DRI McGraw-Hill: "Long Term Forecast for the U.S. Economy, 1996"

**Table 4: Energy Intensive Industries Share of Output**

|                               | 2010                               |                                       | 2020                               |                                       |
|-------------------------------|------------------------------------|---------------------------------------|------------------------------------|---------------------------------------|
|                               | Percent of<br>Total U.S.<br>Output | Percent of<br>Manufacturing<br>Output | Percent of<br>Total U.S.<br>Output | Percent of<br>Manufacturing<br>Output |
| Food and Kindred Products     | 3.8%                               | 11.8%                                 | 3.1%                               | 10.1%                                 |
| Paper and Allied Products     | 1.2%                               | 3.8%                                  | 1.0%                               | 3.2%                                  |
| Chemicals and Allied Products | 1.1%                               | 3.3%                                  | 0.9%                               | 2.8%                                  |
| Petroleum and Coal Products   | 1.3%                               | 4.0%                                  | 1.0%                               | 3.2%                                  |
| Stone Glass and Clay Products | 0.6%                               | 1.7%                                  | 0.4%                               | 1.4%                                  |
| Primary Metals                | 1.1%                               | 3.3%                                  | 0.8%                               | 2.6%                                  |
| Totals                        | 9.1%                               | 27.9%                                 | 7.2%                               | 23.3%                                 |

DRI McGraw-Hill, Fall 1996 Forecast

**Table 5: Projections for Emerging East Asian Countries**

|                            | Percent Share of<br>World Sales<br>(Current) | Percent Share of<br>World Sales<br>(2010) |
|----------------------------|----------------------------------------------|-------------------------------------------|
| Processed Food             | 9.9%                                         | 14.9%                                     |
| Paper and Printing         | 8.1%                                         | 12.9%                                     |
| Chemicals and Plastics     | 11.7%                                        | 16.0%                                     |
| Basic Metals Manufacturing | 19.6%                                        | 24.6%                                     |
| Motor Vehicles             | 3.8%                                         | 6.5%                                      |

Source: WEFA, ICF International, "World Outlook" February, 1997

## ECONOMIC MODELING RESULTS FOR INDUSTRIES

The DRI/McGraw Hill Inter-Industry Model was Used to analyze the impacts of climate policies on specific industries. The model calculates production, detailed inter-industry transactions and trade for 246 industries, using production and trade data from the DRI Macroeconomic Model and detailed projections of changes in efficiency and productivity over time.

Under the central stabilization case, when greenhouse gas emissions are stabilized at 1990 levels from 2010 through 2020, the reductions in emissions from the industrial sector account for about one-fifth of total emission reductions – 19% (48 MMTC) in 2010 and 21% (70 MMTC) in 2020. Reductions in overall energy demand as well as improvements in industrial energy efficiency account for the reductions. Energy intensity

across all industries initially declines at a rate of 3.25% per year then slows to about 1.5% per year vs. a 1.5% initial decline slowing to 1% in the base case.

One major area of concern is the effect of carbon constraints on the most highly energy-intensive industries – cement, aluminum, steel, pulp and paper mills, and the energy-intensive sectors of the chemicals industry<sup>5</sup> – which account for a relatively small portion of total output (2% to 3%) but a relatively large portion (38%) of total industrial energy use. For these industries, whose products mainly serve as intermediate inputs to other manufacturing industries, energy accounts for as much as 30% to 40% of total production costs.<sup>6</sup> As higher energy prices raise their costs, domestic energy-intensive producers might lose market share to competitors from non-Annex I countries under a climate treaty that affects Annex I but not Annex II countries.

The impact of climate stabilization policies on the energy-intensive industries will be very sensitive to how the policy is implemented:

- If emission permits are auctioned off and the revenues are used to reduce the budget deficit, the reduction in government borrowing will reduce real interest rates and, in turn, stimulate demand for consumer durables, new construction and business investment. Higher construction, investment, and durables demand, in turn, raises the demand for such energy-intensive goods as cement, aluminum, and steel. Pulp and paper products, energy-intensive chemicals and other energy intensive products more closely tied to non-durable consumer good consumption do not fare as well under this scenario.
- In contrast, if emission permits are given to households (or the revenues from auctioned permits are returned to them through income tax reductions), the main effect is to stimulate household consumption expenditures rather than business investment. In this case, higher non-durables consumption stimulates the demand for paper and paperboard from the pulp and paper industry.

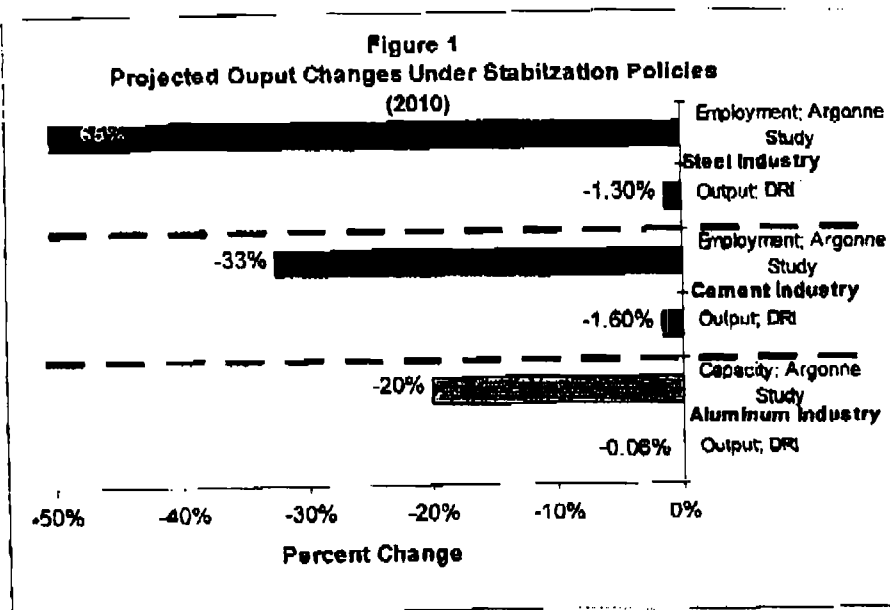
The results from this analysis stand in contrast to other studies, (Sutherland, 1997) which tend to predict that carbon stabilization policies would severely impact U.S. energy-intensive industries and perhaps drive large portions of these industries overseas, with little net effect on global emissions. (Figure 1) While a stabilization policy would certainly have an effect on energy-intensive industries, the most dire of these predictions almost certainly overstate the impacts of climate policies. Geographic and regional shifts in global production of energy intensive products are occurring in the absence of climate policy and are larger than the potential shifts in production from a climate policy.

The potential for new, technologically advanced productive capacity in developing countries will also depend on the returns to new capital investment in these countries. Although foreign direct investment in non-Annex I nations has been increasing, it has done so slowly over time. Differences in returns to investments attributed to differences in capital market imperfections and differences in worker

<sup>5</sup> Industrial Organic Chemicals, Industrial Inorganic Chemicals, Pesticides and Fertilizers account for most energy used in the chemicals sector.

<sup>6</sup> "Energy Intensive Industries" Report from Lawrence Berkeley Labs, 1996.

productivity would likely limit the rate at which new capacity is added and production is shifted from Annex I to non-Annex I countries.



The level of *carbon emissions leakage* under an emissions stabilization policy is important to the effectiveness of binding targets. *Carbon emissions leakage* is defined as increases in emissions in areas not covered by a reduction target. It can be caused by both direct and indirect effects from emission reduction targets. Since two thirds of carbon emissions in the U.S. are from energy used by the residential, commercial and transportation sectors, only about 30% of U.S. emissions are subject to direct leakage. The direct *leakage* is caused primarily by industry relocating to non-Annex I nations as a result of carbon constraints.<sup>7</sup> The direct *carbon emissions leakage* from U.S. industrial sources due to a stabilization policy is small. With the higher range of projected permit values the emissions tied to movement of U.S. production overseas amount to less than 1% of total industrial emissions, (3.4 MMTC). This quantity does not reflect any indirect leakage effects. Additionally, higher carbon emissions per unit of output in non-annex I countries could also generate a higher number. However, the industries with higher carbon emissions per unit output would most likely be the producers to lose market share to foreign competition.<sup>8</sup>

<sup>7</sup> Indirect *leakage* could also be generated from decreased industrialized country demand for fossil fuels. Lower prices in the world market than would have occurred under the business as usual case would be an incentive for non-Annex I nations to increase their use of fossil fuels.

<sup>8</sup> The calculation of emissions leakage was done on the basis of the total share of industrial output lost to increased imports and decreased exports and each industry's share of total industrial emissions.

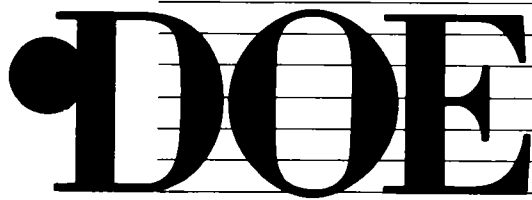
### *Methodology*

The analysis specifically included an assessment of the impact of changes in trade and competitiveness on the total output of U.S. industries. Under the current proposals non-Annex I producers, such as China, India, Mexico, South Korea and Brazil, might not be faced with energy price increases from stabilization policies. Under such conditions, there would be an increase in imports from non-Annex-I countries and decreases of U.S. exports to the world market. To reflect such changes in U.S. import and export shares the analysis took the following steps:

- 1) Based on the share of energy as an input across all sectors, the direct and indirect increases in costs of production for each sector were determined
- 2) The production cost increases were then adjusted on the basis of the changes in wages, interest rates, and exchange rates occurring under the policy
- 3) The share of imports from and exports to non-Annex I countries in each sector was then estimated from adjustment to current Annex I / non-Annex I import and export shares. This was done to account for changes that would occur in the global economy under the policy. For example, cement imports to the U.S. from annex I countries, such as Canada and Spain currently make up 74.5% of total imports. Non-Annex I countries such as Mexico, Venezuela and Brazil account for the remaining 25.5% of U.S. imports. The Annex I share was cut in half to reflect the fact that Canada and Spain would lose a significant part of their share of the U.S. import market due to higher energy prices. The resulting share of U.S. cement imports would be 37.3% and 62.7% respectively.
- 4) Sector specific import and export elasticities were then multiplied by the non-annex I shares calculated in step 3) to determine the changes in U.S. trade that would occur. The elasticities are historically estimated and reflect the rate at which changes in costs of U.S. products lead to changes in import and export shares.
- 5) The changes in imports and exports were combined with other macroeconomic changes, such as consumption and investment, to calculate output losses for each sector.
- 6) Carbon emissions leakage was determined by dividing the total increase in U.S. imports and total decrease in U.S. exports by the total output in each sector. The resulting change in trade as a percent of total output was multiplied by each sector's share of total industrial CO<sub>2</sub> emissions, (based on 1991 MECS data).

Such an analysis could be a more conservative estimate of the actual changes that would occur under the policy. Cutting the Annex-I shares of U.S. imports and exports by half immediately might overstate the shifts resulting from the policy. Additionally, the relatively rigid representation of substitution possibilities in production that characterizes the model may overstate the effect of energy price increases on production costs. In contrast to the DRI model, models that have a more detailed and flexible representation of production technologies (such as general equilibrium models) or that represent technological shifts (i.e. from integrated steel mills to electrometallurgical mini-mills or from primary aluminum to secondary aluminum) would yield lower estimates of

production cost increases. However, given the uncertainties surrounding the impacts on costs of production in the U.S. and other Annex I nations, as well as other key aspects of the global economy, the analysis represents a reasonable assessment of U.S. industry vulnerability.



# NEWS

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**FOR IMMEDIATE RELEASE**  
**July 11, 1997**

## **Report Supports U.S. Direction in Formulating Climate Change Policies**

*The Impact of High Energy Price Scenarios on Energy Intensive Sectors: Perspectives from Industry Workshops*, was released today. This report summarizes a series of workshops conducted by Argonne National Laboratory in 1996 under contract to the Department of Energy.

The report confirms the wisdom of the Administration's basic approach to climate change, namely that, in developing policy to meet our environmental objectives in a realistic way without disrupting our economy, we need to employ a variety of market-oriented, flexible measures both at home and abroad, accelerate R&D into new technologies, and adopt an international regime involving the participation of all nations. This report shows that, unless these elements are part of our policy, several energy intensive sectors such as basic chemicals, iron and steel, petroleum refining, pulp and paper, aluminum and cement could suffer.

The workshop participants examined the impact of large hypothetical energy price increases on these industries, but the price scenarios -- based on analyses of other countries' proposals as of early 1996--do not reflect key policies that the Clinton administration has advocated since that time in international negotiations on climate change. Submitted in January, 1997, the administration's proposals call for developing countries to join in reductions of greenhouse gas emissions and would provide developed countries maximum flexibility in how they can reduce emissions -- for example, by allowing for multi-year emissions budgets, international emissions trading, and credit for "joint implementation" projects that reduce emissions in developing countries. These approaches, in addition to an accelerated climate technology program, can assure that climate change goals are met in the most cost-effective ways.

"The findings in this report reinforces our commitment to pursue climate change policies that reduce emissions and avoid the kinds of negative economic impacts described in the workshops," said Marc Chupka, Acting Assistant Secretary for Policy and International Affairs. "By examining various high energy price scenarios, workshop participants identified important economic risks in key industrial sectors. What we've learned affirms the wisdom of this administration's approach -- to negotiate an agreement based on a set of flexible policies and the participation of all nations."

Media can obtain a copy of the report's executive summary and cover letter by calling 202/586-5806. Others can request a copy from DOE Public Inquiries at 202/586-5575.

**R-97-063**



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## Department of Energy

Washington, DC 20585

July 11, 1997

### MEMORANDUM FOR DISTRIBUTION

**FROM:**

Marc W. Chupka

Acting Assistant Secretary

Office of Policy and International Affairs

**SUBJECT:**

*Impacts of High Energy Price Scenarios on Energy-Intensive Sectors:  
Perspectives from Industry Workshops*

Compiled by Argonne National Laboratory

Climate change is an important national and global issue. In the process of developing policy that will meet our environmental objectives in a realistic, balanced way without disrupting our economy, this Administration has assumed the need for a variety of market-oriented, flexible measures both at home and abroad; accelerated research and development into new technologies; and an international regime involving the participation of all nations. The attached report confirms the basic wisdom of our approach, indicating that unless such elements are part of our policy, several key energy-intensive sectors could experience serious negative impacts. The report is based on a series of workshops conducted in June and July of 1996 by Argonne National Laboratory under contract with the Department of Energy. The views contained in this report are those of the workshop participants.

The workshops explored the possible effects of new climate change commitments on six energy-intensive industries (basic chemicals, iron and steel, petroleum refining, paper and allied products, aluminum and cement) that are subject to significant foreign competition. For each sector, Argonne selected a panel of industry representatives, experts from academia, environmental groups, organized labor, the financial community and government. These panels were then asked to assume a projection of energy price increases that incorporated specific assumptions about the energy price effects of a postulated climate change agreement, and to reflect on the possible industry responses.

The conclusions summarized in this report are predicated on specific restrictive energy price scenarios assumed in mid-1996, which were based upon interagency analyses of proposals advanced by other countries at that time. As such, these price scenarios do not reflect key policies advocated in international negotiations by the U.S. government in the intervening year. For example, the assumed fuel price scenarios do not take into account the impact of multi-year emission budgets, international emission trading and joint implementation. If adopted, these provisions would lower the costs of achieving greenhouse gas (GHG) emission reductions in the U.S. and other developed countries, and would significantly lower the energy price increases assumed in the workshop scenarios. Nor did the workshop participants consider the acceleration of energy efficient and low-carbon technology development from expanded R&D efforts by the



public and private sector, which could cushion the impact of energy price increases. Finally, the Administration has argued that developing countries should assume additional obligations in the near future to reduce their projected rapid growth of GHG emissions. No such actions are reflected in the workshop scenarios.

Participants in each sector met for separate half-day workshops to discuss the impacts these energy price scenarios would have on industry output, employment, energy usage, industry costs, industry prices, imports and exports. Based on the restrictive, and at this point, outdated energy price scenarios described above, the panelists reported negative impacts on the six industries. Under the given scenarios, panelists predicted the industries would experience reductions in output and employment from projected baseline levels. Less-developed countries -- which were assumed in the workshops not to adopt binding commitments to lower GHG emissions in the timeframe considered -- would capture an increasing share of the respective markets. Some industry representatives reported that it would be necessary to relocate under the hypothetical situation, and some reported that industry composition would change.

Despite their limitations, and taken in context, the workshops provided valuable information that has reinforced the need to pursue sensible climate change policies. The environmental and socio-economic issues surrounding the stabilization of GHG gas emissions have been the subject of considerable debate, but are especially sensitive now as participating nations are engaged in a new round of negotiations for further commitments within the Framework Convention on Climate Change that will conclude in December of 1997 in Kyoto, Japan. The U.S. position taken in these negotiations stresses that international agreements to combat the threat of climate change must be flexible, cost-effective, realistic, achievable, and ultimately global in scope. By examining scenarios that do not reflect such policies, the workshop papers have identified important economic risks in key industrial sectors that reaffirm the wisdom of the U.S. approach.

I hope that you find this report a useful contribution to the debate surrounding this important issue.

Go Skip Laitner!

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7/15  
Schaefer

CC Hearing - Janet & Tim Wirtl

2 reassurances from Admin.

- do not rush to sign a treaty - but get one that is achievable
- include all countries, so jobs + ~~etc.~~ etc. won't move overseas.

White - no previous work on the topic of CC

Whitfield - coal mining

Lemkus - coal mining in Illinois

Mr. Sawyer (Ohio) - member

~~being~~. The term economy or economics was brought out a few times in your remarks. Based on over the last four years of analysis, assessment -- and one of Congressman Dingell's points was, first, we have still not seen the Administration's economic model, economic assessment, analysis, even though, as Congressman Dingell pointed out, it has been promised for more than a year. I would be interested in knowing what the problem is. And second, maybe to a bigger point, Mr. Secretary, how can you go forward and make any decisions on economics and the consequences of these actions without any road map, without any analysis, without any assessment, without any model? So you can dive into that, Mr. Secretary, anywhere you wish.

**SEC. WIRTH:** Let me be very careful in what I say because I personally share many of your own frustrations in not having the models out. And I think many of us have been very frustrated by the great difficulty that has been reflected in attempting to take the three different fundamental models that are used and merge them into one. That process has been going on since our announcement in Geneva in 1996. And we had hoped, Mr. Chairman, to have those out early in the year. This task proved significantly more complicated than we had thought it was going to. For example, to give you -- there are three different models. None of them were really sensitive to including the very important joint implementation and emissions trading operations which changes the whole nature of this. That had to be fed in and worked. And that also proved to be very difficult. Second, we have discussed publicly in as many ways as we can, you know, the general approach that we are taking to this. I don't think it's any mystery about what the general parameters of what we are discussing is. Most people know what they are. And in fact, as I noted in my testimony, the first analysis out for peer review on May 15th has been broadly discussed in public. It was in Inside EPA. One of your future panelists used it as a basis of a broad discussion with dozens of highly-respected individuals in Baltimore ten days ago or two weeks ago. So, in fact, that first draft for peer review has been out very publicly. We are now accepting all of the comments. We are in the process of taking all of the comments. We have been asked if we would peer review it. We said, Yes, we would. It went out for peer review. It got leaked. That information is out. We have that back, and we hope to have that in very soon. Third, as a noneconomic modeler, Mr. Chairman -- although I have listened to all of these people to the point of almost becoming thoroughly anesthetized by them -- I do believe that one can put a certain amount of faith in these models. And they only go so far. You know, these models are not going to determine a whole lot of things. These are the same models that were very wrong about what happened with the energy bump up in pricing in 19 -- after the Arab Oil Boycott of 1972. They were models that, for the most part, were very wrong about the cost of the Clean Air Act. They are models that do not reflect a lot of other aspects, what happens with certain investments that we make in alternative energy programs, for example. There are other models. There are other groups out as a final comment.

For example, the Union of Concerned Scientists and NRDC have estimated that we could achieve a ten percent reduction by the year 2010 with investments that pay back to us, focused predominantly in conservation activity. Recently, the National Energy Laboratories Group came out saying that we could stabilize by the year 2010 at the equivalent cost of \$20 a ton, which would be about \$10 billion a year in overall cost to the US economy, which would then be fed back into the economy. And many think that would be a wash and maybe even beneficial. There are all kinds of different ways to looking at these models. We will have it out as soon as possible. Everybody will look at the models. But the models are one high priest of economic activity. Ultimately, we are all

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going to have to make judgments about what we do economically and environmentally and what makes the most sense.

SEN. HAGEL: Well, I understand that. But you reference cost savings, for example. And you reference the economics of some of the actions and the consequences of those actions. And so I'm still confused as to how you get there if you sort of dismissed economic models. And if you just dismissed economic models, then why is it important for us to have an economic model? Somehow along the way, here, Mr. Secretary, we have to base actions and understand consequences as best we can, as you suggest. But we should have some assumptions. We put -- as you know so well -- budgets together around this place based on assumptions.

And if you believe what Senator Byrd's charts referenced this morning and other references to those numbers today, it seems to me the economics of this are probably at the first grade here. And I would say, as you already know -- and I don't know what the problem is within the Administration here, why you can't come up with numbers. But you should have those numbers, Mr. Secretary, because that's going to be a problem.

SEC. WIRTH: Mr. Chairman, if I might, just very briefly, I'm not dismissing economic models. I'm just saying that economic models are a helpful tool like other things. But the ultimate judgment then has to be made by the Congress and the Administration in broad discussion. You know, they are not going to tell you exactly what to do. They are helpful indicators that provide us with information and further grist for the discussions that have to occur. When I mentioned cost savings and economic efficiency, those references, Mr. Chairman, were to joint implementation and to emissions trade. I mean, it's very clear. I don't think anybody disagrees with the fact that joint implementation and emissions trading will make the process and the cost of reducing greenhouse gases significantly lower. I think there is broad consensus on that. There's a great deal of economic data --

SEN. HAGEL: I don't think there is broad consensus on that, Mr. Secretary, not at all.

Senator Sarbanes?

SEN. PAUL S. SARBANES (D-MD): Did the Secretary want to respond?

SEC. WIRTH: Well, I'll be happy, Mr. Chairman, to if you all have questions about where the consensus may or may not be on emissions trading or joint implementation --

SEN. HAGEL: I have a lot of questions on that. But it's Senator Sarbanes time to ask questions. And I'll defer to him. And I'll have my round. We'll come back to it.

SEN. SARBANES: I'd like to try to trace through how we are -- where we are now. The framework convention that was adopted in October of 1992 was a -- that was where the parties committed to voluntarily bringing down the greenhouse gas emissions. Is that correct?

SEC. WIRTH: Yes, Senator Sarbanes. The term of art is a nonbinding aim.

SEN. SARBANES: And were all countries -- how many countries -- I saw 153 countries, I think, sign that. How many ratified it in the end; do you know?

SEC. WIRTH: A hundred and fifty some odd. Or now 161 countries have now ratified.

SEN. SARBANES: Now was each of the countries that ratified committed to the nonbinding objective?

SEC. WIRTH: No, there was a differentiation between countries, Senator Sarbanes, in what are called Annex One countries and non-Annex One countries.

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Now although much remains to be decided before December, Mr. Chairman, we are concerned that the United States has already agreed to a very dangerous principle that now governs the rest of the negotiations. At UN talks in Berlin in 1995, the US agreed to what's become known as the Berlin Mandate. It says that only Annex One countries would have to meet legally binding targets for their greenhouse gas emissions. Other countries, from impoverished developing nations like much of Africa to the fast growing economies of southeast Asia to China and Mexico, would have no binding limits on their emission. With rapid industrialization, the countries with no requirements will soon be responsible for well over half the planet's greenhouse gas emissions. And with no emissions reductions to meet, these countries will attract foreign businesses like a magnet.

While no firm decisions have been made regarding domestic reduction policies, all of the mechanisms under discussion would have the same impact, that is a sharp rise in energy prices, resulting in significant economic dislocation. For example, a carbon tax or carbon permit price of \$100 per ton of carbon is equivalent to a price increase of 26 cents per gallon of gasoline, \$1.50 per thousand cubic feet of natural gas, a \$52-per-ton increase in coal, and two cents per kilowatt hour of electricity. These are minimum levels of energy price increases for a policy to stabilize US carbon emissions at 1990 levels. Several studies have been done to estimate the impact of a treaty on the economy. A range of estimates exist. But even the most conservative estimate shows a large job loss as a result of policies to reduce emission. According to a 1992 study by the US Department of Commerce, a carbon tax that would help the US achieve emission reductions of the scale now being discussed in the UN would cost some 1.7 million US industrial jobs.

More recently, the Administration has conducted two studies estimating the economic impact of meeting emission reduction targets. The first was released in June of '96. And the second is currently in draft form, dated June '97. The '97 study makes new assumptions which reduce the estimated loss of production, or GDP, and implicit job losses by roughly one-half the expected GDP reductions estimated in the analysis a year before. The new assumptions also accelerate the economy's bounce back by several years. In general, under the '97 study, estimated GDP losses are assumed to be one-half of what they assumed in 1996. And they occur, the bounce back occurs, in half the time.

Nevertheless, even with those new assumptions, the Administration draft study shows that 900,000 jobs could be lost as a result of climate change policies. Jobs will be lost in nearly every region of the country and across a broad range of sectors. Those job loss estimates should be regarded as very conservative, Mr. Chairman. A much more realistic estimate of the impact of stabilization at 1990 levels would be in the order of 1.25 to 1.5 million jobs, with even larger job losses to achieve a reduction level below 1990 levels. And you'll recall that the proposal right now from the European community is to reduce below 1990 levels an additional 15 percent by the year 2010.

The '97 Administrative study does not attempt to measure the impact of the job loss to our international competitors who are not subject to emission limitations requirements. This is a crucial matter for jobs and incomes which the Administration must address. The Administration and its consultants expect that natural gas will displace coal in increasing quantities. The DRI model used by the Administration indicates that 57 percent of all emission reductions by 2010 and in the stabilization case would result from a reduced demand for coal. And that would increase to 65 percent by 2020. Energy-intensive industries would be most hurt by rising energy prices. Chemicals, refining,

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aluminum, paper, cement, and steel are included in the list of industries that would suffer the most serious job loss due to energy price increases. And the jobs and production would not disappear. They'd simply move overseas. The rise in energy prices would place US industry at a competitive disadvantage. As energy prices rise to reach more stringent targets, jobs will move to countries -- that's non-Annex One countries -- that do not have to meet those targets. Carbon dioxide emissions, as well as jobs and incomes, will move. Ironically, in those industries where jobs move, emissions of carbon dioxide as well as other air and water pollutants are likely to rise since the industries in the US must already meet more stringent standards, environmental standards, than our competitors. Both the target concentration level and the timetable for meeting these levels are still to be negotiated.

These are crucial decisions and must be carefully considered. A rush to judgment in Kyoto could result in long-term damage to our economy yet produce little or no environmental benefits. Two basic principles must guide our approach of these negotiations. First, all countries of the world must be included in emission limitations. Emissions in China alone are growing rapidly enough to increase carbon dioxide concentrations in the atmosphere even if all other countries were to reduce their emissions. Emissions of China and India will ultimately dwarf the emissions of the US as industrialization proceeds because of their much larger population. Second, emission reductions must not proceed in a manner or in a timetable that causes severe damage to the US economy. Jobs and incomes must be protected and adverse effects on our international competitiveness must be avoided. The current approach in the UN negotiations is fatally flawed, Mr. Chairman. It does not meet the requirements of equity or environmental effectiveness. It requires a very large de facto energy tax, the transfer of a large chunk of our industrial base overseas and at the end of the day, does little or nothing to improve the prospects for a better climatic future.

Mr. Chairman, the AFL-CIO is ready to work with you and your colleagues to develop tools to address climate change in ways that are equitable and genuinely deal with the problems. Global warming is a global problem. And our response must involve the entire international community. Thank you, Mr. Chairman.

SEN. HAGEL: Mr. Trumka, thank you very much. We'll listen to the remainder of the panel and then come back around for questions. Thank you.

Mr. Neidig.

MR. BRYCE NEIDIG: Thank you, Mr. Chairman. My name is Bryce Neidig. I'm a farmer and President of the Nebraska Farm Bureau Federation and a member of the Board of Directors of the American Farm Bureau Federation, which I represent today. My family owns -- and I operate with my son -- a 650-acre corn, soybean, and alfalfa farm in northeastern Nebraska near the town of Madison.

To give you some credibility about it being a farm. I live in the house I was born in, the same House my father was born in. My grandkids think I came with the place, but I didn't. (Laughing.) It's been in the family 105 years. I am very concerned that the international agreement on climate change will hurt my farm operation and others like it across the nation. I appreciate this opportunity to discuss a subject that practically every farmer is an expert on, the weather. Experts or not, they complain about it. It rains too much or too little. It's too cold or too hot. And frost threatens the harvest. We are interested in the weather because our livelihood depends on it.

Farmers who are aware of the Climate Change Treaty are concerned about controls which may be imposed on the farmer to reduce greenhouse gas emissions. They are concerned about higher costs for fuel, energy, vehicles, and equipment. They are concerned about new, burdensome regulation. They are concerned about threats

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are grateful for your time. You have each focused on a particular area that's of immense concern and I very much appreciate the courtesy that you've extended this committee, this body to come forward and talk a little bit about this important issue.

Mr. Trumka, let me begin with you. I'd like to focus a little bit on some of your testimony. I don't know if you were in the room this morning when Senator Wirth talked a little bit about it. My request, the conversation I had with him a couple of days ago regarding the ultimate goal of this treaty of 70 percent reduction in greenhouse gases. That's rather significant. Would you give me some analysis of what that would do to jobs?

MR. TRUMKA: It would devastate jobs, and particularly if the timetable were crunched in as they are currently proposing it. Right now, to get to 1990 levels and stretching it out to the year 2015 or 2020, you're looking at a job loss of a million and a quarter to a million and a half. If you magnified that to the level that you're talking about and keep the timetable the same, you're going to magnify the number of jobs lost. It would actually be devastating to various sectors of the economy. When you balance that against what it would do under the current structure, it makes absolutely no sense because they would shut a power plant down here and build a power plant in Mexico. They would shut a factory or a steel mill down here and build it somewhere else. We lost the jobs, they gained the jobs, and the environment gained nothing in the process.

Mr. Chairman, if you limit justify stabilizing us, stabilizing to the 1990 levels to the annex 1 countries, here's all you do. The CO emissions are scheduled to double, or are projected to double by the year 2066. If you put the burden on us and no one else, it will simply move the timetable back to 2059. Seven years difference in timing with job loss that ends up in the millions. SEN. HAGEL: To continue along these lines, your testimony also included comment that for every \$100 in a carbon tax or equivalent trading program, we'd be talking about roughly a 26 cent per gallon increase in gasoline.

Actually, I think those numbers, at least the numbers I've seen, are even higher than that so I think you take a pretty conservative baseline, which is good. First of all, give me a little more the impact in your analysis and the AFL-CIO's analysis on what that would do to the economy. And second, do you believe your membership, the people of this country would be willing to do that, and it all does connect back to something we talked very little about this morning. We tried to get there, and that's something Mr. Fay talked about, is the cost-benefit analysis of this. When you have no numbers, even though Secretary Wirth dismissed the models to some extent. I don't know how we get anywhere without having some cost-benefit analysis, some ratio, some rationale to accomplish whatever we need to accomplish. The last point on this is, I said right in the beginning of this hearing this morning there are few people that I know in this body or across this country that do not believe we have some problem here. We have to face this. And what we are trying to -- again, the identification of the problem, the magnitude, and then once we identify that with some basis of knowledge, of an analysis, the cost-benefit analysis is very important, then we develop a policy, a commonsense policy. So with that, would you like to talk a little bit about some of those issues, the gasoline tax, your membership. MR. TRUMKA: Absolutely, Mr. Chairman. First of all, it's hard for me as a negotiator, having to have negotiated literally hundreds of contracts, to comprehend how you can go into a negotiation, make proposals that are ultimately binding on you, without knowing with some specificity or at least a

fairly good understanding what those proposals are going to do. That's really what we've been told so far. Every time we've asked for an analysis on what these proposals will do in terms of impact on the economy, impact on jobs, impact on energy price increases, impact on trade, we are told that the models don't exist, we'll get to that. I think that's an unhealthy way of negotiating any kind of deal and I wouldn't advocate it to any of our membership. Our membership look at those prices and let's assume for just one second that they could pay a 26 cents increase for gas, or they could take a one-third increase in the price of their electricity. Are they willing to do that? I think highly unlikely they are, but the more realistic thing is, what does it do long-term to their jobs? Those type of price increases can destroy industries that, take their jobs away. Whether they were willing to pay them or not, they won't be able to pay them. There's simply no reason to rush to that right now until we've done a very thorough analysis of the impact and we can negotiate with all of our partners for a fair, level playing field so that we don't simply displace our jobs by having higher energy prices, higher taxes than our competitors and still have no gain to the economy. I think my membership or the membership of the AFL-CIO would be angered, to say the least, at some of these price increases. If you heat your home with gas, for instance, and the tax would go up \$1.50 per thousand, it's right now \$1.42 per thousand, you are doubling the price of gas. That's before you add the increase of what demand will do to a price increase. You look at the gasoline tax of 26 cents. A family farmer over there, he can't take a hit of that magnitude. They simply cannot do it and survive in today's economy. I think our people really want a clean environment. They want to leave a clean environment to their children, but they also want to leave a healthy, vibrant economy and these aren't mutually exclusive, Mr. Chairman. If we take our time and do it right the first time, we can get both. That's what I think my membership would demand and I think has a right to. SEN. HAGEL: Thank you. Senator Sarbanes?

SEN. SARBANES: Thank you, Mr. Chairman. The first question I want to put to each member of the panel is, do you think there is a serious problem that we have to deal with with respect to global warming? MR. NEIDIG: I think that there is a problem. Is it a serious problem? To be very candid, no, I don't think it's a serious problem. The industry I represent does not think it's a serious problem. Now I don't mean to the flip. I've not been around as long as Senator Byrd has, but in my life time, 1936 in the state of Nebraska, northeast Nebraska, we had 30 days that the temperature never got below 100 degrees in the summer, and 30 days in the winter the temperature never got above 0. We didn't hear a word about global warming. The last four years I could have used a little in the spring when I planted the crop. I don't think there's a serious problem. SEN. SARBANES: So you don't think we need to do anything?

MR. NEIDIG: I don't think there's a rush to do that. I think we need to be very aware and we need to be concerned, and certainly would be willing to work these things, but there is not a compelling reason to rush pell-mell to this at this time. SEN. SARBANES: That's a different question. MR. NEIDIG: Sorry? SEN. SARBANES: That's a different point. I mean, I wasn't exploring whether we should rush pell-mell. I thought never believe in rushing pell-mell into anything because you can always make it worse rather than better. The question is whether there's a serious problem that we need to address, and I take it your position is no. MR. NEIDIG: That's right. SEN. SARBANES: Mr. Fay? MR. FAY: I think our companies would agree with the consensus of the senators here that this is a serious problem that needs to be addressed, but it needs to be addressed over a long time frame, not some emergency short-term action.

SEN. SARBANES: But we need to try to come to grips with it. MR. FAY: Yes.

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...ts it would have on his membership, jobs, the ripple effect. I was talking with Senator Lugar this morning, who is a very distinguished member of this panel. Also, as you know, chairman of the Agriculture Committee. He was telling me that he had met recently with some individuals to the United Nations and they were talking about projecting out population numbers, what it was going to take to the feed the world. Somewhere 9 to 10 billion people in the world in 50 years, what pressure and burden that was going to put on our food producers, our farmers. And connecting that to what we have been talking about today is a pretty significant question and challenge. Would you develop a little bit for this panel, Mr. Neidig, some of the thoughts that you have regarding the numbers that have been thrown around here, what that would do to production, farm production to feed the world? MR. NEIDIG: Well, it would be, as I indicated, it would not only be drastic, it could be devastating. It would be devastating. As indicated in some of the figures I had here, my own farming operation, which is not large, it's average to small. You add that much cost we're talking about, whether it be 25 cents a gallon for gasoline or 50 percent increase or 30 percent increase, whatever, it gets to the point where it is absolutely uneconomical for me to continue the operation. Now that is not necessarily dependent upon the size of the operation because you just magnify the problem with larger operations under those kinds of situations. So we not only would reduce our ability to make a living or be profitable, we would reduce our ability to feed the world, if you will, because as you know, American farmers serve and feed many more people than just those in this country. So we not only become uncompetitive, we come out of business and there exacerbate the problem. It's hard to describe, Senator, exactly the fear and the concern that I and my people have if we faced this kind of a mandatory situation that isn't across the board. And even if it were across the board, we're going to significantly reduce our ability to produce food and fiber for the world.

SEN. HAGEL: Thank you. Mr. Fay, I'd like to get to some of your testimony. I have read your letters to State Department, the White House. I compliment you on each. They are well thought out. As your testimony, I think very poignantly brought out, what we are striving for is some kind of a policy that is economically sound, allows economic growth, continue to a higher standard of living for all our people. This is an argument that gets lost in this. I hear some of my colleagues talk on one side in the morning about, well, we have to give everybody equal opportunity and standard of living. Then in the afternoon they talk about, well, let's cut our economic growth back one or two percent because we're going to go do this. Well, we can do that. Something's going to give here. I am interested in your presentation today and the letters you sent to the White House and State Department from the standpoint of the commonsense approach you've taken on this on economics. First of all, range out a little bit for us on why we have not seen any cost-benefit analysis, any economic modeling, that I have seen at least, that would give us some sense of are we doing the right thing, tying where we want to go, this environmental policy to sound economic policy. MR. FAY: Well, I obviously can't speak for the administration on that point. I do know that it's been promised for over a year. There has been a lot of modeling going on, however, outside of the government. Frankly, it's all pretty consistent and it all points to the kind of conclusions that I outlined. But what is missing is, what are you thinking of in terms of implementation. The types of things you just asked about in terms of imposition of carbon taxes or various policies or measures, we're not interested in pursuing some laundry list of command and control programs or taxes to implement this initiative.

*Mr. Fay, Int. Climate Change Partnership*

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we've heard a lot about a potential of some kind of cap in trade, some emissions trading program. But we'd like to know, well, if you're going to institute a trading program, how are you going to allocate the rights to that and what's the cap going to be?

I can't respond to that. We all kind of know generally where the economic information is sending us, but we're not getting the kind of specifics, we're not getting the kind of dialogue we've been promised. You know, in 1993 the White House promised the White House effect on the greenhouse effect. Well, lately we've felt a little bit more like the whitewash of the impact on a blackout on information. We need to get that dialogue done, and if it's not going to get done by Kyoto, and I fear that it's too late to have that dialogue, then no, there shouldn't be an agreement because we have a right to know. Now they have ideas. They keep telling our information is showing that it's kind of a thing cited by the National Academy of Sciences that Senator Sarbanes referred to, that it's modest, that there are things we can do. That's the wonder of mind-numbing macroeconomic analysis. But there are certainly going to be some people who will suffer, such as Mr. Trumka's members, such as the farm community, such as the manufacturers that I represent.

We want to have that debate. We want to have that dialogue. We want to have it before they agree to the treaty, not after.

SEN. HAGEL: Are you familiar with a study I understand that was done in November, the Argonne National Laboratory study?

MR. FAY: I'm familiar with it.

SEN. HAGEL: My understanding is that the name of the study was "The impacts of potential climate change commitments on energy intensive industries." My understanding is also that that was never released. Do you know anything more about it than that?

MR. FAY: It was never officially released. I guess it managed, like drafts of the current economic analysis managed, to find its way out there. And we've been told that, well, it's a qualitative study, not a quantitative study and yes, it does point up to these objections.

We sponsored a conference last week where we asked them to present somebody to present their view and what was good or bad about the study. The administration declined, and so again, I know the study's out there. I don't think I mean, it suggests very draconian effects, it suggests that a carbon tax won't succeed in achieving the policy objectives they're trying to achieve.

Then it's suggested by the administration that that's not what the study was designed for. But if they are not going to tell us what it was designed for, or what they view it to do, we can't read their minds.

SEN. HAGEL: Mr. Fay, thank you.  
Senator Sarbanes?

SEN. SARBANES: Well, I think that's a very good point. In fact, I think your whole statement was very helpful in terms of its analysis. I take it your starting point is that we should be striving to reach an agreement but we need to be very careful in how we do it and take into account these various concerns that you raise here. Is that a fair statement?

MR. FAY: Yes, sir.

SEN. SARBANES: I have to tell you, I'm not so sure that there's at least it seems to me there's considerable room here to advance with respect to controlling global warming without getting yet into the situation of paying significant costs. Now at some point you're going to get a tradeoff, but you know, if we're using double the energy that our competitors are using -- you know, the price of gasoline in this country is, compared with other industrial countries, is far less.

(H) 203 562

6804

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NORDHAUS

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3/25/97

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Estimating the Economic Effects of Global Climate Change Policy

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(805) 893-3678

DeLamio  
Scott

● Introduce yourself

1. Calling from CEA at Janet's request

2. The topic is the comments on the Interagency analysis of climate change

3. The event that is triggering the call is that your comments have been requested by the Hill (Congress) House <sup>commerce</sup> subcommittee or Energy & Power

⇒ Goes to Congress tomorrow might have  
(Our position - CEA/Admin - we ~~would like~~ to respond to these requests but we ~~want to~~ don't want to blindside you if your comments were sent to the Hill. This could happen as soon as ~~there~~ tomorrow.)

⇒ ~~The document will likely be released tomorrow (undelayed)~~

I am calling from CEA at our chair's request (Janet)  
The reason I am calling is because your comments have been requested by House Commerce Subcommittee on Energy & Power.  
We ~~would~~ (CEA/Admin) would like to respond to these requests ~~but~~ and we don't want you to feel blindsided if your comments are indeed sent to Congress as early as tomorrow

That's fine w/ him - Robert Scott - OK

● (203) 432-4771

~~Aragon~~



Not -

Study on competitiveness

Base

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## **Clinton Presidential Records Digital Records Marker**

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This is not a presidential record. This is used as an administrative marker by the William J. Clinton Presidential Library Staff.

This marker identifies the place of a tabbed divider. Given our digitization capabilities, we are sometimes unable to adequately scan such dividers. The title from the original document is indicated below.

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**3**

Divider Title: \_\_\_\_\_

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

12-Mar-1997 09:40am

TO:            RHOADS\_T

FROM:          Matthew A Oravetz

SUBJECT:      Re: energy models

Tom,

There is a pretty good description of ETA-Macro in the 1992 Manne & Richels book. I can fax you something (maybe the relevant chapter) if you like.

I'll have to look to see if I have a concise description of ERM. Maybe the Edmonds & Reilly book "Assessing Global Energy" c.1985. I'll see what I have.

Thought some more about expecting such "high" AEEI numbers for a 30 yr horizon. No way. The rates EPA wants to use are as high as any numbers we've experienced in the last 40 yrs... and that was on the heels of the Oshocks. We observe that AEEI rates have declined as that episode fades into the past. Both macro & micro studies find this (ie my study, Newell et al, surveys that ask auto purchasers the most desirable attributes of the cars they select).

There may be some autonomous component to energy-efficiency, but there is no way that it will magically stay as high as EPA says. There is just no evidence to suggest that we can maintain those rates of efficiency improvement. Instead, historical evidence suggests that AEEI responds to stimuli. Thus, the only way to maintain elevated AEEI is through policy (price, regulation, maybe leadership & others).

Are such programs forthcoming? Probably not. Even if we are able to intervene through policy, diminishing returns (or other issues, demographic trends, behavioral issues, etc etc) might limit opportunities for conservation (ie. limited amount of structural transformation possible in the macroeconomy - we've already moved towards a 'service' economy & it's not clear how much more efficiency improvement we can expect from this mechanism). No one has begun to study this (the literature is only beginning to be able to predict innovation let alone the diminishing returns). Anyway, the uncertainty and plausibility of arguments that would tend to limit conservation should be reason enough to be more conservative than EPA regarding AEEI assumptions. The diminishing returns argument may be compelling for your target audience. Let me think of some specific demographic & behavior examples.

In short, the EPA values would be unprecedented in historical experience, and hence, are probably overly optimistic.

\*

Hope you can make your way through my logic. I'll see what I can dig up for you. Talk to ya soon.

-Matt

June 17, 1997

**FAX MEMO**

**TO:** Katie McGinty, David Sandalow at CEQ  
Dan Tarullo, Mark Mazur at NEC

**FROM:** Dirk Forrister, Climate Change Task Force

**RE:** Attachment

---

Attached is the version of the document that was delivered to Todd Stern. It was shortened per Todd's comments, eliminating the "message" text.

Thanks.

cc: JY  
JAT  
J.S.  
AM  
JK

## **Climate Change: The President Engages the American Public**

**Overall Goal:** Show the American public that President Clinton is determined to combat climate change in a way that deserves broad support and benefits from the involvement of a broad range of participants.

### **Overall Strategy: A Three Pronged Approach**

1. President's Vision Set Forth at UNGASS
2. Engage American Public in National Dialogue
3. Outreach to Policy Community

#### **1. President's Remarks at UNGASS: Intensive Engagement to Chart Path Forward**

**Goal:** Set President's vision for approaching climate change and begin national dialogue, drawing business, labor and environmentalists into a cooperative process on how best to move forward.

#### **2. Engaging the American Public in a National Dialogue on Path Forward**

**Goal:** Elevate public understanding of the importance of changing climate and build support for national policy priorities developed cooperatively through an open dialogue with the range of affected constituencies.

#### **Strategy:**

- **Presidential Events:**
  - 3 radio addresses by end of September (first possibly on June 28)
  - Message-of-the-day events; for example:
    - Kick-off of Million Solar Rooftops (Virginia PV plant or sites in SW/West Coast)
    - Visit Chicago's Board of Trade SO<sub>2</sub> Trading Center
    - Visit a GLOBE school site
    - Visit the Denver Clean Car Exhibit at G-8
    - Visit New York Harbor to highlight sea level rise issues
    - Visit National Park where fragile ecosystems are threatened.
- **Vice Presidential Events:**
  - Site visits to technology demonstration projects (e.g. biomass or wind demonstrations in Iowa or Minnesota)
  - Announce a New Clean Cities participant (Houston, Phoenix, New York City)
  - Partnership for Advanced Housing Technology (new development at Stapleton Airport in Denver or southern California/Florida in disaster vulnerable areas)
  - Visit a Federal facility participating in the Federal Energy Management Program

- **Regional and National Workshops:** Conduct three regional conferences leading to a White House Conference. Three to five cabinet members and senior White House staff would participate in each. Conferences conducted in roundtable format, chaired by senior Cabinet members. Each would begin with key presentations, followed by open dialogue. Open to press and encourage live C-Span coverage. Conduct press backgrounders before and after. Involve regional corporate CEO's, academics, environmental & labor leaders, governors, other state & local leaders, religious leaders and members of Congress. All conferences would be comprehensive, but each would have a special focus, tailored to region.

**Locations:**

- **East:** New Orleans, Charleston, Miami, or the New Jersey shore. **Highlight:** Coastal storms damage, infectious disease risk and forest system impacts in southern and eastern states.
- **Mid:** Columbus, Detroit, Chicago, or Indianapolis. **Highlight:** Agriculture shifts, coal community impacts, heavy manufacturing impacts and opportunities.
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- **National:** White House/DC, Baltimore, Richmond, New York. **Highlight:** Comprehensive integration of concerns into a need and pathway for action.

### 3. Outreach to the Policy Community

**Goal:** Engage policy community (CEOs and Congress in particular) in design of policies that comprehensively address climate change mitigation and that garner their support.

**Strategy:**

- President and VP should each reserve 10 - 12 slots for climate orientation briefings and meetings with industry leaders between now and Labor Day. Cabinet members should be given key responsibilities for particular sectors/industries. Should schedule in close coordination with National Dialogue meetings. Also encourage Cabinet members to host at least one public meeting and make a major speech.
  - Examples for President: meeting with Nobel laureates, meeting with religious leaders, meet with Congressional leaders to stress environmental imperative.
  - Examples for Vice President: Dinner with Congressional leaders; Lead a Congressional visit with scientific leaders to the Smithsonian's climate change exhibit.
- **Industry Roundtables:** Series of CEO meetings with POTUS, VP, Cabinet members &

other senior staff. Offer our policy inclinations, get feedback and ask for their ideas on what's missing. Examples:

- Invite Norm Augustine, CEO of Lockheed Martin, to bring 10-15 CEOs of major environmental technology firms for meeting.
- Invite John Browne, CEO of BP, to bring 10-15 oil/gas CEOs for meeting.
- Invite R. Linn Draper, CEO of AEP, to bring 10-15 moderate electric utility CEOs for meeting.
- Invite Ken Lay, CEO of Enron, and Dennis Bakke, CEO of AES, to bring 10-15 independent power developers for meeting.
- Invite Michael Bonsignore, CEO of Honeywell, to bring 10-15 energy efficiency technology firms for meeting.
- Invite 10-15 renewable energy CEOs for meeting.
- Disseminate broadly the results of the PCAST review. The Committee has been challenged to produce an energy strategy that will meet the "energy and environment needs of the next century" by October.
- We should still consider an open meeting with the Washington, D.C., policy community on peer-reviewed economic analysis and other information to be used in the regional conferences.

#### Notational Schedule:

|              |                                                                                                                                                                                                                  |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| June 24-7:   | OSTP South East Regional Workshop (Vanderbilt) - <i>scheduled</i>                                                                                                                                                |
| June 25:     | VP Attends OSTP Impacts Workshop (Nashville) - <i>scheduled</i>                                                                                                                                                  |
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| Early July:  | Public Release of Economic Analysis - <i>TBD</i>                                                                                                                                                                 |
| Early July:  | Cabinet Orientation - <i>TBD</i>                                                                                                                                                                                 |
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|                 |                                                                |
|-----------------|----------------------------------------------------------------|
| Late September: | White House National Conference - <i>TBD</i>                   |
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| October:        | PCAST strategy due                                             |

June 17, 1997

**FAX MEMO**

**TO:** Todd Stern, Staff Secretary  
Katie McGinty, David Sandalow at CEQ  
Dan Tarullo, Mark Mazur at NEC

**FROM:** Dirk Forrister, Climate Change Task Force

**RE:** Attachment

---

At the direction of Shelley Fidler and David Sandalow, I have tried to incorporate comments to the attached in response to the morning meeting. OSTP sent several suggestions, which we incorporated as best we could in time available.

Obviously, it got longer. Now 5 pages. I am open to suggestions -- easiest way to shorten is to drop out "messages" and save for later.

Please advise.

Thanks,

Dirk at 343-1060  
(Or fax changes to 343-1162)

cc: JY  
AW  
JAF  
SS  
RJR

DF

## Climate Change: The President Engages the American Public

**Overall Goal:** Show the American public that President Clinton is determined to combat climate change in a way that deserves broad support and benefits from the involvement of a broad range of participants.

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3. Outreach to Policy Community

### 1. President's Remarks at UNGASS: Intensive Engagement to Chart Path Forward

**Goal:** Set President's vision for approaching climate change and begin national dialogue, drawing business, labor and environmentalists into a cooperative process on how best to move forward.

**Message:**

- America has played an important role in this century for a peaceful and prosperous world. There are new challenges on the horizon. As America prepares to enter the 21<sup>st</sup> century, we are committed to improving our public education, advancing free trade, and beginning the transformation to a more sustainable environment.
- Climate change is our most important global environmental challenge as we approach the 21<sup>st</sup> century. The science is firm; the early evidence is consistent. Risks of inaction are high and unacceptable: increased storms, droughts and heat waves; increased sea level rise; more spread of infectious disease; problematic agricultural shifts; loss of forests and ecosystems. Costs of action are low and manageable, provided that policies are flexible and market based and that technology is deployed. Waiting isn't the answer because it makes the job harder to solve.
- I know the economy and how to create jobs. I am going to promote America's economic future and enhance the prospects for American workers. And I am going to find a way to address climate change effectively. We can do both.
- The path forward is clear: we need an effective international policy to control emissions. We're committed to maximum flexibility for businesses so we can achieve the greatest environmental benefits at the lowest cost. We need a commitment to act but act thoughtfully and a recognition that this is a global issue to be addressed globally. We need policies that send strong signals to the market spurring investment and innovation in technologies that reduce greenhouse gas emissions.

- I need the business community to step forward to work with us to find solutions. We need honest dialogue and a common vision. We need pragmatic steps now and ambitious goals for the future. We need to turn our technological prowess into an engine for change in abating greenhouse gas emissions. We can do this together, if we set our minds to it.
- Today, I'm asking every American to consider being part of this solution. Over the coming weeks, I'm asking the Vice President and my cabinet to engage in a new dialogue with the American public to find a common vision on the policy solutions required. I want them to report back to me at a White House Conference in early September with their findings on how best to move forward.
- I know that with the strength of the American spirit, the ingenuity of industry and the dedication to our children, we will meet this new challenge.

## 2. **Engaging the American Public in a National Dialogue on Path Forward**

**Goal:** Elevate public understanding of the importance of changing climate and build support for national policy priorities developed cooperatively through an open dialogue with the range of affected constituencies.

**Message:** We're serious about addressing climate change problems. We can meet the challenge better by working together than apart. We want to share what we have learned about climate science, economic impacts and opportunities, and possible policy alternatives. We want to listen to your views and incorporate them into our decision making. With concrete proposals, business can play a critical role in our decision making. We want to draw together America's best scientists, economists, and industry leaders to chart a path forward. And we want to go united into the world community with a vision of where all of America believes we should go on this critical issue.

### **Strategy:**

- **Presidential Events:**
  - 3 radio addresses by end of September (first possibly on June 28)
  - Message-of-the-day events; for example:
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**Message:** We need your help. Work with us, and we will jointly develop solutions that will work effectively and mitigate negative economic impacts to your business.

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meetings with industry leaders between now and Labor Day. Cabinet members should be given key responsibilities for particular sectors/industries. Should schedule in close coordination with National Dialogue meetings. Also encourage Cabinet members to host at least one public meeting and make a major speech.

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- We should still consider an open meeting with the Washington, D.C., policy community on peer-reviewed economic analysis and other information to be used in the regional conferences.

#### **Additional Points:**

#### **Resources:**

- In order to implement the strategy effectively, we need to significantly upgrade our

outreach effort. It will take significant financial and staff resources to conduct preparations and carry out events and follow up. White House communications and advance personnel could contribute expertise in planning this education drive. In addition, principals would need to make time available for preparation, speeches, roundtables, etc.

- Up to \$2 million (rough estimate) would be required for the regional and White House conference. We will need to designate a central coordinating facility to augment the White House Climate Change Task Force on this project.

**Orientation:** In order to jump start the process, it will be necessary to have a half-day orientation session for principals, perhaps at the Vice President's residence or the Blair House. This would cover science, economics, technology, and policy options. This would happen in early July.

#### Notational Schedule:

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| October:        | PCAST strategy due                                                                                                                                                                                               |

## **Things to think about for global climate change**

15 June 97

### **Immediate issues:**

- Short-term continuation of the IAT
  - Mark M. with a senior advisory committee oversight (CEA, OMB, OSTP, CEQ, NEC) that would coordinate the roll-out
- Op-ed by Ev Ehrlich
- Impact papers from OSTP
- Human resources
  - Abe Haspel (DOE) has volunteered to send a full-time person to CEA

### **Questions**

- What is the ultimate economic message of the Administration on global climate change?
- Who should do an analysis of the 5 options in the memo to the President--the IAT or off-line?
- What economic information would be most helpful to US negotiators before and in Kyoto? (Trade-off frontiers)
- How large a role should the CEA play in the institutional design of emission trading systems?
- Should we use Goulder's CGE model to evaluate the alternative revenue recycling options?
- Should we go off-line to estimate the carbon leakage/carbon addition and compensation ideas for LDC policy?

# Issues for Improving the IAT Modeling Effort

## Summary of Reviewer Comments

### Summary

The IAT draft report was a worthy first step in analyzing the impact of climate change policies on the US economy. This effort could be improved by using additional models and techniques, more adequately representing international and technological aspects, and by modeling the benefit side of policy options. There are also a number of second order details that could be dealt with in a more rigorous fashion.

### First Order Issues

#### 1. *Inadequate Models for the Purpose*

"The suite of models chosen for the analysis is simply inadequate." (Kopp) Specifically, they cannot deal sufficiently well with:

- current domestic policy options (a trading program)
- the effects of international flows on US trade balance and competitiveness
- technical progress and its costs

Reputable and more appropriate models do exist to address these issues, they should be used.

#### *Specifics*

- DRI -- This model is not adequate for the long-term economic forecasting being done. Furthermore, since it's treatment of trade and savings is controversial, we should not be overly reliant on its results.

"This model is especially appropriate for projecting the impacts of monetary and fiscal policy over a time frame of approximately two or three years. For longer term projections, however, it is highly inappropriate and has some important limitations that are well known to the community of economic forecasters. For example, the DRI long term projections are extremely sensitive to assumptions about energy prices...." Furthermore, it uses a fixed-coefficient input-output model, which goes against the primary objectives of climate policies. (Nordhaus & Jorgenson)

"The entire issue of the effect of deficits on saving is controversial, to say the least, and there is no agreement among economists that the way these issues are handled in the DRI model is correct." The DRI results indicate the energy intensive Hydraulic Cement and Primary Aluminum industries are among those that will most benefit from emissions reductions -- a very skeptical result. (DeCanio)

- Markal Macro -- "Not an economic model, and suffers from many weaknesses..." Should consider using a more rigorously tested model -- MERGE. (Kopp)
- SGM -- "The biggest limitation of models like SGM is the representation of the energy-economy interface... In particular, the representation of the cost of abatement

as flowing primarily through specific energy sector investments will not capture the other costs arising from changes in the scale and composition of economic activity. In addition, models like SGM may fail to adequately capture the opportunity costs of technical substitution, thus understating the costs of abatement policies. These models are typically based on a careful characterization of potential technical options, but without a full recognition of the tradeoffs faced by real economic agents.” (?)

- “Understanding the long term consequences of GHG accumulation requires a focus on how economic agents respond to market and non-market signals. None of the models you have selected can address this issue... Equally important, an evaluation of the adjustment costs imposed by policy requires a model of short and long term substitution in response to a different set of policy induced market and non-market signals. In this case, as well, the models are incapable of addressing the question.” (Smith)

### *Next Steps*

- Add a computable general equilibrium model -- candidates include models constructed by Jorgenson and Wilcoxon, Goulder, and Harrison and Rutherford; as well as models from EPA. (Kopp)
- Add a trade model -- “Until you employ a trade model that incorporates the effect of changing prices both within and across countries, [I recommend] that you drop the section on sectoral detail”. (Kopp?)

## **2. International Aspects**

The analysis to date has ignored the possibly large effects of international flows resulting from an international carbon trading system. These could have a substantial impact on the US current account, which would require currency and/or capital adjustments. This needs to be factored into the analysis and cannot be done with the models currently being used.

### *Specifics:*

- World Trade None of the models includes a sufficiently detailed representation of world trade to study the issue of international implementation and impacts. SGM, for example, models energy utilization in each of the regions included in the model. However trade in goods and services among the regions is not modeled.... This is another crippling deficiency of the analysis.” (N&J)
- Investment Diversion If only Annex 1 nations are included in an agreement, outsourcing and carbon leakage may be a problem. “If US firms move (or build new) factories in Mexico, rather than the U.S., this will reduce investment spending in the U.S. As a result, there will be less demand for investment goods and a smaller manufacturing sector overall. This effect needs to be examined carefully...” (Scott)
- International Emissions Permit Trading “I find it very implausible that allowing for international trades in emissions rights would reduce the price of permits by as much as predicted by the SGM model. Even if permit-selling countries initially have much lower costs of abatement... the marginal costs of abatement can be expected to rise

for the permit-selling countries as they undertake more abatement.” Does the SGM model capture this effect? (??)

Under global trading in emissions rights, what is assumed about non Annex-1 emissions constraints? Modeling this behaviour “will require a model with some ‘look-ahead’ capability.” (Richels)

#### *Next Steps:*

- Add a model capable of representing world trade.
- Run an alternative set of scenarios to evaluate the effects of a border equalization tax which could be used to reduce the effects of the cap system on trade and investment flows. (Scott)

### **3. Technology Change**

Most reviewers (6 of 9) were skeptical of the rates of autonomous technological change and the way the “announcement effect” was represented. While most thought these were too high and not justified by the historical evidence, one reviewer believed they are too conservative. There is also concern that none of the models used can represent industry response to government policies and “announcements.” Without such capability, the results are highly suspect. In all, there is little consensus among experts as to how technological change will affect the costs of emissions reduction policies, nor how to model that process.

#### *Specifics:*

- Representation in Models -- “None of the models is well suited to take account of the more rapid diffusion of existing technologies that would accompany a clear and unambiguous price-like signal in favor of energy efficiency.” (DeCanio)

“To my knowledge [none of the models used] has any behavioral equations that would permit an anticipated change in energy prices to affect diffusion rates or rates of technological progress. Moreover, to my knowledge, no model has such behavioral links.” (Kopp)

“How is the announcement effect modeled? Do people run an inter-temporal optimization with look ahead to see what people would do now if the cost of using carbon is substantially higher in 20 years?” (Weyant)

“There is considerable confusion as to how the specified E/GDP ratio is actually implemented in each model. How does it affect the definition of the base case in the 1.25 scenario? What is the impact on the base case carbon emissions? Is it uniform across models?” (Richels)

- Assumptions -- “The sets of assumptions regarding energy efficiency trends seem unsubstantiated and to cover only the high end of the distribution.” Work by a number of researchers suggest trends more like .5 to .7. (Weyant)

“...many reviewers will be interested in the empirical support for the values chosen” for the announcement effect. (Richels?)

- Issues of Analysis -- The analysis appears to hold implicitly that both the current level and the current allocation of R&D is optimal. If this is not the case (and several studies indicate we underinvest in R&D), then increasing aggregate R&D would improve welfare. (DeCanio)
- Costs of Technology "It is quite plausible that the announcement of the policy would stimulate greater R&D and an associated increase in energy efficiency. However, such an improvement involves a resources cost: in general, additional resources must be devoted to R&D to generate this improvement. Knowledge-generating resources usually are not unemployed resources that can be obtained at no cost.... The baseline seems to assume that additional technological progress in energy efficient technologies does not involve any resource cost. This seems overly optimistic." (Goulder)

#### *Next Steps:*

- Mechanism of the Announcement Effect The announcement effect should not lead to an immediate increase in the rate of improvement in energy intensity. The "starting point" scenario should begin with the 1.0% increase and gradually increase the rate to 1.25% over time. (Kopp)
- Energy Efficiency Trends Use .5 or .7 as baseline and go .5 up and down for optimistic/pessimistic cases. (Weyant)
- "One experiment you may wish to conduct with Markal Macro is to explore the technology assumptions required to produce energy intensity reductions of the magnitudes discussed..." (Richels)

#### **4. Benefits**

Nearly every reviewer highlighted the need to examine the benefits as well as the costs of policy options. "Since the overall goal of U.S. policy is fundamental to everything that follows, inattention to the goals of policies is in our view a crippling deficiency..." (N&J)

#### *Specifics*

- "None of the models addresses the overall goals of us policy in the international arena or measures the extent to which different policies attain these goals. (N&J)
- The effort should consider the key policy "end states" (ultimate objectives) and evaluate options according to their effect on those end states. (Smith)

#### *Next Steps*

- "Inclusion of [the risks of climate change] using probabilistic decision analysis is within the capability of modern econmic analysis, and such calculations are crucial to assessing the full magnitude of the climate problem." (DeCanio)
- "Every effort should be made to quantify the benefits of carbon abatement and to integrate these estimates into a modeling framework that leads to the identification of the target and timetable as well as the cost." (Kopp)

## Second Order Issues

### *Assumptions*

- Baseline estimates for energy use and carbon emissions could be improved by running several scenarios of likely growth, especially for the Former Soviet Union. (Kopp) Additionally, the base case carbon emissions growth seem to be on the low side. (Kopp) "Oil and gas prices are assumed to rise, in contrast with the history of declining real prices over the period 1990-95. Coal prices are assumed to fall more slowly than in recent history. What is the basis for assuming faster price increases or slower price reductions than in the past?" (Goulder)
- Price Elasticities for Energy Demand in the DRI model may be on the high side. (Richels)
- Role of Monetary Policy It seems that results are "extremely sensitive to assumptions about monetary policy. The plausibility of these assumptions need to be examined... Is the Fed really going to act as suggested... Can monetary policy have these kinds of permanent effects on the growth rate? What effect does the recent budget agreement have on all of this?" (Richels)
- Nonconventional oil resources "I am hearing more and more talk about the availability of huge supplies of low-cost shale oil and tar sands at prices in the \$15 and \$20 per barrel range. If this turns out to be the case, baseline carbon emissions will be higher than projected as will the cost of a carbon constraint." (Richels)

### *Next Steps:*

- Considerably more sensitivity analysis is necessary to bound the range of costs. (Richels)
- Use more than one set of baseline assumptions. "We caution you... about the pitfalls in relying on a single set of assumptions for all the models. We recommend having a set of runs in which individual modelers use their own baseline assumptions for economic growth and energy utilization in order to describe the possible range of policy impacts." (N&J)

Energy predictions could be compared to the poll results of the 1997 International Energy Workshop published by the International Institute for Applied Systems Analysis.

### *Scope of Analysis*

Current modeling runs and efforts have focused on a few limited scenarios. Several reviewers suggested a more comprehensive analysis be undertaken to answer questions of timing and the optimal reduction.

### *Specifics*

- Analysis is insufficient to answer the timing debate. Specifically, "the issues of concern first involve a target later than 2010 and second the idea that it is better to abate later while enhancing technological knowledge now so that the cost of abatement later is lower." These are not dealt with in the current draft.

- Issues of intertemporal trading should be included in the analysis -- how many years should be in an emissions budget?
- "The [starting point scenario] may represent a reasonable starting point ... the degree to which you experiment with alternative emission constraints seems to be somewhat limited. ... you could examine what might constitute cost-effective strategies for limiting concentrations to alternative levels and *then* explore the implications for near-term mitigation decisions for Annex I nations... Alternatively, you could take an approach favored by many economists and employ cost benefit analysis as a guide to ... identify mitigation strategies that minimize the sum of costs and damages. ... I have seen very few economic analyses that suggest that stabilizing Annex I emissions at 1990 levels in 2010 or 2015 makes sense from the perspective of economic efficiency." (Richels)
- "Our reading of the evidence is that current assessments do not support the idea of focusing primarily on stabilizing emissions, particularly when stabilization is limited to the high-income countries. Indeed, some analyses indicate that stabilizing emissions is worse than doing nothing." Further analysis is needed to identify an "optimal" policy, which could serve as a benchmark for comparison. (N&J)

### *Next Steps*

- "I urge those responsible for the IAT to take a careful look at the existing literature on this topic. Most particularly, I recommend the EMF-14 study which contains a wealth of useful information." (Richels)

### *Alternative Metrics*

- Why the focus on GDP when the report states consumption may be a better measure of consumer welfare? Figures based on consumption look much less optimistic. (Richels) There are alternative metrics for measuring impacts, but their use is not facilitated by the models being used. (Kopp)
- "For ease of comparison, it would be helpful if results were also summarized in terms of discounted present value. Since most of the present values will be negative, this will give some indication of how large the benefits from a climate policy must be in order to outweigh the costs." (Richels)

### *Revenue Recycling*

- "It is not generally accepted... that it is possible to tax ourselves into prosperity... The balance of evidence suggests that although recycling of pollution tax revenues through reducing other taxes is better than simply imposing the pollution taxes, the pollution taxes are justified only if they do ... produce environmental benefits." (DeCanio)
- "Most of the policy analysis in the report assume that revenues [will be used to reduce the deficit]. This implicitly assumes that congress will agree to impose a huge tax on the economy... along with the restriction on emissions... For this reason, the best estimates of the effects of the most likely policies is provided in the "auction, 100% returned to consumers" case..." (?) This case, therefore, deserves more attention. Furthermore, to isolate the effect of the carbon emissions restriction

policies, the deficit reduction effect (from the personal income tax case) should be subtracted from the 1990 level case. (Scott)

- More information is needed to evaluate the way revenue recycling was modeled. "The effect of the policy depends critically on which taxes are reduced in the future in the same way that the effect of a policy involving current tax reductions depends critically on which taxes are lowered today." Assumptions about future tax reductions should be made clearer. (Goulder)
- Theoretical and empirical work [indicates that grandfathered permit] policies are considerably more costly to the economy than if revenues are returned through cuts in other taxes. Yet the results in figure 13 are contrary. "I find this very implausible." (Goulder)

### **Other**

- The current modeling effort should be placed into the broader spectrum of other modeling being done (Stanford's Energy Modeling Forum and others)
- "It should be pointed out that delayed implementation implies a smaller reduction in cumulative emissions." (Goulder)
- "The time frame of analysis is unnecessarily short. The adverse effects of increasing atmospheric concentrations of GHGs occur primarily in the long run, so ending the analysis in the year 2020 necessarily cannot capture these effects." (DeCanio)
- The models "omit feedbacks from conventional pollutants to the economy... Though far from definitive, modeling work by Jorgenson, Goulder, Boyd and Viscusi suggest that such feedbacks are quantitatively significant relative to other net economic impacts of climate policies." (Repetto)

6/11

IAT - Reviewers comments

Markal - Similar to linear programming, is not economic (more technology than MERGE)

DRI - short term vs. long term reliability issue

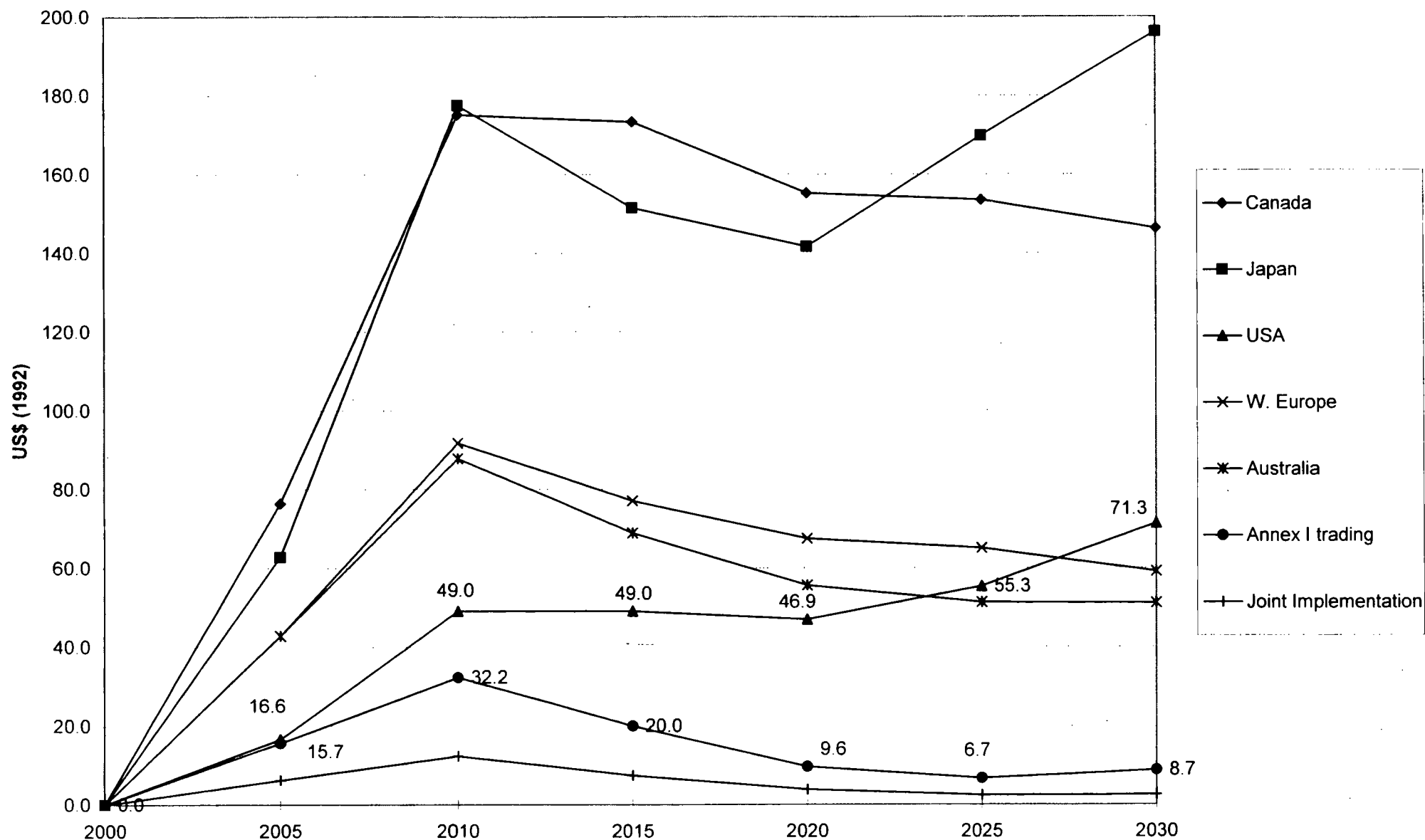
Baseline - suggestion about multiple baselines for FSU.

\* Generate responses to technology questions from reviewers -  
Don and Skip

- 
- arbitrage
  - ex ante/ex post
  - warm glow

- but little suite
- ~~as~~ results consistent

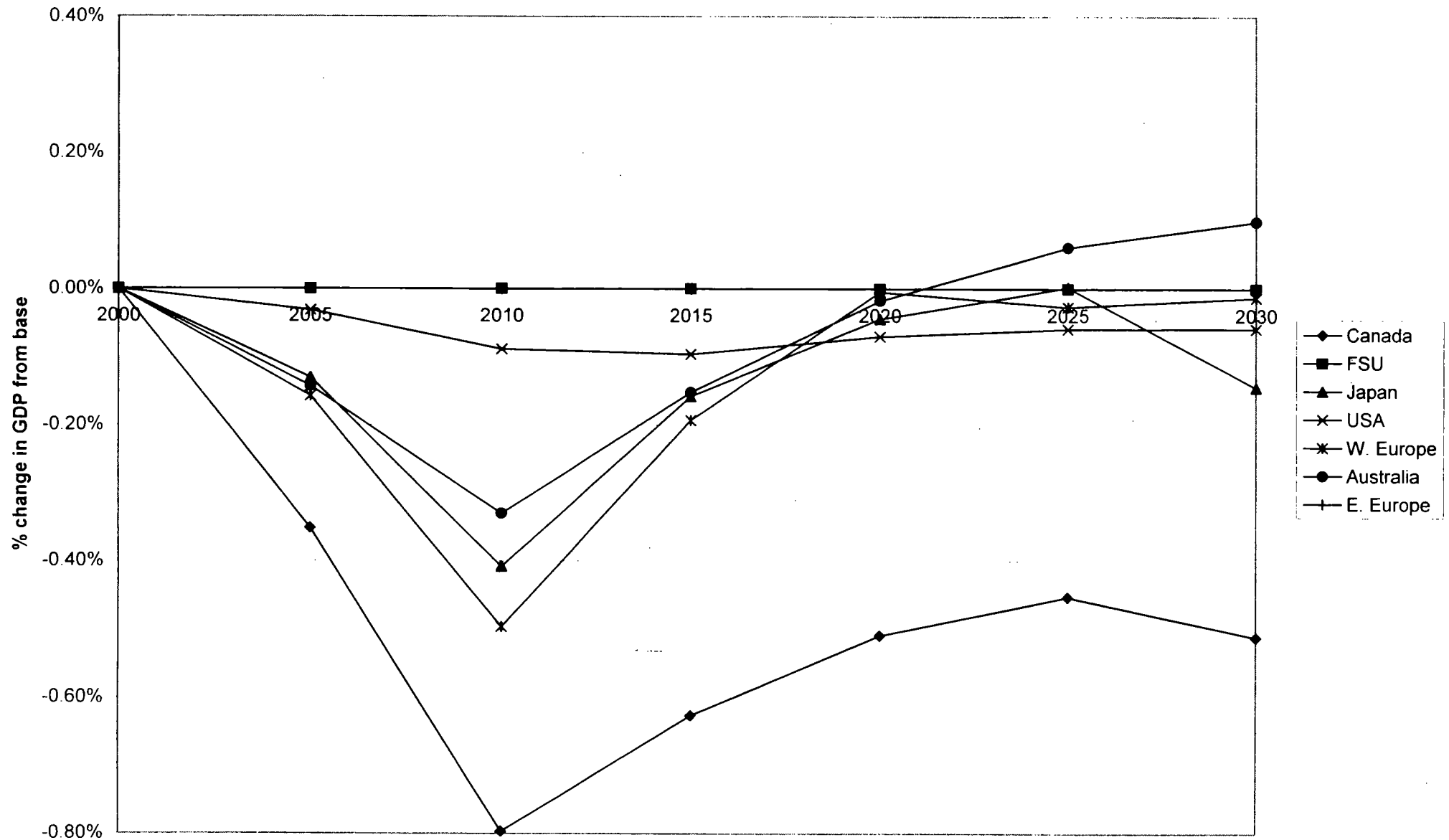
# Implied Permit Prices for Annex I Stabilization



0.75% additional decrease in C/GDP in Annex I  
 Carbon permit revenue recycled 100% to deficit reduction

Annex I stabilizes at 1990 levels in 2010, with 10 year policy base-in  
 FSU and Eastern Europe trade from projected emissions baselines

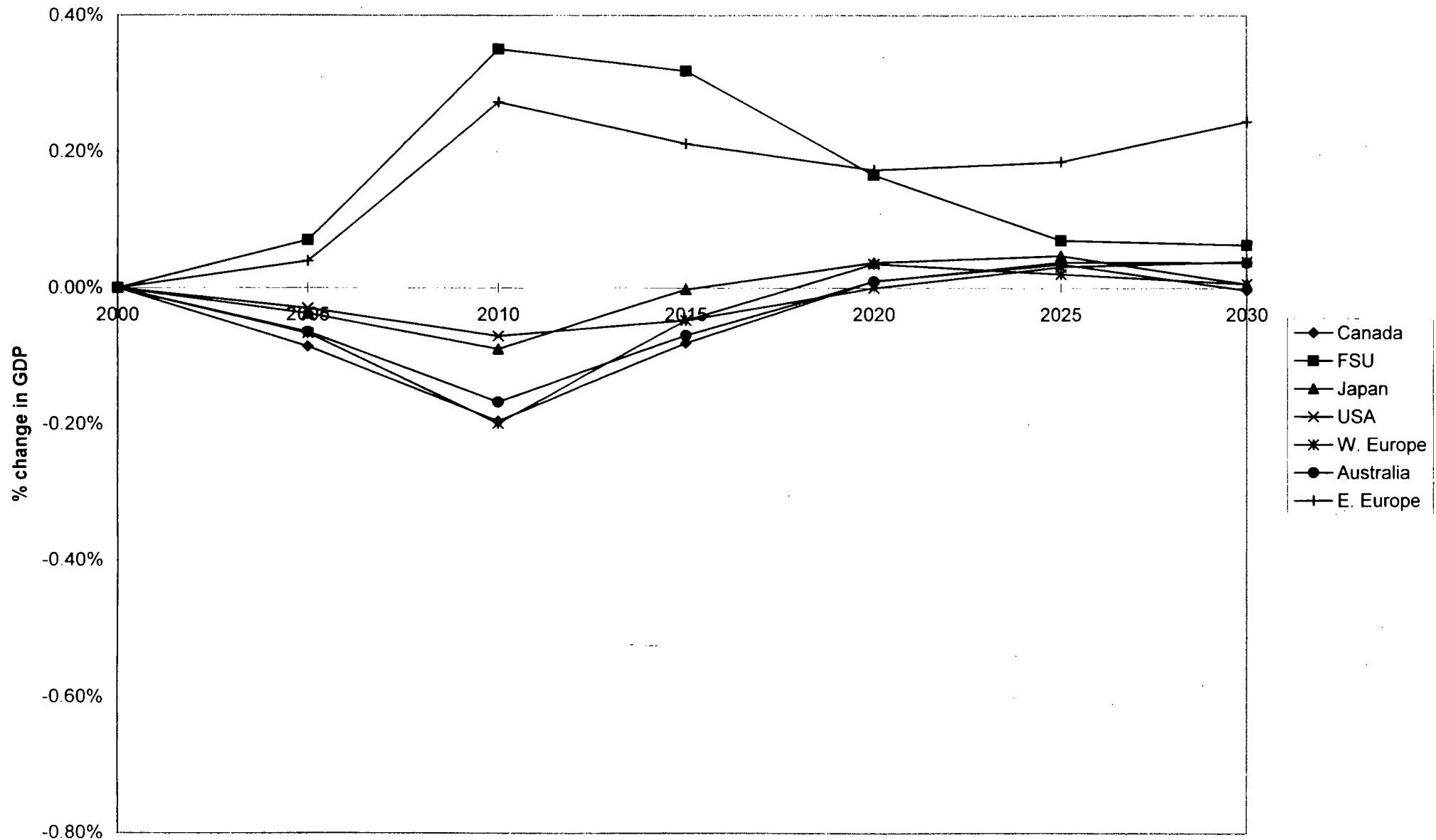
## GDP Impacts of Annex I Stabilization (No International Trading)



0.75% additional reduction in C/GDP in Annex I  
 Carbon permit revenue recycled 100% to deficit reduction

Annex I stabilizes at 1990 levels in 2010, with 10 year policy phase-in

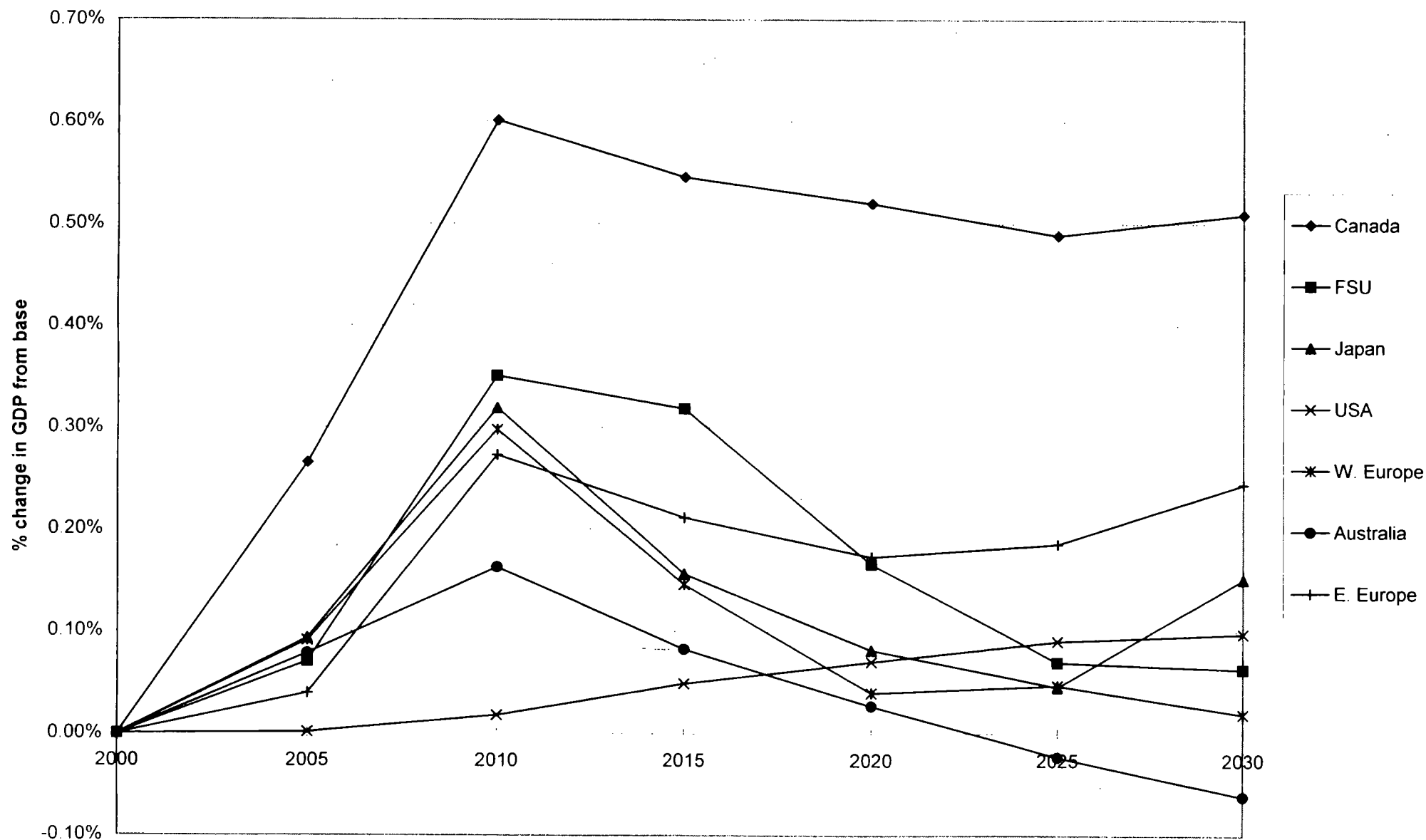
## GDP Impacts of Annex I Stabilization (Annex I Trading)



0.75% additional decrease in C/GDP in Annex I  
Carbon permit revenue recycled 100% to deficit reduction

Annex I stabilizes at 1990 levels in 2010, with 10 year phase-in  
FSU and Eastern Europe trade from projected emissions baselines

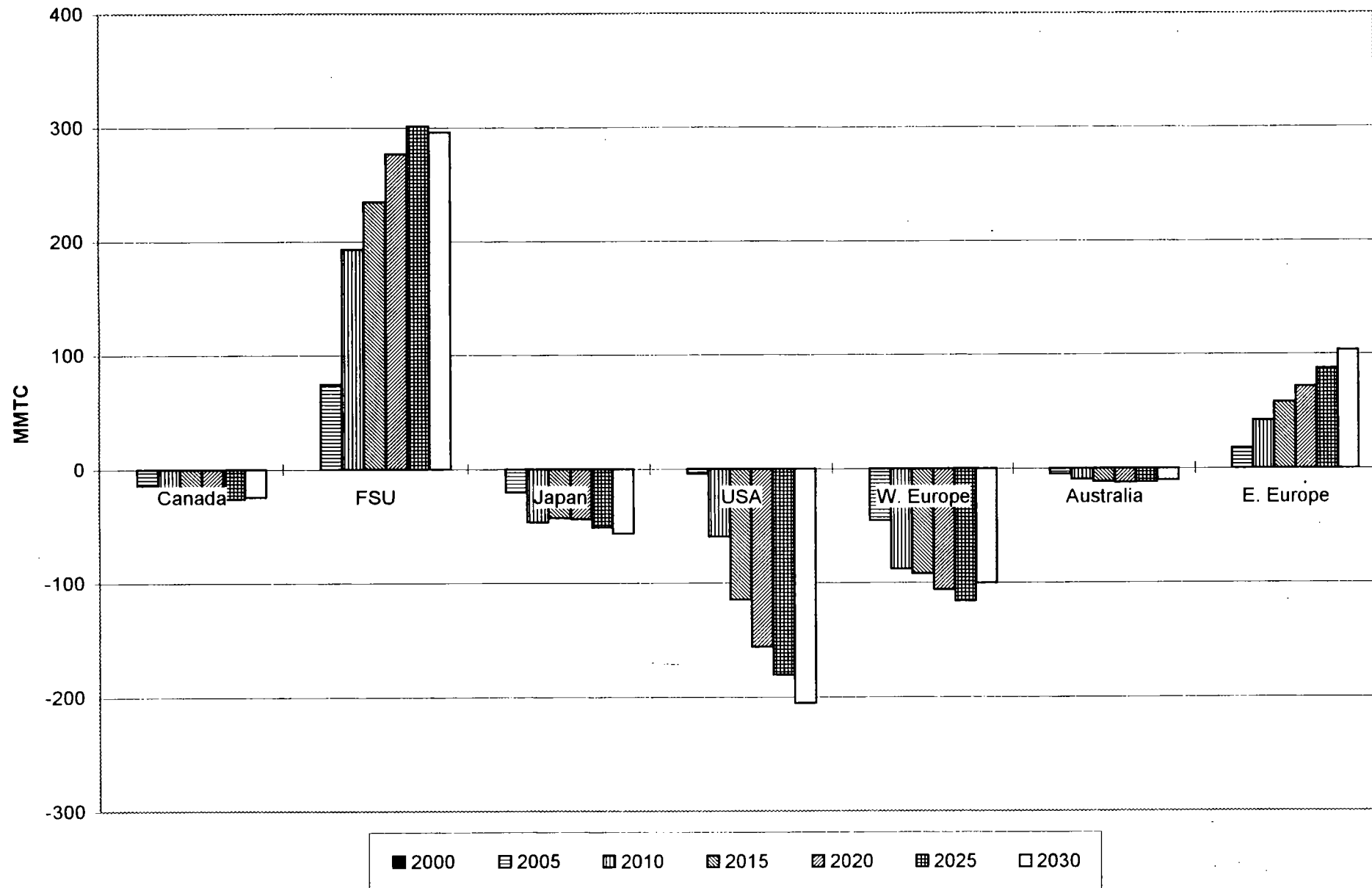
## Gains from Annex I Trade



0.75% additional decrease in C/GDP in Annex I  
Carbon tax revenue recycled 100% to deficit reduction

Annex I stabilizes at 1990 levels in 2010, with 10 year phase-in  
FSU and Eastern Europe trade from projected emissions baselines

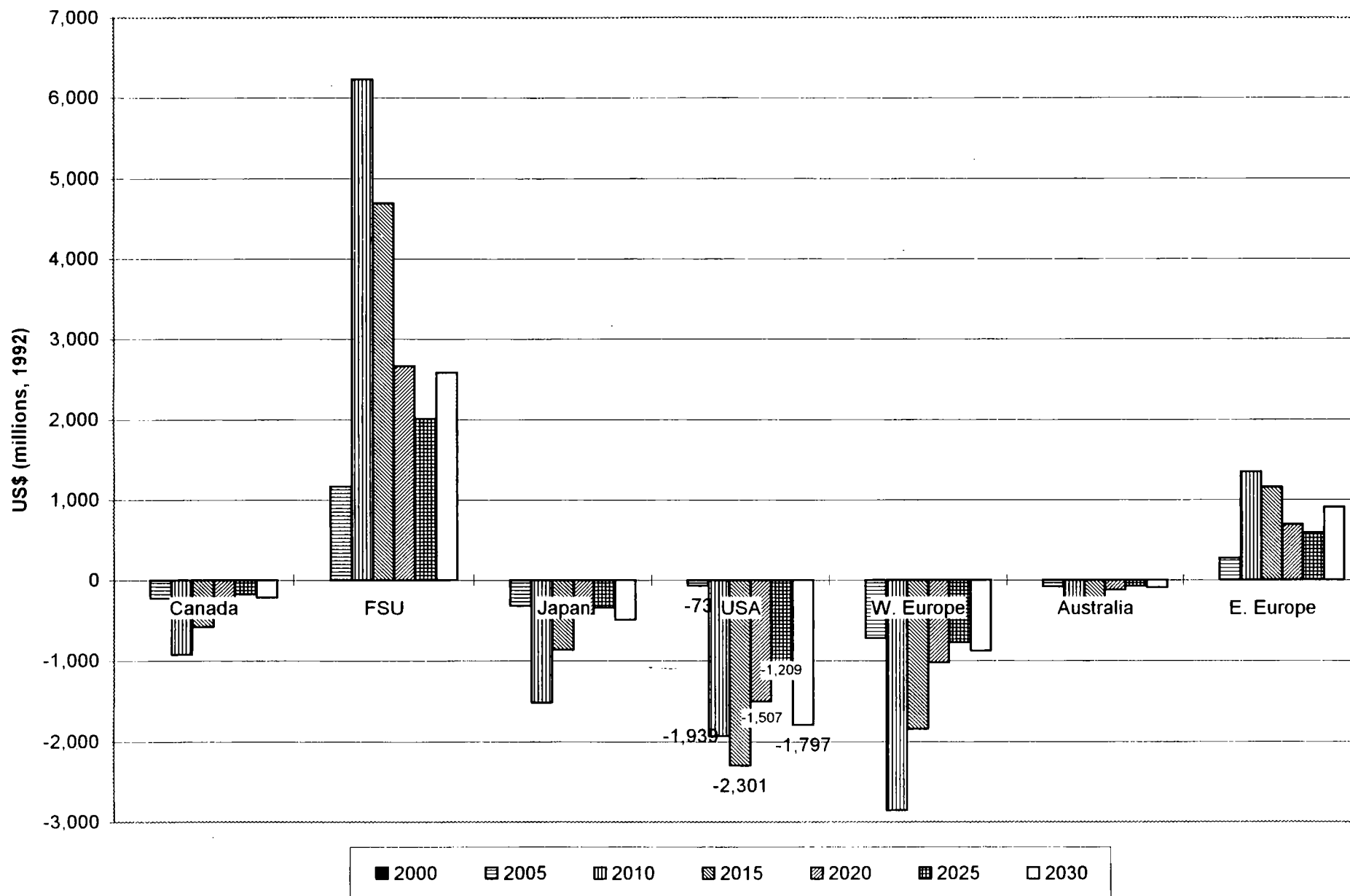
## International Carbon Permit Trading Volumes (Annex I Trading)



0.75% additional reduction in C/GDP in Annex I  
Carbon permit revenues devoted 100% to deficit reduction

FSU and Eastern Europe trade from projected emission declines  
Annex I stabilizes at 1990 levels in 2010, with 10 year policy phase-in

## Value of Internationally Traded Carbon Permits (Annex I Trading)

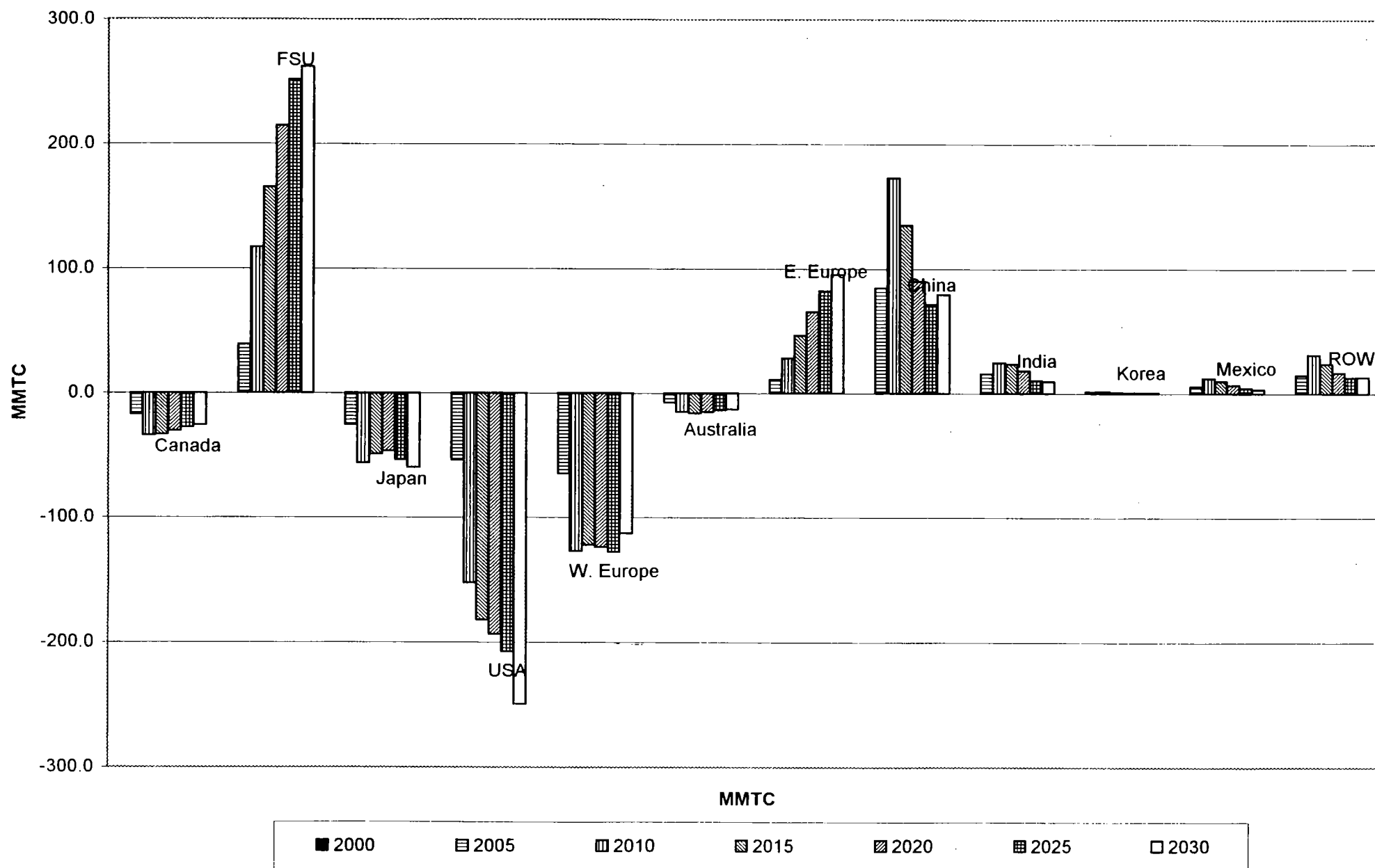


0.75% additional decrease in C/GDP in Annex I

Carbon permit revenues recycled 100% to deficit reduction

FSU and Eastern Europe trade from projected emission declines  
Annex I stabilizes at 1990 levels in 2010, with 10 year policy phase-in

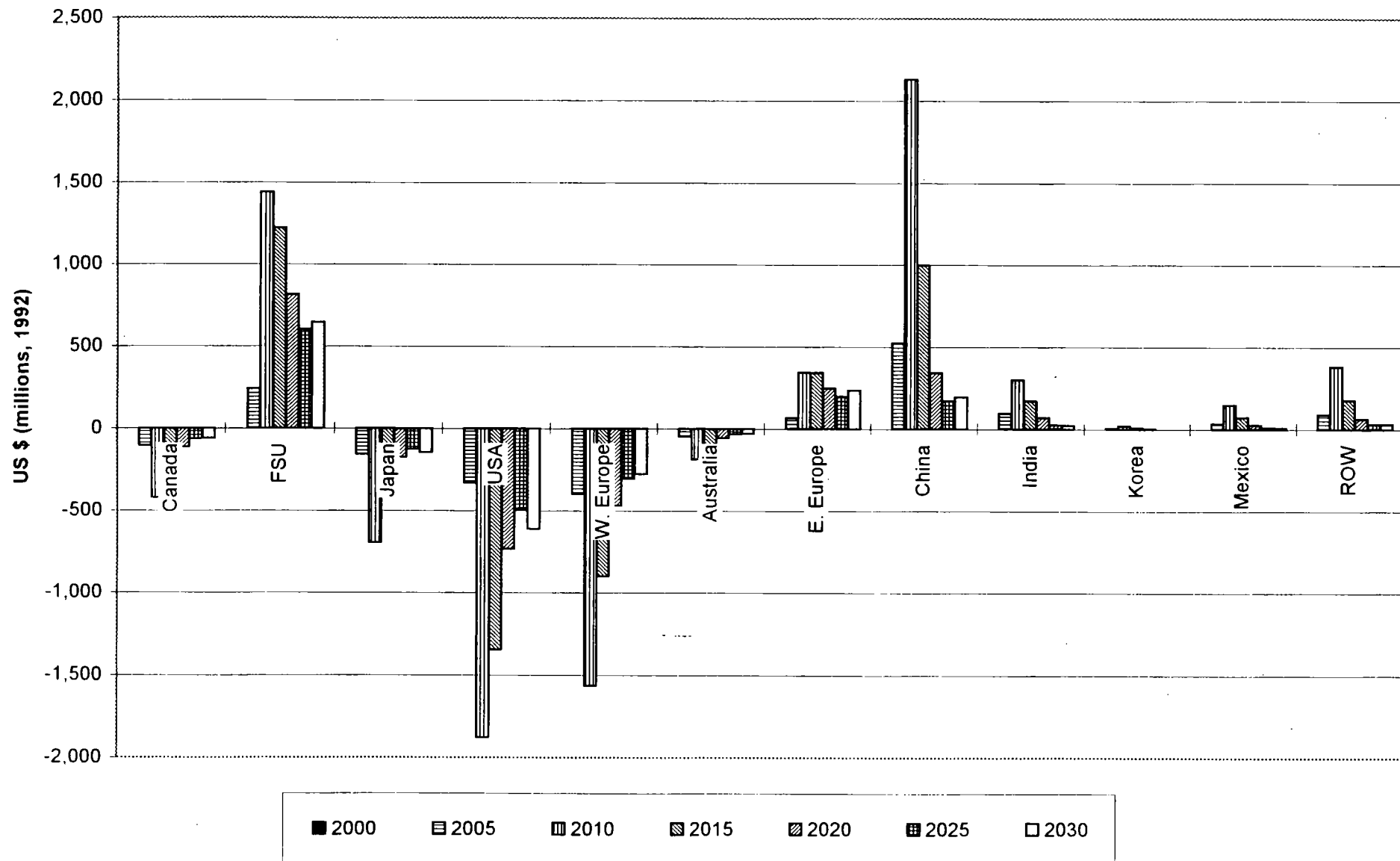
## Carbon Permit Trading Under Joint Implementation



0.75% additional decrease in C/GDP in Annex I  
 Permit revenue recycled 100% to deficit reduction

FSU, Eastern Europe and non-Annex I regions trade from baseline  
 Annex I stabilizes at 1990 levels

## Value of Carbon Permit Trading Flows Under Joint Implementation

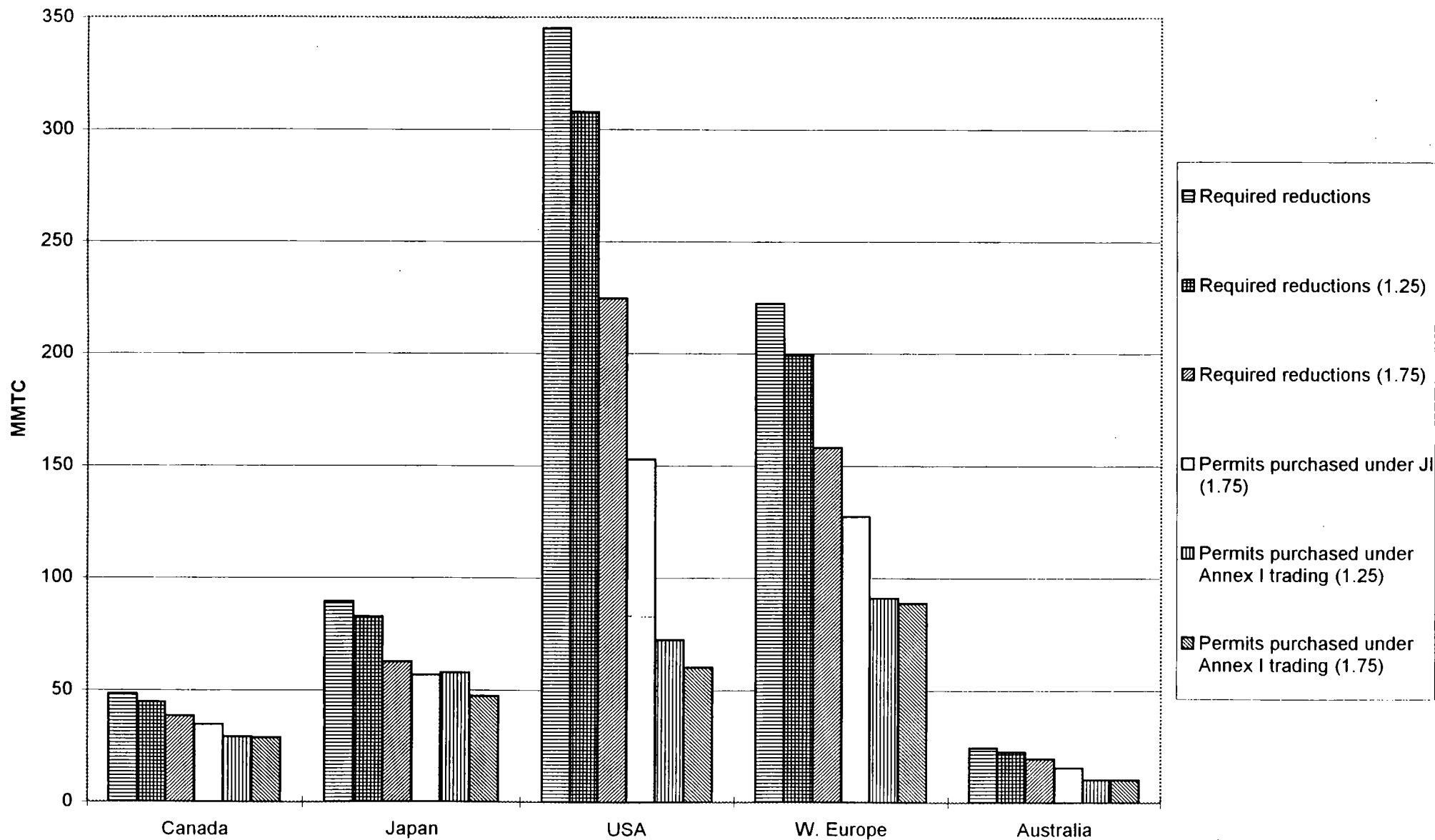


0.25% additional reduction in C/GDP in Annex I

Carbon permit revenue recycled 100% to deficit reduction

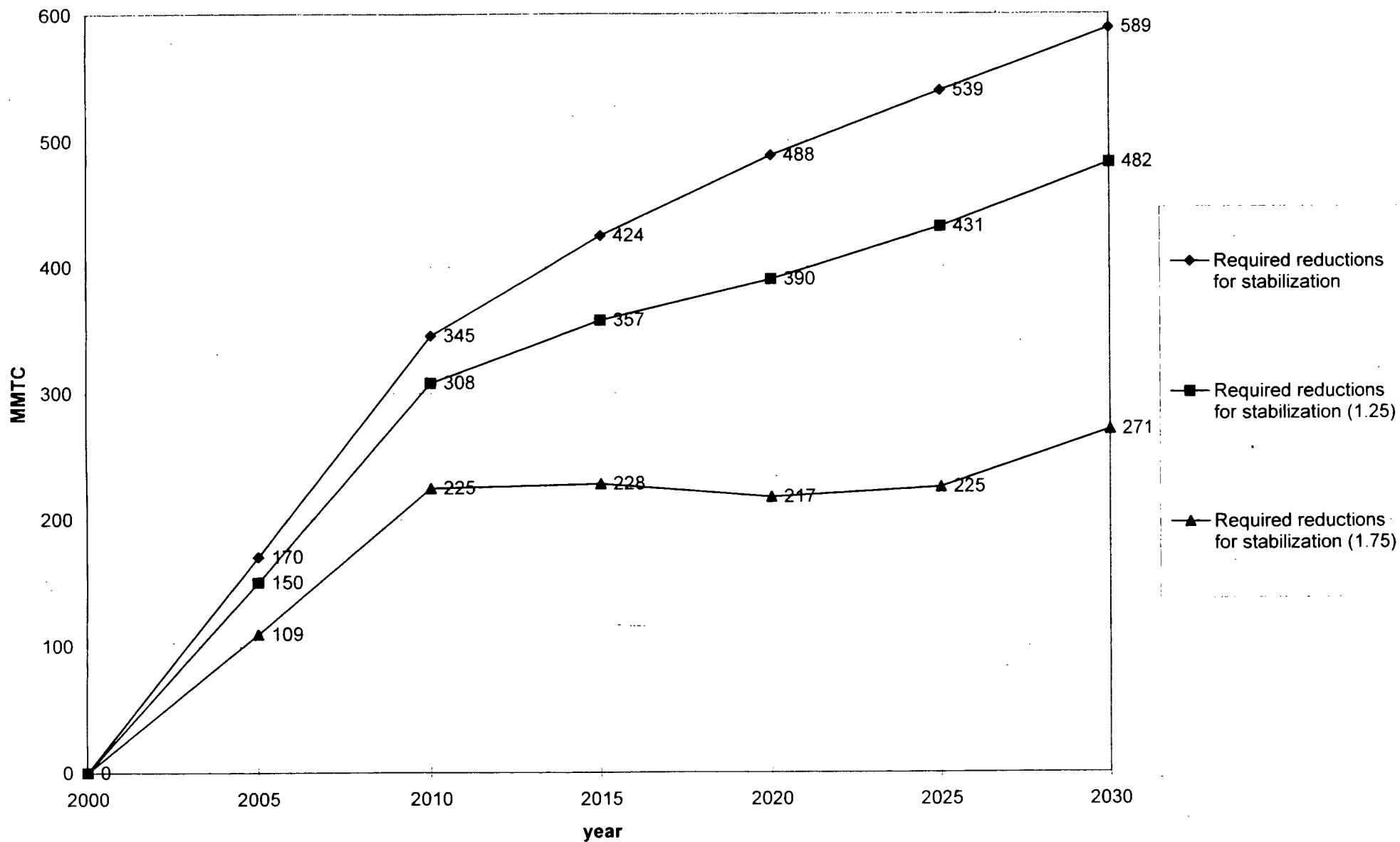
FSU, Eastern Europe and non-Annex I countries trade from projected emission reductions

## Permit Purchases and Emission Reductions Required for Stabilization in 2010



FSU, Eastern Europe, and non-Annex I countries (under JI) trade from projected emissions baselines

## US Emission Reductions Required for Stabilization



Energy Consumption for Energy/GDP Ratio Declining at 1.25% and 1.75% Annual Rates Starting in 2000.  
Declining rates start from 1% in 2000 and increase linearly to 1.25/1.75 in 2010, and stay at 1.25/1.75 thereafter.

| Year | AEO97 Energy<br>Consumption<br>(quads) | AEO97<br>GDP<br>billion \$92 | AEO97<br>E/GDP<br>000btu/\$ | 1.25%<br>E/GDP<br>Improvement | Energy<br>Consumption<br>(quads) | 1.75%<br>E/GDP<br>Improvement | Energy<br>Consumption<br>(quads) |
|------|----------------------------------------|------------------------------|-----------------------------|-------------------------------|----------------------------------|-------------------------------|----------------------------------|
| 1995 | 90.93                                  | \$6,739                      | 13.49                       | 13.49                         | 90.93                            | 13.49                         | 90.93                            |
| 2000 | 97.85                                  | \$7,544                      | 12.97                       | 12.97                         | 97.85                            | 12.97                         | 97.85                            |
| 2001 |                                        |                              |                             | 12.84                         |                                  | 12.83                         |                                  |
| 2002 |                                        |                              |                             | 12.70                         |                                  | 12.68                         |                                  |
| 2003 |                                        |                              |                             | 12.57                         |                                  | 12.53                         |                                  |
| 2004 |                                        |                              |                             | 12.43                         |                                  | 12.37                         |                                  |
| 2005 | 103.36                                 | \$8,390                      | 12.32                       | 12.29                         | 103.09                           | 12.20                         | 102.32                           |
| 2006 |                                        |                              |                             | 12.15                         |                                  | 12.02                         |                                  |
| 2007 |                                        |                              |                             | 12.00                         |                                  | 11.84                         |                                  |
| 2008 |                                        |                              |                             | 11.86                         |                                  | 11.65                         |                                  |
| 2009 |                                        |                              |                             | 11.72                         |                                  | 11.45                         |                                  |
| 2010 | 107.89                                 | \$9,185                      | 11.75                       | 11.57                         | 106.26                           | 11.25                         | 103.34                           |
| 2015 | 110.87                                 | \$9,880                      | 11.22                       | 10.86                         | 107.33                           | 10.30                         | 101.76                           |
| 2020 |                                        | \$10,591                     |                             | 10.20                         | 108.04                           | 9.43                          | 99.87                            |
| 2025 |                                        | \$11,353                     |                             | 9.58                          | 108.76                           | 8.63                          | 98.01                            |
| 2030 |                                        | \$12,171                     |                             | 9.00                          | 109.48                           | 7.90                          | 96.19                            |
| 2035 |                                        | \$13,047                     |                             | 8.45                          | 110.21                           | 7.24                          | 94.40                            |
| 2040 |                                        | \$13,986                     |                             | 7.93                          | 110.94                           | 6.62                          | 92.65                            |
| 2045 |                                        | \$14,993                     |                             | 7.45                          | 111.68                           | 6.06                          | 90.93                            |
| 2050 |                                        | \$16,072                     |                             | 6.99                          | 112.42                           | 5.55                          | 89.24                            |
| 2055 |                                        | \$17,229                     |                             | 6.57                          | 113.17                           | 5.08                          | 87.58                            |
| 2060 |                                        | \$18,469                     |                             | 6.17                          | 113.92                           | 4.65                          | 85.95                            |
| 2065 |                                        | \$19,799                     |                             | 5.79                          | 114.67                           | 4.26                          | 84.35                            |
| 2070 |                                        | \$21,224                     |                             | 5.44                          | 115.44                           | 3.90                          | 82.79                            |
| 2075 |                                        | \$22,752                     |                             | 5.11                          | 116.20                           | 3.57                          | 81.25                            |
| 2080 |                                        | \$24,390                     |                             | 4.80                          | 116.97                           | 3.27                          | 79.74                            |
| 2085 |                                        | \$26,146                     |                             | 4.50                          | 117.75                           | 2.99                          | 78.26                            |
| 2090 |                                        | \$28,028                     |                             | 4.23                          | 118.53                           | 2.74                          | 76.80                            |
|      |                                        | \$30,046                     |                             | 3.97                          | 119.32                           | 2.51                          | 75.37                            |
| 2100 |                                        | \$32,209                     |                             | 3.73                          | 120.11                           | 2.30                          | 73.97                            |
| 2105 |                                        | \$34,527                     |                             | 3.50                          | 120.91                           | 2.16                          | 72.60                            |
| 2110 |                                        | \$37,013                     |                             | 3.29                          | 121.72                           | 1.93                          | 71.25                            |
| 2115 |                                        | \$39,677                     |                             | 3.09                          | 122.52                           | 1.76                          | 69.93                            |
| 2120 |                                        | \$42,534                     |                             | 2.90                          | 123.34                           | 1.61                          | 68.63                            |
| 2125 |                                        | \$45,595                     |                             | 2.72                          | 124.16                           | 1.48                          | 67.35                            |
| 2130 |                                        | \$48,878                     |                             | 2.56                          | 124.98                           | 1.35                          | 66.10                            |
| 2135 |                                        | \$52,396                     |                             | 2.40                          | 125.81                           | 1.24                          | 64.87                            |
| 2140 |                                        | \$56,168                     |                             | 2.25                          | 126.65                           | 1.13                          | 63.66                            |
| 2145 |                                        | \$60,212                     |                             | 2.12                          | 127.49                           | 1.04                          | 62.48                            |
| 2150 |                                        | \$64,546                     |                             | 1.99                          | 128.34                           | 0.95                          | 61.32                            |
| 2155 |                                        | \$69,193                     |                             | 1.87                          | 129.19                           | 0.87                          | 60.18                            |
| 2160 |                                        | \$74,174                     |                             | 1.75                          | 130.05                           | 0.80                          | 59.06                            |
| 2165 |                                        | \$79,513                     |                             | 1.65                          | 130.91                           | 0.73                          | 57.96                            |
| 2170 |                                        | \$85,237                     |                             | 1.55                          | 131.78                           | 0.67                          | 56.89                            |
| 2175 |                                        | \$91,373                     |                             | 1.45                          | 132.65                           | 0.61                          | 55.83                            |
| 2180 |                                        | \$97,951                     |                             | 1.36                          | 133.54                           | 0.56                          | 54.79                            |
| 2185 |                                        | \$105,002                    |                             | 1.28                          | 134.42                           | 0.51                          | 53.77                            |
| 2190 |                                        | \$112,561                    |                             | 1.20                          | 135.32                           | 0.47                          | 52.77                            |
| 2195 |                                        | \$120,664                    |                             | 1.13                          | 136.21                           | 0.43                          | 51.79                            |
| 2200 |                                        | \$129,350                    |                             | 1.06                          | 137.12                           | 0.39                          | 50.83                            |

Pump down  
to 0.7

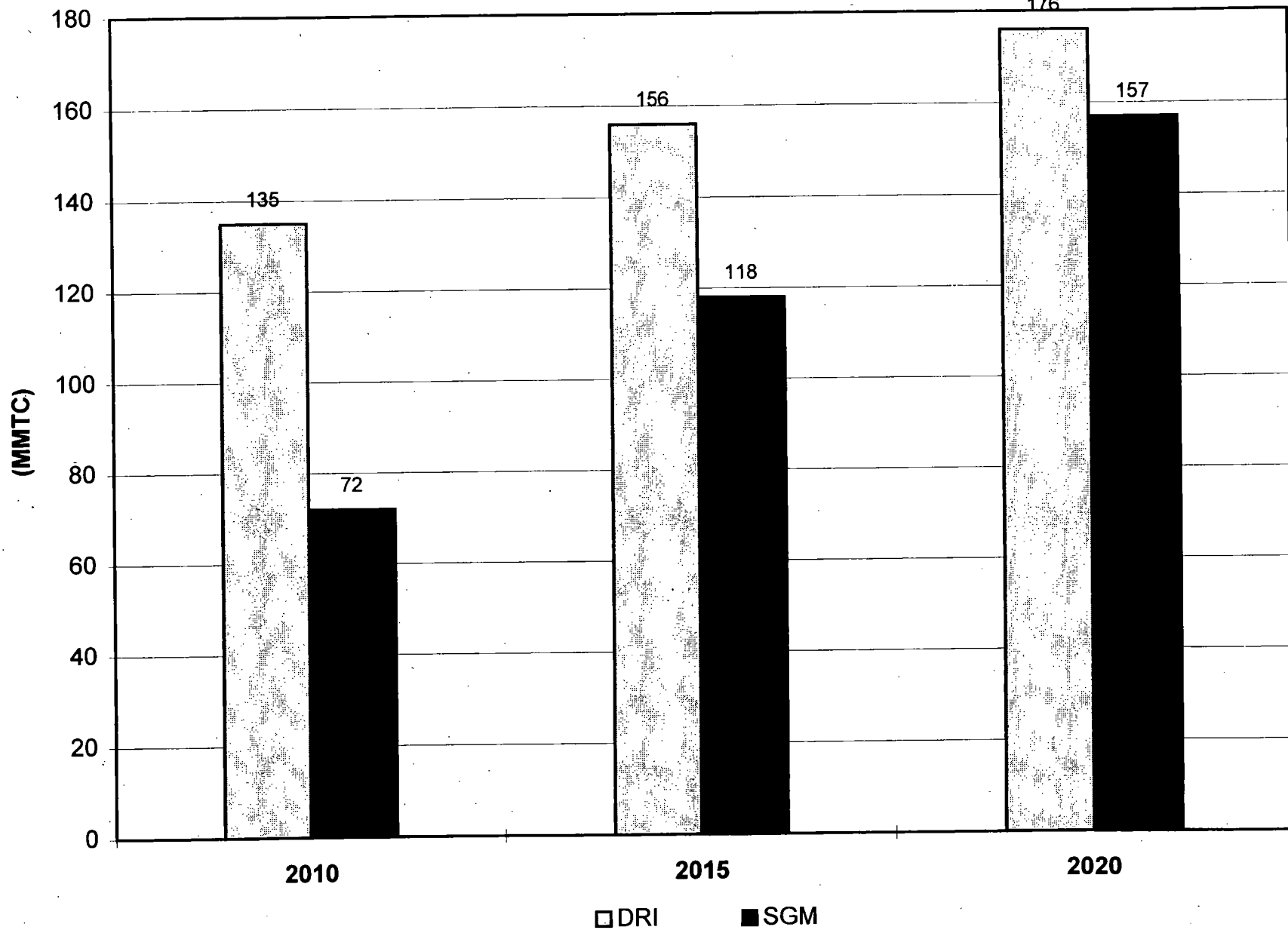
This analysis  
assumes linear  
ramp from 2000 to  
2010. The IAT  
argument was  
an exponential  
ramp from 2000  
to 2010

# IAT Case 1.25, Base

|                                                       | 1990    | 1995    | 2000    | 2005    | 2010    | 2015     | 2020     | 90-95 | 95-00 | 00-05 | 05-10 | 10-15 | 15-20 |
|-------------------------------------------------------|---------|---------|---------|---------|---------|----------|----------|-------|-------|-------|-------|-------|-------|
| <b>Population</b>                                     |         |         |         |         |         |          |          |       |       |       |       |       |       |
| DRI-DRI Energy                                        | 250     | 263     | 276     | 287     | 299     | 311      | 323      | 1.0   | 1.0   | 0.8   | 0.8   | 0.8   | 0.8   |
| AEO97 (NEMS)                                          | 250     | 264     | 276     | 287     | 299     | 311      | 323      | 1.1   | 0.9   | 0.8   | 0.8   | 0.8   | 0.8   |
| SGM                                                   | 250     | 263     | 276     | 287     | 299     | 311      | 323      | 1.0   | 1.0   | 0.8   | 0.8   | 0.8   | 0.8   |
| MARKAL-MACRO                                          | 250     | 263     | 276     | 287     | 299     | 311      | 323      | 1.0   | 1.0   | 0.8   | 0.8   | 0.8   | 0.8   |
| <b>GDP (Bill 92 \$'s)</b>                             |         |         |         |         |         |          |          | 1.9   | 2.3   | 2.1   | 1.8   | 1.5   | 1.4   |
| DRI-DRI Energy                                        | \$6,139 | \$6,743 | \$7,522 | \$8,337 | \$9,172 | \$10,003 | \$10,574 | 1.9   | 2.2   | 2.1   | 1.9   | 1.7   | 1.1   |
| AEO97 (NEMS)                                          | \$6,139 | \$6,739 | \$7,545 | \$8,390 | \$9,182 | \$9,881  | \$10,555 | 1.9   | 2.3   | 2.1   | 1.8   | 1.5   | 1.9   |
| SGM                                                   | 6,139   | 6,739   | 7,544   | 8,390   | 9,185   | 9,880    | 10,571   | ####  | ####  | ####  | ####  | ####  | ####  |
| MARKAL-MACRO                                          | \$6,139 | \$6,739 | \$7,544 | \$8,381 | \$9,203 | \$9,883  | \$10,535 | 1.9   | 2.3   | 2.1   | 1.9   | 1.4   | 1.3   |
| <b>Total Energy Consumption (Quad. Btu's)</b>         |         |         |         |         |         |          |          | 2.2   | 1.2   | 1.0   | 0.7   | 0.3   | 0.2   |
| DRI-DRI Energy                                        | 82.6    | 88.9    | 94.0    | 97.6    | 100.8   | 102.0    | 102.9    | 1.5   | 1.1   | 0.8   | 0.6   | 0.2   | 0.2   |
| AEO97 (NEMS)                                          | 83.7    | 90.9    | 97.5    | 102.1   | 105.6   | 107.8    | 110.9    | 1.7   | 1.4   | 0.9   | 0.7   | 0.4   | 0.6   |
| SGM                                                   | 84.2    | 90.6    | 96.0    | 100.8   | 104.5   | 106.2    | 107.5    | ####  | ####  | ####  | ####  | ####  | ####  |
| MARKAL-MACRO                                          | 83.7    | 90.9    | 96.6    | 101.7   | 106.6   | 108.5    | 113.6    | 1.7   | 1.2   | 1.0   | 0.9   | 0.4   | 0.9   |
| <b>Energy Intensity (Thos. Btu's/\$92GDP)</b>         |         |         |         |         |         |          |          |       |       |       |       |       |       |
| DRI-DRI Energy                                        | 13.5    | 13.2    | 12.5    | 11.7    | 11.0    | 10.2     | 9.7      | -0.4  | -1.1  | -1.3  | -1.3  | -1.5  | -0.9  |
| AEO97 (NEMS)                                          | 13.6    | 13.5    | 12.9    | 12.2    | 11.5    | 10.9     | 10.5     | -0.2  | -0.9  | -1.2  | -1.1  | -1.0  | -0.7  |
| SGM                                                   | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0!  | #DIV/0!  | ####  | ####  | ####  | ####  | ####  | ####  |
| MARKAL-MACRO                                          | 13.6    | 13.5    | 12.8    | 12.1    | 11.6    | 11.0     | 10.8     | -0.2  | -1.0  | -1.1  | -0.9  | -1.1  | -0.4  |
| <b>Coal Minemouth Price (\$95/ton)</b>                |         |         |         |         |         |          |          |       |       |       |       |       |       |
| DRI-DRI Energy                                        |         |         |         |         |         |          |          | ####  | ####  | ####  | ####  | ####  | ####  |
| AEO97 (NEMS)                                          | \$19.88 | \$18.83 | \$18.61 | \$17.38 | \$17.01 | \$15.85  | 15.3     | -1.1  | -0.2  | -1.4  | -0.4  | -1.4  | -0.7  |
| SGM                                                   | 19.88   | 19.45   | 18.47   | 17.21   | 16.40   | 15.66    | 14.91    | ####  | ####  | ####  | ####  | ####  | ####  |
| MARKAL-MACRO                                          | \$19.88 | \$18.83 | \$17.18 | \$16.44 | \$15.46 | \$16.44  | \$16.20  | -1.1  | -1.8  | -0.9  | -1.2  | 1.2   | -0.3  |
| <b>World Oil Price (\$95/barrel)</b>                  |         |         |         |         |         |          |          |       |       |       |       |       |       |
| DRI-DRI Energy                                        | \$25.97 | \$17.33 | \$16.43 | \$19.17 | \$21.49 | \$23.10  | \$24.20  | -7.8  | -1.1  | 3.1   | 2.3   | 1.5   | 0.9   |
| AEO97 (NEMS)                                          | \$24.87 | \$17.26 | \$18.13 | \$19.74 | \$20.53 | \$21.13  | \$22.17  | -7.0  | 1.0   | 1.7   | 0.8   | 0.6   | 1.0   |
| SGM                                                   | 24.87   | 17.27   | 18.20   | 19.71   | 20.40   | 20.88    | 21.57    | ####  | ####  | ####  | ####  | ####  | ####  |
| MARKAL-MACRO                                          | \$24.87 | \$17.26 | \$18.67 | \$20.66 | \$21.41 | \$22.03  | \$22.30  | -7.0  | 1.6   | 2.0   | 0.7   | 0.6   | 0.2   |
| <b>Natural Gas Wellhead Price (\$95/Mcf)</b>          |         |         |         |         |         |          |          |       |       |       |       |       |       |
| 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  | \$1.84  | \$1.88  | \$1.89  | \$1.94   | \$2.44   | -4.0  | 2.7   | 0.4   | 0.1   | 0.5   | 4.7   |
| SGM                                                   | 1.97    | 1.61    | 1.84    | 1.88    | 1.89    | 1.94     | 2.44     | ####  | ####  | ####  | ####  | ####  | ####  |
| MARKAL-MACRO                                          | \$1.71  | \$1.61  | \$1.90  | \$1.99  | \$2.18  | \$2.40   | \$2.70   | -1.2  | 3.4   | 0.9   | 1.8   | 1.9   | 2.4   |
| <b>Gasoline Price (\$95/Gal)</b>                      |         |         |         |         |         |          |          |       |       |       |       |       |       |
| 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  | \$1.20  | \$1.19  | \$1.15   | \$1.16   | -3.0  | 0.7   | 0.2   | -0.2  | -0.7  | 0.2   |
| SGM                                                   | 1.34    | 1.15    | 1.19    | 1.20    | 1.19    | 1.15     | 1.16     | ####  | ####  | ####  | ####  | ####  | ####  |
| MARKAL-MACRO                                          | \$1.34  | \$1.15  | \$1.23  | \$1.35  | \$1.36  | \$1.37   | \$1.37   | -3.0  | 1.4   | 1.9   | 0.1   | 0.1   | 0.0   |
| <b>Carbon Emissions (Mill. Metric Tons of Carbon)</b> |         |         |         |         |         |          |          |       |       |       |       |       |       |
| DRI-DRI Energy                                        | 1,324   | 1,398   | 1,482   | 1,548   | 1,606   | 1,665    | 1,689    | 1.1   | 1.2   | 0.9   | 0.7   | 0.7   | 0.3   |
| AEO97 (NEMS)                                          | 1,339   | 1,424   | 1,533   | 1,612   | 1,672   | 1,723    | 1,780    | 1.2   | 1.5   | 1.0   | 0.7   | 0.6   | 0.7   |
| SGM                                                   | 1,350   | 1,480   | 1,550   | 1,612   | 1,691   | 1,741    | 1,773    | ####  | ####  | ####  | ####  | ####  | ####  |
| MARKAL-MACRO                                          | 1,338   | 1,424   | 1,540   | 1,636   | 1,716   | 1,766    | 1,870    | 1.3   | 1.6   | 1.2   | 1.0   | 0.6   | 1.2   |

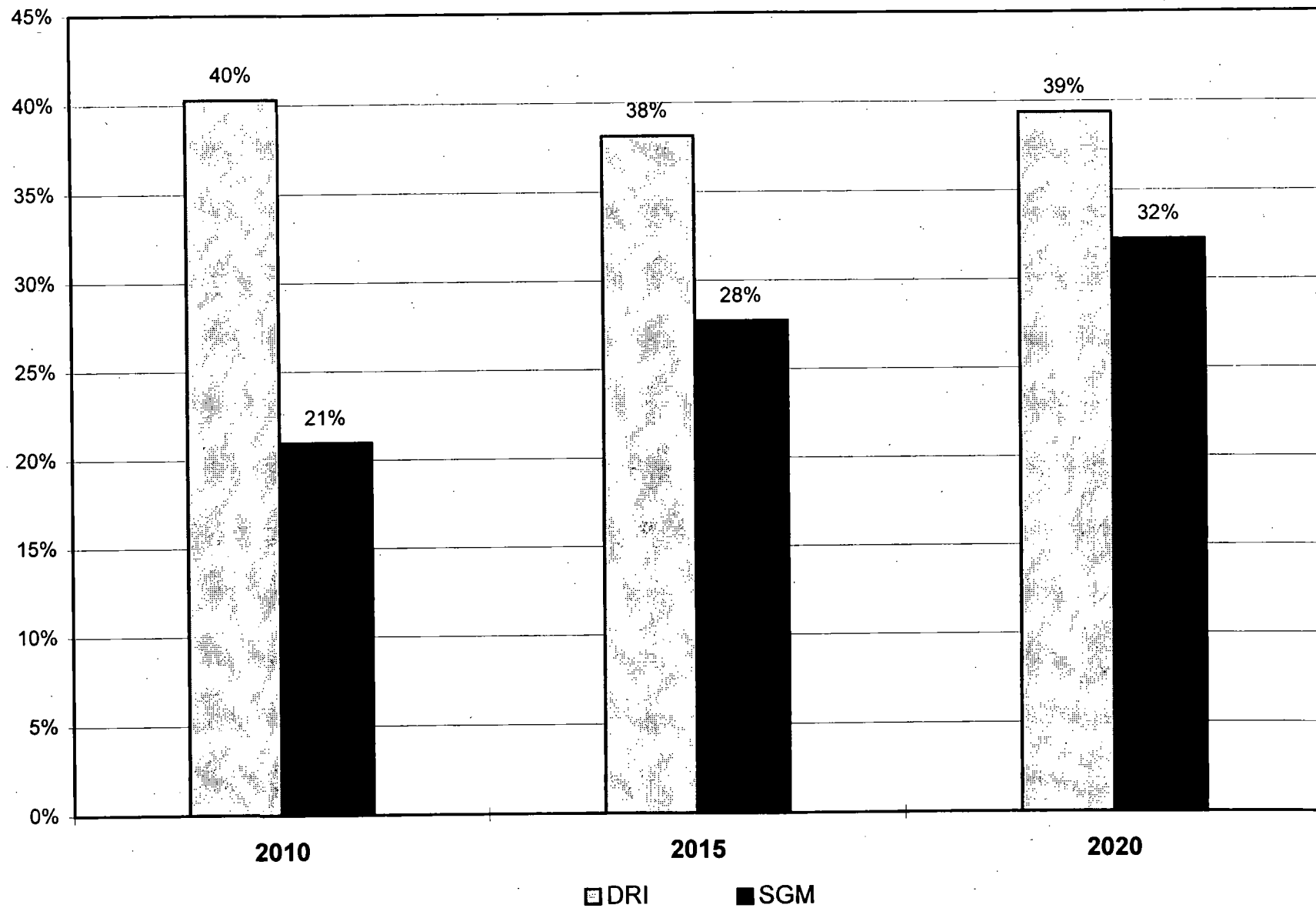
# Carbon Permit Trading by Volume: DRI and SGM Stabilization Case

\$56 permit price



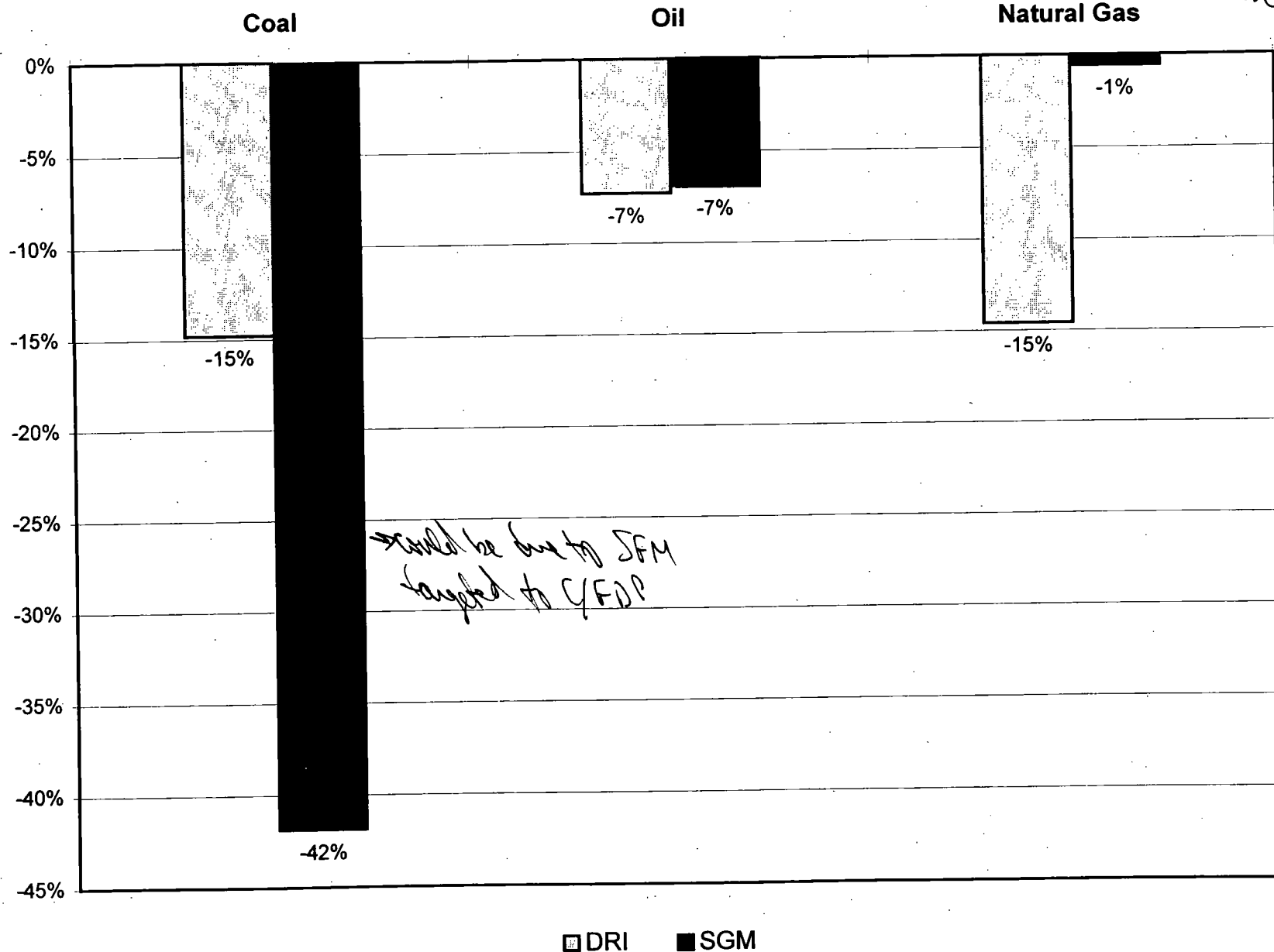
*Needed to get stabilization*

## Percent of Total Reductions from Trading: DRI and SGM Stabilization Scenario



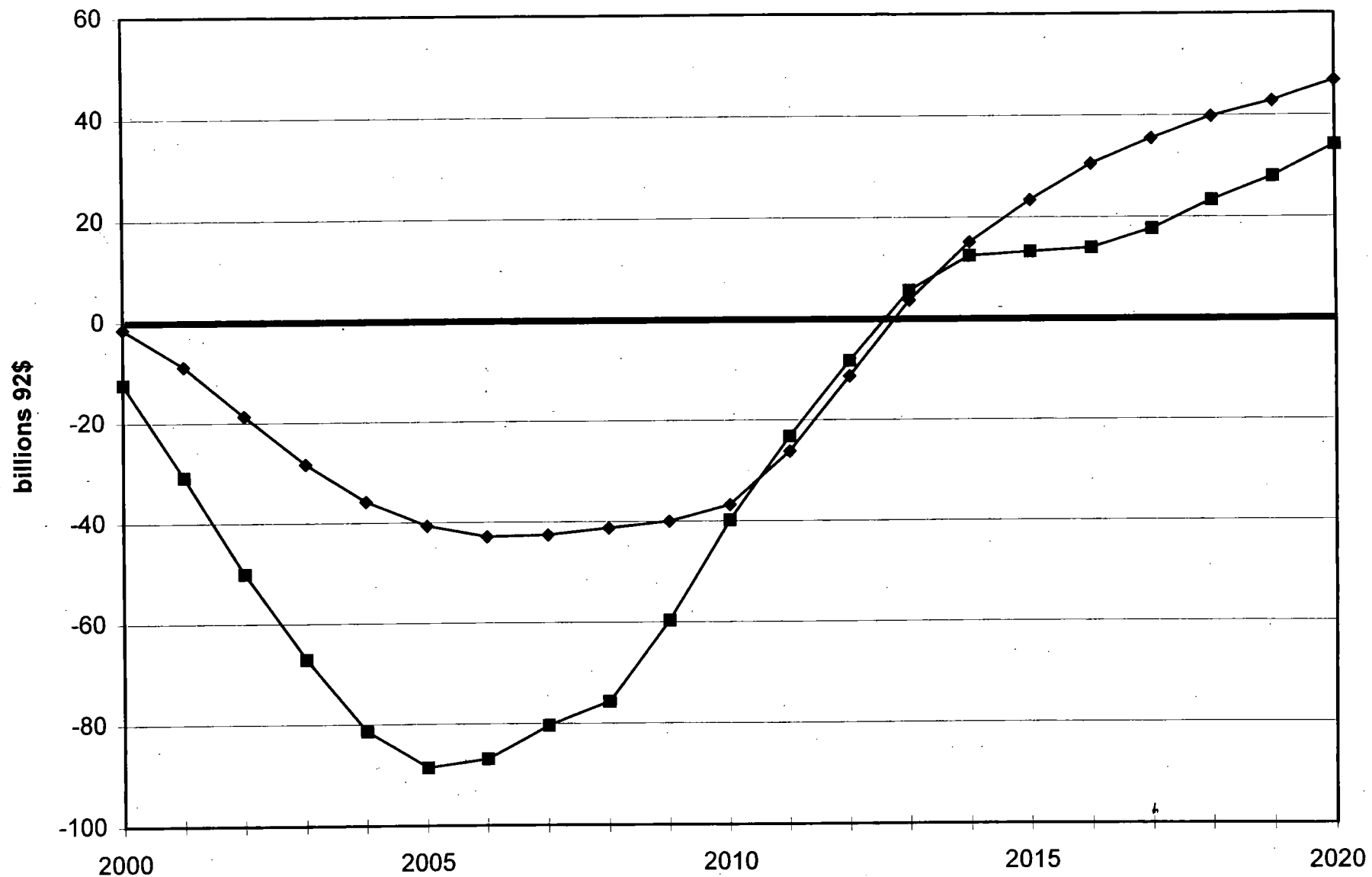
# Energy Use by Fuel Type in 2010: DRI and SGM (% change from base)

*measured from original  
DRI base case*



*→ target C/GDP ratio*

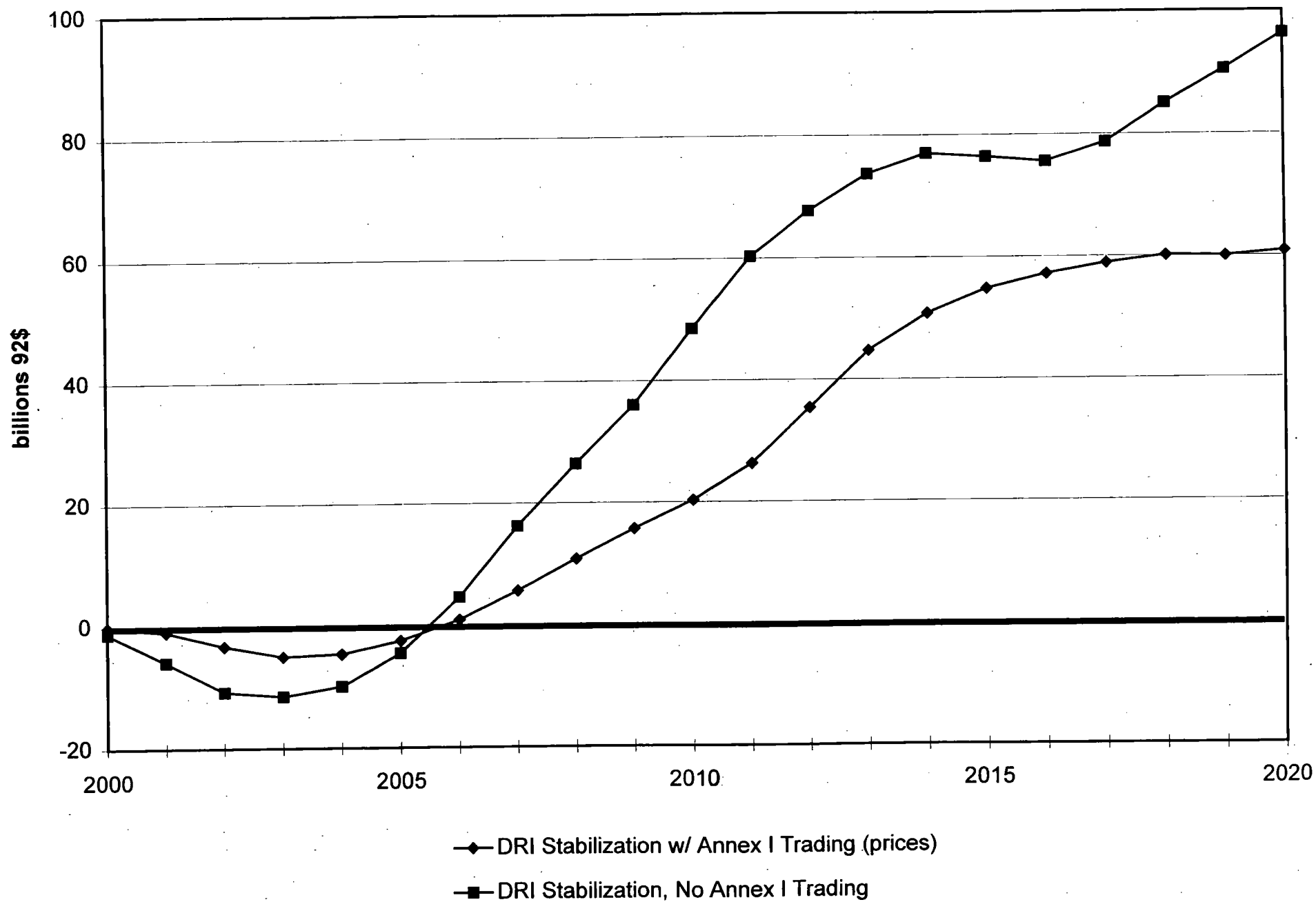
# GDP (change from base)



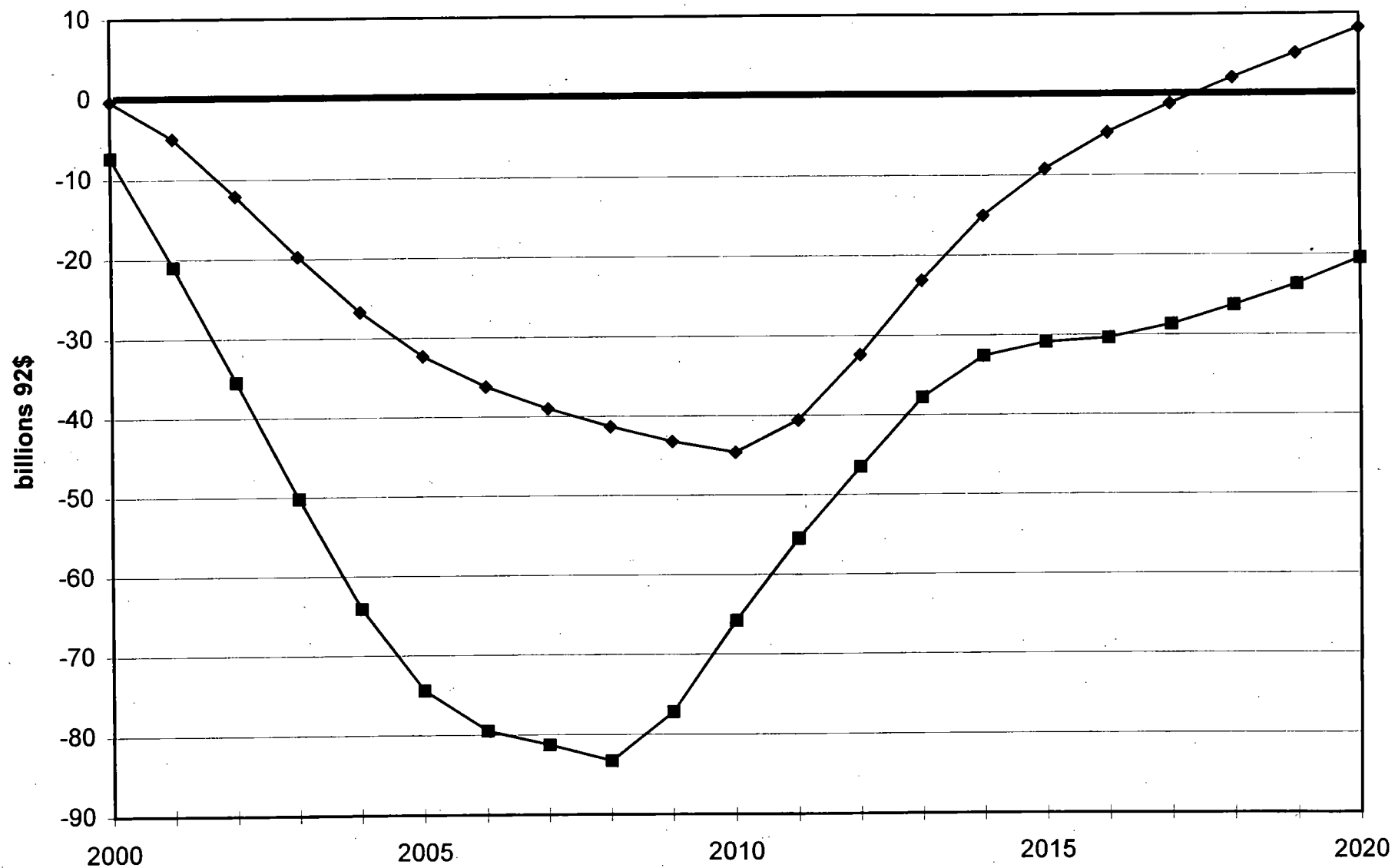
◆ DRI Stabilization w/ Annex I Trading (prices)

■ DRI Stabilization, No Annex I Trading

# Investment (change from base)

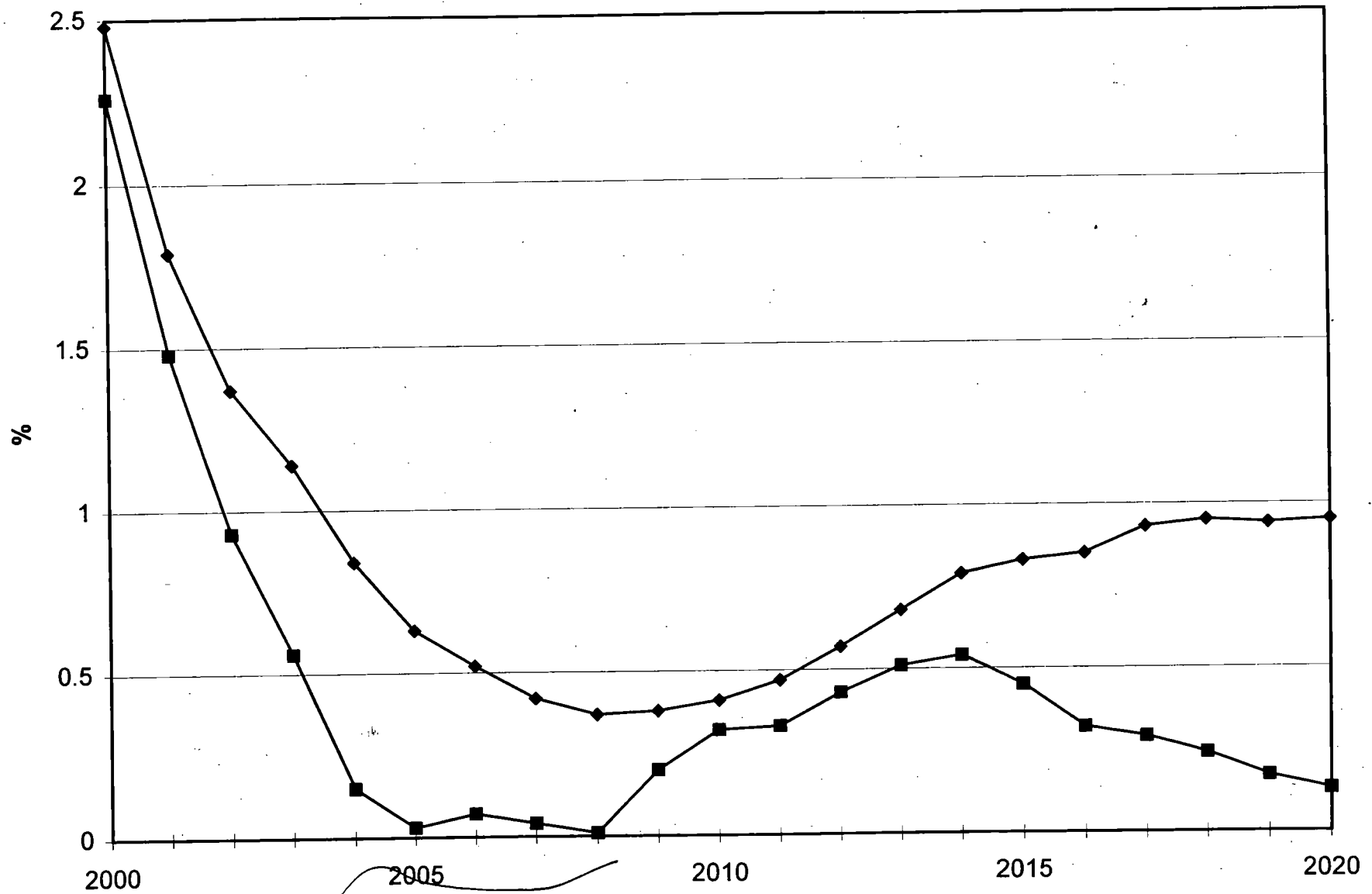


# Consumption (change from base)



◆ DRI Stabilization w/ Annex I Trading (prices)  
 ■ DRI Stabilization, No Annex I Trading

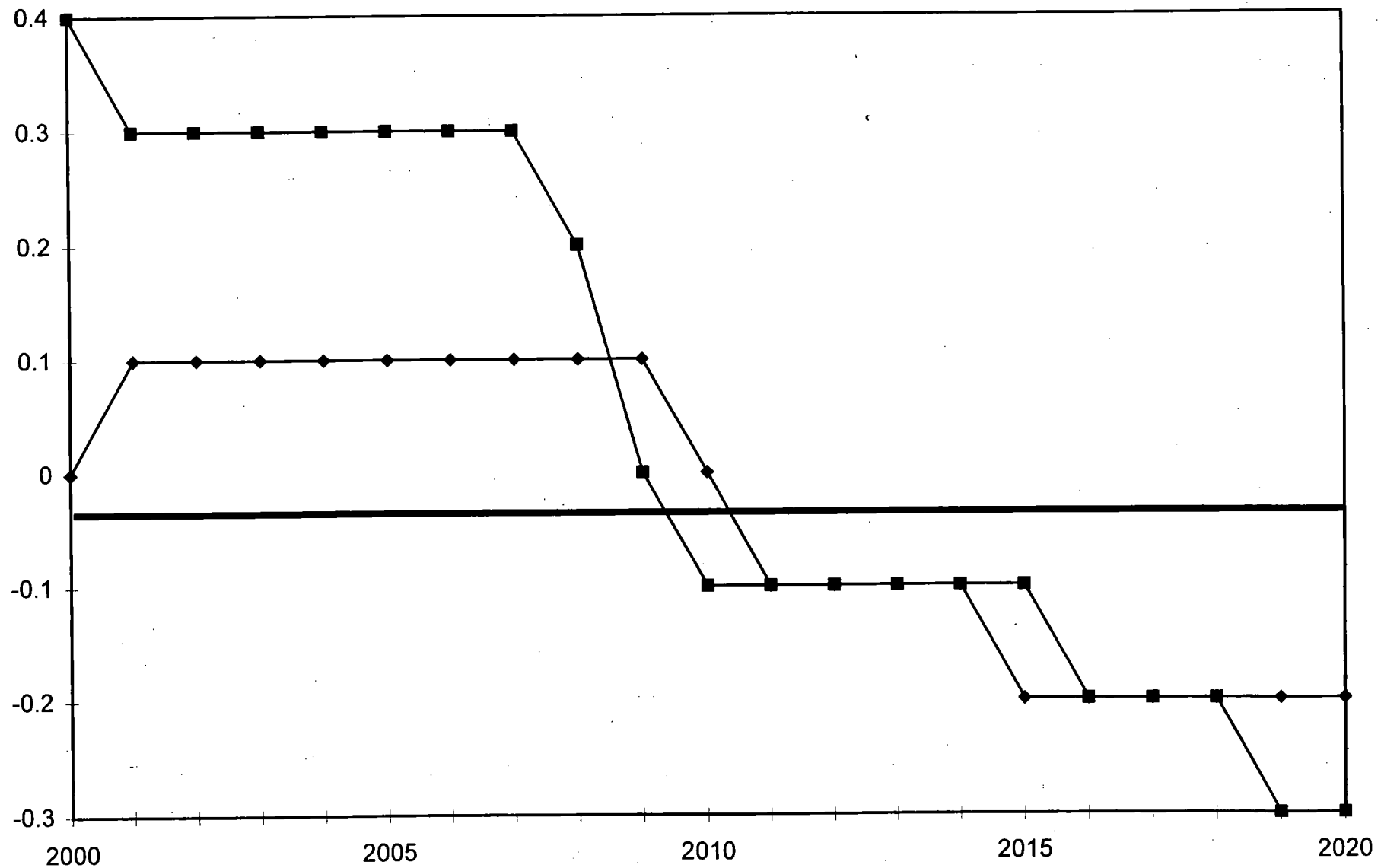
# Real Federal Funds Rate



*don't go negative  
anywhere*

- ◆ DRI Stabilization w/ Annex I Trading (prices)
- DRI Stabilization, No Annex I Trading

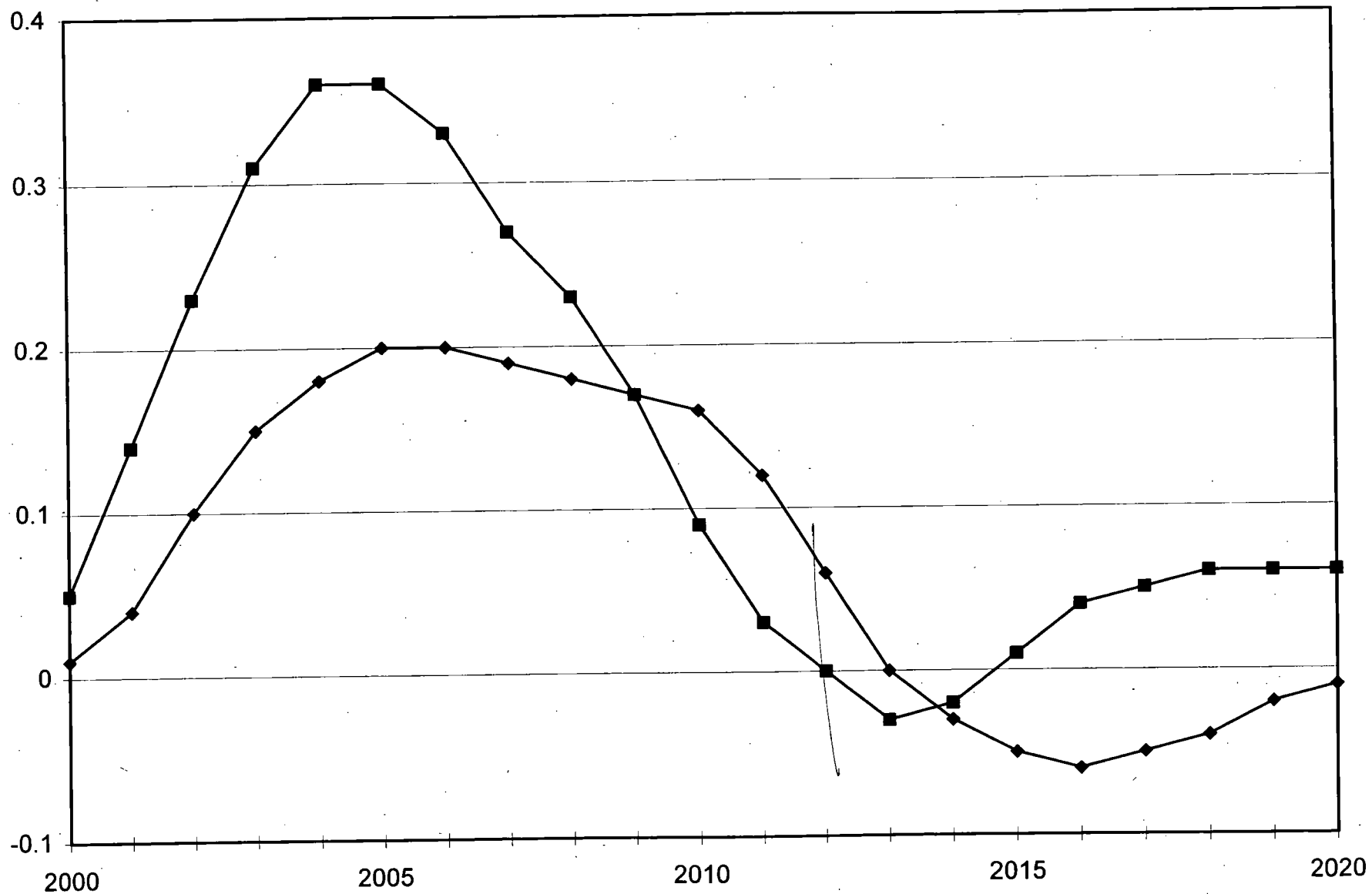
# Inflation Rate (change from base)



—◆— DRI Stabilization w/ Annex I Trading (prices)

—■— DRI Stabilization, No Annex I Trading

# Unemployment Rate (change from base)



- ◆ DRI Stabilization w/ Annex I Trading (prices)
- DRI Stabilization, No Annex I Trading

## Markal-Macro Simulation Results

| GDP (billion 1992 dollars)              | 1995    | 2000    | 2005    | 2010    | 2015    | 2020     | 1995-2010 | 2000-2020 |
|-----------------------------------------|---------|---------|---------|---------|---------|----------|-----------|-----------|
| Case 1: Markal-Macro Base Case          | \$6,726 | \$7,550 | \$8,385 | \$9,198 | \$9,881 | \$10,499 | 2.11%     | 1.66%     |
| Case 2: Markal-Macro Case               | \$6,731 | \$7,544 | \$8,381 | \$9,203 | \$9,883 | \$10,535 | 2.11%     | 1.68%     |
| Case 2: Markal-Macro Stabilization Case | \$6,730 | \$7,538 | \$8,370 | \$9,144 | \$9,803 | \$10,435 | 2.06%     | 1.64%     |
| Case 3: Markal-Macro Case               | \$6,753 | \$7,566 | \$8,436 | \$9,252 | \$9,931 | \$10,604 | 2.12%     | 1.70%     |
| Case 3: Markal-Macro Stabilization Case | \$6,752 | \$7,564 | \$8,431 | \$9,227 | \$9,902 | \$10,575 | 2.10%     | 1.69%     |

| E/GDP (kBtu per 1992\$ of GDP)          | 1995  | 2000  | 2005  | 2010  | 2015  | 2020  | 1995-2010 | 2000-2020 |
|-----------------------------------------|-------|-------|-------|-------|-------|-------|-----------|-----------|
| Case 1: Markal-Macro Base Case          | 13.60 | 12.99 | 12.34 | 11.71 | 11.20 | 11.01 | -0.99%    | -0.82%    |
| Case 2: Markal-Macro Case               | 13.61 | 12.82 | 12.14 | 11.58 | 10.98 | 10.77 | -1.07%    | -0.87%    |
| Case 2: Markal-Macro Stabilization Case | 13.48 | 12.65 | 11.76 | 10.13 | 9.57  | 9.26  | -1.89%    | -1.55%    |
| Case 3: Markal-Macro Case               | 13.23 | 12.16 | 11.08 | 10.54 | 9.85  | 9.35  | -1.50%    | -1.31%    |
| Case 3: Markal-Macro Stabilization Case | 13.22 | 12.10 | 10.96 | 9.90  | 9.19  | 8.80  | -1.91%    | -1.58%    |

| Energy (Quads)                          | 1995 | 2000 | 2005  | 2010  | 2015  | 2020  | 1995-2010 | 2000-2020 |
|-----------------------------------------|------|------|-------|-------|-------|-------|-----------|-----------|
| Case 1: Markal-Macro Base Case          | 91.4 | 98.0 | 103.5 | 107.8 | 110.7 | 115.6 | 1.11%     | 0.83%     |
| Case 2: Markal-Macro Case               | 91.6 | 96.7 | 101.7 | 106.6 | 108.5 | 113.5 | 1.02%     | 0.80%     |
| Case 2: Markal-Macro Stabilization Case | 90.8 | 95.3 | 98.4  | 92.6  | 93.8  | 96.7  | 0.13%     | 0.07%     |
| Case 3: Markal-Macro Case               | 89.3 | 92.0 | 93.5  | 97.5  | 97.8  | 99.2  | 0.59%     | 0.38%     |
| Case 3: Markal-Macro Stabilization Case | 89.3 | 91.5 | 92.4  | 91.3  | 91.0  | 93.1  | 0.15%     | 0.09%     |

| Carbon (MMT)                            | 1995  | 2000  | 2005  | 2010  | 2015  | 2020  | 1995-2010 | 2000-2020 |
|-----------------------------------------|-------|-------|-------|-------|-------|-------|-----------|-----------|
| Case 1: Markal-Macro Base Case          | 1,468 | 1,586 | 1,691 | 1,762 | 1,829 | 1,933 | 1.22%     | 0.99%     |
| Case 2: Markal-Macro Case               | 1,471 | 1,540 | 1,636 | 1,716 | 1,766 | 1,870 | 1.03%     | 0.97%     |
| Case 2: Markal-Macro Stabilization Case | 1,454 | 1,501 | 1,554 | 1,338 | 1,339 | 1,339 | -0.55%    | -0.57%    |
| Case 3: Markal-Macro Case               | 1,425 | 1,440 | 1,467 | 1,492 | 1,497 | 1,502 | 0.31%     | 0.21%     |
| Case 3: Markal-Macro Stabilization Case | 1,425 | 1,429 | 1,447 | 1,338 | 1,339 | 1,339 | -0.42%    | -0.32%    |

| Marginal Cost of Carbon (1990\$/MT)     | 1995 | 2000 | 2005 | 2010     | 2015     | 2020     |
|-----------------------------------------|------|------|------|----------|----------|----------|
| Case 2: Markal-Macro Stabilization Case | n/a  | n/a  | n/a  | \$126.60 | \$124.94 | \$113.87 |
| Case 3: Markal-Macro Stabilization Case | n/a  | n/a  | n/a  | \$66.80  | \$59.81  | \$30.58  |

**Memorandum**

To: Ev Ehrlich  
Through: Howard Gruenspecht  
From: Phillip Tseng  
Subject: Markal-Macro Case175  
Date: April 10, 1997  
CC: Eric Petersen, Skip Laitner

What are they  
getting for free in  
LX SGM?

At a Tuesday, April 8 IAT discussion of technology issues, you decided that it is worthwhile to create a case that will show annual improvement of the Energy/GDP ratio by about 1.75% between year 2000 and 2020. This improvement in energy intensity will be achieved without the need for new regulatory measures or a carbon cap imposing a positive implicit or explicit carbon value. I admire the optimism and vision of some technology analysts. Historical data, however, does not support their view, and I continue to be concerned that this case is not credible as a basis for estimating the economic costs of carbon emissions mitigation for the many reasons expressed in Howard's earlier memo.

In the past 30 years, the only period that showed E/GDP improvement rate greater than 1.75% per year was between 1973 and 1985. In that period, energy prices went up by about 300% in real terms, and the average GDP growth rate was more than 3% per year. The energy efficiency gap was a lot bigger and many low cost energy efficiency options such as storm windows, storm doors, and ceiling insulation were adopted. The long term trend in E/GDP is more moderate. The average annual rate of improvement in the Energy/GDP ratio between 1960 and 1995 is only about 1%. And it is only about 0.32% between 1985 and 1995. Changes in energy intensity reflect the effects of GDP growth rates and energy prices. Projected GDP growth rates are much lower for the next 20 years due to slow population growth. In fact, case175 would involve absolute declines in energy use in the latter part of the simulation period. Energy prices are also projected to increase slowly.

The purpose of this memo is to specify general assumptions for Case175 and the responsibilities of technology analysts and the Markal-Macro modelers.

- Assumptions for Case175 shall be identical to Case125 except for the technology assumptions and some parameter values for energy services in the aggregate CES production function. Consumer hurdle rates will not be reduced for Case175 from the Case125 level and the introduction of new technologies will not create premature abandonment of existing capital stock.
- Technology analysts shall provide technology costs and efficiency information to the Markal-macro modeling group. Technology assumptions should be accompanied by a memo stating/explaining that these assumptions should be used by the modeling group to create Case175.
- The IAT Markal-Macro modeling group shall be responsible for implementing advanced technology assumptions and ensuring model results are consistent with solution algorithm and economic theory. In addition, the Markal-Macro modeling group should document technology assumptions provided and prepare a report to be considered in the internal and peer review process.

Please let me know if you have any questions regarding the general assumptions and the responsibility areas by Friday, April 11, 1997 so that we may develop a schedule for these activities.

**Memorandum**

Date: March 28, 1997

To: Ev Ehrlich

From: Phillip Tseng

Subject: Markal-Macro Simulations

I would like to clarify a few points regarding the performance of the Markal-Macro model in response to Skip's comments at the IAT meeting on Thursday, March 27. First of all, I would like to respond to comments on the MARKAL-MACRO simulations results. Second, are there ways in which the technology group can help? Third, I would like to raise some major concerns regarding the advanced technology assumptions. Fourth, what is the purpose of the MARKAL-MACRO modeling. And finally, and most importantly, what is the objective of the IAT quantitative analysis.

**Markal-Macro Simulation Results**

At the last IAT meeting Skip Laitner stated that there are a number of problems with the Markal-Macro model. The criticisms were inaccurate and misleading. I will respond to a few comments discussed at the meeting.

- Skip stated that the gasoline consumption for case175 is not realistic compared with the base case. Gasoline consumption in 2015 is projected to rise by about 0.1 quad for Case175 before carbon stabilization from the MARKAL-MACRO base case. GDP is projected to increase by about \$50 billion. The income elasticity is about 1.03. This number is well within the 0.3 to 2.5 range published in the Carol Dahl elasticity report. Please also note that in my March 18 MARKAL-MACRO briefing package I clearly stated that Case175 *may not be compatible* with the Base case. It is due to slight differences in the parameter values for some of the energy services in the aggregate production function. These variations do not push the income elasticity out of the range of empirically estimated values.
- Skip also stated that simulation results from the "Other Model" showed significant penetration of advanced vehicle technologies. Markal-Macro can not produce the same kind of projections, therefore, the model has some "fundamental" problems. The IAT technology group uses a vehicle choice logit model to derive advanced vehicle market penetration projections. However, neither the technology assumptions nor the logit model parameters have been developed on the basis of empirical data. The market penetration projections derived from the logit model reflect two sets of undocumented assumptions with respect to technology advancement and consumer behavior changes. Is it appropriate to ignore hard data economic analysis? Should market penetration of advanced vehicles be analyzed solely on the basis of assumptions?
- The analysts in the technology group have a tendency to provide negative comments on results from the model. Responding to comments from the untutored is time consuming. It is increasingly difficult to work on the MARKAL-MACRO modeling analysis. I do not feel it is my task to teach people this model. Most of the questions the technology group raised can be answered if they would study and understand the model and its solutions. The IAT technology group should ask someone at the Brookhaven National Laboratory to assist them in understanding the basic MARKAL-MACRO model structure and results. I will be happy to answer questions pertaining my specific work.

### How Can the Technology Group Help?

In January 1997, the technology group provided annual energy intensity improvement rate estimates. They range from 1.34 to 2.5 annual reduction in E/GDP ratio. It would be very helpful to have the supporting analysis documents made available to the MARKAL-MACRO modelers and the EIA analysts.

If the estimates of the technology group came from specific technologies, MARKAL-MACRO should be able to incorporate the assumptions easily. However, if they are simply assumptions, I suggest we stop wasting our time in pursuing the Case175. We have more important tasks ahead of us before the next public meeting in June.

### Major Concerns Regarding the Advanced Technology Assumptions

Several issues should be resolved before a final model documentation and the analysis paper are released to the reviewers. They are related to the advanced technology assumptions and the penetration of these technologies in the market place.

- How and where do we get the advanced technologies? To date, nobody from the technology group has provided any information or empirical studies to support the assumptions on advanced technologies. The AEO97 base case already incorporated significant improvements in efficiency and costs in most end-use sectors in the period between 2005 and 2015, compared with the 1995 technologies. The advanced technology assumptions for Case175 assume costs and efficiency for some key technologies will improve upon already very cost-effective and efficient future technologies. According to EIA, some of the high energy efficiency technologies are better than the A.D. Little most optimistic technologies. I suggest that at the minimum we let A.D. Little review the assumptions before these advanced technology assumptions are released to the public.
- Vehicle choice and market penetration. I agree that we should not determine who will be the winner in the market place. However, one of the arguments on the penetration of advanced vehicles is that it is the position of this administration to promote more than one technology. With a limited R&D budget, we are asked to assume the penetration of 5 new advanced vehicle technologies. Is this realistic? Staff at the EPA office of Mobile Source and EIA transportation experts apparently think not.
- Industrial Sector technologies. From the technology group, I received a set of energy conservation curves that are not related to specific technologies and their plausibility can not be assessed. Although there is evidence that energy efficiency gaps exist in the industrial sector, these efficiency gaps would be closed if economically and financially feasible. It is entirely possible that the energy conservation curves provide embodied investments that will be made overseas by U.S. energy-intensive industries and would not be consistent with U.S. domestic production levels.

### The Purpose of Markal-Macro Modeling

Markal-Macro is a technology rich model. It is designed to simulate the effects of various economic and technology assumptions on fuel and technology choices. The MARKAL-MACRO model simulation searches for a least cost solution. The model solution algorithm always searches for an economically efficient technology and fuel choice. **Energy efficient** technologies will penetrate the MARKAL-MACRO energy system only if they are also **economically efficient**.

In the past several weeks Markal-Macro has been used to simulate the effects of different hurdle rates and technology assumptions on energy intensity and technology choices. Two questions arise regarding the performance of the model.

- Does the model behave plausibly at the aggregate level? Overall, the responses of total primary energy consumption to changes in hurdle rates and technology assumptions are consistent with microeconomic theory 101. As we lower hurdle rates, more energy efficient technologies penetrate the end-use markets. As a result, energy consumption is projected to decline and GDP to increase. This reflects the benefits of lower energy costs and the interaction between the energy sector and the aggregate economy.
- Is the model solution realistic at the end-use technology and fuel level? Every model has its strengths and weaknesses. Econometric models use fixed coefficients to shape the relationship between endogenous and exogenous variables. Embedded in these estimated coefficients are many behavioral and economic assumptions. The benefit of this type of modeling is consistency between projected and historical values. Its weakness is not being able to analyze non-marginal excursions outside the normal range of economic variations.

There is a trade-off between focusing on the bigger picture and modeling the reality. Many technologies in the model after 2010 do not currently exist. It is hard to say what is reality. We can spend a lot of time to calibrate the model so that the model results can meet some pre-conceived reality check. In the process, the model will lose some of its flexibility in providing valuable insights.

I will follow IAT instruction to calibrate the model and add some constraints to make the detailed model solutions look more realistic.

#### Objective of the IAT Quantitative Analysis

The objective of the IAT modeling analysis is to understand the key economic variables that would have significant impacts on the US economy. I think we have been doing that by using the three models IAT selected. Modeling results from SGM, DRI, and the MARKAL-MACRO are providing valuable insights. For example, the MARKAL-MACRO simulations capture the relationship between energy prices, adoption of energy efficient technologies, capital stock turnover rate, and GDP growth rates. To date, we have not been able to achieve a model run with annual improvement rate of 1.75% in E/GDP ratios due to two key factors:

- First, some of the advanced technology assumptions provided by the IAT technology group are not cost effective enough to penetrate the market. This is especially true for the transportation technologies.
- Second, projected low GDP growth rates do not help either. Average energy efficiency is improved by normal capital stock turnover and the purchase of new equipment to meet new demand. Low GDP growth rates imply a low level of new equipment purchases. The combination of these two factors reduces the total amount of new equipment available to average down the E/GDP.

The MARKAL-MACRO simulation result, however, is consistent with historical data. The E/GDP ratios improved by about 1% per year between 1960 and 1994. Between 1979 and 1985, E/GDP improved at a much greater rate due to significant increases in fossil energy prices and higher economic growth rates. MARKAL-MACRO simulation results for the stabilization case show E/GDP improves at an annual rate of 3% between 2005 and 2010. The rate of intensity improvement drops significantly after 2010, however. This is due to: energy system is projected to reach an economically optimal technology adoption rate, consistent with slower GDP growth rate, and limitations in thermal performance.

The MARKAL-MACRO simulations illuminate the SGM AEEI assumptions. If we could improve energy intensity at an annual rate of 1.75% between 2000 and 2015, it would not be reasonable to assume that AEEI will return immediately to the baseline rate after 2015. The AEEI most likely will eventually return to the long-term average rate of about 1% but the post 2015 AEEI must be lower than the baseline for some time. There are at least two reasons for this.

- First, the technologies available after 2015 may not be very different from previous periods. New purchases may have similar efficiency ratings.
- Second, most technology innovations take time to develop and will become commercially available only if the economics justify it. Many advanced technology assumptions for the case175 are already better than the AEO97 baseline 2015 technologies. It is conceivable that manufacturers may attempt to market new and more energy efficiency equipment that may not be feasible technologically and economically, but I think it an unlikely case.

One of the most important objectives of the IAT modeling effort is to explore implied assumptions that may not be achievable. I think the MARKAL-MACRO is providing valuable input to our understanding by imposing tests of consistency among cases, among economic variables, and to both historic and accounting relationships for E/GDP, energy prices, life-cycle energy services costs, and the relation between economic growth rates and capital turnover. Markal-macro is a strict referee.

At the aggregate level, the MARKAL-MACRO is behaving according to commonsense economics. Simulation results are consistent with historical relationship between E/GDP, energy prices, and economic growth rates.

**FACSIMILE TRANSMISSION**

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**Date:** May 20, 1997

**To:** Tom Rhoads

**Organization/Location:** CEA

**Phone Number:** 395-3114

**Fax Number:** 395-6853

**Subject:** Memo to Ev and MM end-use energy  
prices(shadow prices)

**No. of Pages (with cover):** 8

**From:** Phillip Tseng

**Phone Number:** 586-3892

TABLE 3A: Fuel Shadow Prices By Sector  
(1990 \$ PER MMBTU)

|                              | 1990  | 1995  | 2000  | 2005  | 2010  | 2015  | 2020  | 2025  |
|------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|
| RESIDENTIAL SECTOR           |       |       |       |       |       |       |       |       |
| DISTILLATE                   | 6.12  | 6.16  | 4.71  | 4.81  | 4.90  | 4.79  | 4.55  | 4.90  |
| LPG                          | 11.08 | 10.62 | 9.09  | 9.20  | 9.27  | 9.06  | 9.14  | 9.12  |
| PIPELINE GAS                 | 9.43  | 13.67 | 5.31  | 5.61  | 5.89  | 6.27  | 5.77  | 5.93  |
| ELECTRICITY                  | 3.06  | 3.40  | 2.02  | 2.75  | 2.19  | 2.13  | 2.27  | 2.83  |
| COMMERCIAL SECTOR            |       |       |       |       |       |       |       |       |
| DISTILLATE                   | 6.01  | 5.85  | 4.38  | 4.49  | 4.59  | 4.47  | 4.23  | 4.48  |
| PIPELINE GAS                 | 9.93  | 9.72  | 4.56  | 4.70  | 4.96  | 5.15  | 4.91  | 5.15  |
| ELECTRICITY                  | 1.52  | 1.69  | 1.00  | 1.37  | 1.09  | 1.09  | 1.13  | 1.43  |
| INDUSTRIAL SECTOR            |       |       |       |       |       |       |       |       |
| COAL                         | 1.63  | 0.85  | 0.77  | 0.74  | 0.70  | 0.73  | 0.72  | 1.27  |
| DISTILLATE                   | 5.12  | 5.15  | 3.69  | 3.81  | 3.90  | 3.79  | 3.55  | 4.07  |
| LPG                          | 5.80  | 5.35  | 3.81  | 3.92  | 3.99  | 3.79  | 3.97  | 3.95  |
| FUEL OIL                     | 10.78 | 5.16  | 3.51  | 3.38  | 3.35  | 3.78  | 4.16  | 4.12  |
| PIPELINE GAS                 | 7.69  | 6.75  | 2.61  | 2.68  | 2.85  | 3.05  | 3.31  | 3.18  |
| ELECTRICITY                  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| TRANSPORTATION SECTOR        |       |       |       |       |       |       |       |       |
| DIESEL                       | 10.23 | 10.39 | 8.73  | 9.00  | 9.18  | 9.18  | 9.97  | 9.37  |
| FUEL OIL                     | 10.94 | 5.32  | 3.67  | 3.54  | 3.50  | 3.94  | 4.32  | 4.03  |
| GASOLINE                     | 19.91 | 12.74 | 11.15 | 12.24 | 12.52 | 12.76 | 12.56 | 13.23 |
| JET FUEL                     | 5.10  | 5.14  | 3.58  | 3.80  | 3.89  | 3.76  | 4.14  | 4.40  |
| PIPELINE GAS                 | 0.00  | 12.64 | 8.78  | 9.00  | 9.18  | 9.03  | 9.22  | 13.32 |
| ELECTRICITY                  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| ELECTRIC UTILITY SECTOR      |       |       |       |       |       |       |       |       |
| COAL                         | 1.08  | 1.09  | 1.02  | 0.93  | 1.15  | 1.20  | 1.13  | 1.29  |
| FUEL OIL                     | 10.41 | 4.97  | 3.32  | 3.19  | 3.30  | 3.56  | 4.34  | 3.84  |
| PIPELINE GAS                 | 6.00  | 6.59  | 2.45  | 2.52  | 2.69  | 3.03  | 3.29  | 3.15  |
| NATURAL GAS WELLHEAD PRICE   | 5.58  | 5.58  | 1.61  | 1.63  | 1.84  | 2.03  | 2.28  | 2.16  |
| CRUDE OIL IMPORT PRICE       | 7.68  | 4.44  | 2.73  | 3.02  | 3.13  | 3.22  | 3.26  | 3.39  |
| AVERAGE COAL MINEMOUTH PRICE | 1.00  | 0.77  | 0.71  | 0.67  | 0.63  | 0.67  | 0.66  | 0.64  |

TABLE 3A: Fuel Shadow Prices By Sector  
(1990 \$ PER MMBTU)

|                                     | 1990  | 1995  | 2000  | 2005  | 2010  | 2015  | 2020  | 2025  |
|-------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|
| <b>RESIDENTIAL SECTOR</b>           |       |       |       |       |       |       |       |       |
| DISTILLATE                          | 6.12  | 6.16  | 4.71  | 4.99  | 6.05  | 6.07  | 6.29  | 6.51  |
| LPG                                 | 11.08 | 10.62 | 9.09  | 9.40  | 12.63 | 12.42 | 12.31 | 12.95 |
| PIPELINE GAS                        | 9.43  | 14.24 | 5.45  | 5.61  | 6.30  | 7.03  | 6.92  | 7.11  |
| ELECTRICITY                         | 3.06  | 3.40  | 2.02  | 2.75  | 2.19  | 2.19  | 2.27  | 2.88  |
| <b>COMMERCIAL SECTOR</b>            |       |       |       |       |       |       |       |       |
| DISTILLATE                          | 6.01  | 5.84  | 4.39  | 4.67  | 5.73  | 5.73  | 5.98  | 6.30  |
| PIPELINE GAS                        | 9.93  | 8.94  | 5.07  | 5.43  | 6.78  | 6.88  | 6.91  | 7.37  |
| ELECTRICITY                         | 1.52  | 1.59  | 1.00  | 1.37  | 1.09  | 1.09  | 1.13  | 1.43  |
| <b>INDUSTRIAL SECTOR</b>            |       |       |       |       |       |       |       |       |
| COAL                                | 1.63  | 0.85  | 0.77  | 0.74  | 3.91  | 3.83  | 3.52  | 3.71  |
| DISTILLATE                          | 5.12  | 5.16  | 3.71  | 3.99  | 5.05  | 5.07  | 5.29  | 5.61  |
| LPG                                 | 5.80  | 5.34  | 3.82  | 4.13  | 5.19  | 5.00  | 5.08  | 5.59  |
| FUEL OIL                            | 11.17 | 5.16  | 3.45  | 2.98  | 6.21  | 6.53  | 5.69  | 6.35  |
| PIPELINE GAS                        | 7.69  | 6.75  | 2.62  | 3.03  | 5.60  | 5.42  | 5.34  | 5.55  |
| ELECTRICITY                         | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| <b>TRANSPORTATION SECTOR</b>        |       |       |       |       |       |       |       |       |
| DIESEL                              | 10.24 | 10.37 | 8.79  | 9.24  | 10.54 | 10.71 | 11.17 | 11.61 |
| FUEL OIL                            | 11.33 | 5.22  | 3.61  | 3.14  | 6.37  | 6.69  | 5.85  | 6.51  |
| GASOLINE                            | 23.27 | 12.74 | 11.16 | 12.03 | 15.06 | 15.03 | 15.12 | 15.71 |
| JET FUEL                            | 5.10  | 5.14  | 3.68  | 3.97  | 6.33  | 6.66  | 6.56  | 6.94  |
| PIPELINE GAS                        | 0.00  | 10.37 | 8.79  | 9.24  | 10.54 | 10.57 | 10.71 | 11.43 |
| ELECTRICITY                         | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| <b>ELECTRIC UTILITY SECTOR</b>      |       |       |       |       |       |       |       |       |
| COAL                                | 1.08  | 0.95  | 1.32  | 1.11  | 3.89  | 3.82  | 3.34  | 3.42  |
| FUEL OIL                            | 10.80 | 4.85  | 3.45  | 2.89  | 5.84  | 6.16  | 5.32  | 5.99  |
| PIPELINE GAS                        | 6.00  | 6.59  | 2.46  | 2.51  | 5.54  | 5.36  | 5.27  | 5.49  |
| <b>NATURAL GAS WELLHEAD PRICE</b>   | 5.58  | 5.58  | 1.62  | 1.66  | 2.74  | 2.59  | 2.67  | 2.75  |
| <b>CRUDE OIL IMPORT PRICE</b>       | 7.84  | 4.49  | 2.73  | 2.94  | 2.75  | 2.86  | 3.01  | 3.17  |
| <b>AVERAGE COAL MINEMOUTH PRICE</b> | 1.00  | 0.76  | 0.72  | 0.68  | 0.63  | 0.59  | 0.55  | 0.61  |

Case 2 Stabilization in 2010 at 1990 levels  
MARKAL-MACRO 5/12/97

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**To:** Tom Rhoads

**Organization/Location:** CEA

**Phone Number:** 395-3114

**Fax Number:** 395-6853

**Subject:** Memo to Ev and MM end-use energy  
prices(shadow prices)

**No. of Pages (with cover):** 8

**From:** Phillip Tseng

**Phone Number:** 586-3892

EXECUTIVE OFFICE OF THE PRESIDENT

20-May-1997 12:23pm

TO: rhoads\_t  
FROM: Nagelhout.Peter  
CC: Hohenstein.William  
CC: Scheraga.Joel  
SUBJECT: projected market prices for fossil fuels from SGM

Tom,

Per your request, I have attached a file containing SGM's estimates of the market prices of coal and natural gas under of carbon policy. I am reporting the "plain vanilla" case results: 1.25%/yr. decrease in C/GDP, stabilization at 1990 levels, 100% deficit reduction, and no international trading of carbon permits.

All prices are expressed in 1995 dollars. SGM uses an exogenously specified price of imported crude oil, which I have included in the spreadsheet. The prices for coal and natural gas are endogenously determined.

Please let me know if you need any other information from us.

Peter Nagelhout  
202 260-7015

(See attached file: DATAFO~1.XLS)

divestiture of its local telephone companies. The breakup of AT&T eliminated the system of internal payments, and forced the FCC to make explicit the access charges paid by long distance carriers to local companies. In doing so, the FCC took a big step toward the aforementioned efficient pricing principles by replacing part of the usage-based subsidy with a fixed monthly "subscriber line charge."

**From here on out.** As the 1996 Telecommunications Act created the prospect of multiple local telephone companies, a system under which only the incumbent gets is paid access charges above costs to pay for mandated subsidies of telephone lines would be increasingly untenable. The FCC's recently released reform would reduce usage-based charges closer to cost, and raise rates for all but the first lines in homes. After nearly seventy years, thanks largely to competitive pressures, we are closing in on an efficient pricing structure for local telephone service.

### **How Economists Measure Economic Loss**

In evaluating public policies or business practices, economists frequently want to have some way of measuring their benefits and costs. In doing so, the focus of attention is primarily on the amount of goods and services that people consume. For example, the economic cost of monopoly is that, in order to maximize profits, a cartel or monopolist will typically hold output off the market. Too much output can be costly as well, particularly in environmental contexts, when people may overuse certain goods because they do not take pollution-related damages into account.

Prices are important in that they affect the amount of goods and services we produce and consume, but they are not directly included in economic calculations of costs and benefits. A change in prices, without a change in output, redistributes wealth from one group to another. This redistribution can be important as a matter of both politics and ethics, but as a transfer of wealth from one group to another, it typically does not affect analyses of economy-wide benefits and costs. (This is why economists can sometimes seem "tone deaf" to politics.) One possible exception is that devoting labor and resources to practices whose only purpose is to prop up prices--what economists call "rent seeking"--represent a genuine cost, in that those resources might have instead been devoted to increasing the level of goods and services available in the economy.

When output is too small, economists estimate losses by calculating the value of foregone output to consumers--measured by their willingness to pay--less the cost of the resources that would have been needed to produce that output. Where output is too large, they calculate how much more that extra output costs than the benefits consumers get. In evaluating telephone prices, adding up the losses from too little long distance use under the recently reformed access charge system gives leads to estimates from \$3-7 billion, depending on various demand assumptions.

| year | Nat. gas--baseline<br>(1995 \$/Mcf) | Nat. gas--<br>stabilization w/o<br>trading (1995<br>\$/Mcf) | Coal--baseline<br>(1995 \$/short ton) | Coal--stabilization w/o<br>trading (1995 \$/short ton) | Oil--price of<br>imported<br>crude |
|------|-------------------------------------|-------------------------------------------------------------|---------------------------------------|--------------------------------------------------------|------------------------------------|
| 2000 | \$2.07                              | \$2.07                                                      | \$18.48                               | \$18.48                                                | \$18.20                            |
| 2005 | \$2.10                              | \$2.51                                                      | \$17.30                               | \$30.43                                                | \$19.72                            |
| 2010 | \$2.16                              | \$3.26                                                      | \$16.47                               | \$54.65                                                | \$20.41                            |
| 2015 | \$2.11                              | \$3.31                                                      | \$15.73                               | \$61.26                                                | \$20.98                            |
| 2020 | \$1.97                              | \$3.26                                                      | \$14.96                               | \$65.19                                                | \$21.57                            |

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**To:** Tom Rhoads

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**Phone Number:** 395-3114

**Fax Number:** 395-6853

**Subject:** Energy Prices from DRI Energy Model

**No. of Pages (with cover):** 2

**From:** Phillip Tseng

**Phone Number:** 586-3892

## DRI Macro/Energy Model

Stabilization @ 1990 levels in 2010  
ramped in cap. grandfathered permits

|                                            | 1990  | 1995  | 2000  | 2005  | 2010   | 2015   | 2020   |
|--------------------------------------------|-------|-------|-------|-------|--------|--------|--------|
| NOMINAL PRICES (dollars per million Btu)   |       |       |       |       |        |        |        |
| Implicit Price Deflator (1995=1.00)        | 0.87  | 1     | 1.13  | 1.34  | 1.61   | 1.92   | 2.3    |
| Carbon Tax                                 | --    | --    | 11.89 | 84.58 | 152.81 | 210.72 | 287.13 |
| Imported Crude Oil (\$/barrel)             | 21.76 | 17.14 | 18.17 | 24.66 | 32.83  | 42.1   | 52.97  |
| Domestic Crude Oil (\$/barrel)             | 22.59 | 17.33 | 18.45 | 24.98 | 33.21  | 42.55  | 53.51  |
| Gasoline-Retail                            | 9.73  | 9.64  | 11.04 | 15.12 | 19.81  | 25.03  | 31.3   |
| Residual Fuel-Electric Utility             | 3.31  | 2.58  | 3.04  | 5.28  | 7.75   | 10.18  | 13.22  |
| Coal-Electric Utility                      | 1.45  | 1.32  | 1.69  | 3.82  | 5.86   | 7.64   | 9.98   |
| Natural Gas-Wellhead Spot                  | 1.53  | 1.42  | 2.05  | 2.72  | 3.63   | 4.55   | 5.71   |
| Natural Gas-Residential                    | 5.46  | 5.76  | 6.79  | 9.28  | 12.22  | 15.13  | 18.79  |
| Natural Gas-Commercial                     | 4.55  | 4.79  | 5.73  | 8.04  | 10.74  | 13.36  | 16.69  |
| Natural Gas-Industrial                     | 2.84  | 2.74  | 3.52  | 5.5   | 7.74   | 9.86   | 12.58  |
| Natural Gas-Utility                        | 2.34  | 1.99  | 2.67  | 4.55  | 6.64   | 8.58   | 11.07  |
| Electricity-Weighted Average               | 19.27 | 20.21 | 21.82 | 27.88 | 33.7   | 41.56  | 51.15  |
| Electricity-Residential                    | 22.94 | 24.51 | 26.42 | 33.6  | 40.07  | 48.84  | 59.33  |
| Electricity-Commercial                     | 20.97 | 22.04 | 22.88 | 28.65 | 33.97  | 41.94  | 51.61  |
| Electricity-Industrial                     | 14.11 | 13.99 | 15.37 | 21.24 | 27.02  | 33.84  | 42.2   |
| REAL PRICES (1995 dollars per million Btu) |       |       |       |       |        |        |        |
| Carbon Tax                                 | --    | 0     | 10.56 | 63.33 | 95     | 110    | 125    |
| Imported Crude Oil (\$/barrel)             | 25.02 | 17.14 | 16.14 | 18.47 | 20.41  | 21.97  | 23.06  |
| Domestic Crude Oil (\$/barrel)             | 25.97 | 17.33 | 16.38 | 18.7  | 20.65  | 22.21  | 23.3   |
| Gasoline-Retail                            | 11.19 | 9.64  | 9.81  | 11.33 | 12.32  | 13.06  | 13.63  |
| Residual Fuel-Electric Utility             | 3.8   | 2.58  | 2.7   | 3.95  | 4.82   | 5.32   | 5.75   |
| Coal-Electric Utility                      | 1.67  | 1.32  | 1.5   | 2.86  | 3.64   | 3.99   | 4.34   |
| Natural Gas-Wellhead Spot                  | 1.76  | 1.42  | 1.82  | 2.04  | 2.26   | 2.38   | 2.48   |
| Natural Gas-Residential                    | 6.27  | 5.76  | 6.03  | 6.95  | 7.6    | 7.9    | 8.18   |
| Natural Gas-Commercial                     | 5.23  | 4.79  | 5.09  | 6.02  | 6.68   | 6.98   | 7.27   |
| Natural Gas-Industrial                     | 3.27  | 2.74  | 3.12  | 4.12  | 4.81   | 5.15   | 5.47   |
| Natural Gas-Utility                        | 2.69  | 1.99  | 2.37  | 3.4   | 4.13   | 4.48   | 4.82   |
| Electricity-Weighted Average               | 22.15 | 20.21 | 19.2  | 20.88 | 20.95  | 21.7   | 22.27  |
| Electricity-Residential                    | 26.37 | 24.51 | 23.46 | 25.16 | 24.91  | 25.49  | 25.83  |
| Electricity-Commercial                     | 24.1  | 22.04 | 20.32 | 21.45 | 21.12  | 21.89  | 22.47  |
| Electricity-Industrial                     | 16.22 | 13.99 | 13.64 | 15.91 | 16.8   | 17.67  | 18.37  |

10-year Ramp to 1344 Case (Xf1344nX.d040397a)

Table 2. Energy Consumption by Sector and Source

(Quadrillion Btu per Year, Unless Otherwise Noted)

NEMS

|                           | 1995  | 2000  | 2005  | 2010  | 2015  | 2020  |
|---------------------------|-------|-------|-------|-------|-------|-------|
| <b>Energy Consumption</b> |       |       |       |       |       |       |
| <b>Residential</b>        |       |       |       |       |       |       |
| -Distillate Fuel.....     | 0.85  | 0.80  | 0.71  | 0.66  | 0.64  | 0.60  |
| Kerosene.....             | 0.07  | 0.07  | 0.06  | 0.06  | 0.06  | 0.05  |
| -Liquefied Petroleum Ga   | 0.40  | 0.42  | 0.42  | 0.42  | 0.43  | 0.43  |
| Petroleum Subtotal..      | 1.32  | 1.30  | 1.20  | 1.15  | 1.13  | 1.08  |
| -Natural Gas.....         | 5.01  | 5.21  | 5.01  | 5.00  | 5.15  | 5.24  |
| Coal.....                 | 0.05  | 0.05  | 0.04  | 0.04  | 0.04  | 0.03  |
| Renewable Energy .....    | 0.57  | 0.56  | 0.53  | 0.51  | 0.49  | 0.47  |
| -Electricity.....         | 3.56  | 3.85  | 4.04  | 4.31  | 4.61  | 4.99  |
| Delivered Energy....      | 10.51 | 10.96 | 10.82 | 11.00 | 11.42 | 11.81 |
| Electricity Related Lo    | 7.92  | 8.06  | 7.43  | 7.73  | 8.39  | 9.28  |
| Total.....                | 18.43 | 19.02 | 18.25 | 18.73 | 19.81 | 21.10 |
| <b>Commercial</b>         |       |       |       |       |       |       |
| -Distillate Fuel.....     | 0.41  | 0.36  | 0.34  | 0.32  | 0.32  | 0.31  |
| -Residual Fuel.....       | 0.17  | 0.13  | 0.13  | 0.14  | 0.14  | 0.14  |
| Kerosene.....             | 0.02  | 0.02  | 0.02  | 0.02  | 0.02  | 0.02  |
| Liquefied Petroleum Ga    | 0.05  | 0.06  | 0.06  | 0.06  | 0.06  | 0.07  |
| Motor Gasoline .....      | 0.03  | 0.03  | 0.03  | 0.03  | 0.02  | 0.02  |
| Petroleum Subtotal..      | 0.67  | 0.60  | 0.58  | 0.57  | 0.57  | 0.56  |
| -Natural Gas.....         | 3.16  | 3.32  | 3.27  | 3.29  | 3.41  | 3.54  |
| Coal.....                 | 0.08  | 0.08  | 0.08  | 0.09  | 0.09  | 0.09  |
| Renewable Energy .....    | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| -Electricity.....         | 3.23  | 3.42  | 3.41  | 3.52  | 3.76  | 3.96  |
| Delivered Energy....      | 7.15  | 7.42  | 7.35  | 7.46  | 7.84  | 8.16  |
| Electricity Related Lo    | 7.18  | 7.17  | 6.26  | 6.31  | 6.85  | 7.37  |
| Total.....                | 14.33 | 14.59 | 13.61 | 13.78 | 14.69 | 15.53 |
| <b>Industrial ..</b>      |       |       |       |       |       |       |
| Distillate Fuel.....      | 1.15  | 1.27  | 1.40  | 1.49  | 1.56  | 1.62  |
| Liquefied Petroleum Ga    | 2.01  | 2.06  | 2.07  | 2.08  | 2.04  | 2.02  |
| Petrochemical Feedstoc    | 1.16  | 1.23  | 1.22  | 1.20  | 1.18  | 1.15  |
| Residual Fuel.....        | 0.34  | 0.28  | 0.29  | 0.28  | 0.27  | 0.27  |
| Motor Gasoline .....      | 0.20  | 0.22  | 0.24  | 0.25  | 0.27  | 0.28  |
| Other Petroleum .....     | 3.83  | 4.27  | 4.25  | 4.21  | 4.14  | 4.12  |
| Petroleum Subtotal..      | 8.68  | 9.34  | 9.47  | 9.51  | 9.46  | 9.46  |
| Natural Gas .....         | 9.74  | 10.53 | 10.48 | 10.43 | 10.58 | 10.29 |
| Metallurgical Coal....    | 0.88  | 0.77  | 0.55  | 0.40  | 0.30  | 0.21  |
| Steam Coal.....           | 1.59  | 1.53  | 1.42  | 1.08  | 0.95  | 0.96  |
| Net Coal Coke Imports.    | 0.03  | 0.07  | 0.08  | 0.08  | 0.12  | 0.15  |
| Coal Subtotal.....        | 2.51  | 2.36  | 2.05  | 1.57  | 1.37  | 1.32  |
| Renewable Energy .....    | 1.74  | 1.89  | 1.96  | 2.00  | 2.01  | 1.98  |
| Electricity.....          | 3.46  | 3.88  | 4.14  | 4.16  | 4.25  | 4.32  |
| Delivered Energy....      | 26.12 | 28.00 | 28.10 | 27.67 | 27.66 | 27.38 |
| Electricity Related Lo    | 7.69  | 8.12  | 7.62  | 7.47  | 7.73  | 8.05  |
| Total.....                | 33.81 | 36.12 | 35.72 | 35.14 | 35.39 | 35.42 |
| <b>Transportation</b>     |       |       |       |       |       |       |
| Distillate Fuel.....      | 4.42  | 4.92  | 5.28  | 5.51  | 5.65  | 5.75  |
| Jet Fuel .....            | 3.13  | 3.66  | 3.96  | 4.32  | 4.59  | 4.80  |

|                          |       |       |       |       |       |       |
|--------------------------|-------|-------|-------|-------|-------|-------|
| - Motor Gasoline .....   | 14.65 | 15.54 | 15.56 | 15.24 | 14.82 | 14.43 |
| - Residual Fuel .....    | 1.08  | 1.29  | 1.44  | 1.61  | 1.74  | 1.88  |
| - Liquefied Petroleum Ga | 0.03  | 0.04  | 0.10  | 0.16  | 0.19  | 0.21  |
| Other Petroleum .....    | 0.26  | 0.29  | 0.30  | 0.32  | 0.33  | 0.33  |
| Petroleum Subtotal..     | 23.56 | 25.73 | 26.65 | 27.15 | 27.32 | 27.40 |
| Pipeline Fuel Natural    | 0.72  | 0.79  | 0.95  | 0.98  | 0.98  | 0.98  |
| Compressed Natural Gas   | 0.01  | 0.05  | 0.16  | 0.23  | 0.27  | 0.30  |
| Renewables (E85) .....   | 0.00  | 0.00  | 0.02  | 0.07  | 0.10  | 0.13  |
| Methanol .....           | 0.00  | 0.00  | 0.03  | 0.06  | 0.10  | 0.12  |
| Liquid Hydrogen .....    | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| Electricity .....        | 0.02  | 0.03  | 0.08  | 0.12  | 0.15  | 0.29  |
| Delivered Energy....     | 24.32 | 26.61 | 27.89 | 28.61 | 28.92 | 29.21 |
| Electricity Related Lo   | 0.05  | 0.06  | 0.15  | 0.22  | 0.27  | 0.54  |
| Total .....              | 24.36 | 26.66 | 28.04 | 28.83 | 29.19 | 29.75 |

## Deliver. Energy Cons. All Sectors

|                        |       |       |       |              |       |        |
|------------------------|-------|-------|-------|--------------|-------|--------|
| Distillate Fuel .....  | 6.82  | 7.35  | 7.73  | 7.99         | 8.16  | 8.28   |
| Kerosene .....         | 0.11  | 0.11  | 0.10  | 0.10         | 0.10  | 0.10   |
| Jet Fuel .....         | 3.13  | 3.66  | 3.96  | 4.32         | 4.59  | 4.80   |
| Liquefied Petroleum Ga | 2.49  | 2.58  | 2.65  | 2.72         | 2.73  | 2.73   |
| Motor Gasoline .....   | 14.87 | 15.78 | 15.82 | 15.52        | 15.11 | 14.73  |
| Petrochemical Feedstoc | 1.16  | 1.23  | 1.22  | 1.20         | 1.18  | 1.15   |
| Residual Fuel .....    | 1.58  | 1.70  | 1.87  | 2.02         | 2.15  | 2.29   |
| Other Petroleum .....  | 4.07  | 4.54  | 4.54  | 4.51         | 4.45  | 4.43   |
| Petroleum Subtotal..   | 34.24 | 36.96 | 37.90 | 38.38        | 38.48 | 38.50  |
| Natural Gas .....      | 18.64 | 19.91 | 19.87 | 19.93        | 20.39 | 20.34  |
| Metallurgical Coal.... | 0.88  | 0.77  | 0.55  | 0.40         | 0.30  | 0.21   |
| Steam Coal .....       | 1.73  | 1.66  | 1.54  | 1.21         | 1.08  | 1.09   |
| Net Coal Coke Imports. | 0.03  | 0.07  | 0.08  | 0.08         | 0.12  | 0.15   |
| Coal Subtotal .....    | 2.64  | 2.49  | 2.17  | 1.69         | 1.50  | 1.45   |
| Renewable Energy ..... | 2.30  | 2.46  | 2.52  | 2.58         | 2.61  | 2.59   |
| Methanol .....         | 0.00  | 0.00  | 0.03  | 0.06         | 0.10  | 0.12   |
| Liquid Hydrogen .....  | 0.00  | 0.00  | 0.00  | 0.00         | 0.00  | 0.00   |
| Electricity .....      | 10.27 | 11.17 | 11.67 | 12.11        | 12.77 | 13.56  |
| Delivered Energy....   | 68.10 | 73.00 | 74.15 | 74.75        | 75.84 | 76.56  |
| Electricity Related Lo | 22.83 | 23.39 | 21.46 | 21.73        | 23.24 | 25.24  |
| Total .....            | 90.93 | 96.39 | 95.61 | <u>96.48</u> | 99.08 | 101.80 |

## Electric Generators ...

|                        |       |       |       |       |       |       |
|------------------------|-------|-------|-------|-------|-------|-------|
| Distillate Fuel .....  | 0.09  | 0.07  | 0.04  | 0.04  | 0.04  | 0.04  |
| Residual Fuel .....    | 0.60  | 0.39  | 0.18  | 0.15  | 0.14  | 0.12  |
| Petroleum Subtotal..   | 0.68  | 0.46  | 0.22  | 0.19  | 0.18  | 0.16  |
| Natural Gas .....      | 3.54  | 5.14  | 9.62  | 11.12 | 11.57 | 10.92 |
| Steam Coal .....       | 17.31 | 17.00 | 10.09 | 7.79  | 7.50  | 7.75  |
| Nuclear Power .....    | 7.19  | 7.42  | 7.33  | 7.22  | 7.69  | 9.42  |
| Renewable Energy ..... | 3.99  | 4.11  | 5.22  | 6.58  | 8.18  | 9.66  |
| Electricity Imports... | 0.39  | 0.43  | 0.65  | 0.94  | 0.89  | 0.89  |
| Total .....            | 33.10 | 34.57 | 33.13 | 33.84 | 36.01 | 38.80 |

## Total Energy Consumption

|                        |       |       |       |       |       |       |
|------------------------|-------|-------|-------|-------|-------|-------|
| Distillate Fuel .....  | 6.91  | 7.42  | 7.77  | 8.02  | 8.20  | 8.32  |
| Kerosene .....         | 0.11  | 0.11  | 0.10  | 0.10  | 0.10  | 0.10  |
| Jet Fuel .....         | 3.13  | 3.66  | 3.96  | 4.32  | 4.59  | 4.80  |
| Liquefied Petroleum Ga | 2.49  | 2.58  | 2.65  | 2.72  | 2.73  | 2.73  |
| Motor Gasoline .....   | 14.87 | 15.78 | 15.82 | 15.52 | 15.11 | 14.73 |
| Petrochemical Feedstoc | 1.16  | 1.23  | 1.22  | 1.20  | 1.18  | 1.15  |
| Residual Fuel .....    | 2.18  | 2.09  | 2.05  | 2.17  | 2.29  | 2.41  |
| Other Petroleum .....  | 4.07  | 4.54  | 4.54  | 4.51  | 4.45  | 4.43  |
| Petroleum Subtotal..   | 34.92 | 37.42 | 38.12 | 38.57 | 38.65 | 38.67 |
| Natural Gas .....      | 22.18 | 25.05 | 29.49 | 31.05 | 31.96 | 31.26 |
| Metallurgical Coal.... | 0.88  | 0.77  | 0.55  | 0.40  | 0.30  | 0.21  |
| Steam Coal .....       | 19.04 | 18.66 | 11.64 | 9.00  | 8.58  | 8.83  |

|                         |       |       |       |              |       |        |
|-------------------------|-------|-------|-------|--------------|-------|--------|
| Net Coal Coke Imports.. | 0.03  | 0.07  | 0.08  | 0.08         | 0.12  | 0.15   |
| Coal Subtotal.....      | 19.95 | 19.50 | 12.27 | 9.48         | 9.00  | 9.20   |
| Nuclear Power.....      | 7.19  | 7.42  | 7.33  | 7.22         | 7.69  | 9.42   |
| Renewable Energy .....  | 6.30  | 6.57  | 7.74  | 9.16         | 10.79 | 12.25  |
| Methanol .....          | 0.00  | 0.00  | 0.03  | 0.06         | 0.10  | 0.12   |
| Liquid Hydrogen.....    | 0.00  | 0.00  | 0.00  | 0.00         | 0.00  | 0.00   |
| Electricity Imports...  | 0.39  | 0.43  | 0.65  | 0.94         | 0.89  | 0.89   |
| Total.....              | 90.93 | 96.39 | 95.61 | <u>96.48</u> | 99.08 | 101.80 |

## Energy Use &amp; Related Statistics

|                                                   |         |         |         |         |         |         |
|---------------------------------------------------|---------|---------|---------|---------|---------|---------|
| Delivered Energy Use...                           | 68.10   | 73.00   | 74.15   | 74.75   | 75.84   | 76.56   |
| Total Energy Use.....                             | 90.93   | 96.39   | 95.60   | 96.46   | 99.04   | 101.74  |
| Population (millions)...                          | 263.58  | 275.62  | 287.12  | 298.92  | 311.19  | 323.47  |
| US GDP (billion 1992 do                           | 6738.95 | 7515.69 | 8218.41 | 9025.01 | 9725.26 | #####   |
| Total Carbon Emissions<br>(million metric ton)... | 1423.47 | 1499.36 | 1390.60 | 1347.45 | 1338.05 | 1334.40 |

Table 3. Energy Prices by Sector and Source  
(1995 Dollars per Million Btu)

|                      | 1995  | 2000  | 2005  | 2010  | 2015  | 2020  |
|----------------------|-------|-------|-------|-------|-------|-------|
| Residential.....     | 12.87 | 14.00 | 17.02 | 18.22 | 17.42 | 17.71 |
| Primary Energy.....  | 6.28  | 6.71  | 8.20  | 8.82  | 8.46  | 8.65  |
| Petroleum Products.. | 7.51  | 9.13  | 10.74 | 11.77 | 11.72 | 11.92 |
| Distillate Fuel...   | 6.24  | 7.70  | 9.39  | 10.33 | 10.32 | 10.46 |
| Liquefied Petroleu   | 10.29 | 11.86 | 13.02 | 14.03 | 13.80 | 13.99 |
| Natural Gas.....     | 6.01  | 6.15  | 7.63  | 8.18  | 7.77  | 8.00  |
| Electricity.....     | 24.68 | 26.40 | 30.67 | 31.71 | 29.71 | 29.26 |
| Commercial.....      | 13.25 | 14.19 | 16.99 | 18.02 | 17.17 | 17.09 |
| Primary Energy.....  | 4.82  | 5.23  | 6.76  | 7.44  | 7.14  | 7.34  |
| Petroleum Products.. | 4.58  | 5.81  | 7.44  | 8.41  | 8.36  | 8.46  |
| Distillate Fuel...   | 4.39  | 5.72  | 7.39  | 8.32  | 8.29  | 8.45  |
| Residual Fuel.....   | 2.99  | 3.38  | 5.10  | 6.14  | 6.24  | 6.19  |
| Natural Gas .....    | 4.96  | 5.20  | 6.71  | 7.33  | 6.99  | 7.22  |
| Electricity.....     | 23.47 | 24.65 | 28.82 | 29.88 | 28.01 | 27.45 |
| Industrial .....     | 5.05  | 5.60  | 7.29  | 8.13  | 7.84  | 8.02  |
| Primary Energy.....  | 3.36  | 3.73  | 5.07  | 5.91  | 5.78  | 6.02  |
| Petroleum Products.. | 4.92  | 4.84  | 5.85  | 6.60  | 6.49  | 6.65  |
| Distillate Fuel...   | 4.61  | 5.64  | 7.34  | 8.30  | 8.27  | 8.49  |
| Liquefied Petroleu   | 6.53  | 6.53  | 7.52  | 8.55  | 8.21  | 8.30  |
| Residual Fuel.....   | 2.55  | 3.42  | 5.15  | 6.20  | 6.26  | 6.16  |
| Natural Gas .....    | 2.28  | 2.94  | 4.47  | 5.28  | 5.12  | 5.47  |
| Metallurgical Coal.. | 1.76  | 2.49  | 4.22  | 5.34  | 5.31  | 5.18  |
| Steam Coal.....      | 1.49  | 2.25  | 3.98  | 5.05  | 5.05  | 4.97  |
| Electricity.....     | 14.72 | 15.64 | 18.20 | 18.67 | 17.29 | 16.91 |
| Transportation.....  | 7.92  | 9.11  | 10.66 | 11.42 | 10.98 | 10.94 |
| Primary Energy.....  | 7.92  | 9.10  | 10.64 | 11.40 | 10.96 | 10.89 |
| Petroleum Products.. | 7.92  | 9.11  | 10.65 | 11.39 | 10.95 | 10.86 |
| Distillate Fuel ..   | 8.03  | 9.31  | 10.82 | 11.57 | 11.34 | 11.29 |
| Jet Fuel .....       | 3.85  | 5.73  | 7.37  | 8.28  | 8.21  | 8.40  |

|                                    |       |       |       |       |       |       |
|------------------------------------|-------|-------|-------|-------|-------|-------|
| Motor Gasoline ...                 | 9.23  | 10.41 | 12.01 | 12.83 | 12.27 | 12.17 |
| - Residual Fuel.....               | 2.44  | 3.29  | 5.15  | 6.30  | 6.26  | 6.27  |
| - Liquid Petroleum G               | 8.61  | 13.73 | 14.59 | 15.28 | 14.79 | 14.71 |
| Natural Gas .....                  | 5.77  | 6.39  | 8.26  | 9.52  | 9.56  | 9.93  |
| E85 .....                          | 11.95 | 15.27 | 16.69 | 16.53 | 14.70 | 13.91 |
| M85 .....                          | 15.11 | 12.55 | 14.92 | 14.75 | 14.69 | 17.22 |
| Electricity.....                   | 15.27 | 15.47 | 15.88 | 15.84 | 15.27 | 15.36 |
| <br>Total End-Use Energy....       | 8.25  | 9.14  | 11.09 | 12.02 | 11.61 | 11.76 |
| Primary Energy.....                | 7.84  | 8.75  | 10.59 | 11.47 | 11.06 | 11.16 |
| Electricity.....                   | 20.92 | 22.11 | 25.60 | 26.54 | 24.91 | 24.49 |
| <br>Electric Generators ...        |       |       |       |       |       |       |
| Fossil Fuel Average...             | 1.48  | 2.25  | 4.20  | 5.20  | 5.06  | 5.22  |
| Petroleum Products..               | 2.78  | 3.75  | 5.79  | 6.99  | 7.12  | 7.29  |
| Distillate Fuel...                 | 3.93  | 5.23  | 6.96  | 7.91  | 7.89  | 8.11  |
| Residual Fuel.....                 | 2.62  | 3.48  | 5.52  | 6.76  | 6.90  | 7.01  |
| Natural Gas.....                   | 2.01  | 2.70  | 4.61  | 5.40  | 5.17  | 5.47  |
| Steam Coal.....                    | 1.32  | 2.07  | 3.77  | 4.86  | 4.86  | 4.81  |
| <br>Average Price to All Users ... |       |       |       |       |       |       |
| Petroleum Products....             | 7.07  | 8.00  | 9.45  | 10.23 | 9.89  | 9.87  |
| Distillate Fuel .....              | 6.98  | 8.29  | 9.89  | 10.71 | 10.54 | 10.57 |
| Jet Fuel.....                      | 3.85  | 5.73  | 7.37  | 8.28  | 8.21  | 8.40  |
| Liquefied Petroleum                | 7.20  | 7.60  | 8.75  | 9.87  | 9.64  | 9.78  |
| Motor Gasoline .....               | 9.23  | 10.39 | 12.00 | 12.82 | 12.25 | 12.15 |
| Residual Fuel.....                 | 2.55  | 3.35  | 5.18  | 6.31  | 6.30  | 6.29  |
| Natural Gas.....                   | 3.57  | 3.95  | 5.40  | 6.11  | 5.86  | 6.20  |
| Coal.....                          | 1.36  | 2.09  | 3.80  | 4.89  | 4.88  | 4.83  |
| E85 .....                          | 11.95 | 15.27 | 16.69 | 16.53 | 14.70 | 13.91 |
| M85 .....                          | 15.11 | 12.55 | 14.92 | 14.75 | 14.69 | 17.22 |
| Electricity.....                   | 20.92 | 22.11 | 25.60 | 26.54 | 24.91 | 24.49 |

**Department of Energy**

Washington, DC 20585

**To:**J. Shogren**Fax:**(202) 395-6853**From:**RAY FRANK**Date:****Pages:**, including the cover page.

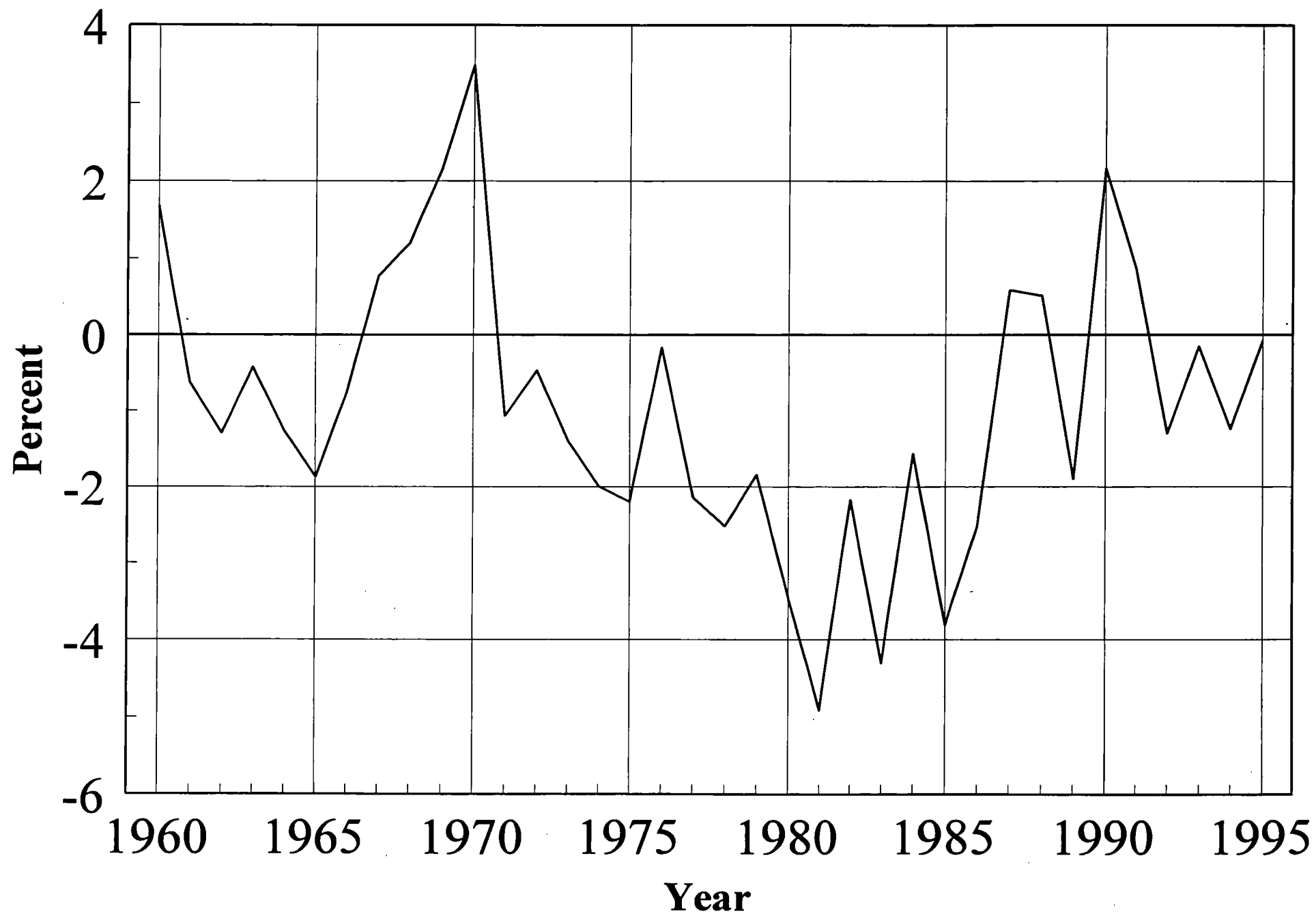
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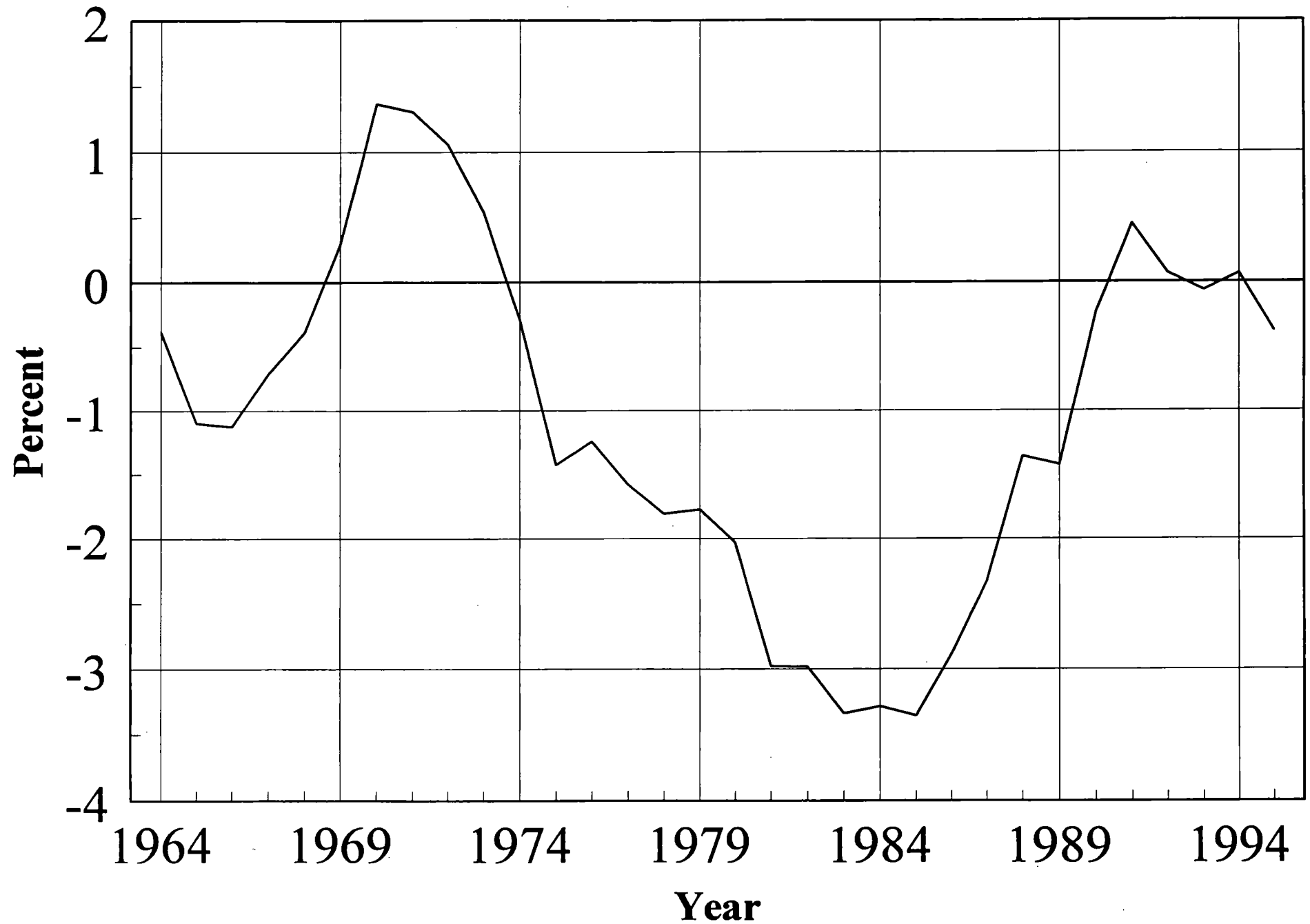
Joanita R. Hayes  
SecretaryRAY FRANKU.S. Dept. of Energy, Office of Economic  
Electricity, and Natural Gas Analysis  
PO-61, 1000 Independence Avenue, SW  
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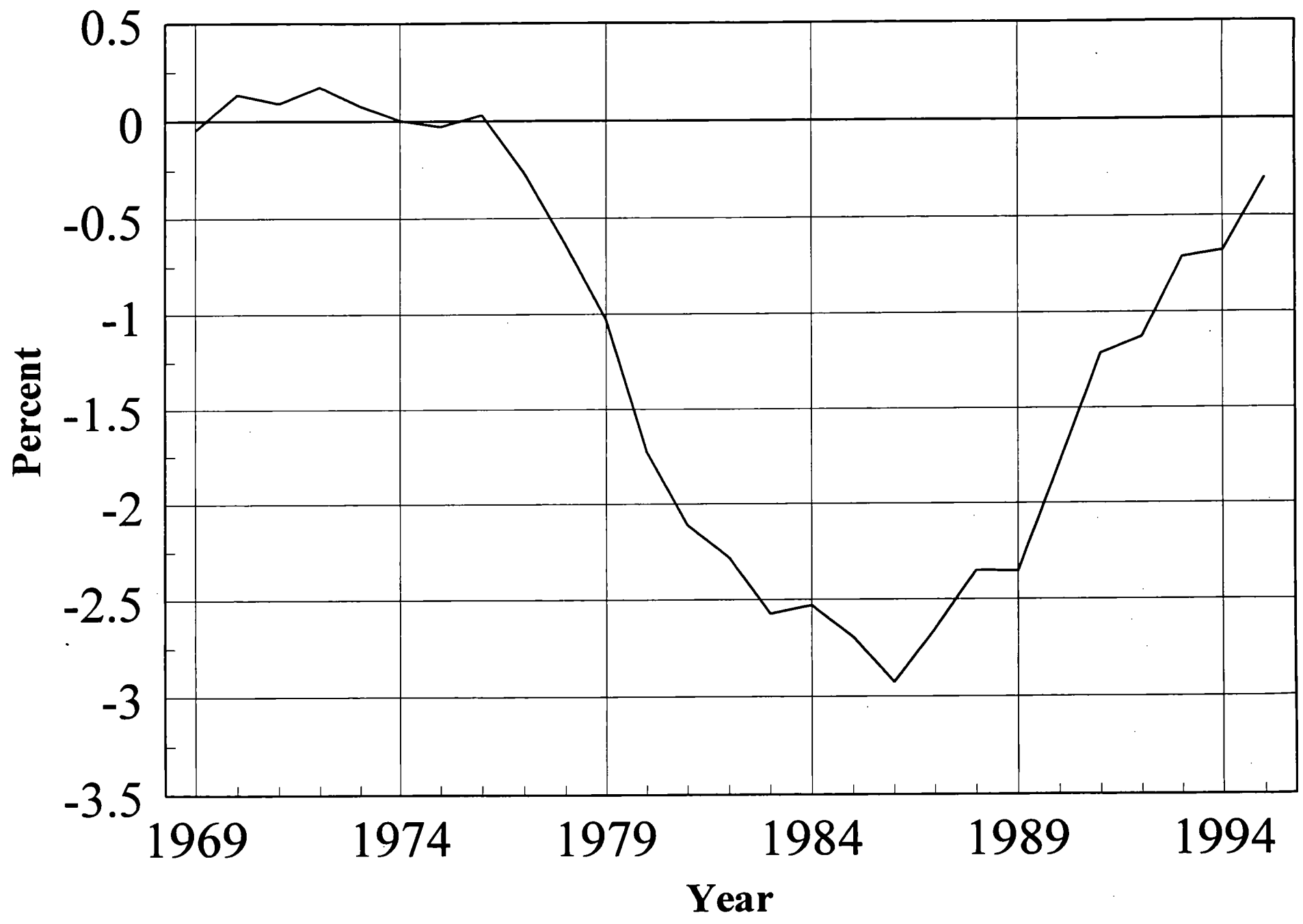
# Annual Change in E/GDP



# 5-Year Moving Average of Annual Change in E/GDP



# 10-Year Moving Average of Annual Change in E/GDP



# Energy Consumption

2010 (Quads)

Residential

18.73

Commercial

13.78

Industrial

35.14

Transportation

28.83

TOTAL

96.48

15 May 1997

To: Jeremy Symons

From: Jason Shogren, CEA  
Robert Tuccillo, OMB

RE: CCAP program projected effectiveness

Thank you for providing the CCAP data. But we need more information before we can understand the projected effectiveness of the program.

Our difficulty with the data is that it does not clearly distinguish fact from assumption. For example, the reported penetration rates required for each of the specified actions illustrates this point. Effectively, the reported penetration rates appear to be a derivative of the particular assumptions about energy savings made for each of the actions. It would be more helpful if you could provide an assumed penetration rate, along with an indication of how the assumption was determined.

Of similar concern:

- We ask that you please split the figures reported for Action 1 into separate components. We would like to see the effectiveness of each of the Energy Star Buildings, Rebuild America, and Combined New Buildings Initiative programs.
- The penetration rate for Action 6 seems excessive if all new and existing homes are included.
- We need the projected penetration rates for each of the reported actions for 2000 and 2020.
- Please explain whether the energy savings data for Action 1 are determined from field experience or if they are forecasted from EPA's Showcase Buildings effort.
- There may be double-counting within and/or between actions.

We appreciate your help to address our concerns so that we can complete our review of the National Communication. It would be helpful if we could get this additional information by COB tomorrow.

If you have any questions about the additional information that we are requesting, please call either Jay (395-5012) or Bob (395-5609).